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Audio's Guide

TO SURROUND SOUND

THE HOME THEATER EXPERIENCE

BEGINNER'S GUIDE

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DIRECTORY OF SURROUND PROCESSORS

DIRECTORY OF IN-WALL SPEAKERS

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Watch what


Audio Menu
1 FM Station Preset
2 AM Station Preset
3 FM/AM Preset List
4 Dolby Surround Set Up
Press number to select
Press MENU to exit menu


CD Magazine List
Mag Title
46 CHOPIN
47 BACH
48 HANDEL
49 STRAVINSKY
50 BARTOK
Use ADJUST to select
Then press ENTER
Press MENU for next


TV Tint


Time Delay Set
Front 12 Surround 8
Use 10-keypad to enter
distance (feet) from you
to the surround speakers
Then press ENTER
Press MENU anytime for
Audio Menu


Tape Menu
1 Tape1 Counter Reset
2 Tape2 Counter Reset
3 On Screen Counter
4 Counter Search
5 Intro Scan Time Set
Press number to select
Press MENU to exit menu


VCR
REW
REM 0:43
1h18m04s

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Audio's Guide

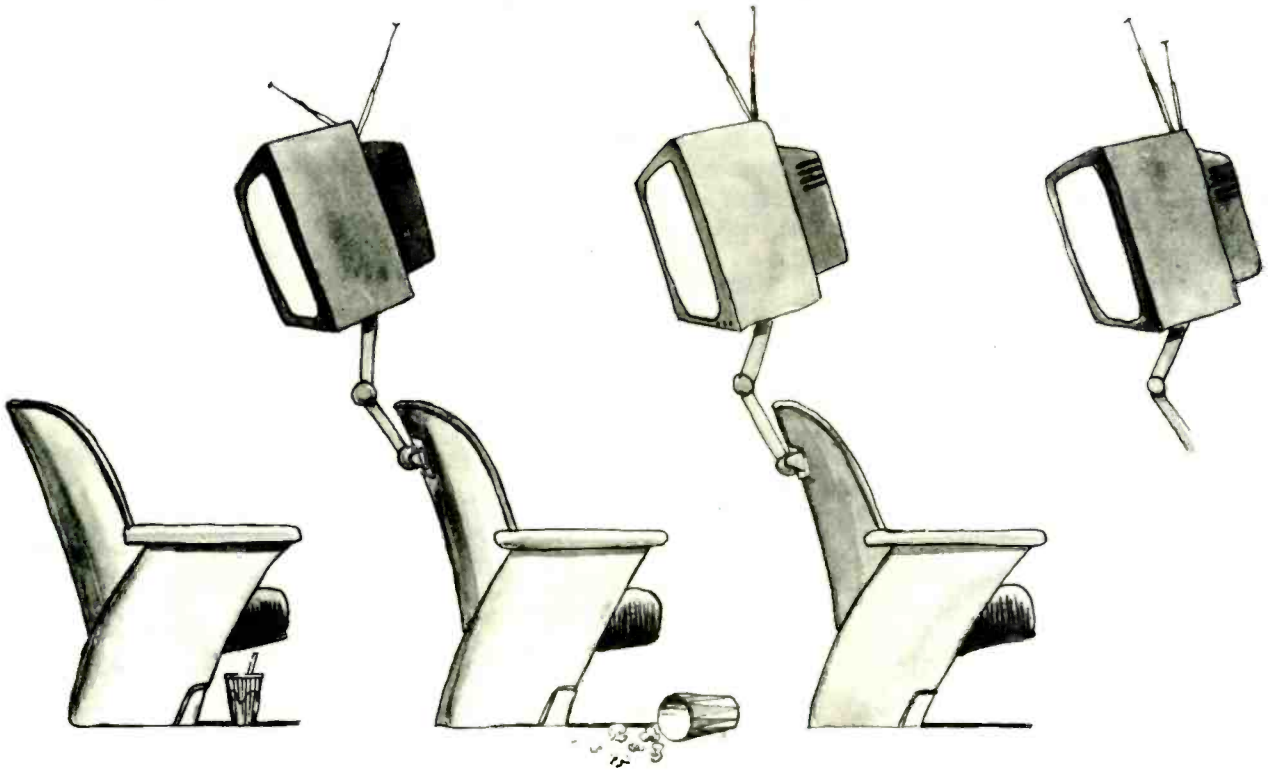
TO SURROUND SOUND

THE HOME THEATER EXPERIENCE

The Cover Equipment: Fosgate, Lexicon, Sony, and Yamaha surround sound processors; Sony KV32XBR50 television; S-100 audio/video stand from Bell'Oggetti International (711 Ginesi Dr., Morganville, N.J. 07751).
The Cover Photographer: Ray Curletti, DCI Photography Studio.

Audio Publishing, Editorial, and Advertising Offices,
1633 Broadway, New York, N.Y. 10019.

If television was okay for home theater, movie theaters would look like this.



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EDITOR'S OVERVIEW

Dear Reader:

Yes, you're right. This is something new—a new publication, which we publishing types call a "Special" or "One-Shot." And it's devoted to a new area, one that's never before flowered with such a wide variety of blossoms—surround sound and home theater.

Those of you who have been around the sport of hi-fi for a couple of decades will remember the Four-Channel Wars, during which the Giants of the Industry belabored each other with warclubs named SQ, CD-4, and QS. Some echoes of those times can still be found in AM stereo, particularly in the automotive market.

Nonetheless, the equipment and electronic techniques covered in this magazine are radically new—and evolving rapidly. Further, they are important because they do extremely good jobs of transporting listeners to the concert hall or movie theater. The techniques use microprocessors, embedded in IC chips, to perform computer-like operations on the audio signals which come from the software—the laser videodiscs, the videotapes, the Compact Discs, and even the good ol' LP. "How do they do what they do?" Well, that's the subject of the handful of reviews we've included in this special publication; some of these test reports are new, but most have been taken from the pages of the parent publication, *Audio*. These Profiles, not incidentally, were chosen to be published in our Special because the gear is especially good at what it does. You'll see why I say that when you read the test reports.

A special addition to the Profiles is a 13-page feature article by the man who reviewed the equipment, Howard A. Roberson. In addition to going over the test methods, Roberson writes about how these very different kinds of equipment should be judged. For example, the digital signal processors from Yamaha and JVC are very different from the movie-oriented Fosgate and Shure units. And what about laser videodisc players? How do they fit into a system? There's also a very important and easy-to-understand discussion of proper speakers and proper placement of speakers for surround sound use. One of the best speaker placements, in my opinion, and certainly the one placement that takes up the least real estate in the listening area, is in the wall. We have therefore included a three-page Directory of these speakers, along with Directories of Surround Sound Processors, Hi-Fi VCRs, and CD/Videodisc Players. Addresses of the manufacturers will be found under Cover III.

I'm excited by this Special, and I think you will be too once you've had a chance to read over the contents. If you haven't listened to or looked at one of these systems, be certain to check out a properly installed home theater system at a dealer.

Most Cordially,

Eugene Pitts
Editor

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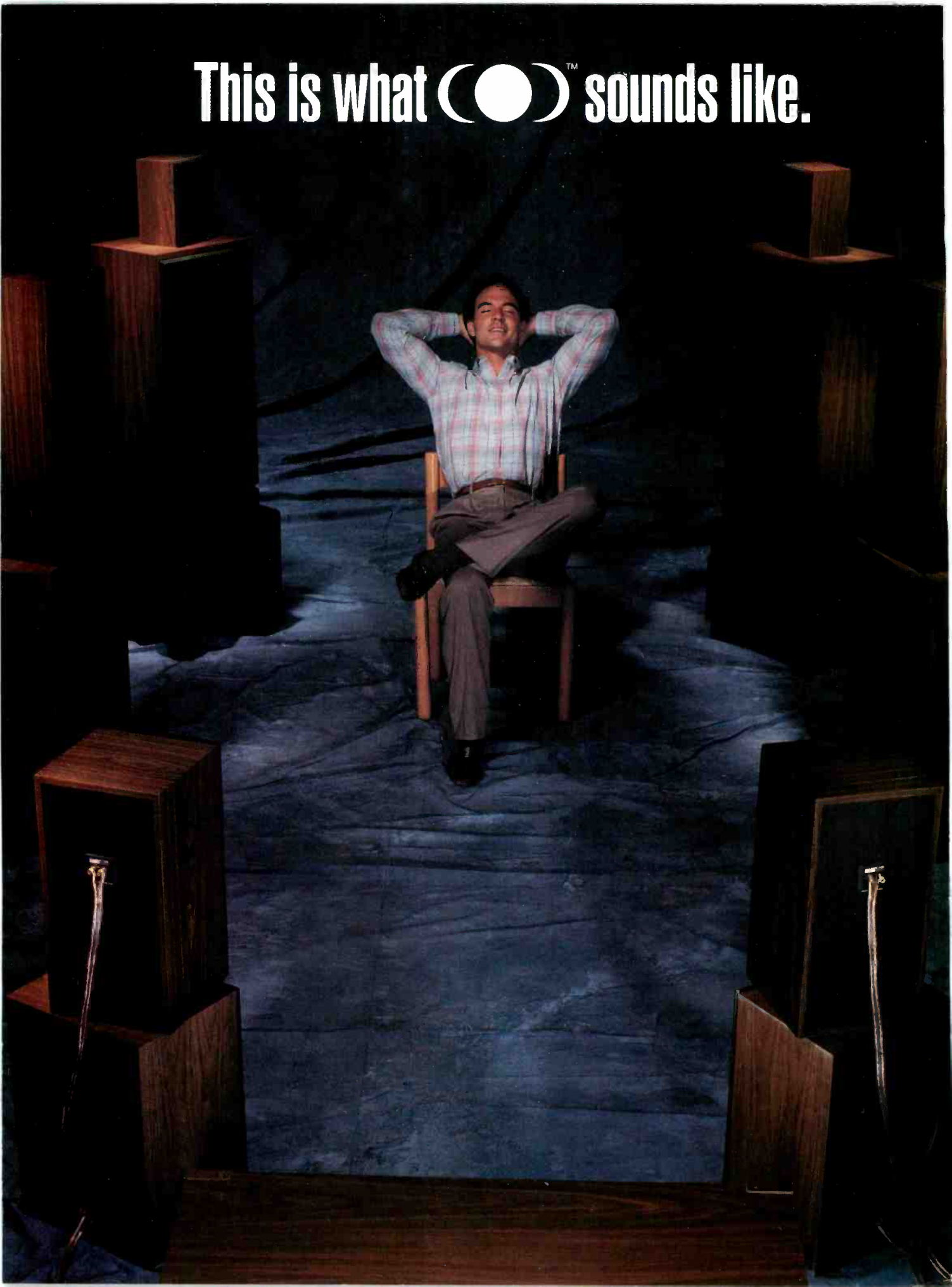
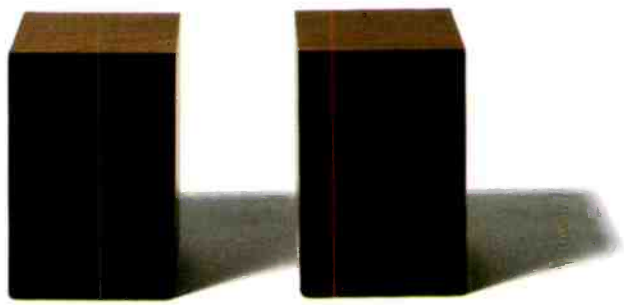

This is what ™ sounds like.

This is what (●)™ looks like.



(●) is the symbol for the new *Sound Retrieval System* that lets you experience true 3-D sound from two ordinary loudspeakers. Read that last sentence again. You probably still won't believe it. But it is real.

In fact, (●) won the Grand Award for Audio Technology in the "Best of What's New", Popular Science, December, 1989.

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So forget expensive surround-type speaker matrices. You don't need to buy a roomful of speakers and sacrifice a lot of square feet of living space to house them. All you need is (●).

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So, when you do look for your new audio system, look for (●).

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SURROUND SOUND

A Wrap-Up

Howard A. Roberson

It doesn't really seem so long ago that I acquired a Pilot FM tuner, a Webster changer for my 78s, a 10-watt Bogen amplifier, a GE loudspeaker (without a cabinet), and a few other items to improve the quality of my music listening. Yet over 40 years later, the primary challenge still remains: How can we create the best illusion when listening to reproduced sound? The quality of monaural systems improved during the 1940s, of course, and the LP started a new era. The introduction of stereo allowed the use of more superlatives, some of them deserved. Greater and greater numbers of people became convinced that stereo recording and listening were definitely superior to monaural. Headphones were discovered—at least by some listeners—as an exciting alternative to speakers. My first reactions to a demonstration at an early New York Hi-Fi Fair, however, were fascination at the details revealed but disappointment and dejection because all the sound was on a line, straight through the head. A few years later, I did acquire a headphone control box made by Jensen that included Benjamin Bauer's crossfeed circuit for more realistic listening.

Stereo continued to improve through better recording techniques and equipment, and many new products were introduced for the home listener. Approaches to four-channel stereo were promoted during the 1960s, and a high point came in September 1969, when Peter Scheiber made a fundamental contribution with his compatible-matrix recording and playback system. The early 1970s saw several new methods of providing some form of four-channel sound. David Hafler offered the Dynaquad system, which required only a minimal investment by consumers. In a relatively short time, RCA introduced Q-8 cartridge tapes, Sansui unveiled the QS disc matrixing and playback system, JVC offered the CD-4 discrete four-channel phono system, Electro-Voice announced the Stereo-4 matrix system, while Columbia Records and Sony promoted the SQ system as the best design.

Most of the systems required encoding four channels into two recording channels to make the encoded disc. During playback, the user's decoder extracted the four channels from the two on the disc. Figure 1 shows the desired infinite isolation in the SQ matrix between the front speaker pair and between the back speaker pair. Unfortunately, isolation between any other speaker pair was only 3 dB in the passive matrix, and thus center image stability was highly dependent on listener position. An active SQ matrix was used to improve the isolation to some extent. Although the JVC CD-4 system was discrete in format, it did require decoding (demodulation) to deliver the four channel outputs.

Many potential buyers at that time were very confused as to the best choice or even what choices were possible. Leonard Feldman wrote "Why the Four-Channel War Need Not Take Place," which appeared in the July 1972 issue of *Audio*. He recommended relatively simple changes in the competing systems to make them compatible with a single decoder/demodulator. In another article (*Stereo*, Fall 1972), Feldman compared results from

ILLUSTRATION: JAMES YANG

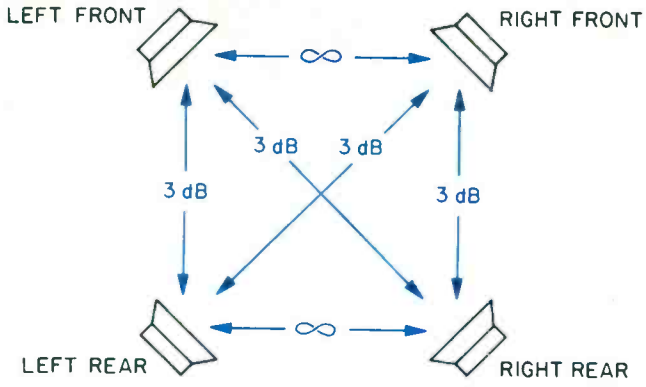

Fig. 1—Interspeaker leakages of the SQ matrix.

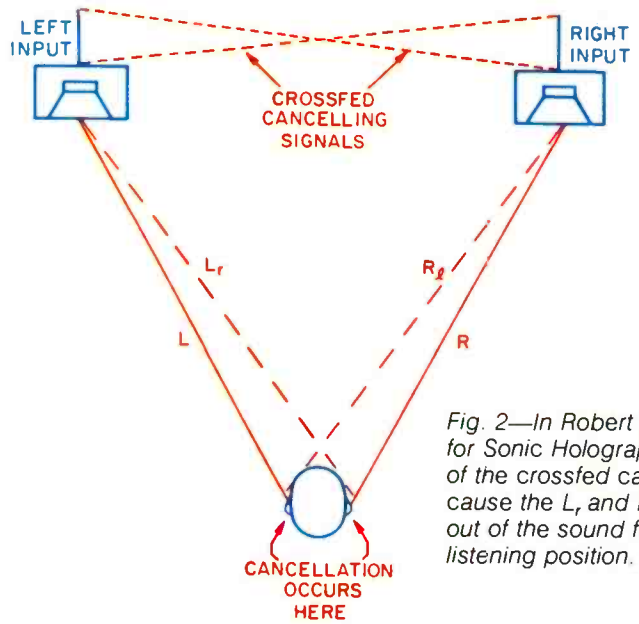

Fig. 2—In Robert Carver's circuitry for Sonic Holography, careful addition of the crossfed cancelling signals will cause the L_r and R_l signals to drop out of the sound field at a selected listening position.

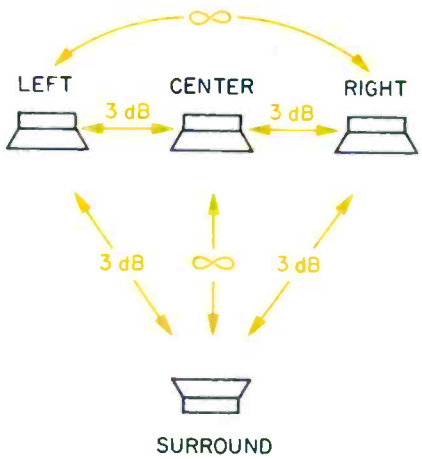

Fig. 3—Interspeaker leakages of the Dolby Surround matrix before directional enhancement.

the competing systems, also commenting on how listening satisfaction varied from one record to another. Many articles during the early 1970s discussed all of the options possible, information that helped the dedicated but discouraged those who were unsure. Quite a few demonstrations by dealers, as well as manufacturers, were poorly set up and conducted. All too frequently, the selected sources presented impressive but ultimately boring ping-pong effects. By the end of the 1970s, interest in four-channel or surround sound had waned except for those who had already become its committed fans.

Some manufacturers took other approaches to improve the sound field in the home listening room. Early on, Bose broadened the apparent source by sending sound energy out of the back of the loudspeakers, causing spreading reflections from the wall behind them. In *Audio*'s March 1982 issue, Robert Carver discussed his Sonic Holography and its use of crossfed cancelling signals to the left and right stereo speakers (Fig. 2) to correct limitations of conventional stereophony. Subsequently, Polk Audio introduced Stereo/Dimensional Array (SDA) loudspeaker systems with crosstalk-cancelling drivers built in to facilitate making such corrections.

Throughout the 1970s and 1980s, claims were made of many products' ability to achieve ambience recovery or expansion of the stereo image. Sometimes additional amplifiers and loudspeakers were called for, but sometimes the magic was supposed to occur without any changes beyond inserting a wonder box in the tape monitor loop. Some of the reverberation or delay designs (the Sound Concepts Model SD-550, for example) were fairly successful in adding realistic ambience. Image expanders of poor design, on the other hand, created such horrors as the sound of soloists jumping back and forth across the front soundstage.

The movie industry made contributions dating back to Walt Disney's *Fantasia* in 1940, and Cinerama certainly made an impression. Yet Dolby Laboratories made a fundamental step in 1975, when they introduced the Dolby Stereo cinema processor. More than 2,000 films have since been released in Dolby Stereo, and more than 13,000 theaters worldwide are equipped to present films with encoded surround sound. The encoding/decoding pro-

cess uses the 4:2:4 MP (motion picture) sound matrix, in which the left, center, right, and surround channels are encoded in the two film tracks and later decoded in the theater to the original channels. Notice the change in channel location from the earlier four-channel sound that did not have the front center speaker, needed for dialog. Figure 3 shows the infinite isolation achieved by Dolby Stereo between the left and right channels, and between the center and surround channels, as well as the 3-dB separation between adjacent speakers in a passive matrix or before the directional enhancement in the active matrix, as is used in movie theaters.

The next step in the evolution of movie surround occurred in 1981, when Dolby Laboratories developed decoding circuitry for consumer audio/video equipment. Increasing numbers of Dolby Stereo movies are being transferred to stereo videotapes and videodiscs, and the home Dolby Surround decoders can extract the four-channel information from these films. The wide ownership of VCRs and the ever-increasing practice of renting and buying movie videocassettes has been a major factor in the greater interest in surround sound. Another step in this evolution was the generation and utilization of sophisticated circuits for processing audio signals in both the analog and digital domains. Throughout the 1980s, digital processing became more and more sophisticated while the levels of noise and distortion decreased audibly.

To facilitate discussing certain aspects of Dolby Surround and other approaches, I photographed my oscilloscope's display in X-Y (comparative) mode under a variety of conditions. The first and second channels of my mixer were nominally left and right, respectively, but I could use the mixer's pan pots to position the signals as desired. The outputs from the left and right channels were fed to the oscilloscope's vertical and horizontal amplifiers, respectively. In Fig. 4, both of the mixer's input channels were fed the same 1-kHz signal. The vertical trace shows both channels panned all the way left. The diagonal trace 45° to the right is the result of both channels panned to center (L + R). The horizontal trace shows both channels panned all the way right. These three traces are the result of adding two equal, in-phase signals. The shorter diagonal trace, perpendicular to the L + R line, is the result of inverting the right input with the pan pots centered. In other words, this is the L − R or difference vector, the one associated with surround information. The trace for the two equal but opposite polarity signals goes between the upper left quadrant (L − R) and the lower right quadrant (− L + R).

Dolby Labs' development of decoding circuitry for consumer A/V equipment was a crucial step for good movie surround sound.

In Fig. 5, the left channel was fed 100 Hz and the right channel was fed about 1 kHz at the same level. (The higher frequency was purposely chosen to make it nonharmonically related to 100 Hz.) The vertical trace is from both pan pots set to the left, and the horizontal trace is from both pots set to the right. The maximum up-and-down and left-and-right excursions occur momentarily when the two waveforms have simultaneous peaks of the same polarity. When both pots are set to center (L + R), momentary out-of-phase signals broaden the diagonal trace as compared to Fig. 4. When the first channel is panned left and the second channel panned right, the bright center-square area is generated over a short time. The area covers all of the possible values between L − R, L + R, − L + R, and − L − R. Notice how energy is distributed at all possible angles, giving an indication of how stereo music, which is far more complex than two tones, includes many clues for left, center, right, and surround sound.

Figure 6 is the stored X-Y pattern created by a few minutes of music from Gershwin's *An American in Paris*. (Some transient excursions occurred too quickly to be stored.) Because the L + R output had more energy than the L − R, the pattern is longer from lower left to upper right than from lower right to upper left. Let me emphasize that the simple "L" and "R" designations do not mean that the left and right music signals are simple tones, constant in frequency and amplitude. The signals are vectors constantly changing in amplitude, frequency, and phase. In other words, L + R is much more complex than 2 + 2 or 3 + 4.

Most music recordings are not encoded at all, certainly not for use with any particular decoding. Most stereo recordings, however, do have a lot of specific information very easily decoded by surround sound processors. And sometimes a program has stereo and surround information when it shouldn't. Figure 7 represents single-voice dialog from an FM station. The sound is really monaural, i.e., L = R, and therefore should appear as a single, thin line. The L − R information, apparently from stereo synthesis, broadened the trace seen in Fig. 7 along its entire length. I have encountered dialog from some stereo TV stations having even more L − R energy; these programs produced instantaneous patterns on the 'scope that were twisted in shape, and the dialog sounded distorted when decoded. (Later text and the reviews in this issue will make mention of the characteristics shown in Figs. 4 through 7).

Substantially all surround decoders are licensed under Peter Scheiber's patents, which go back to the start of four-channel sound. At this point, I should note that Dolby Surround is a term applied to home units, referring both to Dolby Surround passive-matrix decoders and Dolby Pro-Logic active-matrix decoders. Any Dolby Surround passive-matrix decoder meeting Dolby Laboratories' requirements must include an input balance control, a surround matrix stage, a delay circuit adjustable from 15 to 30 mS or fixed at 20 mS, a 7-kHz low-pass filter, and a modified B-type noise-reduction decoding circuit. Such decoders must also include left, right, and surround outputs and a ganged master level control. A center channel is not required, but the simple, passive-matrix surround decoder cannot deliver a good center-channel signal anyway. The Dolby Pro-Logic active decoder must meet the above requirements, must have an adaptive matrix (approved by Dolby Laboratories) responding to the characteristics of the signal, and must include a center-mode control, a calibration noise sequencer, and left, center, right, and

surround outputs with a ganged master level control. The active decoders detect directional clues from the signal and steer it to the appropriate channel(s), making a good center-channel signal possible. A surround decoder does not have to be made to Dolby Laboratories' requirements, but it is mandatory if the term Dolby Surround and the Dolby Laboratories logo are used on the component. Most models have other processing modes, such as monaural enhancement or a music mode, in addition to Dolby Surround or Dolby Pro-Logic.

A number of manufacturers under license to Peter Scheiber do not simply follow Dolby Laboratories' requirements; sometimes they make their own contributions to surround sound. Shure introduced the HTS-5000 processor featuring their exclusive Acra-Vector steering circuits and the Acoustic Space Generator. Jim Fosgate worked with Scheiber in developing the Fosgate 360° Space Matrix with PRO-PLUS logic-steering circuitry. The Yamaha DSP-1 brought us a new world of digital processing with its ability to generate a wide range of simulated sound environments. Its Dolby Surround mode, however, was passive and didn't have enhanced steering. Subsequently, Yamaha offered the DSR-100 PRO, which included Dolby Pro-Logic with its center mode and active steering. The Lexicon CP-1 includes Dolby Pro-Logic and has innovative circuitry for automatic input balancing and azimuth correction. These are but a few examples of how manufacturers may follow the basic plan and offer their own interesting and appealing variations.

The surround sound delivered by a good decoder can make for a very satisfying, even exciting, listening experience. Muting the surround sound makes the sound field collapse to the front soundstage. Such a change in the illusion can make regular stereo seem rather poor indeed.

Selecting a Decoder

The potential purchaser of a surround sound decoder will find the processors in various forms. The processor/decoder may have just a single stereo input with a main stereo output and dual jacks for surround output. Configured as a simple device to be inserted in a tape monitor loop, it will, of course, have its own controls and switches for the processing. (Usually, this decoder has a tape monitor function to replace the one it is connected to.) Such a processor is designed for use with an integrated amplifier, a preamplifier, or a receiver having the needed capabilities for input switching. Some processors, however, have at least some source switching; this can be very helpful and is perhaps essential in some installations. Older receivers, for example, will not have an input for a CD player. Let me interject this comment: The buyer who uses a turntable should be aware that phono preamps are usually *not* included in the processors, even those offering sophisticated switching.

Muting the surround collapses the sound field to the front, immediately revealing how normal stereo pales in comparison.

The processor can also be part of an integrated amp, a preamp, or a receiver. Even in these cases, a phono preamp may not be included. Its omission is even more probable if the decoder is part of a VCR or a TV. Although a stand-alone processor may be very simple, a built-in decoder is more likely to have limited operating modes. Another processor type includes a built-in power amplifier, usually set up for use with the two surround loudspeakers.

The addition of a surround system requires interconnecting audio/video sources, amplifiers, loudspeakers, and a video monitor/receiver. Several manufacturers offer audio/video integrated amplifiers that greatly simplify switching and interconnections. Some decoders include good A/V switching that eliminates the need for an A/V amplifier. Relatively few processors offer simultaneous switching of video and stereo audio, and this combination could be important for your needs. As a potential money-saver, it is important to make a list of all of your present sources and those you might obtain in the future. Be sure to note special connections needed, such as S-VHS and digital (coaxial or fiber optic).

Desirable Decoder Features

I can't state what would be most important for any particular reader. Movies are the beginning and end for some buyers of surround systems; some music lovers, of course, couldn't care less about them. I greatly enjoy what surround sound does for both media. For movies, Dolby Surround and its passive matrix can provide very noticeable improvement over regular stereo. Dolby Pro-Logic and other active steering designs, however, deliver superior results that are quite apparent. Accurate placement of dialog in the center channel is another big plus for these systems. Using a subwoofer helps many movies, but it is not essential that a decoder have a subwoofer output because many subwoofers can be tied across the main amplifier outputs. A monaural enhancement mode is very useful for old movies and music videos, many of which have little surround information. A good input level meter provides two major benefits: Ensuring the level is high enough for the best signal-to-noise ratio and preventing circuit overload. Adjustable delay for the surround channels is very important to ensure full surround without a tell-tale localization of the surround speakers as the specific source.

For music listening, specific music modes can be very beneficial, although the Dolby Surround and Pro-Logic modes may also work very well. In general, a center speaker provides little benefit to music—but a subwoofer does, particularly for organ works. (As noted above, a subwoofer can be connected across the main amplifier outputs.) Music also benefits from adjustable delay to surround speakers, and wide variations in the illusion are possible when reverberation level and time can be adjusted. Music modes may include several parameters which can be changed to create a wide variety of sound fields within the room. The music listener who has a definite sense of how a particular recording should sound may immediately accept making these intricate adjustments. For other listeners, the extra choices may be confusing or even frustrating. Input level meters and overload indicators are also important for music. Output level trim controls and calibration signals for balancing are very useful, albeit not essential, for both music and

movies. If the decoder has a built-in amplifier, a gain control is a must and a balance control is helpful.

The decoder's front panel should have good indicators and displays to convey modes and other important information clearly to the listener/viewer. This information includes input level and overload, mode, selected input, delay time, and sound-field parameter and value for such systems. It is helpful to have indicators for main and surround volume, and front/back and left/right balances, but not essential. Special selectable features should have bright indicators to remind the user of their status.

Sometimes it's easier to perform operating changes at the front panel, but most of the time it makes more sense to make them at the listening/viewing position with the remote control. The remote control should be as simple as possible to execute what the user needs. Having said this, I immediately must add that I like the Yamaha DSP-1's 30-button remote because it allows choosing many program and parameter variations. I don't constantly push buttons, but I might select "Presence" for one piece and "Jazz Club" for another on the same Compact Disc. In my opinion, *all* remotes should include control of the following: Master volume, surround volume or main/surround balance, mode selection, delay time, and system mute. With experience (and particularly for movies), however, the need to change modes and/or adjust delay time would be relatively small. Desirable additions to the remote would be a separate mute for surround (to check what the effects really are) and left/right balance (to trim this aspect of the system or to compensate for some sources). Control of center level and center-channel mode would be helpful if the decoder has Dolby Pro-Logic or another active steering design.

System Planning

The first decision you must make is what room you will use for a surround system. Perhaps it can be far away or isolated from interfering noise sources, such as the kitchen and its appliances. If a room can be designed for listening/viewing before it is built, much can be done to ensure the best possible results. I recognize that this situation would be quite rare, but all users should understand the general rule for room acoustics of surround sound systems: The room should be quite absorbent in general, and wall surfaces should be broken up (with furniture, pictures, etc.) to help diffuse reflections. You might consider combining some redecorating, such as adding drapes, with improvements to the room's acoustics. For those who want details on the many facets benefiting from attention, I recommend F. Alton Everest's *The Master Handbook of Acoustics* (Tab Books) as a source of much helpful information. "Designing a Home Listening Room" by B. V. Pisha and Charles Bilello (*Audio*, September 1987) presents an interesting and helpful description of a state-of-the-art design. (Pisha's listening room was analyzed using Time Delay Spectrometry, which was invented by the late Richard C. Heyser. Heyser was well known for his speaker reviews in *Audio*.) There are questions, of course, no book or article will answer for you: Should you use your present television set or purchase a new projection unit? Where can loudspeakers be located without causing family fights? What size loudspeakers will fit where? Basic questions like these are best settled *before* purchasing surround equipment.

Loudspeaker Configurations

Loudspeakers can be arranged in many different ways so that a listener/viewer is surrounded by sound. (Do keep room and family constraints in mind.) First of all, the two main loudspeakers can be positioned near or against the front wall, displaced to the left and right of the center axis. Normally they would be located for the best stereo sound, following the recommendations of the speaker and decoder manufacturers. The sound can become surround in character by adding just one speaker behind the listener, although it is usually better if two speakers are located behind, and to the left and right, of the listening position. (What does the room allow?) Dolby Surround encoding and decoding matches this basic four-speaker arrangement. (The Lexicon CP-1 has a "Panorama" mode which generates a surround field with just the two main speakers.) Sometimes the added loudspeakers are called effects speakers, and associated controls may be so labelled.

As mentioned, noticeable improvements can be obtained by adding a subwoofer and/or a center speaker. Most subwoofers can be located anywhere that is convenient. The center speaker is best placed just above or

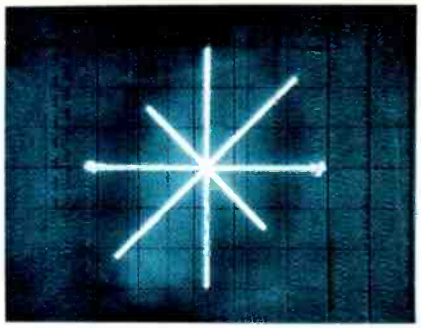

Fig. 4—Mixer's output with left and right channels fed by equal input signals. Various settings were used for the pan pot, and each channel was set differently; see text.

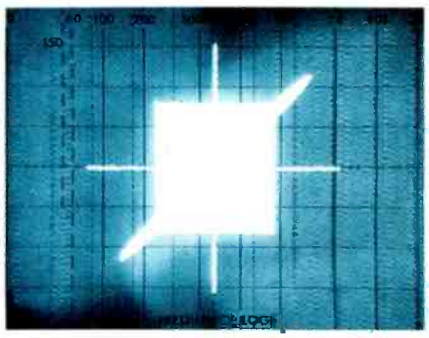

Fig. 5—Mixer's output with left and right channels fed by different input signals. The same settings of the pan pot were used for both channels; see text.

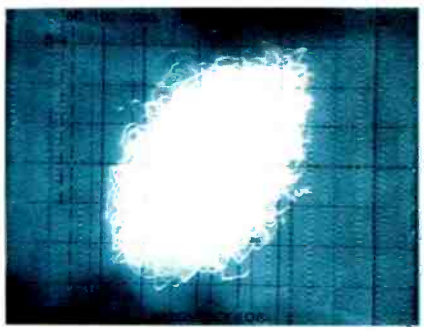

Fig. 6—Oscilloscope pattern generated by left and right signals from a few minutes of Gershwin's An American in Paris; *see text.*

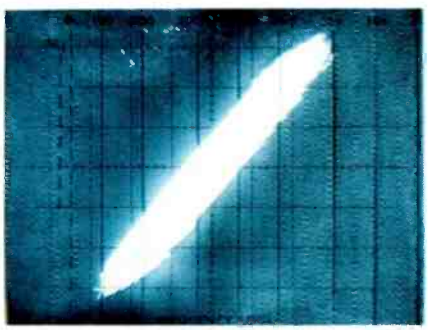

Fig. 7—Oscilloscope pattern from single-voice dialog transmitted by an FM station; see text.

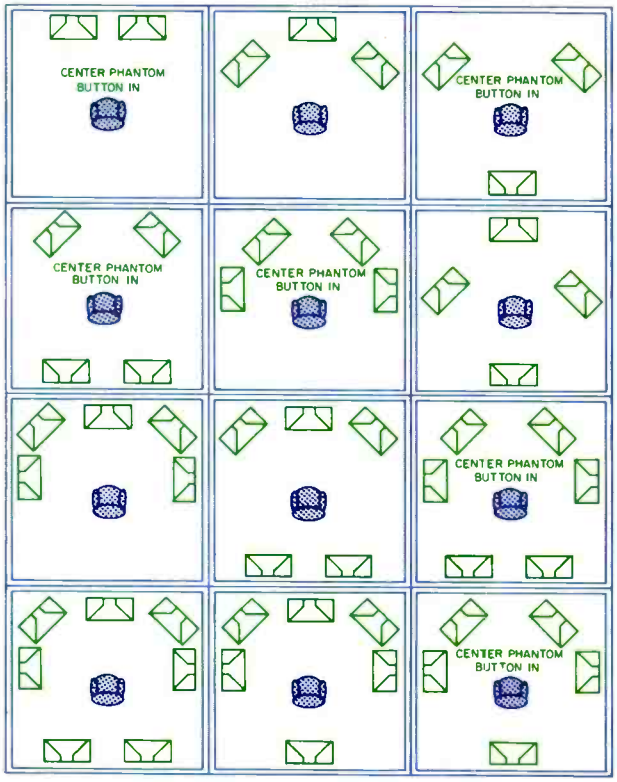

Fig. 8—Speaker configurations for Lexicon's CP-1 surround processor. A subwoofer, not shown, can be used in any of the configurations.

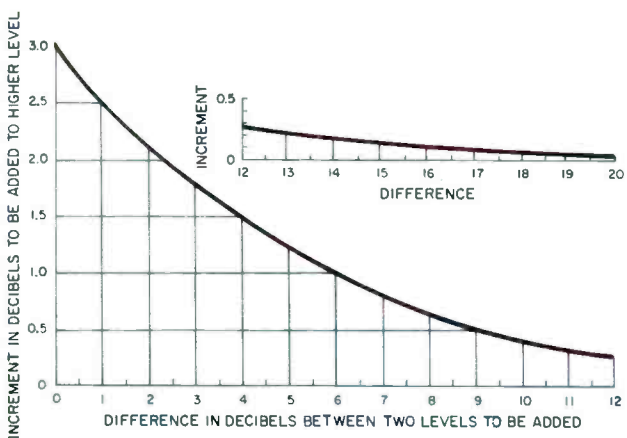

Fig. 9—Chart for combining sound levels by decibel addition.

below the video screen, even if it is not exactly centered between the main speakers. (Some rooms prevent the desired symmetry.) This expanded system requires a total of six loudspeakers—two for main stereo, two for surround/effects, and one each for the center and subwoofer channels. Certain processors deliver more realistic illusions with music when two more effects speakers are added. They might be placed against or near the front wall, outside of the main speakers, or might be out to the side of the general listening area. Now we are up to eight loudspeakers, the configuration I normally use when evaluating surround systems. Many other combinations are possible, of course, by adding and subtracting speakers or shifting them around. Figure 8 shows the 12 speaker arrangements the Lexicon CP-1 can be configured for. A subwoofer is not shown, but it can be used with any of these configurations.

Loudspeaker selection should include consideration of the speaker's sensitivity, a specification expressed in dB SPL and measured at a distance of 1 meter with 1 watt from an amplifier. (This is discussed in detail later.) The best loudspeaker configuration depends on a number of factors. The processor itself offers particular combination(s) of channels that may or must be used to obtain desired effects. Some decoders allow the output configuration to be changed more conveniently when loudspeakers are added later. It is therefore important to think through your long-range plan before making the initial purchase. It may never be necessary to add speakers to your system, but the *possible* need for them should be considered at the start. For example, do not buy two effects speakers soon to be discontinued when you expect to get two more speakers later.

Room dimensions certainly affect which speakers might be selected, just from the standpoint of size or other appearance factors. Many speakers are available in different finishes and/or grille colors. A speaker can be stained or painted, of course, or even covered by a loose-weave fabric of a preferred color. A number of three-speaker systems are available for the main channels, in which two small satellite speakers are used with a larger center speaker. Keep in mind that the center speaker in these systems is not full-range; it will not be usable as a center speaker for movies. In most

three-speaker systems, however, the center speaker will be a good subwoofer. In-wall speakers are possible options in some cases. They certainly make for a neat appearance but can't be moved to try other configurations.

Most surround systems work best when surround/effects speakers are located in accordance with the characteristics of the processor. For example, the Lexicon CP-1 benefits from speakers placed to the side of the listening area, while the Yamaha DSP-1 is configured for the extra effects speakers outside of, and behind, the main speakers. Consider the possible locations for speakers in your listening room, and include both the possibilities and constraints in your planning.

Acoustical boundary effects exist in any room. Excessive bass, for instance, is a probability when surround speakers are placed in the corners. Many times the best overall speaker location is up off the floor and pointed down toward the listening area. The excessive bass will become exacerbated when the speakers are in the corner and near the ceiling. Corrective treatment may very well be in order, and the Everest book cited earlier is a good guide when making acoustical corrections. Few speakers are designed for easy mounting on a wall or ceiling, although some models—made specifically for surround sound—have optional brackets. Brackets made by Omnimount (and others) will support even heavy speakers, and the ball/socket design of the Omnimounts facilitates easy pointing.

In the past, many arguments held that wide dispersion from a speaker was desirable. Now, however, some experts favor less angular spreading from surround speakers to limit unwanted reflections and to ensure the best illusion. Obviously there is a trade-off here between maintaining good coverage over the listening area and reducing reflections. Pointing speakers down at the listening area can help to minimize the effects from reflections, because the absorption of the carpet/rug, upholstered furniture, and the listeners can make the first reflection a weak one. The sound from any speaker increasingly spreads as frequency goes lower, and the lowest audio frequencies will have dispersion of 180° or more. Particularly when a subwoofer is used, overall bass will be better with some low-frequency roll-off of the signal(s) to the effects speakers and perhaps also to the main speakers.

In positioning speakers, you'll have to compromise between maintaining good coverage and reducing room reflections.

Amplifier Needs And Speaker Sensitivity

Although many articles have been written on amplifier power requirements for home listening, amplifier power needs cannot be stated without considering the sensitivities of the speakers used. The listings of full-range loudspeaker systems in *Audio*'s Annual Equipment Directory show figures from 70 to 108 dB SPL at 1 meter for 1 watt from the amplifier. This is a difference of 38 dB, a required power ratio of 6,310 to 1! In other words, for the same sound level, 6,310 watts would be required into the speaker rated at 70 dB SPL as from the speaker rated at 108 dB SPL, each with 1 watt input. Somehow I don't think the 70-dB-SPL speaker would ever take 6,310 watts. Many speaker sensitivities are within 85 to 95 dB SPL, but even this 10-dB spread calls for 10 times as much amplifier power to the speaker rated at 85 dB SPL for the same acoustic output as from the speaker rated at 95 dB SPL.

Let us, for example, consider a single speaker with a sensitivity of 90 dB SPL at 1 meter for 1 watt input in a 2,500-cubic-foot listening room that is quite dead acoustically. The level would be down close to 80 dB SPL at a normal listening distance with 1 watt from the amplifier. Now, if we decide we want the maximum listening level to be at least 106 dB SPL on short peaks, we are concluding we need 26 dB more than 1 watt into the speaker. This is equal to 400 watts—not a small amount of power for an amplifier, to say nothing about the power limit of many loudspeakers. To keep the relationships clear: A speaker rated for 85 dB SPL would need 1,265 watts, and a speaker rated for 95 dB SPL would need 126 watts for a maximum level of 106 dB SPL. For the same total level from *two* loudspeakers, the power requirement for watts per speaker is cut in half. If half of the total sound power comes from the center and surround speakers, the demand from each main speaker would be one-quarter of the original total of 400 watts, or 100 watts per speaker rated at 90 dB SPL. This is an acceptable power level for many speakers for short peaks. If the room is not very absorbent, the total power needed with speakers rated at 90 dB SPL might be 200 watts or less, 50 watts or less to each main speaker. Obviously, the liveness of the listening room has a fundamental effect on the amplifier power needed.

The easiest way to find out what sound pressure level you want in your listening room is to measure the room with your present audio system in it. Perhaps you can borrow or rent a sound level meter that has "C" (preferred) or flat weighting. (If you are unable to borrow or rent a sound level meter, Radio Shack has one that is very good for its $31.95 cost.) Operate the sound level meter using its "Fast" response setting, which is slightly faster than a VU meter. Run your present sound system as loud as you would ever want it, and measure the sound pressure level at various points in the listening area. The actual momentary peak level will be 10 to 12 dB above the meter's maximum level. (If the meter has only a "Slow" response setting, the peak level will be 13 to 15 dB above the maximum level shown on the meter.) This peak SPL is the required goal if the system is to be free of clipping or other overload, even on short music peaks. While you have the meter, you can use it to determine how acoustically live the room is. (With a little practice, clapping your hands sharply and listening to the short decay gives a good clue.) The source must be steady (nonmusic) in nature, such as pink noise or FM interstation noise, and just one speaker should be on. Read the meter 2 feet from the speaker, and read it again at 4 and 8 feet—and at 16 feet if the room is large enough. If the room is very absorbent, the reading will drop 6 dB SPL for each doubling of distance until close to the far wall. If the room is very live, even the first doubling to 4 feet will not show a full drop of 6 dB SPL. Successive doublings will obtain smaller and smaller reductions, probably close to 0 dB between 8 and 16 feet.

When we think of the total acoustic power into the room, we must consider the contributions from all of the amps and speakers operating. A 3-dB higher level can result from an amp putting out twice as many watts or from a replacement speaker whose sensitivity is 3 dB greater. In some surround sound configurations, rooms, and types of program, the great majority of the acoustic power will come from the main stereo speakers. For many movies, however, a lot of the power will come from the center and/or subwoofer speakers. The output level from the effects speakers can cover a wide range depending on the character of the source, the speaker configuration, and the listener's preference. (For some music, I set the level of the effects speakers up to 10 dB SPL higher than the output from the main speakers.)

When amplifiers and loudspeakers are being selected, listening quality is certainly always of primary concern, but cost is also a factor for most people. As a rule of thumb, doubling the ouptut power of an amplifier (same model series from the same manufacturer) will cost 50% more. Although loudspeakers from some manufacturers show a general increase in price with increasing sensitivity, this is not true in most cases. If you decide two speakers are equally appealing, pick the one with the higher sensitivity: You will be able to buy a less powerful, less expensive amplifier for the same acoustic output. Have the dealer conduct a demonstration, and make certain the speakers are driven to the same sound pressure level. A higher level usually sounds better—or at least more impressive. The main stereo speakers need to be of higher quality than the surround speakers, which can have some response roll-off, particularly at the bass end, without compromising the overall system. The surround channels, of course, have the same basic relationships among speaker sensitivity, desired level in the room, and amplifier power needed.

In the sophisticated, complicated system, up to eight or more speakers may contribute significantly to the sound level in the room. We can see how a rather low, 30 watts in each of eight channels adds up to 240 watts, quite a sizable figure for a listening room of medium size. If all speakers had a sensitivity of 90 dB SPL, peak levels could reach 104 dB or more—a very satisfactory upper limit for many people. Remember that the acoustic power from all of the speakers adds within the room and that the doubling of power, from either amplifier(s) or speaker(s), is just 3 dB. A 10-dB change requires 10 times as much amplifier power or a speaker sensitivity that is 10 dB higher. Figure 9 is a chart for finding the total of two amplifier or speaker levels in decibels, which cannot, of course, be added directly. Any number of sources can be added, two at a time. In this way, we can add the contributions from various amplifier power outputs and speaker sensitivities. Start by adding the two lowest level sources first.

If your initial plans for purchasing equipment are well thought out, changing final system configuration will be much easier.

If a number (N) of sources all have the *same* level in dB, then the total level equals the level of the first source plus 10 times the logarithm of N. Amplifier power can be expressed in decibel form by using dBW: The power relative to 1 watt equals 10 times the logarithm of the wattage.

Most people who acquire a surround processor already own a stereo sound system, and the amplifier in this system is probably adequate for the listening room. When buying a new main-channel amplifier, either stand-alone or as part of a receiver, it's best to buy it for the amount of power required for normal stereo use. Buying an amplifier with reduced output is acceptable if the system will operate in surround mode all or most of the time. For movies, a center-channel amplifier should have at least as much power output as a single stereo channel if the center speaker has the same sensitivity as the main speakers. Unfortunately, relatively few high-quality, moderately priced monaural amplifiers are on the market. A few possible choices are the JBL/UREI Model 6210, which I use to drive my center speaker, and a couple of models from Fosgate-Audionics. Stereo amplifiers that are bridgeable to mono can be used (NAD has some moderately priced ones). If the subwoofer needs an amplifier, the recommendation of the speaker manufacturer should be followed. A stereo amp can be used to power the center speaker and the subwoofer.

If possible, plan your initial purchases so that later changes in the final system configuration are easy to implement and relatively inexpensive. Yamaha and other manufacturers offer amplifiers that can be configured for either two- or four-channel operation. This makes it easy to start with two effects speakers and to add two speakers later without having to buy another amplifier. The power output per channel is reduced in four-channel mode, but the total power into the room (with the same model of surround speakers) will be the same or even a bit more. Speakers designed specifically for effects channels can be very good choices, but their sensitivities should always be checked against the power output from the planned amplifier(s). The three-, four-, and six-channel amplifiers made for professional use by Rane and Soundcraftsmen are possible choices for driving various combinations of main, effects, center, and subwoofer speakers.

System balancing will be easiest and most flexible if each amplifier channel has its own gain control. Some surround decoders have level trims on each output, which is very useful and close to essential in some configurations. At the least, a four-channel amplifier should have controls for each set of two channels to facilitate balancing the sound from front to back or, perhaps, from left to right. Many current integrated amps, preamps, and receivers do not have balance controls. The decoder may or may not have left/right balancing as a feature. If you use an equalizer that has channel level controls, such as some Soundcraftsmen models, it can provide the left/right balancing needed. Overall channel level can be changed by raising or lowering all of the filter sliders on a graphic equalizer, but be careful. It is difficult to make small level changes this way, and it is all too easy to make the response uneven.

Some points to remember: If the room is relatively large, the acoustical absorption is relatively great, or the speaker sensitivity is relatively low,

more total amplifier power will be needed for the desired maximum-level listening condition. Plan the main channels for normal stereo requirements, and give consideration to the fairly high demands on the center channel made by movies and to the demands on the surround channels made by both movies and music. The subwoofer adds power at particular times with music and movies, but some of the time it may have little or no output. The calculation or estimation of the demands from the total system, therefore, should not include any possible contribution from the subwoofer.

Equalization

Room treatment should always be done first, to the extent possible, so that the room is at its best acoustically *before* performing electronic equalization. Two of the difficulties in doing the right thing acoustically are the cost involved and the possible negative appearance of the treatment. If the room is dedicated to listening/viewing, however, the high price and unappealing look of some absorbent materials are much more likely to be accepted. Also remember that proper loudspeaker placement can control excessive bass and reduce the need for using equalizers. The best result occurs when the combination of the room and surround system requires no electronic equalization. Yet in most listening rooms, overall sonic performance will be better with some equalization. All too commonly, audiophiles forget about the response shaping provided by loudspeaker drivers' attenuators and tone controls. A fundamental rule of response equalization is to use the device that has the lowest Q but does what you want. General response changes are best made first with the speaker attenuators, next with tone controls, and finally with equalizers. An equalizer must be in the signal path *after* any processing; tone controls will probably be before a post-preamp output of an integrated amplifier, but will be after the record output of the tape monitor loop.

Equalizers are available in many different configurations, confusing more than a few consumers about what type to use. The most common equalizer is the stereo, octave-band graphic type, which has the advantage of generally good electronic performance for low cost. It also offers a fairly good resistance to severe response errors, low Q for less ringing, and easily understood adjustments. Third-octave graphic equalizers have the advantage of better frequency resolution than octave-band units but require more care and time when making adjustments because they have three times as many filters as octave-band units. Trying to use even half of the full filter adjustment of most units can introduce ringing (from high Q) and unwanted jogs in response and phase. The higher resolution of the third-octave equalizer is not necessarily that beneficial in practice, because response peaks and dips may still not line up with the filters. Parametric equalizers offer great flexibility in offering adjustment of filter center frequency, bandwidth (Q), and boost/cut amplitude. They provide great control in shaping general responses at low Q, in ways impossible to achieve with other equalizers. As a class, their disadvantages are a limited number of filters per channel, somewhat higher cost, and the difficulty of learning how to use them effectively.

Professional equalizers provide the advantages of channel gain controls and added high- and low-pass filters which can eliminate unwanted low bass and above-band noise with minimal effect on the rest of the band.

My favorite octave-band equalizer, of the ones I have, is the Soundcraftsmen DC-2214. This stereo octave-band unit has balance indicators and channel gain controls. The four-channel Teac PE-40 is my preferred parametric equalizer. It has four adjustable filters with switchable 60- and 160-Hz high-pass and 15-kHz low-pass filters for each channel. My favorite unit, of all the ones I know of, is the Orban 674A stereo equalizer. It has eight filters per channel and is adjustable for frequency, bandwidth, and boost/cut. It also has gain adjust and continuously adjustable high- and low-pass filters for each channel.

Smoothing system response requires a test source and a monitor of the effects of any equalization changes. Music and even movie sources can be used, and corrections can be made by ear. However, because the character of such sources varies with time and level, it is very difficult to be certain what really has been done to system response. Feeding pink noise to each loudspeaker will reveal response differences among them. Make certain the input connection comes after the processing circuitry. It is difficult to pinpoint just by listening exactly what to do to make all the speaker responses flat and sound the same. A pink-noise source and an octave-band real-time analyzer can show a great deal about system responses; a third-octave RTA will provide even more detail. The instructions for most consumer RTAs say to point the mike at the speaker, but this will usually cause a response that is peaked above 10 kHz. With most of these units, their response is flattest when the microphone is angled, so that the sound from the speaker is close to grazing across the mike's face.

Whether it's your ear or an RTA serving as the monitor, move it close to the speaker being energized with pink noise. Move it back and forth across the front of the speaker, locating each driver of the speaker system. Then

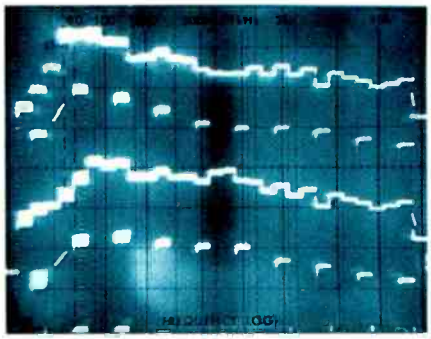

Fig. 10—Loudspeaker response before equalization (top traces) and after equalization (bottom traces). Vertical scale is 10 dB per division.

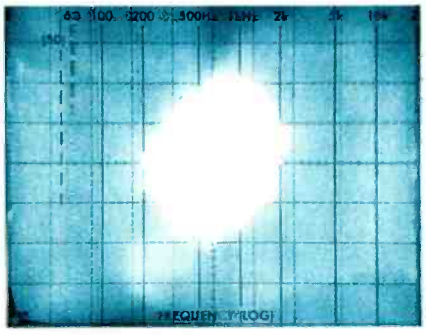

Fig. 11—Oscilloscope pattern for a section of dialog from Singin' in the Rain; *see text.*

move the monitor back far enough to make the woofer, midrange, and tweeter blend smoothly together. Adjust any speaker controls to improve overall smoothness of the response. Listening to music later may lead you to make changes, perhaps increasing midrange level for more presence or reducing the tweeter to make the sound less piercing. If the tone controls are post-processing, they can be used for further smoothing of the speaker responses they affect. By making the above changes first, equalizer adjustments and their associated negative effects will be minimized.

A general rule for making equalizer adjustments is that it is more important to smooth out response peaks than it is to fill in the narrow valleys. Increase the pink noise/amplifier level to ensure the room level is well above background noise levels. Trim the level or adjust the RTA so that the response display is at a convenient position. Bring down the most obvious peak using the filter(s) that match its frequency. If the response is pulled down adjacent to this area, the adjacent filters can be pushed up slightly to flatten the response. A filter of a parametric equalizer can be centered in frequency, and the bandwidth and cut can be adjusted to achieve the best reduction of the peak. Make adjustments for other peaks in the response as needed. You can compensate for broad areas of response droop by using moderate boost. (The valleys should not be very deep after bringing down the peaks.) If a third-octave RTA is used, do *not* equalize for deep notches, such as from a speaker crossover. Third-octave equalizers tantalize some users into pushing sliders up or down at each frequency in an attempt to make the display perfectly flat. System response smoothness is a good goal, but it's all too easy to cause perturbations in electronic response that are not shown in the display. The great majority of equalizers have more boost and cut than should be used, except in unusual cases.

Figure 10 shows octave and third-octave displays of a loudspeaker response before and after equalization. The before-equalization response includes the results of adjusting the speaker midrange and tweeter attenuators. The additional detail provided with third-octave information is immediately apparent in this 'scope photo. The little response jogs are the sort of thing that unfortunately lead some owners of third-octave equalizers into performing excessive equalization, pushing sliders up and down, even by several dB, in an attempt to obtain perfect smoothness. The drop at 3.15 kHz, for example, is at the crossover notch, which should not be re-equalized. My main goals with the Teac PE-40 parametric equalizer were to reduce the increasing boost below 500 Hz and to bring up the relative 500 to 1,000 Hz level. The change was accomplished primarily by broadband cut. The roll-off above 1 kHz was from trimming to make the sound best to the ear.

You should equalize each channel, in turn, following the procedures given earlier and keep the RTA fairly close to the speaker. Make notes on all of the equalizer settings to establish your baseline reference. Move to the listening position, and recheck each channel's response after increasing gain to obtain the same RTA level as before. The bass may be too high because of room effects; notice how much cut would be needed to make the response flat. The close-to-speaker equalization done earlier made the direct sound wave reasonably flat, so cutting would make it bass-deficient. You should reduce the bass just enough for the best overall sonic result. The RTA display should not be the final arbiter on what is correct for any part of the spectrum. Trim the equalization, as needed, to get the most satisfying sound in the listening area according to *your ears*.

Recommended Sources

Compact Discs are the best source for music played through surround systems, just as they are for regular stereo systems. A number of surround processors' modes—including reverberation, particularly if it is adjustable—can match almost all CDs in generating a satisfactory illusion. Decoders that do not include such processing are generally most successful with CDs having a good amount of liveness in the recordings themselves. Results when listening to mono CDs, usually remastered from LPs or even

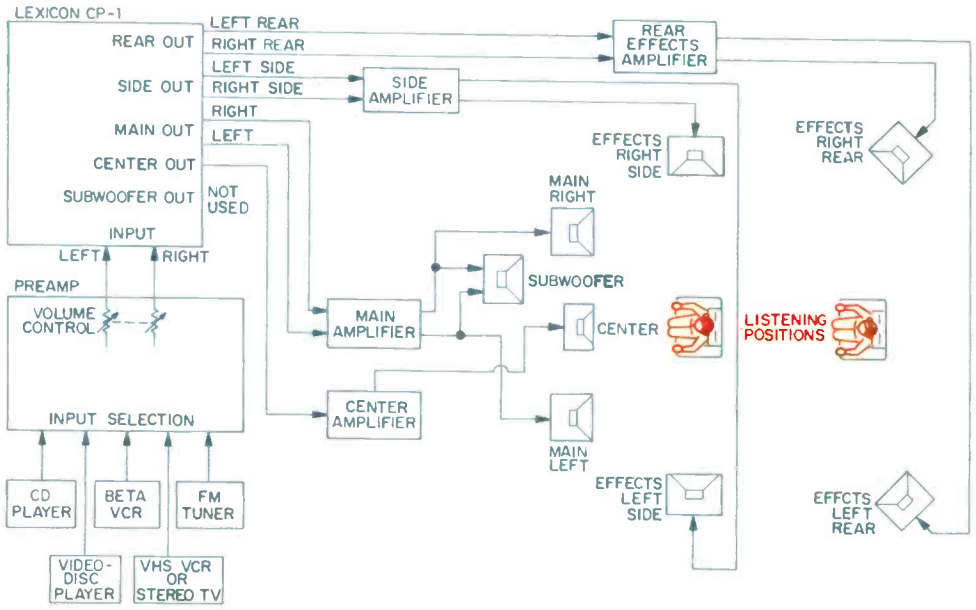

Fig. 12—System setup used by the author to evaluate Lexicon's CP-1 processor. Two listener positions were used; see text.

78s, can be quite enjoyable, and mono enhancement modes can accomplish good effects. Prerecorded tapes and LPs call for the same basic guidelines. Ticks on LPs, however, can be very distracting with surround systems, especially those simulating reverberation or repeated echoes. Even with delay, the ticks can become all too noticeable, because you'll hear them coming from all around the room. Thus, pristine LPs become even more of a treasure when using surround sound.

Stereo recordings you have made yourself may be excellent sources for a surround system. The displays on my oscilloscope showed that my own recordings have a great deal of surround information, and various decoders have created impressive illusions of the original performance halls. Many FM stations use CDs, and their broadcasts of tapes and discs are other good sources of surround material. Getting a natural voice sound that is centered, along with good music surround, is desirable; some decoders do much better than others in this regard. One of your decoder's modes may be better for music than it is with speech quality, and vice versa. Depending on your preferences and the program material, therefore, you may often have to compromise on the processing mode you select.

Laser videodiscs are the highest quality source for movies and videos, both for picture and sound. Quite a few have digital sound, but even if the videodisc player's analog output is used, the results can still be spectacular. Remember that the format does not guarantee the presence of good surround sound: The director (and others) may not have taken the time and effort needed. Unfortunately, many videodiscs of movies encoded with Dolby Surround are not labelled to confirm the fact. Videocassettes, on the other hand, are quite consistently labelled "Dolby Surround" when the movie is encoded. Although videocassettes do not match videodiscs in picture or sound quality, they are usually offered at lower prices and availability is generally better. (I gave up on acquiring several videodisc titles; after seven months, the manager of my local video store wasn't able to get them from his supplier!) Some recent music videos on videodisc have excellent surround sound, but many earlier ones are basically mono. Videocassettes are much easier to handle, in general, but videodiscs are more convenient for jumping to the next scene of a music video, and the nondestructive scanning is appealing.

The videodisc format is sonically and visually superior, but it can't guarantee the presence of good surround sound.

Be wary of discs or tapes that have synthesized stereo: They can be quite poor. Material from before 1980 should be suspect, musicals from the 1950s and 1960s in particular. The MGM/UA videocassette of *Singin' in the Rain* has stereo synthesis throughout. Terrible, frustrating, and horrifying are the adjectives that came to mind when I first heard it. The harsh, distorted dialog jumps in level and leaps about the room like a frightened gazelle. Figure 11 shows the X-Y oscilloscope pattern from a section of dialog with the actor Gene Kelly centered in the scene. Notice how the signal is spread among the four quadrants (the leaping gazelle). The synthesis on some of the music is acceptable, but I suspect even here the final result might have been better by using mono enhancement of a good decoder on the original monaural sound.

