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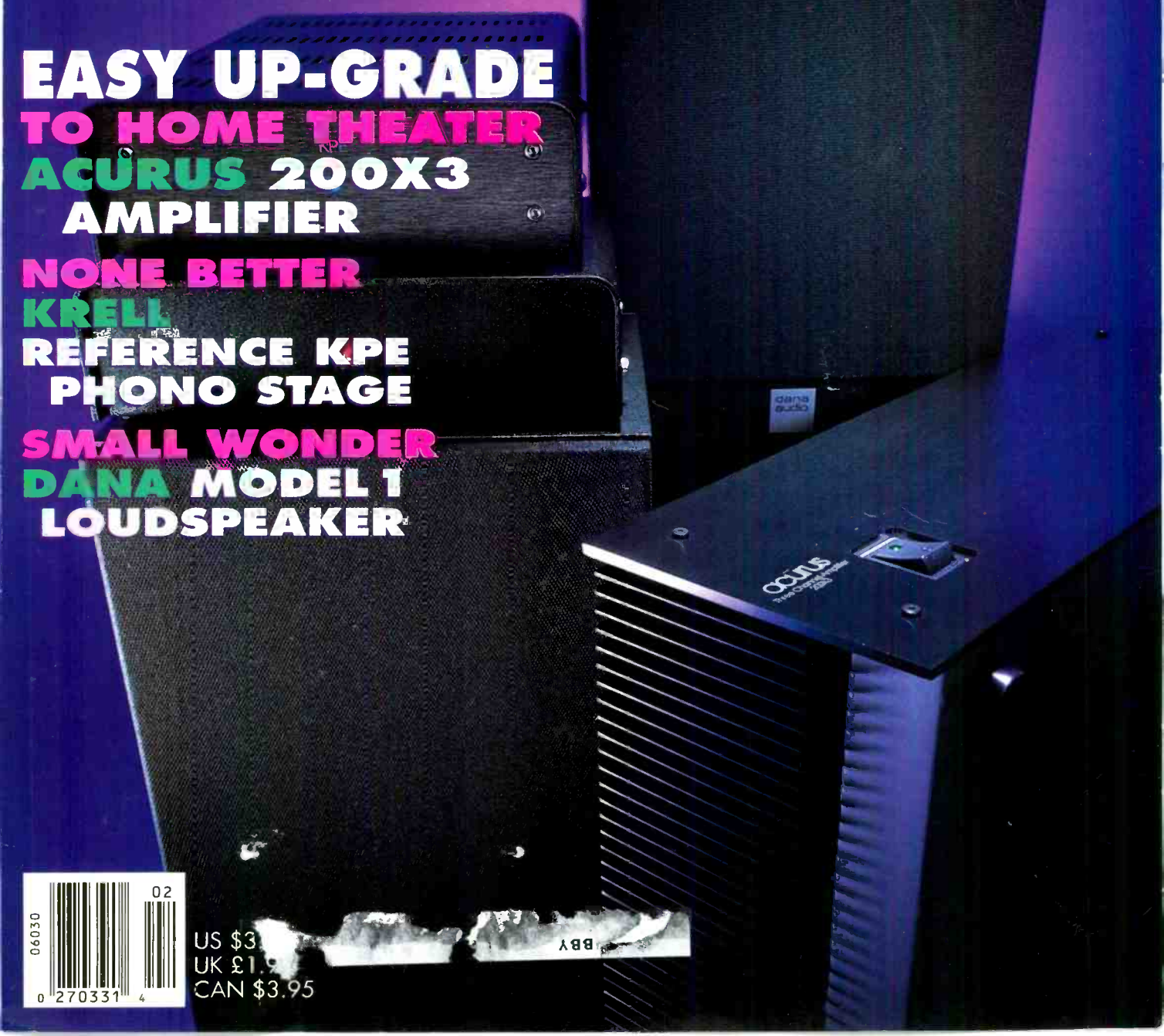

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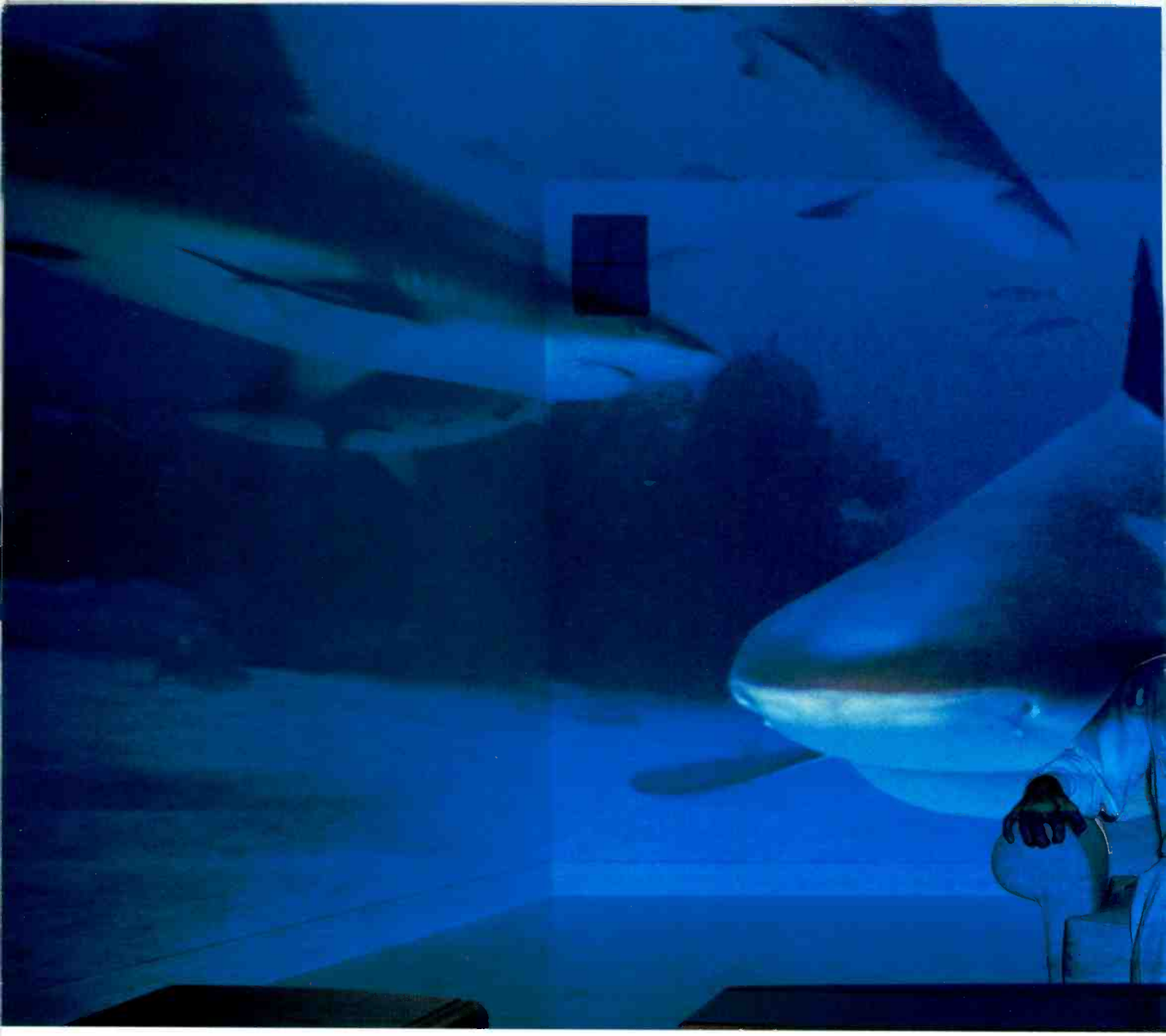

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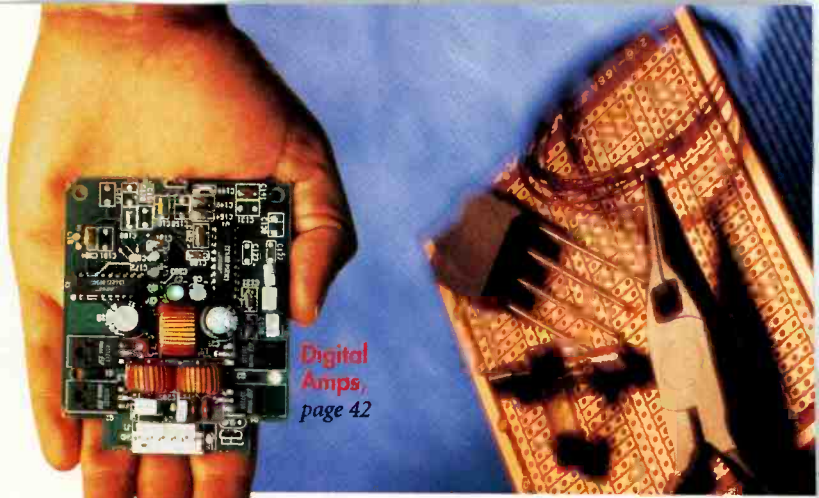

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The Cover Photographer: Bill Kouirinis Studio
The Cover Equipment: Krell Reference KPE MC phono stage, Dana Audio Model 1 speaker, and Acurus 200X3 three-channel amp

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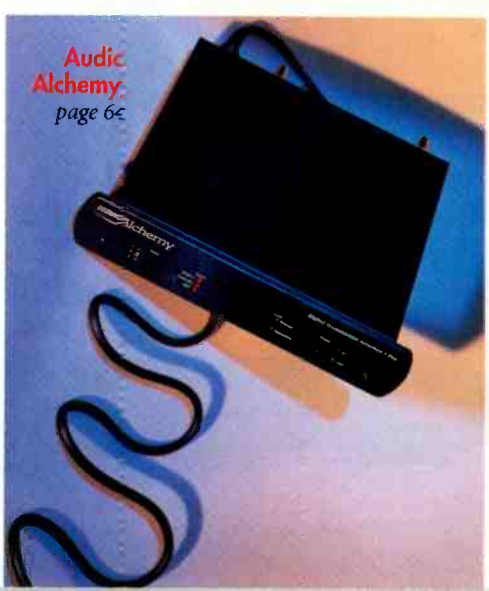

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Enter No. 18 on Reader Service Card

Henry Kloss with the Editor

There was a birthday party held not so long ago in the east balcony of New York City's Grand Central Terminal for Acoustic Research. An odd place, you might think, to hold a birthday party, but AR for many years had a music room on the west balcony of the terminal. While I didn't earn my college tuition by working in that demo room, I know that there are some professionals still in the business who did. For many thousands of commuters, AR's music room was a convenient place to stop, prior to boarding a train home, and listen to a bit of music to "soothe the savage breast."

AR was founded in 1954 with Edgar Villchur as the principal, along with Henry Kloss, who did much of the engineering. Villchur wrote several articles that were published in *Audio Engineering*, which later on became *Audio* magazine. These articles were gathered up into a small book entitled *Reproduction of Sound* and published first in 1962 by AR and then in 1965 by Dover. Attendees of AR's party were given a new commemorative edition, and as the dedication page says, "the book remains a lucid and accurate description of audio basics. . . ." Villchur had another article published in *Audio* last July, on the least noticeable change in frequency response, while Kloss was the subject of an interview back in February 1992.

For me, the most important thing about Acoustic Research is that its speakers embodied a new principle, acoustic suspension, wherein the stiff mechanical suspension in a speaker cone was exchanged for a very compliant one. In addition, the acoustic suspension speaker required a closed box, one of just the right size, to supply a restoring force from the stiff air-spring. My first "real hi-fi speaker" was an AR 2a.

Both Villchur and Kloss were in attendance at the party. I had met Kloss several times, since he's been active in the audio industry ever since the AR days. Villchur, on the other hand, had been in virtual retirement from the audio business until getting involved with Roy Allison to start up RDL Acoustics. I had met Villchur only once, in the lobby of New York's Waldorf

The Editor with Edgar Villchur

Astoria many years ago during an Audio Engineering Society Convention, when I proposed he write something for *Audio*. He politely demurred, and I could hear him thinking "Who is this young upstart?"