I have been a bit puzzled when I thought about the amount of time and effort involved in making a Dolby Stereo move. As long as someone had to pan some of the dialog and maybe most of the effects, why didn't they do a better job of it? It doesn't seem as though it would have been too tough to pan dialog within the scenes, or at least within some of them where accurate speech localization would have added drama. And panning dialog off screen, to where the performer was, would have increased realism greatly. From the writings of Tomlinson Holman, Corporate Technical Director of Lucasfilm, however, I have come to understand the difficulties and possible problems in trying to pan dialog. Usually it's easier to pan effects—although it's not done as much as it should be, in my view. In suspense movies, correctly positioning threatening sonic clues and music can raise a movie's rating by as much as one star in my method of film criticism.

Producers of videotapes and videodiscs have taken different approaches with movies made originally for wide theater screens. Some releases are simply chopped off on both sides to fill the TV screen vertically. Others have black areas on the top and bottom (called letterboxing) so that the whole horizontal panorama can be seen. Neither approach is completely right or wrong: The really wide-screen movies just don't translate very well in most home viewing rooms. How big can the screen be, and where do you have to sit to make the wide scene realistic? If letterboxing is important to you, check the tape/disc label. For example, a notice on the MGM/UA *Ben-Hur* videotape reads: "Chariot sequence in Letter-Box Format."

Stereo TV has a long way to go to fulfill its promise, but more and more special productions deliver really good surround sound to the home. The Public Broadcasting System does a good job with many music programs. In some cable-TV areas, at least, HBO, Showtime, and MTV are available with simulcast of the stereo sound. A VCR with a simulcast input will facilitate recording programs and retaining the stereo sound and any encoding. Some stereo TV broadcasts cause erratic operation of the MTS decoder in my VCR; the SAP indicator flashes on and off, and a loud buzz is recorded on all tracks. In these cases, the X-Y display has shown distortions of the normal patterns. I hope you don't have the same problem in your area! (By using my Beta VCR, which does not have an MTS decoder, I am able to record in mono without getting this buzz.)

Testing Surround Systems

When I first evaluated a surround system for *Audio*, I had a rather hodgepodge collection of sources, amplifiers, and speakers. Since then, I have changed my system to increase the flexibility of the evaluations and improve overall system performance. I expect to continue making changes, when possible, for the same reasons.

Currently, I use a Yamaha AVC-50 for switching the various input sources. These sources are a Yamaha TX-900U tuner, a Yamaha CDX-730 CD player,

an Akai VS-555U VHS Hi-Fi VCR, a Sanyo VCR7200 Beta Hi-Fi VCR, and a Yamaha LV-X1 videodisc player. For power amplification, I use the second section of the Yamaha AVC-50 for the main stereo channels, a JBL/UREI 6210 for the center channel, and a Yamaha four-channel M-35 for the surround channels. The speakers are two JBL 4301s (main stereo), a JBL 4408 (center), a self-powered Triad Speakers HSW-300 (subwoofer), and four Model A25 systems from Dynaco (surround). The Akai VS-555U VCR is used as the stereo TV decoder. If I need to get video back to r.f., I use an Archer modulator from Radio Shack. I connect a two-channel oscilloscope across the left and right inputs, and operate it in X-Y mode to show the presence or absence of stereo and surround information. The reference surround unit is a combination of the Yamaha DSP-1 processor and the DSR-100 PRO Dolby Pro-Logic decoder.

Figure 12 shows the arrangement I used to test the Lexicon CP-1 decoder. To evaluate particular modes of this unit, a second listening position was used, directly between two side effects speakers. When testing other processors, I might place those speakers outside of, and behind, the main speakers or perhaps I might not use them at all. Whatever system is evaluated, I use about a dozen CDs, selecting one to three discs each from chamber music, classical, concertos, musicals, opera, organ, piano, pop/rock, and vocals. I might occasionally include a tape or an LP but usually don't. I rate the processor on how successful it is in creating illusions with each CD. When checking performance with movies and videos, I prefer to use videodiscs because of their superior images and sound. I do use videocassettes frequently, however, because I have a wider selection of them. The decoder is checked on its success in positioning dialog, generating good surround without localization to the surround speakers, and other characteristics. I refer to the oscilloscope's X-Y display frequently to see what the localization should be.

I use the processor with music broadcast on FM to find its best modes for the music and to see what happens during voice announcements. I watch several programs on stereo TV, always verifying that the stereo detector is on and checking the oscilloscope X-Y display whenever questions arise (such as why the sound is distorted on a news broadcast). All facets of the processor's operation are evaluated, of course, including the remote control and the owner's manual.

When auditioning systems at a dealer, take along favorite CDs of musical performances that you've heard often.

If you go to a dealer to evaluate a surround system, take along your favorite CDs. If you can, include music you have heard in live performance. The dealer might have CDs matching your taste—but maybe not, and salespeople are likely to use music that tends to overwhelm. Listen carefully: How satisfactory is the illusion? Is the demonstration room well arranged and isolated from distracting outside noises? Are the speakers positioned in accordance with the guidelines recommended by the processor's manufacturer in the owner's manual? Will you be able to follow the same plan in your own listening room? When you listen to the system with movies, keep track of how well dialog is positioned within the scene or kept centered. Dialog should be kept completely out of the surround channels, although some low-level leakage might occur. (I considered compiling a list of possible videotapes or videodiscs for movie evaluations, but there are many more good choices than I could list.)

The reviews in this issue include comments on my assessment of the tapes and discs that I have tried. The dealer should be able to supply good examples of current movies meeting the criteria of correct dialog positioning, effective use of special effects around the listening area, and good use of surround by the background music. Poor processors can make movies with good surround and dialog sound unsatisfactory, perhaps even confusing with poor steering, but good processors cannot create exciting surround from a poorly done movie. When you hear poor localization or effects that never get out of the front soundstage, it's very difficult to know where the fault lies. The source must be good to make the processor sound good. If there is dialog leakage to the surround channels, it's probable the decoder and/or its input balance setting are at fault. The dealer should be able to demonstrate the ease of obtaining accurate Dolby Surround balance; excuses for noticeable leakage should not be accepted. Remember that passive-matrix decoders cannot deliver a good, strong center channel and a good stereo spread, while the more expensive, active-matrix decoders can. Make certain you're really hearing these characteristics.

The Future of Surround Sound

With the expanding interest in home entertainment centers, including surround systems, I expect there will be increased interest in better viewing/listening rooms in future homes. The Lexicon CP-1 has a mode to facilitate loudspeaker listening to recordings made for binaural headphone listening. Perhaps more recording engineers will decide that dummy-head microphone pickup produces the best results, leading to more changes in home listening and surround sound. More processors will have digital processing of at least some functions, and units will appear that are completely digital. Further cost reductions in chip design and fabrication could bring to consumers equalization which will correct responses of both the direct sound wave and the room.

With the increasing number of Dolby Stereo and other surround sound theaters, consumers will likely put more pressure on owners of theaters having poor sound to upgrade their equipment. More movies (I hope) will have good localization of both dialog and effects on and off screen. Videodiscs may attain the popularity they deserve, and perhaps we'll see price reductions both in discs and players. The number of stereo TV programs with good surround may increase, and (another fervent hope) stereo synthesis on bad program material will disappear. Standards for HDTV will be finally set, and the ratio of the screen dimensions should be a much closer match to the original movies. Regular stereo will continue long into the future, but I'm certain we will see continuing changes brought about by further advances in surround sound processing.

For music purists with an unlimited budget.

In the relentless pursuit of musical perfection, Infinity has created some of the world's best sounding speakers. Including one for the decidedly well-heeled: the 7½ foot, $50,000 Infinity Reference Standard V. Acclaimed internationally as the most sonically-accurate speaker ever made. (With unlimited space and budget you might choose the imposing sound—and imposing presence—of the IRS V.)

For music purists with limited space.

Now Infinity introduces another Reference Standard for people whose passion for music must be in harmony with their living space: the Environmental Reference Standard Series.

Infinity ERS environmental in-wall speakers use no floor or shelf space, and they can be painted to match or accent your room's decor. In short, they offer the best of both worlds—filling your rooms with spacious, extremely accurate stereo sound, but without imposing on your environment.

Audition the phenomenal ERS Series speakers and pick up your copy of "Infinity Answers Your Questions On Environmental Sound." Only at a selected Infinity ERS dealer.

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ES

Seven years ago, Sony made your turntable obsolete.

Our Digital Signal Processing is about to do the same to the rest of your system.

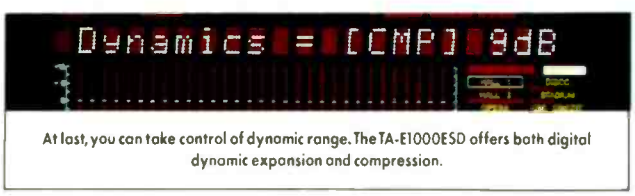
Sony proudly presents the TA-E1000ESD Preamplifier, incorporating the most advanced Digital Signal Processing in high fidelity.

Seven years ago, Sony engineers astonished the world with the Compact Disc, the first giant step for digital high fidelity. Now, the Sony ES Series is pleased to introduce the second step: bringing the digital technology of the Compact Disc to the rest of your system.

Sony's new TA-E1000ESD Preamplifier incorporates Digital Signal Processing (DSP) to maintain the integrity of Compact Disc sound from input to output. This incomparable

Ten factory preset combinations of digital soundfield-plus-equalization are at your disposal—ready to be adjusted for literally trillions of alternate settings.

circuitry not only handles digital sources in the digital domain, it even converts analog sources to digital. So all your music can receive the full DSP treatment, including digital expansion, digital compression, digital parametric equalization, digital reverberation, digital delay, and digital surround sound encompassing ten digital soundfield parameters. Now you can heighten sonic performance digitally, obtaining optimum ambience and brilliance without enduring the veil of conventional signal processing.



At last, you can take control of dynamic range. The TA-E1000ESD offers both digital dynamic expansion and compression.

Direct the Dynamics.

The numerical prowess of DSP puts you in full digital control of dynamic range, with nine discrete steps of compression or expansion. So you can finally do a proper job of fitting live music within the limitations of analog cassettes. Or use DSP expansion to bring your existing analog sources closer to digital standards.

Bass and treble controls were never like this.

Sony's DSP also accomplishes digital parametric equalization. It's simple, effective, and free from the distortion, phase shift, and noise of analog EQ. With any of 31 center frequencies and four slope settings, you have a choice of over three *trillion* EQ curves. Which is more than enough boosting, peaking, shelving and tweaking to overcome even quite severe acoustical deficiencies.

If you don't like your listening room, change it.

Because listening rooms were never designed to contain the Vienna Philharmonic, Sony's digital surround sound places you in your choice of symphony hall, movie theater, stadium, studio or small club. Unprecedented digital adjustments let you choose room depth, width, wall absorbancy, reflection times—even the row and number of your seat! You get acoustic environments so detailed, so authentic, they have a palpable presence. And for Dolby Stereo™ movies, our six-channel Dolby Pro Logic™ Surround Sound projects a more vivid soundstage than most sound stages.

For the ultimate in surround sound processing of Dolby Stereo™ movies, the TA-E1000ESD incorporates six-channel Dolby Pro Logic™ circuitry.

After all these digital attainments, Sony didn't forget that the TA-E1000ESD is also a preamplifier. So we included five low-noise audio inputs, three digital inputs, seven A/V inputs, a programmable remote control and a three-year limited parts and labor warranty—the same one that covers ES power amps, CD players, cassette decks and receivers.*

All of which leads to one simple conclusion. The company that wrote the book on digital audio has just inaugurated a whole new chapter.

ES

SONY®

THE LEADER IN DIGITAL AUDIO™

HOME THEATER

PUMP UP THE VOLUME

Today's giant TV screens and high-performance components let enthusiasts bring the movie experience right into their living rooms—bigger, better and more dramatic than ever.

Music lovers strive to re-create the concert experience in their listening rooms . . . movie enthusiasts are no different. They want the best Hollywood has to offer in their homes . . . dazzling pictures, state-of-the-art sound. And with new technologies recently unveiled, they are close to achieving the ultimate in home entertainment.

When designing a Home Theater, the true movie aficionado *knows* what's best. They recognize the superiority of 70mm prints, Dolby Stereo soundtracks, the Lucasfilm THX sound system and look for components that will perform similar magic in their homes. Dolby Surround decod-

ers have been available for years and tantalized viewers with the potential of the ultimate home theater. And now the cutting-edge THX system is available for use at home.

"The THX system uses a series of proprietary electronic and loudspeaker advances designed to reproduce movie sound in the home as it was originally created by the filmmakers," said Laurie MacPherson, Vice President and General Manager of the THX Group. "Originally developed for use in movie theaters by Tom Holman, Lucasfilm's corporate technical director, the system lets consumers hear exactly what George Lucas and Steven Spielberg heard in the dubbing stage. And what they experience in the theater will be accurately re-created in their homes." Lucasfilm has begun licensing home THX technology and Technics was the first company to sign on board. Snell and Lexicon quickly followed.

A complete Home THX Sound System will be available from Technics this Fall consisting of a THX controller, three stereo amplifiers, an A/V switcher, front left, right and center channel speakers, a subwoofer and two surround speakers. Ms. MacPherson added that THX is designed for use with any Dolby encoded software including videotapes and laser discs, "even from filmmakers other than George Lucas!" Ear-witness reports of the home THX systems also report the musicality of the components with CDs and audio cassettes is top notch. According to Deborah McGrath, VP of Snell Acoustics, their Multimedia/Home THX Audio Loudspeaker System "had to be hi-fi speakers first." The price for Snell's three front, surround, and subwoofer system is just under $5,000 and they are available now. Lexicon's CP-3 THX decoder will be released in the first quarter of 1991 and will cost around $2,800. The CP-3 will also have 15 Digital Signal Processing (DSP) modes.

Although THX will be blazing new ground, manufacturers continue to refine components for high-quality home theater systems. A good example is Yamaha's hot-selling AVS-700 A/V Selector ($299) and DSP-A700 A/V Amplifier ($1,099). Combining Digital Signal Processing, Active Servo Technology, Dolby Pro Logic and up to 7 channels of amplification, the pair is one of most flexible A/V control centers available. Philips has also just introduced a pair of A/V powerhouses, the AV1001 pre amplifier and AV1002 multi channel power amp ($3,000 for both). The AV1001 has a Pro Logic decoder, a digital signal processor and a Bitstream converter. The AV1002 can deliver six 50-watt channels in 6 channel mode and be configured between three and five channels as well. Sony's TA-E1000ESD DSP pre amp ($1,000) does all of its processing in the digital domain, offers 10 soundfield settings as well as Pro Logic decoding and extensive audio/video inputs/outputs. Coupled with Sony's 200-watt TA-N77ES power amplifiers ($1,200 each), it forms the cornerstone of an advanced, high-performance home theater system. Another recent entry is B&K's Video 5 ($1,298) with five channels of power (85 watts each).

Adcom GFP-565 and GFA-565

Engineers are also upgrading and expanding the capabilities of the new generation of A/V receivers. Pioneer's new VSX-D1S ($1,350) not only offers Dolby Pro Logic decoding it is the first to use Digital Signal Processing to prevent degradation that sometimes occurs within Pro Logic circuits, filters, tone controls, level balance between channels and muting. Five soundfield effects are also available including theater, dance, jazz, concert hall and church. Other companies have improved or introduced Pro Logic A/V receivers including Denon's AVR-1010 ($1,000), Mitsubishi's 125-watt M-R8010 ($1,399), the Marantz RS3559 ($800), Onkyo's TX-SV90

Vidikron TGS 200

This special supplement was produced by David Elrich for the Publisher of AUDIO Magazine. The editorial staff of AUDIO was not involved in its preparation.

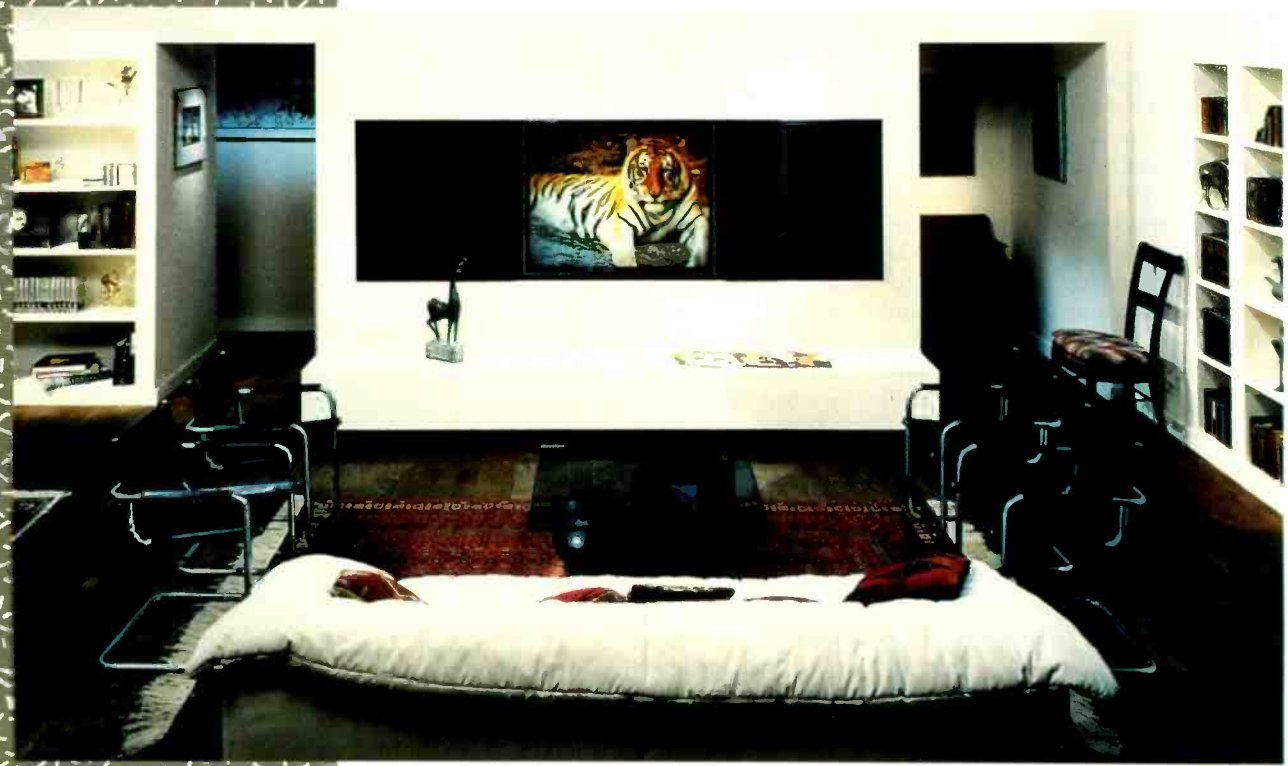
HOME THEATER

PRO ($1,100) as well as Sansui's RZ-9500AV ($769). Many A/V receivers can also control components in other rooms and the names to look for here are Pioneer and Luxman.

Although the popularity of A/V receivers is rising, many home theater enthusiasts want individual components to perform the Dolby Surround decoding and power amplification functions. Fosgate•Audionics is a top name in this field and their Model DSL Two ($1,299) uses proprietary Digital Servo Logic technology. Surround Sound Inc. also has several models (System 4500, $599, and 4000II, $549) with their own proprietary active steering logic circuitry.

To complement a separate Surround processor with built-in amplification, many enthusiasts use pre amps and mono block amplifiers to drive the individual speakers. Adcom has designed the GFP-565 and GFA-565 just for those situations. The Class A GFP-565 pre amp ($799) has a special processor in/out switch to cleanly accommodate Dolby decoders while the GFA-565 300-watt mono block amps can handle the most complex loudspeakers ($849 each); 200- and 100-watt versions are also available.

Although a first-class Steven Spielberg blockbuster on laser disc would be ideal to test out a Dolby Surround system, a Dolby-encoded compact disc would be the next



best thing. RCA Victor has released a series of remixed Dolby Surround encoded CDs. Naturally, the material is film related including "Motion Picture Classics" by the Boston Pops. RCA has also just released the first album recorded and mixed for Dolby Surround, "Mancini In Surround—Mostly Monsters, Murders & Mysteries."

THE BIGGEST PICTURE

Video quality has more than kept pace with these sonic advances. New 1990 model projection TVs (both front and rear) as well as direct view sets have already *exceeded* current software capability. The finest laser discs or Super VHS cassettes deliver 400 lines of horizontal resolution at their peak (resolution is a measure of picture detail). It is now common to find even true big screen TVs with resolution capability of almost 800 lines. Even the largest rear projection TV available, the Mitsubishi VS-12001 with a screen size of 10 feet (diagonal), is rated at over 750 lines. At approximately $20,000 (depending on the complexity of the installation), the giant Mitsubishi is for the lucky few. Depending on your budget and amount of space in your media room, there's a wide variety of rear projection TVs with screen sizes ranging from 40 to 70 inches. Mitsubishi, Pioneer, and Philips are leaders in this area.

Philips has also unveiled WallVision, a series of projection TVs designed for home theaters. They can be used as standalone sets or come with special kits that lets users install them directly in the wall. The kit ($200) partially consists of a screen frame, a slip on color enhancement filter and a detachable speaker grille. The finished product looks like the fabled "TV that hangs on a wall" and blends nicely into any decor. The sets range from 46 to 61 inches (prices range from $3,000 to $3,700) and come with Picture-in-Picture capability, learning remotes, plus 50 watts of total power and Dolby Pro Logic decoding!

Another big screen alternative is a front projection TV system, consisting of a separate projector and screen. Unfortunately, many dismiss the concept out of hand, believing they don't have enough room for such a setup. One of the key advances in this arena has been the downsizing of the projectors. Vidikron's TGS 200 ($5,995) can easily be mounted on the ceiling or rest on the floor. Quality has come a long way as well, as the Vidikron delivers over 500 lines.

Yamaha AVS-700/ DSP-A700

Although the goal is a dedicated room with a full-blown big screen TV and seven-speaker Dolby Pro Logic system, not everyone has the space. Sony televisions with Sound Retrieval System (SRS) technology offer a small-scale alternative. Developed by Hughes Aircraft, this space-age circuit generates what many describe as an "aural hologram." The 27-inch Sony KV-27XBR50 ($1,449) not only has a sizzling picture but offers stereo imaging no matter where you sit.

Pioneer VSX-D1S

Just as a CD player is a must for any top audio system, a laser disc player is vital for the best quality video. Pioneer continues to introduce world-class machines including the Elite LD-S2 ($3,500), an LD player with a video signal-to-noise ratio of 52 dB, 6 dB higher than the highly rated LD-S1. The Pioneer CLD-3080 ($1,400) offers two-sided play, digital special effects and 50 dB video S/N. Another top LD player is Philips new CDV600 with Bitstream technology.

High quality speakers would round out any superior home theater system. For electrostats, a pair of Martin-Logan Monolith IIIp ($6,500 a pair) would do nicely for front left and right channels. As alternatives to in-walls, a pair of EPI Model 110 two-way WallPlane loudspeakers ($299 for both) would do the trick.

Sony KV-27XBR50

As we enter a new decade, creating a home theater with state-of-the-art audio and video is one Hollywood story with a very happy ending. ●

YAMAHA DSP-3000 DIGITAL SOUND FIELD PROCESSOR

Manufacturer's Specifications

Analog Inputs and Outputs: 2.5 V rms maximum.

Analog Output Gain: 0, ±0.5 dB.

Digital Input and Output Levels: 0.5 V peak to peak.

Sampling Frequencies: 32, 44.1, and 48 kHz, with automatic selection.

Video Input and Output Levels: 1 V peak to peak.

A/D Converter: 16-bit linear quantization with 48-kHz sampling frequency, independent stereo channels, and internal dither circuitry.

D/A Converter: 18-bit (main) and 16-bit (effects) quantization.

Processing Programs: 35 preset and 20 user-set.

Harmonic Distortion: 0.002% on main outputs and 0.005% on effects outputs with analog input; 0.003% on main outputs and 0.005% on effects outputs with digital input.

Frequency Response: 10 Hz to 100 kHz for main and 20 Hz to 20 kHz for effects with analog input; 20 Hz to 20 kHz, ±0.5 dB, for both with digital input.

S/N Ratio: 110 dBA for main and 94 dBA for effects with analog input; 110 dBA for main and 105 dBA for effects with digital input.

Channel Separation: 80 dB at 1 kHz with analog input, 90 dB with digital input.

Power Requirements: 120 V a.c., 60 Hz.

Power Consumption: 45 watts.

A.c. Outlet (Switched): 300 watts maximum.

Dimensions: 17⅛ in. W × 3¾ in. H × 13⅞ in. D (43. 5 cm × 9.55 cm × 35.2 cm).

Weight: 21.1 lbs. (9.6 kg).

Price: $1,899.

Company Address: 6722 Orangethorpe Ave., Buena Park, Cal. 90620.

(Originally published November 1988)

When Yamaha introduced the DSP-1 digital sound field processor, I was among many who marveled (June 1987) at what it accomplished for the listening experience. Because of the great sophistication of that unit, I forecast (to myself) that the next unit would be less complex at a lower price. The DSP-3000, however, is more sophisticated in a number of respects, and the price is roughly twice as high.

Let's take a look at the features with attention to the changes made. The new Yamaha processor offers 20 sound fields with a total of 35 variations. There are 17 new environments, including concert halls sampled in several countries. There also are two new presence modes and a new surround program. Four new movie-theater modes simulate the effects of commercial movie theaters; the self-descriptive program names are "Adventure," "Classic," "Musical," and "Standard."

The master volume control changes output level on all channels simultaneously with the use of the remote control or a rocker-type switch on the front panel. (The DSP-1 requires external means, such as the Yamaha MVS-1, for such control.) An internal pink-noise generator can be switched on for setting system balances. This is a great convenience when setting up, and it is always available if a recheck is needed.

There is a video input/output loop to superimpose program parameters and other function readouts on the screen of a TV monitor. A program menu is used to set the preferred type and time duration of display and one of the nine background colors. If video is fed in, the background color disappears, and the display is superimposed in white. The DSP-3000 can select among two analog inputs and a direct digital input. The digital input allows direct effects processing of CD or DAT signals and eliminates one stage of A/D conversion. There are also the obligatory tape recorder input/output connections and monitor switch.

Yamaha's proprietary Hi-bit, floating 18-bit approach combines with a dual-converter configuration for improved signal-to-noise ratio and dynamic range, and lower distortion when the direct digital input is used. The digital processing of the DSP-3000 uses four-times oversampling digital filters for improved time-base resolution, phase coherence, and transient response. The four effects channels and the two main channels use one filter each. The main-channel filters are activated only when the digital input is used.

The new processor has a front-panel program-stepping switch which provides some convenience. The remote control selects any basic program directly and allows making the great majority of possible changes from the listening position. The DSP-3000 contains stored acoustic data based on a number of different performance environments. An original Yamaha VLSI (Very Large Scale Integrated) circuit chip, operating in real time, calculates dozens of discrete early reflections based upon this data. Each of the Yamaha YM-3818 VLSI chips used in the DSP-3000 incorporates a high-speed multiplier and an adder and subtractor. These enable the DSP-3000 to produce up to 88 discrete reflections, 22 for each of the four effects channels. Figure 1 is a block diagram of the processor.

The digitally processed delays create time lags between the sound arrivals from the main speakers and the arrivals from the effects speakers. These delays, in the relatively small listening room, are the same as those between the direct sound and the reflections from the walls in a concert hall or other venue. The generated sound field removes the boundaries of the home listening room, as it were, and replaces them with the characteristics of the performance hall. The processor offers a wide variety of possible fields by providing control over many of the parameters involved in the synthesis. It is easy to vary such things as "liveness," initial time delay, and reverberation level over wide ranges for the most satisfying home listening experience.

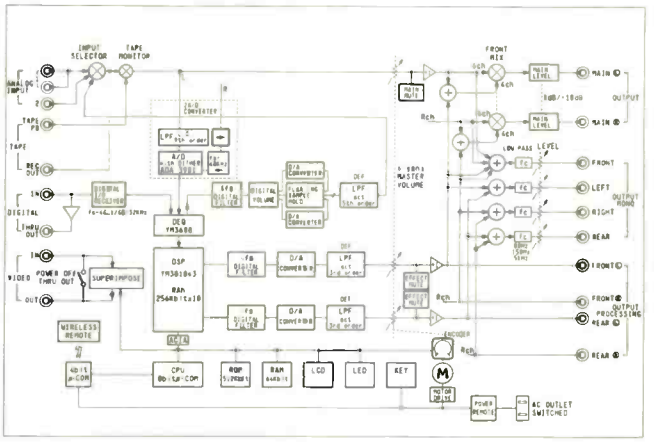


Fig. 1—Block diagram. Note that all surround processing takes place in the digital domain.

Control Layout

The on/off "Power" pushbutton is at the lower left of the front panel. Above it is a display area that extends from the panel's left end almost to the middle. At the left of this display is the receptor for the remote control. To the right of that are the red LED "Mute" indicators for "Main" (top) and "Effect" (bottom). The LEDs are not large, but the muting status can be seen at least 25 feet away. The separation between them prevents confusion as to which function is muted. Just to the right of the LEDs are the yellow annunciators for "Preset" (top) and "User Prog" (bottom). They are not easily read at a distance, but relative position shows which function is being used.

Further to the right is the bright yellow LED program-number display. The numbers are large enough to be read over any normal listening-room distance. They immediately dispel any doubt about which program is in use. Last in the display panel is the large, 2-line by 16-character LCD display. Its alphanumeric characters are gray on a white background and are quite easy to read at normal distances. The

Four-times oversampling digital filters are used for better phase coherence, time-base resolution, and transient response.

default mode shows the program name on the top line and the first changeable parameter below. Pushing buttons on the remote control causes this display to report, at least momentarily, what has happened. I will give more detail on this very useful feature later on.

Just to the right of the display panel are the "Input Selector" switches (from left to right, "Digital/1, 2, 1") and the "Master Volume" rocker. Bright yellow LEDs are above the left end of each "Input Selector." Pushing any of these switches gets a 2- to 3-S display of the selection made. Push "Digital/1" without an actual digital signal, and the LCD display shows that the DSP-3000 has automatically switched to analog input 1, instead. (It makes this decision even if analog input 2 was in use before.) This is a very minor perturbation, in my view, considering the advantage of the automatic decision.

The volume rocker has "Down" printed above its left end and "Up" above its right. With a push on either end, "Volume Level" is displayed with a row of up to 28 small vertical bars on the second display line. (No bars are shown at the zero-volume setting.) The user needs to keep in mind that this horizontal bar graph shows the setting of the six-gang, motor-driven volume control: It does not show the actual signal level within the unit. I really like being able to control all output levels at the same time, and the status display makes this feature even more convenient.

Below the input selectors are the "Tape Monitor" switch and the down/up "Program" rocker. A red LED illuminates when the monitor switch is on. Changing the switch position results in a momentary status display each time. Holding in the "Program" rocker steps the programs up or down at about three per second. Going below "1" of the preset programs calls up "20" of "User Prog"; going above preset "20" calls up "1" of "User Prog." (Some presets, as we'll see later, have multiple modes, making a total of 35 preset programs.) All of the above button switches and rockers have good tactile and audible clues with actuation, although the monitor switch has a soft sound.

The back panel has 24 gold-plated phono-jack input/output connections. From the left are stereo (L/R) pairs for "Analog Input" (two sets for "1" and one set for "2"), "Tape" inputs and outputs, and the "Main" and "Processing" ("Front" and "Rear") outputs. The two sets for "Analog Input 1" allow looping the signal through to other equipment. Above the main output jacks is a "Main Level" slide switch with "0 dB" and "−10 dB" positions; this can be an aid in getting the desired system balance. (I have been using the −10 dB setting most of the time with the original DSP-1, which I use as a reference system.)

A "Front Mix" slide switch above the "Front Processing" jacks selects "4 ch" or "6 ch" to match the system configuration. The normal system has four separate effects channels in addition to the two main channels. When the system will have just two effects speakers, "4 ch" is used to get a mixing of effects into the main stereo speakers. In this fashion, a good part of the created sound field is maintained even with the compromise.

In the center of the back panel, from left to right, are four "Output/Mono" jacks ("Front," "Right," "Left," and "Rear") for reinforcing the lower frequencies. Each output has a level control and a low-pass filter with slide-switch settings of 80 Hz, 150 Hz, and 5 kHz. The pot knobs are very small, but knurling makes them easy to turn. As Fig. 1 shows, appropriate outputs for the effects channels are summed to feed each of the mono outputs: Front left and rear left feeding left, for example. Front, however, is also fed from the left and right main channels as well as from front left and front right effects channels.

To the right are the "Digital" "In" and "Thru/Out" jacks. This configuration allows sending the digital signal from a CD player or DAT recorder to other equipment as well as to the DSP-3000. (The processor's power does have to be on for feeding through.) "Video" "In" and "Out" jacks allow similar looping through, but in this case, power does not have to be on. There is superimpose circuitry under the unit's control for TV-monitor display of programs and any other material that would appear on the front-panel LCD display. The back panel also has a switched a.c. outlet which will handle up to 300 watts; this is quite high, and much better than on many other units.

I removed the heavy top cover to get a look at the internal construction and found that two side-by-side sheet-metal covers remained. I took off the one that covered the power supply and the majority of the circuitry—mostly digital. The three Yamaha YM-3818s are quite apparent from their large size and grouping on the excellent p.c. board. The layout is very neat and clean, and parts and functions are well labelled. The transformer was hot to the touch—but not to the point of being painful—after hours of operation. It is well encased in a heavy cover, and I did not notice any ventilation paths. I could see why the transformer would be on the warm side, but I could also appreciate that the construction would minimize any coupling and radiation problems. A sheet-metal cover/shield enclosed the analog circuitry, and I did not remove it. The chassis construction was very rigid, even with the top covers removed.

Remote Control and Programs

Operating the Yamaha DSP-3000 is best understood by discussing the remote control, the sound-field programs, and other functions. The remote control is not heavy, but it is larger than most. The wide power on/off button is the first one at the emitter/transmitting end of the control; a white-on-red label next to it catches the eye. Next is a row of three "Input" selector buttons and then a row of three more buttons. "Memo" (labelled in red) is used for enabling the system to put user-generated parameter values into one of the user-program positions. To the right, "Preset" and "User" (in white) select the class of program. Pushing either button always gets the program that was last used under that category.

The next four rows, with five buttons each, select programs identified by name and number. Each button has a white number on its face, and above each button or group of buttons is the designation in gold lettering. The first row of five buttons are all designated "Concert Hall": "1" gets "Hall A (or B) in Europe"; "2," "Hall C (or D) in Europe"; "3," "Hall E (or F) in Europe"; "4," "Hall G (or H) in U.S.A.," and "5," "Live Concert A (or B)." The first listing, in each case, is the default choice; the "Parameter" decrease or increase but-

LUCASFILM THX AUDIO

LUCASFILM has been working for years to improve sound and picture quality in movie theaters. That's because filmmakers want to see and hear their work portrayed perfectly, just as they experienced it when it was made. Now, Home THX Audio brings new technical developments to the home so that the original sound of the dubbing stage can be clearly heard. And it works with the thousands of titles that already exist on disc and tape—in fact, the closer the disc or tape sounds to the original, the better Home THX makes it sound.

Home THX starts with components that are designed to rigid specifications for excellent *audio* performance. The components are also uniquely well matched to one another. Proprietary technology is added to make a transparent transition from listening in the dubbing stage to listening in your home.

Only the Home THX System includes features such as surround decoders which tame overly shrill high frequencies, make the surround sound field more enveloping, and match the timbre of sound panned between the front and surrounds. The design of the front loudspeakers includes controlling the vertical directivity so that their energy is directed at the listener, not at the ceiling and floor. The side loudspeakers use a unique radiation pattern that stimulates the listening room without directing excess energy at the listener, enhancing surround sound.

Perfect Sound for Home Theaters

- Brings a new sense of localization and envelopment to home theater sound.
- Enhances the presentation of the thousands of readily available video discs and tapes.
- Improves music listening with excellent frequency range and balance.
- Available as individual components or complete systems.

The Home THX System is uniquely poised to offer what we think is the absolute best in music reproduction as well. The loudspeaker developments alone improve the enjoyment of music—it is easier to localize sources like the different parts of a drum kit in a jazz recording.

Whether you buy a whole system, or just one of the components for the time being, you can be assured that you are getting an enhanced experience

The generated sound field replaces the boundaries of the home listening room with the characteristics of the performance hall.

ton (discussed below) is used to get the second choice for these or other programs.

Buttons "6" to "10" are in the second row: "6" selects "Opera," with "Balcony" and "Mezzanine" choices; "7," "Cathedral "; "8," "Church," and "9" and "10" select "Jazz Club" "1" and "2," respectively. "Jazz Club 1" offers "Village Vanguard" and "Village Gate," based on acoustical data from those two New York City clubs. "Jazz Club 2" has "Cellar Club" ("small and cozy") and "Cabaret" ("fuller, richer sound").

The third row ("11" to "15") selects "Chamber," for chamber music, and "Rock Cnct," which provides "The Roxy Theatre" of Los Angeles and "Arena." Next is "Disco," with "New York" and "Tokyo" based on locations in those cities. "Pavilion" is for re-creating the sound field of a multi-purpose enclosed pavilion, and "Stadium" selects the sound fields of "Anaheim Stadium" and "Bowl."

The fourth and last row of program buttons ("16" to "20") comprises: "Presence A (or B)" for a close-up effect; "Surround A (or B)" for a feeling of being surrounded by performers and the sound; "Movie Theater" "1" and "2" ("18" and "19," respectively), which are synthesized modes for "Adventure" and "Standard" ("1") and "Musical" and "Classic" ("2") movies. Last is the standard Dolby Surround mode, labelled with the double-D symbol plus "Sur."

Beneath these program selection buttons is a row of four white-labelled "Parameter" buttons: "Down," "Up," "Dec," and "Inc." "Down" and "Up" change selection in the parameter menu. "Dec" and "Inc" decrease or increase the value of the selected parameter. Below this row, on the left side of the control, is the "Title Edit" button, which selects the mode to generate an original title up to 16 characters long for any user program. Upper- and lower-case letters, plus numbers and symbols, are available. I didn't take advantage of this feature, but it would be very nice for some users.

The "Utility" button, next below, brings many desirable functions under its rather dull name. Two pushes, while in any program, put the display in "Bit Monitor" mode, and the level status of the incoming signal is displayed in terms of the number of bits that can be extracted from the highest levels. With the level of the source adjusted for "16 bit," the user knows that he is getting all that's possible in this regard. The lowest level indication is "<13 bit," and the highest is "Full," which calls for a reduction back down to "16 bit." "Utility" also accesses the menu for "Display Control for Superimpose" to define the TV monitor display, and it enables system balancing in combination with "Preset" and the built-in pink noise source. (The "Measurements" section of this profile will provide more details.)

To the right of "Title Edit" and "Utility" are the "Effect" level buttons: "Balance" ("Rear" and "Front") and "Level" ("Down and "Up"). A push of any of these four buttons displays the existing balance or level and any change from holding the button. The final setting is displayed for about 3 S after the button is released. Below are the two large "Master Volume" buttons, "Up" and "Down." A push of either displays "Volume Level" and its horizontal bar graph. To the left of these are the "Main" and "Effect" "Mute" buttons. As mentioned earlier, actuation of a muting mode turns on a red LED on the front panel.

Measurements

First, let me point out that all measurements were made after completing the listening tests. When I stood straight out from the DSP-3000 and pointed the remote directly at the front panel, the effective range was greater than 27 feet. At 10 to 15 feet, the remote position could be off axis up to 80° in the horizontal plane and at least 30° up or down from the horizontal axis. The pointing of the remote was actually noncritical. The LCD display could be read at 15 feet or more and up to 45° off axis horizontally. The highest contrast of the display was when looking at it in the same horizontal plane or from slightly higher. There was less contrast when viewing it from a lower angle.

The "Bit Monitor" display showed "13 bits" with 0.146 V at the input, "14 bits" with 0.295 V, "15 bits" with 0.594 V, "16 bits" with 1.214 V, and "Full" with 2.440 V. Clipping in the main output appeared with 7.34 V. These figures apply from 20 Hz to 1 kHz. With increasing frequency above 1 kHz, there was increasing reduction in the input voltage for any number of bits. By 20 kHz, for example, 16 bits was reached with 0.442 V. The reductions appeared quite acceptable in comparison with the spectral content of actual music. With a 1-kHz tone burst, it was possible to reach clipping without causing the display's "Full" legend to turn on. The clipping point, however, was greater than 10 dB above where "16 bits" appeared with the same tone burst.

The frequency response of the main channels was down 0.05 dB at 20 Hz and 0.4 dB at 20 kHz. The −3 dB points were at 1.7 Hz and about 80 kHz. The output levels were −0.8 dB, relative to the input for left, and −0.7 dB for right. The harmonic distortion for the main channels was 0.002% at 1 kHz. (Frequency response and distortion tests cannot be run on the effects channels because their responses are purposely modified internally. However, I heard nothing from these channels which I could classify as distortion or frequency response errors.)

Noise in the main channels was more than 100 dBA below 1 V for any position of the volume control. The front- and rear-channel output noise was 88 dBA below 1 V with the volume control at maximum and 100 dBA below 1 V with the control at minimum. The output impedance was 966 ohms, and channel separation was 79 dB at 1 kHz. Spectrum analysis of the six outputs showed no evidence of a 48-kHz residual or any sidebands from a high-level 1-kHz test tone. All such components were at least 87 dB below the level of the test tone.

The tracking of the volume control for the two main channels was within ±0.1 dB over the range from 0 down to at least 65 dB of attenuation—much the best that I have ever seen. With a little practice, I was able to set any exact level I wanted within ±0.1 dB for up to 35 dB of attenuation. There is no need to be that precise, of course, but I have had frustrating experiences with other motor-driven pots that I could not set even roughly close. The two front-channel volume controls tracked each other within 1 dB over the whole range, which is excellent. The two rear-channel volume controls tracked within 1 dB for about 50 dB of attenuation, which is quite good. The effects-channel volumes tracked the main-channel volume within 1 dB for about 45 dB, which is really very good for the six sections involved.


Now, music lovers
with totally different
tastes will enjoy
something in common.
D. VONG

The Adcom GFB-800 Music Control Center.

A New Concept in Home Music Systems

Music is playing a more important part in most households. Just about everyone in the family loves music, but not everyone loves the same music. Until now, the only way to satisfy different musical tastes in the same household was to share the family stereo or for each individual to have his or her own stereo system. Adcom has solved this dilemma with its GFB-800, an innovative new approach to a centralized, remotely controlled music system.

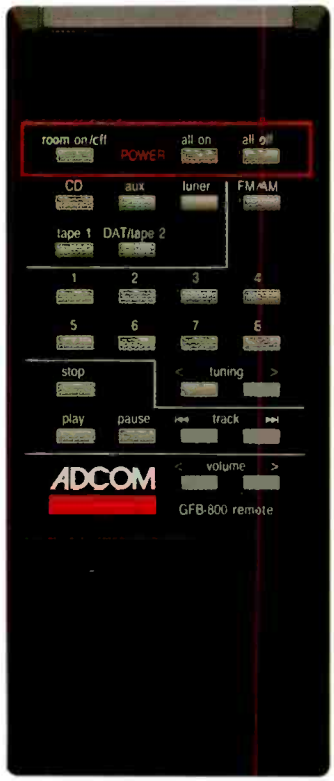
Now, with the Adcom GFB-800 Music Control Center, you have individual, remote control of up to five different audio sources (CD player, FM tuner, cassette player, turntable [optional], digital audio tape) in two or more rooms.

Until the introduction of the GFB-800, other approaches to providing music throughout an entire home have had serious limitations in either sound quality or in operational features, or both. At the lower end of the market, glorified intercom systems have long been available which do nothing more than distribute a mediocre quality of "elevator" music throughout the home. At the higher end, several audio manufacturers have offered remotely controlled components which provide distribution of sound from the main system to other rooms. While some of these systems offer better sound quality, they are still limited in their ability to play different sources in different rooms. The Adcom GFB-800 Music Control Center, used with Adcom power amplifiers and remote sensors, delivers superior sound quality along with highly flexible system control in each room.

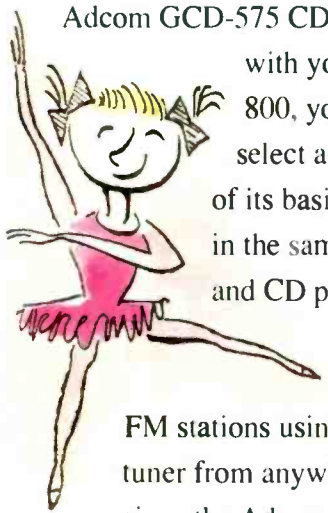
You Have Total Control In Every Room

Using the Adcom GFB-800 as a centralized control center fed by up to five different sound sources, each room has its own remote sensor, power amplifier and pair of loudspeakers. You can choose to use either one hand-held remote which you carry from room to room, or, for convenience, you may want an additional remote control transmitter for each room. Upon entering a room, you can turn on your GFB-800 Music Control Center regardless of where it is located in your home, and select your choice of all available sources.

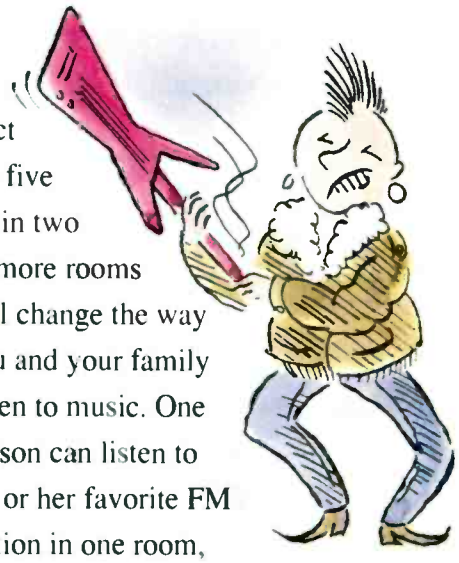
You can then control any of the five sources as well as adjust the volume level in that room. This ability to select and control any source from any room is a truly innovative feature of the GFB-800 system which sets it apart from all other remote systems. For example, if you are using the Adcom GCD-575 CD player with your GFB-800, you may select and use any of its basic functions as if you were in the same room with the GFB-800 and CD player. Likewise, you can tune up and down the FM dial or select specific FM stations using Adcom's GFT-555 II tuner from anywhere in your home. And since the Adcom remote sensors have a repeater system built in, almost any infrared remote component can be used and controlled within this system. A remotely controlled cassette tape deck, for example, can be used through this repeater system.



The easy-to-use Adcom Remote Control Transmitter can be taken from room to room, or a separate hand-held remote may be added for each room.



Multi-Room, Multi-Source



Having the power to individually select and control up to five different sources in two or more rooms will change the way you and your family listen to music. One person can listen to his or her favorite FM station in one room, while another listens to a CD in a different room, and you may listen to a cassette tape in still another room. Each person can always adjust the listening level he or she selects in that particular room. Perhaps the greatest benefit of the Adcom GFB-800 is that it allows listeners in each area independent access to a superlative sound system, a broad choice of sources, and control over the volume at which it is played.

Add One Room At A Time

The GFB-800 is remarkably flexible and can be tailored to your individual needs because of its modular, plug-in design. Each GFB-800 comes with two plug-in "room boards" which allow distribution and system control in two separate rooms or areas.

You can add one or more rooms at a time by purchasing an additional plug-in room board, remote sensor, a power amplifier and a pair of loudspeakers for each room. For even greater convenience, you may also add a remote control transmitter for each room. This modular approach lets you install

fabulous sound (not just "elevator" music) throughout your home, room by room, as your requirements expand or as your budget allows.

Large Scale, Daisy Chained Installations

Music systems designed around the Adcom GFB-800 are limited only by one's imagination, making it a perfect solution for very large scale residential or other specialized applications such as installations in restaurants, offices or classrooms.

The GFB-800s can be daisy-chained, meaning they can be hooked together to give you multiples of five different rooms or zones. Two GFB-800s with the appropriate room boards, remote sensors and power amplifiers can, for example, provide sound in 10 different rooms. Three GFB-800s can provide individually controlled music in 15 different rooms!

SPM-500 II: Inconspicuous remote sensor installed in the wall and it is no bigger than a typical light switch.

SR-500 II: Free standing, enclosed remote sensor in black enclosure to match other Adcom components.

Imaginative use of speaker selectors could further extend the locations in which this system is able to play music to dozens of rooms or areas.

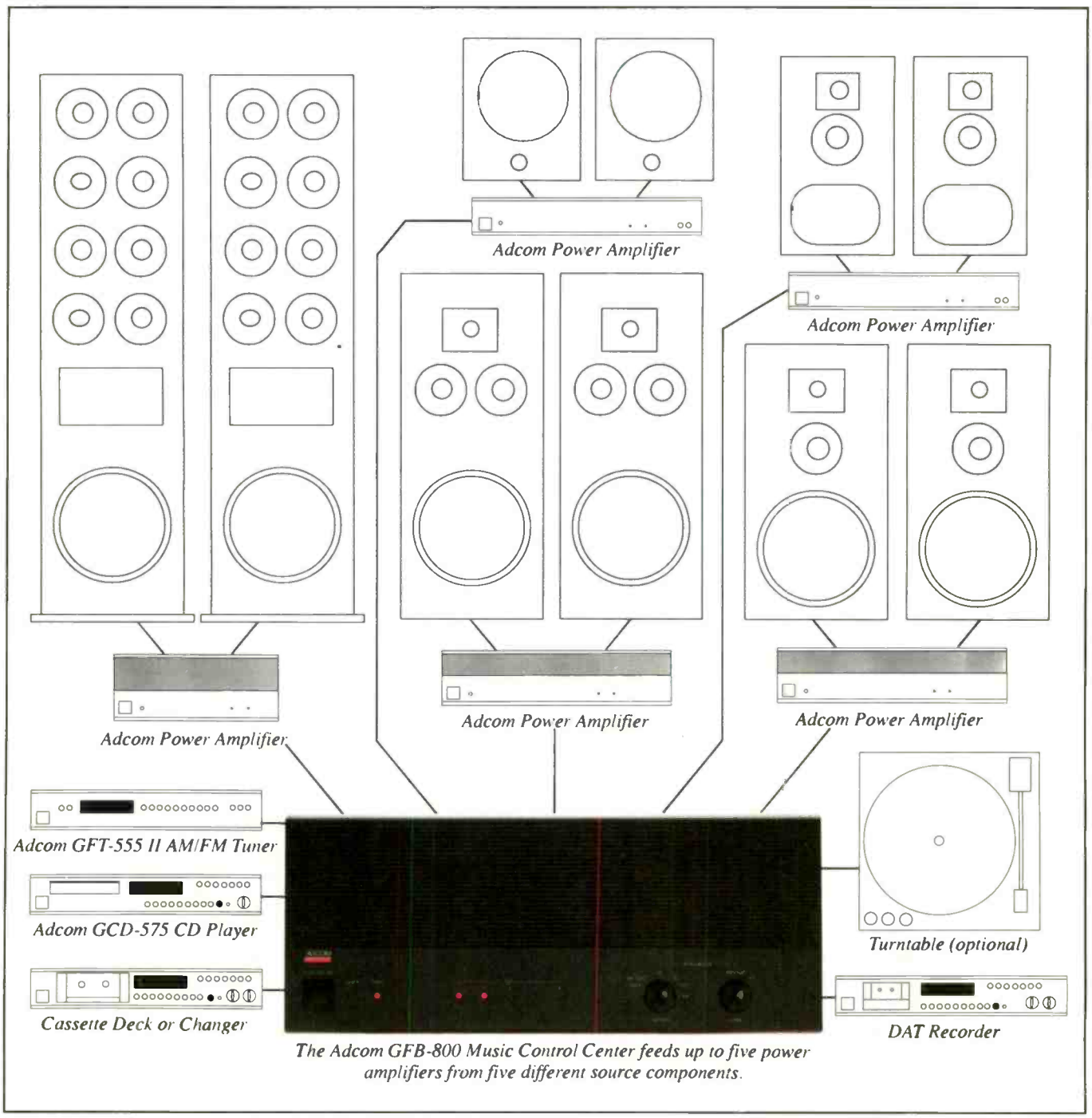
Designing And Installing Your System

For best results, designing and installing a multi-room system around the Adcom GFB-800 may require more than a casual knowledge of audio equipment. There are many details which should be considered if top performance is to be achieved. In cases of new home construction, you may also want to involve your architect and builder in the planning stages.

Your Adcom audio dealer is equipped and trained to help you select the right combination of components for your specific needs. Many Adcom dealers also have separate departments or divisions which specialize in the design and installation of customized music systems. We highly recommend that you visit your Adcom dealer to discuss your specific needs. The number of possibilities and scope of system design with the GFB-800 are virtually limitless.

(cont. on back page)

Listen to your CD player in one room while playing FM music in another... and cassette tapes in yet another!



The Adcom GFB-800 Music Control Center feeds up to five power amplifiers from five different source components.

As Always, More Sound ...Less Money

Adcom has earned a reputation for delivering superior sound at reasonable prices. Many of its components, in fact, have been rated more favorably than others costing two and three times as much. The GFB-800 continues this tradition of offering more sound for less money.

Installing a large, multi-room music system around the GFB-800 is an ambitious but rewarding project. If desired, you can start at a more moderate cost level and add additional rooms later without waste or duplication. Its ingenious design makes such efficient use of high quality source components that it is now economically feasible to provide a truly superior level of sound quality throughout your home from a single set of source components.

Now, with the GFB-800, the cost of multiple sets of source components is eliminated along with the physical space necessary to house them. The money saved can be invested in higher quality source components, substantially improving the overall sound quality of your home music system.

If music plays an important part in your home, or if you would like it to, please visit your authorized Adcom dealer and find out how the GFB-800 will let everyone in your family march to the beat of his or her own drummer.

ADCOM®

details you can hear

11 Elkins Road, East Brunswick, NJ 08816 U.S.A. (908) 390-1130
Distributed in Canada by PRO ACOUSTICS INC. Pointe Claire, Quebec H9R 4X5

Specifications

Output Impedance
Rooms Output: 100 ohms
Tape Output: 475 ohms
Daisy-Chain Output: 475 ohms

Output Level (Rated)
Rooms Output: 2.0V
Tape Outputs: 2.0V

Output Level (Maximum)
Rooms Output: ≥ 7.5V
Tape Outputs:: ≥ 7.5V

Frequency Response (± 0.5dB)
High Level: 5Hz-50kHz
Phono: 5Hz-50kHz

THD -Noise (@ Rated Output, 20Hz-20kHz)
High Level: 0.03%
Phono: 0.06%

IMD (SMPTE, @ Rated Output)
High Level: 0.07%
Phono: 0.07%

Signal-to-Noise (@ Rated Output, "A" Weighted)
High Level: ≥100dB
Phono: ≥95dB

Input Impedance
High Level: 100,000 ohms/100pF
Phono: 47,000 ohms/100pF

Input Sensitivity (@Rated Output,1kHz)
High Level: 310mV
Phono: 3.5mV

RIAA Accuracy (20Hz-20kHz): ±0.1dB
Crosstalk (1kHz @ Rated Output): –90dB
Separation (1kHz @ Rated Output): ≥ 85dB

General

Power: 120VAC 50-60Hz
(available in 220V or 240V on special order)
Power Consumption: 50 watts max.
Chassis Dimensions:
17" (432mm)W x 16 1/8" (410mm)D x 6 1/2" (165mm)H
Maximum Dimensions:
17" (432mm)W x 17 1/8" (435mm)D x 7 1/4" (184mm)H
Weight: 24lbs. (10.9kg)
Weight Packed: 28lbs. (12.7kg)
Accessories for GFB-800:

RC-800	Hand-held Remote Control Transmitter
SPM-500II	Remote Sensor, switch-plate mount
XR-500II	Remote Sensor, enclosed, shelf or table mount
IRA-500II	Infrared repeater for other brand components
ERB-801	Extra room board
PHO-802	Phono preamplifier board
DSY-803	Daisy-chain board

Various extension cables and plugs are also available for use with SPM-500II and XR-500II remote sensors.

Specifications subject to change without notice

Obviously, you run this from your easy chair, since the remote control has 43 buttons and the faceplate carries only nine.

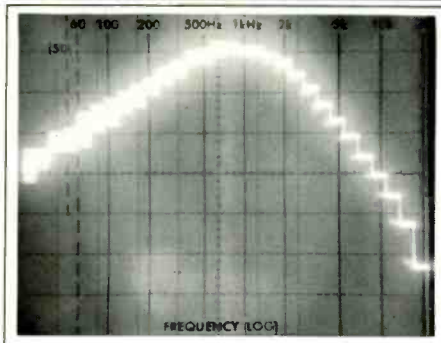


Fig. 2—Balance test signal generated by the DSP-3000. Though called "pink noise," its frequency content is actually optimized for speaker balancing. See text.

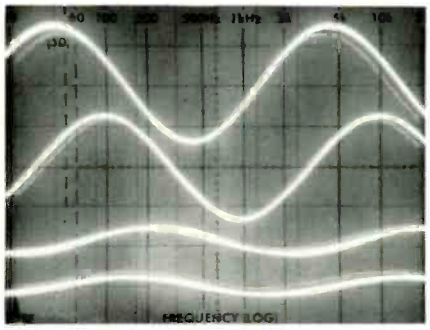


Fig. 3—Output from effects channels in "Movie Theater/Adventure" mode, with 742.6-Hz test tone. Traces are (top to bottom): LF, RF, LR, and RR. Changing the test frequency would change the phase and amplitude relationships between the channels. See text. Vertical scale: 2 V/div.

The effects level and balance displays each had 10 vertical bars, one for each 10%. The balance display had a double bar right at the 50% point. Checking the Dolby Surround input balance demonstrated that the best setting for the minimum sound to the surround speakers with a mono input was with the Dolby input balance at 54% to the right. All effects levels could be changed in 1% steps.

The results of level tests of the DSP-3000's mono outputs were a little confusing, but the majority of times, the left, right, and rear output levels were about 7 dB below the power total for the two summed channels. The front output level, with its contributions from four channels, was more variable but usually was at least 4 dB below the total from the sources. My own judgment was that these levels might be too low to drive some amplifier/subwoofer combinations. A check of the memory function showed that effects balances and levels were saved but not the overall volume.

Figure 2 presents the ⅓-octave spectrum of the DSP-3000 test-noise output, which the owner's manual refers to as "pink." If it were truly pink, the response would be flat. (Personally, I would prefer that the noise be flat for response comparisons.) The purpose of the noise source, however, is to facilitate setting levels, so peaking the noise at frequencies where most speakers work quite well might be better, in some cases, than true pink noise. The level of the noise at the main outputs was 25 mV. Figure 3 is just one example of how the outputs of the four effects channels can differ from each other. Notice that the test-tone frequency is stated quite precisely as 742.6 Hz. Just small changes in frequency caused noticeable shifts in level and relative phase in the four channels, compared to what is shown here.

Parameters for the various programs include such elements as room size, liveness, initial delay, reverberation time, reverberation level, and settings for high- and low-pass filters. Simple stepping tests demonstrated the excellent resolution of parameter values. "Room Size" is adjustable in 40 steps, from 0.1 to 4.0, and "Liveness" has a range from 0 to 10 in steps of 1 (both in arbitrary dimensions). The initial delay can be set in 1-mS steps from 1 to 150 mS, while the setting for reverberation time has a range from 0.3 to 10.0 S, with 0.1-S steps. The level of reverberation can be set from 0 to 100% in 5% steps. The high-pass filter can be set for "Thru" (flat) or in ⅙-octave steps from 32 Hz to 1.0 kHz. The low-pass filter can be set for "Thru" or in ⅙-octave steps from 1.0 to 16 kHz.

Parameter values can be stepped with a series of pushes on "Dec" or "Inc." Holding in either of these buttons caused a rapid changing in value after a second or two. All of the programs have preset values which are protected under the "Preset" function. Any combination of original and modified parameters can be saved as a "User" program. User-program memory is maintained by a special long-life back-up battery which should last about five years. If the battery voltage is getting low, "** Warning ** User Mem. Error" appears in the LCD display when the unit is first turned on. Yamaha states that a qualified service center should replace this battery. They also recommend that the user fill in the manual's program parameter tables to ensure that important program information is not lost.

Setting Up

Yamaha makes specific recommendations on the listening room and the placement of the loudspeakers. They state that the sound-field creation is best if the room is "as acoustically dead as possible," which really calls for much more surface absorption than it makes sense to have. However, the manual does mention normal means to keep the

There are programs within programs, so 20 buttons can select 35 factory-set and 20 user-set simulated acoustical environments.

room from being too live. For one thing, it states that the main speakers should be 3 to 6 feet from the front wall, with the front effects speakers a few feet above and behind them. However, the user's main speakers might need to be closer to the wall for good bass performance.

It is probable that most users will not be able to meet all of Yamaha's criteria. Having said that, let me reassure the reader that perfection of equipment, its arrangement, and the acoustics of the room are *not* essential for great listening. The six-channel arrangement, however, is noticeably better than the four-channel arrangement, and a center speaker and subwoofer are very desirable, in my view.

Figure 4 shows the arrangement of the evaluation system that I have been using for surround-sound systems of any type. The Yamaha DSP-1 is the reference processor. To help in making comparisons, all of the in/out connections for the processor are normalled through a jack field, which allows for easy insertion at all nine of the DSP-3000 inputs and outputs shown. A Yamaha AVC-50 serves as the preamplifier and the main amplifier. Other equipment includes Magnavox and Pioneer CD players, a Dual turntable, a Sanyo Beta VCR, JBL main and center speakers, a Lafayette center-channel amplifier, Dynaco effects speakers, a Triad Design subwoofer, and a Yamaha FM tuner, videodisc player, and effects-channel amplifier. My VHS VCR with MTS failed at the start of the evaluation, so I picked up a Realistic TV-100 TV-sound receiver at the local Radio Shack. I used a Radio Shack Archer r.f. modulator on the video output of the DSP-3000 to show the superimpose function on my TV set.

Use and Listening Tests

As stated earlier, I did all of the listening before any measurements. The owner's manual has 64 pages of helpful and interesting information. The format is open, and the large type and illustrations make for very easy reading. However, discussions on room acoustics, speaker placement, and program parameters and their effects would benefit from more detail. The section on adding auxiliary speakers never states what the four mono output signals ("Front," "Right," "Left," and "Rear") really consist of. It would be easy to assume, for example, that "Front" is simply a mono summing of the main channels, but the summing also includes the front effects channels. The actual combinations are clear in the block diagram at the back of the manual, but at least a few words are needed in the earlier text.

I ran through various setup operations, using the functions available on the DSP-3000 remote control. I adjusted the volume of the preamplifier to get the 16-bit display with the first source. The manual suggests that this is a one-time setting, but I checked it frequently. Source levels, even from CDs, varied greatly from one time to another. I had come to a fairly prompt conclusion: The DSP-3000 sounded quieter than the DSP-1, and yet I hadn't driven it into distortion. I believe a good part of the improvement came from being able to set levels exactly to the point which would yield full 16-bit processing.

Using the built-in noise source to match main and effects levels, I found that I had to switch the main output to −10 dB to have the desired level range. Throughout my listening tests, I shifted effects levels and front-to-rear balance to suit. I set the operating conditions for the video superimpose, which made it easier to set parameters because of the much larger display on the TV.

In the listening evaluation, I purposely picked sources to match the various programs, and then tried other programs if that seemed worthwhile. Unless stated otherwise, CDs were the sources.

First was the assessment of the five "Concert Hall" programs, each with two choices. For Berlioz's "Symphonie Fantastique" with Dutoit and the Montreal Symphony (London 414203-2), I liked Halls A, B, and E in Europe and G in the U.S.A. during the first part of the listening. I ended up concluding that I really liked Hall B in Europe best of all, with Hall H in the U.S.A. in second place.

With Dvořák's Symphony No. 9 with Solti and the Chicago Symphony (London 410116-2), I preferred Hall G in the U.S.A., but I also liked Halls B and C in Europe and Live Concert A (program 5). Some overtures by Elgar, with Gibson and the Scottish National Orchestra (Chandos CHAN-8309), sounded best with Hall E in Europe, although Hall B and Live Concert B also were quite enjoyable. Tchaikovsky's "Serenade in C for String Orchestra" with Marriner and the Academy of St. Martin-in-the-Fields (Philips 411471-2) was a very good match for Hall C, with very satisfying sound also possible with Halls A, D, and H.

LPs were used for the assessment of "Opera/6." Puccini's *La Bohème* with Freni, Gedda, Schippers, and the chorus and orchestra of the Rome Opera House (2-Angel 4AVB-34025) sounded better with "Mezzanine." Gounod's *Faust*, on the other hand, with de los Angeles, Gedda, Cluytens, and the chorus and orchestra of the National Theatre of Opera (Angel 3622), was more satisfying with "Balcony." I tried "Church/8" during the scene in the church and it didn't sound right at all. The "Soldiers' Chorus" was smoother in "Mezzanine," but there was less excitement in the singing.

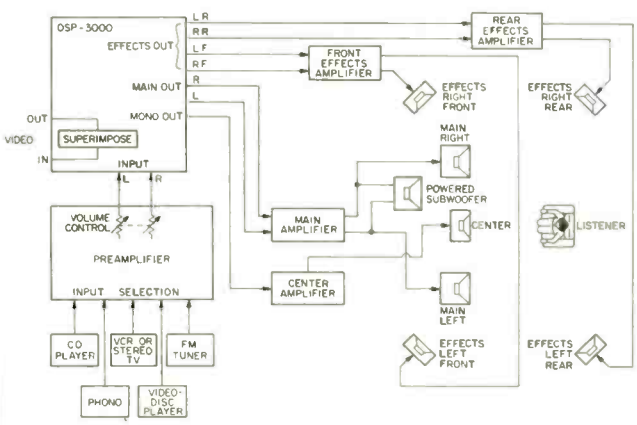
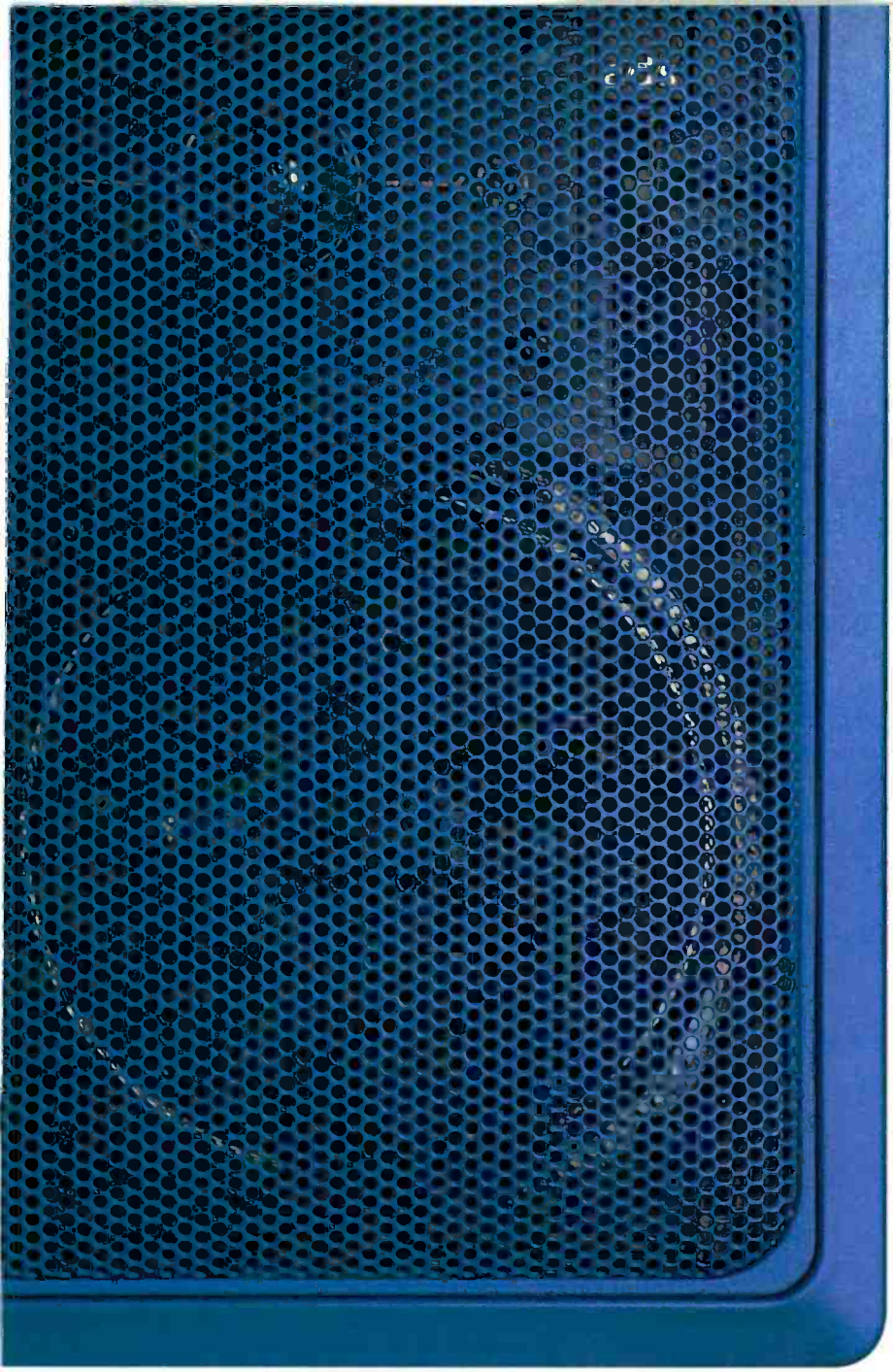


Fig. 4—Layout of the sound system used in evaluating the DSP-3000.



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Accuracy. To achieve the transparency and resolution that define every a/d/s/ loudspeaker, the unison one-inch high-frequency driver is used not only in our tower monitors, but throughout the line.

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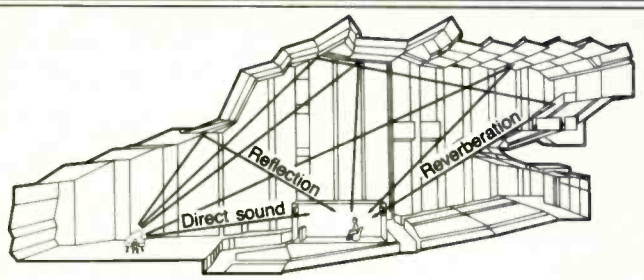
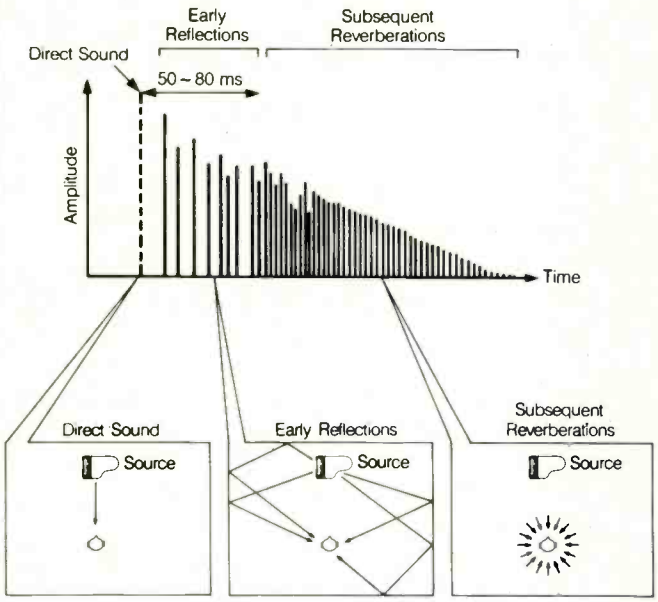
The signal-level display reads in bits, so you can optimize for low distortion with maximum S/N ratio.



Sound field in a typical concert hall.



Directional characteristics of direct sound, early reflections, and reverberation.

I generated a user program for "Cathedral/7" by reducing reverberation time from 4.0 to 3.2 S and the initial delay from 95 to 85 mS. These changes may not seem large, but they gained important changes in the sound field. On *20 Christmas Carols* with St. George's Chapel Choir (Abbey CDMVP-827), the preset program was a very good fit—except for "Ding, Dong, Merrily on High," which benefited from the changes in the user program. It sounded even better, however, with the user version of "Church/8." Victoria's "Requiem," with The Tallis Scholars (Gimell CDGIM-012), was best overall with one of the "Cathedral" versions. I preferred Michael Murray on *The Organs at First Congregational Church, Los Angeles* (Telarc CD-80088) with the user program, but most other people preferred the preset.

My user version of "Church/8" had reverberation time reduced from 2.5 to 1.5 S and the initial delay reduced from 40 to 35 mS. The *20 Christmas Carols*, Victoria's "Requiem," and many of my own in-church recordings were very good matches to the sound fields of either the preset or user versions.

"Jazz Club 1/9" and "Jazz Club 2/10" have similar sound fields in general, but the differences can be easily heard with most music. Jennifer Warnes on *Famous Blue Raincoat* (Cypress YD-0100) matched well to "Village Vanguard," "Village Gate," and "Cellar Club" but not to "Cabaret." This CD also was good with "Rock Cnct/12/Arena" but not "Disco/13." Creedence Clearwater Revival on *Chronicle* (Fantasy FCD-CCR2-2) and Air Supply on *Love & Other Bruises* (Columbia CK 35047) sounded better with the "Jazz Club 1" choice. The former did sound good with "Jazz Club 2," but I kept switching between "Cellar Club" and "Cabaret," depending upon the tune. The Air Supply tunes were better with "Cabaret." I judged "Village Vanguard" to be the best choice overall among all programs for recorded dance music from the big band era. It might seem strange, but I thought that an NBA playoff game sounded quite good with either "Village Vanguard" or "Cellar Club."

"Chamber/11" was modified for a user program by reducing the reverberation time from 1.1 to 0.8 S. A collection of short baroque works with the Paillard Chamber Orchestra and others (Erato ECD-55018) sounded better with the user program for all of the works. I found that even if the reverberation was reduced by only 0.1 S, the change was noticeable. I came to the same conclusion with Mozart's "Eine Kleine Nachtmusik" with Mackerras and the Prague Chamber Orchestra (Telarc CD-80108) and Bach's "Brandenburg Concerti" with I Musici (2-Philips 412790-2). With these CDs, however, the preset program was the better choice quite a few times. Other possible programs for this music were "Opera/6," "Jazz Club 1/9," "Jazz Club 2/10," "Rock Cnct/12," "Stadium/15," and "Presence/16." In other words, don't be afraid to try any program: There might be particular sound-field qualities that you like.

"Rock Cnct/12" was another good choice for Jennifer Warnes and Creedence Clearwater Revival, particularly "Arena." Air Supply sounded good with "The Roxy Theatre" as well. I thought "Disco/13," with its "New York" setting, was a better match to Creedence Clearwater Revival and Air Supply, but the heavier bass of the "Tokyo" position could be the preference of others.

"Pavilion/14" and "Stadium/15" were possibilities for some of the pop/rock groups, but they weren't my choices. The music of Sousa in *Peaches and Cream* with Kunzel and the Cincinnati Pops (MCD 10005) did sound quite good with both of these programs. After listening for some time, I moved the high-pass filter up to 63 Hz to reduce what sounded like a form of bass hangover.

"Presence/16" is a good choice for all types of sources when an up-front sound character is wanted. It's a good compromise setting for listening to FM music programs. The effects are quite pleasurable and the announcer won't sound like he's in a garage. "Presence A" and "Presence B"

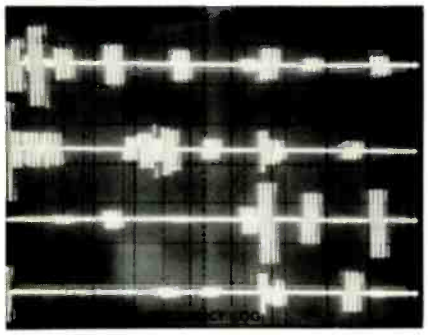


Fig. 5—Output from effects channels in user-modified "Presence A" program, with three-cycle, 700-Hz tone burst. Traces are (top to bottom): LF, RF, LR, and RR. See text. Scales: Vertical, 1 V/div.; horizontal, 11 mS/div.

are usually quite different in the listening. *Kiss of the Spider Woman*, with William Hurt and Raul Julia (Showtime simulcast), had much centered dialog and I much preferred "A" over "B." *Ladyhawke*, with Matthew Broderick, Rutger Hauer, and Michelle Pfeiffer (videodisc), had more spread, but I still preferred "A." I thought that the NBA playoff game had a being-there quality with "A." In fact, I thought that this was the best choice of all for sports listening, including the announcing.

I decided to use the editing capability of the "Presence" program to create my own sound field. I put in 11 reflections each for the left and right channels. I purposely increased the angle off axis for each increase in reflection delay. I varied the levels and reversed polarity somewhat randomly. Figure 5 shows the output from the four effect channels with a 3-cycle, 700-Hz tone burst. The channel levels of the delayed bursts correspond to the levels and angles that I programmed in. The sound was smooth in character for different types of music, and quite enveloping but not very exciting after listening more than a few minutes.

"Surround/17" was very satisfactory for the two movies with either "A" or "B." *Spenser for Hire*, on ABC television, was similarly successful.

"Movie Theater 1/18" and "2/19" provided good choices for movies and TV shows. "Standard" was the best choice for *Kiss of the Spider Woman* and *Spenser for Hire*. "Adventure" was my preference for *Ladyhawke* and for the 1960 movie, *Heller in Pink Tights* with Sophia Loren and Anthony Quinn. *Lucas* (1986), with Corey Haim and Kerri Green (cable simulcast), was best with "Standard." *Kingdom of the Spiders* (1977), with William Shatner and Tiffany Bolling, was a good match for "Classic." The limitation of all of them was that the dialog seemed disembodied. It was centered, but it was also spread. I tried using "Front" to drive the center speaker, but the level was too low and the sound character wasn't what I wanted.

I did find that I could improve the dialog by reducing "C. Sptl Exps," "C. Liveness," and "C. Ini. Dly" in a variety of combinations. Unfortunately, the more dialog was improved, the poorer the background music and effects became. I added left and right connections from the main channels to the center-speaker amplifier (in mono mode) and put the voices back with the bodies. I returned the three parameters mentioned above to their preset values, getting the best results for all of the movies and TV shows.

Each main output can be Y-connected to drive both the main amplifier and a stereo amplifier with a mono function for driving both the center speaker and a subwoofer with its own low-pass filter. (Readers, please note that a Y connector *cannot* be put *across* the left and right outputs.) I do feel that the DSP-3000 lacks in not having mono center and subwoofer outputs from the main channels. Most powered subwoofers can be connected across the main speakers, so I see the missing mono center output as more of a limitation. I should note, however, that turning on the speaker of the TV set or monitor at a low level may be sufficient if the sound quality is adequate. The DSP-3000 does not have the Sound Effector programs of the DSP-1, but they have little value for normal music listening, and they have no value for movie or TV program sound.

"Dolby Surround/20" was a very good choice for Dolby-encoded movies. Although the surround channels did not match the results with other programs, there was excellent dialog centering and the voices were embodied—where they belong! For even better results, Yamaha offers the DSR-100 Dolby Pro Logic decoder, which provides the directional orientation, dialog channel, and front/rear separation of commercial theater systems. The $599 cost is high, except perhaps for confirmed movie buffs.

Conclusions

Yamaha has added to its DSP-1 laurels by bringing out the DSP-3000. Features such as the bit monitor, the excellent displays, the direct digital input, and the noise source all contribute to the value of this superb equipment. New programs such as Opera and Movie Theater, more concert halls, jazz clubs, and all the other venues provide very worthwhile one-button choices to match specific sources. The system delivers no-fuss selection of an incredible variety of sound fields. Changing parameters is very easy for those who want to, and "Presence" offers an opportunity for involved sound-field creation. Muting the effect channels emphasizes what is lost, and collapse of the sound field to stereo is *not* pleasurable.

The Yamaha DSP-3000 is an expensive device but it is *the* premier means of enhancing the listening experience. Additional dollars would need to be spent for the effect channels equipment, but whatever is invested will bring much more than simple enjoyment. The DSP-3000 lacks the main mono center and subwoofer outputs of the DSP-1. Outside of that, the DSP-3000 sets new and higher standards in quality, performance, and flexibility in the creation of exciting, realistic sonic illusions. *Howard A. Roberson*

FOSGATE DSM-3610 PRO-PLUS SURROUND PROCESSOR

Manufacturer's Specifications

Static Separation: Better than 35 dB side to side, center to surround, and surround to front. Typically better than 50 dB from center to surround and surround to center.

Dynamic Separation: Sufficient for instantaneous localization in all directions simultaneously.

Main-Channel Distortion: 0.05% at 2 V output.

Frequency Response: 5 Hz to 35 kHz, ±1 dB.

S/N Ratio: 90 dBA, re: 1.5 V.

Surround-Channel Distortion: 0.3% or less.

Dolby Surround Frequency Response: To Dolby Laboratories specifications.

Surround-Channel S/N: 85 dBA, re: 1 V.

Subwoofer Frequency Response: 5 to 80 Hz, with roll-off at 12 dB/octave above 80 Hz.

Bass EQ: Up to 18 dB boost.

Input: 100 mV to 3.5 V, 75 kilohms.

Output: Up to 4 V, 1.5 kilohms nominal.

Dimensions: 17¼ in. W × 2¾ in. H × 11 in. D (43.8 cm × 7 cm × 27.9 cm).

Weight: 9.8 lbs. (4.5 kg).

Price: $1,429.

Company Address: P.O. Box 70, Heber City, Utah 84032.

(Originally published March 1989)

Jim Fosgate and Peter Scheiber have been involved for many years in creating designs and products for various forms of surround sound. The result of their latest collaboration, the Fosgate 360° Digital Space Matrix DSM-3610 Pro-Plus, is an advanced separation-enhancement system.

Sophisticated digital control technology allows the time constants of the logic steering circuitry to change constantly with the dynamics of the source. This is true whether the material is encoded with Dolby Surround or is regular stereo. The attack and release times of the logic-control signals are automatically adjusted in response to complex material, thereby preventing IM distortion, pumping, or breathing effects. These times can be very short when called for.

An analog time delay is used, which the makers feel has a more natural sound than digital delays. The Pro-Plus system includes a modified Dolby B NR circuit, to encode 10 dB of noise reduction in addition to Dolby Surround's standard 5 dB. Fosgate states that the combination "results in a time-delay system with the quietness of digital and the natural sound of analogue."

The DSM-3610 offers four operating modes: "Mono," for synthesized stereo surround from monaural sources, plus "Regular," "Medium," and "Wide" surround modes, all of which are compatible with Dolby Surround. It has input switching for four audio/video sources, plus A/V tape-monitor connections. Controls for input level and balance, surround level and delay, and bass EQ (adjustable from 0 to +18 dB) are on the front panel. The supplied infrared remote control can change overall volume and main/surround balance, mute system output when needed, and restore all factory-set adjustments with the touch of a button. (Adjustments for more exact level matching to external amplifiers, should that be necessary, are available inside the DSM-3610.)

The unit has outputs for main stereo, center front, and subwoofer channels as well as for the left and right side and left and right rear surround channels. The surround delay is continuously adjustable from 15 to 30 mS.

Control Layout

Along the left side of the front panel are 11 pushbuttons, each with a large LED indicator, in groups of five, two, and four. These buttons require a firm push to ensure latching. Light-touch switches may be in vogue these days, but I have seen such switches fail with time and not work no matter how much pressure was applied. The switches used by Fosgate have contacts that wipe across each other in operation, which promotes long-term reliability.

The first group of five pushbuttons is for "AV Source." The buttons labelled "One" through "Four" have green LEDs and are mechanically interlocked. "Tape Monitor," the last of the five, is not interlocked with the others and should not be. When it is on, its yellow LED cautions the user that the DSM-3610 is in monitor mode. When activated, all of these "AV Source" buttons switch both video and stereo audio.

The next two buttons to the right are "Logic" (red LED) and "Center Ch" (yellow LED). "Logic" engages the Fosgate Pro-Plus steering logic. "Center Ch" activates the center-front channel to feed a center amplifier and speaker.

The next group of switches is for "Sound Stage Width." These buttons, each with a green indicator, offer choices of "Mono Enh," "Regular," "Medium," and "Wide." "Mono Enh" is used with monaural sources and enhances them by synthesizing a surround effect. "Regular" provides better-than-theater Dolby Surround effects from encoded sources and provides a distant perspective for stereo listening. "Medium" yields a mid-hall perspective with stereo or surround-encoded material. It omits the normal Dolby Surround delay and response-restricting, 7-kHz filter from the side (but not the rear) channels. "Wide" is used to get an up-close, "you are there" perspective from a variety of sources.

In the center of the front panel, just to the right of the pushbuttons, are a number of LEDs and the remote sensor. From left to right are: "Dialog" (red LED), "Surround" (red LED), "IR Sensor," "IR Receiver" (red LED), and "Input Level" (three green, one yellow, and one red LED, side by side). When processing stereo material, the "Dialog" and "Surround" LEDs flash on and off in accordance with the relative center and surround content of the program material. The small, round infrared sensor is inset into the panel to protect it from possible damage. Its LED flashes rapidly whenever the remote control is used, confirming that transmission is being received. The "Input Level" LEDs form a simple, left-to-right level meter. The leftmost green LED is always on when the unit is powered, the yellow LED indicates caution against higher levels, and the red LED calls for level reduction.

Further to the right are five rotary controls: "Input Level," "Input Balance," "Bass EQ," "Surround Level," and "Surround Delay." Below each are guiding labels at the counter-clockwise and clockwise ends of rotation. The labels are, respectively, "Min/Max," "Left/Right," "Bypass/+18 dB," "Min/Max," and "15 mS/30 mS." Each of the medium-sized knobs has good knurling and an obvious white index line, both of which are very helpful. It would be even better if each index line extended onto the face of the knob: When a knob is at either extreme position, its index line cannot be seen from above. At the far right is the power on/off switch. The panel's gold legends are hard to see on the black background if the light is somewhat dim.

On the back panel are four groups of gold-plated phono jacks. From right to left, the first six are the "Video Switch" group, labelled "1," "2," "3," "4," "Tape," and "Out." The "Tape" jack allows connecting the video output from a VCR, so its output is looped through when the tape-monitor switch on the front panel is used. The "Out" jack will feed the selected source to a video monitor. The second group consists of "1" through "4" stereo pairs for the "Audio Inputs." Next is the "Tape Recorder" group, which has audio "Tape Out" and "Tape In" stereo pairs. The "To External Power Amplifiers" group has stereo pairs for "LF/RF" (main), "LS/RS" (side), and "LB/RB" (back surround), and single mono outputs for "CF" (center front) and "Sub" (subwoofer). To the right of the unit's power cord are two unswitched a.c. outlets. The fuse-holder below the cord has a flat cap with a screwdriver slot. This good design makes it possible to check a fuse externally but does not make it that easy to diddle. A label calls attention to the fact that this Fosgate unit has been treated with Tweek, to prevent corrosion and to maintain good contacts at connections.

Removing the top cover revealed a chassis-size p.c. board having an open and very neat layout. Some parts numbers are shown, and many components and sections are identified by function. The eight user-adjustable trim pots are very clearly marked, and an accompanying statement warns the user about changing any other controls. I noticed that the other, factory-adjusted trim pots were marked and staked in place by small dabs of red lacquer. Three fairly large black boxes (literally) are the "Pro-Plus D-3 Digital Control Voltage Generator," "Pro-Plus MX High Separation Matrix," and "V-1 Electronic Volume Control." Many parts of the highest quality were in evidence. The soldering on a small vertical board was excellent; I did not remove the bottom cover to look at the soldering on the main board. The power transformer, mounted on the side rail and the board, was fairly hot to the touch after hours of operation. The chassis was good and rigid without the top cover—more so, of course, with it back in place.

The remote control is very simple in comparison with many others, and its functions are easy to understand. This

The DSM-3610 was successful in placing voices with the on-screen characters while maintaining spread in the music and effects.

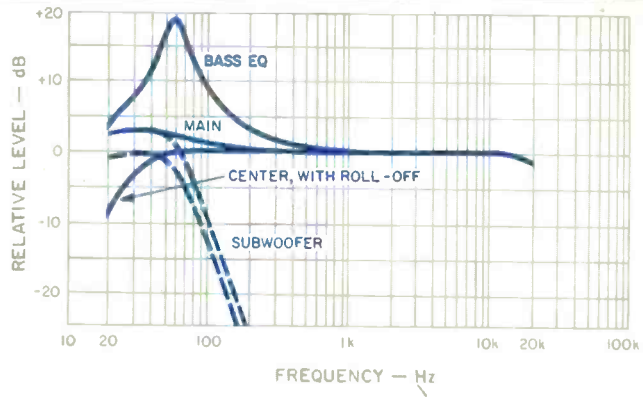


Fig. 1—Swept-frequency response curves for various channels and settings of the DSM-3610; see text.

simplicity could be a considerable advantage for many users, although others will miss being able to switch modes from the listening position. The remote's two "Vol" buttons increase or decrease overall level, while the two "Bal" buttons shift the front/back balance. A push of "Ref" returns volume and balance settings of the DSM-3610's voltage-controlled amplifiers to factory-set references. "Cue" drops the volume to a low level when desired, such as when answering the telephone. A second push, or a touch of either volume button, restores the set volume.

Measurements

I should first note that all measurements were made after I had completed the listening tests that are discussed later.

The main-channel frequency response (Fig. 1) rose slowly as the frequency decreased below 1 kHz, reaching +1 dB at 100 Hz and close to +3 dB from 40 down to 20 Hz. It then rolled off to reach 0 dB at 4.3 Hz and −3 dB at 2.7 Hz. Above 1 kHz, response was flat to nearly 20 kHz, then rolled off to −0.8 dB at 20 kHz. The −3 dB point was reached at 45.9 kHz.

The center channel's response was basically the same as the main channel's, including the low-end boost. Figure 1 also shows the low-frequency response of the center channel with its internal roll-off switch on. This roll-off would be recommended for center speakers having poor bass capability or for a better overall balance when a subwoofer is used. The subwoofer output rolled off above 50 Hz, reaching a slope of 18 dB/octave at about 80 Hz. The subwoofer internal trim pot had a range of 25 dB. Figure 1 shows the subwoofer channel's response with this pot adjusted to match the main channel's level at 40 Hz (+3 dB) and with the pot adjusted to match the main channel's 1-kHz output (0 dB). The bass EQ's boost peaked at 58.5 Hz, with a maximum rise of 17.2 dB; this is in addition to the main channel's normal response boost of 2 dB or so at that frequency. The side channels were −3 dB at 30 Hz and 7.7 kHz, and −10 dB at 9.7 kHz in "Regular." In the "Wide" operating mode, the −3 dB point moved out slightly, and −10 dB was reached at 12.6 kHz. The back surround-channel responses for all modes were close to the "Regular" side-channel response.

Harmonic distortion for 1 V at 1 kHz was 0.03% in the main channels, falling to 0.028% at 20 Hz and rising to 0.3% at 20 kHz. At 0.5 V, a much more likely voltage, the distortion at 20 kHz was 0.12%, which is much better. The surround channels had 0.05% distortion for 1 V at 1 kHz. The 20-Hz figure was 0.15%, and the high-frequency distortion was 0.3% just before the roll-off point.

With "Ref" volume and balance, the S/N ratio of the main channel was 93.3 dBA referred to 1 V, and this would be close to typical over a range of adjustments. With volume at maximum and balance all the way to the front, the ratio decreased to 80 dBA, which is a worst-case figure. The side channel's S/N was 91.7 dBA with reference volume and balance. The back surround channel's S/N varied from 80 to 90 dBA, depending on particular settings. This ratio was typically 85 dBA with reference volume and balance and with the surround-level pot at 1 o'clock.

The maximum input level for a 1-kHz test signal was greater than 31 V. With the input-level pot wide open, 0.196 V would just turn on the level meter's red LED; actual waveform distortion appeared 4 dB above that. I fed in a 5-kHz tone burst to check the response of the LED meter and set the continuous level 1 dB above where the red LED turned on. I was quite impressed to see that the LED was still flashing brightly with a burst as short as 10 mS. In fact, it was still flashing, albeit faintly, with bursts as short as 0.4 mS. The decay time was about 250 mS, somewhat faster than a VU meter. The DSM-3610's little meter may not look like much, but it is an important and well-implemented feature.

Maximum output, defined by the onset of clipping, was 6.7 V with the internal level-adjustment trim pot turned up. This voltage is much higher than is called for by the sensitivity of any power amplifiers I know of. There was, therefore, no need to keep the trim this high, so I returned it to the factory setting. The input impedance was a satisfactory 22 kilohms with the input pot at maximum and a good 39 kilohms with it at midpoint, a more likely position. The output impedance was 675 ohms, which is a very good figure. The surround delay time could easily be set anywhere from 10.8 to 30.0 mS.

Using a monaural source, I adjusted "Input Balance" to get a minimum level in the surround channels. With this setting, the left main-channel output was just 0.3 dB higher than the right. The left and right sections of the input-level pot tracked within 1 dB from 0 to 40 dB of attenuation, which is fairly good. Remote-control volume and balance tracked within 1 dB for about 25 dB over their total 40-dB range. From maximum volume and balance all the way front, "Ref" reduced the main channel's volume by 18 dB, including a

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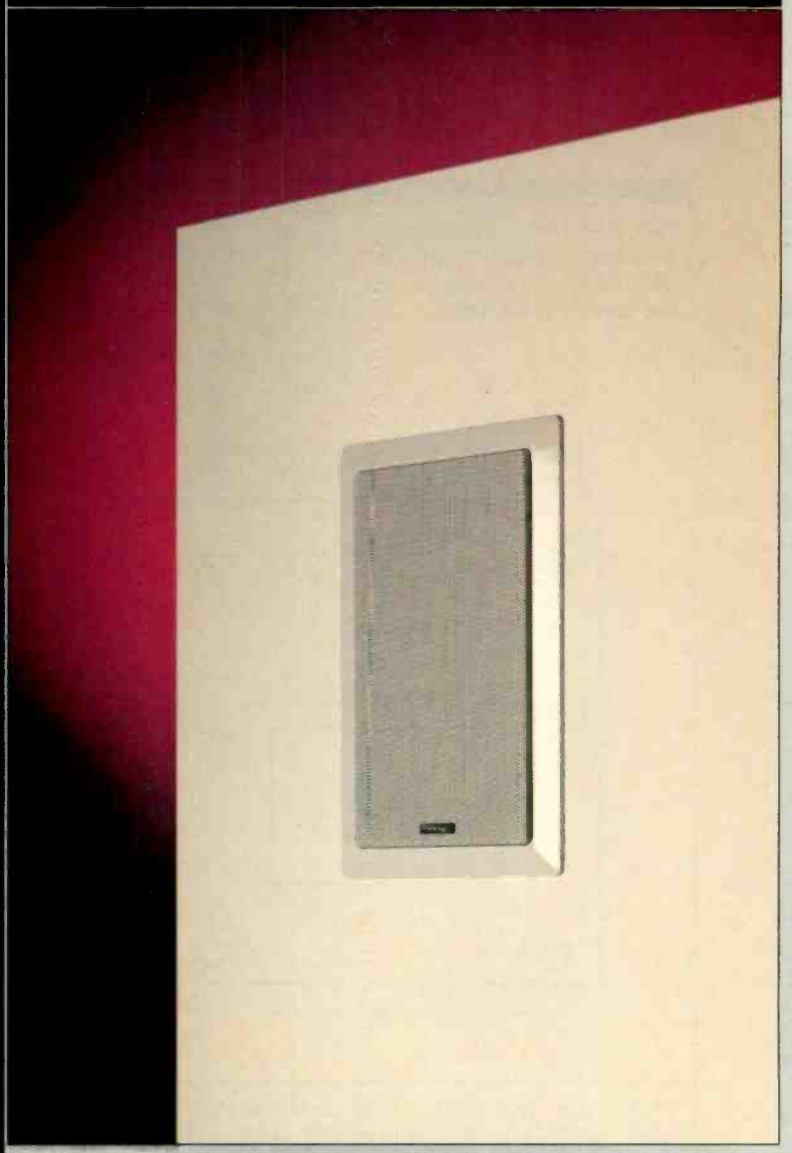

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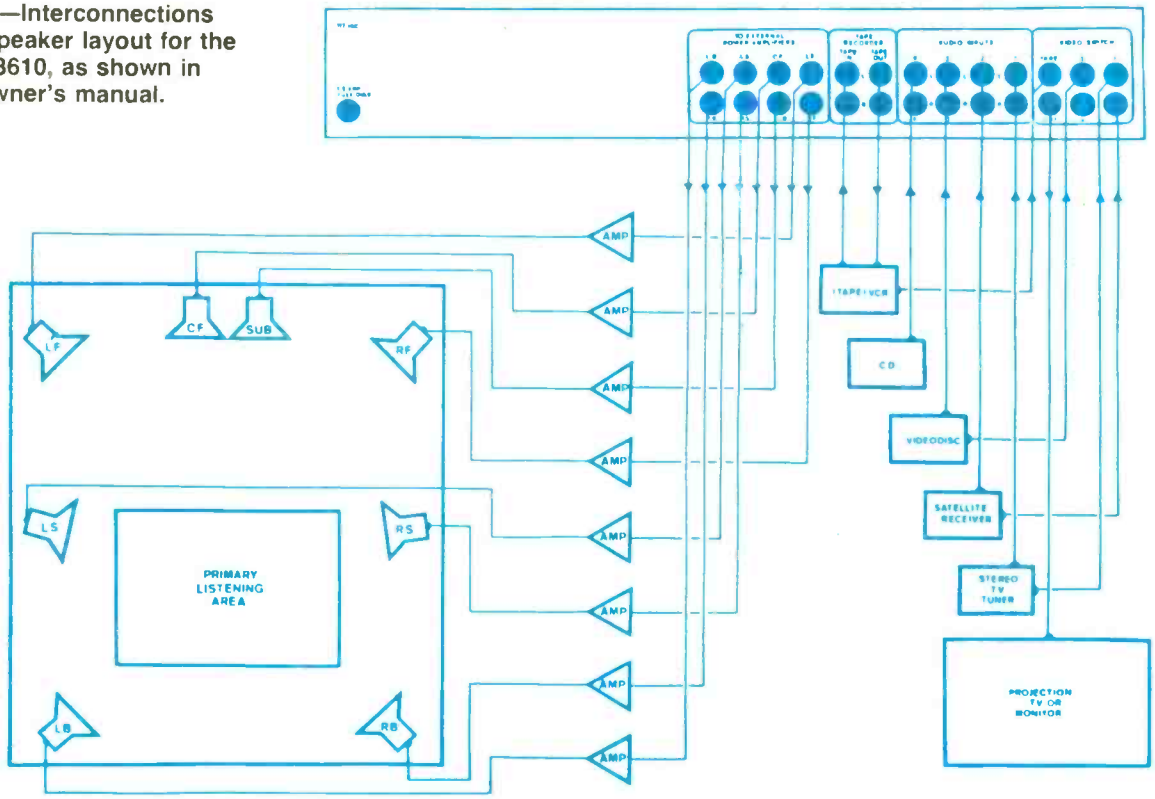
I was pleasantly surprised at how well the combination of music and announcements sounded. Some processors can't manage both at once.

Fig. 2—Interconnections and speaker layout for the DSM-3610, as shown in the owner's manual.



14-dB level drop plus a 4-dB balance shift from front to back. "Cue" reduced the maximum volume by 37 dB.

Use and Listening Tests

The DSM-3610 owner's manual starts with a quick hookup guide for those who can't wait to hear something. The final step recommends reading the entire manual, which I feel is a must for the best use of this Fosgate processor. There is good discussion on front-panel controls, rear-panel connections, and the possible sources of audio and video, plus some suggestions on which modes to try. The installation instructions are quite good, but they would be improved if references to the illustrations at the back of the manual were included. It's good to instruct the user on checking loudspeaker connections for consistent polarity relative to amplifier outputs. Missing, however, is the caution that some power amplifiers invert polarity, and some do not. The section on making internal adjustments is well written and includes the steps needed to get personalized reference-level settings for future use of "Ref"; here, though, users should have been referred to the back-of-the-manual illustration of these pots. The sections on "Optimizing System Performance" and "In the Event of Difficulty" are succinct, lucid, and pertinent.

My reference processor for the listening/viewing tests was the Yamaha DSP-1. Other equipment included a Yamaha AVC-50U for input switching and main-channel amplification, a Yamaha TX-900U AM/FM tuner, a Magnavox FD1041BK CD player, an Akai VS-M930U-B VHS Hi-Fi VCR, a Sanyo VCR-7200 Beta VCR, a Yamaha LV-X1 videodisc player, a Soundcraftsmen DC2214 octave-band equalizer, a Yamaha M-35B four-channel amplifier for the side and surround speakers, a Lafayette amp for the center channel, a QSC amp for trying other speaker locations, and speakers from JBL, Dynaco, and Ramsa. The Akai VHS Hi-Fi VCR was used as the MTS stereo-TV decoder. I used a patchbay that facilitated making fairly fast changes between the Fosgate DSM-3610 and the reference Yamaha DSP-1.

Figure 2 is a reproduction of one of the illustrations in the DSM-3610 owner's manual. I did not use the tested unit for switching inputs, but the outputs, amplifiers, speakers, and arrangement in Fig. 2 match what I did.

For my first listening/viewing test, I watched a VHS Hi-Fi version of Paramount's *Planes, Trains and Automobiles*, with Steve Martin and John Candy. Some of the balances weren't quite what they should have been, but I hadn't taken the time to adjust them according to the manual. I did, however, set the surround delay to correspond to the listening area and came to a number of conclusions fairly quickly: The results were best with "Logic" and "Center Ch" on; the sound effects and background music were well integrated into the overall sound; "Medium" was the preferred mode; I couldn't sit close to a back surround speaker, and the character of the dialog was very good.

The DSM-3610's quality and performance should interest those who want high-quality home-theater sound together with enhanced stereo music.

Even though I had more setup adjustments to do, I made a fast comparison with the Yamaha DSP-1 and confirmed my judgment that the DSM-3610 delivered superior dialog from this movie. The improvement in the sound of the dialog led me to re-aim the center speaker so that my preferred listening position would be more on its axis. Then I followed the procedures in the manual to get better level balances among all the speakers. The next source was the NBC movie, *A Stoning in Fulham County*, with Ken Olin, Jill Eikenberry, and Ron Perlman. The results were very good with both "Logic" and the center channel on, and were not as good with either or both off. I was able to set the center channel's level exactly where I wanted for good, centered dialog without losing a good spread in music and effects. Because I had matched levels well, particularly between the side and back speakers, it was much more difficult to localize the rear surround speakers than it had been before. I determined that the remote control was effective up to at least 25 feet and over 30° off axis.

Aliens, with Sigourney Weaver, on Showtime, had good dialog centering even when the center channel was off, but I preferred it on. There were good, pertinent alterations in the sound field with changes in the scene. Poor surround systems can produce changes that are interesting but wrong for what appears on the screen. One scene was particularly exciting. A warning beep was sounding, and I suddenly realized that I was getting tense from the action and from being surrounded by this persistent tone—very effective. A rented VHS tape, *From Beyond*, with Jeffrey Combs and Barbara Crampton, required the monaural setting and "Logic" off. The results were fairly good—better than I expected.

The Warner Home Video *Ladyhawke* videodisc, with Rutger Hauer, Matthew Broderick, and Michelle Pfeiffer, produced the best sound I'd yet heard from this setup, to say nothing about the best picture. "Logic" and the center channel were both on, and "Medium" was the preferred mode—especially for the music, which I really like. There was one short section where there was some soft popping, but it disappeared with the steering logic off. The popping did not occur at any other point, so I suspect the disc itself was responsible. This conclusion was reinforced when I played Paramount Home Video's *Rustlers' Rhapsody* videodisc, with Tom Berenger. The results were similarly excellent and without any popping. I have commented in the past about other systems that spread stage-center voices out in space until they seem disembodied. These two discs helped to emphasize the DSM-3610's success in placing voices *with* the characters, while maintaining spread in the music and effects.

When listening to my favorite FM station, I preferred "Medium" or "Wide" mode, depending on the music. I left "Logic" in and the center channel on most of the time and was pleasantly surprised at how well the combination of spoken announcements and played music sounded. Previously tested surround processors offered the choice of good voice quality or good music sound—not both.

I used CDs for most of the music-source listening. The well-known Pachelbel Canon in D Major, performed by the Jean-Francois Paillard Chamber Orchestra, was best using "Medium," with center and logic off. The sound had good, smooth quality, but, overall, it was not a match for what was possible with the Yamaha DSP-1. I came to similar conclusions for other pieces on this Erato CD, entitled *Pachelbel: Canon/Albinoni: Adagio* (ECD-55018).

For Mozart's Symphony No. 39, played by the Bamberg Symphony Orchestra with Eugen Jochum (Orfeo C045901A), the "Regular" and "Medium" modes were both good. *Music of Wagner* (Minnesota Symphony Orchestra with Neville Marriner, Telarc CD-80083), Schubert's *Death and the Maiden* (Amadeus Quartet, Deutsche Grammophon 410024-2 GH), and some Charpentier motets (Concerto Vocale, Harmonia Mundi HMC-901149) were all best with "Medium" selected. Dire Straits' *Brothers in Arms* (Warner Bros. 25264-2) was especially good with "Wide." The center speaker was very good for pointing up vocals on this and other pop/rock CDs. "The Atlantic Records 40th Anniversary Show" on HBO featured, among others, Phil Collins, Sam Moore, The Bee Gees, The Rascals, and Dan Aykroyd. The center channel was definitely needed for good vocal centering and presence. I thought "Wide" mode was best for both music and a "being there" audience sound.

Although I had wished for more features on the remote control during setup and early testing, I did not feel so limited after some use. I suspect that many audiophiles would have a similar experience: After learning what modes and control and switch settings are best for particular sources, those choices will be made when selecting the source while at the equipment. That's also the time to check input level and change bass EQ, if necessary.

In my own listening, I thought that the sound was good and full with bass EQ at zero. I did not judge the bass to be excessive and was a bit surprised at the response boost revealed in the later measurements. If a turntable is used with this system, a subsonic filter may be needed to reduce possible rumble. There is a slight lag when changing volume or balance with the remote, but the shifts are desirably smooth. "Cue" requires a short hold on the button—a quick tap is not long enough for response, even though the front panel's "IR Receiver" light goes on. I liked the way the muting went on and off because the level changed very quickly but smoothly—not abruptly, as is typical.

I do feel that Fosgate's combination of the 360° Digital Space Matrix and the Pro-Plus steering logic is successful. This is particularly true for movies—whether broadcast, on videocassette, or on videodisc. Music performances on TV, including music videos, also benefited from the performance of the DSM-3610. In comparison to the reference processor, however, the Fosgate was audibly less successful with classical music—although it did provide a better compromise for some broadcast music programs with spoken commentary.

One of the tested unit's strong points is its provision for side speakers, which secure a general improvement in the smoothness of the sound field. The side speakers also enlarge the possible listening area and make the back surround speakers less likely to be localized.

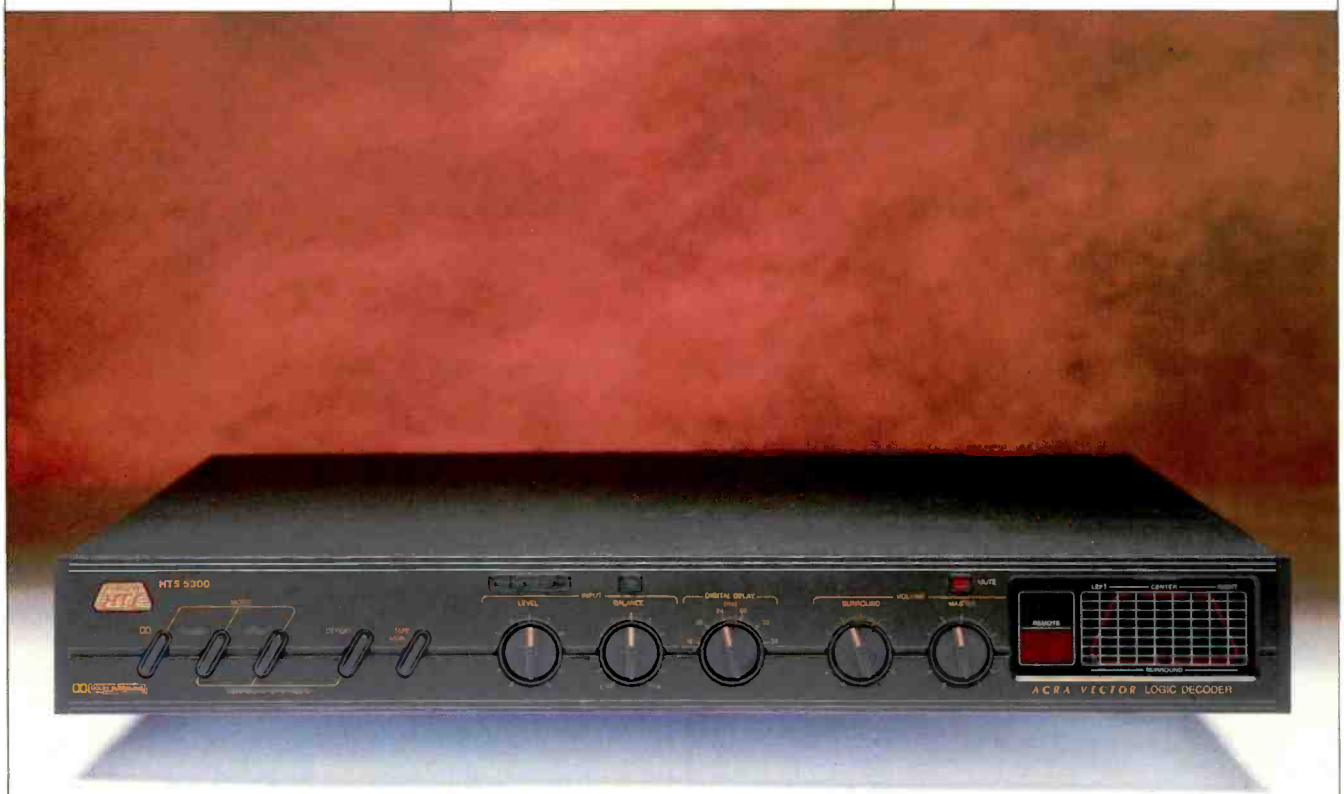
The Fosgate DSM-3610 has a high price, but its quality and performance make this sound processor of interest to those who want really high-quality home-theater sound and better-than-stereo music reproduction. *Howard A. Roberson*

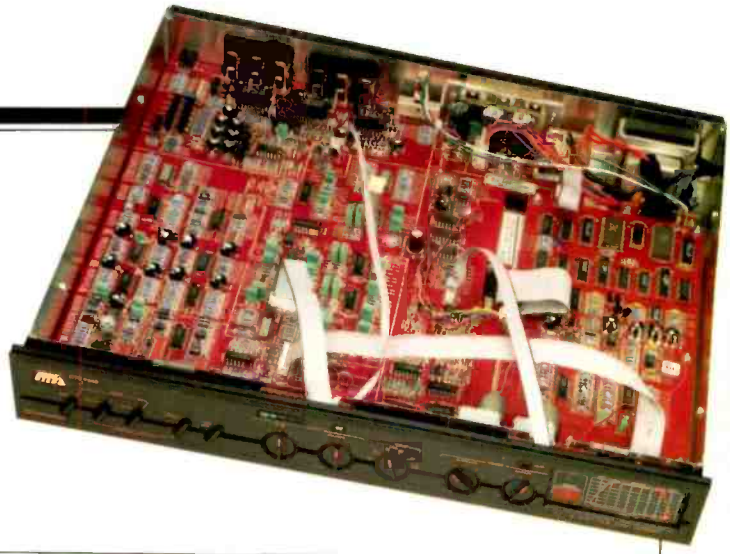
SHURE HOME THEATER SOUND HTS 5300 SURROUND DECODER

Manufacturer's Specifications

Frequency Response: Front left, center, and right, 20 Hz to 20 kHz, ±0.5 dB; subwoofer, −3 dB at 80 Hz with 12-dB/octave roll-off; surround, 50 Hz to 7 kHz, −3 dB (per Dolby Surround specifications).
Input Sensitivity: 0.25 V.
Maximum Input and Output Levels: 4.0 V.
Range of Input-Balance Control: ±9 dB.
Range of Output-Level Trim Pot: 20 dB.
Impedance: Input, 75 kilohms; output, 5.5 kilohms.
Distortion: Main channels, 0.1%; surround channels, 0.3%.
S/N Ratio: 90 dBA re: 1 V, with volume controls centered.
Signal Polarity: Noninverting at all outputs.
Surround Delay: 16 to 36 mS, in 4-mS steps.

Dimensions: 16 13/16 in. W × 2 3/8 in. H × 15 1/16 in. D (42.7 cm × 6 cm × 38.2 cm).
Price: $999.
Company Address: Shure HTS, 222 Hartrey Ave., Evanston, Ill. 60202.
(Originally published July 1989)





The HTS 5300 is the surround-decoder part of the Shure HTS Theater Reference System. The complete $5,990 system contains all that is needed for a surround-sound installation except for sources and miscellaneous accessories. Besides the decoder, the system includes three HTS 50SPA power amplifiers, one HTS 50CF center-front loudspeaker, one HTS 50SW subwoofer, and four HTS 50LRS loudspeakers. The latter four speakers are used for the main left and right stereo channels and the two rear surround channels.

My testing was restricted to the decoder, but it is worthwhile to discuss the entire Theater Reference System. This is truly the result of a system design approach: It is *not* a collection of already available components stuck together just to have all the parts. The configuration, of course, revolves around what the decoder does with the proper sources, but I'll go into more detail on that later. At this point, I'll restrict my comments to stating that the decoder's outputs consist of the normal stereo pair plus one each for center-front and subwoofer and a pair for the surround channels. The three two-channel power amplifiers drive the six speakers.

The typical home surround system has been somewhat of a hodgepodge, with amplifiers and speakers used from previous systems—perhaps with additional purchases made to get all the channels needed. Often, the new amps and speakers are not the same as the original ones, for various reasons. As far as I know, Shure HTS is the only manufacturer which offers a complete system with correlated designs. The discussion that follows will not only detail what it consists of but should also help explain the interrelationships among the components of a surround system.

The HTS 50SPA is a signal-processing power amplifier with switch-selectable operating modes to match the speaker complement; it delivers 100 watts per channel. Each of the two channels has a level control with useful decibel scaling and a six-position "Operational Mode" rotary switch. The knobs are rounded discs with large slots which reject casual diddlers but accept large coins or a strong thumbnail for turning. The first five settings are "Flat," "LRS," "LRS_x," "CF," and "CF_x." The sixth position is "SW" for channel 1 and "Bridged" for channel 2.

In "Flat," the amp's rated response is ±0.5 dB from 20 Hz to 20 kHz, and there is no processing in the signal path except for a defeatable clipping-protection circuit. The "LRS" setting switches in an 80-Hz low-frequency cutoff for use with the HTS 50LRS (left/right/surround) loudspeakers in a system with a subwoofer. The "LRS_x" position, on the other hand, is for the same speakers in a system without a subwoofer. In this case, the response extends down to 60 Hz. The "CF" output has an 80-Hz roll-off to match the response of the HTS 50CF (center-front) loudspeaker in a system with a subwoofer. With "CF_x" engaged, the center-speaker response is extended down to 55 Hz for a nonsubwoofer system. The output of channel 1 in the "SW" mode matches the HTS 50SW subwoofer, covering only the frequencies from 33 to 80 Hz and adding a controlled low-frequency boost. The "Bridged" setting of channel 2 reconfigures the amplifier into a single-channel unit delivering 250 watts into 8 ohms. In this mode, the channel 1 selector determines the response of the amplifier, matching it to any of the HTS 50 loudspeakers. The amplifier has circuitry to limit cone excursion, which is particularly important in this mode. Having the ability to instantly configure response to suit specific applications is very appealing to me: Unwanted energy is not fed to any particular speaker, and all of the amp's power is available for the band selected. The amplifier can, of course, be used with any brand of speaker, though preferably with its mode switch in the "Flat" position, which provides only overload protection.

All of the HTS 50 loudspeakers are rated to handle 200 watts peak program material and 100 watts nominal amplifier power. With each of these speakers, the HTS 50SPA amplifier reduces system distortion by controlling cone ex-

Shure HTS seems to be the only manufacturer to offer a complete surround *system* of correlated decoder, amp, and speaker designs.

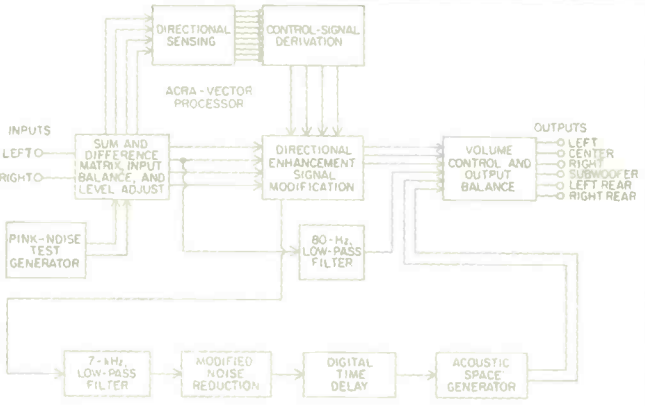


Fig. 1—Block diagram of signal processing in the HTS 5300.

cursion at low frequencies and very high sound levels. All speakers have double magnet systems to reduce interference with TV picture convergence and purity. "In a high-performance home theater sound system, the loudspeaker used in the center-front position is subjected to the most rigorous performance demands, particularly in regard to output capability," says the company.

The HTS 50CF center-front speaker has two 6½-inch low-frequency drivers and a single 1-inch, soft-fabric, damped-dome tweeter. The response of the HTS 50CF runs from 55 Hz to 18 kHz in a system where subwoofers are not used, so the amplifier is set for extended response ("CF_X").

The HTS 50LRS, used for the left and right surround speakers, is generally similar but has only one low-frequency driver—which is sufficient because of the lower power demands of the surround channels. This speaker's response goes from 60 Hz to 18 kHz in systems where the amplifier is set at "LRS_X" because there is no subwoofer. Both the center-channel and surround speakers play only the frequencies above 80 Hz when a subwoofer is used; the amplifier channels are set to "CF" and "LRS," respectively. The HTS 50CF and HTS 50LRS speakers have two-way, fourth-order crossovers with corrections for impedance equalization and midband response. The HTS 50SW subwoofer has a 12-inch transducer mounted in a fourth-order vented box. Combining this with the second-order, high-pass 33-Hz filter of the HTS 50SPA (that is switched in when the amplifier is in "SW" mode) yields sixth-order dynamic tuning. The amplifier also has a second-order, low-pass filter at 80 Hz; the total 80-Hz filtering is fourth-order when the HTS 5300 decoder's subwoofer output is used.

Acra-Vector Decoder Circuitry

Figure 1 is the block diagram of the HTS 5300 decoder's signal processing. This latest Shure HTS Acra-Vector decoder has 80% more sensing points than previous models, for smooth and accurate imaging. Acra-Vector logic emulates the Dolby Stereo theater decoder and uses directional-enhancement (steering-logic) circuits which recover the original four recorded channels with a high degree of separation between adjacent channels. On complex source material, the HTS 5300 is more capable in the "proper enhancement of multiple simultaneous sound sources," says the manufacturer. The HTS 5300 has independent control signals for enhancement of left-right, center-surround, and similar signal oppositions. As a result, according to the company, there can be "simultaneous enhancement of two opposite directions at one time." Low-level directionality is also more accurately detected.

The HTS 5300's digital time delay has twice as much memory as the previous Shure HTS decoder; this has reduced noise up to 9 dB in the surround channels. The decoder uses the Shure HTS Acoustic Space Generator for "clean, spacious theater and concert hall ambience extraction" and a "full spatial field with a minimum of surround speakers." Sonic performance has been improved by extending the headroom at high frequencies. The HTS 5300's front panel has Shure's Image Analyzer display, which shows sound fields in high contrast. A built-in precision test generator steps automatically from channel to channel for easy balancing of speaker levels.

Control Layout

At the left end of the front panel are five thin, bar-type pushbutton switches. The first three are interlocked "Mode" buttons for Dolby Surround (indicated with a double-D symbol), "Stereo," and "Mono." The next button, "Defeat," is tied with a line and a "Surround Synthesis" label to the "Stereo" and "Mono" buttons. "Defeat" does not affect the Dolby Surround mode, which, of course, is normally the best match for sources that have been specifically encoded for Dolby Surround. "Stereo" and "Mono" select synthesized surround sound to go with any stereo or mono sound source, unless "Defeat" is on. The last of the five buttons, "Tape Mon," switches to recorder input connections.

In the center of the panel are two rotary "Input" controls ("Level" and "Balance") and a six-position "Digital Delay" rotary switch. Above "Level" is a horizontal, five-LED level meter. From the left, the first four LEDs are green; the last one is red, indicating maximum allowable input level. "Balance" has a single green LED above it which turns on when there is center/monaural energy and the control is set correctly for good Dolby Surround separation. The pot has no center detent, nor should there be: The control adjusts for out-of-balance sources within limits of ±9 dB.

The "Digital Delay" switch has positions for "16," "20," "24," "28," "32," and "36" mS. This is a very good range for delay, and I have commented before that processors with a 30-mS limit would be compromised in some large rooms. Delay settings do not have to be precise, and this decoder's 4-mS steps are quite acceptable. Further to the right are two rotary "Volume" controls, "Surround" and "Master." Above the latter pot is the red LED that shows when the remotely controlled "Mute" is on. To the right of the "Master" pot is the infrared "Remote" receptor, and above this receptor is a green LED that flashes to confirm reception of the remote's commands. All panel designations are in gold and are easy to read against the black panel. Large, gold index lines on the four rotary pots and the rotary delay switch make it easy to see these controls' settings from a considerable distance.

The matching Shure HTS amp custom-tailors itself for side, center, or subwoofer speakers in the context of the entire system.

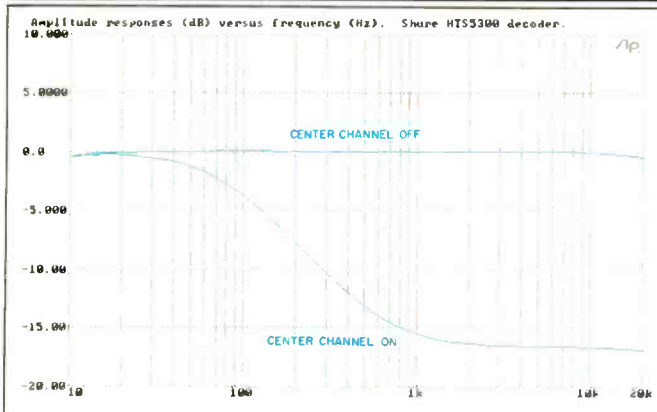


Fig. 2—Frequency response of main stereo channels with a mono input. The high-frequency reduction with the center-channel output on is deliberate; see text.

Further to the right, at the end of the panel, is the very useful image Analyzer display, exclusive to the Shure HTS decoders. The display consists of shaped red LEDs that form a trapezoid. A center bar at the top illuminates when there is center-positioned energy. To the left and right are shoulder-shaped bars that turn on with left and/or right signals. Completing the figure are a rounded "L" at the bottom left and a backward rounded "L" at the bottom right. Both of these will turn on when the source has surround-type information. This display conveys immediately whether the source is strictly monaural, stereo, and/or has surround artifacts to be utilized. The varying intensity of each LED bar indicates the strength of each directional component of the signal.