Thus it is with some large amount of playfulness that we publish these photos of Mr. Kloss and Mr. Villchur. Note that in the second photo, Ed Villchur is telling me what he thinks of my editing skills.

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WHAT'S NEW

Creek
MM Phono Pre-Preamp

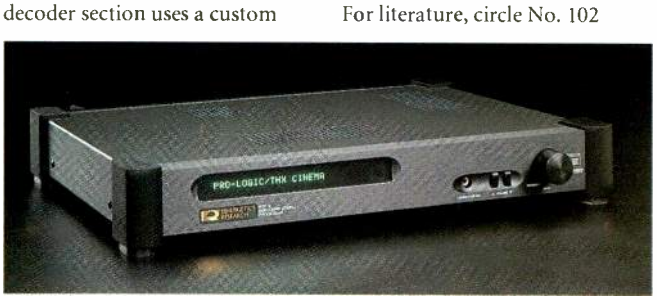
The Creek OBH-8 amplifies signals from MM phono cartridges to line level, and adds RIAA equalization. Input sensitivity is 3.5 mV, and input impedance is 47 kilohms, with 220-pF capacitance. Frequency response is 20 Hz to 20 kHz, +0, –0.5 dB; RIAA deviation is within ±0.5 dB. THD is less than 0.05%, and S/N is better than 70 dB. An MC version, the OBH-9, is also available. Prices: OBH-8, $229; OBH-9, $299.
For literature, circle No. 100

Pietsch Signal Processor

Notch filters at 60, 120, and 180 Hz let the Pietsch Electronics ASP 100 minimize a.c. hum in signals; the filters have a Q of 4 and 95% signal rejection; adaptive logic is used to allow music at these frequencies to pass. A harmonic enhancer circuit is also included, to restore punch and clarity without adding hiss. Slightly larger than a radar detector, the unit can be operated from 12 V. Price: $229.95.
For literature, circle No. 101

Kinergetics THX Surround Decoder

Amplification circuits in the THX-certified Kinergetics KSP-2 are hybrids using discrete bipolar and J-FET devices, operating in Class A, and incorporate a hysteresis-cancelling circuit. The decoder section uses a custom algorithm to decorrelate the rear channels. Both the Dolby Pro Logic decoding module and the surround module can be removed and replaced for upgrading or updating, and the control software is on reprogrammable EPROMs. Price: $4,500.
For literature, circle No. 102

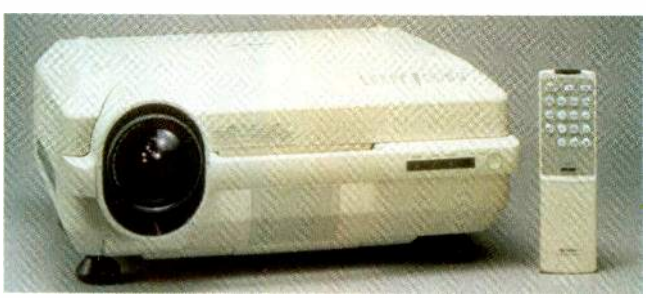


MIT Video Enhancer Cable

A circuit network within the MIT RES-LinQ video cable is said to optimize connections between home video components and counteract deficiencies in such equipment. Claimed benefits include improved detail reproduction and a reduction in haze and bloom on older or dubbed tapes. Price: $79.95 for a 1-meter cable.
For literature, circle No. 103

Mark Levinson Monaural Amp

The Mark Levinson No. 33 Reference amplifier delivers 300 watts into 8 ohms, and can deliver 2,400 continuous watts into a 1-ohm load. Each 300-pound amp includes 12 39,000-µF capacitors and about 1,200 joules of energy storage. Fully balanced from input to output, the No. 33 achieves common-mode noise rejection in the loudspeaker voice-coil. Vertically oriented design reduces floor-space requirements. Price: $32,000 per pair.
For literature, circle No. 104



Sharp
LCD Video Projector

Convertible for ceiling or table-top mounting, the SharpVision XV-S90U projector uses three LCD panels, one per color, to produce 500 lines of horizontal resolution. The 250-watt lamp produces 600-lux picture brightness. Motorized lens shift minimizes "keystoning" picture distortion when the projector is angled up or down. Variable masking allows for normal (4:3 aspect ratio) and wide-screen (16:9 and 21:9) projection. The unit weighs only 30 pounds, for a degree of portability. An amplifier and speaker are built in. Price: $9,995.95.
For literature, circle No. 105

WHAT'S NEW

Concentric Speaker

CST's Monitor uses cylindrical enclosures built up from computer-cut concentric fiberboard rings, 1½ inches thick, for extreme rigidity. Damping is further enhanced by alternating layers of lead and high-density felt in varying thicknesses; the outside is finally wrapped in leather. The two-way system has separate enclosures for its 7-inch woofer and 1-inch tweeter. Separate Cardas binding posts for woofer and tweeter connections of the externally mounted crossover make bi-wiring and biamping convenient. Sensitivity is 89 dB.

Frequency response is 41 Hz to 25 kHz, ±3 dB. Price: $11,995 per pair.
For literature, circle No. 106

Legacy Speaker

With the goal of providing "even more versatility and tighter bass" than the company's Focus loudspeaker, Legacy Audio has introduced the Focus II, which includes a passive notch filter centered at 63 Hz to help eliminate room-gain problems. The filter can be deactivated by a switch on the biamp-capable terminal plate. Bass is handled by a pair of 12-inch woofers, midrange by two 7-inch Kevlar cones, and highs by a 1¼-inch soft-dome tweeter and a 3½-inch ribbon supertweeter. The tweeter and supertweeter are placed between the two midrange units, whose spacing is said to reduce floor and ceiling reflections by 20 dB through the midband frequencies. Response is 16 Hz to 30 kHz. Prices: $4,850 per pair with oak, walnut, or black lacquer finish and $5,100 per pair with rosewood or ribbon mahogany.
For literature, circle No. 107

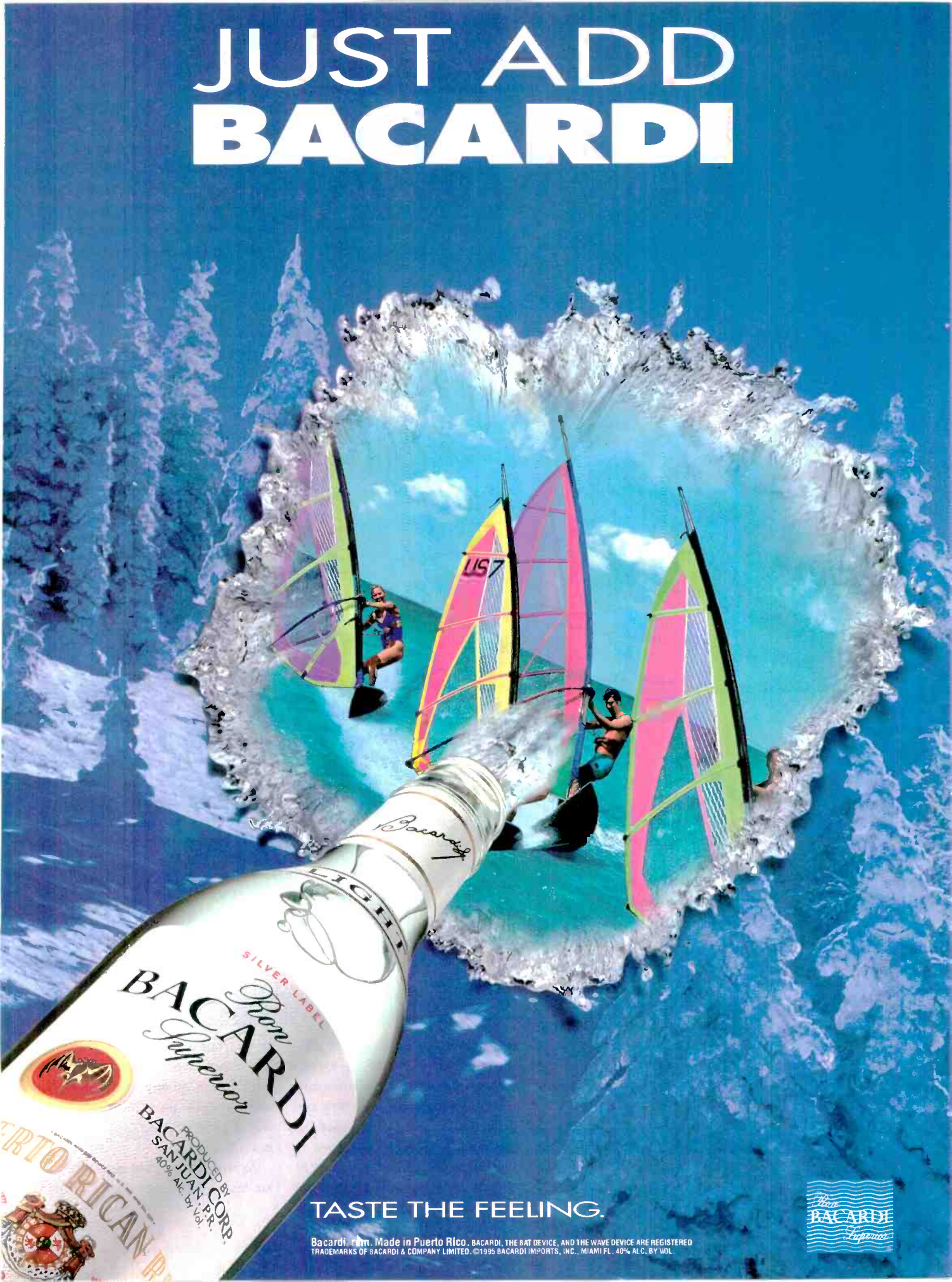
Advent Speaker

The two pivoting sections of the Advent HT204 home theater speaker each hold one 2¼-inch, full-range driver. The pivoted design, the drivers' magnetic shielding, and optional floor stands and wall mounts allow a wide variety of placement options. Frequency response is 100 Hz to 20 kHz, and the speaker is compatible with amps up to 100 watts at 8 ohms. The speaker is 11½ inches high, 3¾ inches wide, and 3½ inches deep. Price: $149 per pair.
For literature, circle No. 108

Hubbell Speaker

The SV552 from Hubbell Sound Systems is a bookshelf/mini-monitor design with a 5¼-inch poly-cone mid-bass and a ¾-inch aluminum-dome tweeter; the latter's silver internal wiring is said to improve resolution throughout its frequency range. Hubbell physically separates the mid-bass and tweeter crossover components to help prevent crosstalk and any associated distortion. With a response of 70 Hz to 20 kHz, ±3 dB, the SV552 may be used with or without a subwoofer. Amp requirements are 10 to 100 watts per channel. Sensitivity is 87 dB, and impedance is 8 ohms nominal, 6 ohms minimum. The cabinets are ¾-inch medium-density fiberboard with lacquered-oak or black-oak veneer. Price: $559 per pair.
For literature, circle No. 109