The remote control is simple, having just "Master Volume," "Surround Volume," and "Mute" controls. The volume controls are long bars at an angle, which makes them easy to actuate when the control is held in the right hand. The bars are rockers: Pushing down on the grooved left ("−") end reduces volume, and pushing on the smooth right ("+") end increases it. A push of "Mute" will cut off all outputs or restore them; pushing either volume bar will also disable the mute. Actuation of any remote-control function illuminates a bright green LED near the transmitting end of the remote. If "Mute" is held in for 3 S, the HTS 5300 test generator is turned on. Then, a Noise Sequence circuit for speaker balancing automatically steps the generated test tone (from left to center to right to surround, and repeating) for adjusting levels as needed. Another push of "Mute" turns the sequence off.

Seven trim pots are available from underneath the unit. At the left front is "Mono Enhance," for modifying the factory-set mono enhancement if desired. Access is obtained near the back panel to the pots for "Front" ("L" and "R"), "Surround" ("L" and "R"), "Center," and "Subwoofer." Next to each access hole is an arrow indicating rotation direction to increase level. These trim pots can be very important if one or more amplifying channels lack any means of controlling volume.

On the back panel, from right to left, the first jack is for an optional "Wired Remote." Next is a pair of gold-plated stereo phono jacks for "Input," two pairs of "Tape" jacks labelled "Send (Record)" and "Return (Play)," "Outputs" jack pairs for "Front" and "Surround," and individual jacks for "Center Output" (top) and "Subwoofer Output" (bottom). A white line from the "Center Output" jack guides the user to a three-position slide switch ("Off," "Lo Cut," and "On"). It is important that this switch be set correctly because it affects how the signals are processed to the main speakers as well. Above this switch is a "Remote Sensor" jack for use with the optional remote-extender accessory, an infrared remote sensor that can be sited to pick up instructions from the remote control where the HTS 5300 itself would not be in the user's direct line of sight.

I removed the top and side cover to get a look at the inside construction. There were two large p.c. boards, one covering two-thirds of the chassis area and the other most of the remaining one-third. Support for the two boards was good, and they were less springy than I thought they would be. The power transformer, mounted in the small space not used by the boards, was just warm to the touch after hours of operation. Immediately, I was impressed by the large number of quality components in a very orderly layout. There were a number of transistors as well as many ICs. Parts were all identified, and many of the trim pots were also labelled by function. Most pot adjustments were held in place with a spot of glue, helping to ensure long-term stability.

Most interconnections were made with multi-conductor cables, some with plugs and some soldered. I could not see the foil side of the boards, but my examination of component leads and holes on the top showed that solder flow was excellent. There was one fuse in clips. Because of its sheet-metal side rails, the chassis was quite rigid, even more so with the cover back in place.

The reader should be aware that the HTS 5300 does not have a power switch, though I do not see this as a potential problem for most users. If desired, the decoder can be plugged into a switched outlet on a preamp, integrated amp, or receiver.

Measurements

Let me first point out that all of the measurements were made *after* all of the listening and viewing.

Figure 2 shows main-channel frequency responses with a mono input. When the center-channel output was off, response was basically flat, down 0.1 dB at 20 Hz and 0.9 dB at 20 kHz. Output was down 3 dB at 3.1 Hz for both channels and at 30.0 and 39.0 kHz for left and right, respectively. When the center channel was on, the response of the main channels with the mono input was definitely far from flat. Note how its level, just about 0 dB at the lowest frequencies, falls off steadily with increasing frequency until reaching a shelf at about −17 dB for frequencies above 1 kHz. Briefly I was puzzled, but then, the light: When the center channel is on, it *should* be carrying the in-phase energy (especially the higher frequencies), and the stereo channels *should not*. This is one more example of the HTS system's automatic level and response compensation.

Shure's latest Acra-Vector logic decoder has 80% more sensing points than prior models, for smoother and more accurate imaging.

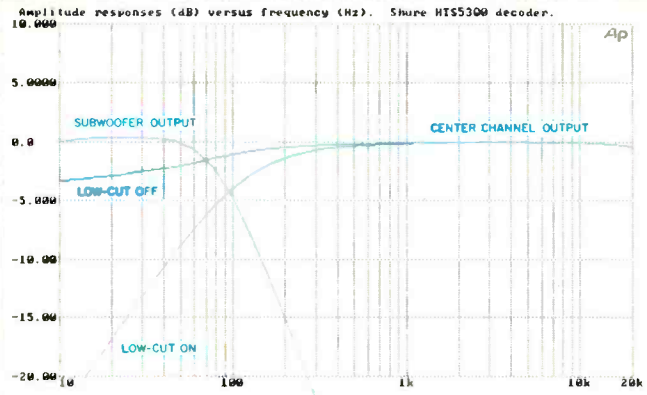


Fig. 3—Frequency response of center and subwoofer channels; see text.

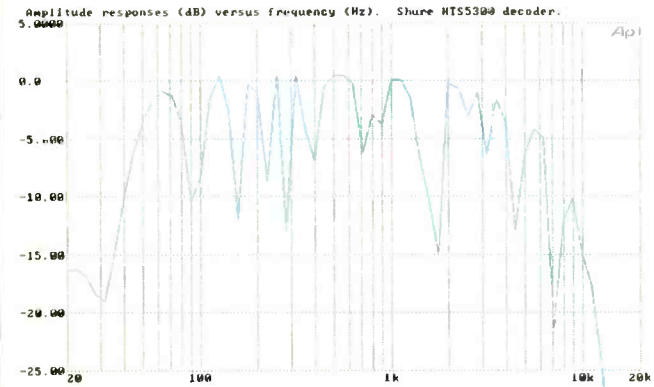


Fig. 4—Frequency response of surround channel, with left and right inputs of opposite polarity. The comb-filter effects shown are normal for such signals, but channel response is essentially flat, as seen by the envelope of the curve peaks.

Figure 3 shows the responses of the center and subwoofer channels. The response of the center channel with the rear-panel "Lo Cut" switch off was down 2.5 dB at 20 Hz and down 0.9 dB at 20 kHz; the droop at the lowest frequencies was purposeful, to make the total (center plus left and right) acoustical power flat with the Shure HTS speakers. This would be easy to equalize, if needed, with loudspeakers of other brands. The center-channel response is also shown with the rear-panel "Lo Cut" switch on. The roll-off below 200 Hz could be of benefit if a limited-response speaker is used for the center channel, particularly with a subwoofer. The response curve for the subwoofer channel shown in the figure has a roll-off above 80 Hz at a rate of 12 dB/octave. I could have trimmed the output down to the same maximum level as the other curves, but I didn't take the time to do that. The surround channels have no output unless nonidentical signals are fed to the right and left main inputs, and phase differences between these signals normally produce comb-filter effects. This is shown in Fig. 4, for which left and right input signals of opposite polarity were used. Frequency response can be roughly gauged from the envelope of the curve's peaks, but the apparent surround-channel response varies with the mix of signals in the main channels. After observing several such mixes, I'd say that surround-channel response is about 3 dB down at 40 Hz and 7 kHz.

Input sensitivity at 1 kHz was 250 mV for the maximum acceptable input level (the point at which the red LED of the level indicator just lights) and with the input-level control at maximum. Input clipping appeared at 3.9 V and output clipping at 4.9 V. The signal-to-noise ratio was 90.6 dBA for the main channels and 92.1 dBA for the surround channels, with a 1-V reference. Figure 5 shows the THD + N for the main channels, 0.04% or less across the entire band, at 1 V input and output. The surround-channel figures reached 0.06% over much of the band, but this is really quite good and well within specification.

The input impedance was 72 kilohms, and the output impedance was 5.4 kilohms. The input impedance is a good figure and was not affected by the setting of the input-level pot. The output impedance, however, would be on the high side if used with an amplifier having an input impedance of 10 kilohms or less. The Shure HTS 50SPA amplifier's input impedance is 100 kilohms, which is plenty high for the 5.4 kilohms of the decoder output. The two sections of the input-level pot tracked almost perfectly, staying within ±0.2 dB over its 20-dB range. The sections of the "Master" volume control tracked each other within 1 dB, from wide open to more than 80 dB of attenuation—*outstanding*.

A check of the output-level trims on the bottom panel revealed that each was factory-adjusted to its maximum setting and that close to 20-dB attenuation was possible with each. Exact Dolby Surround input balance with a mono input (null in the surround outputs) was achieved with the control at a little past 12 o'clock. The best null was close to 60 dB deep at 1 kHz, although the adjustment was touchy and the level bounced around. Typically, the nulls were 35 to 45 dB deep across the frequency band, which is very good. The separation between the main left and right channels was between 45 and 64 dB. (The lower figure was measured using a higher-than-normal level.) I tried a test videocassette that Shure had supplied. With a good level from the left-channel speaker, I heard substantially nothing from the right-channel speaker and a very low level from the surround speakers.

The delay adjustment range was from 16 to 36 mS in 4-mS steps. Each setting was accurate within 0.3 mS. The polarity was the same as the input at all channel outputs. The input-level meter's green LEDs turned on at −29, −18.8, −12, and −6 dB relative to the red LED turn-on at 0 dB. The red LED turned on with a 90-mS, 5-kHz tone burst when the continuous level was set 1 dB above turn-on. Decay time was about 230 mS for the bottom LED to just

Pioneer introduces Home Theater without the usual paperwork.

PIONEER®

The Art of Entertainment

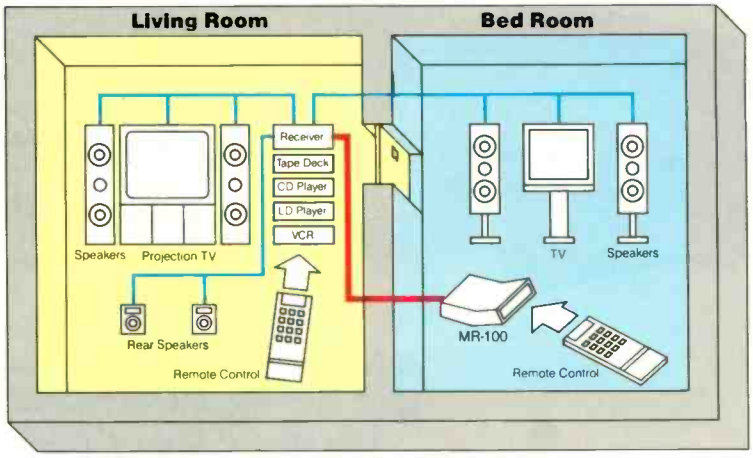
Home Theater for the '90s

Who can forget their first glimpse of a sizzling red sports car flashing down the highway? Or the experience of a full-blown surround sound system in their favorite movie palace? Road rockets that top $100,000 are truly for the lucky few. Fortunately, the dramatic impact of a roaring Star Wars spaceship can be enjoyed by almost every enthusiast in their very own cutting-edge home theater—without having to break the bank, tap into a home equity loan or get an advanced degree in electrical engineering. Let Pioneer show you the way...

Some think if they turn up the volume on their old 19-inch TV sets, they can re-create the incredible experience of a Steven Spielberg or George Lucas epic. That's truly science fiction. The reality is even better. The Home Theater components of 1990 can magically transport you light years ahead of your current equipment's capabilities—and at a reasonable price. Many people have the mistaken impression that they have to toss out all of their equipment and spend $50,000 for a great home theater experience. However, all that is really required is a love of music, movies and concerts. A few key components will do the rest.

Affordable Family Entertainment

Pioneer's goal is a simple one—to maximize your audio/video experience within the confines of your budget. Pioneer wants to rock your walls, shake your chandeliers



High-powered multi-room home entertainment from Pioneer.

(without bothering the neighbors!) and deliver a Home Theater experience that will keep you and your family riveted with outstanding entertainment. Although Pioneer equipment is eminently suited for the media rooms of the rich and famous and is used by custom installers everywhere, the company knows most consumers can't spend lavishly on a $10,000 CD player or mono block amplifiers.

"For a relatively small investment, families can get close to experiencing a Madonna concert or a Hollywood blockbuster in their homes," said Mike Fidler, Pioneer's senior vice president of home entertainment. "Today's affordable technology can re-create those experiences in your living room," Mr. Fidler added. "Millions can now enjoy movies with Dolby Surround soundtracks, superior Laser Disc video quality, dramatic big screen TV performance and crystal clear digital sound."

Best In Sight And Sound

Although price increases have impacted many products, quality home entertainment equipment continues to be a Best Buy. Pioneer now has a combination CD-Laser Disc player priced under $500 (the CLD-980). This new model is really two supercharged components in one as it can play 3- or 5-inch compact discs as well as 8- and 12-inch Laser Discs. The ubiquitous VCR still has its place in a Home Theater system, especially for taping TV shows. But with over 5,000 laser titles now available, LD's unsurpassed picture and sound quality, and the popularity of the compact disc, the '90s are quickly becoming the Decade of the Disc.

Pioneer CLD-980

Pioneer, an unquestioned leader in projection television, continues to improve home video quality. The latest models offer brightness and resolution levels that were unheard of just a few years ago. Images are much more life-like, with radiant colors that put ordinary TV sets to shame. Complementing excellent picture performance are advances that make the 40-, 45- and 50-inch PTVs truly state of the art. And anyone cramped for space will be impressed with how much quality Pioneer engineers designed into TVs with attractive cabinets that take up very little floor space.

Power At Your Fingertips

Although audio and video components are key concerns, the heart of the new Home Theater of the '90s is the A/V receiver. A/V receivers not only tie your entire collection of components into one powerful command center, they have built-in decoders so you can experience Dolby Surround sound effects at home. Simply add a pair of speakers in the back of the room, connect them to the VSX-9700S, play a Laser Disc, and you and your family will be approaching Home Entertainment Heaven. And with its multi-room capability, superb A/V quality can be enjoyed throughout the house.

"All of this technology is easy to use, cutting edge and affordable," remarked Mr. Fidler. "And you can upgrade step-by-step, using components that are part of your current system." Pioneer has introduced a Home Theater without the usual paperwork. Get ready to experience the best in sight and sound in your own livingroom.

Pioneer SD-P4543K

A/V Receivers

A/V receivers have come a long way. From low-powered components with a few sets of audio and video inputs, 1990 models can control the most advanced home theater systems—or the most basic. Not only can they accommodate almost any equipment configuration with power to spare—TVs, VCRs, tape decks, CD/Laser Disc players—advanced receivers offer multi-room, multi-source capability so you can control your system anywhere in the house. And to transport you and your family to different worlds (thanks to Hollywood hits), top A/V receivers incorporate Dolby Surround decoders and amplifiers.

"In order to truly bring the movie theater experience home, a receiver with built-in Dolby Surround is an absolute must," said Mike Fidler. "Almost every top Hollywood film has a Dolby Stereo soundtrack. The sound effects can come to life in your livingroom simply by using an A/V receiver and two pairs of speakers."

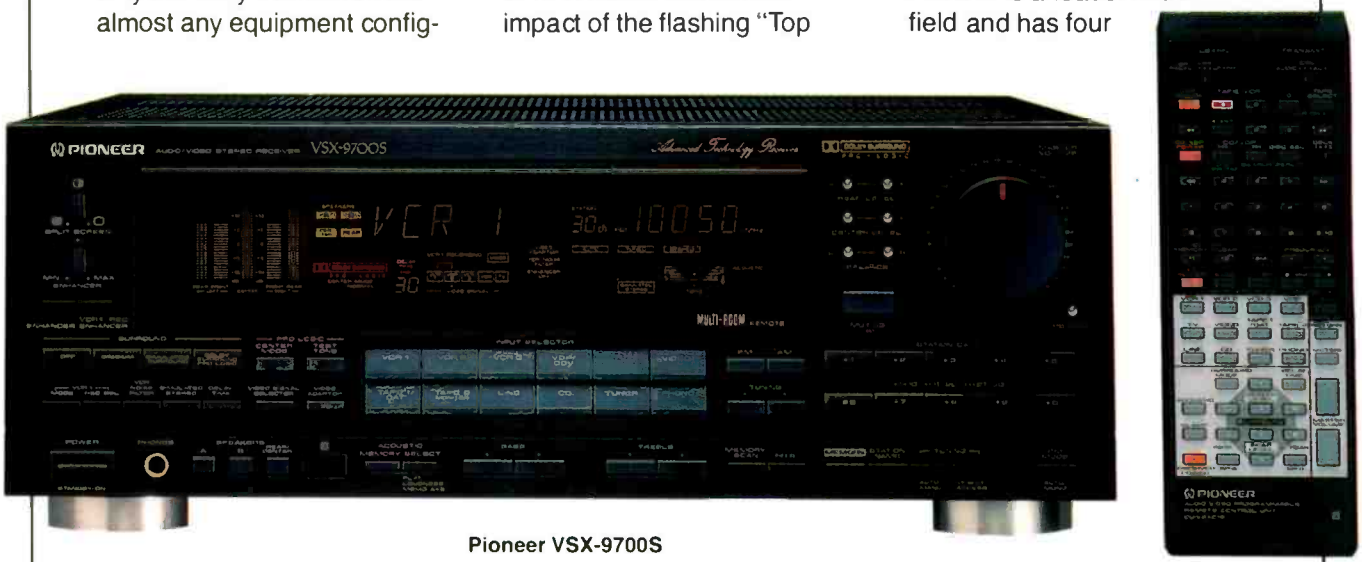
Dolby Stereo has been thrilling moviegoers for over 15 years. With the Dolby system, four channels of sound are compressed onto a film soundtrack—front left/right, center and surround. In order to re-create the dramatic impact of the flashing "Top Gun" F-14s at the home in the early '80s, you needed a separate Dolby Stereo decoder/amplifier that was more suited for a rocket scientist than a movie lover. Manufacturers such as Pioneer then designed powerful receivers that incorporated Dolby Stereo decoders and enough amplification to power all of the speakers required for a top-notch home theater.

Hollywood's Finest

The first A/V receivers with Dolby used the passive matrix system that created a "phantom" center dialog channel. With an active matrix system—Dolby Pro Logic—the sound effects are more accurately placed in your livingroom. Rumbling boulders and roaring jets soar across the ceiling while the spoken word comes from the TV screen. In fact, Pioneer was the first company to design advanced Dolby Pro Logic circuitry into their A/V receivers (the VSX-9300S) in 1988. Today, Pioneer is a leader in the field and has four A/V receivers with Dolby Pro Logic and four with Dolby Surround at prices that fit every budget and system.

To see what the new generation of receivers can do, look at the new VSX-9700S. It delivers 125 watts to the front channels, 40 watts to the rear speakers and 40 to the center dialog channel. Simply hook up the speakers and you're ready to sit back and enjoy the best Hollywood has to offer.

Pioneer A/V receivers also bring multi-room capability to your home theater system. By adding optional MR-100 or MR-101 remote control adaptors, you'll be able to listen to the FM tuner, play a cassette or watch a movie in rooms other than your media center. The only limit is your imagination.



Pioneer VSX-9700S

CD/CDV/LD Players

$100,000 sports cars need supercharged engines... the Home Theaters of the '90s are no different. Just as you wouldn't put a four cylinder engine into a Ferrari (12 is more like it), hooking poor quality video and audio sources to high-powered receivers and big-screen televisions makes even less sense. Today—and for years to come—CD digital audio is the standard for superior sound. And for the ultimate in quality video, the Laser Disc player simply has no equal.

Combine CD and Laser Disc capability in a single component, and you'll understand why the combination player is the hottest component in consumer electronics.

"In one supercharged machine, you can play any size disc—ranging from 3-inch CD singles, to 5-inch CDs, up to 12-inch laser discs with the latest Hollywood favorites," said Mike Fidler.

Pioneer has almost single-handedly kept the 10-year-old laser video format alive under the onslaught of the VCR revolution. And while the VCR has its place in a home theater for taping TV shows, many consumers now know that the Laser Disc delivers a picture 60 percent better than VHS. Combine this excellent picture with digital sound and you'll understand why operas and rock concerts are among the most popular Laser Discs sold today. Laser enthusiasts have over 5,000 titles to choose from—many at $24.98 suggested retail.

You can now buy a CD/LD player for just a bit more than a quality CD player. Pioneer's new CLD-980 ($500 list) not only can play any size disc, it has audio and video performance that was wishful thinking a few years ago.

Moving up in price improves audio and video parameters while increasing programming flexibility. Pioneer's new CLD-2080 ($850) and CLD-3080 ($1,400) take convenience a step further by automatically playing both sides of a disc. The CLD-3080 even incorporates pro-level Digital Time Base Corrector circuits to eliminate jitter. And by using a 20-bit digital filter with 8x oversampling, its digital audio quality matches the world-class picture.

Today—and for years to come—there is no debate: The combination CD/Laser Disc player is the centerpiece for the High Quality Home Theater of the '90s.

Pioneer CLD-3080

Projection TVs

Impact. It can be the crashing sound of a sonic boom or the overwhelming images projected in a movie theater. Pioneer big-screen projection TVs are on the cutting edge of video and audio quality for today's home theaters—like yours. Any thoughts of holding out until High Definition TV (HDTV) reaches stores later in the decade will vanish once you see Pioneer's latest 40-, 45- or 50-inch monitor/receivers in action.

Pioneer SD-P5047-Q

Two key criteria for top-quality rear projection sets are brightness and resolution. When a TV picture gets larger, it tends to dim, making the brightness level (measured in foot lamberts) critical for optimum viewing under different light conditions. The higher the rating, the better. Resolution determines the amount of detail you will see on a single scanning line (measured in horizontal and vertical lines). Again, the higher the number, the finer the picture you will see. For example, the new 1990 Pioneer 40-inch projection monitor receiver (SD-P404K) has a brightness rating of 550 foot lamberts and horizontal resolution of 720 lines. Resolution jumps to 750 lines with the 45-inch SD-P454-K which has a 460 foot-lambert brightness level. The top-of-the-line SD-P5047-Q—with an impressive 50-inch screen—has a brightness rating of 400 foot lamberts and super-sharp horizontal resolution of 800 lines. These specifications equal a picture that comes close to the goal of true-to-life video in your home, making the investment in a Pioneer projection TV pay off in years of state-of-the-art viewing.

While maximum A/V quality and conveniences were key Pioneer projection TV goals, so were cabinet design and overall size. Not everyone has an infinite amount of space for a rear projection TV and their growing home theater. For these consumers, Pioneer introduced the Slim Design Cabinet concept. This attractive shape (in black or oak) is less than 30 inches deep—even with our largest 50-inch set.

The impact of Pioneer big-screen TVs is dramatic. It is the difference between the *best* and second place... a difference you will see every time you turn on your set.

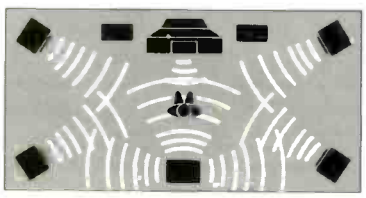
Pioneer SD-P4543K

Speakers

Pioneer *knows* speakers. As one of the world's largest and oldest manufacturers of loudspeakers, Pioneer understands just how important this often overlooked component can be to your growing home theater system.

"Upgrading your system with a new TV, combination player and an advanced A/V receiver is terrific," remarked Mike Fidler. "Not spending the same amount of attention to your speakers—whether you use two, five, or more—is like listening to a concert with ear muffs on."

Pioneer has won plaudits for its world-class TAD (Technical Audio Devices) studio monitor speakers. That same professional engineering know-how can be enjoyed in your home with the internationally-designed and American-built S-T series. The highly efficient loudspeaker systems of the S-T500, S-T300 and S-T100 can reproduce a wide frequency range, from booming basses to the highest highs. The latest advances in space-age driver materials, cabinet design and crossover technology combine to produce loudspeakers that deliver exceptionally accurate response. Our least expensive S-T edition (S-T100) has a frequency response of 30-40,000 Hz—and can fit almost anywhere.



Dolby Stereo is actually four channels of information encoded onto a film soundtrack (front left and right, dialog or center, surround). While the S-T Series are excellent building blocks for a home theater system, additional *smaller* speakers are required for the full Dolby Surround effect. With the decoding and amplification provided by a Dolby Surround A/V receiver, a pair of our CS-X5Q speakers will be more than adequate for the rear channels. If you decide to buy an A/V receiver with Dolby Pro Logic, another CS-X5Q would be appropriate as well for the center or dialog channel.

Pioneer S-T500

Pioneer CS-X5Q

As if five speakers weren't enough, some Home Theater enthusiasts want to add more booming bass to the experience. For them, nothing less than a powered subwoofer that shakes the floor will do.

Pioneer S-W1000

The Pioneer S-W1000 will make you feel as though boulders were rumbling through your livingroom, chasing after you and Indiana Jones!

Pioneer has the speakers you need, with superior sonic quality and prices that won't break the bank.

All Together Now

As we stated at the outset, turning your living room into a sophisticated Home Theater does not require a degree in electrical engineering or a magic touch on Wall Street. You can build your system component by component at the pace and price of your choosing. And although you can continue to use some of your old equipment—even from different makers—after a quick walk through your dealer's showroom to see real-life demonstrations of what we've just described, you'll only need to know one brand when you shop—Pioneer.

Pioneer is a leader in those key components required to dramatically alter the way you watch movies and listen to music. And Pioneer is *the* name to know with combination compact disc and Laser Disc players. Pioneer has maintained its high quality standards while lowering the cost for the high-powered machines. For a price just a bit more than a quality CD player, you now can get a component that delivers superb digital sound *and* laser video—the best prerecorded video medium available.

Performance Leaders

Once you've added a high-powered source component, upgrading your playback equipment can be next. Pioneer 1990 Slim Design cabinets let almost everyone enjoy a big-screen TV in their home—no matter how limited their space. Picture quality and brightness levels are dazzling. Add advanced audio capabilities, built-in amplification, and extensive hook-up capability and you'll understand why Pioneer is the performance leader in big-screen projection monitor receivers.

Pioneer also leads the way in variety, technology and price with the heart of the new Home Theater—the A/V receiver. Pioneer was the first to incorporate Dolby Pro Logic into this key component and now has a full lineup of A/V receivers with Dolby decoding capability—including our top-of-the-line VSX-D1S with built-in Dolby Pro Logic *and* Digital Signal Processing, another industry first. Couple all of these advanced and reasonably priced components with cutting edge loudspeaker systems and you'll be able to surround yourself with vivid sound. In fact, Pioneer is one of the oldest and largest manufacturers of speakers in the world. Add optional multi-room, multi-source capability and you'll know why Pioneer and Home Theater are now synonymous.

You don't have to change your financial lifestyle to have a Pioneer Home Theater but there is no doubt you and your family will be changed. Movies enjoyed in your living room will look and sound as good as they do at your favorite cinema. And music will feel like you're front row center at a jamming concert. That's why it can be said: Pioneer is The Art of Entertainment.

PIONEER

The Art of Entertainment

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"Dolby," "Dolby Surround" and "Pro-Logic" are trademarks of Dolby Laboratories Licensing Corporation

"Non-Switching" is a trademark of Pioneer Electronic Corporation.

Chick Corea Electric Band · Belinda Carlisle · La Boheme
Aerosmith—Things that go Pump · Jody Watley

The Image Analyzer display conveys at a glance if the source is monaural, plain stereo, or has usable surround characteristics.

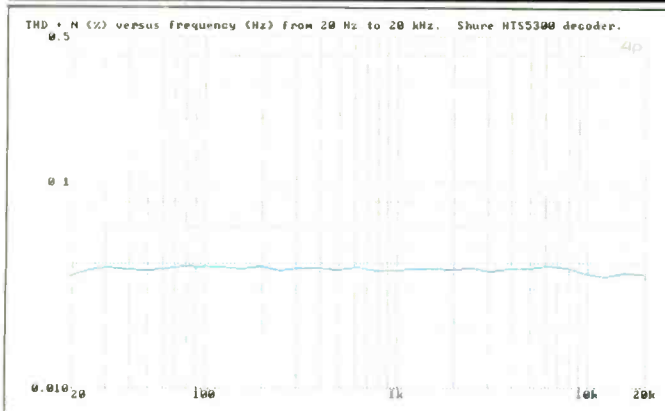


Fig. 5—THD + N for main channels.

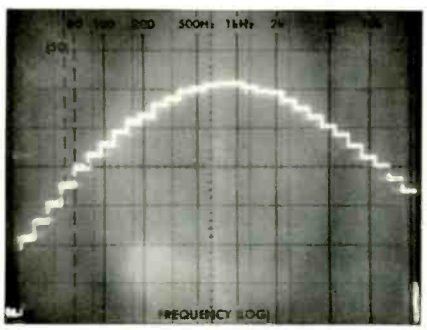


Fig. 6—Third-octave spectrum of speaker-balancing test signal generated by the Shure HTS 5300; see text.

Fig. 7—Listening setup used in evaluating the HTS 5300.

turn-off. Clipping, with a test tone, was 5.5 dB above the red LED's threshold. This simple meter will give good indications of level, although it does not respond to the shortest peaks. Shure recommends input level be set for just occasional red flickering, and this instruction should be followed.

Figure 6 shows the third-octave spectrum of the HTS 5300 test signal used for balancing speaker levels. The noise is broadband but is peaked in the middle of the band. This is actually good, because it minimizes sonic differences from speaker to speaker caused by response deviations at the frequency extremes.

Use and Listening Tests

The evaluation system, including the Shure HTS 5300, is shown in Fig. 7. Input and output connections were made in a jack field, which facilitated making a change to my reference Yamaha DSP-1 processor without too much delay. A Yamaha AVC-50 amplifier was used for input switching of the various sources: A Yamaha TX-900U AM/FM tuner, a Magnavox FD1041 CD player, a Sanyo VCR-7200 Beta VCR, an Akai VS-555U VHS VCR, and a Yamaha LV-X1 videodisc player. For power amplification, I used the second section of the AVC-50 for the main stereo channels, a Lafayette amplifier for the center channel, and two channels of a Yamaha four-channel M-35 for the surround channels. The speakers were two JBL 4301s (main stereo), a JBL 216 (center), a self-powered Triad Design HSW-300 (subwoofer), and two Dynaco A25s (surround). Because I used the Triad Design self-powered subwoofer, which has its own left/right bass summing network and crossover, I did not use the HTS 5300's subwoofer output. The Akai VCR was used as the stereo-TV decoder. A 26-inch Zenith TV was the video monitor.

The owner's manual concentrates on how to interface the HTS 5300 with the rest of the Shure HTS Theater Reference System, but many of the instructions are easily applied to other equipment. To make certain there is no confusion, the manual has a section on interfacing with other equipment, including cautions on making certain that polarity is correct. There are brief but lucid instructions on setting the delay time to match specific listening rooms, a short but helpful section on program sources, and a list of film releases that have been surround-encoded.

By naming the division responsible for surround products Home Theater Sound and by making "HTS" part of the model designations for these products, Shure emphasizes that home video/movie viewing is primarily what the system is designed for. Each year, more and more movies are released with Dolby Stereo encoding, which shows as Dolby Surround encoding on videodiscs and videocassettes for the home user. My viewing and listening concentrated on movies, but I also listened to CDs and FM stations.

For an X/Y display of the left/right input signal, I used an oscilloscope. I set the HTS 5300's delay at 24 mS to match my listening room. I confirmed the manual's statement that aiming of the remote control was noncritical. I even pointed the remote behind me and directly to the sides, and it worked reliably.

I tried a few stereo TV shows but found little of sonic interest. On CBS, *TV 101* had all of the dialog, even for off-

The peak in the middle of the broadband test signal makes it easier to balance speakers having different frequency response limits.

The complete HTS Theater Reference System would include the HTS 5300 decoder (shown here with remote control and remote extender), three of the HTS 50SPA amplifiers, four of the small speakers shown at the left, one center-channel speaker (middle), and one subwoofer (right).

screen action, right in the center. This sonic result was confirmed by the straight line at 45° on the 'scope and by the center-bar illumination in the decoder's panel display. The music and effects had some stereo spread but substantially no surround. When I watched a mono Celtics/Nets basketball game, the mono synthesized mode was best; my enjoyment increased after I raised the surround level to get to a good crowd-noise level. Overall, results for stereo TV with the Shure HTS 5300 were superior to those with the reference Yamaha DSP-1.

The first movie I tried was *Wall Street* (HBO simulcast), with Michael Douglas, Charlie Sheen, and Daryl Hannah. It was Dolby Surround encoded, and stereo spread in the music and effects was good. Surround information was just occasional (indicated better on the Shure HTS unit than on my 'scope), but it was used effectively. The dialog was strongly and, in the main, realistically centered. The 1987 movie, *The Whales of August*, with Lillian Gish and Bette Davis, was tried in the videocassette version. The sound was mono, but "Mono" synthesized surround did not improve the listening. On the other hand, a cable broadcast of *Jeremiah Johnson*, the 1972 mono-sound movie starring Robert Redford, was significantly improved with the same setting. Dialog was well centered, and surround effects were worthwhile.

When the rest of the family decided that they wanted to watch *Ben-Hur*, with Charlton Heston, on Showtime, I agreed reluctantly: What would be possible from an old 1959 movie? And it's so long! Unenthusiastically, I selected Dolby Surround and waited for confirmation that a synthesized mode would be needed. In a very short time, I realized that surround sound was alive and well and living in a 30-year-old movie. The dialog was clearly defined in position, on or off the TV screen, and there was even a shifting of sonic position between actors within the same scene. The 'scope showed the straight line for the monaural character of the talking but changed its tilt anywhere from straight up and down for all the way left (off screen to the left) to horizontal for all the way right.

Music and effects in *Ben-Hur* had continual stereo information, and the surround-sound quality allowed setting the level high without any detectable speaker localization. During the chariot race, the cheering by sections of the arena crowd for their respective heroes was positioned around the room. The storm after the crucifixion scene was very effective, especially the thunder—although it was somewhat distorted. The soundtrack had some other limitations, such as compression of the cymbal crashes in the music at the end of the movie. There were jumps in the positioning of the dialog, but the great majority of the time, the change in localization matched the change in the scene. The panning mixer missed the timing just a few times in a very long movie. Despite my initial skepticism, *Ben-Hur* gave an emphatic demonstration of what is possible with a good source and a good decoder.

I switched to videodiscs as sources and picked *Ladyhawke*, with Matthew Broderick, Rutger Hauer, and Michelle Pfeiffer (Warner Home Video). This is one of my favorites, and the sound quality is excellent. The sounds of Broderick's escape from prison right at the start of the movie were more detailed and had better clarity than I have noticed with any other system. Surround sound was very good throughout, both for music and effects. Dialog was very clear and was never spread in character. I would have preferred some shifting of dialog position to go with the picture, but the 'scope and analyzer displays showed that the source did not provide any such information. In a previous "Equipment Profile," I had commented on another system's popping in one part of a scene of *Ladyhawke* and suggested that the problem might have been with the videodisc. However, the HTS 5300 showed no such negative artifacts from beginning to end of the selfsame disc.

Back to the Future, with Michael J. Fox and Christopher Lloyd (MCA Home Video), delivered very good surround on the music and effects using the Dolby Surround setting. The skateboard chase and the car take-offs and landings were particularly good. Again, I would have preferred at least some panning of the dialog, but none was in the source.

For movies, the results with the HTS 5300 were noticeably superior to those with the DSP-1.

I then turned my attention to Compact Discs. *Carols from Winchester Cathedral*, with the Winchester Cathedral Choir directed by Martin Neary (ASV CD QS6011), had a fairly smooth sound field with stereo surround synthesis, but it was noticeably better with Dolby Surround. Bach's Brandenburg Concerto No. 1, from the I Musici set (Philips 412790-2 PH2), was slightly better with stereo surround synthesis than with Dolby Surround. Both were certainly superior to stereo without surround. Delay settings from 20 to 28 mS were all good for these two CDs; delays longer than 28 mS yielded a more spacious sound, but it was not as smooth.

Mozart's "Posthorn Serenade," performed by the Prague Chamber Orchestra with Sir Charles Mackerras (Telarc CD-

Some recordings of music fared best with the Dolby Surround setting, others with stereo surround, but all benefited.

80108), was best with Dolby Surround. "Tam O'Shanter" by Malcolm Arnold, from *Scottish Overtures* with the Scottish National Orchestra and Sir Alexander Gibson (Chandos CHAN 8379), seemed equally good using Dolby Surround or stereo surround synthesis. Some cymbal crashes were far better than they would have been with normal stereo. I wanted to make the surround sound more live (reverberant) with these two CDs, but there was no way to do that.

Time Warp, with Erich Kunzel and the Cincinnati Pops (Telarc CD-80106), produced strong surround indications on the HTS 5300 panel display. It wasn't surprising that Dolby Surround was a good choice for a number of the pieces. "Ascent," by Don Dorsey, was one of the best from this collection. Leonard Bernstein's *West Side Story* (Deutsche Grammophon 415254-2 GH2) has limited surround information, and the music remained too much front-centered no matter what I tried. Emmylou Harris' *The Ballad of Sally Rose* (Warner Bros. 25202-2) had good surround indications, and Dolby Surround was the preferred mode.

For the carols and the Bach Concerto, I had slight but firm preferences for the DSP-1 processor's "Chamber" program setting with adjusted reverberation. The HTS 5300 could not generate the liveness I wanted for the Mozart and Arnold works, although I could get it with the DSP-1's "Hall" programs. Various DSP-1 modes were also preferred for the *West Side Story* and Emmylou Harris CDs.

On FM broadcasts, the HTS 5300 kept vocals and announcements centered when I listened to rock music. It did not make announcements sound odd, as music-oriented reverberation systems do. In many cases, reverberation on announcements is quite acceptable, so I would be inclined to use such reverb systems on those classical recordings that would benefit from sound-field manipulations not possible with the Shure HTS unit.

The Shure HTS 5300 decoder provided the best localization of dialog and effects for movies, in any format, of all surround processors tested to date. Setting the level for good surround sound without distracting localization was less critical than it was with Shure's previous models. The HTS 5300 did not generate any spurious artifacts from any of my sources, as has occurred with other units. It provided very satisfying sound fields with certain CDs and FM music, but it was not a match for the reference Yamaha DSP-1, with most music, in generating realistic hall illusions.

The complete Shure HTS Theater Reference System offers possible advantages to the dedicated movie fan. Although the system's price is not inexpensive, it is not necessary to buy all of its components, and the cost of the HTS 5300 is in the same price range as other decoders. If the prospective user's emphasis is on theater sound in the home, this Shure HTS processor should definitely be considered.

Howard A. Roberson

SONY SDP-777ES DIGITAL SURROUND PROCESSOR

Manufacturer's Specifications
Sampling Frequency: 48 kHz.
Code Format: 16 bits linear.
Delay Time: 0.1 to 80 mS in 0.1-mS steps, independently adjustable for left and right channels.
Harmonic Distortion: 0.008% at 1 kHz.
Dynamic Range: 90 dB, A-weighted.
Frequency Response: Digital section, 5 Hz to 20 kHz. Analog section, center, 110 Hz to 100 kHz; subwoofer, 12 dB per octave below 110 Hz.
Power Requirements: 120 V a.c., 60 Hz.
Power Consumption: 30 watts.
Dimensions: 18½ in. W × 3⅜ in. H × 13⅝ in. D (47 cm × 8.6 cm × 34.5 cm).
Weight: 13.4 lbs. (6.1 kg).
Price: $850.
Company Address: Sony Dr., Park Ridge, N.J. 07656.
(Originally published August 1989)

The SDP-777ES, the surround processor in Sony's premium ES series, features Dolby Pro-Logic, the movie-theater version of Dolby Surround. Pro-Logic, as compared to regular Dolby Surround, has superior steering and localization when decoding Dolby Stereo movies. All of the processor's six channels are available for this mode. The outputs are for two front (main) speakers, two rear/surround speakers, a subwoofer, and a center speaker. The center-channel output ensures optimum dialog centering. If the system does not include a center speaker, a "Phantom" mode can be selected to feed centered information equally to the two main speakers.

The front/main (stereo) and rear/surround speakers would normally be used with any of the other three surround modes: "Matrix," "Hall," and "Simulated." The subwoofer output can also be used in all modes, but the center output is operational only with Dolby Pro-Logic.

"Hall" surround re-creates the sound of a concert hall by reproducing the direct sound from the front and the reverberative sound from the back. Acoustics appropriate to the program source can be created by adjusting the delay time of the reverberative sound. A low-pass filter can also be set in this mode, at any frequency from 1 to 16 kHz as well as flat (out of circuit); its factory-set default is 7 kHz. The "Matrix" surround circuits, according to Sony's brochure, create "a hard-driving sound that causes everything around you to vibrate." This surround mode can make the listener feel that he is at the center of the stage; Sony recommends it for rock music. "Simulated" surround mode gives a stereo effect to monaural sources by re-creating sound reflected from various directions.

The digital delay times can be adjusted in 0.1-mS steps from 10.0 to 30.0 mS for Dolby Pro-Logic and from 0.1 to 80.0 mS for the other three modes. These are wider ranges than many other units offer, and their precision is much greater than most. The ability to adjust left and right delays individually is a good feature, and few units have it. When the surround speakers are not the same distance from the listening area, the delays can be set so that the two sound waves arrive at the same time.

The polarity of a channel can be inverted with a push of a button. With some source material, you can thus get a more expansive sound field.

The SDP-777ES offers two other operating modes, presence delay and stereo reverberation, in addition to the main surround modes discussed above. The presence-delay circuit is designed to expand the apparent music source. In this mode, the surround speakers are placed outside of the main speakers and pointed at the wall behind them. The stereo reverberator circuit, according to the manual, "re-creates sound like that of a live house which is full of the reverberative sound."

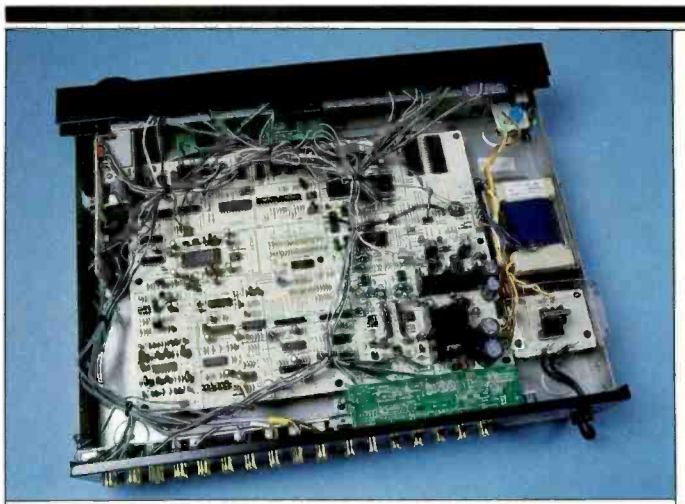
The front panel has close to a full complement of switches and controls, including "Master Volume," providing much more operating convenience than many units do. A front-panel display gives the status of the various modes. Usually, it shows the mode and delay times; if a level is changed, the display shows level status while you're making the change. The six-channel "Master Volume" control can also be operated with the remote control.

The remote has many other functions, including input selection, surround mode, and adjustment of delays and levels. This flexibility enables you to make instant comparisons among modes from the listening position, which is important, in my view. The SDP-777ES has input selection for one audio and four video sources. Pin-jack connections for video dubbing are included, as well as two sets of connections for S-video in and out.

Control Layout

The power switch for the SDP-777ES is at the upper left of the front panel. Below the switch and to the right are the surround-mode selector buttons: From left to right, "Off," "Matrix," "Hall," "Simulated," and Dolby Surround for Dolby Pro-Logic ("Dolby" is indicated with the standard double-D symbol). Above the mode selector buttons are "Time Memo-

Being able to adjust delay times separately for right and left channels is good. Few other units offer this useful feature.



ry" ("Set," "1," "2," and "3") and then "Delay Time" (with separate increase and decrease buttons for left and right). Up to three sets of left and right delay times can be stored for each surround mode. When "Set" is pushed, "Memory" appears in the display panel, and about 4 S remain in which to select the memory storage position. Left and right delays are easily adjusted, independently and to any desired value from 0.1 to 80.0 mS for "Matrix," "Hall," and "Simulated," and from 10.0 to 30.0 mS for Dolby Pro-Logic. A single, short push of a delay-time button will cause a 0.1-mS change. Holding in the button obtains continuous stepping, with a speedup after about 2 S. All of the switches described give good tactile and audible cues when actuated. The mode switches also cause relay actuations which are quite audible.

Above the memory and delay-time switches is the display panel. The word "Digital," permanently screened at the upper left, notes the delay type; below it is the receptor for the remote control. The display usually shows the left and right delay times in bright, bluish-white numerals with "msec" after each number. To the left of these numerals is a small orange number corresponding to the delay-time memory in use. No number appears when delay is in its default mode or is being changed. "Memory" appears above this number when time delay is being set in memory. "Over," which is above "Memory," will turn on if the input level is too high in Dolby Surround. Selecting a surround mode turns on the appropriate indicator at the top of the display: From left to right, "Off," "Matrix," "Hall," "Simulated," and the Dolby double-D symbol. Simultaneously pushing "Set" and "Hall" turns on presence delay, indicated *only* by the delay times being shown. Pushing "Set" and "Simulated" at the same time turns on the stereo reverberator circuit, indicated by "Sdp Pro." Other information appearing in the display will be discussed when the action that produces it is covered.

To the right of the display, along the top, are the electrically interlocked input-selector switches. "Video 1" is first on the left, followed by "Video 2," "Video 3," "Video 4," and "Audio." The video buttons have full-width, red LED status indicators along their tops; the audio button has a green LED. "Audio" can be selected in conjuction with any video input, but a second push on that video button, or a change in the video selection, will turn the "Audio" function off. This is actually very logical, because the audio may come from a simulcast or other non-video route.

Below "Video 1" is the "Input Level" pot, with "Min" and "Max" labels at its left and right extremes of rotation. The bar knob makes turning very easy, and the narrow face of the bar has an index groove. The "Input Balance" pot, to the right, has the same type of knob, a soft center detent, and "L" and "R" at its limits of rotation. Next is the "Center Mode" pushbutton for "On," "Phantom," and off; red LEDs indicate when either "On" or "Phantom" is selected. Starting from off, pushing the switch gets "Phantom," then "On," and then off again. This switch operates only in Dolby Surround mode. "Phantom" feeds movie dialog or other centered sounds to both left and right speakers for a phantom center. "On" is used when a center speaker is part of the system. When the switch is off, Dolby Surround can be used for music without causing unwanted centering effects.

In Dolby Surround, pushing "Test Tone," which is next on the right, initiates a shaped pink-noise signal. The signal automatically cycles from left front, to center, to right front, to the surround speakers, and then around again. If the system has no center speaker, the tone switches back and forth between the front and surround speakers. Pushing the button again turns the tone off. The bar-type knob just to the right, "Surround Level," matches the knobs on the "Input Level" and "Input Balance" pots. However, turning it reveals that it is a spring-loaded rotary switch. When this knob is turned to the left ("−") or right ("+"), the display shows the surround level. During adjustment, the display shows a small orange "S" in its lower left corner and bluish-white numbers indicating left- and right-channel attenuation. Attenuation can be set anywhere from 0 to −79 dB in 1-dB steps, and then finally muted (shown as "−∞ dB"). The attenuation starts increasing or decreasing less than 1 S after you turn the knob. With the knob held, attenuation changes continuously, at a rate of about 8 dB per S. The "Master Volume" control, with its very large knob and helpful red LED index line, is the last control on the right. The panel labels are all quite easy to see, although in dim light, the white ones are easier to see than the gold.

The front panel carries a fairly full complement of controls and switches for operating convenience that other units lack.

The remote control is fairly large and might be difficult for some to operate with one hand. A small red LED near the emitting end goes on whenever a button is pushed. The front-panel receptor does not flash in response, but the effect of any transmitted instruction is easy to see or hear. The top row of five buttons duplicates the input selector switches: "Video 1," "Video 2," "Video 3," "Video 4," and "Audio." The next row has the "Surround Mode" choices: "Off," "Matrix," "Hall," "Simulated," and Dolby Surround. The following row is for "Time Memory," with "Set," "1," "2," and "3" duplicating the front-panel choices.

The two rows of buttons just below control "Delay Time" ("L," "R," and "L&R") and "Hall LPF"; the upper row of buttons here increases the setting, and the lower row decreases it. Notice the helpful addition of "L&R" buttons on the remote. If the right and left delay times are different, the "L&R" *change* is the same, in mS, for both. It is *not* possible to change left and right simultaneously on the front panel by holding in both the left and right buttons—nothing changes if that is done. A push of either "Hall LPF" button in "Hall" mode changes the display to a small orange "L" and two bluish-white displays of the cutoff frequency. This can be set in 1-kHz steps from 1.0 to 16.0 kHz and out (or flat).

Below the remote's "Hall LPF" buttons is the "Center Mode" button. The next two rows control "Surround Level" and "Center Level." Once again, the upper row increases the setting, and the lower row decreases it. "Surround Level" has separate "L," "R," and "L&R" buttons. This arrangement is just as helpful to have on the remote as it is for the "Delay Time" controls. It can be very useful in some systems because it facilitates balancing the sound level when the two surround speakers are different distances from the listening position. The "L&R" button steps attenuation equally for the two channels—even if they have different values to begin with.

The remote's last two rows control polarity inversion, low bass, master volume, and the test-signal generator. "Bass Level" and "Master Vol" have stacked "+" and "−" buttons. The "Inv" buttons ("L" and "R") operate in all modes and can be used for a possible expansion of the sound field. The "Inv" indicators on the front-panel display are immediately above the delay-time numbers. The "Bass Level" buttons affect the main channels, in Dolby Pro-Logic mode, when the "Center Mode" is set to "On" or "Phantom." The level can be changed about ±10 dB in 1-dB steps, indicated in the display by an orange "b" and by the amount of boost or cut. The remote's "Master Vol" buttons for increasing and decreasing level are angled, which makes it easy to rock back and forth between them. The attenuation in dB is not displayed, but the front-panel control's red index shows clearly what the setting is.

At the left of the rear panel are 10 gold-plated jack pairs for audio signals. The first three pairs are stereo inputs for "Audio," "Video 4," and "Video 3." Next are the stereo input/output connections for "Video 2" and "Video 1," followed by the "Line Out" stereo pairs ("Front" and "Rear") and the monophonic "Center" and "Subwoofer" jacks. The "Video 2" and "Video 1" input/output jacks can be used for regular tape recorders if they are not needed for video units. Further to the right are the video jacks. Again, "Video 4" and "Video 3" are for input only, while "Video 2" and "Video 1" have inputs and outputs. The latter two video circuits, and the adjacent "Monitor" output, have both pin and S-video jacks.

I removed the wood side pieces and the metal top and side cover to get a look at the processor's internal construction. The unit had been operating for several hours, and I made my standard temperature checks. Putting my fingers directly on the laminations of the transformer, which is mounted on the left side rail, showed me that the transformer was hot, although not excessively so. I did not spot any fuses, but I did notice an r.f.-suppression filter on the incoming a.c. power lead, which is a good feature. The great majority of the circuitry is on one high-quality p.c. board which covers most of the chassis area. The parts' quality is high, and each part is identified by number. Sections of the board are labelled by function.

Smaller boards, positioned around the main one, hold the circuitry for the front panel, input/output interfaces and connections, and the master volume control. The boards are interconnected by multi-conductor cables and plugs.

The soldering is excellent, and very little flux was left around any of the hand-soldered points. The main board is supported by side and center rails, running from front to back, which rest on a bottom-chassis stiffener. This is better board support than is found in most units. The side rails of the main chassis add still more overall rigidity, and the resistance to twisting and bending is certainly among the best I have seen. Replacing the cover and side pieces increased the overall ruggedness.

Measurements

Let me first point out that all measurements were made after the listening and viewing.

Figure 1 shows the main-channel frequency responses in Dolby Surround mode, with a mono input, for two "Center Mode" settings. The flatter response, obtained with the "Phantom" setting, is actually +2.2 dB at 20 Hz and −1.5 dB at 20 kHz. With "Center Mode" set to "On," response is almost 3 dB down by 100 Hz. It falls off steadily with increasing frequency—as it should with the center speaker handling the in-phase information. In other surround modes,

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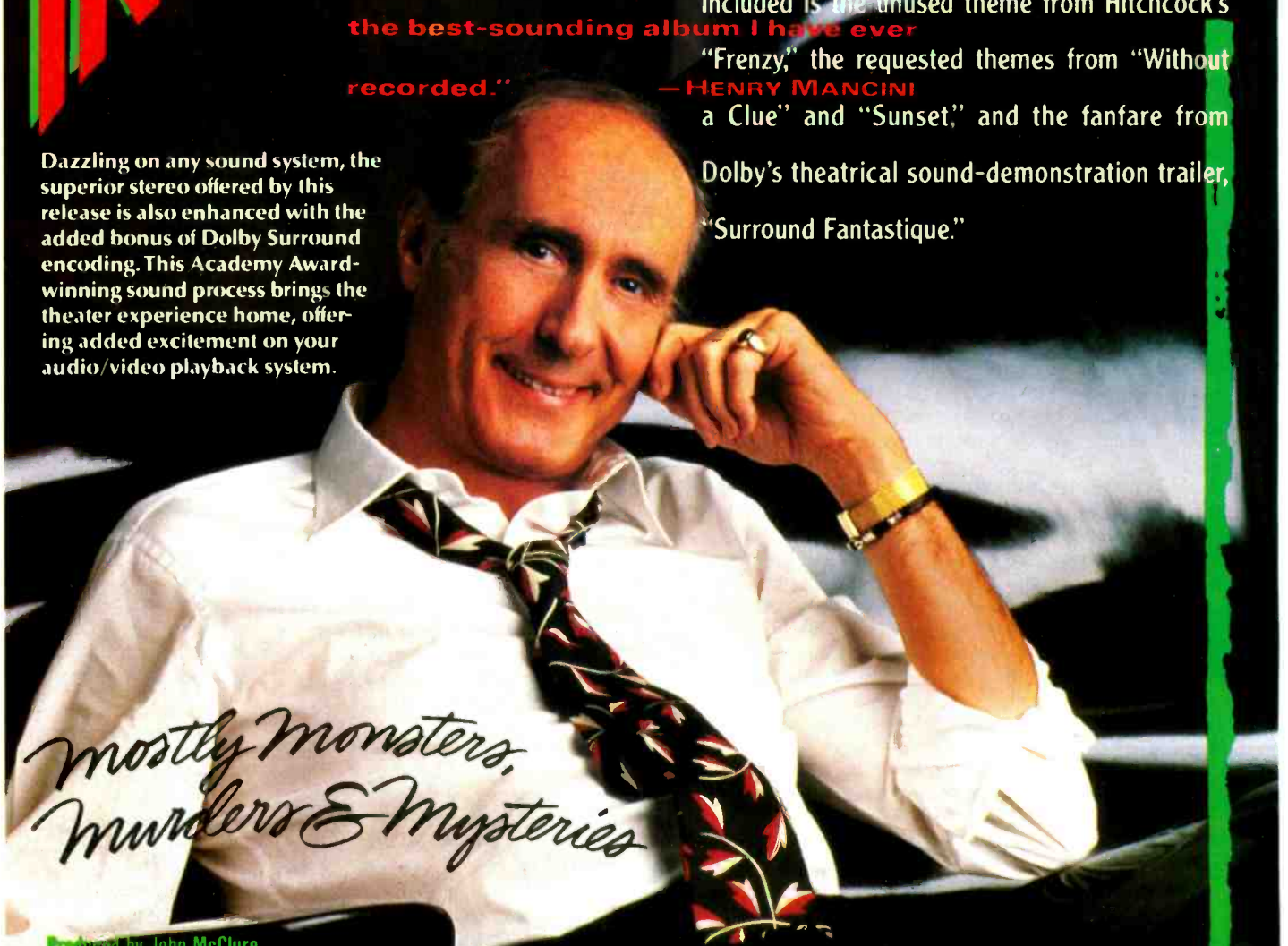

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This surround signal brings the music to three-dimensional life. The difference is as dramatic as color TV comparec to black-and-white. When you add a Dolby Surround decoder and the extra rear speakers, the music comes toward you, freed from the one-dimensional line between the two front speakers of conventional stereo. Around and behind you are all the echoes and reverberations of the original recording site. Effectively, you're no longer in your listening room—you're sitting right next to the microphones in the concert hall.

HOW DOLBY SURROUND CAME ABOUT

Dolby Surround became known first for enhancing the soundtracks of stereo video cassettes, LaserDiscs and TV broadcasts. That's because Dolby Surround was originally developed to bring the distinctive spatial effects of Dolby Stereo movie soundtracks into the home.

For more than a decade, most motion pictures have been released in Dolby Stereo. This sophisticated film soundtrack process incorporates a technique to encode surround effects (the sounds you find so involving in the theater) onto the two optical soundtracks on 35mm movies. When Dolby Stereo films are transferred to two-channel stereo video cassettes and LaserDiscs, or are broadcast over stereo TV, their original encoded surround information is transferred or broadcast as well. Dolby Surround was developed as a means of extracting and reproducing that surround signal at home, much like in the theater.

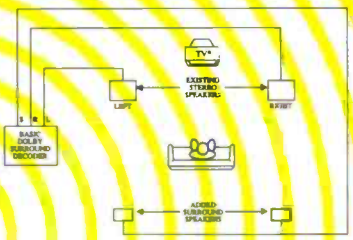

Figure 1: Basic Dolby Surround playback system

With movies, surround is occasionally used for spectacular effects such as spaceship flying overhead, or gunshots ricocheting all around you. But much of the time, surround is used to recreate the atmosphere of the original location and the natural ambience of the music. It is this "opening up" of the sound that attracts recording engineers to the improvement Dolby Surround makes on music-only recordings.

ADDING DOLBY SURROUND TO YOUR STEREO SYSTEM

For playback of specially encoded music recordings in Dolby Surround you need a basic Dolby Surround decoder/amplifier and two small speakers. In fact, several consumer electronics manufacturers provide all that you need in complete, easily installed packages.

Many manufacturers also offer more sophisticated Dolby Surround decoders incorporating advanced Pro-Logic technology. In addition to the extra speakers at the rear, Dolby Surround systems with Pro-Logic use a front center-channel speaker, just like in a movie theater (see Figure 2). The extra speaker and the additional Pro-Logic circuitry sharpen sound positioning both for listening to Dolby Surround music recordings and for watching Dolby Surround videos and TV broadcasts.

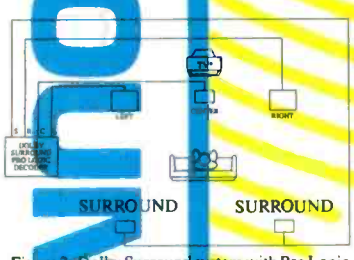

Figure 2: Dolby Surround system with Pro Logic

*Optional for viewing stereo videos and TV broadcasts with Dolby Surround

Your local audio/video retailer can demonstrate and help you choose the Dolby Surround equipment just right for your needs and budget. In the meantime, you can fully enjoy Dolby Surround recordings on your regular stereo equipment. If you would like more technical information on how Dolby Surround works, circle the reader service number provided below or contact Dolby Laboratories, 100 Potrero Ave., San Francisco, CA 94103.

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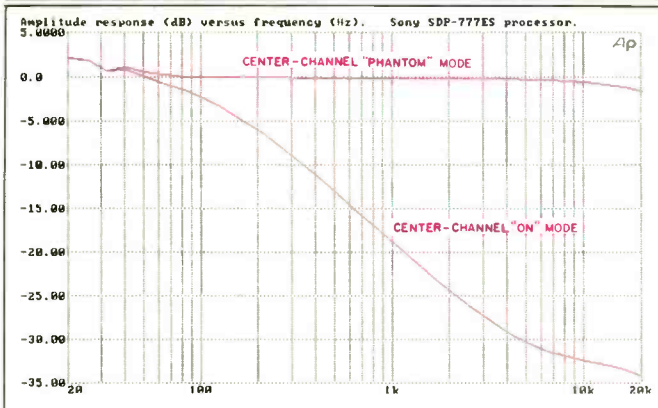


Fig. 1—Frequency response of main channels to mono inputs, for two settings of "Center Mode." The frequency slope with "Center Mode On" is complementary to the center-channel response seen in Fig. 2; see text.

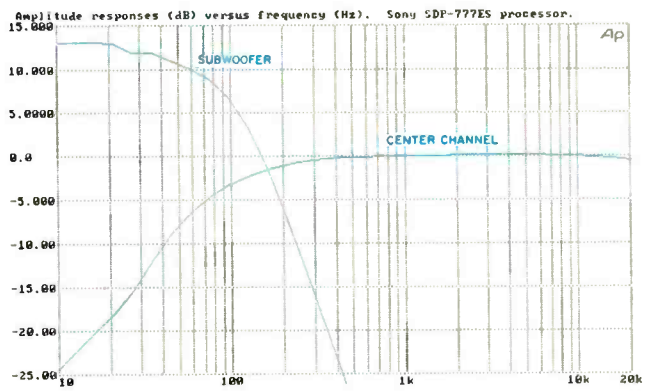


Fig. 2—Frequency response of center and subwoofer outputs to swept test signals.

responses were down 0.02 dB at 20 Hz and 0.03 dB at 20 kHz. The −3 dB points were at 1.5 Hz and 198 kHz.

Figure 2 shows the subwoofer and center-channel responses with the center level at maximum. There is no subwoofer level control, and its output at 20 Hz is about 13 dB higher than the center-channel maximum. The subwoofer roll-off above 100 Hz is at 18 dB per octave. If the subwoofer level were reduced to make its 60-Hz level match the center-channel level at 1 kHz, the two responses would cross at 100 Hz, close to 3 dB down. The center-channel response was at −18.5 and −0.8 dB at 20 Hz and 20 kHz, respectively. Notice how this response is complementary to the main-channel response (Fig. 1) when the center channel is on. Figure 3 shows the response of the surround channels in Dolby Pro-Logic mode. The response was 7.1 dB down at 20 Hz and 2.8 dB down at 7.0 kHz, showing agreement with Dolby Surround standards. The crosstalk in the surround channels in Dolby Surround mode (Fig. 4) was measured with the balance pot centered and my test signals fed to left and right inputs.