JUST ADD BACARDI



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EDWARD TATNALL CANBY

AR ANNIVERSARY

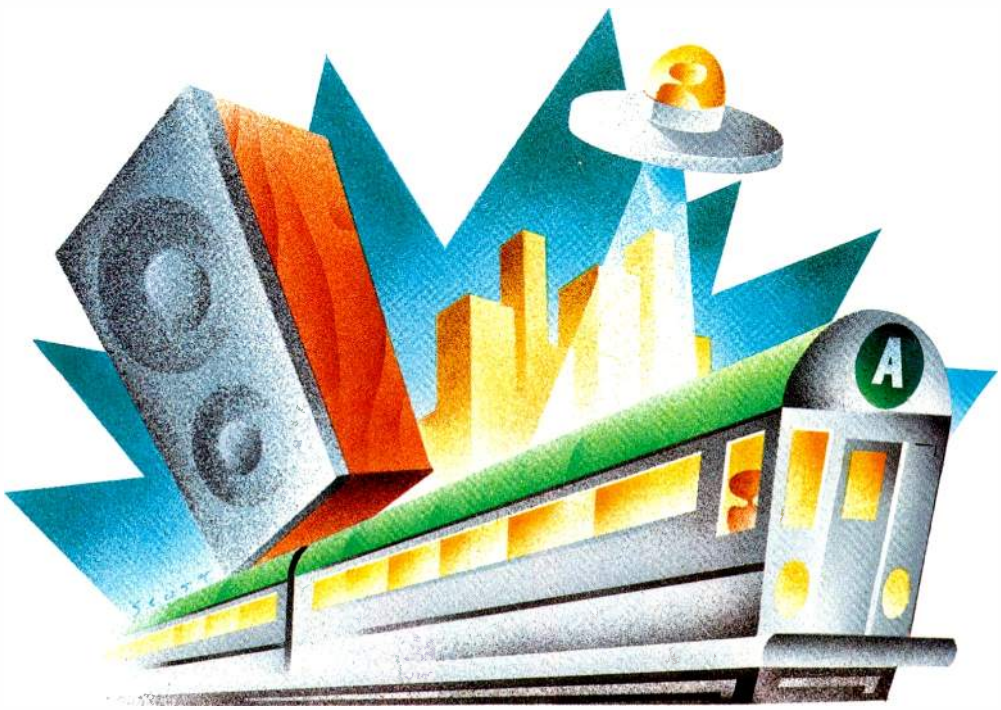

Illustration: Bob Scott

Anniversaries are becoming more and more mathematically absurd. One outfit I belong to has been celebrating its 50th for three years. There was also the anticlimax of my own 81st after two glorious 80th parties—neither on my birthday. Our Presidents' Day, combining both Linc and Gwash, to use modern terminology, is a mathematical absurdity, while the official birthday of the Queen merely celebrates spring. And does anyone remember the year we had two Thanksgivings? So, taking the bull by the horns, I'm inclined to celebrate any old time, whether the arithmetic is right or no, if an update seems useful.

My first update was precipitated by a current show on CBS called *Rescue 911*. You've probably seen it. And 57 years ago—plus a few odd months, days, and hours—there was another show, same network, at a symbolic moment—9 p.m. on October 30, 1938, Halloween eve. Spooky. If you are elderly, you may remember that program—the Martian invasion of the earth, a radio drama heard across the country and taken for real by millions of listeners. It was put on the air by a dynamic, magnetic, positively photonic genius actor of 23, Orson Welles, one of the great innovators in the adaptation of literary and dramatic classics to the broadcast medium. His unexpected success on that occasion shows how much he already knew, a master of *believable* radio technique in the terms of that particular era.

CELEBRATING ITS 40TH ANNIVERSARY, AR HELD A PARTY IN NEW YORK'S GRAND CENTRAL TERMINAL.

Quick synopsis for the youthful: Thousands and thousands of Americans, mostly hearing only a fragment of the broadcast, rushed their families into the family car and took off wildly at full speed, in any old direction, to escape the Martian horror. Giant machines emerging from a huge rocket-like cylinder that buried itself in the earth at tremendous speed—spewing out instant death rays and poison gases, wrecking everything in their path. It took hours and hours all over the country before the incredible resulting confusion was untangled and everybody back home. Not a soul died by a death ray or poison smoke, but a lot of people ended up with red faces the next morning.

Could it happen again today? Yes, I say. But very differently. A different medium.

As previously told (a good while back), I heard that broadcast, but did not panic. Right away I was able to recognize it as a fabrication, and then suddenly I remembered the source, one of my favorite sci-fi stories by H. G. Wells, "The War of the Worlds," written in 1898 just 50 years earlier (anniversary) as a Martian invasion of England. The broadcast script relocated it to the present and to more familiar territory, the U.S.A. Indeed, the cylinder landed at a specific New Jersey hamlet named Grovers Mills, arbitrarily picked off a road map by the script writer! By the sheerest coincidence this was only a few miles from where I sat, listening. I was unperturbed. At the end of the hour I went quietly to bed, totally unaware of the incredible panic outside. I knew nothing of it until the next day.

As we all know, broadcast shows are team affairs, even if it is mainly

"The HCA-2200[II] has all the features and flexibility any audiophile could want...," notes Stereophile.

Sure, it's nice to be hailed as a "benchmark." But what, exactly, does that mean? Well, let's read the quote in context:

"While the HCA-2200[II] has virtually unlimited brute power, it has enough finesse to let the music come through largely unscathed. Over the last six months it has proven, with a variety of speakers in both my listening rooms, that it's a benchmark product against which other amplifiers can be measured. If an amp of equal or greater price isn't at least as good as the HCA-2200[II], it doesn't cut it."

It's clear that Mr. Stone has discovered the virtues of our amplifier. And while we're pleased he found the process so enjoyable, we aren't surprised. It's all part of our design philosophy, whose essence he captures nicely when he says, *"...a middle-class audiophile like myself no longer has to take out a second mortgage on his house to afford a musically satisfying amplifier."*

"...A BENCHMARK PRODUCT AGAINST WHICH OTHER AMPLIFIERS CAN BE MEASURED."

– STEVEN STONE, *STEREOPHILE*, VOL. 17 NO. 3, MARCH 1994

But what did surprise us, as well as flatter us, was being thrown into the ring with $12,000 monoblock behemoths. The result of this apparently absurd comparison? Not carnage, but rather: *"...the Parasound HCA-2200[II] gives them all a run for the money, and even beats 'em in flexibility and price."* He continues, *"...a pair of HCA-2200[II]s performed with Apogee full-ranges on a par with a pair of Boulder 250 AEs and four VTL Deluxe 300 amps. Dynamic impact and attack were excellent...Compared to the VTL300, the HCA-2200[II] had a greater sense of extension..."*

Enough quotes. It's time to experience one yourself. Just visit your local Parasound dealer and learn that "benchmark" is the expert's way of saying you don't have to break the bank to get the best. And you can quote us on that.

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the principals who get the credit. More than 30 years after that broadcast, the man who actually wrote the script, including Grovers Mills, put together a book that included not only the script itself but a splendid collection of pictures, news clippings, exhaustive discussions as to what happened and why, and interviews with numerous participants (including the panicked). Howard Koch was the writer, and his book is *The Panic Broadcast*, published in 1970. You surely can find it through your local library. My reaction to that book, 32 years after the event, was different—how astonishing that in 1938 we fell for what in 1970 seemed an incredibly outdated, old-fashioned broadcast style. (You should hear the recorded broadcast itself, even more old-fashioned.) It struck me then how rapidly our broadcasting had changed, without my noticing. In 1970 the script was simply quaint. So courtly and formal! So long-winded, full of "And now, ladies and gentlemen, we take you to . . ." Can you imagine an "anchor" today (replacing the old announcer) calling a TV audience "ladies and gentlemen"? Even in 1970 this was wholly anachronistic, from another time.

And now, another 25 years? Today we have a visual broadcast world. Eyes are far more specific than ears. We are brought up on precise visual stories, marvelously crafted for the eyes. Advertising, too, has invaded every area with half-truths, easy to swallow. All this is now so familiar that we take it for granted as an accustomed background to our real lives. Could we ever go so far as to take it literally? And panic? We haven't yet.

We are so used to fantasy on the screen—broadcast, cabled, by satellite, from the VCR, not to mention movies and home video—that we have learned to discriminate. Still, a faked-up news broadcast, though not likely (we learned that lesson), could send us off again—if the illusion were perfect down to the smallest detail. Otherwise we wouldn't believe.

I have been watching *Rescue 911* the last year or so with considerable interest because it is an excellent example of the sort of persuasion that is possible today. Actually, this program is as rigidly fixed in its format as any soap opera or ancient fairy tale, invariably ending with the almost-victim living happily ever after. What distinguishes it, and makes it uniquely dramatic, is the use of the actual people involved in the rescue by the ever-virtuous 911 forces—i.e., it's a true story. Racing ambulances, screaming police sirens, helicopters, the works, but what is amazing is that the drama seems to involve scenes actually taken on the occasion—the perpetrators, the victims, the families and friends. Other scenes just have to be reenacted after the fact. Or maybe all of them? You simply cannot tell. The drama comes from not knowing what is real and what isn't.

MANY SPEAKER DESIGNERS GOT THEIR START IN THE BUSINESS BY WORKING AT ACOUSTIC RESEARCH.

If there were to be another panic broadcast, it would have to be done with the extraordinary expertise of this program, so that we would not know what to believe. Yes, we *could* go for the worst. And panic again.

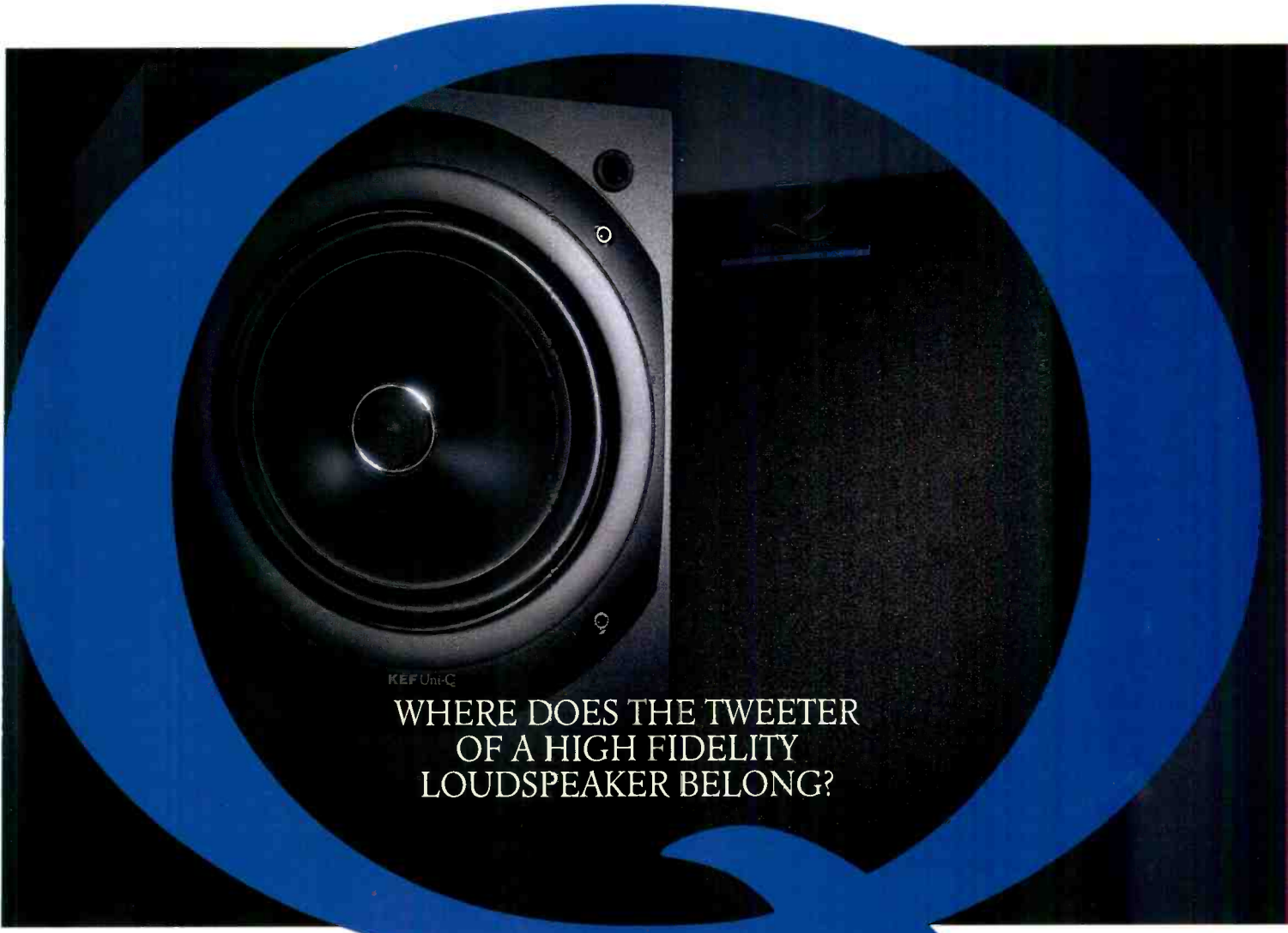
I mustn't forget—I do have a real, mathematical, genuine anniversary to mention, celebrated at an immense press party on, of all places, the balcony of that great indoor space, Grand Central Terminal in New York. AR, Acoustic Research, had its 40th anniversary, and it was again sheer coincidence that New York's subway system had its 90th that very day—so I rode the shuttle to GCT on a train of 1917 cars, their roofs weirdly painted a bilious lime green. Publicity? If NYC ever saw a working subway car with that coloration, I'll eat a lime in one bite.