The S/N ratio, relative to 1 V, was 115.8 dBA for the main channels in all modes except Dolby Surround, which had a ratio of 89.9 dBA. The ratios for the surround channels varied with mode but were about 80 dBA for "Matrix," "Hall," and "Simulated," and from 88 to 92 dBA for Dolby Surround, depending on the center-speaker mode. These figures would be 10 dBA higher with the rated maximum output level of 3 V as the reference.

Figure 5 shows THD + N across the band for the main channels at 1 V input and output. The rise in distortion at the highest frequencies is limited to just about 0.005% at 20 kHz. With the input-level control at maximum, the input sensitivity was 117 mV for maximum acceptable input level in Dolby Surround, with "Over" just on. Clipping appeared at 6.5 dB above "Over" turn-on, a much better margin than some units have. The "Over" indicator turned on with a single-cycle, 5-kHz tone burst whose level was 1 dB above the indicator turn-on point—the fastest response I've seen to date. The input pot had no effect on the level in other modes. Depending on the mode selected, input levels of 2.2 to 2.9 V were needed for clipping to show in the surround outputs, and levels up to 6 V did not cause clipping in the main channels.

Figure 6 shows the surround-channel output in "Hall" mode with 30-mS delay (bottom trace) for an 8-mS, 5-kHz tone-burst input (top trace). The surround output shows two bursts, one synchronized with that in the main output, followed by a delayed, lower level replica. Although referred to as "reverberative," the delayed signal is basically a simple echo without decay. I tried the stereo reverberator by pushing "Set" and "Simulated." Reverberation-like energy did appear after the test tone burst, although it seemed to be low in level. However, I had heard this mode in the earlier listening tests, and it sounded quite good. (More on this later.)

The output's polarity was the same as the input's in all channels. The main-channel level change from input to output, with the volume control at maximum, was −0.9 dB for all modes except Dolby Surround, which had a change of −0.2 dB. Input impedance was 24 kilohms. Output impedance was close to 1 kilohm on all channels.

The two sections of the input-level pot tracked within 1 dB of each other, from wide open down to −45 dB. The master volume control's sections tracked within 1 dB over a 50-dB range. The surround channel levels tracked very accurately and made precise 1-dB steps from 0 down to −79 dB. The Dolby Surround input-balance control had a range of ±35 dB. Exact balance with a 1-kHz mono input, indicated by a null in the surround outputs, was achieved with the control positioned at the 12 o'clock center detent. The 10 steps of

The components, soldering, and p.c. boards are all of high quality, and the main board's support is better than on most units.

"Bass Level +" gave a maximum boost of 9.0 dB at 35 Hz. The 10 steps of "Bass Level –" caused a total cut of 6.5 dB. The maximum cut is not close to the expected 10 dB, but I don't see the discrepancy as particularly important.

The delay adjustment range was from 10.0 to 30.0 mS in Dolby Surround and from 0.1 to 80.0 mS in the other modes. All delay settings were accurate to well within 0.1 mS. Relative to 1 V, the 48-kHz residual from the digital sampling in the outputs was down more than 87 dB in the main and surround outputs.

The test signal was shaped pink noise, rolled off above and below 800 Hz; the signal's −3 dB points were at 300 Hz and 2 kHz.

The remote control was reliable out to at least 25 feet, as long as the beam was no more than ±20° off the axis of either the processor or the remote. At normal viewing and listening distances, the remote could be positioned up to ±45° off axis when aimed at the processor, and it could be pointed at least ±45° away from the unit when located on the processor's axis.

Use and Listening Tests

The reference processor was the Yamaha DSP-1 used with the DSR-100 PRO Dolby Pro-Logic decoder. The decoder was added recently, to get better steering with movies that have Dolby Surround encoding. A Yamaha AVC-50 amplifier was used for switching the various input sources: A Yamaha TX-900U AM/FM tuner, a Magnavox 1041 CD player, a Sanyo VCR-7200 Beta VCR, an Akai VS-555U VHS VCR, and a Yamaha LV-X1 videodisc player. For power amplification, I used the second section of the AVC-50 for the main stereo channels, a JBL/UREI 6210 for the center channel, and a Yamaha M-35 for the surround channels. The speakers were two JBL 4301s (main stereo), a JBL 4408 (center), a self-powered Triad Design HSW-300 (subwoofer), and two Dynaco A-25s (surround). A Yamaha MX-35 amp was used to drive speakers that were substituted during the presence-delay tests. The Akai VS-555U VCR was used as the stereo-TV decoder. I connected a two-channel oscilloscope across the left and right inputs and operated it in X/Y mode to show the existence or lack of stereo and surround information. Figure 7 demonstrates how the display is used to detect the absolute and relative polarity of the left and right input signals.

The trilingual (English, Dutch, and French) owner's manual contains an impressive 30 pages in each language. It has a good table of contents, which some large manuals sorely lack. The overview of the surround modes is rather brief, however, and hoped-for details do not appear later. The illustrations and instructions on speaker location are good, and six pages on system connections provide desirable detail. The 10 pages on system setup, balancing, and operation offer a very good combination of illustrations and text. Many of the pages have additional comments at the bottom, beneath a separating line. I compliment Sony on the quality of the comments but wish important ones had not been separated from the main text. Input/output tables are helpful inclusions, particularly for dubbing.

In general, the front-panel display was easy to read from my listening/viewing position. I couldn't make out the little orange letters or the program names very well, but I knew what function I had selected and could tell the name from its position in the display. With the processor in Dolby Surround mode and using a mono source, I set the input balance for minimum output from the surround speakers. With Shure's special test videocassette, left/right separation was very good, and there was little crosstalk in surround. The SDP-777ES, however, was not quite as good as the reference system in this respect. I used "Test Tone" to trim levels among all the speakers and reduced main-channel levels to

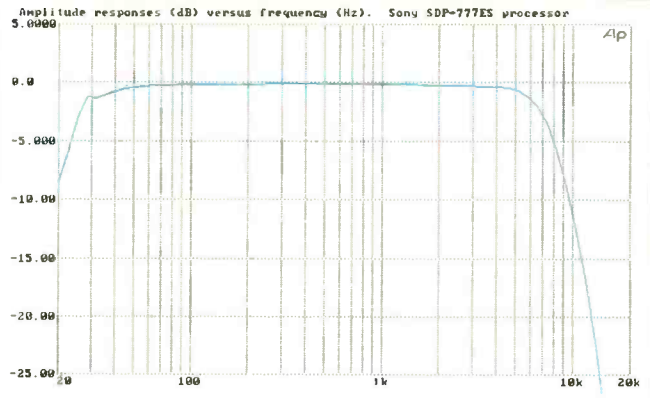


Fig. 3—Response of surround channel to left and right swept-frequency inputs of opposite polarities, in Dolby Pro-Logic mode. The high-frequency roll-off is deliberate and is called for by Dolby Surround standards.

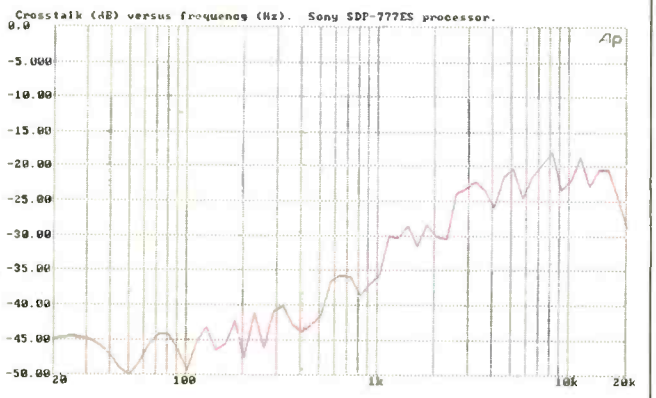


Fig. 4—Crosstalk in surround channels with left and right inputs of same polarity.

The S/N ratio for the main channels was 115.8 dBA in all modes except Dolby Surround; surround channels measured 80 to 92 dBA.

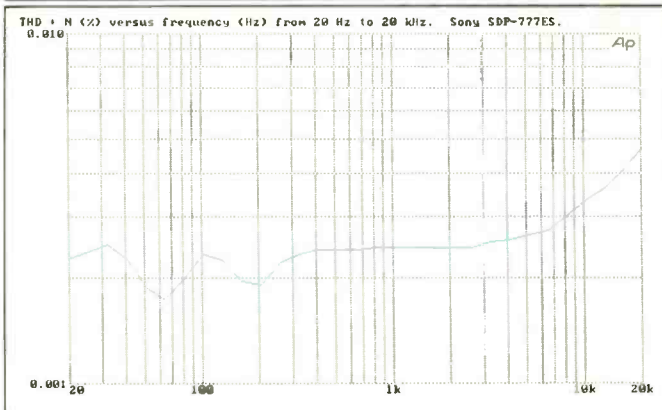


Fig. 5—THD + N vs. frequency for main channel, at 1 V in and out. Note the expanded distortion scale.

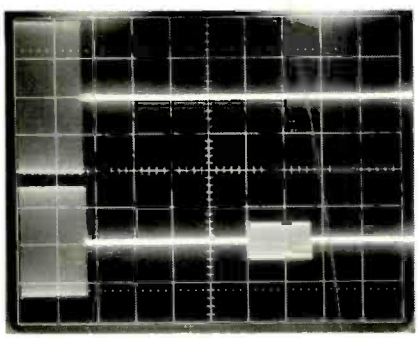


Fig. 6—Surround-channel output in "Hall" mode and set for 30-mS delay (bottom trace), for 8-mS input burst of 5-kHz tone (top trace). Note the delayed, lower level repeat burst in the surround output. (Horizontal scale: 5 mS/div.)

get a wider relative adjustment range for the surround channels. In the process of running these checks, I realized that the SDP-777ES has no specific muting function. It was easy to switch to an unused input, but I still missed the mute.

After some preliminary listening and switching among the available modes, I changed some of the preset delay times to suit my particular room and my preference for a greater sense of space and liveness. The three preset delays in the "Hall" and "Simulated" modes were increased by 5 mS apiece. Dolby Surround settings were unchanged, and for the "Matrix" mode I increased the delay in preset memory 2 from 0.1 to 5 mS. Occasionally during listening, I made other temporary delay changes as well. I kept left and right delays the same in all cases, as the listener/speaker distances are the same for left and right surround in my evaluation system. I did not feel a need to adjust "Bass Level" of the main speakers, so I did not use this function. I concluded that I liked "Hall" mode better after I set the low-pass filter 1 kHz higher, to 8 kHz. I tried the stereo reverberator circuit along with the regular surround modes. Because the presence delay mode required a change in loudspeaker position, I didn't try it until after all my other listening.

The CBS program, *Hard Time on Planet Earth*, had limited surround and effects; Dolby Surround with "Center Mode On" was best. The following program, *Jake and the Fatman*, had much more stereo and surround with music and effects. I put a slight presence boost in the center channel for better voice quality. A repeat of HBO's May 1988 *Atlantic Records 40th Anniversary Show* featured many artists, including Foreigner, Phil Collins, Genesis, and Roberta Flack. I brought the center channel up and the surround channels down to get the needed vocal presence. Dolby Surround was definitely best overall. "Hall" mode was next best, but the vocals were too diffused for my taste.

Around the World in 80 Days, with Pierce Brosnan, was on NBC after I had finished my intended evaluation. I'm glad I decided to check this made-for-TV movie anyway, because it showed what television *can* accomplish. Dialog was not panned to match the scene, but very few regular movies have dialog panning. There was good surround of music and effects, and panning was used with sounds of trains and carriages, tracking them into and out of shots. The videocassette version of *My Fair Lady*, the 1964 movie starring Rex Harrison and Audrey Hepburn, surprised me with its regular panning of dialog to match the scene. Sometimes the voices seemed almost too far left or right, but I won't fault Dolby Surround for that. Voices from the back of the scenes had the added depth (room sound) called for. Unfortunately, this happens rarely in movies made recently.

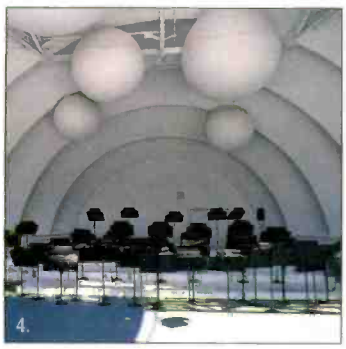
Moonwalker, on Showtime, with Michael Jackson and Joe Pesci, had Dolby Stereo encoding. The music and effects in surround were very good, and Dolby Surround was preferred most of the time. Some portions of a concert scene, however, were better in "Matrix," with 30-mS delay. *Biloxi Blues*, with Matthew Broderick and Christopher Walken, was also on Showtime. This movie had little stereo or surround information, but the various modes helped make it more realistic. Dolby Surround with "Center Mode On" was best; "Hall" and "Simulated" were fairly good. The videocassette *E.T.*, from MCA Home Video, demonstrated effective use of music and effects in surround sound. Low-level music and effects were very well done to establish moods, heighten tension, etc. Switching Dolby Surround off caused an immediate, obvious loss. The flying bicycle scene had very good integration of picture, dialog, music, and effects. I thought the final chase was just great.

Sheena, with Tanya Roberts, was on HBO, and I overcame my resistance to watching it when I found it was Dolby Stereo encoded. Some of the surround effects were quite good in Dolby Surround, but the script and the acting did

Ralph's house.

Ralph's house.

Ralph's house.



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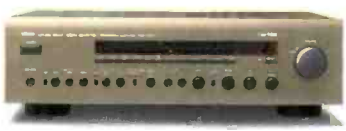


Ralph's home theater system.

YST-SE10
Deep bass effects channel speaker.*

Ralph actually lives in a one bedroom condo.

That is, until he starts pressing the buttons on his Yamaha DSP-A700 Digital Soundfield Processor.

Then he starts turning his place into all different kinds of entertainment environments.

How?

Well, a few years ago, our engineers and sound technicians packed their bags and headed out to sample a variety of entertainment environments all over the world.

Opera houses, stadiums, jazz clubs, concert halls, movie theaters, discos, cathedrals and amphitheaters.

And after several months of testing, recording and eating strange food, they brought home actual acoustic samples of dozens of these types of environments. Digitally recorded them onto a computer disk. And put them all onto one tiny computer chip.

Then they added seven channels of amplification, Dolby* Surround Sound, Dolby Pro Logic and YST technology. And put it all into one component.

All the jet lag and hard work paid off because they came up with one of the most advanced, yet simplest home theater components on the market.

But don't take our word for it. Drop by a Yamaha dealership and press a few buttons yourself. And find out just how big your place can be.

YAMAHA

1. Movie theater. 2. Outdoor stadium. 3. Cathedral 4. Amphitheater. 5. Indoor stadium. 6. Music hall. 7. Disco. 8. Jazz hall.

*Our compact YST-SE10 wall/shelf speakers will enhance the performance of your effects channels with deep, powerful bass.

The Sony had enough flexibility to give me reasonable settings for all the varied program material I used with it.

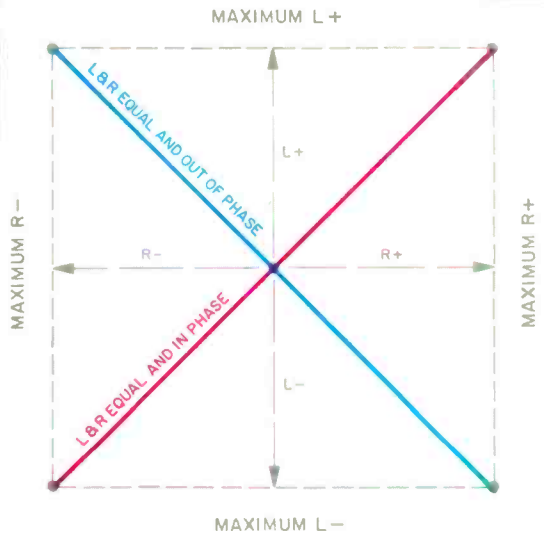


Fig. 7—Vector indications of X/Y oscilloscope displays. Left-channel signal amplitudes are indicated by trace height, right-channel amplitudes by trace width. Equal, same-polarity ("in-phase") signals from each channel, representing monophonic information, create a trace from lower left to upper right; opposite-polarity ("out-of-phase") signals, representing stereo difference information, create trace from upper left to lower right.

not improve—no matter what button I pushed. *Planes, Trains and Automobiles*, with Steve Martin and John Candy, was watched in the videodisc version. Dolby Surround was needed for good dialog centering and presence. I preferred a fairly high surround level for music, crowd and traffic noises, and effects, but other viewers found my level setting distracting. The *Gremlins* videodisc, from Warner Home Video, delivered high-quality sound and was at its best, overall, with Dolby Surround. There was very good use of music and other effects to support scenes, building suspense in a number of cases. The Pioneer *Duran Duran* videodisc had substantially no stereo or surround information on it. Dolby Pro-Logic could not extract much from it, and "Simulated" was actually best, which is not surprising, considering the monaural character of the source.

The first Compact Disc I used was Mozart's *Eine Kleine Nachtmusik*, with Charles Mackerras and the Prague Chamber Orchestra (Telarc CD-80108). It sounded best in "Hall" with 30-mS delay. I tried inverting a channel, but I didn't consider the resulting change an improvement. The stereo reverberator gave perhaps too much of an effect, but the results were quite good. For Mozart's Symphony No. 40, with Eugen Jochum and the Bamberg Symphony Orchestra (Orfeo C-045901), I had the same first choice ("Hall"), also liked the stereo reverberator, but didn't like "Inv." I did find, however, that "Matrix" with 30-mS delay sounded good after polarity inversion. "Hall" with 40-mS delay was the best overall setting for Tchaikovsky's "Nutcracker Suite," with Neville Marriner and the Academy of St. Martin (Philips 411471-2-PH). Polarity "Inv" was perhaps better for some pieces, but the stereo reverberator had an undesirable liveness. When in "Hall" mode, switching the surround circuits off caused an obvious and undesirable collapse of the sound field to normal stereo.

Elgar's Overtures, with Alexander Gibson and the Scottish National Orchestra (Chandos CHAN-8309), seemed best to me in "Hall" with delay at 40 to 50 mS. Polarity "Inv" was just acceptable, in my view, but "Matrix" with 30-mS delay was fairly good. I could neither get the greater sound spread I wanted, nor could I control some of the good things I heard with the stereo reverberator. The Sousa music on *Peaches and Cream*, with Erich Kunzel and the Cincinnati Pops (MMG MCD-10005), was quite a good match to "Hall" with the delay increased to 50 mS and the filter cutoff lowered to 6 kHz. "Matrix" with delay of 30 to 40 mS was quite good for marches but not for other things. Polarity "Inv" was not good with either of these modes. The stereo reverberator was quite good for most of the tracks on this CD.

I tried Victoria's Requiem Mass, with The Tallis Scholars (Gimell CDGIM-012), using "Hall" and 50-mS delay, but the sound was better after a reduction to 30 mS. "Matrix" with 40-mS delay was fairly good, but voices became too pointed. Polarity "Inv" was not good with either mode, but the stereo reverberator was a possible choice. The Charpentier *Motets* CD, with the Concerto Vocale (Harmonia Mundi HMC-901149), sounded best with "Hall," 40-mS delay, and a low surround level. I couldn't get the sonic illusion of the room I wanted, and the stereo reverberator had too much of an effect. The Swingle Singers' *Anyone for Mozart, Bach, Handel, Vivaldi?* was good with "Hall," a high surround level, and a short delay of 20 mS. Longer delays were good at times but only with lower surround levels. The stereo reverberator was a good choice, particularly for some tracks. I wondered what sort of illusion I would get for an opera and tried Puccini's *La Bohème*, with Moffo, Tucker, Leinsdorf, and the Rome Opera House Orchestra and Chorus (RCA 3969-2-RG). The opera was quite good in "Matrix" and "Hall," although the presence that "Matrix" added to the voices was not successful at all times. Dolby Surround centered the voices too much, and "Simulated" was less effective overall than "Hall" or "Matrix." The stereo reverberator added too much liveness for this music.

The Brahms Trio in B from *The Piano Trios*, performed by the Beaux Arts Trio (Philips 416838-2-PH2), was fairly good in "Hall" with 40-mS delay and the surround level set at −6 dB. Occasionally, however, the piano's sonic placement seemed to slip sideways a bit. "Matrix" provided more stable localization but was less satisfactory in other ways. Polarity "Inv" was not acceptable, but the stereo reverberator was quite good in this case, including a steady piano image. For the Brahms Concerto No. 2 for Piano and Orchestra, with Ashkenazy, Haitink, and the Vienna Philharmonic (London 410199-2-LH), "Hall" with 40-mS delay and −9 dB surround level was my choice. The stereo reverberator was a good mode for the orchestral sound but not for the piano. I preferred just about the same combination for

The inclusion of circuitry for Dolby Pro-Logic makes the SDP-777ES well worth comparing to more expensive surround decoders.

Michael Murray's *Bach: The Organs at First Congregational Church, Los Angeles* (Telarc CD-80088). I liked a higher surround level (−5 dB), though, and the stereo reverberator was basically good for this organ CD.

"Matrix" seemed best to me for *Brothers in Arms*, the Dire Straits album (Warner Bros. 25264-2). I set the delay anywhere from 0.1 to 30 mS, reacting to the particular track. The surround level was reduced (−10 dB) to help emphasize the vocals. Dolby Surround with "Center Mode On" was very good on some tracks for bringing vocals out of the total sound. The stereo reverberator failed because it was lacking in vocal presence. Patti LaBelle, on *I'm in Love Again* (Philadelphia International ZK-38539), did not fare well with Dolby Surround until I switched "Center Mode" to its "Phantom" setting, to make the voice sound less brittle by spreading it. The stereo reverberator feature was also good, making the voice less brittle than the "Matrix" mode did.

Sony also suggests a presence delay mode, obtained by positioning the surround speakers outboard of the main speakers and pointed at the wall behind them. Since my surround speakers are hard to move, I substituted others. The effect of all this was generally pleasant for many of the CDs, but I did not think the sonic results were superior to those from the other music surround modes. With the changed speaker positions, the four regular modes would be greatly compromised and, in my view, basically lost without compensating advantages. The positioning of dialog and localization in the surround field for television and movies were very nearly the same for the SDP-777ES and the reference Yamaha DSP-1 and DSR-100 PRO. The Sony unit provided very satisfying reproduction of music—far superior to regular stereo. It was not possible, however, to manipulate the processing to create definite room illusions, as is possible with the reference DSP-1.

The Sony SDP-777ES processor has low noise and distortion and very good frequency response. This unit's Dolby Pro-Logic surround mode is certainly one of its best features, particularly for those who want good sound from Dolby Stereo movies. The range of delays is good for all modes, and the precision of the settings is better than would ever be needed. Control of levels is quite complete, especially with the remote control. Many users will benefit from being able to set different levels, and delays, for the two surround speakers. The easily read front-panel display and the flexible input/output connections and switching add to the value of the Sony processor. The music surround modes are not a match for those of the reference processor, but their superiority over regular stereo is very obvious. The relatively moderate price of the Sony SDP-777ES, considering the inclusion of Dolby Pro-Logic, makes this unit worthy of comparison to other processors at noticeably higher prices.

Howard A. Roberson

JVC XP-A1010 DIGITAL ACOUSTICS PROCESSOR

Manufacturer's Specifications

Digital Inputs: Optical, coaxial, and DAT play (coaxial) with automatic selection of 32-, 44.1-, or 48-kHz sampling frequency.

Analog Inputs: Line in and tape play.

Digital Outputs: Optical and coaxial line out, coaxial DAT record.

Analog Outputs: Main, front DAP (Digital Acoustics Processor) and rear DAP out, and tape record.

Input Sensitivity: 500 mV.

Maximum Output: 5 V.

THD: Main, 0.002%; DAP, 0.004% from digital sources and 0.005% from analog sources.

Frequency Response: Main, 5 Hz to 100 kHz, +0, −3 dB; DAP, 5 Hz to 20 kHz, +0.5, −1 dB (digital) or +0.5, −3 dB (analog).

S/N: Main, 110 dB analog and 100 dB digital; DAP, 94 dB.

D/A Converter: 16-bit linear with four-times oversampling digital filter.

A/D Converter: 16-bit with 64-times oversampling, left and right independent.

Sound-Field Patterns: 20 programmed and 20 manual.

Power Requirements: 120 V a.c., 60 Hz.

Power Consumption: 25 watts.

Dimensions: 18¾ in. W × 4 in. H × 14 3/16 in. D (47.5 cm × 10.2 cm × 36 cm).

Weight: 15 lbs. (6.8 kg).

Price: $1,200.

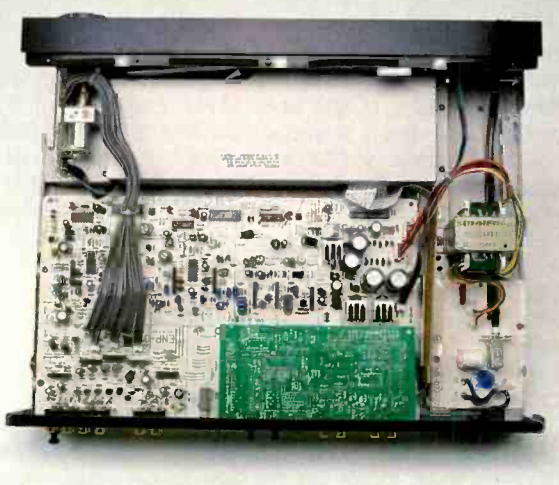
Company Address: 41 Slater Dr., Elmwood Park, N.J. 07407.

(Originally published September 1989)

The XP-A1010 is the digital acoustics processor part of JVC's Super Digifine line of digital-ready audio components. Its digital circuits simulate the sound fields of live music performances by digitally replicating directions and levels of reflections and reverberation. The processor contains ROM (read-only memory), where a vast amount of data from actual sound-field measurements is stored. A newly developed digital acoustics processing LSI (large-scale integration) device synthesizes the early reflections with proper direction, timing, and reverberation, in accordance with the stored data. The digital processing is performed in 16-bit quantization at a sampling rate of 48 kHz, using a four-times oversampling D/A converter and a 64-times oversampling A/D converter. The entire process operates independently in the left and right channels to ensure accurate re-creation of the sound fields.

Twenty sound-field patterns are stored in ROM, and 20 user-programmable sound fields can be stored for one-button recall. Several acoustical parameters can be adjusted, including room size, liveness, and reverberation level. Ambience compensation can be set for both the source and the listening room. The system can be configured for either four- or six-channel operation, and the six-gang volume control adjusts all channel levels simultaneously. Figure 1 is a block diagram of half (left or right) of the XP-A1010. The front-panel fluorescent display is programmable.

In any performance hall, reflections from the room surfaces create a sound field unique to that particular site. The acoustical characteristics of the hall can be analyzed by measuring these reflections. JVC uses a pulsive source located on the stage and an array of six microphones placed at the best listening position. These measurement microphones are located on X, Y, and Z axes, as shown in Fig. 2. Each microphone pair is spaced a distance "d" apart, and each microphone is ½d from the origin "O." Usually, there are many peak signals among the impulse responses of the microphones. For accurate analysis, it is necessary to identify the peak signals caused by the same reflection of the pulsive sound source.



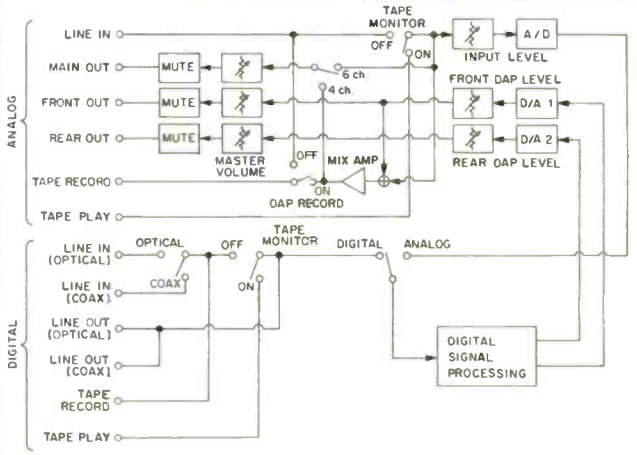


Fig. 1—Block diagram of one set of channels (left or right) of JVC's XP-A1010 processor.

Three relationships lead to correct identification. The first is that the arrival times to each pair of microphones are different but symmetrical for each pair, relative to the arrival time at the origin (Fig. 3). Second, the arrival angles X, Y, and Z are related, as the sum of $\cos^2 X$, $\cos^2 Y$, and $\cos^2 Z$ is equal to 1. Finally, the peak signals from the same reflection are very nearly equal in amplitude at all six microphones. The advantage of this measurement system is that virtual images can be obtained with reasonable accuracy by identifying individual reflections—even when more than one reflection is received in the same time span.

Control Layout

At the left end of the front panel are large pushbutton switches for, top to bottom, "Digital Direct," "Power," and "Remote Sensor." To the right are three orange status lights for "Sampling Frequency": "48 kHz," "44 kHz" (actually 44.1 kHz, for CDs and some prerecorded DATs), and "32 kHz." With a digital source connected, the unit automatically switches to the correct frequency and illuminates the corresponding LED. "Digital Direct" is a light-touch switch; if its small orange status light is on, this indicates that the analog inputs are disconnected. When the switch is off, the analog inputs are connected and the 48-kHz LED is on.

Further to the right are red status indicators for "Tape Monitor" and "DAP Recording." (Although "DAP" stands for "Digital Acoustics Processor," the "P" can also stand for "Processed" or "Processing," depending on the context.) The two associated switches, which will be described later, are interlocked so they cannot both be on at the same time; their circuit positions can be determined from Fig. 1. When "DAP Recording" is selected, the front DAP signal is mixed into the main-channel feed to "Tape Rec." "DAP Recording" is not available with the digital input.

The JVC XP-A1010 offers 20 preset programs, lets you store 20 more, and has adjustments for listening room and source material.

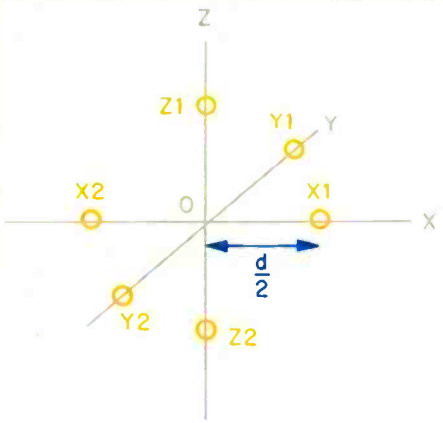


Fig. 2—Two-dimensional representation of the three-dimensional array of measurement microphones used in developing the XP-A1010. The "Y" axis, shown here as a diagonal, would actually be at right angles to this page; see text.

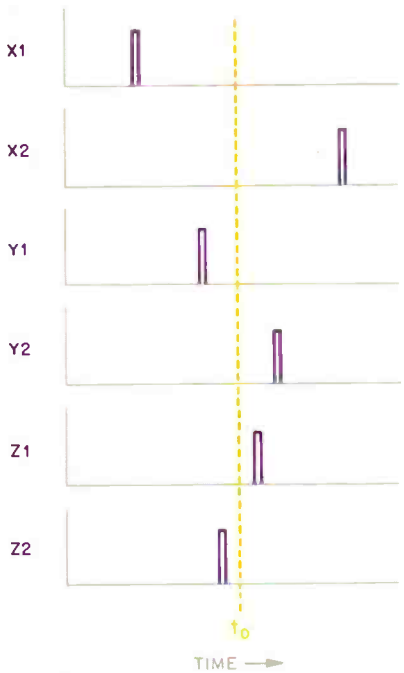


Fig. 3—Symmetry of sounds' arrival times at measurement microphones, relative to arrival time at origin; see text.

The amber, multi-mode display covers a good part of the panel, and its large size and the contrast of its characters make the display easy to read at a good distance. Operating modes, parameters, and other information are shown in various combinations, depending upon choices made with front-panel and remote-control switches. For example, the top line might show "P10: Church" and the second line "High-Ceilinged Space." The "P10" indicates that this is the tenth programmed preset. I will describe more of what is shown when the switching is discussed. The "Master Volume" control, with its really large knob and helpful white index, is at the far right. The knob's side is smooth, but its large size makes this control easy to turn. It is motor-driven when the remote is used. A small, orange "Mute" indicator is just above the knob.

A fold-down access cover extends from the remote sensor on the left to the volume knob on the right. Behind it are a total of 15 small, light-touch buttons. The first two, "Tape Monitor" and "DAP Recording," are electronically interlocked, as mentioned before. The next three, to the right and slightly separated, are "Spread/Point," "Source Reverb," and "Listening Room"; all three buttons are on the remote control as well. Pushing any of these switches changes the display. "Spread/Point" selects either a mode for spread sources, such as orchestras, or a mode for point sources, such as piano. A push of this button shows the present mode, "Spread" or "Point," on the bottom line of the display; a second push changes to the other mode, with the display reflecting this change. About 5 S after "Spread/Point" is pressed or a change is made, the display returns to its original content.

Pushing "Source Reverb" changes the display's second line to "Source Reverb = M.Ns" ("M.Ns" is the time in seconds and tenths). Up and down buttons toward the right end of the row can be used to set the time anywhere from 0.0 to 5.0 S in 0.1-S steps. A single push of either button gets a one-step change. After the button is held in for about 0.5 S, the time changes continuously at a rate of about 10 steps per S. One limitation of the XP-A1010, in my view, is that any change in this parameter is applied to all programs, not just the one in use. The second line of the display continues to show this information for about one minute after "Source Reverb" is pressed or after a change is made, then switches back to its original content.

A push of "Listening Room" changes the second line to "L. Room Reverb = M.Ns," and "M.Ns" can be set in 0.1-S steps from 0.2 to 0.6 S. A second push of "Listening Room" changes the display to "L. Room Size = " and one of the three selectable room sizes: "<10 m^2," "10 - 16 m^2," or ">16 m^2." Being able to adjust these two parameters, listening room reverb and size, is certainly unusual, and JVC argues persuasively for how important this is in obtaining the best listening conditions.

Next on the right is a simple but important LED input-level meter, with only three LEDs for each channel. The first two of the three are yellow LEDs for "15 Bit" and "16 Bit" levels; the last LED in each channel's row is red and is labelled "Over." Pressing the "Input Level" button, just to the right, causes that legend to appear on the top line of the display, with a 13-segment level meter on the line below. The meter is

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A Living Portrait for Your Home.

You are probably more aware of our inventions than you are of our name...Philips. Yet, our "Firsts"—from the audio cassette to compact disc technology—are just a few of many Philips breakthroughs. We are one of the world's largest consumer electronics companies and the largest producer of projection television. It's from this heritage and technological expertise that we've launched WallVision.

Start with a wall. Now imagine a large-screen projection television...nestled into that wall. Add equipment cabinets for your VCR, disc players and audio components, then surround the room with speakers. Now watch. And listen. WallVision makes entertainment the focus of a room...but without overpowering it.

WALLVISION™
A Masterpiece of Home Theatre

Actual PTV Picture

Philips WallVision becomes the masterpiece of your home theatre. It customizes your entertainment environment, then brings it to life with sight and sound. Once you've selected the audio and video components, WallVision integrates them—both electronically and aesthetically—creating a seamless blend of equipment and lifestyle.

In Perfect Perspective to the Roomscape.

For the select few who truly appreciate the technical beauty of quality equipment, WallVision makes a bold personal statement. It reflects your pursuit of viewing and sonic excellence, surrounding you with space and dimension.

WallVision puts electronics on display, showcasing your audio components, combining technology and art to produce precision sound. Electronic breakthroughs such as Philips' AV1000 digital surround sound processor fit into the WallVision image. Six channel audio power and Dolby Pro-Logic surround sound decoder will deliver sound quality you've experienced only in the theatre. Those with an ear for excellence will find Philips sound system unlike any other. Our FB1000 speakers use Philips patented

WALLVISION™
A Masterpiece of Home Theatre

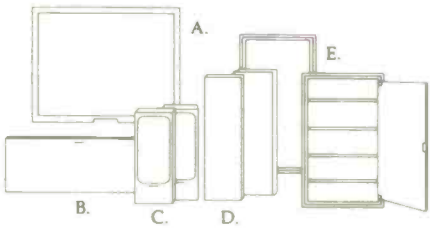
Actual PTV Picture

isophase midrange and tweeter system. That, combined with polypropylene and carbon fiber woofers, allows the speaker system to provide amazing high-resolution sound.

The WallVision projection television provides video that complements the audio excellence. WallVision's theatre size, 61" screen takes a powerful, yet unassuming place in your in-wall location. Our largest of screens envelopes you in 25% more viewing area than our 52", and 43% more than our 46" screen, with absolutely no loss in picture clarity. This successful audio-to-video relationship is the reason to take your roomscape to the limit.

WallVision Components.

WallVision starts with any free-standing Philips projection television. Each model—61", 52" or 46"—features Picture-in-Picture capability and Uniremote control. And all projection televisions convert to inwall treatment with a minimum of modification.



WallVision Kit

A. Enhancement Filter/ Frame Molding
B. Standard Speaker Grille

WallVision Components

C. FB815 Speakers
D. Custom Speaker Grilles
E. Equipment Cabinets

Basic WallVision Kit. To create WallVision in your home, you'll start with the basic kit, consisting of:

- Contrast enhancement filter
  - Improves picture quality
  - Protects the projection television screen
- Screen frame molding
  - Gives the unit custom-installed appearance
- Air dam
  - Controls internal air flow of projection TV
  - Necessary piece for in-wall installation
- Standard speaker grille
  - The finishing touch for a built-in look
- WallVision Installation and Hook-up Guide

For our 52" models, these options are also available:

Speaker grilles. Custom decor facades fit onto the Philips FB815 speakers or over any other speaker housing in systems that utilize optional speakers, in addition to or instead of the standard unit.

Equipment cabinets. Wall-mounted shelving units add four shelves (for a total of five compartments) to your system for audio or video components. Smoked glass doors protect your equipment.

WallVision lets you paint your own picture of home theatre. It's a versatile concept, as simple or as elaborate as you choose. Not all rooms are created equal, nor are any two systems identical. But with simple and creative design, WallVision can be tailored to match your personal vision of a totally integrated home theatre experience.

Planning begins with the basic WallVision kit, and expands with your choice of accessory items.

Philips Consumer Electronics Company
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52LP52SA 61LP60SA 46LP40SA 52LP52SB

Prepare yourself for the picture quality and clarity of Philips projection television. Superior brightness over every inch of the screen, a remarkable horizontal viewing angle of 160 degrees, outstanding film-like color ranges, and resolution exceeding 600 lines make whatever size screen you choose a dramatic improvement over what you're watching now.

BRING YOUR WALLS ALIVE !
Call 1-800-874-7156 To Order
Philips WallVision Video Tape Now.

This VHS videotape dramatically shows how you can create a theatre environment in your home using Philips WallVision projection television system. The video describes:

- Three Room Settings:
  - A Multimedia Home Entertainment Room
  - A Traditional Family Room Setting
  - A Dedicated Audio/Visual Room.
- Philips WallVision Features such as Picture-In-Picture and Use of Philips Universal Remote Control.
- Installation Guidelines and Optional Philips Components.

Call today. Order your copy for $9.95 to bring your walls alive!

Technical Specifications

Free Standing Projection TV		46LP40SA	52LP52SA	52LP52SB	61LP60SA
Video Specifications					
Screen Size (DIAG)	Inches	46	52	52	61
Brightness	FtL	450+	350+	350+	300+
Tuning Capability	Channels	178	178	178	178
Horizontal Resolution	Lines	550	600+	600+	600+
Audio Specifications					
Speakers (Stereo Pair)	Bass	6"	6"	6"	6"
	Tweeter	2"	2"	2"	2"
Total Power	WATTS*	50	50	50	50
General Specifications					
Power Requirements	Volts/Hz	120/60	120/60	120/60	120/60
Power Consumption	Watts	187	187	187	187
Weight (approx)	lbs.	210	225	225	250
Dimensions (approx)	Width	39-1/2"	44-1/4"	44-1/4"	51-3/8"
	Height	46-1/4"	48-3/4"	48-3/4"	56-7/8"
	Depth	27-1/16"	29-1/16"	28-1/2"	30-5/8"
Video Specifications					
7" Tubes		■	■	■	■
Liquid Cooled/Coupled Lens		■	■	■	■
Electronic Dynamic Focus		■	■	■	■
Velocity Modulated Scan		■	■	■	■
160° Black Matrix Screen		■	■	■	■
P.I.P. Features					
Freeze		■	■	■	■
Swap		■	■	■	■
Position		■	■	■	■
General Video Features					
Comb Filter		■	■	■	■
S-Video Input		2	2	2	2
A/V Inputs		■	■	■	■
General Audio Features					
Dolby ProLogic		■	■	■	■
Fixed Outputs		■	■	■	■
Variable Outputs (Dolby Pro Logic)		■	■	■	■
External Speaker Terminals		■	■	■	■
Universal Features					
Total Buttons		42	42	42	42
Pre-Programmed Universal		■	■	■	■
LCD/Learn Universal		■	■	■	■
On-Screen Menu Controls		■	■	■	■
Sleep Timer		■	■	■	■
Personal Preference (5 + factory)		■	■	■	■
Parental Control		■	■	■	■
Channel Guide/Captioning		■	■	■	■
Control Options					
VCR		■	■	■	■
Cable		■	■	■	■
Audio		■	■	■	■

*Front: 12.5 watts RMS per channel into 8 Ohms from 20Hz to 20kHz, with no more than 0.5% THD.
Rear: 12.5 watts RMS per channel into 8 Ohms from 20Hz to 20 kHz, with no more than 0.5% THD.

Specifications subject to change without notice.

PHILIPS

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JVC persuasively argues the importance of being able to adjust for the size and reverb time of your listening room.

calibrated from "−24" to "0," and its bottom segment remains illuminated even when there is no input. The first step down is about 1.5 dB, followed by a series of 2-dB steps to −16.6 dB, a 1-dB step to −17.6 dB, and two 2-dB steps to −21.7 dB. This range and resolution is quite acceptable for setting the levels into the DAP A/D converters. It is best to set the input level high enough for a 16-bit indication, but if you switch to a higher level source, be careful. In case of doubt, always check the level indicator to make certain that "Over" is not turning on.

Pushing "Input Level" again resets the display to show "Input Balance," with a 13-position balance scale running from "L" through "C" to "R," and a balance-indicating cursor block. When the block is right on the center, it blanks out "C." The six steps each way from center are roughly 2 dB each, with a total reduction of 11 dB when all the way left or right. Correct balance is indicated when the L and R bit indicators in the little level display flash equally. This balance adjustment affects only the surround outputs, not the main ones.

"Character," the next button on the right, is for titling manual-preset programs. A push of this button starts a cursor flashing under the first available position in the second display line. Pushing the up and down buttons at the right steps through the alphabet (upper and lower case) and the digits 0 to 9. When the desired letter or number is on the screen, pushing the "Character" button again enters your choice and steps the cursor one position to the right, for your next entry. The result can be saved in memory.

The next button, "Parameter," selects the processing parameters to be adjusted for the 20 user-programmable sound fields. For the first 15 programs, successive pushes of this button select "Room Size," "Liveness," "LPF" (low-pass filter), "Reverb Level," "HF Reverb," and "Offs Delay" (offset delay—more on that later). For programs 16 to 19, "Rear Delay" is added between "HF Reverb" and "Offs Delay"; only "Rear Delay" can be adjusted for program 20. The parameter being adjusted and its current setting appear on the second line of the display—e.g., "Room Size = 1.0"—and remain there for one minute. "Room Size" and "Liveness" have a range of 0.5 to 2 in arbitrary units. The program preset values are 1.0, and adjustments can be made in 0.1-unit steps by using the up/down buttons. The low-pass filter ("LPF") can be set anywhere from 1 to 16 kHz in 1-kHz steps or to "Thru" (flat). Program preset values range from 3 to 16 kHz, depending on the particular program selected.

"Reverb Level" is adjustable over an arbitrary scale from 0 to 2 in 0.1-unit steps, starting from an initial value of 1.0. The calibrations for "HF Reverb" are the ratios between the signal's high- and low-frequency reverberation, and they range from 0.1 to 1 in 0.1-unit steps. The initial preset values for this parameter range from 0.3 to 1.0, depending on the program.

According to the manual, offset delay is used only when the stereo system's main amplifier is JVC's AXZ911BK operating in its Digital Pure-A mode. In this mode, digital input signals are delayed while the amplifier's circuits assess the signal, predict the output level it will require, and adjust the power supply's voltage so the amp will be able to stay in

Class-A operation when the signal finally reaches it. "Offs Delay" on the XP-A1010 processor adds an extra delay to the surround channels to compensate for this delay in the amp; it's a unique feature and a sign of the times.

"Rear Delay" has an adjustment range from 15 to 30 mS in 1-mS steps. Its initial value is 20 mS for programs 16 through 20.

To the right of the "Parameter" button are the "F/DAP Level" and "R/DAP Level" buttons. A push displays the parameter name and a horizontal, 13-segment level meter. Each attenuation step down from maximum level is about 2 dB, for a total of close to 22 dB when the first 12 bars are turned off. A 13th push turns off the 13th bar and mutes the front and rear outputs. After the last change, the DAP level display stays on for 5 S.

The next two buttons are for "Programmed Preset" and "Manual Preset." The first of these selects the supplied programs stored in ROM (read-only memory). When the XP-A1010 leaves the factory, its 20 manual preset programs have all the same parameter settings as the equivalent programmed presets. But in "Manual Preset" mode, these parameters can be changed, and the second line of each program's title display can be edited.

Just to the right are the "Down" and "Up" buttons, each marked with an open-V arrowhead; the many functions of these switches have already been discussed. The last button to the right, "Memory," is for entering modified programs when in "Manual Preset" mode.

I removed the wood side pieces, then the top and side metal cover. The power transformer is in a relatively narrow section along the left of the chassis. It was just warm to the touch after some hours of operation. Electronic circuitry covers the remainder of the chassis area. The front portion, just behind the front panel controls and display, has a metal

As soon as I began fooling around with the XP-A1010, I was immediately struck by its smoothness of sound.

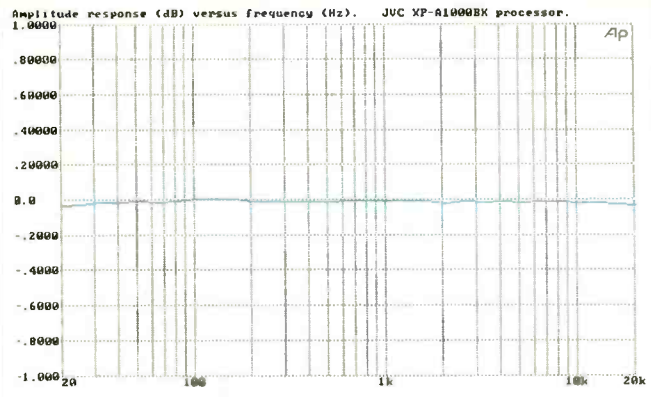

Fig. 4—Frequency response of main outputs.

cover which I did not remove. The p.c. board is large and of very good quality. It extends from the covered portion to the back panel and has high-quality parts in a neat, ordered layout. Parts are identified, and adjustment pots and function areas are labelled. I noticed with favor the generous heat-sinks for a number of transistors.

The soldering, in general, was excellent. There were a few spots with flux remaining—some apparently from last-minute changes. Interconnections were made with multi-conductor cables, most with plugs. The multi-section master level control and its motor drive are at the right front, with a shaft extension to the front-panel knob permitting direct manual adjustment. A horizontal, medium-sized p.c. board is mounted to the back panel. The board is light, but I thought it would benefit from additional support. The back panel itself is springy, but the rest of the chassis is fairly rigid—more so with the cover in place.

From the left, the rear panel has gold-plated stereo jack pairs for "Line In," "Main Out," "F/DAP Out," "R/DAP Out," "Tape Rec," and "Tape Play." A pushbutton farther to the right selects "DAP Mode" ("4 Ch" or "6 Ch").

Close to the center of the panel are six jacks and a slide switch for "Digital" connections. The "Line" connections include both optical and gold-plated coaxial jacks for digital-signal "In" and "Thru Out." The latter simply feeds the signal on to other components with digital inputs. The slide switch selects either the optical or coaxial connections; a fiber-optic cable is supplied with the XP-A1010. Gold-plated coaxial "DAT" record and play jacks complete this connection array.

The remote control, like those for most sound-field processors, is somewhat complex, with a total of 41 buttons. However, the remote's light-gold labels are easy to read against the black background.

The four buttons at the transmitting end of the control select either programmed or manual presets, enable manual preset changes to be stored in memory, and control display modes. Pressing the "Display" button once turns off the input-level indicator, pressing it again turns off the panel display, and a third push turns both back on again.

The 20 numbered keys in the next five rows select individual programmed or manual presets. Having only numbers for these preset buttons frustrated me at first, until I had used the remote control long enough to remember the names of the associated programs. The first six programs are all named "Symphony Hall" and are numbered the same as their memories. Numbers 1 to 3 are labelled "Shoebox Type" on the second display line; numbers 4 to 6 are "Vineyard Type," which indicates a fan-shaped layout with tiered seating. The seventh program is "Recital Hall," subtitled "Small Musical Space"; next come "Opera House," with "Tiered Seating," and two churches: "Cathedral/Gothic Style" and "Church/High-Ceilinged Space."

The rest of the preprogrammed sound fields are oriented more toward pop music. First come two "Live Club" programs ("Jazz Club" and "Discotheque"), "Pavilion/Live Concert," "Gymnasium/Hard-Floored Hall," and "Stadium/Outdoor Live Concert." Last come the five "Movie Theater" sound fields, subtitled "Small Space," "Medium-Sized Space," "Large Space," "Extra-Large Space," and "Standard."

The remaining 17 buttons fall into two main groups. The first group includes buttons for "Character," "Parameter," "Source Reverb," and "Listening Room," as well as buttons ("+" and "−") for adjusting these functions and "Spread/Point" and "Main Mute" buttons. All of these duplicate front-panel buttons except "Main Mute." When "Main Mute" is pressed, the main stereo channels are muted, the orange LED above the volume control flashes, and "Main Muting" is shown in the second line of the display until another button is pressed. A second press of the muting button turns off the mute, stops the flashing, and returns the second line to its original content.

The final three rows, which control "F/DAP Level," "R/DAP Level," and "Master Volume," have identical layouts. Each has, from the left, a "Mute" button, the control title, and "Down" and "Up" buttons. When the front or rear DAP channels are muted, the LED above the front-panel volume control flashes and either "Front Muting" or "Rear Muting" appears in the display. The "Master Volume" muting button turns off all six channels. Therefore, there is no display readout when this mute is activated—although the orange LED goes on steadily. Either the F/DAP or the R/DAP horizontal, 13-segment bar graph appears whenever an associated "Down" or "Up" level button is pushed.

Measurements

All measurements were made after the listening and viewing. As Fig. 4 shows, the right main-channel response was very flat, down only 0.04 dB at 20 Hz and 0.02 dB at 20 kHz. The −3 dB points were at 4.1 Hz and close to 200 kHz. The left-channel results were almost exactly the same. Figure 5 shows the comb-filter-type response of the F/DAP output with a mono input and one of the preset programs; another program would have a different response.

Input sensitivity was 362 mV, the input level which just turned on the level indicator's "16-Bit" LEDs; the maximum acceptable input level (red LEDs just on) was 768 mV. I did

Dialog centering turned out to be better than I had expected, despite the lack of a center channel.

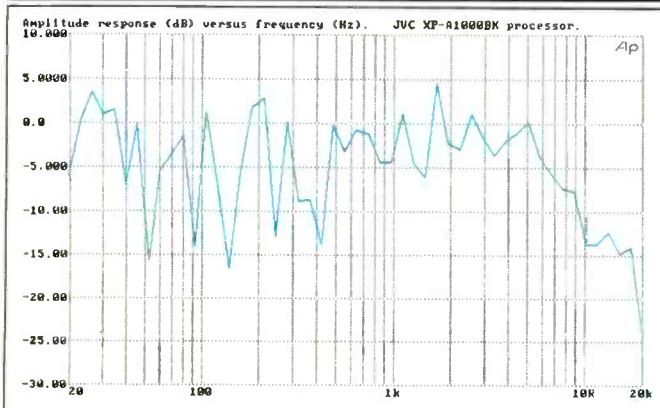

Fig. 5—Frequency response of left F/DAP output with mono signal input using modified version of the "Symphony Hall 5" preset program. Response for other programs would differ.

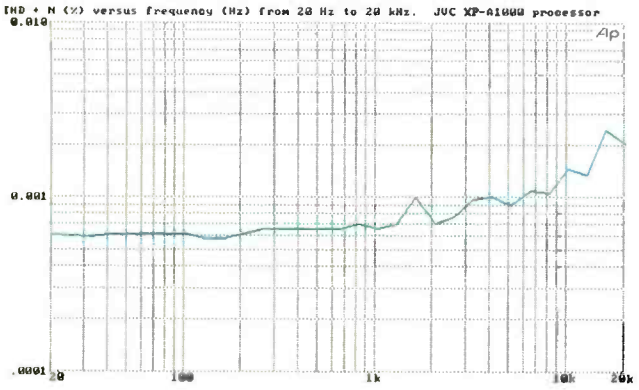

Fig. 6—THD + N for right main channel at 1 V.

not find anything I could call input clipping for the DAP channels, but waveform distortion was obvious at 600 mV, which is actually below the level where the red LEDs turned on. The maximum, no-clipping input level for the main channels was 6.5 V; output clipping did not appear at the 6-V output obtained with "Master Volume" at maximum. The S/N ratio, with a 1-V reference, was 118 dBA for the main channels and close to 99 dBA for the DAP channels. The right R/DAP channel, however, measured 95.3 dBA, which is still excellent. Figure 6 shows THD + N across the band for the main channels at 1 V input. The excellent figures are less than 0.001% over most of the band, reaching only 0.0025% or so near 20 kHz.

The output/input level difference was −0.7 dB on the left main channels and −0.6 dB on the right, with the "Master Volume" at maximum. Input impedance was 42 kilohms; output impedance was very close to 660 ohms on all channels. The two sections of the input-level attenuator tracked well within 1 dB over the control's complete range. All six sections of the "Master Volume" control tracked within 1 dB over a range of nearly 70 dB, which is outstanding. Fairly exact balance with a mono input—null in the R/DAP outputs—was achieved with the input balance set to "C." The 40-dB null at 1 kHz might have been better if balance were set with a trim pot rather than in 2-dB steps.

In the "Movie Theater" modes, the rear-delay adjustment range was from 16 to 32 mS, in accurate 1-mS steps. With the "Master Volume" at maximum, the 48-kHz residual was more than 100 dB below 1 V in the main outputs, 88 dB in the F/DAP outputs, and 99 dB in the R/DAP outputs. With the volume at a more normal 1 o'clock position, the residuals were down another 10 dB. Separation between the main left and right channels was 80 dB or better across the band. Figure 7 shows the DAP outputs in manual preset, with the "Symphony Hall 5" program, when a two-cycle, 300-Hz tone burst with a 100-mS period was fed to the inputs. Two periods, a total of 200 mS, are shown. Other programs produced other patterns in the four channel outputs.

Output polarity was the same as input; this was true for both the main and DAP channels.

The red "Over" LED was triggered by a 10-mS burst of 5-kHz tone only 1 dB above the continuous signal level required for indicator turn-on. This is good peak detection, but the user should still adjust levels for minimum flashing of this LED, even on peaks. The decay time for turn-off of the 15-bit LED was about 150 mS, which is slightly short.

Use and Listening Tests

The reference processor for the listening/viewing tests was the Yamaha DSP-1. A Yamaha AVC-50 amp was used for switching the various sources: A Yamaha TX-900U AM/FM tuner, a Magnavox 1041 CD player, a Sanyo VCR-7200 Beta VCR, an Akai VS-555U VHS VCR, and a Yamaha LV-X1 videodisc player. I adjusted responses of the various channels with a Soundcraftsmen DC2214 octave-band equalizer and a TEAC PE-40 four-channel parametric equalizer. For power amplification, I used the second section of the AVC-50 for the main stereo channels and a Yamaha four-channel MX-35 amp for the surround channels. The speakers were two JBL 4301s (main stereo), a self-powered Triad Design HSW-300 (subwoofer), and four Dynaco A-25s (front and rear surround).

The Akai VS-555U VCR was used as the stereo-TV decoder. I connected a two-channel oscilloscope across the left and right inputs and operated it in X/Y mode to show the existence or lack of stereo and surround information. As Fig. 1 shows, the JVC processor has no center or subwoofer channel outputs. I have always considered a center output to be essential for the best results with movies, but the proof would be in the viewing and listening. Self-powered subwoofers, such as my Triad Design HSW-300, can be connected across the main speaker lines, so this lack is not a fundamental limitation on subwoofer use.

With music sources, JVC's XP-A1010 generated many satisfying, even exciting, sound-field illusions.

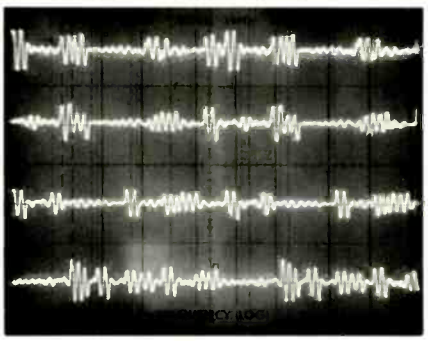

Fig. 7—Surround outputs for modified version of "Symphony Hall 5" preset program, with two-cycle, 300-Hz tone burst fed to input. Results shown are, from top to bottom, for left F/DAP output, right F/DAP output, left R/DAP output, and right R/DAP output.

The owner's manual is fairly good, with considerable detail on combining and interconnecting associated equipment. The descriptions of panel and remote-control functions and the instructions on balancing are well written. I do feel, however, that there should have been more details on the acoustics of the programs and on what parameters to change for particular sonic modifications. The manual states that the remote control is effective up to 23 feet on axis. I got response at 30 feet, which was confirmed by the flash of the front-panel "Remote Sensor" red LED. At great distances, the control must be pointed accurately, and the sensor's reception angle is narrow. At short distances, reliable operation is possible with much wider angles.

I spent some time just fooling around with the XP-A1010, trying various sources. Immediately, I was struck with the smoothness of the sound. I also felt that a number of the programs sounded very close to one or more others. The default balances provided too low a level of surround sound—at least with my equipment—and I increased F/DAP and R/DAP levels for all of the programs to meet my preferences. I changed parameters for most of the programs to get combinations that produced what I felt were more realistic illusions, and set the parameters for listening room reverberation and size which matched my room. I could not set individual source reverberation times for each program, which was a little frustrating. I programmed a value of 1.2 S but ended up changing it for some programs.

Although the JVC processor does not have a center-channel output, I concluded that movie dialog required that center source. Roman Polanski's *Frantic*, with Harrison Ford (Warner Home Videodisc), had excellent overall sound quality. I tried "Spread/Point" to see its effect on dialog; there was little change between settings, and I sometimes preferred the results with "Spread." The presence of the dialog was noticeably better than I had expected, but it was not a match for the results I would have gotten from a center speaker. The character of the surround was very good, and the sound quality was excellent. One puzzlement: There was no surround sound during scenes inside the movie's disco-like Blue Parrot Cafe; there could have been more than an occasional pan of dialog or effects. Among the movie theater programs, I preferred "Medium-Sized Space" or "Standard."

Indiana Jones and the Temple of Doom, also with Harrison Ford (Paramount Home Videodisc), had very good music and effects for surround sound. I found that I could set the R/DAP level quite high and at twice that for F/DAP. I preferred the "Large Space" movie theater program, but the surround was so good at points that "Extra Large Space" was a better choice. "Spread" was better for dialog than "Point" in a number of places. *Top Gun*, with Tom Cruise and Kelly McGillis (Paramount Videodisc), really needs surround sound to be effective. I was able to set the levels for F/DAP and R/DAP quite high without speaker localization. The positioning of effects, especially jet flyovers, was very good by ear and in the oscilloscope X/Y display. Once again, the quality of dialog without a center speaker was better than expected.

Stevie Nicks—In Concert (Pioneer Artists Videodisc) puzzled me at first, in that I couldn't find any program I really liked or disliked. This source had very strong in-phase information and little that could be called "surround." I found that some preferences emerged at higher levels: "Live Club 1/Jazz Club" and "Live Club 2/Discotheque." The source, however, remained a disappointing one.

The first thing I tried on TV was a CBS broadcast of a Georgetown versus Pittsburgh basketball game. There were stereo signals, and it was curious to watch the considerable out-of-phase information during the announcing—stereo synthesis, anyone? I did get much more of a "you are there" feeling, though, with modified "Live Club 1/Jazz Club," "Live Club 2/Discotheque," "Pavilion," and "Gymnasium." I turned the TV speaker on at a low level at times, and I did prefer that.

I also liked the increased sense of being there during the ABC *Wide World of Sports* coverage of the U.S. Figure Skating Championships and the World Alpine Ski Championship. In this case, my preferences were for "Live Club 1/Jazz Club," "Gymnasium," and the movie theater programs subtitled "Small Space" and "Standard." I know some of these choices sound odd, but that's the way it turned out. *B. L. Stryker*, with Burt Reynolds on ABC, had all dialog centered, according to the oscilloscope; announcements during the commercials, however, had some "stereo." The background music and effects had good, worthwhile surround elements. Preferred programs were the movie theater programs subtitled "Small Space" and "Standard."

For each of the CDs, I chose between "Spread" and "Point" as well as whether to lengthen or shorten the reverberation time. I had previously made modifications to each of the programs and stored them in the manual presets. Unless noted otherwise, these presets and "Spread" were

When the emphasis is on listening to music, JVC's XP-A1010 surely deserves serious consideration.

used for orchestral works. The first CD I tried was Beethoven's "Quintet for Piano and Winds," with André Previn and the Vienna Wind Soloists (Telarc CD-80114). Although I thought I might prefer "Point" for the small group, "Spread" was definitely better. I enjoyed the results with "Recital Hall" the most, and a slight increase in reverb time made it better. My second choice was "Symphony Hall 3," with the same increased reverb. Vivaldi's "The Four Seasons," with Seiji Ozawa and the Boston Symphony Orchestra (Telarc CD-80070), also was best with "Spread." I preferred "Recital Hall" and "Symphony Hall 3" again, but I found others that were nearly as good. I used slightly longer reverberation for this music: It seemed to fit the mental image of the larger group in a larger space.