I've told so many stories about early AR days that I will wait maybe for its 50th on that score. But it must be said that Acoustic Research and the revolutionary speaker suspension with the cone supported by an air-spring (and limp surround) was a major influence on our audio world and indeed continues important today, though the AR company is now part of a conglomerate, International Jensen. The present AR got together a remarkable assemblage of people including, of course, the founder, who had the idea, Edgar Villchur, and a number of his early collaborators, notably the ubiquitous K, Henry Kloss—K in KLH, then Advent, then his present Cambridge SoundWorks. The audio speaker field, in fact, is sprinkled with AR spinoffs mostly still in Cambridge, Massachusetts, AR's longtime (and former) home.

The AR speakers were, of course, precomputer, minus the immense benefits now available for speaker design. Nevertheless, by hook or crook, they sounded good and still do. Do I hear a rumor that the famous AR 3a is to be "reissued"? It would be easy to add a bit of update, not too much, and come out with a terrific speaker once again. Using AR's peculiar algebraic nomenclature, might it be the AR $3a^x$?

Finally, I was interested to discover, in our November 1994 issue, that Tom Stockham was also involved in a problem that suddenly became important with the advent of stereo. I was intensely interested at the time—I called it double liveness, the twin acoustics of the original recording place and the playback space, superimposed. AR's well-remembered "live versus recorded" demos depended on an understanding of this phenomenon: For a direct comparison, the prepared recording had to be "absolute," as I called it—totally dead. No liveness. AR used an open meadow near Villchur's home, and I was there. Alternatively, I remember a scary session in a large anechoic chamber, room-size. Absolutely claustrophobic! All the sound was inside your head, no space whatsoever. The AR demo with live string quartet and two 3a speakers was incredible; even I, knowing the music, was fooled. (The musicians merrily "played" at some points soundlessly, while the speakers projected the music.) Stockham, working with Amar Bose, calls it "Second Venue." Same thing.

We would have better Virtual Reality today if more audio people understood the Second Venue. It's still with us and always will be. No anniversaries. A



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JOHN EARGLE

REVIEWING EVEREST

The first 12 CDs in Vanguard Classics' ambitious Everest reissue series are now on the market, and what a marvelous venture it is! Accordingly, I am devoting this month's column to capsule reviews of most of these items—but first, a brief look at the series overall.

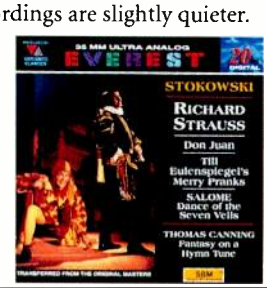
The basic A/D transfers from the 35-year-old masters are nearly flawless. What problems were encountered have apparently been so successfully dealt with that no blemish is obvious. Supervised by Vanguard president Seymour Solomon, the transfer process employed vintage equipment to accommodate the original three-track masters, some of which are on 35-mm magnetic film, the others on standard half-inch 15-ips magnetic tape. Further restoration, using Sony's Super Bit Mapping, was carried out primarily by Sony Classical. (See last month's "Currents.") You will not be aware of any striking technological differences between the two formats of the original masters, but close listening will reveal that the film-based recordings are slightly quieter.

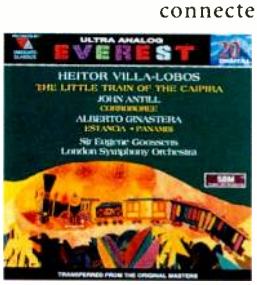
The CD packaging is simple but appropriate. Excepting the 16-page booklet for the Beethoven Symphonies, liner notes are given in an insert of two or three panels, sufficient space to carry the original notes or a slightly abridged version of them. The notes were written by prominent individuals in record annotation, including David Hall and Paul Affelder. A generic insert in each CD gives technical information common to all the releases as well as details on future releases (the next group is expected momentarily).

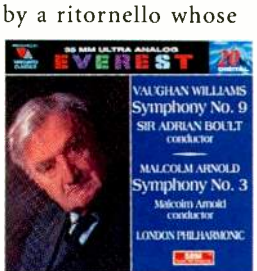
The recordings in this first wave of reissues were all originally released over a busy four-year period, from 1958 to 1961. Most of them were made in London—and of these, all but one were recorded at Walthamstow Assembly Hall in the suburbs. Walthamstow, as it is known, is still used for town meetings, boxing matches, and, when it is available, recording sessions. There is a stage at one end, and the main floor seating can be removed, making it possible to place the performing ensemble directly in the middle of the acoustical space.

In Walthamstow, original Everest recording engineer Bert Whyte had his ideal recording venue. The room sounded back immediately, and the balance between direct and reverberant sound could easily be adjusted, section by section, by moving the players as required. No wonder that Walthamstow could handle music from just about all corners of the repertory. (All recordings listed below were made at Walthamstow, unless otherwise indicated. Dates given are original release dates.)

Falla: *The Three-Cornered Hat*, London Symphony Orchestra/Jorda (1960); **Bartók**: Dance Suite, London Philharmonic Orchestra/Ferencsik (1959); Everest/Vanguard Classics EVC 9000. The Falla is very idiomatic, and Enrique Jorda knows exactly when to bend and shape the tempos, particularly in the non-dance sections. While present-day conductors are apt to rush this music, Jorda keeps the dance tempos on the moderate side. The sound is vintage Walthamstow. János Ferencsik shows much the same attention to the Magyar aspects of Bartók's gripping Dance Suite. Appropriately, the mikes are a bit closer, emphasizing the sardonic, diabolical aspect of the work. The six dances are based largely on Bartók's extensive ethnomusicological research into native Hungarian folk music. They are played without interruption and are connected by a ritornello whose







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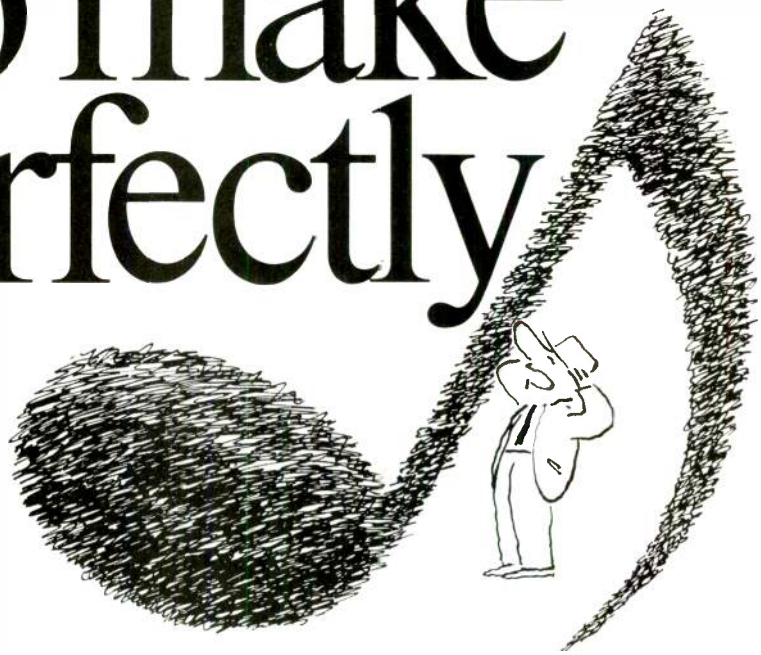

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Recommended accessory in *Stereophile,* Vol. 12 No. 4, April 1989.

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—Ken Pohlman, *AUDIO,* November 1987.

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haunting and wistful nature is the very essence of Bartók.

Vaughan Williams: Symphony No. 9, LPO/Boult (1958); **Arnold:** Symphony No. 3, LPO/Arnold (1959); EVC 9001. The Ninth Symphony was recorded just hours after the composer died, and this reissue includes (for the first time on disc) a short eulogy spoken by Sir Adrian Boult. The music has much the same brooding, often jarring, nonpastoral quality that had been introduced in the Sixth Symphony. The writing is complex but always clear, and it makes skillful use of a saxophone section clearly independent of the standard orchestral winds. Boult's affinity for Vaughan Williams is shown better here than in his EMI recordings. Arnold's symphony is reminiscent of his many overtures (short movements, lilting rhythms) and is thoroughly entertaining.

THE RECORDING OF GOULD'S SPIRITUALS DISPLAYS THE ESSENCE OF BERT WHYTE'S THREE-MIKE APPROACH.

Rachmaninoff: Symphonic Dances; **Stravinsky:** *The Rite of Spring*, LSO/Goossens (1958, 1960); EVC 9002. This is one of the great Symphonic Dances. Today, most conductors take the first movement too fast, robbing it of majesty and elegance. Sir Eugene Goossens gets it just right. The waltz and the final *Allegro vivace* are taken at more familiar tempos. The Stravinsky, with Bert Whyte's normal Walthamstow setup, comes across at what you might call "mid-perspective," which I prefer over the close-up perspectives favored by many conductors and producers today. Sane tempos throughout.

Copland: *Appalachian Spring*; **Gould:** Spirituals for String Choir and Orchestra, LSO/Susskind (1958); **Gershwin:** *An American in Paris*, Pittsburgh Symphony Orchestra/Steinberg (1960); EVC 9003. There are many accounts of *Appalachian Spring* to choose from, and this one measures up nicely. But the real find here is Gould's Spirituals, by far the best available recording of this marvelous work. Here is the essence of what Whyte's three-mike approach was all about: The balance between direct and room sound is ideal, and the sense of depth is remarkable. Listen for the various percussion details. They are all just where they should be—bass drum, anvil, cymbals, and all the rest. As for *An American in Paris* . . . , in the entire body of Everest recordings, there are no more than a handful that do not measure up to Whyte's high standards, and this recording is one of them. The Pittsburgh orchestra does not play at its best, and the recording in Heinz Hall simply does not have the bloom of Walthamstow.

Strauss: "Till Eulenspiegel's Merry Pranks"; "Don Juan"; "Dance of the Seven Veils" from *Salome*, Stadium Symphony Orchestra of New York/Stokowski (1959); **Canning:** Fantasy on a Hymn Tune, Houston Symphony Orchestra/Stokowski (1960); EVC 9004. The Stadium Symphony is, in fact, the New York Philharmonic Orchestra. At the time of this recording, the NYPO was under contract to Columbia, so another name had to be used. Manhattan Center, the recording venue for the Strauss, is a large ballroom that was much used for orchestral recording back in the 1960s and is still available today. The Strauss is played as only Stoky could do it, with grand sweep and momentum. And certainly the orchestra could keep up with him technically. Sonically, the immediacy of the room's reverberation fleshes out the music, giving it a quality similar to Walthamstow but not quite as expansive. The Canning work, taped at Jones Hall in the Houston Civic Center, is sort of an American version of Vaughan Williams' Fantasia on a Theme by Thomas Tallis. It is played and recorded beautifully.

Shostakovich: Symphony No. 6, LPO/Boult (1958); Symphony No. 9, LSO/Sargent (1960); EVC 9005. The Sixth opens with a 20-minute Largo that moves freely from tension to release, followed by a contrasting pair of short scherzos. The Ninth is as different as it can be, a set of five relatively short movements in the classical mold.

Vaughan Williams: *Job*; Overture to *The Wasps*, LPO/Boult (1959); **Arnold:** Four Scottish Dances, LPO/Arnold (1959); EVC 9006. The cavernous acoustics of the Royal Albert Hall give something of a medieval mystery-play quality to the work based on William Blake's *Illustrations for the Book of Job*. Literal representations abound, and the depiction of the devil by oily slides on the saxophone is typical of the composer's tone-painting. The Overture to Aristophanes' play is one of Vaughan Williams' most engaging short works, and Arnold's spritely Scottish Dances (recorded at Walthamstow) complement it nicely.

Villa-Lobos: "The Little Train of the Caipira"; **Antill:** "Corroboree"; **Ginastera:** "Estancia," "Panambi," LSO/Goossens (1958, except Villa-Lobos, 1960); EVC 9007. These works draw on ethnic material from the composers' native countries of Brazil, Australia, and Argentina. The scores are all gorgeous, with lots of exotic percussion, and acoustics to match. The recordings are still of demonstration quality.

Bartók: Concerto for Orchestra, Houston/Stokowski (1961); **Kodály:** "Psalmus Hungaricus," LPO/Ferencsik (1959); EVC 9008. This Bartók recording shows once again how underrated Leopold Stokowski is today. It is a beautiful performance that holds its own with any in the catalog. János Ferencsik's account of Kodály's "Psalmus" suffers a little from its English translation but otherwise is idiomatically well done. Jones Hall in Houston, the venue for the Bartók, sounds very good.

Hindemith: Violin Concerto, J. Fuchs/LSO/Goossens (1959); Symphony in E-flat, LPO/Boult (1958); EVC 9009. Hindemith was still in his heyday when these recordings were made. His star has since set—let's hope temporarily. This music is too good to be missed, and a generation has grown up knowing almost nothing of the man. Both performances are beautifully done and highly recommended.

Apart from a sampler, *The Sound of Everest* (EVC 9050), the one remaining item in this first wave of Everest reissues is a five-CD set given over to Josef Krips' traversal of the Beethoven Symphonies with the London Symphony Orchestra (EVC 9010/14). Time and space don't allow a survey here, but take my word that it is a handsome, well-annotated set, with notes by Krips himself. A

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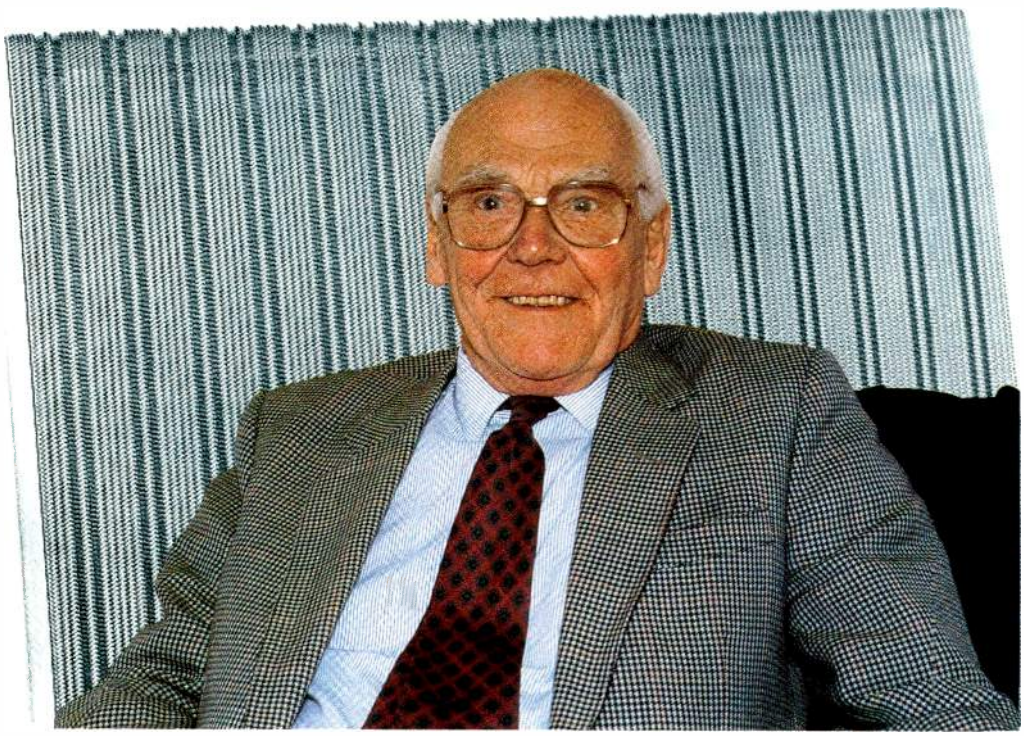
MONDO AUDIO

KEN KESSLER

INTERVIEW: PETER WALKER



Peter Walker and his original QUAD ESL.

Ask a group of British audiophiles to name the grandaddy of hi-fi in the U.K., and the majority will say "Peter Walker" without hesitation. This quick, natural, almost instinctive response is the result of a legacy that includes a run of classic products and the creation of a company that is probably the oldest specialist hi-fi manufacturer still under the ownership of the original family.

QUAD Electroacoustics Ltd.—born as S. P. Fidelity Sound Systems in March 26, 1936, before changing its name that year to The Acoustical Manufacturing Company—has an uninterrupted history matched by no other producer of audio components, and Peter Walker controlled it for the first 50 years before handing over control to his son, Ross. Peter Walker wrote, in G. A. Briggs' *Audio Biographies*, that "By 1952, my firm was of sufficient size to enable me to delegate nearly all management and departmental responsibilities; in fact, shed myself of all those aspects of business which did not appeal to me." Luckily for us, he immersed himself in research and design.

Any company would be proud to have created one milestone product, yet Walker's can claim at least four of them: The QUAD II tube preamp and power amp, the original electrostatic loudspeaker, and the current electrostatic, the ESL-63. Although it's as the seminal producer of electrostatic speakers that the company is known, QUAD actually began with public address equipment and, eventually, produced a successful ribbon-hybrid, the horn-loaded Corner Ribbon Loudspeaker, in 1949.

SOME PEOPLE THOUGHT QUAD'S ORIGINAL ESL WAS A ROOM HEATER; THEY'D STAND BY IT TO FEEL THE WARMTH.

I recently had the privilege of talking with Peter Walker about his company's remarkable achievements.

Why did you move from the original ribbon speaker to what became the original QUAD electrostatic?

From a theoretical point of view, an electrostatic is an ideal way to make a loudspeaker—it matches the air perfectly and it's all predictable, as ordinary loudspeakers are rather variable. It has *some* problems that are rather difficult, mainly due to the stretching of the diaphragm. It mustn't shrink and that sort of thing. Very high voltages, 10,000 volts, make it difficult. But it's an ideal. I think most loudspeaker manufacturers have looked at it and said, "What a lovely way to make a speaker, but it's not very *practical*." And a lot of manufacturers have tried it, too, and most of them have said, "This is not *profitable*. Get back to putting loudspeakers in boxes and sell 'em, lad!" [*Laughs.*]

I've always thought, from about 1945, that an electrostatic would be a nice way of doing it. But in the back of your mind is the question: How *can* you do it? It had a lot of problems. But the ribbon was a very good way of getting very good—I dare say, excellent—high-frequency response.

The ribbon was a hybrid. The ribbon itself had very good response from 2,000 cycles upwards, and the bass unit was very good up to 500 cycles. It wasn't very good in the middle, which I can admit now, but there you are.

Did working with the ribbon help you learn techniques for later use in the electrostatic?

Not at all. A ribbon is just a little bit of aluminum in a very large magnet

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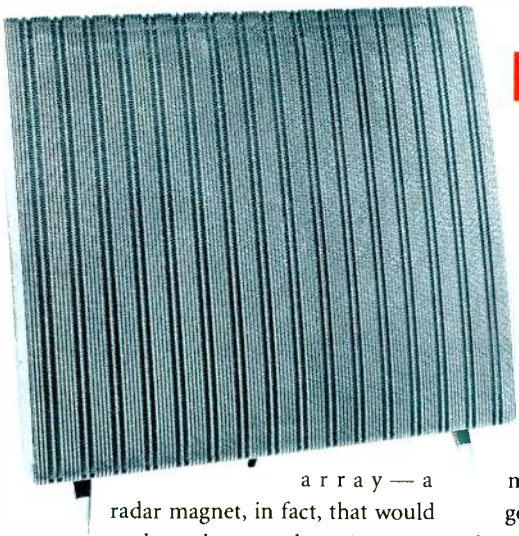
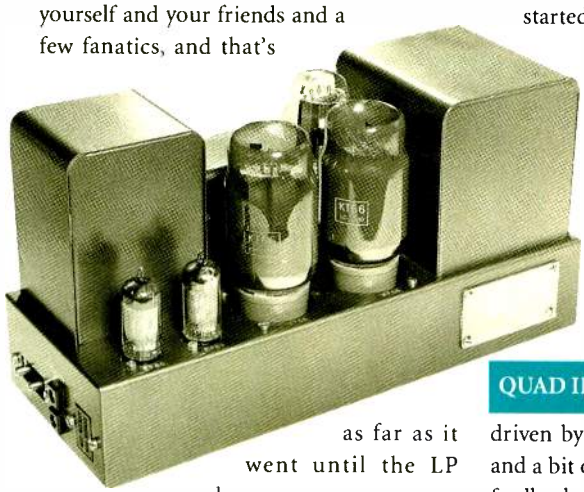


Original QUAD ESL speaker

array—a radar magnet, in fact, that would only go down to about 2,000 cycles unless you had *lots* of magnets. You could make a long strip one, but it would have been very expensive in those days.

At the time you introduced the ribbon, circa 1949 to 1950, who was serving the hi-fi community in the U.K.?

At that time the hi-fi industry hadn't really taken off. It never really took off until we had the LP record, where you could play through a whole symphony without messing about, jumping up and down, and without having surface noise from the disc. It was a *very* small market. You perhaps remember the days of P.G.A.H. Voigt; I admire him greatly. He made an excellent speaker, and he sold *two* a week. That was the sort of market. You made amp and speakers for yourself and your friends and a few fanatics, and that's as far as it went until the LP came along.



QUAD II amplifier

During the ribbon speaker's life, we sold less than a thousand units. It wasn't pairs; it was all mono—there wasn't any stereo then. And they were £95 at the time, which in present-day money is quite a lot.

Around the same time that the LP was introduced—around 1954, 1955—the electrostatic was introduced. I think our first public demonstration of the speaker was in 1955.

How many years had you been working on it?

Well, you don't work on it for years and years. You have a little go and get rid of a few problems, and then you forget that and get on with other things that you can make. But it stays in the back of your mind, and you think, "Oh, we could get over that—what about dust and these high voltages?" And you think of another idea and go on a little bit more. And then you forget it again for a long time; you're not working every day on the same thing. It's like the ESL-63 loudspeaker. It took us 18 years to develop, but it wasn't 18 years every day. [*Laughs.*] Not at all.

QUAD's roots, though, appear to be in amplification, especially since the acronym stands for Quality Unit Amplifier Domestic. Or was there a speaker before the ribbon hybrid?