I increased the reverb time further, to about 3 S, with "Cathedral" for Handel's "Dettingen Te Deum," with the Westminster Abbey Choir (Archiv 410647-2). The surround sound was just right for the music, but I did not greatly prefer this program to using "Church" with the reverb time set to about 2 S. When I tried Berlioz's "Symphonie Fantastique," with Dutoit and the Montreal Symphony Orchestra (London 414203-2-LH), I had to reduce the reverb time to about 1.6 S. In the early parts of this music, I preferred "Symphony Hall 1" or "Symphony Hall 4," but with more listening time, I came to select "Symphony Hall 5" as the best. On the other hand, Tchaikovsky's Symphony No 4, with Maazel and the Cleveland Symphony Orchestra (Telarc CD-80047), seemed best to me with "Symphony Hall 1," and I didn't pick out any others as very close.

A number of programs delivered very good sound for Stravinsky's "Firebird" Suite, with Robert Shaw and the Atlanta Symphony Orchestra (Telarc CD-80039). I really thought "Symphony Hall 2" was best over a good listening period; "Symphony Hall 5" and "Symphony Hall 6" were close, as were "Opera House" and a couple of others. I retained my preference for "Symphony Hall 2" for the early portions, but I liked "Symphony Hall 5" for the later parts. I certainly would have enjoyed either program for the entire piece. I then tried some overtures from *William Tell & Other Favorite Overtures*, with Erich Kunzel and the Cincinnati Pops Orchestra (Telarc CD-80116). My choices varied a bit from one piece to the next, but my preference was quite strong for "Symphony Hall 4" when playing Hérold's overture from "Zampa." It was a good choice in general and was especially good on the bass drum beats in one spot.

Beethoven's Piano Concerto No. 3, with Rudolf Serkin, Seiji Ozawa, and the Boston Symphony Orchestra (Telarc CD-80063), got me switching back and forth between "Spread" and "Point." The sound was good with either choice, but I concluded that I liked the concentration of the piano sound that went with "Point." To my ears, "Symphony Hall 3" was best, with "Symphony Hall 6" not far behind. I mentioned before that I had modified all of the programs and stored the changes in the manual presets. However, when I tried Saint-Saëns's Symphony No. 3, with Michael Murray, Eugene Ormandy, and the Philadelphia Orchestra (Telarc CD-80051), one of the original programs sounded best. At first, I thought that modified "Symphony Hall 1" was superior, followed by "Symphony Hall 4," also modified. Then I tried "Symphony Hall 2" unmodified and had to conclude that it was better—less muddy sounding, for one thing. I increased the reverb time a little and got one of the best sonic results in the entire listening period. I tried "Point," but the emphasis put on the organ made for poor sound.

Creedence Clearwater Revival's *Chronicle, Vol. I* (Fantasy FCD623CCR2) benefited from modified programs "Live Club 1/Jazz Club," "Stadium," and "Live Club 2/Discotheque." Although "Point" was best many times, the choice varied from number to number. I found that the modified "Pavilion" and "Gymnasium" programs just didn't work at all; the unmodified "Pavilion" and "Gymnasium" presets were certainly better. The two "Live Club" presets and the one for "Stadium," however, were not a match for the modified versions. I was a bit surprised when *Star Tracks*, with Erich Kunzel and the Cincinnati Pops Orchestra (Telarc CD-80094), was best with my modified "Pavilion." The music did sound very good with a number of other programs, both modified and unmodified, all with "Spread."

Jennifer Warnes' *Famous Blue Raincoat* (Cypress 661111-2) seemed best to me with modified programs, especially "Live Club 2/Discotheque," mostly with "Point." "Live Club 1/Jazz Club" was better for a couple of numbers, and "Stadium" was also good. I found "Pavilion" good for a surrealistic effect, particularly with "First We Take Manhattan." *Spirituals*, with Simon Estes and the Howard Roberts Chorale (Philips 412631-2-PH), sounded very good with several modified programs. "Recital Hall" and "Church" seemed best to me, and "Opera House," "Live Club 1/Jazz Club," and "Pavilion" were also good. "Cathedral" was not a good choice, which seemed sensible, considering the music, but "Gymnasium" was quite good and that was a bit confusing. Well, the name of the surround-sound game is what gives the best illusion, not what the program name is.

Conclusion

The XP-A1010 did quite well with broadcast and videodisc movies—better than I thought it would without a center-channel output. With this type of source, however, it was no match for the reference Yamaha DSP-1 processor and even less of a match for the units designed primarily for home theater use. The stereo on TV broadcasts remains a rather poor thing in most cases, and the JVC processor did fairly well with the programs tried. With music sources, the XP-A1010 could generate many very satisfying, even exciting, sound-field illusions. I would have preferred being able to store different source reverberation times in each of the programs, as is possible with the DSP-1. With much of the music, however, the JVC processor produced a more appealing smoothness in the surround sound.

The XP-A1010 has admirable responses and low distortion and noise. It has many worthwhile features, including the input-level bit meter, front-panel control of functions and parameters, inputs for listening room characteristics, the excellent display, and a remote control with much flexibility, including control of channel and overall volume. Although the price of this unit is high, it is in the same range as other processors. When the emphasis is on listening to music, the JVC XP-A1010 deserves serious consideration.

Howard A. Roberson

LEXICON CP-1 DIGITAL AUDIO ENVIRONMENTAL PROCESSOR

Manufacturer's Specifications
Frequency Response: Analog, 10 Hz to 100 kHz, +1, −3 dB; digital, 10 Hz to 16 kHz, +1, −3 dB.
THD: Less than 0.05% at maximum level, all channels.
Minimum Input Level: 300 mV rms.
Maximum Output Level: 3.5 V rms.
Input Impedance: 50 kilohms.
Output Impedance: 500 ohms.
S/N Ratio: 85 dBA, referred to maximum level at 1 kHz.
Power Requirements: 120 V a.c., 60 Hz.
Dimensions: 17 in. W × 2½ in. H × 12½ in. D (43.2 cm × 6.4 cm × 31.8 cm).
Weight: 11 lbs. (5 kg).
Price: $1,395.
Company Address: 100 Beaver St., Waltham, Mass. 02154.
(Originally published November 1989)

Lexicon is well known for its many recording-studio and professional sound-reinforcement products. The CP-1 surround processor is its first home high-fidelity product, however, and an interesting one it is. Sophisticated processors from other manufacturers have programs that are based on a series of acoustical measurements at specific performance sites. The CP-1, on the other hand, has programs that are based on fundamental characteristics of good performance halls in general. Lexicon reviewed the work of many people (Manfred Schroeder, A. H. Marshall, Michael Barron, and others) to aid in pinpointing the important factors that needed to be understood.

A rough summary of the conclusions from this analysis is that the best halls generate large differences in sound between the two ears of the concert-goer. Michael Barron found that this characteristic was created by lateral, sideways-moving reflected sound, and he defined it as "spatial impression" (SI). Only the reflections moving from side to side produce SI; those from other directions actually muddy the sound. The CP-1 is designed to increase SI from the original recording or to generate a new acoustic environment. (Some readers might like to refer to "Early Lateral Reflections in Some Modern Concert Halls," by Lothar Cremer, in the March 1989 issue of the *Journal of the Acoustical Society of America*.)

In the CP-1's "Panorama" programs, SI is extracted from the recording and processed to increase its effect; the choices are "Normal," "Wide," and "Binaural." "Binaural," a program unique to the CP-1, creates a realistic sound field from a source that was recorded for binaural headphone listening. When a listener is in the correct spot, these programs provide an almost ideal re-creation of the original recording space. Digital processing is used to cancel the crosstalk between the listener's ears from the different loudspeakers. The cancellation is high-order—much better than the first-order approach used by some processors and loudspeakers. With the CP-1's "Panorama" program, the sound is effectively spread from the two front loudspeakers in a wide arc in front of the listener. Adding speakers increases the realism of the illusion.

The Lexicon's "Ambience" and "Reverb" programs, three of each type, provide signals for driving widely spaced side and rear speakers, directly exciting sideways sound and heightening the impact over a large listening area. When there are no side speakers, these programs can be set to include a "Panorama" effect, to move the stereo image outward, past the main speakers. The "Ambience" and "Reverb" programs transform the listening room into a new acoustic space, providing six choices of environment to match the music and the listener's mood. Unlike some other hall simulators, the Lexicon provides full stereo processing.

The "Ambience" programs generate side and rear reflection patterns like those of idealized rooms and concert halls. The "Reverb" programs are similar, but they place more emphasis on rich, dense reverberant decay than on early reflections. Large, highly reverberant spaces are well simulated. Choices of "Small," "Medium," and "Large," for both "Ambience" and "Reverb," provide considerable flexibility in finding the desired hall depth, liveness, and realism to match classical, popular, jazz, or rock music.

The CP-1 incorporates the first completely digital Dolby Pro-Logic surround decoder. It is the only processor with automatic correction of azimuth and channel-balance errors, which are the most common problems in currently available films. Lexicon has also included a "Stereo" logic program for playing stereo music through a surround-sound speaker setup and "Mono" logic for expanding monaural film soundtracks.

All of the preset programs discussed above have parameters that can be modified for storage in any of 12 user program positions; the CP-1 has a front-panel LCD display for programs, parameters, and level changes. An input-level meter helps you set maximum levels which are high enough for good processing without causing distortion. The main, side, rear, center, and subwoofer outputs have level-set pots. The unit has a switch to get a phantom-center mode, in case a center speaker is not used. An unusual and valuable feature of this Lexicon processor is that it can be internally configured to match any of 12 speaker layouts in the listener's home.

Control Layout

The Lexicon CP-1 has a relatively simple front panel with easily read white designations. From the far left are three pairs of mechanically interlocked pushbuttons: "Source" ("I" and "II"), "Monitor" ("Source" and "Tape"), and "Tape" ("Pre" and "Post"). "Pre" means the tape deck gets the signal unaltered, or pre-processing; "Post" applies processing to the tape output from the CP-1, thereby including effects in what is being recorded. For such recording, the unit must be in its two-speaker configuration mode. (These

The "Binaural" program in the CP-1 creates realistic sound fields, via speakers, from recordings made for binaural headphone use.

modes will be discussed later.) Next on the right is the "Input Level" control, with a handy bar-type knob. Above is the very useful horizontal input-level meter, with 11 green LED segments and one red segment for each channel. Input meters are essential for units with digital circuitry, to ensure that the level is high enough for the best processing but not so high as to cause overload.

To the right of the meters is the two-line alphanumeric display. Each line can have up to 16 amber characters announcing programs, parameters, levels, and other useful information. When you turn on the CP-1, the software's version number and copyright date, and then the speaker configuration, are displayed for 2 S each. The last-used program is then shown until changes are made. (Details of what is displayed will be provided when the remote control is discussed.) Further to the right are three square LEDs. The first, which is green, goes on whenever a button is pushed on the remote control. The red "System Mute" LED is next, followed by the orange "Effect Mute" indicator. The "Power" on/off switch is at the lower right end of the panel.

From right to left, on the back panel, are gold-plated stereo pairs for "Inputs" ("I" and "II"), then the tape input and output jacks. Further to the left are the jacks and trim pots for the "Center," "Sub Woofer," "Main," "Side," and "Rear" outputs. The trim-pot knobs are very small, but their good knurling makes them easy to turn. Having convenient trims on all the channels makes matching levels much easier, and I'm glad Lexicon provided them. To the right of the subwoofer jack is a "Center/Out, Phantom/In" pushbutton. This switch ensures that centered information, such as dialog, is fed to the center output only if the channel is operating with a speaker.

I removed the top and side cover to get a look at the internal construction. What at first appeared to be one high-quality, chassis-size p.c. board was actually two boards. They are separated by a front-to-back stiffening rail which also provides mounting for the power transformer. This transformer was barely hot after hours of operation with the cover in place and the manual and some other papers on top. All of the parts and adjustments are identified. I could pick out elements of the circuitry which demonstrated the stereo processing capability. A Lexicon VLSI chip caught my attention, as did the Zilog Z80 CPU. The label on the socket-mounted Lexicon software chip showed that it was Version 1.04. This is a very interesting and potentially important feature: If there is an update in the programs to improve performance, a simple chip replacement is possible for all owners. As mentioned earlier, the user can check the software version of his unit just by watching the display when he turns the CP-1 on. A small touch, perhaps, but a good one.

A small board for the trim pots and associated circuitry is well supported at the back panel. I noted two fuses in clips near the transformer. The combination of the center rail and two side rails establishes good rigidity for the unit; it's even better with the cover in place. Rack adaptors are available for the CP-1. According to Lexicon, these are trays which go almost all the way back to the rear of the unit. That's an improvement on the usual mounting ears, which are only acceptable for use in systems that aren't moved around much. For use in a rack that's transported frequently (admittedly unlikely, for a home unit like this), I'd prefer to see the unit anchored at the back as well, to minimize front-panel stresses.

All program selections and parameter changes are made with the remote control unit. The Lexicon controller is smaller than those for some other surround units and is easily held and actuated. Its 26 buttons are positioned in a logical arrangement. From the emitting end are four columns of buttons, in six rows, and then a final two-button row.

The first four rows are for programs and parameters. The program buttons are in the first three columns, with "Panorama" in the first row, "Ambience" in the second, "Reverb" in the third, and "Surround" in the fourth. "Panorama" provides programs with enhanced lateral sound for either music or films. It is effective even when using just two front loudspeakers. The choices are, from the left: "Normal," "Wide," and "Binaural." "Binaural" is a program specifically designed for loudspeaker reproduction of recordings made with a dummy head. This program is unique, as far as I know, and would be very useful with such music.

The "Ambience" programs are "Small," "Medium," and "Large" and simulate concert halls of different sizes, generating reflections of appropriate directionality, delay, and spectral shape and sending them to side and rear speakers. "Ambience" has an adjustable liveness parameter, but "Reverb" is preferable when you want long reverberation times. "Reverb" has "Small," "Medium," and "Large" programs for simulating rooms of three sizes with the use of side and rear channels. The "Surround" programs are "Mono," "Stereo," and Dolby Pro-Logic, indicated by the standard double-D symbol. "Mono" logic expands the music and effects on monaural films while leaving the dialog in the front center. "Stereo" logic enhances music by bringing in the surround speakers, and it allows adjustment of parameters that are fixed in the Dolby Pro-Logic program, which provides the same decoding used in Dolby Stereo theater systems and uses up to eight speakers.

The fourth column of the remote's program section has a "Bank" button to switch between two program memory banks (for 12 factory-preset programs and 12 user-modified ones), a "Param" button to cycle through the adjustable parameters, and a pair of buttons to adjust each parameter up and down.

When "Bank" is pushed, it switches to the other set of memories without changing program number, rather than switching to whatever program was last used in that bank. Because I store my modified programs in the same memory positions as the preset programs I derived them from, I find that Lexicon's approach makes comparisons between preset and user versions easier.

Holding "Bank" in for a few seconds puts the CP-1 into configuration mode. "LCD Contrast Adj" appears in the display, and the parameter up/down buttons are used to set the contrast to personal preference. Pushing "Param" while the above words are still displayed will get the current speaker configuration.

There are 12 such configurations, and a change to any other one is a simple matter of pushing the up/down buttons. The choices are: Two main speakers; two main and one center speaker; two main and one rear speaker; two

ADCOM®
POWER AMPLIFIERS
HIGH CURRENT, HIGH PERFORMANCE

The modestly-priced amplifiers that deliver price-no-object sonic performance.

ADCOM POWER AMPLIFIERS.

These high-power, high-current amplifiers easily and accurately interface with virtually any speaker system available today (perhaps even tomorrow)—including some troublesome exotic types whose impedance falls as low as 1 ohm.

GFA-535

GFA-545

GFA-555

Before we tell you about Adcom's amplifiers, there are a few facts you should know about amplifiers in general.

Amplifiers vary enormously in two related areas: how accurately they present the audio signal to the speakers, and how well they interface with the complex electrical load presented by many speakers. The latter is probably the least understood of all the factors affecting the ultimate sound in a given stereo system.

All the specifications that describe an amplifier's performance—including our own—are laboratory measurements made with standard purely resistive loads. These measurements provide relative benchmarks, but do not fully predict an amplifier's performance with any particular speaker system.

The importance of high current.

The standard 8-ohm impedance at which an amplifier's output power is normally referenced may not even be close to the actual moment-by-moment impedance presented by a given speaker under typical operating conditions. That is, with a music signal driving a speaker.

A speaker with a nominal rating of 8 ohms can actually present the amplifier with a load anywhere from almost 60 ohms to less than 2 ohms, depending on the frequencies it is handling at any given moment.

But even when operating well within normal limits, an amplifier's output circuit interacts with the speaker's impedance variations to affect, for better or worse, how the music sounds.

As speaker impedance falls, increased current is drawn from the amplifier output stage. In fact, many amplifiers, when pushed to very high levels and very low impedances, reach a point where their protection circuitry had better shut them off . . . or their output transistors will self-destruct.

Which brings us to Adcom.

Despite their affordable prices, Adcom's amplifiers were conceived and designed to be compared with "esoteric" price-no-object amplifiers.

The flagship of this new generation is the GFA-555. Throughout its development, we subjected it to comparative blind listening tests against highly-regarded amplifiers priced up to nine times higher.

Although some listeners reported hearing subtle differences among all the amplifiers, none heard anything to suggest that the Adcom amplifier was priced much lower than the others.

When a production model of the GFA-555 was tested by Stereophile magazine (Vol. 8, No. 4), the results were even more gratifying:

"It is so clearly superior to past amplifiers in the low- to mid-priced range—not to mention most amplifiers two to three times its price—that I can unhesitatingly recommend it for even the most demanding high-end system.

". . . it rivals any transistor power amplifier in its price class that I have heard—including high-powered receivers or amps with trick power supplies—at any price."

Why Adcom amplifiers sound better than those more expensive amplifiers.

High current output stage.

The GFA-555, GFA-545 and GFA-535 all use multiple high-current discrete output transistors, each capable of handling large amounts of current. In the GFA-555, for example, 16 such devices are used, providing a capability of more than 20 amperes into low impedance loads.

The GFA-545 and GFA-535 use 12 and 8 of these devices, respectively, and achieve high levels of current capability that few amplifiers with comparable power claims have been able to deliver up to now.

Transient capability—which differentiates the demands of music from conventional test procedures—is greater than 800 watts into 2-ohm loads with the GFA-555. The GFA-545 and GFA-535 also produce considerably more dynamic power than their continuous power measurements would suggest. And the continuous power is always there whenever you need it, not just for milliseconds. All Adcom amplifiers are designed to remain stable, without glitches or oscillation, under virtually any operating condition.

No matter how complex a load it presents, no speaker made yesterday, today—or probably even tomorrow—should be a problem for Adcom amplifiers.

Well-regulated, high-current power supplies.

Adcom amplifiers use custom-designed transformers that provide especially tight regulation and a minimum of interchannel crosstalk, vibration, hum, or noise. The GFA-555 and GFA-545 use expensive toroidal transformers, which are noted for their higher performance capability. The GFA-535 uses two transformers, one for each channel, in order to provide some of the benefits of toroidals without the additional cost.

The power supply in all three models is designed with separate rectifier bridges and specially-designed filter storage capacitors. The GFA-555 has a total capacitance of 60,000 microfarads, the GFA-545, 40,000, the GFA-535, 27,200. This high capacity provides tremendous reserves for high dynamic power demands. (As an informal but impressive way of experiencing these reserves, you can unplug the AC line cord of an Adcom amplifier while your system is operating, and the music will probably continue for several seconds.)

This rugged, efficient and stable power supply is extremely important, and is largely responsible for maintaining low distortion down to very

low frequencies—and for performance that remains relatively unaffected by fluctuations in AC line voltages.

No current-limiting protective circuitry.

The only protection needed against short-term overloads is power-supply fusing.

To protect against long-term overloads that can cause overheating, a thermal circuit breaker shuts down the amplifier when the heat-sink temperature reaches 75 degrees C. When the temperature drops, normal operation resumes automatically.

Advantages of direct coupling.

Coupling capacitors can be responsible for a variety of subtle signal distortions. Some manufacturers minimize the problem by using special and expensive capacitors. By direct coupling of the input and output of the circuitry, Adcom eliminates the need for such capacitors, and thus eliminates the problem at the source.

No protective output coil.

Most amplifier designs have protective coils in their output circuits to prevent spurious oscillations under typical load/signal conditions. But these coils are responsible for most amplifier/speaker interface problems. They introduce frequency-response irregularities and lower damping factor.

And when the amplifier is connected to high-capacitance loads, such as electrostatic speakers and some esoteric cables, the coil resonates to produce the oscillations they are supposed to prevent.

This is another problem Adcom solved by the direct coupling of the output. The damping factor remains high at all frequencies, phase shift is kept low, and sonic performance into difficult loads—particularly electrostatics—is improved.

Simple gain path throughout.

The gain path is simple and direct, with a minimum number of components, each of high quality, from input to output. This means less waveform distortion and less phase shift. Further, Adcom power amplifiers use only discrete circuit elements rather than integrated circuits. This allows for total flexibility in selecting individual elements and calibrating them for optimum performance at every stage. Functionally, the input circuit uses a differential input transistor pair, followed by a single voltage-gain transistor. Both active elements in this stage are class-A biased, using very sophisticated double-regulated active current sources. This current supply is unaffected by variations in the power supply or signal.

This circuit design provides pure Class A operation for the input and second gain stages, resulting in low noise, low distortion and low DC offset voltages.

Instantaneous distortion alert.

The instant that any form of distortion—THD, IM, TIM, SID, etc.—exceeds 1 percent, a front-panel LED illuminates.

The highly accurate indicators are activated by unique circuitry that monitors the activity in the internal feedback loop.

Final word.

If you are looking for a new amplifier, appreciate the need for considerable power, understand the importance of high-current capability—and know great value when you hear it—you'll certainly want to compare the Adcom amplifiers to any others, at any price!

When you do, you'll hear for yourself that higher cost does not necessarily mean better performance. And like many other music lovers, you're likely to prefer any of ours purely on their own sonic terms—sight unseen and price unknown.

Anything less is a compromise.

SPECIFICATIONS:

AMPLIFIERS	GFA-555	GFA-545	GFA-535
Power output, watts/channel, continuous, both channels, 20 Hz-20 kHz, < 0.09% THD:			
8 ohms	200	100	60
4 ohms	325	150	100
Bridged, mono, 8 ohms, 20 Hz-20kHz, < 0.25% THD:	600	n/a	n. a
Bridged, mono, 4 ohms, 20 Hz-20 kHz, 0.25% THD:	850	n/a	n. a
Signal-to-noise ratio A-weighted, full output:	>106 dB	>106 dB	>105 dB
Input impedance:	22 kOhms	22 kOhms	22 kOhms
Input sensitivity: for rated output: for 1 watt:	1.85 volts 130 mV	1.3 volts 130 mV	1.0 volt 130 mV
Damping factor (20 Hz-20 kHz):	>130	>130	>130
Dynamic headroom (at 4 ohms):	2.3 dB	2.6 dB	3 dB
Voltage:	120V/60 Hz (Available in 220V/50Hz on special order)		
Dimensions:	17 x 7 3/8 x 14 1/2" D. (432mm x 187mm x 292mm D.)	17 x 5 1/2 x 12 1/2" D. (432mm x 140mm x 318mm D.)	17 x 3 1/4 x 12 1/2" D. (432mm x 83mm x 318mm D.)
Shipping weight:	35 lbs. (15.9 kg.)	27 lbs. (12.2 kg)	22 lbs. (10 kg.)
Optional rack mount adaptors:			
Black:	RM-7	RM-5	RM-3
White:	RM-7W	RM-5W	RM-3W
Silver	RM-7S	RM-5S	RM-3S

Cover photo: GFA-555 with optional RM-7 rack mount adaptors

ADCOM®

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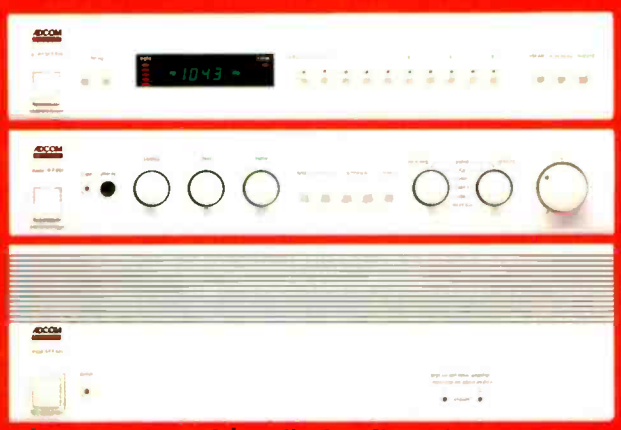


Adcom products are available with white or silver front panels on special order. Shown: GFA-545 with GFT-555 AM/FM stereo tuner and GFP-555 preamplifier with white front panels.

The CP-1's Dolby Pro-Logic surround decoder section, totally digital and with automatic correction, is the first of its kind.

...peakers; two main and two side speak-
...enter, and one rear speaker; two main,
... side speakers; two main, one center,
...ers; two main, two side, and two rear
... one center, two side, and two rear
... one center, two side, and one rear
...ain, two side, and one rear speaker.
...s made, the front-panel display shows
...ation is—i.e., "Configuration: 11, 2FR 1CT
...e CP-1 automatically responds to whatever
...n you select by changing its internal connec-
...d processing to get the best results with both the
...cted program and the actual speaker complement be-
...g used. It is very easy to make changes in the surround system, adding speakers or moving them and reconfiguring the system electronically by pushing buttons.

Modifiable parameters, primarily for the "Panorama," "Ambience," and "Reverb" programs, can be stored in the user program bank. (All of the programs also have "Set Program Name" and "Memorize Program" commands.) In the following discussion of parameters and their possible values, the factory-preset default values are shown in parentheses. In a "Panorama" program, the first push of "Param" gets "Input Balance," which has ±16 steps relative to center zero ("0"). Next are "Listener Position," with 254 steps ("127"), and then "Speaker Angle," with 12 values from 29° to 90° ("49"), which are set when calibrating the "Panorama" program. "LF Width," with unit steps from "−25" to "+25" ("0"), controls the ratio between the low-frequency information in the sum and difference channels; this varies the sense of warmth and spaciousness in the signal. "Rear Level" has unit steps from "0" to "32" ("16"). "Rear Rolloff" has 15 choices from 329 Hz to 14.1 kHz ("2.9 kHz"). "Rear Delay" has unit steps from 0 to 32 mS ("16"). Pushing "Param" until the display shows "Calibrate" puts the CP-1 into "Panorama" calibration mode. (I'll say more later about adjustments for best listening.)

The first "Ambience" parameter is "Room Shape," with "Rectangle" the default and "Fan" the other choice. "Liveness" has steps from "0" to "6" (default is "4"). "Rolloff" has 15 choices, from 329 Hz to 14.1 kHz, with 5.9, 3.6, and 2.9 kHz the defaults for "Small," "Medium," and "Large," respectively. "Panorama Eff," used for image expansion when side speakers are not used, has steps from "0" to "32" ("28"). Next are "Listener Pos," with 254 steps ("127"), and then "Speaker Angle," with 10 values from 33° to 91° ("51"). These two parameters are normally set to match the results obtained in the "Panorama" program calibration. Because of a difference in processing, the "Speaker Angle" values of "Ambience" are not exactly the same as those for "Panorama"—a minor discrepancy. The "Speech Detector" is normally on to detect monaural speech, which makes announcements with music programs sound much better; it can be switched off, if desired.

The first adjustable parameter for "Reverb" programs is "Mid RT," which stands for midrange (mid-frequency) reverberation time. Default values are 0.46, 0.92, and 2.16 S for "Small," "Medium," and "Large," respectively. Each range has 10 values, from 0.32 to 2.8, 0.64 to 5.6, and 1.28 to 11.2 S for "Small," "Medium," and "Large," respectively. "Bass RT" is the low-frequency reverberation time; its values are in terms of ratios to "Mid RT." The choices for all three room sizes are "0.7," "Equals," and "1.25." The default values are "Equals" for "Small" and "1.25" for the other two room sizes. "Treble" is the roll-off parameter, with a range of 329 Hz to 14.1 kHz; defaults are 5.9, 4.2, and 3.6 kHz for "Small," "Medium," and "Large," respectively. "Panorama Eff" has unit steps from "0" to "32"; default is "0" with side speakers and "28" without. "Listener Pos" and "Speaker Angle" are the same as for "Ambience" programs. "Predelay," with 8-mS steps from "0" to "120 mS" ("0 mS"), delays the start of reverberation, making the hall seem larger.

The only adjustable parameter for the "Surround" program's "Mono" setting is "Treble," which has a 2.3-kHz default and a range of 329 Hz to 14.1 kHz. The first two parameters for "Stereo" are "Front Effect" and "Rear Effect," which both have defaults of "8" and a range of "0" to "16." The settings determine the amount of signal steering, with higher values for more steering. "Rear Rolloff" has a default of 14.1 kHz and the standard range of 329 Hz to 14.1 kHz, plus an "Automatic" mode. In this mode, the rear channels are rolled off above 7 kHz, until the logic steers a sound effect to the rear channels, at which point the bandwidth opens up to beyond 15 kHz. "Bass Blend" takes low-bass energy from the center and shifts it to the main left and right speakers. The range is from "0" to "16" ("0").

The next "Stereo" parameter, "Auto Azimuth/Bal," is normally off, as it should be for music. When turned on for movies, it will automatically adjust the level and time offset of the two incoming channels, eliminating the need for an input-balance control for Dolby-encoded material. "Rear Delay" has a range of "0" to "32 mS" ("8 mS"), with 2-mS steps. "Rear Noise Chip" is normally off, which is best for music; it is turned on to get the special Dolby B NR used in Dolby Surround. "Calibrate" is used to check and adjust channel levels in multi-speaker systems and is *not* the same mode as "Calibrate" in the "Panorama" program. (The "Surround" program "Calibrate" will be discussed later.) The first Pro-Logic parameter is "Rear Delay," which has a range of "16" to "32 mS" ("20 mS"). Other parameters for Pro-Logic that are the same as "Stereo" are "Calibrate" and, except for defaults, "Auto Azimuth/Bal" ("On") and "Bass Blend" ("6").

Below the program and parameter sections on the remote control are the two rows of level controls. The far-left column has the "Effect" up and down buttons. Next are the "Balance" "F" (front) and "B" (back) buttons and the "R" (right) and "L" (left) buttons. The "Volume" up and down buttons are in the far-right column. A little arrow next to each level button minimizes confusion. The display of effects levels has figures from "1" to "63" for "Panorama" programs and "−64" to "−00 dB" for other programs. The horizontal bargraph-type display conveys the effective level immediately. Front/back and left/right balances are indicated with a left/right shifting bar. "Volume," which controls all channel levels simultaneously, goes from "−64" to "−00 dB." In the remote's last row are buttons to mute the entire system or the effects channels alone.

The front-panel LCD display always presents information in an easily understood form. The current program selection

Judging spatial effects is easiest from the listening position, so the CP-1's programs are selected and varied from its remote.

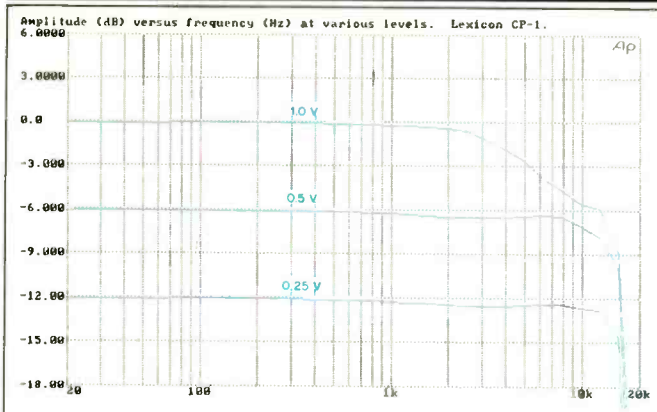


Fig. 1—Frequency response of side channel at several input levels; see text.

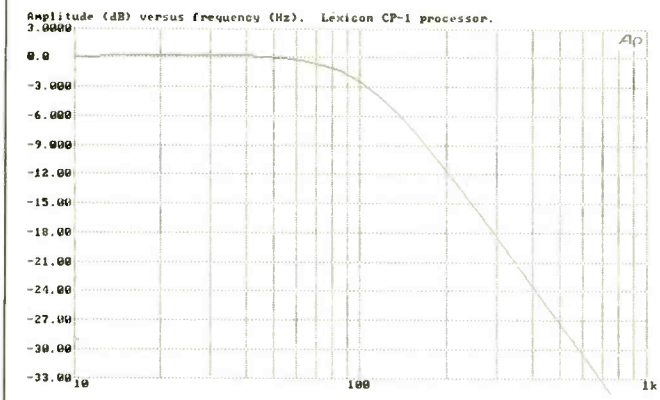


Fig. 2—Frequency response of subwoofer channel.

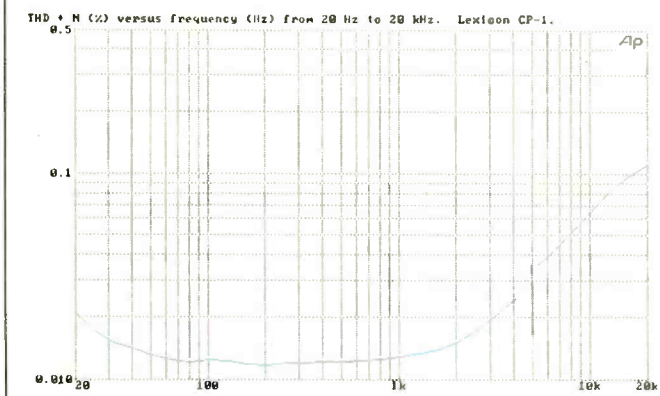


Fig. 3—THD + N at 3 V out; right main channel is shown.

is continuously shown, except when paramet
rameter values are being changed. Non-progra
tion is normally displayed for 5 S after the last ins

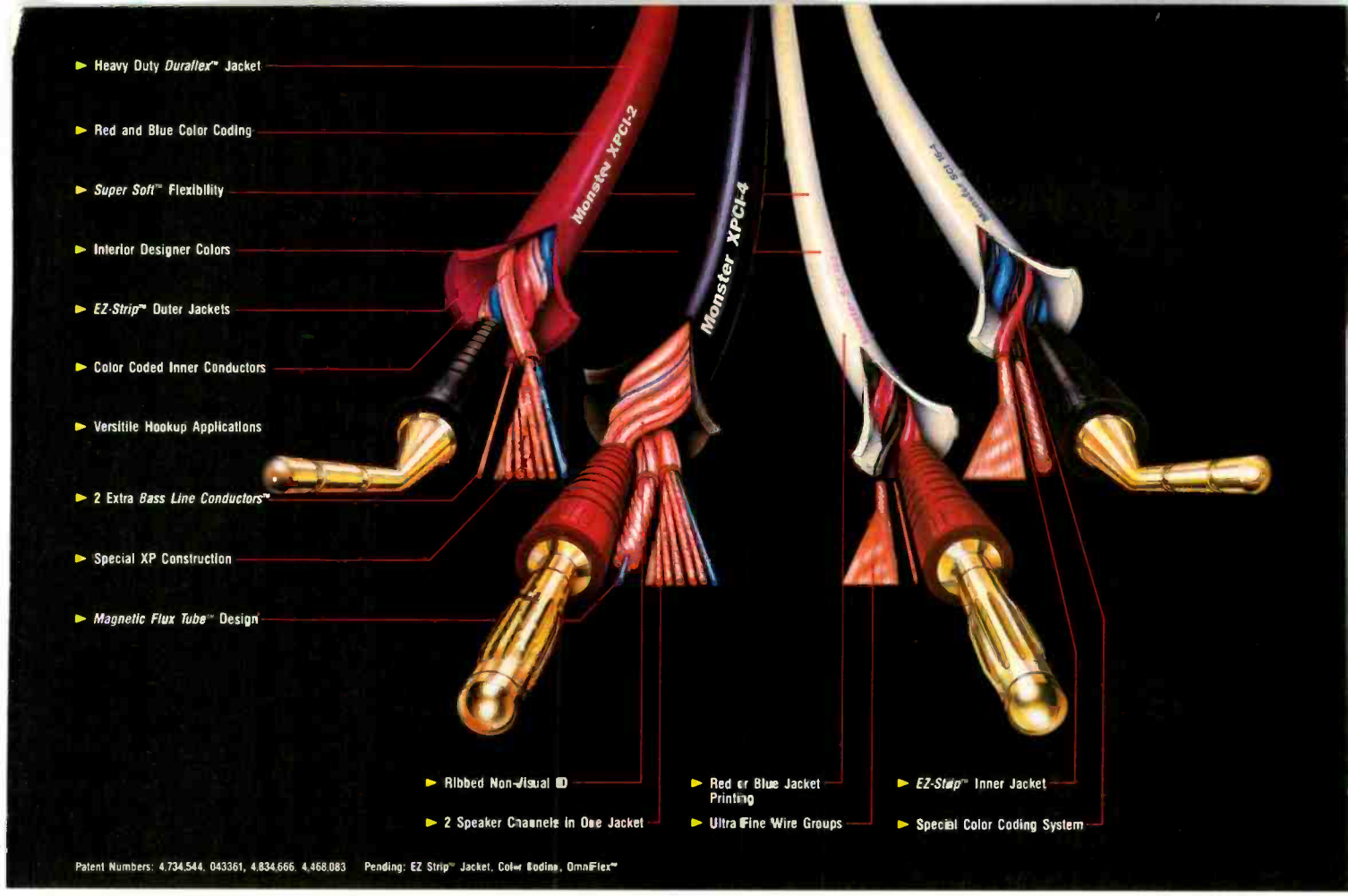
I noted some items of good protocol while u
remote. Parameters with on/off functions are turned
its "Param" up button and off with its down button. Th
parameter checked or changed can be shifted immed
with a push of the up or down button, without pus
"Param" first. The white labels on the remote control a
very easy to read against the black background.

Measurements

Let me first point out that all measurements were made after the listening and viewing. With the aid of the CP-1 service manual, I was able to defeat the normal processing so I could make instrument tests. The CP-1 was set, with the input pot, for close to maximum level (red LEDs just off) for an input of 316 mV. The main-channel response was down 0.09 dB at 20 Hz, 0.04 dB at 20 kHz, and 3 dB at 3.0 Hz and 140 kHz. The input voltage was increased to 1 V, and the pot was turned down until the red LEDs just turned off. The side-channel responses were then taken in "Surround" Pro-Logic, at input voltages of 1.0, 0.5, and 0.25 V. The reference level (0 dB) in Fig. 1 was the output voltage at 1 kHz with the 1 V input. The response at this maximum input level has a high-frequency roll-off which is less significant than it first appears. The test signal was a stepped sine wave, and the test-signal level above 2 kHz was much higher than spectral levels of music would be for the same frequencies at the same overall input level. The responses at lower, normal levels were close to 0 dB down at 20 Hz and less than 3 dB down at 16 kHz, showing agreement with specifications. The subwoofer-channel response curve is shown in Fig. 2. The roll-off above 100 Hz is at 12 dB per octave.

With the pot settings used for the listening tests, the S/N ratio was 100.5 dBA for the main channels, relative to 1 V in and out. The S/N ratios (re: 1 V in and out) for the side and rear channels, respectively, were 113.7 and 85.1 dBA for the "Panorama" program's "Wide" setting, 85.3 and 95.8 dBA for the "Ambience" program's "Medium" setting, 89.6 and 90.7 dBA for the "Reverb" program's "Medium" setting, and 82.2 and 80.6 dBA for the "Surround" program's "Stereo" setting. Overall, these figures are very good, to say the least; with the specified 3.5-V reference level, all of these figures would be 10.9 dBA higher. Figure 3 shows THD + N, across the band, for the right main channel at 3 V output. The results are typical for any of the channels, with very low distortion over most of the band.

The input sensitivity was 270 mV for maximum acceptable input level, with the input-level control at maximum, just below red-LED turn-on. The level for input clipping above the LED's turn-on varied with program selection. Waveform distortion seemed to appear with "Panorama" just about turn-on, but perhaps that was from level-sensitive processing. Input levels could be noticeably higher for other programs, but setting the control for prevention of red-LED turn-on makes sense for all programs. The maximum input level, with the control turned down, was greater than 31 V. With red-LED turn-on as the 0-dB reference, the green segments turned on at −50, −43, −37, −32, −28, −24, −19,



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The processor is easily configured for optimum results with any of twelve common speaker setups.

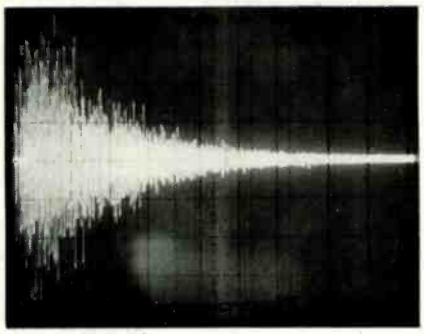

Fig. 4—Output from surround channel, in "Reverb" program's "Large" mode, for a 1-mS burst (one cycle) of a 1-kHz sine wave. Note the smooth decay; see text. (Horizontal scale: 0.2 S/div.)

−15.4, −11.2, −7.3, and −3.3 dB. The level range of the meter is certainly wide, which is good, but smaller steps at the top would be of some help. The red LED turned on with a 1-mS, 5-kHz tone burst at a continuous level 1 dB above indicator turn-on. The LED indicating −19 dB turned off 245 mS after the signal stopped—a shorter decay time than a peak-detecting meter should have. The Lexicon's meter will detect very short peaks, so the user should respond to any red flashing by reducing level. The output level for clipping was at least 4.7 V.

Figure 4 shows the output from a surround channel in the preset "Reverb" program's "Large" mode, with a single-cycle, 1-kHz burst. The smooth decay can be observed over the 2-S sweep of the oscilloscope, which is very close to the 2.16-S "Mid RT" default. The output polarity was the same as the input in the main channels. The main-channel output level was the same as the input level when the preset "Reverb" program was in "Medium," with the input level set for red-LED turn-on, the back-panel trim at maximum, and the main volume control at −11 dB. This relationship varied from program to program. The input impedance was 41 kilohms. The output impedance was 490 to 500 ohms for the various channels.

The two sections of the input-level pot tracked within 1 dB from wide open down to −47 dB. The master volume control's sections tracked within fractions of a dB for 55 dB. Each of the level steps were within ±0.03 dB of the indicated 1 dB. With a monaural input, left and right rear channels were down 25 and 27.5 dB, respectively, in the "Surround" program's "Stereo" mode and greater than 31 and 45 dB, respectively, in Pro-Logic mode. The delay adjustment range was from 0 to 32 mS. Each of the 2-mS steps was accurate within ±0.2 mS. The residue of the 33-kHz sampling frequency was down over 96 dB in the main outputs. The spectrum of the calibration noise used for channel balancing was centered at 800 Hz, with roll-offs at 400 Hz and 1.6 kHz.

Use and Listening Tests

The reference processor for the listening and viewing tests was the Yamaha DSP-1. A Yamaha AVC-50 amp was used for switching among the various sources: A Yamaha TX-900U AM/FM tuner, a Magnavox 1041 CD player, a Sanyo VCR-7200 Beta VCR, an Akai VS-555U VHS VCR, and a Yamaha LV-X1 videodisc player. For power amplification, I used the second section of the AVC-50 for the main stereo channels, a JBL/UREI 6210 for the center channel, and a Yamaha M-35 four-channel amp for the side and rear channels.

The speakers were two JBL 4301s (main stereo), a JBL 4408 (center), a self-powered Triad Design HSW-300 (subwoofer), and four Dynaco A-25s (surround). The Akai VS-555U VCR was used as the stereo TV decoder. I connected a two-channel oscilloscope across the left and right inputs and operated it in X/Y mode to show the existence or lack of stereo and surround information on the incoming signal. Figure 5 shows the arrangement of the system for evaluating the CP-1. The processor's subwoofer output was not used, as my subwoofer is designed to be connected across the main speakers. Two listener positions are shown because I moved back and forth, depending on the program selected and the speaker configuration used.

The owner's manual provides much useful information in a friendly page format with lucid text and well-done illustrations. Many pertinent comments throughout help the user to operate the unit and to understand what happens. The instructions on channel balancing and calibration of the "Panorama" program are well written. The sections on speaker setup and configuration and on programs and parameters are particularly good—the manuals for too many surround-sound units do not provide the detailed guidance needed. A 16-page section on theory and design is a good tutorial on certain aspects of concert halls, the design of the CP-1 programs, and how to get the most out of them. Lexicon also supplies a handy, single-sheet reference guide on stiff paper.

When setting up the CP-1, I first adjusted the contrast of its front-panel display for easiest viewing from my main listening position. Then, I moved around with the remote control to check its range. Up close, commands were received up to ±150° off axis horizontally and up to at least ±30° vertically. Control response was reliable out to ±45° at 25 feet and to greater than 30 feet on axis. I tried "Panorama" with just the center and front speakers (configuration 2) and was impressed by the spread possible in this mode. The calibration process worked well, and I found the specific parameters for my listening area quite speedily. I used the default "127" for the listener-position setting, but I preferred a speaker angle of 55° over the default "49." I did find that the best results in "Panorama" were secured with a listening position closer to the main speakers than for the other programs, particularly if the side speakers were off. The "sweet spot" did require sitting in the exact center: It was quite amazing to hear substantially nothing in the right ear with the "Calibrate Left Only" signal.

During the majority of the listening, I used two speaker configurations: Two front, two rear, and one center, and with two side speakers added. I checked all of the speaker

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With its high standard of build quality, superbly clean and dynamic sound, the Monitor 9 is a loudspeaker which, for $499 can rightly be said to offer amazing value for money. Do yourself the favour of not overlooking these speakers if you've got around $499 to spend."

Hi-Fi Review

MONITOR 11

"Listening to these, I could discern everything that was happening, follow all the instrument lines, hear the sound in full focus. Tiny transients emerged that I've never heard before, such was the clarity with which the Monitors conveyed the signals the front end was producing.....They uncover all the detail, but in a transparent way which involves and excites the listener. You hear all the components of the music, but the music is not dismantled. The flow, the timing, the continuity, all these remain intact."

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MONITOR 14

"A compact floor standing loadspeaker using high grade drive units.....
A sophisticated and good looking enclosure that is capable of an exceptional performance....
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Audiophile

MA700 GOLD

"..when I closed my eyes I could picture the musicians and their performance. When the beat needed to be lively, it was. When things shifted down a gear, the 700s responded in kind. My toes tapped, hand slapped against knee, and I was held in my chair, engrossed, as the tracks progressed."

Hi-Fi Review

MA852 GOLD

"The MA852 Gold showed itself to be an infussy loadspeaker capable of handling anything from unaccompanied female voice....to club reggae, from Cajun to classical."

Hi-Fi Review

MA952 GOLD

"The MA952 Gold are undoubtedly fine all-rounders; they will stand high power levels on disco material.-.....their good tonal balance and freedom from box colourations stands them In good stead on classical recordings."

Hi-Fi News & Record Review

* Official "Recommended Component" status in Stereophile.

MA1200 GOLD

"Piano had the right balance of weight and clarity, while guitar was especially well reproduced, with almost electrostatic speed and fluency. The transient response of this speaker is as good as I have ever heard from a cone reproducer, attesting to the achievement of the design goals in the gold anodized tweeter.

Female and male voice both had a very natural character, while choral voices showed not only the clarity of inner vocal lines, but an exceptional spatiality, the image floating, and the depth palpable. There is a combination of overall coherence and detail that is very unusual in any but the most expensive speakers; in other words, with this speaker you get the whole picture in perspective, as well as all the parts clearly portrayed."

Audio Ideas Guide

MA1800 GOLD

"The R1800/Gold is, I would say, worthy of heading the Monitor Audio Reference series, a sequence of designs which has audibly gone from strength to strength as it has progressed. It is an eminently listenable loadspeaker whose impressive power handling ability leaves one in no doubt at all as to its potential (there is a quality about a reserve of power handling in loudspeakers which seems to manifest itself in terms of greater transperancy even at modest listening levels). It is also beautifully styled and finished and should look relatively unobtrusive in the room, even recommended in the sensibly written booklet. Confidently recommended."

Gramophone

STUDIO 10

"The Monitor Audio Studio 10s, came out of their box, were placed on (initially non-dedicated) stands, and from the off, sounded great. I was stunned.....this was above all an *involving* speaker. The sound was very full and rounded. More importantly, it was enjoyable."

Hi-Fi Review

"...the MA's ability to project a convincing image is stunning—to say the least. Again, speaker stands are important. Set up in the manner we described, the Studio 10s transcend their existence and project a first-rate sound-stage to listeners. Focal points are correct, instrumental and vocal placements are unwavering and the illusion of a live performance is fulfilled.

To sum it all up, lets say that the Studio 10s are worthy contenders for a high-end system."

The Inner Ear Report

"I found listening to this design to be an exhilarating experience bardering on intoxicating at times, and one that didn't pull."

Hi-Fi Review

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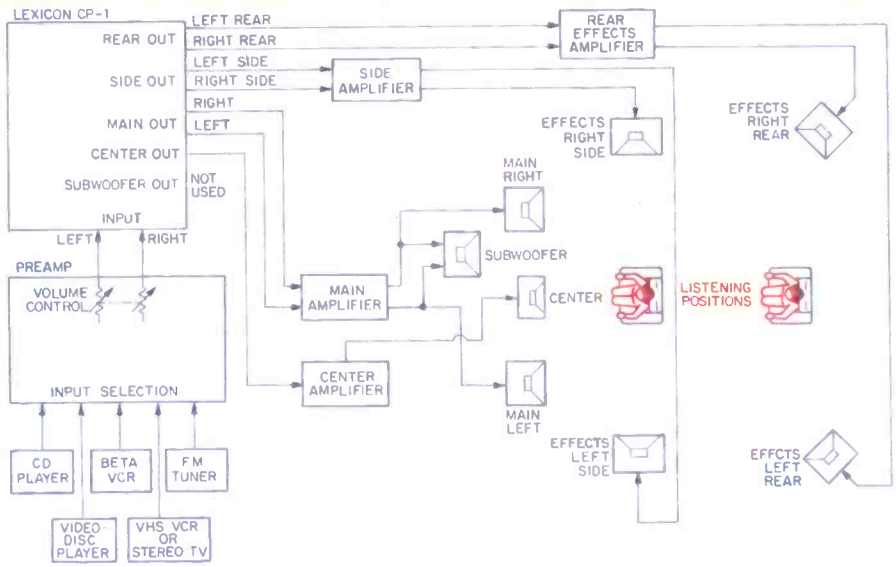

Fig. 5—Listening setup used in evaluating the Lexicon CP-1. Two listener positions were used; see text.

levels by using the calibration mode of "Surround" Pro-Logic. It was very easy to trim the levels with the back-panel trim pots as the shaped-noise signal stepped from speaker to speaker. Then I ran through all of the programs to review the effects of varying the parameters. I changed a number of values and stored all of the modified programs in the user memories.

Television

The first source I tried was television, with *Tour of Duty*, the CBS series, received in mono on the channel I used. "Surround" in "Mono" was the only acceptable program, made better with some reduction in effects level. Dialog centering was good, without any of the spread or diffusion that occurs with systems lacking center speakers. The results were similar on *Dance with a Stranger*, a movie on the Arts & Entertainment channel featuring Miranda Richardson and Rupert Everett. In both of these cases, effects were well handled, and I found some benefit in adding some voice-presence EQ.

Fine Romance (ABC), *48 Hours* (CBS), and *Different World* (NBC) all showed stereo on applause and effects but with all the dialog monaural and right in the center. I preferred "Panorama" in "Normal" and "Wide" when I was in the close listening position and "Surround" in "Stereo" and Dolby Pro-Logic when sitting in the regular position. The oscilloscope monitor showed that some television programs which turned on the stereo TV's detector had no stereo information, real or synthesized.

Videocassettes and Videodiscs

The videocassette of *Bull Durham*, the Orion film with Kevin Costner and Susan Sarandon, had a more pointed dialog sound with "Stereo," but Pro-Logic delivered a better voice quality and a superior sound quality overall. The steering of off-screen sound was very good, and the importance of the center speaker for dialog was demonstrated again and again. The videodisc of MCA Home Video's **batteries not included*, with Hume Cronyn and Jessica Tandy, was very satisfying with Dolby Pro-Logic. This program was definitely the best, with a combination of stable dialog centering and good spread of the effects, particularly when the little spaceships were zipping around. This movie had good changes in voice presence to go with the action in each scene.

Runaway Train, an MGM/UA Home Video videodisc with Jon Voight, Eric Roberts, and Rebecca DeMornay, was very good with both speaker configurations mentioned above. Many effects were very well positioned: The crowd during the boxing match, the panning of the sound of the passing train, the fast change in scene and sound localization when the runaway train hits the caboose, and the creative positioning of music. Yelling, off screen and to the left at the start of the movie, was well localized. Occasional effects actually seemed too far right or left with either speaker setup. The distraction was very minor and very much outweighed by all the evidence of good steering. Pro-Logic was the preferred program, but "Stereo" was more exciting with some scenes, including a few with the runaway locomotive. The subwoofer helped to give a solid bottom to the sound.

Star Trek IV, a Paramount Pictures videodisc with William Shatner, Leonard Nimoy, and DeForest Kelley, also benefited from the subwoofer. The whale rescue had good surround, as did a number of other scenes. "Stereo" was the better mode for this movie; Pro-Logic seemed to be more echoey. More and more, I came to the conclusion that the excessive liveness was a property of the soundtrack on the disc. Then I tried a Pioneer laser videodisc of Carole King, *One to One*. The amount of good surround information varied from track to track. The user versions of "Ambience" in "Small" and of "Surround" in "Stereo" gave the best

The CP-1 is the first unit I've reviewed that creates both good hall illusions for music and well-steered movie surround and dialog.

results overall, but for some of the tracks, I liked the preset "Panorama" in "Wide" better.

Compact Discs

The first CD I tried was Mozart's *Sinfonia Concertante, K. 364*, with Iona Brown and the Academy of St. Martin-in-the-Fields (Argo 411613-2-ZH). The user "Ambience" in "Small" or "Medium" gave me the best illusion of the hall sound I wanted. "Ambience" in "Large" was not good, but "Reverb" in "Small" and "Panorama" in "Normal" were possibilities that others might prefer. High-level trumpet notes showed some obvious modulation distortion in *The Extraordinary Roger Voisin: The Baroque Trumpet*, with the Kapp Sinfonietta (MCA Classics MCAD2-9807). The improvement over regular stereo was still very obvious with the preset "Panorama" in "Normal" and "Ambience" in "Medium." "Ambience" in "Small" was the best of my user-modified programs.

Debussy's *La Mer*, with Slatkin and the St. Louis Symphony Orchestra (Telarc CD-80071), was particularly appealing during the early, quiet parts with "Panorama" in "Normal." In later parts, I favored the illusion generated with "Ambience" in "Large" or with "Reverb" in "Medium." For Tchaikovsky's *Capriccio Italien*, performed by Kunzel and the Cincinnati Symphony Orchestra (Telarc CD-80041), it was a toss-up between "Panorama" in "Normal" and "Ambience" in "Large." "Reverb" in "Medium" provided a fairly good illusion, but "Reverb" in "Large" was unacceptable—more so in the user version. *The Music of Waldteufel*, with Kunzel and the Cincinnati Pops Orchestra (MMG MCD-10025), was much the best with "Panorama" in "Normal." A few spots with the bass drum were particularly realistic with this program. "Ambience" in "Small" was good for its tone color, and the other "Ambience" programs were also satisfactory choices.

The Fauré *Requiem*, with Shaw and the Atlanta Symphony Orchestra and Chorus (Telarc CD-80135), had a lovely, detailed sound quality with "Panorama" in "Normal," but I preferred the more large-church sound of "Ambience" in "Medium" and all the "Reverb" programs. In the "Sanctus" and "Agnus Dei" sections in particular, I felt "Reverb" in "Large" was best of all, with "Medium" my second choice. "Reverb" in "Small" was rated just below "Ambience" in "Medium." Mozart's *Opera Arias*, with Te Kanawa, Davis, and the London Symphony Orchestra (Philips 411148-2PH), sounded better with the preset programs than it did with my versions. "Ambience" in "Small" and "Panorama" in "Normal" were the best, according to my ears, and "Ambience" in "Medium" and "Panorama" in "Wide" were the only others I liked for some pieces. I found it interesting that I also preferred the same basic programs for much of Puccini's *Tosca*, with Milanov, Bjoerling, Warren, Leinsdorf, and the Rome Opera House Orchestra and Chorus (RCA 4514-2-RG). With the opera, however, the user versions created better illusions for most of the scenes, and "Ambience" in "Small" was the best overall.

Beethoven's *Piano Trio No. 11*, with the Beaux Arts Trio (Philips 420231-2PH), immediately seemed to be a good match for "Ambience" in "Medium," with the preset program the better one. This was very satisfying listening, and as I have heard the Beaux Arts Trio almost every year over a period of 30 years, I have very definite ideas on what they and the hall should sound like. For a different piano style, to say the least, I listened to *The Joint Is Jumpin'*, with Fats Waller (Bluebird 6288-2-RB). Preset "Panorama" in "Normal" and "Ambience" in "Small" were pretty good, but user "Surround" in "Stereo" was the best for this CD, which had very little stereo information on any track. I was surprised by the amount of the improvement, considering the age of the original source material.

Air Supply's *Love & Other Bruises* (Columbia CK-35047) was a good match for "Panorama" in "Wide," both the preset and user programs. Infrequently, the spread was almost too wide with these programs. "Surround" in "Stereo" and Dolby Pro-Logic weren't as good as the "Panorama" programs overall, but they had a larger good-listening area. Preset "Panorama" in "Normal" and "Wide" were both good choices for the "Italian Concerto Presto" track of Don Dorsey's *Bachbusters* (Telarc CD-80123). They weren't pleasurable earlier, however, and overall, I liked user "Ambience" in "Small" for most of the tracks. The Police's *Synchronicity* (A&M CD-3735) was very good with both preset and user "Panorama" in "Normal" and "Wide," as long as I stayed right in the center. "Ambience" in "Small" was the best choice for a larger listening area.

Conclusion

A great deal of pleasurable listening was obtained with the smooth surround sound from the Lexicon CP-1. I did not detect any limitations I would ascribe to the 33-kHz sampling rate or the related 16-kHz roll-off in the surround channels. The "Panorama" programs are different from those available from stored-measurement-type processors such as my Yamaha DSP-1 reference unit. The "Panorama" programs can provide a class of very satisfying sound fields—even with just two speakers—that are not even possible with other processors. The ease with which the internal operation of the CP-1 can be changed to match any of 12 speaker configurations is unique and could be a very important feature for some users. The CP-1 is the first unit I have reviewed that provides good performance-hall illusions with music and also delivers well-steered surround sound and properly localized dialog with movies. (I should note that I did not evaluate the Yamaha DSP-1 or DSP-3000 with the DSR-100 Pro decoder for Dolby Pro-Logic.)

The CP-1 almost always delivered a nice-sounding illusion, even if it wasn't exactly what I envisioned before selection. From one choice to another, the sound character did not usually change as noticeably as it did with the DSP-1. However, other listeners, using different parameter settings, might not agree. Whatever high-performance surround processor is evaluated by the potential buyer, the demonstration arrangement should correlate to the particular design of the unit. The Lexicon CP-1 performs best with side loudspeakers, but it can be set up for operation in a home listening space that might not accept this configuration. Its limitations are minor, and its price is quite reasonable for its features and performance quality. For music *and* movies, the Lexicon CP-1 is worthy of comparison to any other units currently on the market. *Howard A. Roberson*

SSI SYSTEM 4000 II DOLBY SURROUND DECODER

Manufacturer's Specifications

Separation: Front center to surround, 65 dB; left to right, 35 dB.

Frequency Response: Front channels, 18 Hz to 50 kHz, +0.5, −0 dB; surround channels in "Music" mode, 18 Hz to 50 kHz, +0.5, −0 dB; surround channels in "Dolby" mode, per Dolby Surround specifications, +0.5, −0 dB.

Distortion: Front channels, 0.03%; surround channels, 0.25%.

A-Weighted Output Noise: Front channels, −85 dB at 1 V rms; surround channels in "Music" mode, −75 dB at 1 V rms; surround channels in "Dolby" mode, −68 dB at 1 V rms.

Dynamic Logic Steering Factor: −3.

Delay Range: 10 to 30 mS, adjustable.

Input Balance Range: 0 to 6 dB of correction.

Input Impedance: Audio, 47 kilohms; video, 75 ohms.

Power Amplifier Output: 45 watts total continuous power into 8 ohms.

Power Requirements: 120 V a.c., 60 Hz, 120 watts.

Dimensions: 17 in. W × 3¼ in. H × 13 in. D (43.2 cm × 8.3 cm × 33 cm).

Weight: 14.2 lbs. (6.5 kg).

Price: $549.

Company Address: 400 South Date Ave., Alhambra, Cal. 91803.

The SSI System 4000 II decoder is somewhat larger than some processors, but it includes a two-channel power amplifier for driving the surround speakers. Its five operating modes are "Dynamic Logic," "Dolby" Surround, "Music," monaural enhancement, and bypass. SSI's exclusive Dynamic Logic steering circuit keeps residual sound in each channel to prevent sonic voids that can appear in other steering systems. Three modes of center-channel operation give the user flexibility in matching the surround to his particular listening environment. The switching arrangement and jacks provide for playing or dubbing up to four audio or audio/video sources. Delay times range from 10 to 30 mS in 5-mS steps, usable with "Dynamic Logic," "Dolby" Surround, and monaural enhancement modes. The front panel includes front/rear balance and up/down volume controls. The remote control handles these as well as many other useful functions.