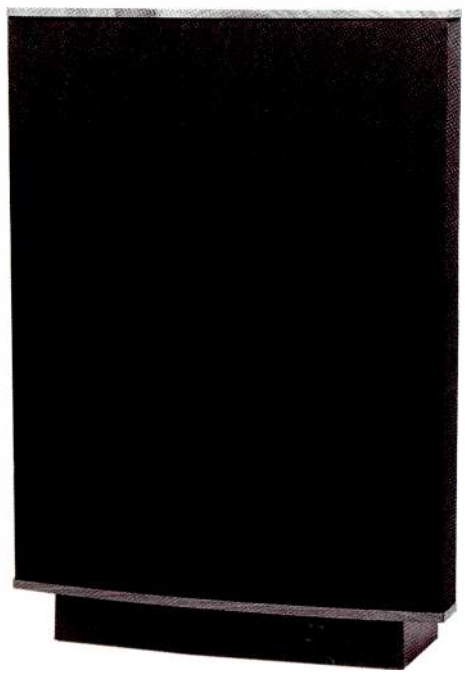
Well, there *was*, but it wasn't very good. The SL15, I think it was called, a quarter-wave resonant. Don't forget, we started off in 1936 making amplifiers for public address, dance bands, and things, and then started making high-fidelity equipment because you were interested in it, for yourself, and your friends were interested.

We made a jolly good amplifier before the war, with triodes like PX4s. It was excellent; it would sell nowadays. Direct-coupled and all the rest of it, but there was no market for that in those days at all. Two PX25s driven by an MH4, an ML4 before that—and a bit of feedback on it, actually. Oh yes, feedback came out in 1936; it wasn't used a lot, just a little bit. They were good amplifiers, 12 watts.

Were there any other earlier electrostatics with which yours had to bear comparison?

There was certainly the Janszen in the U.S. There was one before the war which was called the Primastatic, I think, that was just a tweeter. Several German electrostatics were made, but they really didn't make a big market at all. None of the Janszens came to England unless you went over with a suitcase. The original ESL just competed against other loudspeakers, and it wasn't as loud, so people who wanted to shake the windows didn't buy a QUAD electrostatic speaker.

Was it an immediate hit? Did the audio journalists of the time recognize it as revolutionary?



QUAD ESL-63 speaker

Some of them did, and some of them didn't. It was quite an oddball sort of thing. "What's this funny-looking thing?" They thought it looked like a room heater. In fact, we'd have people stand by them to feel the warmth.

Was it easier to launch in the U.S.?

No. We had a very, very good review in America. A man came over and said it is most wonderful but it's not loud; it doesn't shake the windows, but it gives the most natural reproduction, by a wide margin, more than we've ever heard before. And that got us *some* orders from America. But it wasn't very good with American high-powered amplifiers, which would just bust 'em, spark 'em to bits.

Americans had larger rooms, their whole basements given over to hi-fi, and it had to be pretty loud. The poor old ESL wouldn't

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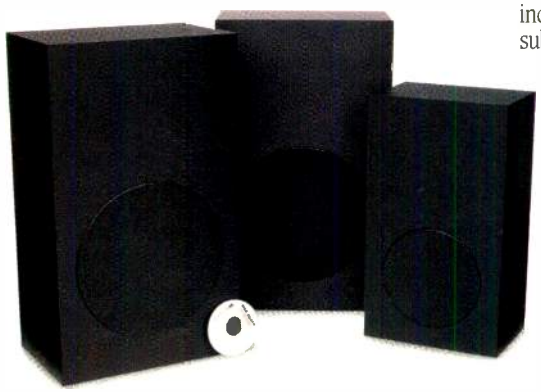
Cambridge SoundWorks makes two "dipole radiator" surround sound speakers. Dolby Laboratories recommends dipole radiator speakers for use as surround speakers. *The Surround* has a very high power handling capacity and is often selected for "high end" surround sound systems. *Audio*, describing a system that included *The Surround* said, "In many ways the surround sensation was every bit as good as far more expensive installations." **$399 pr**. The smaller *The Surround II* is arguably the country's best value in a dipole radiator speaker. **$249 pr**.

Powered Subwoofers

The original *Powered Subwoofer* by Cambridge SoundWorks consists of a heavy-duty 12" woofer housed in an acoustic suspension cabinet with a 140-watt amplifier and a built-in electronic crossover. *Stereo Review* said it provides "deep powerful bass...31.5 Hz bass output was obtainable at a room-shaking level... they open the way to having a 'killer' system for an affordable price." **$699**. Our *Slave Subwoofer* uses the same woofer driver and cabinet, but does not include the amplifier or crossover. It can only be used in conjunction with the *Powered Subwoofer*. **$299**. The new *Powered Subwoofer II* uses a 120-watt amplifier with an 8" woofer. **$399**.



Our *EXO-1* electronic crossover can be used with either of our powered subwoofer systems, or with powered subwoofers made by other companies. Its high pass filters keep strong, low bass signals out of the main stereo speakers, and directs them to the powered subwoofer. **$299**.

Home Theater Speaker Systems

We have assembled a number of home theater speaker systems that consist of center channel, surround and main stereo speakers. The combination we show here is our best seller. It includes our critically acclaimed *Ensemble* subwoofer satellite speaker system (with dual subwoofers), our *Center Channel Plus* and a pair of our best surround speakers, *The Surround*. You could spend hundreds more than its **$1,167** price without improving performance.

For information on other home theater speaker systems - or on any of the products we make and sell - call 1-800-FOR-HIFI for your free color catalog. Thanks.

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do that. But a number of people liked it very much. You either did, or you didn't like it at all. And when stereo came along, you had to have two of 'em. The ESL was a bit big for that, but it worked very well. In fact, after we made 400 of them—serial number 409, I think it was—we modified the directivity because of stereo. The directivity pattern was made for mono—not quite the same as stereo.

How did you change it? Driver shape?

No. It was just the electrical distribution between the elements. There were no other modifications, as far as I know.

At what point did you feel that transistors were acceptable for your amplifiers?

In 1968. Prior to that, you only had germanium transistors, which didn't do high frequencies very well. They would blow up a bit and weren't as good as valves. But in 1968, we could make a transistor amplifier as good as or better than valves. Not everybody believes that, but that's what we thought.

But do you ever think back that, while the solid-state equipment measured very well, maybe it didn't sound as good as the valve equipment?

No. I think this going back to valves is partly fashion and partly the fact that you can make a valve amplifier fairly easily and it will always sound good. Transistor amplifiers are much more difficult to design, and it's easy to make one that measures quite well but gives current overload. Things go wrong like that—secondary breakdowns and all sorts of things—so it's not so easy. But if you make it properly and do all the measurements properly, and do all the proper listening tests, oh, yes, then it's the right way to make an amplifier. It still is. The fashion for valves is, I think, just a fashion.

If you were starting QUAD all over again today, what areas in the hi-fi chain do you feel would still need to be addressed?

The relationship between the loudspeakers and the room, and to somehow try to improve stereo. Stereo comes out of two loudspeakers, whereas from an orchestra, for example, sound comes out of a whole lot of little sources, and two loudspeakers—though extremely good—don't quite do that. Binaural *could* do it if you had special headphones designed to suit your own ears, pinnae, which is very difficult to do. Particularly if you take into account the distance between your ears, but it's quite impractical from a commercial point of view. But if it is done, and the recording is made with little microphones in your own ears, then what you hear is as perfect as it's going to get.

And if you were to produce a QUAD ESL-95? How would it differ from the ESL-63?

I don't know whether it would.

Bass response?

Bass response on the 63 is quite good. It doesn't get the oomph-oomph-ooomph like lots of cabinet speakers. But if you measure it, then it's only 6 dB down at 36 cycles, which is not bad. There are some that will go lower, but not many.

And maximum SPLs?

We can get just over 100 dB at two meters, which is adequate for me and 95% of our customers. With some sorts of music, the louder you play it, the better it sounds.

And what would you have changed in the original electrostatic?

[*Laughs.*] Ooh, dreadful question. Well, I couldn't have made it better at the time. You take a silly old man of 78 and ask him what he would have done in 1950. Well, if I had my present experience, I'd have made something like the 63, which I made to improve over the first one in the first place. In a lot of respects, anyway. Let me tell you what was difficult about the first one. It had what was, in effect, a woofer and a tweeter. Getting those two exactly level, and matching in response, wasn't easy because they'd vary slightly—variation in the gap or variation in the tension of the diaphragm would upset it a bit, you see. One wanted to avoid that. I can't think of anything else. Would I have made it bigger? Well, it would have upset a whole lot of people who wanted a small speaker. Would I have made it smaller? No, because then you wouldn't have enough bass. It was roughly the right size.

The original electrostatic cost £52 when it came out—what the price would be now, goodness only knows. But there was always a waiting list for them. We allocated them *and* the amplifiers at that time to dealers, and they were allowed only a few a month. You didn't ask a dealer how many he wanted; you *told* him what he could have. We didn't have any salespeople; we didn't need them. [*Laughs.*] Wonderful situation! A

How Do You Improve On "...The Best Value In The World"?

Cambridge SoundWorks Introduces *New Ensemble*, *New Ensemble II* – and a new member of the family, *Ensemble III*.

Audio magazine once said our *Ensemble*® speaker system may be "the best value in the world." Since then, numerous critics have applauded our *Ensemble* and *Ensemble II* systems. Designed by Henry Kloss (founder of AR, KLH and Advent), they became best sellers by offering quality construction and accurate, wide-range music reproduction — at factory-direct prices.

We're pleased to introduce new versions of our *Ensemble* and *Ensemble II* systems, as well as our new, ultra-compact *Ensemble III*.

The *New Ensemble*

New Ensemble is an improved version of our original dual-subwoofer/satellite speaker system. *New Ensemble* maintains the dual subwoofer design, which allows for maximum room placement flexibility. Placement of bass and high-frequency speakers in a room (and how those speakers interact with the room) has more influence on the sound quality of a music system than just about anything. *New Ensemble's* ultra-slim (4 1/2") subwoofers give you more placement flexibility than any system we know of.

So What's New?

New Ensemble maintains the tonal balance, frequency range and quality of construction of the original. There are two basic differences.

1. *New Ensemble* uses a new 8" woofer with a very long "throw" for linear cone excursion and more accurate bass. An integral heat sink provides improved power handling.

2. *New Ensemble's* satellite speakers use the same speaker drivers and crossover as the original, but with new midrange and high frequency balance controls.

The midrange control lets you choose the same output in the key 800-1600 Hz octave as in the original, or you can emphasize that octave by 2 dB. *Ensemble* satellites have relatively less output in this range to avoid the "boxy" sound typical of many speakers. This results in an "open" sound on large-scale symphonic works. For small-scaled music, the higher output position proves a "warmer" sound.

A high frequency control has three positions: A) The same balance as original *Ensemble*. B) A 2 dB high frequency increase. C) A 2 dB high frequency decrease. The switch can subtly increase the system's "airiness" (Increase) or it can reduce any tendency towards "edginess" (Decrease).

In terms of "real life" performance, we believe our *New Ensemble* system competes head-on with speakers selling for hundreds more. Available with black-laminate subwoofers for **$629**, or with vinyl-clad subwoofers for **$549**.

The *New Ensemble II*

New Ensemble II is an improved version of our best-selling speaker system. It's more affordable than *New Ensemble* because it uses one cabinet to house both subwoofer speakers. *New Ensemble II* maintains the tonal balance, frequency range, power handling and construction quality of the original *Ensemble II*. But its satellite speakers use the same tonal balance controls as *New Ensemble's*.

New Ensemble II also uses a new flared subwoofer port. The subwoofer cabinet encloses two 6 1/2" long throw woofers mounted in a sealed "acoustic suspension" chamber. They project into a second chamber fitted with the flared port, which provides smoother air flow, eliminating extraneous noise on strong bass notes.

Stereo Review said the original *Ensemble II* "performs so far beyond its price and size it can be compared only with much larger speakers at substantially higher prices." *New Ensemble II* carries on this tradition, outperforming other speakers in its category, including well-known models for about twice the price. Factory-direct price, **$439**.

The *Ensemble III*

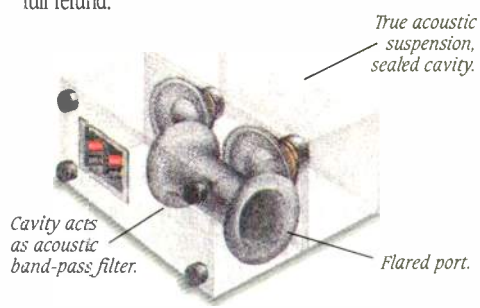
Now you can bring the clear, balanced wide-range sound of *Ensemble* speakers to a small, crowded room. Our new *Ensemble III's* satellite speakers are only 4 1/2" x 6 1/2" x 3" and its subwoofer is 8" x 8" x 15".

Compared to *New Ensemble II*, *Ensemble III* gives up a little in power handling, low bass range, and efficiency. Unlike the "cube" satellite speakers you'll find in most similarly priced systems, *Ensemble III's* satellites are two-way speakers. *Ensemble III's* 6 1/2" woofer uses two voice coils in a cabinet with a flared port for smooth air flow.

With most recordings *Ensemble III* will sound virtually identical to *New Ensemble II*. It simply won't play as loud. Its construction quality is normally found only in much more expensive speakers. Factory-direct price, including connecting wire, cutter/stripper and Hook-Up Guide, is only **$329**.

30 Day Home Audition.

All Cambridge SoundWorks speakers are backed by a 30-Day Total Satisfaction Guarantee. So you can audition your speaker the *right* way — in your home, with no salesman hovering nearby. If within 30 days you're not happy, return your system for a full refund.



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Brand-Similarity Recognition

Dear Editor:

Ever since A/V receivers have been on the market, I have noticed how similar many models look, regardless of their brand. But now I'm wondering if there's more to it than meets the eye.

Last fall, I purchased a Pioneer VSX-D602S receiver. When I saw the "Equipment Profile" of the Optimus STAV-3400 in the April 1994 issue, that unit's uncanny resemblance to my Pioneer made me realize this was way beyond the A/V receiver similarities I'd seen in the past.

Except for the "Power" switch, every single thing on the front panels of the two models was identical, even down to the tiny gold buttons for surround mode, the display, and all the specs. But what really got me was your photo of the STAV-3400's remote, which is *exactly* my remote but for the word "Optimus" replacing "Pioneer."

Can you tell me what gives? Did Pioneer buy from Tandy [parent company of Optimus] or vice versa? Did some other manufacturer crank these products out with no name plate, ready to sell to whoever wanted them? If that is indeed the case, how many other distributors are selling this fine instrument, perhaps having more cleverly disguised it?

John R. Peterson
Pleasant Grove, Utah

Editor's Reply: The odds are that Pioneer built the Optimus for Tandy. Considering the companies involved, it's unlikely (though not impossible) that some third manufacturer built both. And it's very likely that the remote handsets came from yet another company.

Nobody—even companies big enough to build their own ICs—builds everything from scratch. Companies routinely buy parts (capacitors, line cords, knobs), subassemblies (tuner modules, tape or CD transports), or even entire components from other companies. Unless you plan to make a heap of something, it's cheaper to buy it from outside—and selling it outside helps raise production to the economical "heap" stage.

A company's own-brand products and what they sell to others aren't always identical, however. Buyers often specify circuits and features that they want added or omitted to suit their own markets or price points; suppliers sometimes withhold proprietary circuits and features to maintain a marketing edge. Such differences may or may not show up in specs—and identical products may have slightly different specs if, for example, one company chooses to rate an amplifier at a very low distortion point while another rates it at a distortion level higher up the curve in order to claim a few more watts.

As for the remote, such ancillary devices are very commonly purchased from specialist companies. For example, I've noticed strong similarities between the remotes of a Luxman surround decoder and a Denon tuner, which have nothing else in common.

The odds are, no one is selling a better disguised version of your unit; front-panel tooling costs are high.—*I.B.*

Tube Sources

Dear Editor:

I inherited a Hallicrafters TW-500 four-band radio from my grandfather. It contains tubes with the following markings: 1V5, 3V4, 1V4, and 1L6. All of the tubes are imprinted "Hallicrafters."

Do you know of a source for such tubes or a place that can test them? Additionally, I would be interested in hearing from any reader who has (or knows where I can obtain) the instruction or repair manual, preferably both. Only the AM band appears to pick up any stations, and I would like to restore the unit to working condition, for sentimental reasons.

Steven Tadlock
1080B Cold Stream Circle
Emmaus, Pa. 18049

Editor's Reply: Our own "Classified Advertising" section carries ads for tube purveyors. In a recent issue, I saw ads for the following:

AccuTech Audio, 87 Church St., East Hartford, Conn. 06108; 203/290-8979.

BWS Consulting, 5609 North 23rd St., Arlington, Va. 22205; 703/536-3910.

Michael Percy, Box 526, Inverness, Cal. 94937; 415/669-7181.

Sonic Frontiers, 760 Pacific Rd., Unit 19, Oakville, Ont., Canada L6L 6M5; 905/847-3245.

Some other tube purveyors that I know of include:

Antique Electronic Supply, 6221 South Maple Ave., Tempe, Ariz. 85283; 602/820-5411.

ARS Electronics, P.O. Box 7323, Van Nuys, Cal. 91406; 818/997-6279.

New Sensor, 133 Fifth Ave., New York, N.Y. 10003; 800/633-5477.

I can't guarantee that any of these suppliers will have the tubes you seek, as I don't think I've ever seen these tubes used in audio, as opposed to radio, circuits. We are therefore running your letter, in hopes someone will be able to help.

If the radio picks up the AM broadcast band as is, it's likely that the tubes are working, though perhaps not well. The radio might be able to pick up other bands if you added a proper antenna. Check your local library for books on short-wave or amateur radio, or get a book catalog from the American Radio Relay League (Newington, Conn.).—*I.B.*

MANY A/V RECEIVERS OF DIFFERENT BRANDS LOOK SIMILAR. IS THERE MORE TO THIS THAN MEETS THE EYE?

AM Bandwagon

Dear Editor:

As a longtime fan of AM broadcasting, I have been delighted with the number of letters in this column expressing interest in the subject. Unfortunately, just as interest in nighttime listening of those clear-channel powerhouse stations seems to be increasing, we are now witnessing the trashing of the entire AM band by the FCC at

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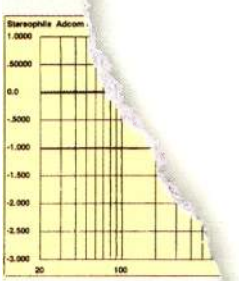

Fig.1 Adcom GDA-600, fr
(top); de-emphasis err
channel dashed, 0.5dB/

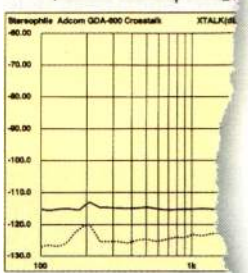

Fig.2 Adcom GDA-600, cr
dashed, 10dB/vertica

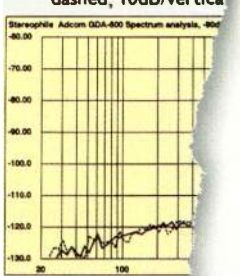

Fig.3 Adcom GDA-60
1kHz tone at –9
spuriae (⅓-octave
dashed).

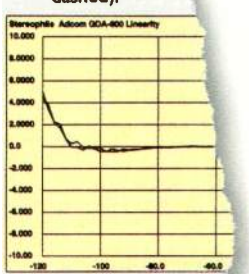

Fig.4 Adcom GDA-600, d
linearity (right chanr
2dB/vertical div.).

the behest of the National Association of Broadcasters (NAB).

In spite of the fact that in many markets across the country there are far too many AM (and FM) stations splitting the advertiser's dollar, the FCC has accommodated virtually every rule change proposed by the NAB to allow ever more stations to be licensed in a given market. Approximately 10 years ago, new "short-spacing" rules were adopted that allow nighttime co-channel stations to operate on the same frequencies as those of the traditional clear-channel stations. For example, a station licensed here in Denver may operate at night on the same frequency as Chicago's WMAQ, effectively ending the latter's status as a clear-channel broadcaster.

Is the public interest truly being served by this "whoring" of the AM broadcast band? Only if the present situation of stations going bankrupt and off the air is. Only if the proliferation of cheap, shoddily produced programming with maximum shock value to suck in listeners is. And only if the lousy technical quality of broadcasts (due to maximum compression techniques, overmodulation, or even lack of routine maintenance) that are designed to sound loud, and nothing more, on a Walkman is.

THERE'S LITTLE WE CAN DO BUT WRITE TO OUR FAVORITE CLEAR-CHANNEL STATIONS AND TELL THEM THEY DO HAVE LISTENERS.

An unfortunate fact also appears to be that as more and more clear-channel stations are bought up as leveraged investments by corporate conglomerates, they are no longer interested in the out-of-town listener who doesn't show up in the all-important Arbitron surveys that make or break a station in terms of what can be charged for an ad spot.

In order to save what's left of the AM band, there's little listeners can do but write their favorite clear-channel station—be it KNX, WBAP, WLW, or WCBS—and tell them they do have listeners in the sticks and that those listeners buy their advertised products. I'd also suggest writing the FCC (Chief, Mass Media Bureau, FCC, Washington, D.C. 20554) and telling them that the trashing of today's AM broadcast band is a consequence of the Commission's actions. A copy of listeners' correspondence sent to the head of the House of Representatives' Telecommunications Committee might be helpful.

The NAB, like any kid, has gotten all the candy it wants at the FCC for years, and as a direct result, the broadcast industry is sick. More public involvement in decision-making is long overdue.

Bill Kleronomos
Lyons, Colo.

Buy for the Sound, Not the Name

Dear Editor:

I am one who loves music. My library is home to Eric Clapton, John Mayall, B.B. King, Ray Charles, Benny Goodman, Art

Making music memorable.

Be assured: The LS5 Mark II stereo line-level preamplifier from Audio Research is no mere nostalgic nod to the past. Rather, it represents a significant advance in the technology of vacuum-tube amplification as applied to the retrieval and transmission of meaningful musical information from any input source, analog or digital. The difference is one you will hear immediately in your music system—and never forget.

The technology making this all possible includes a sophisticated, fully regulated power supply using patented Decoupled Electrolytic Capacitor circuits; fully balanced, cross-coupled, all-vacuum-tube amplification stages; and switch-selectable gain allowing a wider range of useful volume control settings with different input sources. All this, plus the harmonic richness and timbral magic of dual-triode vacuum tubes. From the manufacturer with 25 years of experience in bringing recorded music to life.

If ever there has been a preamplifier that will markedly—even astoundingly—improve the performance of any deserving audio system, the LS5 Mark II is it. You'll hear your favorite music as though illuminated from within, played specially for you. Intimate. Profound. Lasting. The way music was meant to be experienced, and remembered.

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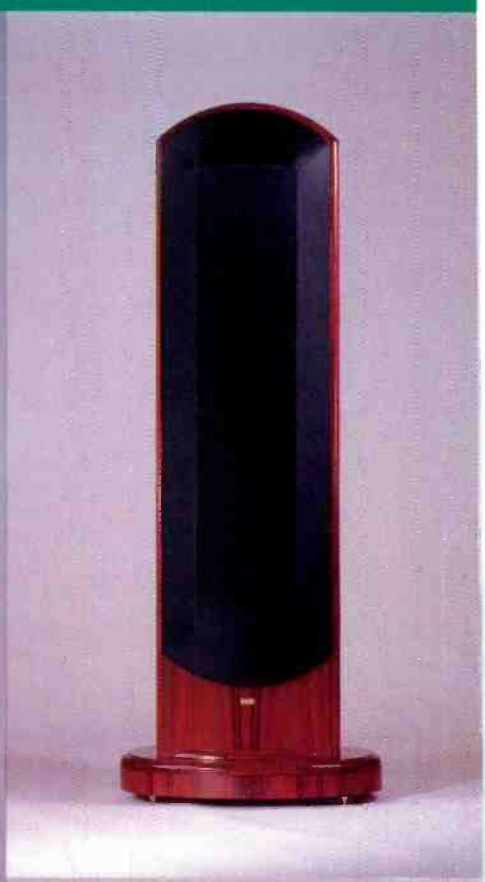

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800-283-4644 Fax 217-744-7269 Tech Support 217-544-5252

Blakey, The Mills Brothers, and many more. Reproduction of such music is, for me, fascinating. Trial and error, with time, has been an excellent instructor. Appropriate literature answers questions of how and why. My music system today is excellent—the best system I have owned, the best system I have listened to.