Control Layout

The large, rectangular "Power" button is at the lower left of the front panel, just below the remote control sensor. To the right are the "Balance," "Null," and "Amp" controls, each having a relatively small knob with excellent knurling. The multiple detents of "Balance" and "Amp" give a feel somewhat like that of a professional attenuator, but I would prefer the finer resolution available without detents. "Balance" controls the relative output levels of the built-in two-channel amplifier, "Null" is the input balance pot for Dolby Surround, and "Amp" is the volume control for the built-in amplifier. Located at the extremes of rotation are "L" and "R" for the "Balance" knob and "Min" and "Max" for the "Amp" control.

Next on the right is the "Delay" change button, with a display above it. The selected delay is shown by an LED array, with a yellow LED for 10 mS at the left, a red LED for 30 mS at the right, and three green LEDs between them. The leftmost indicator is always on in the "Dolby" Surround or "Mono Enhance" mode. Each push of "Delay" adds 5 mS and illuminates another LED; when all five are illuminated (30 mS), another push returns the delay to 10 mS. Any delay selected remains in memory when power is turned off.

The "Audio Video Selector" to the right has four buttons ("A" to "D"), each with a red indicator confirming the choice made. A green LED "Surround" indicator is above and between the "B" and "C" LEDs. The level of surround energy in an incoming signal is shown by the brightness of the indicator. Next on the right is the "Surround Mode" button, which steps the mode from "Dynamic Logic" to "Dolby" to "Music" to "Mono Enhance" to "By-pass" and finally back to "Dynamic Logic." Indicator LEDs are green for all choices except "By-pass," which has a yellow LED to remind the user that there is no processing in this mode.

At the extreme right are the "Balance" ("Front" and "Rear") and the "Volume" ("Up" and "Down") buttons. "Front" and "Up" are above the "Rear" and "Down" buttons, which seems very logical to me. Arrows above the top buttons' labels and below those of the bottom ones help convey the functions immediately. The "Balance" arrows are double, helping to differentiate them from the single arrows on the "Volume" buttons.

The labels on the panel, the labels and arrows on the buttons, and the indices on the knobs are all gold and are easily seen against the black panel over a wide range of lighting.

At the back panel's extreme left are the audio ("Left" and "Right") and video phono jack inputs. From left to right, they are "D," "C," "B," and "A," with the video jacks above the audio. Next on the right, near the bottom of the panel, is the three-position slide switch for center-channel mode. In position "1," left plus right is fed to the left, center, and right channels, spreading monaural signals across the whole frontal stage; this mode would be useful for a wide listening area. In position "2," left plus right is fed only to the center channel, putting monaural sources in the center; individual left and right signals maintain their stereo position. In "3," the center channel is off and left plus right is mixed into both the left and right channels, generating a phantom center. The numbers labelling the center-channel switch positions are farther apart than the actual positions of the switch, which leads to a little confusion when it is first used.

Next on the right are stereo phono jack pairs for "Dub Out" and "Front" (both with video output jacks above them) and for "Amp Input." There are paralleled mono output jack pairs for "Center," "Surround," and "Subwoofer."

The System 4000 II does not have a tape monitor function as such, but one of its inputs and the "Dub Out" jack can serve this purpose. The unit also provides the advantage, to some users, of switching any associated video source. The 4000 II is supplied with U-shaped wire links connecting the two "Surround" outputs to the amplifier inputs. The links can

Sibilance on a news show was caused by the station's twisting the mono signal's phase until it looked like a pretzel on my 'scope.

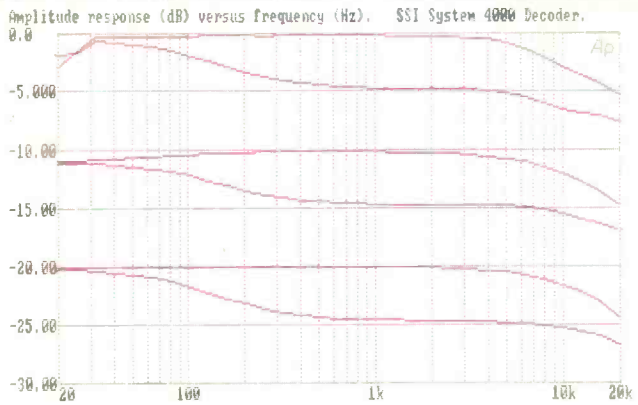

Fig. 1—Frequency response of main channel at three signal levels. The flatter curve of each pair is with the center-channel switch in position "3," while the curves that plateau at 600 Hz were made in switch position "1." See text.

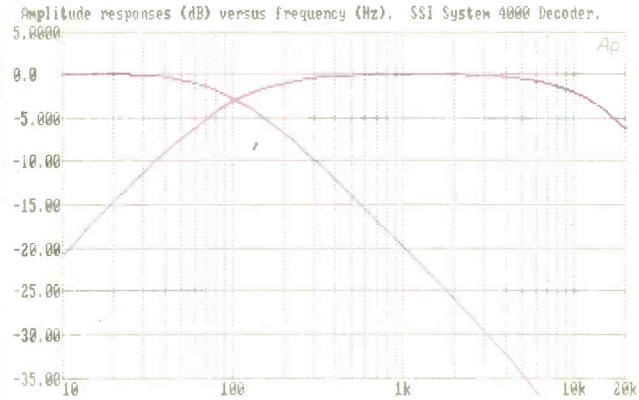

Fig. 2—Frequency response of subwoofer and center channels in switch position "1."

be moved to obtain two other configurations: Both amplifier channels driven by "Center," or one channel driven by "Center" and one by "Surround." This is a simple arrangement and well thought out by SSI. Further to the right are "Left" and "Right" spring-loaded speaker terminals. Finally, at the upper right is a post-type fuse-holder—a worthwhile convenience, in my view. The labels are white and very easy to read against the black panel.

When I took off the unit's top/side cover to examine its interior, I noted a number of impressive things: The very large heat-sinks for the power amplifier; the half-chassis-size, high-quality main p.c. board, and the many components on the board and their neat arrangement. Superior-quality components were in evidence, and all parts were labelled. Three other boards are used, for the power supply and power amplifier, the back-panel video in/out circuitry, and the circuitry behind the front panel. Soldering was excellent, for the most part, and the hand-soldered points had relatively little flux remaining. Interconnections between boards were made with multi-conductor cable and plugs. The boards were well supported, in general, but there was some springiness. The front panel could be bent back and forth rather easily, while the back panel was more rigid. (Replacing the cover did make everything much more rigid.) The large power transformer was quite warm after driving the amplifier at full power for some time. Without the power amplifier driven, the transformer remained cool to the touch.

The remote control is a convenient size to hold in one hand and operate the buttons with the thumb. "Power On/Off" is the button nearest the emitter end. Below it are the side-by-side "Mode" and "Delay" buttons. Below these are the "Balance" ("Front" and "Rear") and "Volume" ("Up" and "Down") buttons; the positioning of these four controls corresponds to their positioning on the unit's front panel. Last comes the "Mute" button—a most logical place for it to be. Except for the red "Power On/Off," all of the labels are gold, easily seen against the black background. The light gray buttons stand out clearly, even in dim light.

Measurements

All of the measurements were made after the listening and viewing. Figure 1 shows the main-channel frequency response at three different levels for two positions of the center-channel switch on the rear panel. In each case, the response where the level drops off above 20 or 30 Hz and reaches a plateau at 600 Hz is obtained with the switch in position "1," and with the same signal fed to both inputs. In this position, a left-plus-right sum signal is fed to the left, center, and right channels. When just one input channel is driven, the response is basically flat. In other words, in position "1," the bass frequencies of a monaural signal are more prominent in the left and right speakers than are the higher frequencies. The other response curves shown were obtained with position "3," in which center is off and a phantom center channel is made by feeding a left-plus-right sum signal to the left and right channels. As the level is reduced, the responses for these two switch positions become flatter at the frequency extremes. In position "2" (not shown), left plus right is fed to the center channel, and left and right individually are fed to their respective channels. The main-channel response in this position was close to the low-frequency characteristic of position "3" and the gentle, high-frequency roll-off of position "1." In position "2," the response was down 0.29 dB at 20 Hz and −1.9 dB at 20 kHz. The −3 dB points were at 4.4 Hz and 25 kHz. At the frequency extremes, all of the responses show some effects of the level-sensing circuitry.

Figure 2 shows the subwoofer and center-channel responses. The subwoofer roll-off above 100 Hz is at 6 dB/octave. In switch position "1," the center-channel response is rolled off below 100 Hz at 6 dB/octave. The response

The SSI decoder was totally reliable throughout my tests. Changing settings was a snap, and the remote control was easy to use.

crossover was 2.8 dB down, very close to the −3 dB (half-power) point. In this position, the main speakers are boosted in the bass region, relatively speaking, as was shown in Fig. 1. With the switch in position "2," the response would be close to that of the main channels for this switch position. The center channel is off in position "3."

Figure 3 shows frequency response of the surround channels in "Dolby" and "Music" modes, with those for "Music" obviously flatter than those in "Dolby." The "Dolby" mode responses are in basic agreement with Dolby Surround standards.

The output in the surround channels in "Dynamic Logic," with a mono input (Fig. 4), was measured with the "Null" control in three different positions. The top curve was obtained with the null control to one extreme, the middle curve resulted when the knob was centered at 12 o'clock, and the bottom curve was run after trimming the knob position (to about 12:15) for more separation. Both of the latter two curves are excellent, and it was possible to get even better separation (more than 70 dB) by very careful trimming. The signal-to-noise ratio, in "Dynamic Logic" mode with a 1-V reference, was 91.0 dBA for the main channels and 81.2 dBA for the surround channels.

Figure 5 shows THD + N across the band for the main channels at 2 V input and output. The higher THD + N curve was obtained with the center-channel switch in position "1." The output in this position was 2 V at only the lowest frequencies, before the response roll-off shown in Fig. 1. The bottom curve was made in position "3." These results are quite acceptable but not overly impressive. The maximum input level before waveform distortion began to appear at the main outputs was 2.8 V with both inputs driven. The main outputs did not clip at any setting of the master volume control up to maximum. At the point where the front and rear output levels were equal, the level in each channel was about 9 dB below its maximum. A little checking revealed that waveform distortion appeared in the main outputs only when there was clipping in the surround outputs. An input level of 1.0 V at 1 kHz was the maximum that would ensure against any type of waveform distortion in the surround outputs in any surround mode. This somewhat low maximum might be limiting in particular cases, but I did not hear any distortion I would attribute to it. In "Music" surround mode, the input level could be at least 3 V without any waveform distortion.

The input impedance was 18.2 kilohms. The main channels' output impedance was a nice, low 510 ohms. Output polarity was reversed in the main and center channels. As Fig. 6 shows, distortion in the amplifier's output, at the 20-watt power level, was low over most of the frequency range but rose at higher frequencies.

The main channel's input-to-output level change in "Bypass" mode was +1.1 dB on both channels with the master volume control at maximum. The master volume control covered a range of 56 dB in 31 steps, and its sections tracked within a fraction of a decibel over that entire range. The first steps from zero attenuation averaged about 1 dB each, increasing to about 2 dB each by −9 dB. If the "Down" volume button was held in, it took 5 S to cover the attenuation range from 0 to 56 dB (which is also the muting level). The "Front/Rear" balance control operated over 15 steps, to yield a maximum attenuation of 19 dB at either front or rear. The number of decibels per step varied with the setting of the volume control, which had to be at least 11 dB below its maximum setting for the full balance range to be available. The Dolby Surround input balance control ("Null") could reduce the level of either channel up to 6.7 dB from the center position.

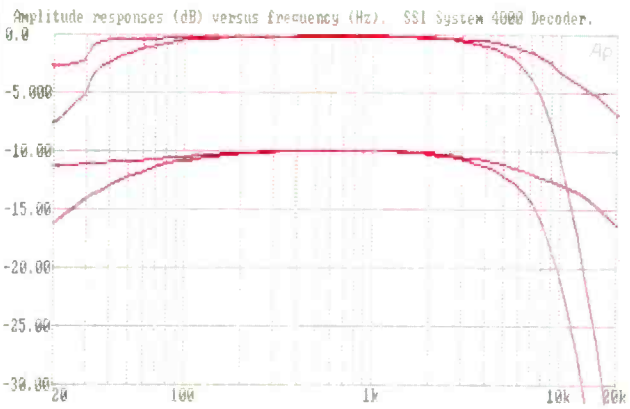

Fig. 3—Frequency response, at two signal levels, of surround channel in "Music" mode (top curve of each pair) and "Dolby" mode (bottom curve of each pair). The Dolby Surround standard mandates the bass and steep treble roll-offs shown.

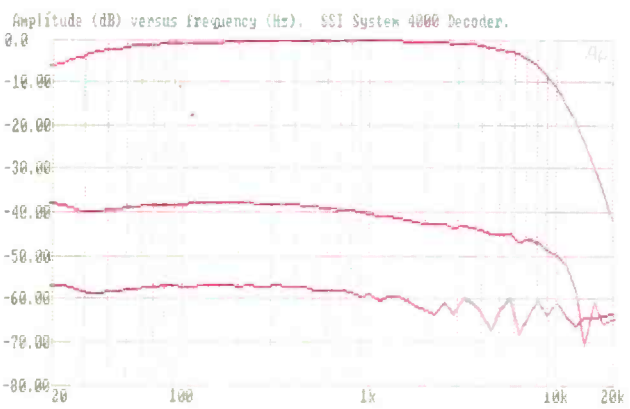

Fig. 4—Output from surround channels in "Dolby" mode with mono signal fed to left and right channels. Top curve is with "Null" control at one extreme, middle curve is with control at 12 o'clock, and bottom curve is with knob trimmed to about 12:15 for greater separation. See text.

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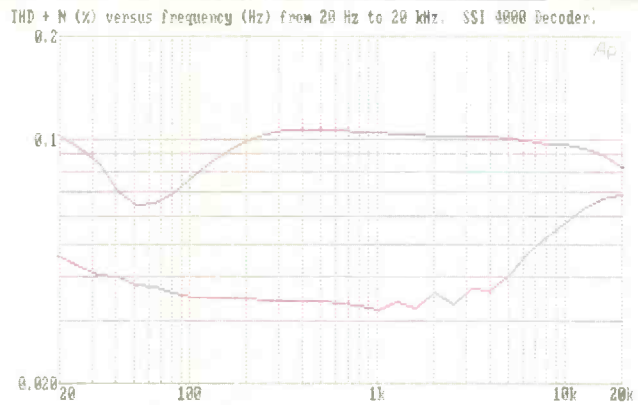

Fig. 5—Main-channel THD + N at 2 V in and out in "Dolby" mode, with center-channel switch in positions "1" (top) and "3" (bottom).

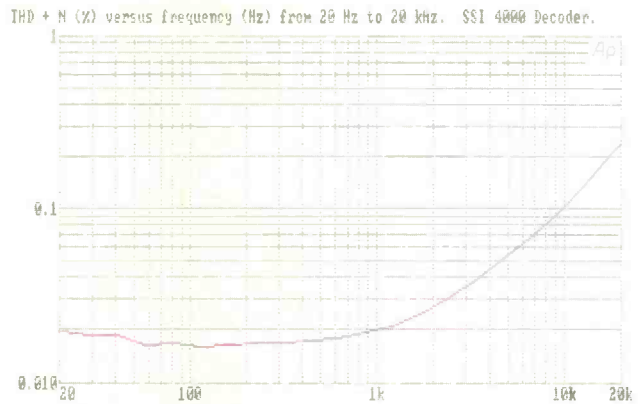

Fig. 6—THD + N of power amplifier at 20 watts per channel into 8 ohms, both inputs driven.

The delay times were 8.6, 12.5, 18.7, 22.2, and 29.4 mS, which are at some slight variance with the specified range of 10 to 30 mS. As a practical matter, this discrepancy is not important; the measured delay times are good for matching the great majority of listening rooms.

The remote control was reliable out to at least 25 feet on the sensor's axis and could be pointed just ±15° off axis at this distance. At normal viewing/listening distances, the remote could be positioned up to ±60° off the sensor's axis as long as it was aimed at the System 4000 II, and could be pointed as much as ±30° off axis when it was located on the sensor's axis.

Use and Listening Tests

My evaluation and monitoring system was the same as I have used in the past. The reference surround unit was the combination of Yamaha's DSP-1 processor and DSR-100 PRO Dolby Pro-Logic decoder. For the listening tests, I did not use the System 4000 II's built-in amplifier.

The SSI's instruction manual provides good guidelines for setup and operation. The instructions on setting delay are correct in a general sense, but the manual is wrong in stating that the user will hear definite echoes as a guide. The manual should have stated that too short a delay can cause localization to shift to the surround speakers, and too long a delay can reduce the smoothness of the surround. Although the manual's text is lucid, the first line of each paragraph is not indented, which makes reading a little more difficult. On the plus side, a number of large connection diagrams cover a wide variety of hookups and show clearly what to do.

On Showtime, I watched *Dancers*, with Mikhail Baryshnikov and Alessandra Ferri. I thought "Music" mode was best overall, but "Dynamic Logic" and "Dolby" Surround were also good; "Mono Enhance" was not a good choice. "Bypass" (regular stereo) provided good detail but had a collapsed sound field. At one point I thought I noticed slight sibilance in the surround channels in "Music," but then I discovered it was in the source. On another station, *The Oprah Winfrey Show* had stereo synthesis and some sibilance; the latter was lowest with "Mono Enhance" or "Bypass." On the same station, the sibilance was very high during two remote news broadcasts. The display on my oscilloscope revealed that a monaural signal was causing a very distorted, convoluted X-Y pattern, apparently because of stereo synthesis. A number of stereo stations and programs do show a narrow ellipse on mono signals, evidencing some phase shift, but not the twisted pretzel I saw in these cases.

Unless noted otherwise, I used "Dynamic Logic" for regular movies and music videos. *The Witches of Eastwick*, the Warner Home Video VHS tape with Jack Nicholson, Cher, Susan Sarandon, and Michelle Pfeiffer, has a good storm sequence at the beginning. The System 4000 II provided excellent surround sound, and using a subwoofer with it proved valuable. I felt overall bass was a bit excessive with the center-channel switch at position "1," so I used "2" after some adjustment to center level. With few exceptions, the dialog was always exactly centered as it was in the source—even when the actor was off screen. I heard one spot of sibilance, but I did not detect it in surround. The Paramount Home Video videodisc of *Beverly Hills Cop*, with Eddie Murphy, has a good opening music track. Quite a bit of the sound is mono, although some stereo and surround is used, including good effects in a chase sequence and a gunfight near the end. The SSI decoder did well with the limited surround in the source.

Little Shop of Horrors, the Warner Home Video videodisc with Rick Moranis and Ellen Greene, had good surround; music and effects were well placed. During vocals, I detected a couple of small jumps in sound localization to center. I wasn't certain about their cause, but I did pin down at least one sudden jump in vocal presence to the source. *Stevie*

The SSI 4000 II performed well, especially with films. Much lower in cost than several other decoders, it is definitely a good value.

Nicks—In Concert, a Pioneer Artists videodisc, benefited from my raising the center speaker level. The music had relatively little stereo or surround—perhaps necessary for a concert illusion. The crowd noise and applause, however, generated good surround. I had a slight preference for "Dynamic Logic" or "Dolby" mode over "Music" and "Mono Enhance." The overall results provided by the System 4000 II were noticeably better than those I had obtained previously with the same videodisc using another, more expensive surround decoder.

The first CDs I tried were Bach's *Brandenburg Concertos* performed by I Musici (Philips 412 790-2). I used center-channel position "3," which has a phantom center image. In general, "Dynamic Logic" mode provided more spaciousness but "Music" had more detail. I noted that with Concerto No. 4, I liked the liveness with "Music" mode but wanted it to surround me more. The results with Concerto No. 5 were pretty much the same. I did notice occasional jogs in localization in "Music" at first, so I shifted the balance to the front to reduce them. The next selection was Schubert's "Death and the Maiden" string quartet, with the Amadeus Quartet (Deutsche Grammophon 410 024-2). The string tone was a bit pointed in center-channel position "3," and I liked the result better after a switch to "2" but with the center channel turned off. To me, "Dynamic Logic" and "Dolby" modes were more solid, but "Music" was more detailed. I shifted balance somewhat to the rear for more liveness.

Mozart's *Eine Kleine Nachtmusik*, performed by Mackerras and the Prague Chamber Orchestra (Telarc CD-80108), sounded best with the same basic settings used for the Schubert work. This CD has more liveness, however, and I shifted the balance slightly back toward the front. I definitely preferred "Music" mode for the Berlioz *Symphonie Fantastique*, with Dutoit and the Montreal Symphony Orchestra (London 414 203-2). I wanted more liveness, and the challenging "March to the Scaffold" seemed constrained very slightly. The value of using the subwoofer was demonstrated a number of times. Borodin's "Music from Prince Igor," performed by Shaw and the Atlanta Symphony Orchestra (Telarc CD-80039), was somewhat better in "Music" than in "Dynamic Logic" and "Dolby" modes. During the dance music, the bass drum was very impressive. *William Tell & Other Favorite Overtures*, with Kunzel and the Cincinnati Pops Orchestra (Telarc CD-80116), seemed better to me in "Music" mode. In some respects, parts of Offenbach's "Orpheus in the Underworld" seemed closed-in sonically, but there certainly was no doubt about the *big* bass drum.

The System 4000 II produced quite a good result in "Music" mode when I played Brahms' *Piano Concerto No. 2*, performed by Ashkenazy with Haitink and the Vienna Philharmonic (London 410 199-2). With Michael Murray's *Bach: The Organs at First Congregational Church, Los Angeles* (Telarc CD-80088), I wanted much more liveness than I could get for the large-church illusion, and bass seemed to be hanging on, somehow, after some of the pedal notes. Next I tried Beethoven's "Choral" Fantasy, with Rudolf Serkin, Ozawa, the Boston Symphony Orchestra, and the Tanglewood Festival Chorus (Telarc CD-80063). I preferred "Music" mode with the piano and orchestra, but when the chorus was added my preference switched to "Dynamic Logic." Localization of the piano shifted from slightly left toward the center a couple of times. For Puccini's *La Bohème*, sung by Moffo and Tucker with Leinsdorf and the Rome Opera House Orchestra and Chorus (RCA 3969-2-RG), I shifted balance slightly to the right to obtain better placement of voices. "Dynamic Logic" was preferred over "Music" mode, and vocal presence was fine without the center loudspeaker.

Creedence Clearwater Revival's *Chronicle, Vol. 1* (Fantasy FCD-623-CCR2) needed the center speaker on. I set it at a lower level than I did for movies, but the center localization was important for vocals. This CD is mostly mono, with some left/right positioning. I switched among all the surround modes, the choice depending on the track. "Proud Mary" and "Down on the Corner" came across particularly well with the SSI decoder surround. *Star Tracks*, with Kunzel and the Cincinnati Pops (Telarc CD-80094), has a lot of good surround sound. I left the center speaker on but set its level fairly low. The sounds of bass drum and cymbal crashes were handled well, and the music in general was a good match for the System 4000 II. I switched back and forth between "Dynamic Logic" and "Music" modes to get the best results for each track. Jennifer Warnes' *Famous Blue Raincoat* (Cypress 661 111-2) is primarily monaural because of the vocals, but it does have important surround sound. For most of the tracks, it sounded best in "Dynamic Logic" or "Music" mode with the center level up. I liked the surrealistic character of "First We Take Manhattan," obtained effectively from "Music" mode with the center level down. Handel's *Water Music*, a recording by Stokowski and the RCA Victor Symphony that I heard on FM, had good surround sound, and the "Music" mode delivered good listening from it. In center-channel position "2," station announcements were fine and had good presence, even if the center level was low.

The SSI decoder and its controls were completely reliable throughout the testing. The indicators clearly showed how the controls were set, and the "Surround" LED was nice to have. The remote control was very easy to use; I used it to change modes, delays, levels, and balances without any confusion. For stereo TV and movies, the performance of the System 4000 II was close to that of the much more expensive reference processor. When a source was poor in some way, especially as a result of stereo synthesis, the SSI decoder did generate occasional sonic artifacts not heard with the reference unit. The System 4000 II provided good sonic illusions from a number of Compact Discs, but the processing of the reference decoder was needed if I wanted to change liveness or another room parameter. Several times, the SSI unit provided accentuated bass that would be appealing to many users. In a couple of cases, I concluded that the bass was better articulated by the reference processor.

The SSI System 4000 II surround decoder performs well, particularly with movies. Its flexible input switching of video and audio will be very helpful, perhaps essential, to some users, and the built-in stereo amplifier offers a convenient way to drive surround speakers. The System 4000 II, much lower in cost than several other decoders, is a good value.

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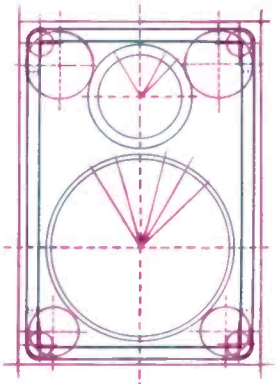

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PROTON SD-1000 SURROUND DECODER

Manufacturer's Specifications
Frequency Response: 12 Hz to 85 kHz, ±1 dB.
Maximum Input Level: 3.0 V.
Maximum Output Level: 7.5 V.
Input Impedance: 71 kilohms.
Output Impedance: 150 ohms.
S/N Ratio: 80 dB.
Dynamic Range: 100.5 dB.
THD: 0.008%.
Muting Attenuation: 64 dB.
Square-Wave Response: No overshoot, tilt, or ringing.
Slew Rate: 13 V/μS.
Rear-Channel Slope: 6 dB/octave, −3 dB at 4.5 kHz.
Separation: 40 dB between adjacent channels, 50 dB between nonadjacent channels, 58 dB between any two opposite channels.
Power Requirements: 120 V a.c., 60 Hz, 15 watts.

Dimensions: 16½ in. W × 2¾ in. H × 9⅝ in. D (41.9 cm × 7 cm × 24.5 cm).
Weight: 9 lbs. (4.1 kg).
Price: $1,000.
Company Address: 5630 Cerritos Ave., Cypress, Cal. 90630.

The Proton SD-1000 surround decoder has three operating modes: "Music," "Cinema," and "Bypass." "Music" mode provides up to six separate and different outputs (plus subwoofer) for "a full panorama of sound," according to the manufacturer. This mode captures a great deal of the natural ambience of the musical performance, feeding different program material, not just added echo and reverberation effects, into the surround channels. In the "Cinema" mode, for video or stereo audio programs with surround encoding, the SD-1000 automatically adjusts overall balance, shapes frequency response, and assigns speakers for the best match to cinema material. In "Bypass," no processing is done.

In both "Music" and "Cinema," the SD-1000 will provide up to 50 dB of separation enhancement, "far better than has ever been accomplished before." The Proton processor automatically adjusts its decoding to suit the number of channels actually connected to it, by sensing which of its output jacks have cables plugged in. In "Music" mode, all six channels have full audio bandwidth; in "Cinema," there is some roll-off in the surround channels. In both modes, the Proton unit automatically enhances separation, using vector cancellation.

Directional information hidden in the source material is constantly measured using the Aphex RatioMetric Detection System. This system's detectors operate over an extremely wide dynamic range, eliminating the need for an input level control. The SD-1000 also has an exclusive Dialogue Scatter Reduction circuit to keep sibilant sounds in the center front and to improve results from noisy recordings.

To ensure maximum sound quality, Proton avoided using circuitry they considered unnecessary. The surround channels do not have a delay line, for example, and stereo simulation and synthesis are not used. In "Music," the stereo surround image is controlled by the front stereo information. The SD-1000 has a subwoofer output which is active in all modes.

Although relatively simple, the remote control selects inputs, modes, Separation Enhancement, and muting; adjusts volume and balances, and turns power on and off. It also controls a tape monitor circuit, so the SD-1000 can be used conveniently even on systems whose built-in tape jacks are all in use.

Control Layout

The front panel is uncluttered and very neat in appearance. At the far left is the momentary-contact pushbutton "Calibrate" switch. When it is actuated, the front channels are muted and the "Input Balance" control, just to the right, can be adjusted until the surround channels' output is at a minimum when a mono signal is fed to the unit. This control's large knob makes for easy turning, but because the knob and its index groove are both black, it is easier to feel the groove than to see it.

All operating controls are on the remote, so the rest of the front panel carries only a wide display section. At the far left of the display are bright yellow "Mode" indicators for "Music," "Cinema," and "Bypass." To the right of these are "Volume" indicators, orange arrows pointing up and down. The relative brightness of these arrows conveys the approximate volume quite clearly. The top arrow is off when the unit is muted or the level is low, the arrows are equally bright at mid-level settings, and the bottom arrow is off at maximum volume. The "Balance" display just to the right is similar but has red arrows above, below, and to each side of its label. Again, the relative brightness of the arrows tells immediately how the unit is set.

The Proton processor senses how many channels are plugged into it, then automatically adjusts its action to match.

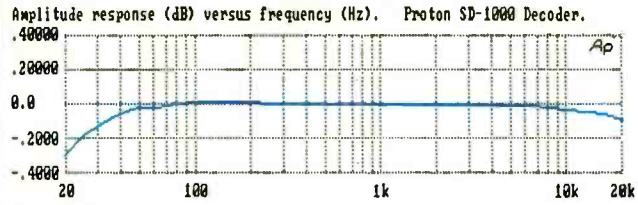

Fig. 1—Frequency response of main and center outputs, in all modes, and of surround outputs in "Music" mode.

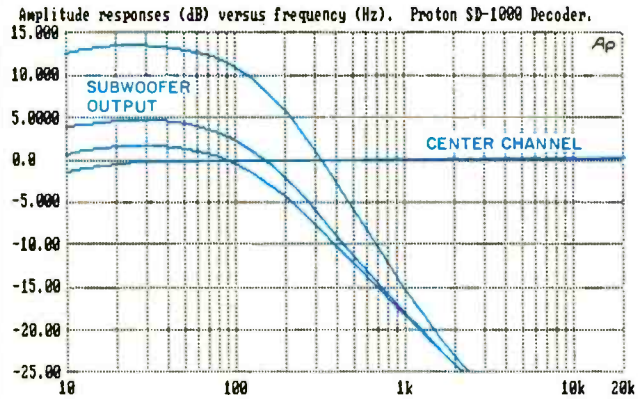

Fig. 2—Frequency response of subwoofer output, at four level settings, compared to that of center channel. The difference between the center-channel curve shown and that of Fig. 1 is due to a change in vertical scale.

The three yellow LEDs of the "Separation Enhancement" indicator, next on the right, are off when there is no enhancement. One LED glows with up to 6 dB of enhancement, two glow for 6 to 18 dB of ennancement, and all three glow for the maximum enhancement of up to 50 dB between adjacent channels. The red LED indicator for "DSR" (Dialogue Scatter Reduction) is next. These two unusual features caught my attention, and I looked forward to trying them later. The orange "Monitor" indicator is the next item to the right, followed by the remote-control sensor. The white labels have good contrast against the black panel and are easily read.

The transmitting end of the remote control is bent down so that the infrared emitter will point horizontally at the SD-1000 when the remote is held at a good viewing and operating angle. Rubber side ribbing makes the remote easy to hold securely. A red LED at the upper left confirms when the controller is transmitting, and just below is the green "Power" button. Further below and to the right are the buttons for Dialogue Scatter Reduction, Separation Enhancement, and "Mode." Next come the "Balance" buttons, arranged in a logical diamond pattern, with "F" at the top, "B" at the bottom, and "L" and "R" at the sides. Nearby is the tape monitor button; below this is the red "Mute" button, with "–" and "+" volume controls to its right.

At the left end of the decoder's rear panel is a post-type fuse-holder, which is a desirable convenience in my view. In the middle of the panel are the output jacks and individual trim pots above them. From left to right are "Front" ("Left" and "Right"), "Center" ("Front" and "Back"), "Back" ("Left" and "Right"), and "Sub" (subwoofer). Although the trimmer knobs are very small in diameter, their knurling is good so they are relatively easy to turn. Further to the right are the jacks for "Tape Monitor" and "Tape Record" output (both with "Left" and "Right"). At the far right end of the panel are the "Input" jacks ("Left" and "Right").

I removed the top/side cover for a view of the interior construction. Immediately I was struck by the excellent quality of the main p.c. board, about three-quarters chassis size, and the control board, half that size, mounted above. The layout is very neat, parts are all identified, and components quality is high. Both boards are well supported, better than in most units I have seen. Rigidity is outstanding because of two full-height side rails and four front-to-back mounting rails. The power transformer, just warm after hours of use, and the power-supply board are between a side rail and one of the four mounting rails. The p.c. board behind the front panel has the same high quality as the others.

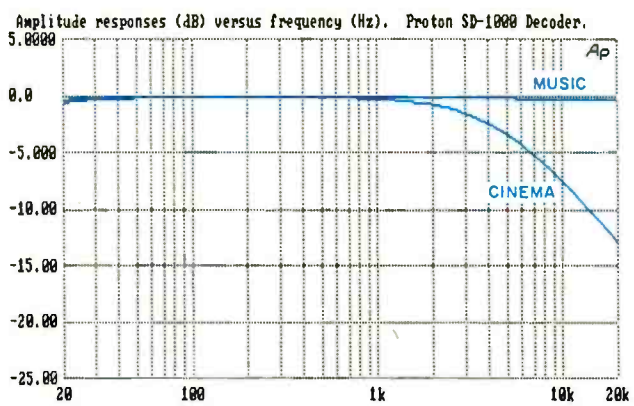

Fig. 3—Frequency response of surround channel in "Music" and "Cinema" surround modes; see text.

The Separation Enhancement feature operates as billed but only where it's needed, at frequencies above 100 Hz.

Interconnections were made using multi-conductor cables and plugs. The soldering was excellent, and residual flux at hand-soldered points was low.

Measurements

Let me first point out that all of the measurements were made after I completed my listening and viewing. Figure 1 shows the main and center-channel frequency responses, which were down by 0.31 dB at 20 Hz and by 0.08 dB at 20 kHz. The −1 dB points were at 10.7 Hz and 72 kHz, and the −3 dB points were at 5.5 Hz and 133 kHz. These response figures apply to the front outputs in all modes; in "Music" mode they apply to all outputs except subwoofer.

The subwoofer response (Fig. 2) has a roll-off above 100 Hz, reaching a final slope of 6 dB/octave. With the subwoofer trimmer at minimum and the center trimmer at maximum, the maximum subwoofer level was 2 dB above that of the center channel. Figure 2 also shows the change in level and response when the subwoofer trimmer was set at mid-position and at maximum. At first, I reacted negatively when finding such a relatively high subwoofer output level, but then I remembered that my own self-powered subwoofer needs a relatively high input signal.

Figure 3 shows the response of the surround channels in "Music" mode (the similarity to the curve of Fig. 1 is obscured here by the difference in vertical scaling) and in "Cinema" mode. In both modes, output was down 0.32 dB at 20 Hz; at 20 kHz, response was down 0.35 dB in "Music" mode and 12.9 dB in "Cinema." The high-frequency −3 dB point in "Cinema" mode was at 4.5 kHz. The center channel's response was the same as that of the surround channels in this mode.

Without enhancement, separation between the left and center channels was 3 dB. Figure 4 shows the additional separation gained from the three settings of Separation Enhancement. (The curves have been normalized to show the degree of enhancement rather than separation itself; therefore, the original 3-dB separation between left and center channels is shown as the 0-dB curve at the top.) Notice the definite and significant increases in separation when this function was used. The circuit did not have much effect below about 100 Hz, where speakers are primarily nondirectional.

The effect of input balance settings on the surround (back) output when feeding the same signal to left and right inputs is demonstrated in Fig. 5. The top response curve was obtained with the input balance pot all the way to the left, but it would have been similar with the pot at its opposite extreme. The middle trace shows a separation of 25 dB, secured with the pot set at 12 o'clock. The bottom trace was taken after the pot was adjusted for minimum output in the surround channels, as indicated by meter. (The resultant pot position was 12:30.)

Figure 6 shows how signals reaching both main inputs in opposite polarity are removed (to reappear in the surround channels) for various Separation Enhancement settings. Notice how the separation can be increased to almost 70 dB at some frequencies, if desired—which it may not be for normal music listening; opposite polarity signals occur normally in regular stereo program material. As mentioned earlier, the Separation Enhancement circuit has (and needs) very little effect below 100 Hz.

The signal-to-noise ratio in "Music" or "Cinema" mode, using a 1 V reference, was 88.2 dBA for the main channels and 90.2 dBA for the surround channels. When I used the SD-1000's rated maximum output level of 7.5 V as the reference, the S/N ratios were 105.7 and 107.7 dBA, respectively, for the two modes.

Figure 7 shows THD + N across the band for the main channels, in all modes, at 1.0 V in and out. The lower curve was run with one channel driven; the upper curve was made with both channels driven. All of the distortion is acceptable, but I was surprised at the considerable rise above 1 kHz.

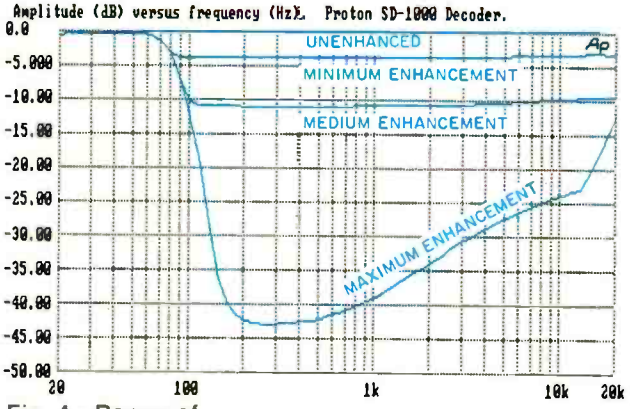

Fig. 4—Range of Separation Enhancement at center-channel output with main-channel input. Actual separation is 3 dB greater than shown for all four curves; see text.

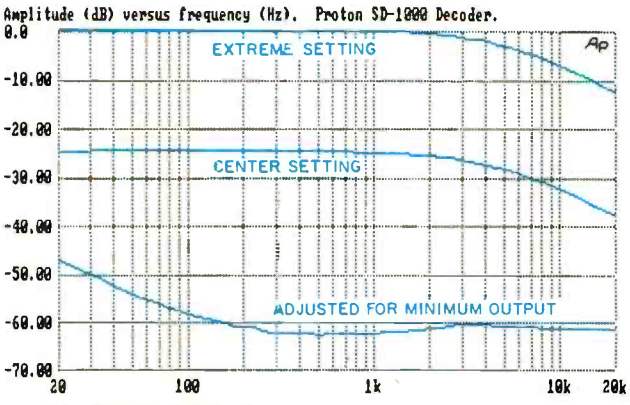

Fig. 5—Effect of input balance settings on surround outputs when feeding a mono signal to the main inputs; see text.

The high separation between music and dialog let me raise the surround level without being too aware of where the surround speakers were.

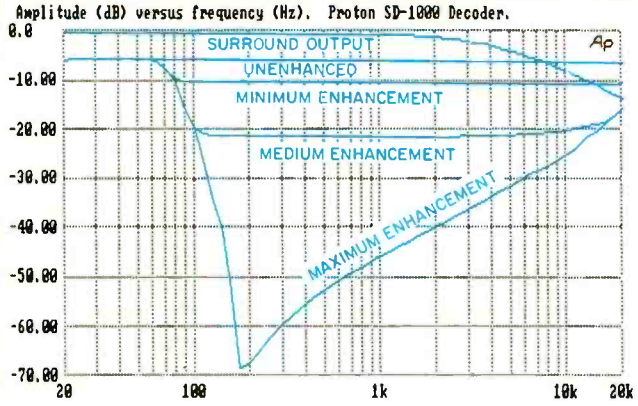

Fig. 6—Effect of Separation Enhancement circuit on main-channel outputs for input signals of opposite polarity; see text.

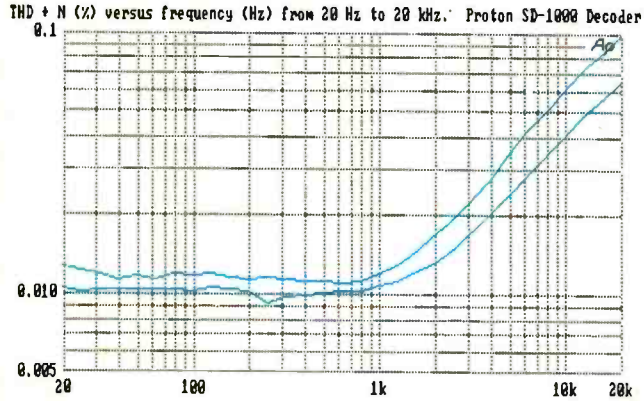

Fig. 7—THD + N vs. frequency for main channel at 1 V in and out, in "Cinema" surround mode. In upper curve, both channels are driven; in lower curve, only one channel is driven.

With the volume control at maximum, input clipping appeared when the input signal level reached 2.9 V; with the volume control turned down, it appeared at 3.95 V. The output clipped at 7.5 V. The slew rate measured 13 V/μS, and the square-wave output was close to perfect.

Output polarity was the same as the input in the main, center, and subwoofer channels. The input impedance was 70.3 kilohms, and the output impedance was 230 ohms; both are excellent figures.

The level change from main inputs to main outputs was +1.2 dB on both channels, with the remote's volume control set at maximum. The volume control covered the range from 0 to 27.5 dB of attenuation in 0.5-dB steps; there followed one 2-dB step and additional steps of about 5 dB, down to a total attenuation of 65 dB (which was also the muting level). The sections of this control tracked each other within a small fraction of a decibel over this entire range. With the "–" button held in, the total attenuation from 0 dB to the muting level was covered in about 5 S. The output trimmers provided up to 17 or 20 dB of attenuation, except for the subwoofer trim pot, which had 11.9 dB. The input balance control could provide up to 9.3 dB of attenuation in any direction from center. This gave a good total balance range of almost 20 dB from left to right or front to rear.

The remote control was reliable out to at least 25 feet on the sensor's axis and could be pointed as much as ±30° off at that distance. At normal viewing/listening distances, the control could be positioned up to ±75° off the sensor's axis as long as it was aimed at the unit and could be pointed as much as ±60° off when it was located on the sensor's axis.

Use and Listening Tests

A Yamaha AVC-50 integrated amplifier was used for switching the various signal sources, which included a Yamaha TX-900U tuner, a Magnavox 1041 CD player, an Akai VS-555U VHS Hi-Fi VCR, and a Yamaha LV-X1 videodisc player. For power amplification, I used the second section of the AVC-50 for the main stereo channels, a JBL/UREI 6210 for the center channel, and a Yamaha M-35 for the back/surround channels. The speakers were two JBL 4301s (main stereo), a JBL 4408 (center), a self-powered Triad Speakers HSW-300 (subwoofer), and two Dynaco A25s (surround). Although a center rear surround speaker can also be used with the SD-1000, my listening area does not allow this. The Akai VCR was used as the stereo TV decoder. I connected a two-channel oscilloscope across the SD-1000's left and right inputs and operated it in X-Y mode to show the presence or absence of stereo and surround information. The reference decoder consisted of the Yamaha DSP-1 and DSR-100 PRO together.

The SD-1000's owner's manual presents the needed information in a nice, open format with good illustrations and lucid text. The manual is not long, but I missed having page numbers. Details are given on various functions, and additional comments help the user get the most out of this decoder.

After reading the instructions, I prepared to use the Proton unit by pressing its "Calibrate" button and adjusting the input balance for minimum output in the surround channels. Then I checked out several stereo TV programs.

Very few programs had much stereo information of any sort, outside of background music in dramas. I discovered I could improve the sound by setting Separation Enhancement to match what I thought the sound field should be. I found that making this adjustment was also useful when listening to music on FM, to make the announcements sound natural and have good presence. "Cinema" was best for TV, but "Music" was the preferred mode for FM whether the center speaker was on or not. Most of the time, I

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The SD-1000's noise level was low enough for me to detect the low-level noises recorded between tracks on a CD.

preferred this speaker off. For both stereo TV and FM, I found occasions when Dialogue Scatter Reduction was an improvement.

The first movie cassette I tried was *The Color Purple*, with Whoopi Goldberg and Danny Glover (Warner Home Video). It was best in "Cinema," and as would be expected, the oscilloscope monitor showed the great majority of the dialog to be centered. The infrequent off-screen speech was very well positioned by the Proton decoder. The SD-1000 provided good stereo and surround sound from the film's background music and effects, including a rainstorm. I found I could set the surround level quite high without getting the feeling that the sound was coming from the specific locations of the surround speakers. I kept the center speaker on throughout the film, preferring 18 dB of Separation Enhancement most of the time. The separation of dialog from music and effects was very good, which allowed me to set the surround level high when I wanted to. I heard pops on excited dialog at one point in a dinner table scene, but I was able to reduce them to a fair extent by trimming input balance.

The videodisc of *Witness*, with Harrison Ford (Paramount Home Video), had a nice, smooth, solid sound, particularly during surround background music. A gunfight scene in a parking garage sounded odd because it was recorded without the reverberation and echoes that a real garage would have. The sound of a thunderstorm was much too centered, especially considering the images on screen. A subwoofer growl during the search for Ford at the Amish farm added to the feeling of suspense, and placement of sound effects and music was very good. The cassette of *Lethal Weapon*, with Mel Gibson and Danny Glover (Warner Home Video), has an exciting gunfight near the beginning. Much of the sound was centered, but music and effects in the surround were very potent. Dialog in a garage was strongly centered, but at least there was some liveness. The character of the surround was generally successful for a chase in the desert and a car explosion. I preferred the "Cinema" mode for these two movies. The *Judy Garland in Concert* Pioneer Artists videodisc has rechannelled stereo sound that was moderately successful. I think I preferred "Cinema" here for its restricted frequency response as much as anything else.

The first CD I tried, *Pachelbel: Canon/Albinoni: Adagio* (Erato ECD-55018) features the Paillard Chamber Orchestra and I Solisti Veneti with Claudio Scimone. A very short listening period confirmed my feeling that the center channel was best left disconnected or kept at a low level. "Music" was better than "Cinema," partly because of its wider bandwidth, but I needed to sit close to the center to maintain proper left/right balance. I noticed some low-level noise at pauses between some tracks; it was actually on the CD (coded AAD), and the SD-1000's noise level was low enough to reveal it. In general, the music was detailed but the instrument locations were diffuse. Hearing a pizzicato passage coming from the left, instead of the left front, was distracting, so I shifted the balance further front.

The Prelude to Act I of *Die Meistersinger,* performed by Neville Marriner and the Minnesota Orchestra on *Music of Wagner* (Telarc CD-80083), sounded better at times with

"Cinema" mode. The sonic wrap using "Music" was nicely enveloping but seemed unrealistic. The sound was smooth in character but unexciting to me because I wanted it more live. Hamish MacCunn's *Land of the Mountain and the Flood (Concert Overture), Op. 8*, with Sir Alexander Gibson and the Scottish National Orchestra (Chandos CD-8379), was a good match to the SD-1000. Many of the passages were exciting, and cymbal crashes were very impressive.

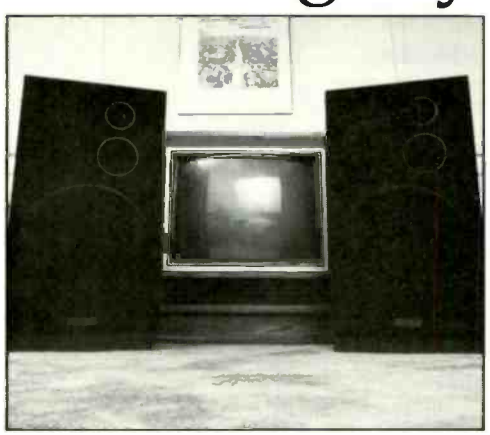
Beethoven's Concerto in C, with the Beaux Arts Trio, Bernard Haitink, and the London Philharmonic Orchestra (Philips 420231-2), produced very satisfying listening overall. The piano localization on *Oscar Peterson—The History of an Artist, Vol. 2* (Pablo CD 2310-895) shifted back and forth a bit, even in regular stereo ("Bypass" mode). I could accept this limited movement of the sonic image, but the shift from front left to straight left in "Music" mode was too distracting. A performance of the Saint-Saëns Symphony No. 3, with Michael Murray, Eugene Ormandy, and the Philadelphia Orchestra (Telarc CD-80051), had a diffused frontal localization in "Music," but this mode was successful overall.

The Duruflé "Requiem," with Robert Shaw and the Atlanta Symphony Orchestra and Chorus (Telarc CD-80135), had very pleasurable surround after I shifted the balance more toward the back. I noticed this particularly when listening to the "Kyrie." The sound did not, however, create any illusion of being in a large church or cathedral. Puccini's *Tosca*, with Milanov, Bjoerling, Warren, Erich Leinsdorf, and the Rome Opera House Orchestra and Chorus (RCA 4514-2-RG), sounded better in "Cinema" mode at times. The "Music" mode also had some appeal with this recording, but only if I turned up the center speaker to reduce exaggerated shifting of the soloists from left to right. Simon Estes on *Spirituals*, with the Howard Roberts Chorale (Philips 412 631-2), sounded very good with all control settings I tried. The liveness present in the recording itself was a big contributor to this.

I preferred *Time Warp*, with Erich Kunzel and the Cincinnati Pops (Telarc CD-80106), in "Music" mode. I liked a

Using just any loudspeaker for home theater can produce unsound

and unsightly



effects.

Using just any loudspeaker for home theater can have its drawbacks.

You might find the speakers (especially in-walls) can't handle the dynamic demands of surround sound. Or the critical separation between music and dialogue.

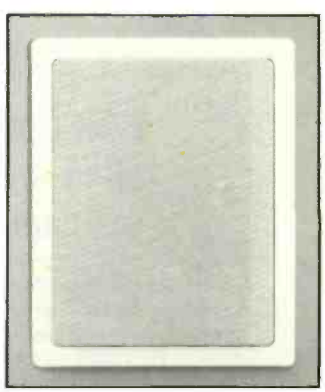
On the other hand, the speakers might perform adequately, but leave a lot to be desired aesthetically when made the focal point of the room. After all, the concept of home theater is to gracefully integrate components into the home, not overrun it.

There is, however, a company that has achieved the ideal balance between performance and aesthetics.

QUART, Europe's leading designer and manufacturer of loudspeakers.

Our elegant column speakers are unmatched for left, right and center channel positions, flawlessly capturing everything from the subtlest musical nuances to the slightest whispers of dialogue. Their advanced technology is reflected in the 5 octave tweeter range, specially aged driver cones, and proprietary Moving Control System, an "acoustical resistor" that insures unsurpassed dynamic behavior. Their uncompromised aesthetics are found in QUART'S selection of 6 different furniture finishes and tongue & groove cabinetry.

No other speaker creates as stunning a visual and auditory presence.



The QUART QM 90 series is the new in-wall standard, combining rear surround channel placement convenience with the multi-level sonic dimensionality found in the best theaters. QUART in-walls utilize an 8" woofer, as opposed to the typical 6", for accurate, deep bass with amazingly fast response. A close tolerance crossover compensates for the fixed placement by creating superb ambient soundstaging no matter where a listener is in the room.

All of these achievements could only come from a company that designs and builds practically all component parts of a speaker.

QUART. The speaker reference for home theater.

QUART

For More Information

41258

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In "Music" surround mode, the sound field wrapped all the way around the front and sides of my room, and it had a nice, smooth character.

fairly high surround level, although I then found some positionings to be distracting (left front to left back and right front to right back). On Emmylou Harris' CD, *The Ballad of Sally Rose* (Warner Bros. 25205-2), instrumental passages sounded good with either "Music" or "Cinema" mode. To get the desired vocal articulation, balance needed to be shifted toward the front, and the center speaker level increased. Liveness was not needed for this music. Deniece Williams on *So Glad I Know* (Sparrow SPD 1121) delivered a good sonic impact. The instrumental passages sounded better without the center speaker, but the level had to be raised for good vocal articulation. "Music" with the center speaker on at a low level was the best combination for *Beer Barrel Polka* (Sound Sensation EGBR-2516).

In "Music" mode, the sound field wrapped all the way around the front and sides of my listening room, and it had a nice, smooth character. For this and other reasons, I found it a successful mode for a number of the CDs I listened to. Many times, however, I was distracted by hearing the sound of instruments coming from my right or left rather than from the right and left of a frontal "stage," unless I shifted the balance more to the front. I accept Proton's viewpoint that delay and reverberation processing might add distortion, noise, and unwanted artifacts, and I continually noticed the smoothness of the SD-1000's sound. Yet in "Music" mode, the undelayed sounds from the left and right surround speakers made the instruments seem to be in locations that I did not find realistic for any concert hall. And without reverberation, some CDs sound quite dead, particularly in surround, although other CDs are live enough without this.

Overall, for stereo TV, movies, and FM broadcasts, the SD-1000 in "Cinema" mode equalled the performance of the reference Yamaha DSP-1 and DSR-100 PRO combination. The Proton decoder's selectable Separation Enhancement was a definite plus. However, I felt that most of the music I listened to from CDs would benefit even more from the more extensive manipulations possible with my reference Yamaha DSP-1, which also has the advantage of allowing balances and levels for particular programs to be stored and recalled later.

The SD-1000 and its remote were easy to use, and all controls and functions were completely reliable. Its smooth sound and low noise and distortion were always impressive. I found the wraparound character of the sound in "Music" mode distracting, but others could very well prefer it. I really liked being able to select the separation I wanted with movies, and I did appreciate the Dialogue Scatter Reduction, at least occasionally. The price of the Proton SD-1000 surround decoder puts it in the same range as many other units with which it should be compared; its particular appeal is its performance and operating flexibility with movies in "Cinema" mode. *Howard A. Roberson*

ULTIMATE SATISFACTION

LUXMAN BRINGS THE SHUTTLE HOME

Created with Luxman Home Audio technology, the Alpine 5952S CD Shuttle for the car delivers a sound so pure ... so rich, even concert hall aficionados have applauded it. It's a sound that's hard to leave behind and now you don't have to.

With the Luxman DC-114 CD Shuttle you can take this incredible sound with you, from your car right into your living room. The DC-114 is the only Compact Disc changer in the world that's compatible with the Alpine 5952S CD Shuttle. Simply remove the six disc magazine from your car's audio system and plug it into your home system.

That's the type of convenience and engineering know-how you can expect from Luxman, a recognized leader in sonic excellence for over 65 years. The DC-114 boasts a myriad of advanced features, including 8-fold oversampling digital filter, 18 bit dual digital-to-analog converters, Luxman's patented Duo-Beta Circuitry to minimize the audible effects of negative feedback, and Star Circuit Topology to significantly reduce noise and distortion. And thanks to its rugged durability, it comes with our exclusive 5 Year Parts and Labor Warranty, the finest in the industry.

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CD/VIDEODISC PLAYERS

MANUFACTURER	Model (RI)=Remote Included, (RD)=Remote Optional	Disc Capacity	Decoding System; Number of Bits—Oversampling Rate	Output Filtration: Analog Plus Digital=A, Digital Only=B, Analog Only=C	Line Outputs: Fixed=F, Var.=V, Balanced Analog=B	Other Outputs: Headphone=H, Headphone with Level Control=HL, Subcode=S, Coaxial Digital=D, Fiber Optic=F	Frequency Response, Hz to kHz, ±dB	S/N Ratio, "A" Wtd., −dB	THD, %	Elapsed-Time Display: From Disc Start=D, From Track Start=T, Both=B	Remaining-Time Display: To Disc End=D, To Track End=T, Both=B	Number of Programmable Selections	Repeat Functions: Entire Disc=D, Track=T, A-B Phrase=P, Entire Program=E	Weight, Lbs.	Price, $	Notes
DENON	LA-3000(RI)	1	20-8X	A	F/V		5-20 ±0.3	109	0.003	B	B	20		28½	1000.00	S-video outputs.
	LA-2000(RI)	1	20-8X	A	F		5-20 ±0.5	106	0.004	B	B	20		21	700.00	
HITACHI	VIP RX6EX(RI)	1	1-8X	A	F	HL	4-20	107	0.003	B	B	24	T/P/E	16½		
MS8 TECHNOLOGY	Gold CDV(RI)	1	16-4X	A	F	None	10-20			B		20	D/T/E		2995.00	
PANASONIC	LX-200(RI)	1	18-8X				4-20	106	0.003				D/T/P/E	20.3	850.00	
	LX-1000(RI)	1	MASH				4-20	110	.0027				D/T/P/E	25.4	1400.00	Jog/shuttle control.
PIONEER	CLD-3080(RI)	1	18			F						20		24½	1400.00	Plays both sides of videodisc; S-video output.
	CLD-2080(RI)	1										24		23¾	850.00	Plays both sides of videodisc.
	CLD-1080(RI)	1				H						24		16½	600.00	
	CLD-980(RI)	1	16									24		16⅜	500.00	Dual D/A converters.
	Elite CLD-92(RI)	1	20			F						20		28⅝	2000.00	Plays both sides of videodisc; S-video output.
QUASAR	LD9090(RI)	5	18-8X	A	V/B	HL/F	4-20 ±0.5	106	0.003	B	B	20	D/T/P/E	20	899.95	
REALISTIC	16-302(RI)	1	16-4X	A	F	H	20-20 ±2	90	0.03	B	B	20	D/T/E		499.95	
SHARP	MV-D2000(RI)	1	16-4X	A	F		20-20	90	0.03	B		20	D/T/E	19	839.95	
	MV-D100(RI)	3	16-8X	A	F/V	H/F	5-20	98	0.007	B		20	D/T/E	30	1899.95	
SONY	MDP-333(RI)	1	PLM	A	F	HL/F	4-20 ±0.2	112	0.002	B	D	20	D/T/P/E	16¾	650.00	
YAMAHA	CDV-1700(RI)	1	18-8X		F	HL/F	5-20 +0.5,-1	70	0.004	B		15	D/T/P/E	20½	699.00	

AMBIENCE & SURROUND SOUND PROCESSORS

MATRIX CODE
A—Ambisonics
D—Dolby Surround
DP—Dolby Pro-Logic
H—Hafler Dynaquad
QS—QS
SQ—SQ
O—Other

UNIT TYPE

DELAY FUNCTIONS

OUTPUT CODE
2F—Left & Right Front
3F—Left, Center, & Right Front
2B—Left & Right Back
3B—Left, Center, & Right Back
2S—Left & Right Sides
SW—Subwoofer

MANUFACTURER	Model (RI)=Remote Included, (RD)=Remote Optional	Matrix—See Code	Time Manipulation: Delay=D, Reverb=R	Other Manipulation Techniques: Frequency Shaping=F, Comb Filter=C, Phase Manipulation=P, Other=O	Number and Use of Outputs—See Code	Delay Time, mS	Number of Hall/Room Simulations	Hall/Room Adjustments: Volume=V, Shape (Height/Width Ratio)=S	Continuous Amp Power, Watts	THD, %	S/N Ratio, "A" Wtd., −dB	Channel Separation, dB	Stereo Simulation?	Number of Tape Monitors	Video Inputs?	Price, $	Notes
ARCHER	15-1279	D	D		2F, 2B	20			10 x 2, 5 x 4	0.5	70		Yes	2	No	129.95	
ATLANTIC TECHNOLOGY	Pattern Surround Home Theater	DP	D	P	3F, 2B, SW	30	1		15 x 5, 60 x 1	0.085	85	60	No			1499.00	Includes speakers.
AUDIOSOURCE	SS One/II	D/O	D	F/P/O	2B	10-30			30 x 2	0.01	85	60	Yes	1	No	199.95	100-Hz and 10-kHz boost; front/rear fader; master volume.
	SS Two(RI)	D/O	D	F/P/O	2B	10-30			30 x 2	0.01	85	60	Yes	1	No	249.95	As above.
	SS Three(RI)	DP	D	F/P	3F, 2B, SW	10 or 30	1	V	30 x 2	0.01	90	60	Yes	1	No	399.95	Automatic balance calibration; selectable crossover frequency; subwoofer level control.
CARVER	DPL-33	DP	D	P/O	3F, 2B	20 or 30	2		25 x 3	0.05	85	80	Yes	1	No	399.00	Master volume control; surround-channel level display.
DENON	AVC-3000(RI)	DP	O		3F, 2B	0-40	6		80 x 2, 35 x 1, 35 x 2	0.08, 0.4, 2.0			No	5	8	1000.00	Five-channel amp; digital delay; S-video inputs and outputs; video detail and sharpness controls; on-screen TV display.
	AVC-1000(RI)	DP	D		3F, 2B, SW	0-40	3		55 x 2, 25 x 2, 25 x 2	0.08, 0.4, 2.0			No	5	5	700.00	Four- or six-channel amp; S-video inputs and outputs; on-screen TV display.
	AVC-700(RI)	DP	D		2F, 2B	15,20, 30	1		55 x 2, 18 x 2	0.4, 2.0			Yes	1	5	600.00	Four-channel amp; five-channel preamp outputs; digital delay; S-video inputs and outputs; on-screen TV display.
	AVR-1010(RI)	OP	D		3F, 2B	0-40	3		100 x 2, 35 x 2, 35 x 2	0.08, 0.4, 2.0			No	4	5	1000.00	AM/FM tuner and four- or six-channel amp; S-video inputs and outputs.
OYNACO	QD-1 Series II	H		P	2B								No	0	No	50.00	Passive ambience retrieval.
FISHER	ASR-975	DP/O	D	F/P/D	2F, 2B	10-30	5		20 x 3	0.4	85	70	Yes	3	5	599.95	Includes three speakers.
FOSGATE-AUDIONICS	DSL One	D/O		F/C/P/D	3F, 2B, SW		8	V/S	20 x 2	0.05	90	45	Yes	1	No	699.00	Proprietary logic steering.
	DSL Two(RI)	D/DP/O	D	F/C/P/O	3F, 2B, 2S, 3SW	15-32	8	V/S	20 x 2	0.05	90	45	Yes	1	No	1199.00	As above; Dolby Time Link digital delay.
	3610 Pro-Plus(RI)	D/O	D	F/C/P/O	3F, 2B, 2S, SW	16-32	3	V		0.10	90	60	Yes	1	Yes	1429.00	Proprietary logic steering; Class-A audio circuitry.
HITACHI	HA V5EX	A/D/DP/SQ	D		3F, 2B	0-30	6	V	†	0.09	90	60	Yes	1	Yes		†In Dolby modes, 45 watts x 2 and 15 watts x 2; other modes, 50 watts x 2.

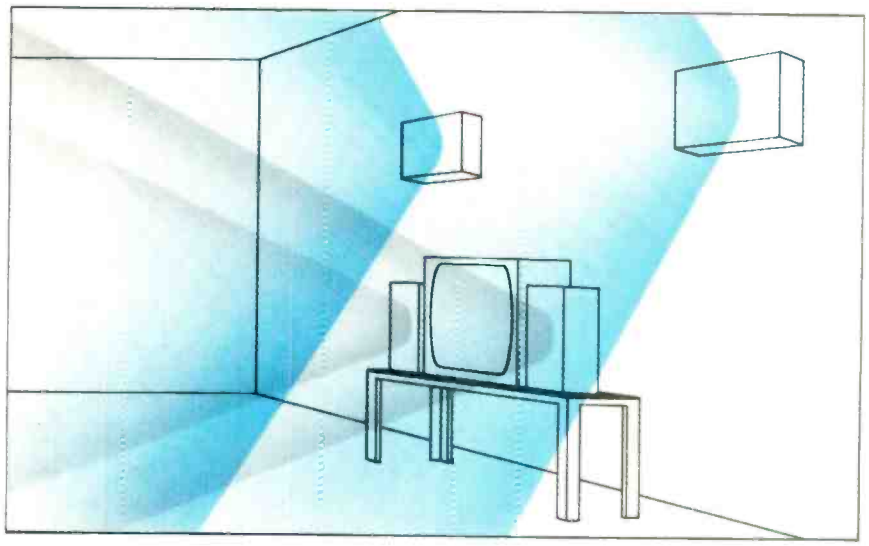
Q: IS THERE REALLY SUCH A THING AS A VIDEO SPEAKER?

A: No – the important thing is to have the *right* speaker. What works for stereo music should also work for video.

Audio speakers *and* video speakers. Why buy both? Common sense provides reasons not to. One is cost. The money needed for two pairs of speakers could be used to buy a much better single pair. The second is performance. By design, video speakers are supposed to be placed right next to the television. That's fine for dialog, but what happens to stereo soundtracks and special effects? Speakers separated by a 25 inch television screen are too close together to produce wide-open stereo. The third is space. Few people have the room for extra speakers.

The best modern theater sound systems–like this 1983 installation at the Academy of Motion Picture Arts and Sciences–have speakers mounted in an acoustical plane behind the screen for better performance.

If video speakers aren't really ideal for video, can audio speakers do the job? The answer is yes, as long as it's the right type of speaker. The best-sounding new theaters have a wall behind the screen with speakers built right into it. So instead of just their baffle or front surface, the speakers have an entire wall, or *acoustical plane*, to act as a sound radiating surface. This directs most of the primary speakers' energy toward the audience, reducing unwanted diffractions and reflections. In addition, each wall-mounted speaker system sits in its own separate enclosure for full bass response. The result is the sharply focussed, omnipresent, *powerful* sound so noticeable in today's premier movie theaters.

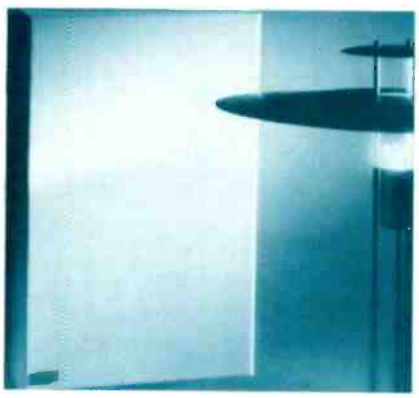


EPI WallPlane™ speakers deliver wider stereo and deeper bass than conventional speakers while taking up less space, because they use the listening room wall as an acoustical plane. Sound converges in the listening area with minimum diffraction and maximum stereo separation.

The EPI WallPlane™ speaker concept for audio *and* video.

Building home speakers into the wall would improve the sound image but at the expense of low frequency response. After all, the average wall is not designed to function as a loudspeaker cabinet. The hi-fi solution to theater sound at home would be two speakers in one: capable of using the wall as an acoustical plane and equipped with its own enclosure for full bass– just like a state-of-the-art theater system. This way, they could be positioned far enough apart for full stereo with music while using the cinema acoustical plane principle for proper video performance. This is the idea behind EPI's new Model 110 WallPlane™ speaker system.

The Model 110 WallPlane™ speaker's unique low-profile enclosure places the sound radiating surface as close against the wall as possible without requiring a hole, effectively making the speaker and the wall acoustical partners. The sound converges on the listeners with a minimum of diffraction and a maximum of stereo separation. Because the WallPlane™ speaker has its own defined enclosure, it produces the deep, satisfying bass required for the full impact of theater-quality sound. Most important, the Model 110 is visually unobtrusive, with its low profile design and completely enveloping cool grey grilles (also available in optional designer colors).



The EPI Model 110 Wallplane™ speaker requires no shelves or large holes. Simply hang it on the wall for extraordinary audio and video performance.

Clearly, the Model 110 is an audio and video product welcome by those who value performance and innovation.

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PERFORMANCE
INNOVATION

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As a special offer to *Audio* readers, return this coupon to EPI after purchasing Model 110 WallPlane™ speakers and receive a pair of FREE optional designer grilles in your choice of color (check choice below). Offer expires November 30,1990; coupon must be postmarked by December 15, 1990. You must include a copy of your sales receipt for EPI Model 110's. Allow 6-8 weeks for delivery.

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AMBIENCE & SURROUND SOUND PROCESSORS

MATRIX CODE
A—Ambisonics
D—Dolby Surround
DP—Dolby Pro-Logic
H—Hafler Dynaquad
QS—QS
SQ—SQ
O—Other

DUTPUT CODE
2F—Left & Right Front
3F—Left, Center, & Right Front
2B—Left & Right Back
3B—Left, Center, & Right Back
2S—Left & Right Sides
SW—Subwoofer

MANUFACTURER	Model (RI)=Remote Included, (RO)=Remote Optional	Matrix—See Code	Time Manipulation: Delay=D, Reverb=R	Other Manipulation Techniques: Frequency Shaping=F, Comb Filter=C, Phase Manipulation=P, Other=O	Number and Use of Outputs—See Code	Delay Time, mS	Number of Hall/Room Simulations	Hall Room Adjustments: Volume=V, Shape (Height:Width Ratio)=S	Continuous Amp Power, Watts	THD, %	S/N Ratio, "A" Wtd., –dB	Channel Separation, dB	Stereo Simulation?	Number of Tape Monitors	Video Inputs?	Price, $	Notes
JVC	XPA1010(RI)	D	D/R	F/O	4F, 2B	0-200	20	V/S		0.002	110		No	1	No	1200.00	Compensation for listening room size, listening room reverb time, and source reverb.
	SUA400(RI)	D/O	D	F/P	2F, 2B	15-30	2		10 x 2	0.5	85		Yes	1	No	305.00	
	SUA30	D/O	D	F/P	2F, 2B	15-30	2		10 x 2	0.5	85		Yes	1	No	235.00	
KENWOOD	SS-79	D	D		2B	20 or 30	2		15 x 2	0.9	62					249.00	
LEXICON	CP-1	D/DP/O	D/R	F/C/P/O	3F, 2B, 2S, SW	†	21	V/S		0.05	85	40	Yes	1	No	1395.00	†0 mS to 14 S. True digital decoding; auto azimuth; auto input balance.
	CP-2	D/DP/O	D	F/O	3F, 2B, SW	0-32	0			0.05	85	40	Yes	0	No	895.00	As above.
	CP-3(RI)	DP/O	D/R	F/P/O	3F, 2B, 2S, SW	†	9	V/S		0.01	90	85	Yes	1	Yes	2500.00	As above; high-frequency attenuation of reverb signal; THX; on-screen TV display.
LUXMAN	F-116	D/DP	D	O	3F, 2B	0-32	0			0.05	80		Yes	0	No	950.00	
MEMOREX	DSS-100		D		2F, 2B	20			5 x 4, 10 x 2				Yes	1	No	249.99	Includes pair of Series 10 speakers.
ONKYO	ES-300	D	D		2B	20 or 30	2		30 x 2	0.9	79		No		No	279.95	
OPTONICA	SMA-75(RI)	D/O	D	O	2F, 2B	0-92	14	V/S	35 x 2, 25 x 4	0.8	82	50	No	†	4	400.00	†Two VHS, one audio tape.
PANASONIC	SY-DS1	O	R						8 x 2	10			No	0	No	279.95	Built-in stereo speakers; 16-bit digital processing; reverb time, 0.9 to 2.4 S; headphone jack.
PARAMOUNT PICTURES	135	D	D		3F, 2B, SW	15-30		V/S	†	0.05	85	50	Yes	0	Yes	269.00	†20 watts x 1 into 8 ohms, 25 watts x 1 into 4 ohms.
PHILIPS	AV-1001(RI)	DP	D/R	O	3F, 2B	1-99	10	V/S						2	Yes	2000.00	Bitstream D/A conversion; digital signal processing; matrix switching for nine A/V inputs, including S-video.
PIONEER	VSP-555(RI)	D					3		38 x 2	0.05	90		Yes		4	375.00	Dolby, stadium, and simulated surround.
	SP-700D	D/DP	D	F/P	3F, 2B, 2S, SW	1-50	5	V/S			90		Yes		No	700.00	
	SP-91D	D/DP	D	F/P	3F, 2B, 2S, SW	1-50	8	V/S			95		Yes		No	1000.00	18-bit D/A conversion.
PROTON	SD-1000(RI)	O		F/P	3F, 3B, SW					0.008	100	58	No	1	No	1000.00	
SANSUI	RZ-9500AV (RI)	DP	D	P	3F, 2B	0-350	3	V/S	100 x 2, 30 x 2, 40 x 1	0.02	85	70	Yes	2	Yes	769.95	AM/FM tuner and five-channel amp.
	RZ-7500AV (RI)	D	D	P	2F, 2B	20 or 30	1	V/S	100 x 2, 20 x 2	0.02	85	70	Yes	2	Yes	579.95	As above but four-channel.
SHERWOOD	ES-1280	D/D	D		2F, 2B	15-30	4	V	20 x 2	0.3	86		Yes	1	No	199.95	
SHURE HTS	HTS5300(RI)	DP	D	O	3F, 2B, SW	16-36				0.1	90	65	Yes	1	No	999.00	Logic steering; digital delay.
SONY ES	SDP-777ES (RI)	DP/O	D	O	3F, 2B, SW	0.1-80	3			0.008	90		Yes	1	4	850.00	
	TA-E1000ESD (RI)	DP/O	D/R	F/O	3F, 2B, SW	0.1-2500	20	V/S		0.003	110		Yes	2	5	1000.00	Digital preamp/surround processor.
SOUND CONCEPTS	SSD550	D	D/R		2F, 2B	5-100		V		0.1	92	80	Yes		No	869.00	Music/film mode switching.
SSI SURROUND SOUND	System 1000	D	D		3F, 2B, SW	10-30	0		20 x 2	0.05	85	50	Yes	1	No	199.00	With speakers, $249.00.
	System 3000(RI)	DP	D		3F, 2B, SW	10-30	0		25 x 2	0.02	80	65	Yes			349.00	
	System 4000II(RI)	D/D	D		3F, 2B, SW	10-30	0		45 x 2	0.03	95	70	Yes	4	4	549.00	Logic steering; amp switchable for center channel or surround channels.
	System 4500(RI)	D/O	D		3F, 2B, 4S, SW	10-30	0			0.03	95	70	Yes	4	4	599.00	Logic steering; adjustable center-channel balance.
TECHNICS	Home THX Sound System	D							100 x 6						Yes	12,000.	Includes one controller, three stereo power amps, three front speakers, two surround speakers, and one subwoofer.
YAMAHA	DSP-3000(RI)	D/O	D	D	5F, 3B, 2S, SW	1-150	35	V/S		†	110		No	1	Yes	1899.00	†Main channels, 0.002%; effects channels, 0.005%. Digital sound-field processing.
	DSP-A700(RI)	DP/O	D/R	O	5F, 2B	1-99	12	V/S	60 x 2, 15 x 5	0.012	105	60	No	1	Yes	1099.00	Digital sound-field processing; active servo amplification; for use with AVS-700 source selector.
	DSP-E300(RI)	DP/O	D/R	D	3F, 2B	1-99	12	V/S	15 x 5				No	1	Yes	799.00	As above.
	AVX-700(RI)	DP/D	D/R	C	3F, 2B	5-30	3		65 x 2, 14 x 3	0.02	98	65	No	2	4	649.00	Active servo amplification.
	AVX-500(RI)	DP/D	D	C	3F, 2B		1		80 x 2, 15 x 3	0.01	96	65	No	1	3	549.00	As above.
	DSR-70 PRO	DP	D		3F, 2B, SW	20 or 30				0.02					No	249.00	
	SR-508	D/D	D	C	2B	10-30	5		25 x 2	0.03	103	47	Yes	1	No	299.00	

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At right is an example, Powered Partner 570. With 40 watts of power in each speaker, the 570 uses a 5" polypropylene woofer and liquid-cooled tweeter to deliver better bass and sweeter high-frequencies. Plus it's shielded to prevent screen distortion when used with video or computer.

The 570 offers more music source options, and provides treble, bass and volume controls. It adapts to any listening environment with a simple universal mounting bracket. The automatic on/off switch turns off soon after the music stops—a convenience for hard-to-reach mountings.

Another side of the 570's versatility is the portability of AC/DC power. A battery pack, car cigarette lighter adapter, and carrying case are available. DC input voltage from 12V to 25V can be used.

For more information and free literature on the complete line of Powered Partners, call 1-800-288-AR4U.

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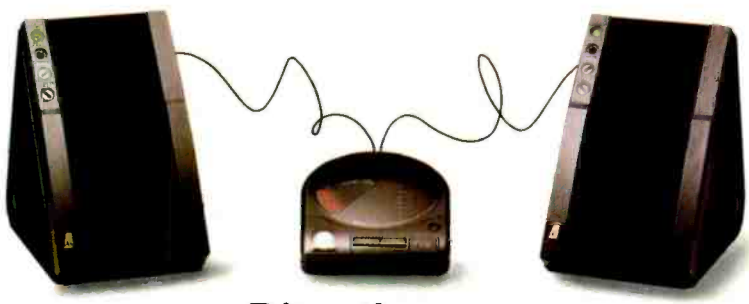
Disc.



Discotheque.

Get out your dancing shoes. Now your portable disc player can easily fill a whole room with music. Plug Powered Partners amplified speakers into it or into your portable cassette's headphone jack, and feel the room come alive. After all, it takes more than one to tango. Free literature, call 1-800-288-AR4U. **Powered Partners. Superior Sound Simplified.**

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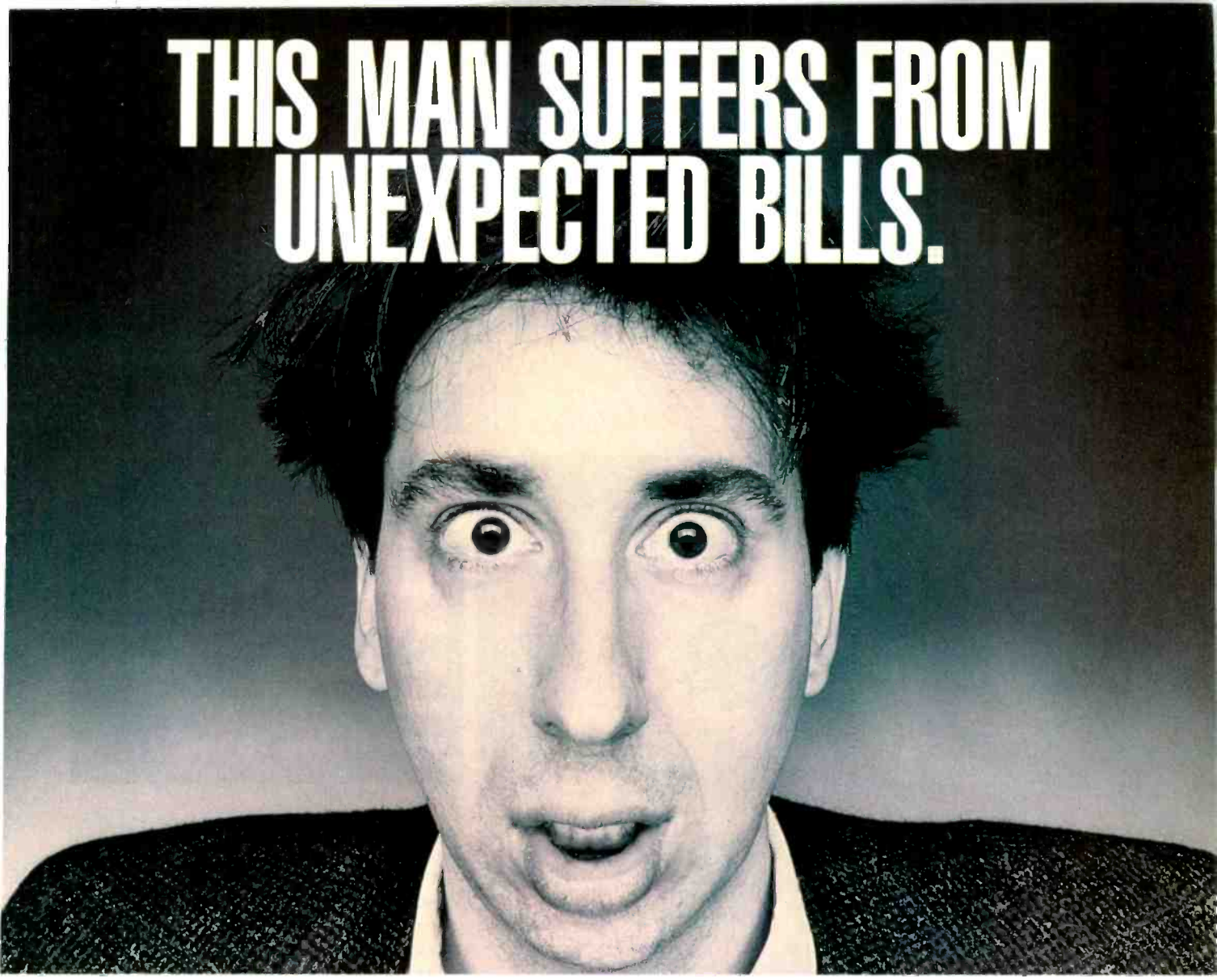
HI-FI VCRs

MANUFACTURER	Model	Format	Standard Audio Tracks: Mono = M, Stereo = S. Stereo with Dolby NR = D	Frequency Response, Hz to kHz, ± dB	Audio S/N Ratio, – dB, re: 0 dB	THD, %	Separation, dB, at 1 kHz	Simulcast Recording?	Dynamic Range, dB	Wow & Flutter, Wtd. Peak, %	On-Screen Programming?	Programmability: Number of Days/Number of Events	Audio Dubbing?	Phone Jack?	Volume Control on Phone Jack?	Number of Tape Speeds, Record/Play	Price, $
BANG & OLUFSEN	Beocord VX5000	S-VHS HQ	M	20-20 ±3		0.5	55	Yes	80	0.005	Yes	365/8	Yes	Yes	Yes	2/3	1995.00
FISHER	FVH-7600	VHS	S	20-20 ±3	90 dBA	0.4	45	Yes	90	0.005	Yes	365/6	Yes	No		3/3	529.95
	FVH-Z1	S-VHS HQ	M	20-20 ±3	90 dBA	0.3	50	Yes	90	0.005	Yes	365/6	Yes	Yes	Yes	3/3	1499.95
	FVH-S6800	S-VHS	M	20-20 ±3	90 dBA	0.4	45	Yes	90	0.005	Yes	365/6	Yes	Yes	Yes	3/3	899.95
GE	VG4200	VHS HQ	M	20-20 +0,-3	75 dBA	0.5	70	Yes	90	0.005	Yes	31/4	No	No		3/3	469.00
	VG4202	VHS HQ	M	20-20 +0,-3	75 dBA	0.5	70	Yes	90	0.005	Yes	365/8	No	No		3/3	499.00
GRUNDIG	VS-900A	VHS HQ	S	20-20 +0,-3	90 dBA	0.005	60	Yes	90	0.02	Yes	31/8	No	No		3/3	499.00
	VS-9600	VHS HQ	S	20-20 +0,-3	90 dBA	0.05	60	Yes	90	0.02	Yes	31/8	No	Yes	Yes	3/3	599.00
HITACHI	VT-F441A	VHS HQ	M	20-20 ±3	70	0.3	60	No	90	0.005	Yes	365/8	No	No		2/3	599.95
	VT-F445A	VHS HQ	M	20-20 ±3	70	0.3	60	No	90	0.005	Yes	365/8	Yes	Yes	No	2/3	649.95
	VT-F540A	VHS HQ	M	20-20 ±3	70	0.3	60	No	90	0.005	Yes	365/8	Yes	Yes	Yes	2/3	699.95
	VT-S730A	S-VHS HQ	M	20-20 ±3	70	0.3	60	No	90	0.005	Yes	365/8	Yes	Yes	Yes	2/3	1099.95
JVC	HR-S5500U	S-VHS	S	20-20	40			Yes	90	0.005	Yes	14/8	Yes	Yes	No	2/3	1299.00
	HR-S6600U	S-VHS	S	20-20	40			Yes	90	0.005	Yes	14/8	Yes	Yes	No	2/3	1499.00
	HR-SC1000U	S-VHS	M	20-20	40			Yes	90	0.005	Yes	14/8	Yes	Yes	No	2/3	1599.00
	HR-S10000U	S-VHS	S	20-20	40			Yes	90	0.005	Yes	14/8	Yes	Yes	No	2/3	3500.00
	HR-D780U	VHS	S	20-20				No	90	0.005	Yes	31/8	No	Yes	Yes	2/3	
	HR-D860U	VHS	S	20-20				No	90	0.005	Yes	31/8	No	Yes	Yes	2/3	
	HR-D960U	VHS	S	20-20				Yes	90	0.005	Yes	31/8	Yes	Yes	Yes	2/3	
	HR-D970U	VHS	S	20-20				Yes	90	0.005	Yes	31/8	Yes	Yes	Yes	2/3	
MITSUBISHI	HS-U82	S-VHS HQ	M	20-20 ±3		0.3	60	No	90	0.005	Yes	28/8	Yes	Yes	Yes	2/3	1699.00
	HS-U62	S-VHS HQ	M	20-20 ±3		0.3	60	No	90	0.005	Yes	28/8	Yes	Yes	Yes	2/3	999.00
	HS-U53	VHS HQ	M	20-20 ±2		0.3	60	No	90	0.005	Yes	28/8	Yes	Yes	Yes	2/3	699.00
	HS-U52	VHS HQ	M	20-20 ±2		0.3	60	No	90	0.005	Yes	28/8	Yes	Yes	Yes	2/3	649.00
OPTONICA	VC-G980U	VHS HQ	S	20-20			60	Yes	90		Yes	365/8	Yes			3/3	500.00
	VC-G990U	S-VHS HQ	S	20-20			60	Yes	90		Yes	365/8	Yes	Yes	No	2/3	900.00
PANASONIC	PV-4060	VHS	S	20-20					90	0.005	Yes	31/2	No	No		2/2	429.00
	PV-4062	VHS	S	20-20					90	0.005	Yes	31/4	No	No		2/2	499.00
	PV-4066	VHS	S	20-20					90	0.005	Yes	31/8	No	No		2/2	549.00
	PV-4070	VHS	S	20-20					90	0.005	Yes	31/8	Yes	No		2/2	729.00
	PV-S4080	S-VHS	S	20-20					90	0.005	Yes	31/8	Yes	No		2/2	829.00
	PV-S4986	S-VHS	S	20-20					90	0.005	Yes	31/8	Yes	Yes		2/2	1099.00
	PV-S4990	S-VHS	S	20-20					90	0.005	Yes	31/8	Yes	No		2/2	1599.00
PHILIPS	VR 6605	VHS HQ	M	20-20	95				90		Yes	31/8					599.95
	VR 6705	VHS HQ	M	20-20	95				90		Yes	31/8					749.95
	VR 6995	S-VHS HQ	M	20-20	95				90		Yes	31/8					1799.95
PIONEER	VH-930SD	S-VHS HQ	S	20-20			60	Yes	90		Yes	21/8	Yes	Yes	Yes	3/3	1500.00
QUASAR	VH6205	VHS HQ	M	20-20 +0,-10	60			Yes	90	0.015	Yes	31/2	No	No		3/3	459.95
	VH6405	VHS HQ	M	20-20 +0,-10	60			Yes	90	0.015	Yes	31/4	No	No		3/3	529.95
	VH6408	S-VHS HQ	M	20-20 +0,-10	60			Yes	90	0.015	Yes	31/8	No	Yes	Yes	3/3	819.95
	VH6505	VHS HQ	M	20-20 +0,-10	60			Yes	90	0.015	Yes	31/8	Yes	Yes	Yes	3/3	779.95
RCA	VR671HF	VHS HQ	M	20-20 +0,-3	73 dBA	0.1	60	Yes	83	0.005	Yes	365/8	No	No		3/3	529.00
	VR675HF	VHS HQ	M	20-20 +0,-3	73 dBA	0.1	60	Yes	83	0.005	Yes	365/8	No	No		3/3	579.00
	VR685HF	VHS HQ	M	20-20 +0,-3	73 dBA	0.1	60	Yes	83	0.005	Yes	365/8	Yes	Yes	Yes	3/3	699.00
	VR740HF	S-VHS HQ	M	20-20 +0,-3	73 dBA	0.1	60	Yes	83	0.005	Yes	365/8	Yes	Yes	Yes	3/3	899.00
REALISTIC	16-616	VHS HQ	M	20-20 +3,-6	43			Yes	80		Yes	365/8		No		3/3	499.95
	16-617	VHS HQ	M	50-20 ±3	43			Yes	65		Yes	365/6		No		3/3	449.95
SANYO	VHR9670	VHS HQ	S	20-20 ±3	90	0.4	45	Yes	90	0.005	Yes	365/6	Yes	No		3/3	449.99
	VHR9500	VHS HQ	M	8-52 +0,-3	78 dBA	0.57	72	Yes	80	0.032	Yes	21/6	No	No		3/3	399.99
	VHR9600	VHS HQ	M	8-52 +0,-3	78 dBA	0.57	72	Yes	80	0.032	Yes	21/6	No	No		3/3	499.99
SHARP	VC-H860U	VHS	M	20-20				Yes	90		Yes	365/8	No	No		3/3	499.00
	VC-H870U	VHS	M	20-20				Yes	90		Yes	365/8	No	No		3/3	499.00
SONY	SLV-575	VHS HQ	M	20-20	90 dBA				90	0.005 wrms	Yes	31/8	Yes	Yes	Yes	2/3	600.00
	SLV-676	VHS HQ	M	20-20	90 dBA				90	0.005 wrms	Yes	31/8	Yes	Yes	Yes	2/3	700.00
	SLV-757	VHS HQ	M	20-20	90 dBA				90	0.005 wrms	Yes	31/8	Yes	Yes	Yes	2/3	1200.00
TOSHIBA	M-641	VHS HQ		20-20		0.005	60	Yes	90	0.005	Yes	365/8	No	Yes	Yes	2/3	499.00
	SV-771	S-VHS HQ		20-20		0.005	60	Yes	90	0.005	Yes	365/8	Yes	Yes	Yes	2/3	799.00
	SV-F990	S-VHS HQ		20-20		0.005	60	Yes	90	0.005	Yes	14/8	Yes	Yes	Yes	2/3	1799.00
ZENITH	VRG520HF	VHS	S	20-20 ±6	40		60	Yes	80	0.008	Yes	31/8	Yes	No		2/3	649.00

THIS MAN SUFFERS FROM UNEXPECTED BILLS.



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IN-WALL SPEAKERS

HIDDEN MAGIC

The newest generation of in-wall speakers can overpower your senses *without* taking over your living space.

Sonance II

Sonance III

This special supplement was produced by David Elrich for the Publisher of AUDIO Magazine. The editorial staff of AUDIO was not involved in its preparation.

Out of sight but definitely not out of mind is the philosophy behind the latest engineering advances of in-wall loudspeaker systems.

As the Home Theater Revolution sweeps through America's living rooms, enthusiasts are looking for options that let them live comfortably with their equipment. The primary objective is "big picture, big sound" . . . an experience close to their favorite movie palace. With a full-blown Dolby Pro Logic system, however, nearly half a dozen loudspeakers are required, sometimes even more. Few rooms can comfortably accommodate that much equipment. Enter the in-wall architectural speaker—loudspeakers with the capability to deliver a full range of sound without taking up any floor space.

"Enthusiasts look for the widest possible frequency response and dynamic range when they buy loudspeakers. This holds true if they are listening to either movie soundtracks or music. The challenge of every manufacturer is to design equipment that can easily be mounted into a wall and deliver the same high-quality performance for a Home Theater, CDs or even an FM tuner," said Scott Struthers, president of Sonance, the largest maker of in-wall

a/d/s/ 750iL

speakers. The popular Sonance II ($245 a pair with brackets) is a good example of a 1990 built-in. The two-way speakers use a 4-layer voice coil to roll off the high frequencies; a 1-inch ferro-fluid damped polycarbonate dome tweeter is also part of the system as is a 6½-inch polycarbonate woofer with a frequency response (F/R) of 55-20,000 Hz with an efficiency rating of 90 dB. The Sonance IIIC ($375 a pair with brackets) is rated at 45-20,000 Hz and 89 dB efficiency.

"Many people make the mistake that in-wall speakers are just fill-ins," added Bill McGrane, president of MB Quart, another top speaker manufacturer. "With current technology, they can easily be the primary speakers in your media room or used throughout the house." The new Quart 90M In-Wall Speaker System ($599 a pair including brackets) uses an 8-inch woofer for accurate bass and a 1-inch titanium dome tweeter to capture the high-end. The crossover is fixed at 2,000 Hz, 12 dB/octave to ensure both tweeter and driver operate within their most efficient frequency ranges. Frequency response for the 90M is 46-32,000 Hz with an 88 dB efficiency rating.

Polk AB900

While there is definitely some appeal to high-quality audio in the kitchen it's the emerging popularity of Home Theaters with Dolby Surround that is the fueling the new in-wall speaker competition. To appreciate the best Hollywood sound engineers have to offer, a four-speaker system powered by an A/V receiver with a *passive* Dolby Surround decoder is a minimum (front left/right and two rear surround units). Moving up from passive Dolby Surround decoding to *active* receivers or standalones with Dolby Pro Logic requires an additional speaker for the center dialog channel and possibly side speakers. One of the biggest concerns for consumers trying to re-create the cinema experience at home is the difficulty of running wires along baseboards, under rugs or along the ceiling for the surround speakers. Rather than disrupting a carefully designed decor to add the dramatic impact of Dolby Surround, installers (or advanced do-it-yourselfers) now can run wires through the walls to hookup high-quality built-in speakers that are available from a wide range of manufacturers—without compromising their sonic standards.

Paradigm AMS-200

DRIVING TO THE TOP

Just as Indiana Jones searched for the Holy Grail, Home Theater enthusiasts reach for the best performance possible. Anyone who has experienced Indy trying to escape an on-rushing boulder in the theater during "Raiders of the Lost Ark," wants to re-create that sensation at home. To achieve the deep, rumbling bass, one manufacturer has designed in-wall speakers with satellites and subwoofers. The Polk AB900 ($750) has an overall frequency response of 25 to 20,500 Hz with an 88 dB efficiency rating. The subwoofer uses two 6½-inch bi-laminate drivers that are acoustically coupled to eliminate harmonic distortion. Each

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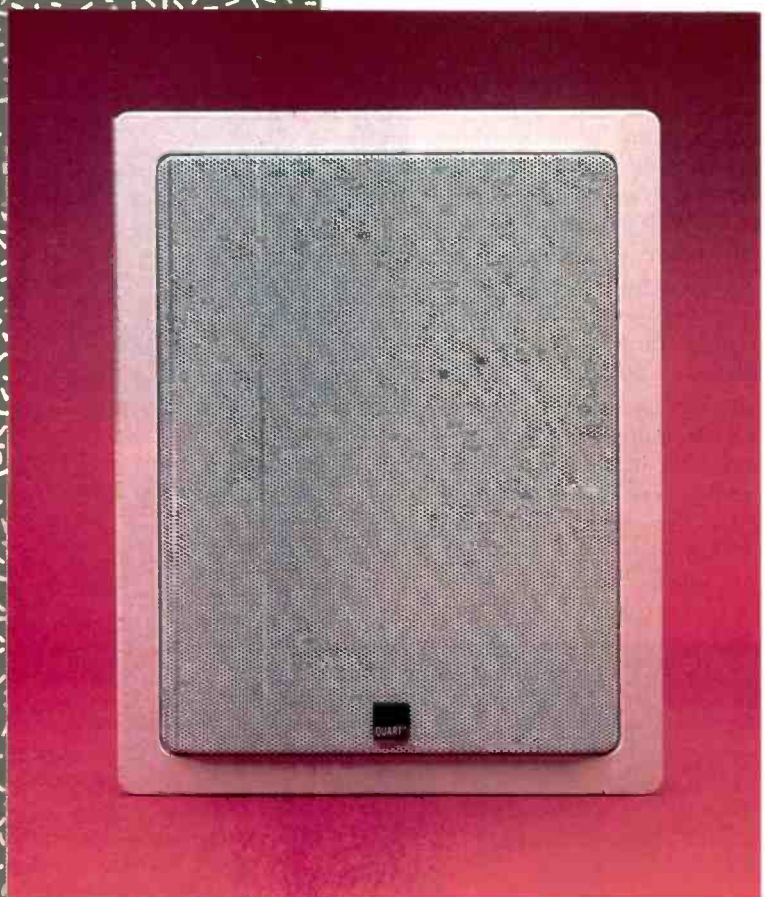


MB Quart 90M

"Today's in-walls not only can handle the Dolby Surround channels but the demands of the most sophisticated audio systems."
Bill McGrane/MB Quart

satellite (which are slightly larger than light switchplates) includes a ¾-inch tweeter and a 2½-inch driver in a self-contained rear enclosure which isolates it from the wall cavity for top performance.

Infinity, maker of the famed $50,000 IRS V Reference Standard loudspeakers, has taken some the knowhow developed for the chosen few and incorporated it into their top-of-the-line in-wall, the Environmental Reference Standard Series ERS800 ($550 a pair). The Infinity in-wall uses the EMIT *k* tweeter found in the IRS family and offers a level control that can be adjusted for different room acoustics. It also has an 8-inch IMG long-throw woofer to deliver frequency response of 45-55,000 Hz. John Stiernberg, Infinity's Director of Environmental Products, said the ERS800 in-walls offer "accurate highs and good dispersion throughout the listening area."

As speaker makers have turned their attention to in-walls, they are also discovering innovative ways to refine the technology. The new 750iL from a/d/s/ locates the drivers on the same plane as the wall to eliminate potential cavity resonances. It uses a 4th order Linkwitz-Riley 3-way crossover network, high energy 3-way unison copolymer drivers (1-inch tweeter, 1½-inch midrange and a 7-inch long excursion woofer) as well as a cast aluminum mounting system. Priced at $1,200 the pair, the a/d/s/ 750iL offers frequency response of 35-20,000 Hz and the efficiency rating is 90 dB.

AUDIOPHILE SPECS

Paradigm engineers have designed a one-piece die cast aluminum chassis for their first in-wall model, the Architectural Monitor Series AMS-200. According to Bill Vander Marel, company president, "In order to reach audiophile specs, an in-wall speaker must take into account wall vibration and flexing. An aluminum chassis will not only dramatically cut down mechanical

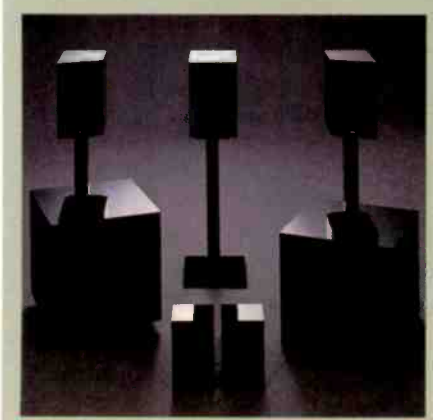
vibration, it acts as a heat sink for the woofer and tweeter for increased power handling." The new 2-way AMS-200 feature a quasi-Butterworth dividing network that is time- and frequency-aligned. They cost $299 a pair ($49 for brackets) and deliver F/R of 70-30,000 Hz with 88 dB efficiency rating.

With in-wall speakers becoming such an integral part of Home Theater systems—whether it's for the center dialog channel, the side and rear effects channels or for all of the possibilities of Dolby Pro Logic—it was only natural that one of the pioneers of surround sound would also design an in-wall speaker. Fosgate°Audionics, manufacturer of some of the most intricate home Dolby decoders, has a series of architectural speakers and the AS802 is the top-of-the-line. It's a sealed in-wall unit with an 8-inch polypropylene woofer/midrange coupled with an open-back soft-dome tweeter housed in its own subenclosure. Bass performance reaches 44 Hz with 22,000 Hz the high end. Fosgate°Audionics offers a series of Dolby decoding components and in-wall speakers that lets you mix and match for optimum results. Other leading manufacturers of in-wall speakers include Boston Acoustics, MTX and KEF.

Infinity ERS Series

Optimum sound reproduction without taking up valuable floor space is the philosophy behind the new generation of in-wall speakers. Accessibility is another key word, according to Bill McGrane of MB Quart. "Everyone wants to experience a great Dolby Surround system in their homes but may not have the room for all of the speakers required. Today's in-walls not only handle the Dolby Surround channels but the demands of the most sophisticated audio systems as well." ●

A SOUND ALTERNATIVE



NHT Surround Sound Speakers

While in-wall speakers fit many Home Theater applications, some manufacturers are designing small loudspeaker systems that deliver the big sound necessary for a true livingroom movie experience without eating up floor and shelf space. Now Hear This (NHT) has expanded upon their popular Model 1 shielded speaker and designed the Model 1C ($170) for a Pro Logic center channel. Also new is the Zero 3-Pack ($270), three 2-way 4-inch speakers for use with center and surround channels.

Companies such as Atlantic Technology, Bose and Cambridge Soundworks have even made it possible to hide the subwoofer under the couch so only two or more satellites are on view. There's no question regarding the life-like performance of the Bose Acoustimass system. Atlantic Technology developed its 3-piece Pattern system with its own built-in amplification specifically designed for use with any source—from CDs to MTS TV stereo. The Ensemble from Cambridge Soundworks offers two satellites and two subwoofers for $499. Other alternatives include powered speakers from Acoustic Research.

Some enthusiasts even find a way to fit bookshelf speakers into their home theaters. Monitor Audio is renowned for its sophisticated gold dome tweeters and metal cone woofers. The company's new Studio 10 bookshelf speakers ($3,000 the pair) are slightly over 16 inches tall and deliver a world-class sound with a F/R of 40-20,000 Hz. Add a subwoofer to the system and you're on your way to your own at-home cineplex.

Monitor Audio Studio 10

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IN-WALL SPEAKERS

MANUFACTURER	Model	Design Principle, Enclosure or System Type	Woofer Diameter, Inches	Midrange Diameter, Inches	Midrange Type	Tweeter Diameter, Inches	Tweeter Type	Separate Level Controls? Woofer = W, Midrange = M, Tweeter = T, Supertweeter = ST	Anechoic Frequency Response, Hz to kHz, ± dB	SPL, 1 Watt:1 Meter, dB	Recommended Min. Amp Power, Watts Ch.	Crossover Frequencies, Hz	Impedance, Ohms: Nominal/Minimum	Dimensions, Inches (To Nearest Inch)	Finish	Grille Color and Material	Weight, Lbs.	Price, $
ACCLAIM/ MAVRICK	Wallspeaker Ribbon WP9	In-Wall, Aperiodic Pressure Release	6			1	Ribbon		40-22 ±3	91	20		5/4	15 x 1 x 16		Opt.		900.00 Pair
	Wallspeaker Ribbon WP16	In-Wall, Aperiodic Pressure Release	6				Ribbon		40-40 ±3	91	20		5/4	15 x 1 x 16		Opt.		1600.00 Pair
	Wallspeaker Ribbon WP26	In-Wall, Aperiodic Pressure Release	(4) 6x6				Ribbon		40-40 ±2	88	50		5/4	15 x 1 x 36		Opt.		2600.00 Pair
	Wallspeaker Ribbon WP66	In-Wall, Aperiodic Pressure Release	(8) 6x6	(8)	Ribbons		Ribbon		35-40 ±2	90	50		5/4	15 x 1 x 60		Opt.		6600.00 Pair
	Wallspeaker Ribbon Custom	Ribbon			Ribbon		Ribbon									Opt.		
A/D/S/	750IL	In-Wall Inf. Baf.	7	1½	Dome	1	Dome		35-20	90	50	1k,4k		18 x 10		Perf. Metal		1200.00 Pair
	C300I/s	In-Wall Inf. Baf.	5¼			1	Dome		50-20 ±3	90	5	2.5k	4/	7 x 9	Opt.	Dpt., Metal	10 Pair	380.00 Pair
	C400I/s	In-Wall Inf. Baf.	6			1	Dome		42-30 ±3	91	5	1.6k	4/	7 x 11	Opt.	Opt., Metal	13 Pair	560.00 Pair
AES	1	In-Wall Sat.	6			2¼	Cone		55-20 ±3	90	10	2.8k	8/6	8 x 12 x 3	Matte White	White Perf. Steel	6	249.98 Pair
	2	In-Wall Sat.	6			1	Dome		40-20 ±3	91	10	2.5k	8/6	8 x 12 x 4	Matte White	White Perf. Steel	7	359.98 Pair
	3	In-Wall Subwoof.	6x9						28-90 ±3	90	10	90	8/6	8 x 12 x 4	Matte White	White Perf. Steel	9	459.98 Pair
	4	In-Wall Subwoof.	6x9						28-90 ±3	90	10	90	8/6	8 x 12 x 4	Matte White	White Perf. Steel	10	295.00
	.5	In-Wall Sat.	5¼			2¼	Cone		65-20 ±3	90	10	2.8k	8/6	8 x 11 x 3	Matte White	White Perf. Steel	5	199.98 Pair
ALTEC LANSING	ITW 265	In-Wall, Inf. Baf. Sat.	6½			⅞	Dome		40-20 ±3	90	10	3.5k		12 x 9 x 4	Plast.	White	10	300.00 Pair
	ITW 260	In-Wall Subwoof.	(2)6½						32-250 ±3	90	30	180		20 x 13 x 4	Black Vinyl	White	45	400.00 Pair
AMBRIA	C300	In-Wall Inf. Baf.	6½			1	Dome		45-20 ±3	90	15	2.5k	/8	9 x 12 x 3	White ABS	White Steel	4	
	C200	In-Wall Inf. Baf.	5¼			¾	Dome		60-20 ±3	89	10	3k	/4	8 x 11 x 2	White ABS	White Steel	2½	
ATLANTIC TECHNOLOGY	Pattern	Powered Sat. & Subwoof.	(2)6½			(2)3	Cones	W	38-20 ±3	93	Inc.	100	10k/ 2k	Three Pieces	Black Plas., Black Vinyl	Black Metal, Black Plas.	35 Sys.	499.00 Sys.
AUDIO CONCEPTS	Premier Wallspeaker	In-Wall	7			1	Dome	T	60-20 ±3	89	30		8/6	12 x 8	White	Opt.	10	249.00 Pair
AXIOM AUDIO	AX 1.5 Wallmount	In-Wall	6½			¾	Dome		45-22 ±2	89	15	3.5k	8/6	14 x 19 x 1	Opt.	Black Knit	16 Pair	328.00 Pair
BOSTON ACOUSTICS	380	In-Wall	8			1	Dome		48-20 ±2	90	5	2.7k	8/	10 x 13 x 4	Matte White			500.00 Pair
	360	In-Wall	6½			1	Dome		58-20 ±2		5	3k	8/	12 x 9 x 3	Matte White		4	400.00 Pair
	350	In-Wall	5¼			1	Dome		68-20 ±2	90	5	3.5k	4/	10 x 7 x 3	Matte White		3	300.00 Pair
	325	In-Wall	5¼			¾	Cone		68-20 ±3	90	5		8/	7 x 7 x 2	Matte White		2	200.00 Pair
	305	In-Wall	5¼				Cone		68-17 ±3	90	5		8/	7 x 7 x 2	Matte White		2	130.00 Pair
B & W	CWM6	In-Wall	6			1	Dome		45-20 ±3	89	10	3k	6/	12 x 8 x 3	White	Opt.		
	CWM8	In-Wall	8			1	Dome	T	35-20 ±3	90	10	3k	4/	13 x 10 x 3	White	Opt.		
CANTON	Inwall 6	In-Wall Inf. Baf.	6			½	Dome		45-22	89		2.5k	8/	7 x 7 x 3		Opt.	5	450.00 Pair
	Inwall 9	In-Wall Inf. Baf.	9			1	Dome		34-22	89		2.5k	8/	10 x 10 x 3		Opt.	7	600.00 Pair
	Inwall Sub	In-Wall, Inf. Baf. Subwoof.	9						25-150	89		150	8/	10 x 10 x 3		Opt.	7	350.00 Pair
DYNACO	FL 650	In-Wall	6½			1	Dome		58-20 ±3	92	5	2.5k	8/6	12 x 8 x 4	White	Fabr.	7½	170.00 Pair
	FL 525	In-Wall	5¼			1	Dome		68-20 ±3	90	5	3k	8/6	11 x 7 x 2	White	Fabr.	6	150.00 Pair
FOSGATE-AUDIONICS	AS803	In-Wall Inf. Baf.	(2)8	8	Cone	1	Dome	T	38-22	89	20	2.5k	4/3	14 x 56 x 4			60	1599.00 Pair
	AS802	In-Wall Inf. Baf.	8			1	Dome	T	48-22	89	20	2.5k	8/6	14 x 28 x 4			33	999.00 Pair
	AS602	In-Wall	6			1	Dome	T	75-22	87	10	3k	8/6	12 x 9 x 4			12 Pair	425.00 Pair
	AS502	In-Wall	5			1	Dome	T	85-18	87	10	3k		11 x 8 x 3			10 Pair	350.00 Pair

IN-WALL SPEAKERS

MANUFACTURER	Model	Design Principle, Enclosure or System Type	Woofer Diameter, Inches	Midrange Diameter, Inches	Midrange Type	Tweeter Diameter, Inches	Tweeter Type	Separate Level Controls? Woofer - W, Midrange - M, Tweeter - T, Supertweeter - ST	Anechoic Frequency Response, Hz to kHz, ±dB	SPL, 1 Watt 1 Meter, dB	Recommended Min. Amp Power, Watts Ch.	Crossover Frequencies, Hz	Impedance, Ohms: Nominal/Minimum	Dimensions, Inches (To Nearest Inch)	Finish	Grille Color and Material	Weight, Lbs.	Price, $
FOSTEX	LS2	In-Wall	12		Compr.		Compr.								Wal. Ven.	Opt.		3300.00 Pair
	LS3	In-Wall	(2)15		Compr.		Compr.								Wal. Ven.	Opt.		4000.00 Pair
	LS4	In-Wall	12, (2)15		Compr.		Compr.								Wal. Ven.	Opt.		6000.00 Pair
	SH2020	In-Wall	8				Dome		48-20			2.5k		9 x 12	White	White Metal		195.00
	SH2510	In-Wall Subwoof.	6				Dome		32-250					11 x 11	White	White Metal		250.00
GC ELECTRONICS	30-3500	In-Wall	5¼		Cone	1	Dome	W,T	50-20 ±3	90	35	2.8k		8 x 11 x 2	White Plast.	White Metal	3⅜ Pair	87.50 Pair
GOLD SOUND	8C	In-Wall	8			1¼	Dome		40-25 ±3	92	5	4k	4/8		Opt.	Opt.	10	199.00 Pair
	8AC	In-Wall	8			2	Cone		32-20 ±3	92	5	3k	4/8		Opt.	Opt.	18	249.00 Pair
	GS10C	In-Wall Inf. Baf.	10			1	Dome	T	30-20 ±3	94	5	4k	8/4	10 Dia. x 5	Opt.	Opt.	12	129.00
	GS12C	In-Wall Inf. Baf.	12			1	Horn	T	25-20 ±3	94	5	3k	8/4	12 Dia. x 5	Opt.	Opt.	17	169.00
	GS15C	In-Wall Inf. Baf.	15			3x6	Horn	M,T	20-25 ±3	96	5	3k	8/4	15 Dia. x 6	Opt.	Opt.	20	229.00
	824	In-Wall Subwoof.	8						32-2 ±3	92	5		4/8		Opt.	Opt.	16	199.00 Pair
	844	In-Wall Subwoof.	8						30-2 ±3	92	5		4/8		Opt.	Opt.	24	249.00 Pair
INFINITY	ERS800	In-Wall	8				EMIT	T	45-45	89	20	3.5k	4/3.5	16 x 11 x 4	Beige ABS	Beige Metal		600.00 Pair
	ERS600	In-Wall	6			¾	Dome	T	55-22	89	15	4.4k	4/4	18 x 9 x 4	Beige ABS	Beige Metal		350.00 Pair
	ERS500	In-Wall	5¼			1	Cone		70-20		8	5k		8 x 8 x 3	Beige ABS	Beige Metal		275.00 Pair
JBL	S-3	In-Wall Inf. Baf.	5¼			1	Dome		125-22 ±3	86	10	3k	4/3	11 x 7 x 4	Matte White	White Metal	14 Pair	269.00 Pair
	S-4	In-Wall Inf. Baf.	6¼			1	Dome		125-22 ±3	88	10	3k	4/3	12 x 9 x 4	Matte White	White Metal	16 Pair	329.00 Pair
KEF	CR200F	In-Wall or Ceiling Mount	8			1	Dome		55-22 ±2	90	10	2.5k	4/	13 x 10 x 4	White	White Metal	5	
	CR160S	In-Wall or Ceiling Mount	6½			¾	Dome		60-17 ±2	88	10	3k	4/	9 x 9 x 4	White	White Metal	4	
	CR160R	In-Wall or Ceiling Mount	6½			¾	Dome		60-17 ±2	88	10	3k	4/	9 Dia. x 4	White	White Metal	4	
	CR250SW	In-Wall or Ceiling Subwoof.	10						32-150 ±2	90	10	150	4/	13 x 13 x 4	White	White Metal	8	
LUXMAN	S-503	In-Wall	6½			1	Dome	T	60-22 ±2.5	89	20	7k	8/5.6	9 x 12 x 3	White	White		300.00 Pair
	S-505	In-Wall	8			1	Dome	T	50-22 ±2.5	89	20	3k	8/5.6	14 x 10 x 3	White	White	6⅝	500.00 Pair
MB QUART ELECTRONICS	Quart 90M	In-Wall	8			1	Dome		46-32		100			12 x 10 x 3	White	White	5	599.00 Pair
McINTOSH	WS-200	In-Wall	6			1	Dome		70-20	86	30	1.3k	8/	12 x 9 x 3	White	White Metal	43 Pair	649.00 Pair
MTX	WS 62	In-Wall	6			1	Dome		62-22 ±3	93		3.5k	6/	16 x 11 x 2	White	Cloth		174.95
	WS 82	In-Wall	8			1	Dome		55-22 ±3	94		1.8k	6/	18 x 12 x 3	White	Cloth		174.95
	WS 103	In-Wall	10	5	Cone	1	Dome		48-22 ±3	95		650,3.7k	6/	26 x 14 x 4	White	Cloth		224.95
	WS 10	In-Wall Subwoof.	10						38-800	93		800	4/	14 x 14 x 4	White	Cloth		149.95
NEAR	PS-2.0	In-Wall	6			¾	Dome		55-25 ±2	88	30	3.3k	8/5	9 x 12 x 3	White	White	12	550.00 Pair
NILES AUDIO	100	In-Wall Inf. Baf.	6½			1	Dome	T	55-20 ±3	87	10	4k	8/7.5	12 x 9 x 3	White ABS	Opt.	6½ Pair	
	200	In-Wall Inf. Baf.	6½			1	Dome	T	55-20 ±2	88	10	2.8k	8/7	12 x 9 x 3	White ABS	Opt.	9 Pair	
	300	In-Wall Inf. Baf.	8			1	Dome	T	40-20 ±2	89	10	2.5k	8/6.5	14 x 10 x 4	White ABS	Opt.	12 Pair	
PARADIGM	AMS-200	In-Wall Inf. Baf.	6½		Cone	1	Dome		70-20 ±2.5	88	15	2k	8/6	12 x 8 x 3	White	White Steel	12 Pair	Kit, 185.00
PARAMOUNT PICTURES	Series P-652	In-Wall Inf. Baf.	6½			½	Dome		50-24	90	20	3.5k	8/6	10 x 7 x 3	Opt.	Opt.	3	204.00
	Series P-552	In-Wall Inf. Baf.	5¼			½	Dome		65-24	89	20	4k	8/6	9 x 6 x 3	Opt.	Opt.	2	190.00
	Series P-653-S	In-Wall Inf. Baf.	6½			½	Dome		80-24	92	20	6k	8/6	10 x 8 x 3	Opt.	Opt.	2	176.00
	Series Tech 6	In-Wall, Inf. Baf. Subwoof.	6½						32-150	92	20		8/6	15 x 10 x 3	Opt.	Opt.		300.00
PHASE TECHNOLOGY	CI-20	In-Wall Sat.	6			2¼	Cone		55-18	90	15	2.8k	8/6	8 x 12 x 3	White Matte	White Perf. Steel	5	140.00
(Continued)	CI-40	In-Wall Sat.	5¼			1	Dome		55-20	90	15	1.5k	4/4	8 x 12 x 4	White Matte	White Perf. Steel	8	190.00

IN-WALL SPEAKERS

MANUFACTURER	Model	Design Principle, Enclosure or System Type	Woofer Diameter, Inches	Midrange Diameter, Inches	Midrange Type	Tweeter Diameter, Inches	Tweeter Type	Separate Level Controls? Woofer = W, Midrange = M, Tweeter = T, Supertweeter = ST	Anechoic Frequency Response, Hz to KHz, ± dB	SPL, 1 Watt/1 Meter, dB	Recommended Min. Amp Power, Watts/Ch.	Crossover Frequencies, Hz	Impedance, Ohms: Nominal/Minimum	Dimensions, Inches (To Nearest Inch)	Finish	Grille Color and Material	Weight, Lbs.	Price, $
PHASE TECHNOLOGY (Continued)	CI-60	In-Wall Sat.	6			1	Dome		40-20	90	15	1.2k	4/4	8 x 12 x 4	White Matte	White Perf. Steel	8	240.00
	CI-SUB	In-Wall Subwoof.	6x9						28-90	90	25	90	4/4	8 x 12 x 4	White Matte	White Perf. Steel	9	225.00
POLK AUDIO	AB900	In-Wall Sat. & Subwoof.	(2)6½	2½	Cone	¾	Dome		40-20 +0,-3	88	20	175,4k	6/	Three Pieces	Ivory Plast.	Opt.	45 Sys.	799.95 Sys.
	AB800	In-Wall	(2)6½			1	Dome		52-20 +0,-3	91	10	3k	6/	6 x 16 x 3	Ivory Plast.	Opt.	12 Pair	549.95 Pair
	AB700	In-Wall	6½			1	Dome		55-20 +0,-3	90	10	3k	6/	6 x 10 x 3	Ivory Plast.	Opt.	8 Pair	399.95 Pair
	AB500	In-Wall	5¼			¾	Dome		56-20 +0,-3	91	10	3k	6/	7 x 10 x 3	Ivory Plast.	Opt.	6 Pair	249.95 Pair
POSH	528d	In-Ceiling	8	8	Cone	¾	Dome		58-22	87	20	150	8/6	18 x 14 x 7	Opt., Plast.	White	12	450.00 Pair
PSB	HW-1	In-Wall	6½			¾	Dome		56-20 ±2	89	5	2.4k	8/	12 x 9 x 4	White	White Metal		300.00 Pair
RBH SOUND	C-6.2	In-Wall	6½			1	Dome		48-22	90	5	2.5k	8/	12 x 9 x 4	White ABS	White Perf. Metal	35 Pair	350.00 Pair
	C-5.2	In-Wall	5¼			¾	Dome		60-22	90		3k	8/	11 x 8 x 3	White ABS	White Perf. Metal	32 Pair	275.00 Pair
	C-52	In-Wall	5¼			¾	Dome		65-22	90		3k	4/	11 x 8 x 3	White ABS	White Perf. Metal	32 Pair	195.00 Pair
	C-820	In-Wall Ac. Sus.	8			1	Dome	T	40-22	89	20	3k	8/	28 x 4 x 15	Black Wood	Opt., Cloth	33	895.00 Pair
	C-820s	In-Wall Ac. Sus.	8			1	Dome	T	40-22	89	20	3k	8/	28 x 4 x 15	Black Wood	Opt., Cloth	33	895.00 Pair
	C-860	In-Wall Ac. Sus.	8	6	Cone	1	Dome	M	40-22	91	30	200,3k	4/	55 x 15 x 3	Black Wood	Opt., Cloth	55	1195.00 Pair
	C-88SW	In-Wall, Ac. Sus. Subwoof.	8						28-100	89	20	100	4/	32 x 4 x 15	Black Wood	Opt., Cloth	33	425.00
SNELL MULTIMEDIA	LCR500	Inf. Baf.	(2)6½			(2)¾	Domes	T	90-20 ±1.25	89	30	2.7k	8/5	22 x 10 x 7	Gloss Black	Black Cloth	35	799.00
	SUR500	Inf. Baf.	(2)6½			(2)1	Domes	No	80-20 ±2		15		8/4	17 x 10 x 7	Gloss Black	Black Cloth	60 Pair	1598.00 Pair
	SUB500	Bass Ref. Subwoof.	10						22-100 ±2		30		8/8	23 x 19 x 15	Gloss Black	Black Cloth	60	499.00
SONANCE	S45	In-Wall Inf. Baf.	8¼			1	Dome	T	35-22 ±2	90	5	2.7k	8/6	16 x 12 x 3	White	Opt., White	11	650.00 Pair
	S40	In-Wall Inf. Baf.	8			1	Dome	T	40-20 ±3	89	5	2.8k	8/8	16 x 12 x 3	White	Opt., White	10	499.00 Pair
	SIIIc	In-Wall Inf. Baf.	6½			1	Dome	T	45-20 ±2	88	5	3k	8/6	12 x 9 x 3	White	Opt., White	9	375.00 Pair
	SII	In-Wall Inf. Baf.	6½			1	Dome		50-20 ±3	89	5	3.2k	8/8	12 x 9 x 3	White	Opt., White	8	245.00 Pair
	SIA	In-Wall Inf. Baf.	6½			2	Cone		70-17 ±5	90	3	3k	8/8	12 x 9 x 3	White	Opt., White	7	185.00 Pair
	M30	In-Wall Inf. Baf.	4			1	Dome		70-20 ±2	86	5	4.5k	8/8	9 x 7 x 3	White	Opt., White	4	300.00 Pair
	M10	In-Wall Inf. Baf.	4						75-15 ±5	87	3		8/7	9 x 7 x 3	White	Opt., White	4	130.00 Pair
	PSW2	In-Wall, Inf. Baf. Subwoof.	8¼						30-125 ±3	87	(2) 25	125	8/4	16 x 12 x 3	White	Opt., White	14	450.00
	ASW1	In-Wall, Powered Subwoof.	8¼						30-100 ±2	92	Inc.	50/75/ 100 (Sel.)	8/8	16 x 12 x 3	White	Opt., White	15	260.00
SPEAKERLAB	SL3	In-Wall	6½			¾	Dome		40-20	90	10	3k	8/7	9 x 12 x 1	White	White Perf. Steel	5	200.00 Pair
STAR AUDIO	WS-105	In-Wall/ Ceiling	5			1½	Cone		70-17 ±3	88	10	1.9k	8/6	11 x 8	White	White Plast.	6	125.00
	WS-205	In Wall/ Ceiling	5¼			2	Cone		60-19 ±3	90	10	3.5k	8/6	13 x 10	White	White Plast.	7	212.50
TRIAD SPEAKERS	In-Wall Five	In-Wall, Ported	5			2	Cone		85-16 ±3	88	25	2.8k	8/	12 x 8 x 4	White	Cloth, Metal	9	
	In-Wall Six	In-Wall Sat. & Powered Woofer	8	3½	Cone	¾	Dome	W	42-20 ±3	89	20	160,3.2k	8/4	Three Pieces		Cloth, Metal	20 Sys.	
	In-Wall Seven	In-Wall Sat. & Powered Woofer	12	5	Cone	1	Dome	W	38-20 ±3	88	20	120,2.5k	8/6	Three Pieces		Cloth, Metal	40 Sys.	
	In-Wall Six Woofer	In-Wall, Powered Woofer	8					W	42-160	90	70 Inc.		8/6			Cloth, Metal	16	
	In-Wall Seven Woofer	In-Wall, Powered Woofer	12					W	38-120	92	70 Inc.		8/6			Cloth, Metal	24	
WALLSPEAKER TECHNOLOGIES	Vista Inwall V3I	In-Wall, Vented	8	4	Cone	1	Dome	M,T	38-20 ±3	87	35	200,3.5k	6/4	13 x 3 x 64	Black	Opt.	50	1600.00 Pair
	Series II	In-Wall, Vented	7			1	Inv. Dome	T	42-17.5 ±3	88	25	2k	8/5	13 x 3 x 49	Gran.	Opt.	45	1650.00 Pair
	Series III	In-Wall, Vented	8	5	Cone	1	Inv. Dome	M,T	37-18 ±3	89	25	300,3.5k	8/4	13 x 3 x 73	Gran.	Opt.	57	2450.00 Pair

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