In years past, my living room, and my ears, have grown familiar with names such as Yamaha, Sony, Altec Lansing, Dual, JBL, Kenwood, Nakamichi, Akai, Tandberg, Bose, etc. For the most part, a very pleasant experience. For the most part. Here and there, not so pleasant. To be specific . . . Sony and JBL. In one word, *pitiful.* Looking back, my mistake is easy to find: Sony and JBL were judged by my eyes, *not* my ears. I bought the name, not the sound. The common magazine, such as *Audio*, endorses these brand names 100%.

Consumer, buy the component for the sound, *not the name.*

Lawrence O'Connor
Norman, Okla.

The Editor-in-Chief's Reply: Mr. O'Connor, I think you mean we endorse Sony and JBL. Curiously, prior to an item that appeared in last month's "PlayBack," we had not done a review of a JBL product for at least two years. In any case, we agree with your motto: Buy for the sound, not the name—or the looks.—*E.P.*

Reel-to-Reel Request

Dear Editor:

I want to thank you for the superb magazine you publish month after month. You offer almost everything: New product reviews, interviews, technical help, critiques of new and old CDs of various types of music, and questions and answers for various audio problems.

For years I've been trying to locate an Akai 1722W reel-to-reel, and any Ampex machine with a built-in amp and detachable speakers. My first recorder was a Radio Shack 909 reel-to-reel. Obsolete? Of course! Nostalgic? Definitely.

Hence, one area I wish you would discuss occasionally is reel-to-reel equipment and tapes. They were the backbone of the industry until recently. By adding this, you would truly cover all audio from cover to cover, with no publication able to touch

you. I know many others still love those reel-to-reels.

Nevertheless, I deeply appreciate your magazine, as it is enjoyable to read and relieves me of the stress I experience as a pastor. Thank you very much!

Don Vincent
Bald Eagle St.
Box 203
Blanchard, Pa. 16826

Kudos to Boston Acoustics

Dear Editor:

I recently ordered from Boston Acoustics a replacement woofer for my A70 Series 1 loudspeaker system. I was told it was out of stock and would have to be manufactured—but I was perfectly willing to accept this, since a year ago I went through a similar situation.

SOME MANUFACTURERS SPEND CAPITAL ON THEIR IMAGE, ONLY FOR IT TO BE DESTROYED BY CARELESS REPAIR SHOPS.

I had ordered the same part through the service department of Pittsburgh's most established audiophile retailer and waited for more than two months to receive the item. They gave numerous excuses, and when the woofer finally arrived at the shop by UPS, it was severely damaged. The shop was more than an hour from my home, so it was frustrating to have to make yet another trip to pick up the next woofer. The shop was unwilling to ship the woofer to my home and made no apologies for the inconveniences.

When the woofer in my other A70 went down (the speakers are more than 10 years old), I called Boston Acoustics directly. I ordered the item, delighted to hear it would arrive at my home within a week. When the speaker did not arrive, I called about its status. I was told it would have to be manufactured, and the service representative assured me that the situation would be addressed promptly.

Three days later, the woofer arrived via UPS overnight delivery, and I noticed that it had been manufactured just two days previously. Furthermore, Jeff Litcofsky, customer service supervisor, enclosed a note stating the item would be free of charge. I was astonished.

In my experiences as the director of a private university's audio/visual center, I have dealt with many electronics companies and repair centers. I am always befuddled by major manufacturers spending inordinate amounts of capital on their public image, only for it to be destroyed by careless repair shops. I encourage all readers to take the bull by the horns and deal directly with the manufacturer, not with these repair shops.

It is quite refreshing to encounter a company that truly cares about its customers and is willing to do whatever it takes to make them happy. Boston Acoustics, you've a friend and customer for life.

Mark Wydareny
Pittsburgh, Pa.

Manuals Wanted

Dear Editor:

I have several pieces of equipment for which I don't have owner's manuals. I was hoping your readers could help me obtain them. The equipment is as follows:

dbx: SNR-1 single-ended source noise-reduction system, 1BX-DS one-band dynamic range expander, and 120X-DS subharmonic synthesizer.

SAE: Two P10 power amplifier and Two PA10 preamplifier.

I would appreciate any help. Thank you.

James T. Jones
969 Broadhead Lane
St. Louis, Mo. 63138

DCC: No Love Lost

Dear Editor:

I'm sorry to read that the Philips DCC system is selling poorly—but it doesn't surprise me. With only 45 minutes of continuous recording time before there is an audible gap while the system changes direction, DCC is essentially useless for live recording.

This was incredibly shortsighted engineering. A small digital buffer would have allowed 90 minutes of gap-free recording. Why Philips failed to include such a buffer is beyond me.

Norm Strong
Seattle, Wash.

Definitive's PowerField 1500 Wins the Subwoofer of the Year Award

Our extraordinary new PowerField™ 1500 features a 250-watt RMS amp, fully adjustable electronic crossover and massive 15-inch driver for only $995

"Showstoppers" – *Stereo Review*

Definitive's PowerField 1500 has triumphed, winning Subwoofer of the Year in the Audio Video Grand Prix. We set out to build the world's finest sounding subwoofers, and we have done it. Experts agree that we have achieved the perfect synergy of powerful, earth-shaking bass for home theater and a refined and expressive musicality.

All three Definitive powered subwoofers feature our PowerField Technology, monocoque cabinets, high-power high-current amplifiers, fully adjustable electronic crossovers and massive 15" or 18" drivers. The result is the absolute ultimate in subwoofer performance, awesome bass which thunders down below 15 Hz, yet retains complete musical accuracy for your total enjoyment.

Our Audio Video Grand Prix and CES Design & Engineering Award winners deliver ultimate bass performance to you.

Perfect Bass for Your System

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Archiving Radio Programs

Q *I have several hundred 7-inch reels of old-time radio programs. To reduce the cost of recording media, I recorded one of these monophonic programs on each of the tape's two channels. I recorded at 3¾ ips because 1⅞ ips would not have been practical for trading shows with other collectors. I am concerned about finding a more lasting medium on which to archive these programs. It would also be nice if I could do all this without going broke. Taking into consideration both cost and recording density, what medium is best? I have considered DAT, MiniDisc, and even 8-mm videocassettes. Am I missing some other possibility? I would have to buy new equipment for DAT or MD, but I already have an 8-mm deck. My concern is that 8 mm is still tape and subject to a limited life. MiniDiscs are optically recorded; this would seem to offer the hope of long life. With any of these formats, can I still continue using the left and right channels to record separate programs?*—Ronald Riemer, Phoenix, Ariz.

A I'm also thinking of copying my many reels of old-time radio shows to some other medium. However, I know of no machine in any of the formats which you mentioned that can record each channel separately. That will be no problem when copying your existing tapes, which already have two simultaneous programs running together. When you copy new material, you may have to sacrifice the economy of your current double-tracking system, unless you can simultaneously feed two mono programs into the recorder at once, using one channel for each.

As to long life, all the systems you name (and one more contender, which I'll get to later) use tape, except for MiniDisc. Its magneto-optical recording system, while possibly not offering the life expectancy predicted for CD, may well be the safest of the lot for archival recording.

To determine recording density, we must see how the various formats stack up. If you record at 3¾ ips in quarter-track mono and use 1-mil tape, you will get six hours on each reel. That would double if you could simply recopy the programs onto reels at 1⅞ ips. (Whatever you do, though, don't consider using half-mil tape.)

You can use conventional C-90 cassettes. If you can arrange to simultaneously record two programs, one on each channel, you will really get 180 minutes of recording on such a tape. However, I am not convinced of the really long-term stability of most audio cassettes. (Good open-reel tape holds up quite well.) I have used Maxell UD tape and to date have not had problems with it. And the cost is low: 90-minute cassettes usually sell for less than $3 each.

With MiniDisc (MD), you can record 74 minutes or so—but again, if you can record two separate programs at one time, you'll double that. The resulting 148 minutes isn't bad, but even so, if you're recording half-hour programs, you'll only be able to get two of them on each track. Later this year, there should be MD recorders that will be able to make 148-minute mono recordings as well as 74-minute stereo ones. Aside from the convenience for your purpose, this would let you get five, instead of four, programs per disc, allowing 29.6 minutes for each program. However, MD is much more expensive than cassettes—about $18 for a 74-minute disc.

At standard speed, DAT cassettes offer maximum stereo recording time of 120 minutes; most DAT recorders also have a long-play mode that gets double this recording time. When you record separate programs on each channel, you then have up to eight hours per DAT cassette. It is very, very unlikely that any of your shows have upper frequencies above 10 kHz, so you shouldn't mind that the frequency response at this speed is flat to only about 14.5 kHz. The Minidisc can rival that, but there are some problems with transients on this medium. Discount mail-order houses sell R-120 DAT tapes for about $10 each. I therefore think that this is a very competitive price compared to the others.

We can throw in another system, VHS Hi-Fi. In the six-hour mode, when recording separate programs, it can actually hold up to 12 hours of programming. I have found some good-quality VHS tapes at less than $3 each, so this system can prove economically practical. I have had some problems here and there with edge damage, which can cause flutter and distortion at times. This can sometimes be corrected if the machine has a manual tracking control; I have yet to see how well these problems can be compensated for when using an automatic tracking system. So, I am not truly sure if this medium is really good for archival purposes, although I use it that way.

Last, we have the 8-mm video format. Just how well this stacks up depends on the machine. At a minimum, it will let you record up to two hours per reel, doubled if you use your recording scheme. Some machines can also record in an all-audio mode, like VHS Hi-Fi. Some machines let you record six pairs of stereo channels, each of which can record up to two hours per tape, for a total of 12 hours—24, if you record as you do now. Still other 8-mm machines have six stereo pairs that can each hold up to four hours per channel, which will double to eight hours when recording in simultaneous mono. This is an astounding 48 hours of taping on a little cassette! That's impressive! I can't say for sure what the price for each tape may be, but you can bet that if you figure a price per hour, this 8-mm system will beat the pants off any other system.

I do not know for sure what the life span of these tapes is, but I suspect that it may be better than standard VHS Hi-Fi tapes. I also do not know the frequency response on a machine of this type. Unfortunately, it is very hard to find machines of this type as new items. Kodak used to make a machine that provided the six stereo pairs at two hours per pass. Sony, with its SV-3000, could record our 48 hours per reel. These are no longer made. If you want to find any of these machines, about all I can suggest is that you place an ad in our Classified section. I have been told, too, that Audiomart

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(Rte. 3, Box 692, Crewe, Va. 23930) can sometimes come up with odds and ends like this.

Before we get completely carried away, we are forgetting that the more information packed onto a small space, the harder it will be to retrieve. You will have to maintain very careful records of counter settings, for both left and right channels, versus program name. If we are talking 8-mm, we must keep track of all this plus the particular pair of channels on which to look for the program. This is a formidable task of record-keeping. It can be done, but be prepared to spend long hours compiling your data base, and you had better make good backups of the information.

The DAT and MD formats are the only ones I know of that can solve the retrieval problem to any extent. During the recording process, whenever you start recording or when both channels are silent, the recorder will set an index mark that the machine can readily find in playback. If you're recording in simultaneous mono, where the silences might occur in only one channel at a time, you can put an index mark on the tape or disc by pressing a button. The DAT system won't retrieve information as fast as one can search for information on a MiniDisc, but it is certainly fast enough for most applications.

Audio on Ice

Q *I have heard a great deal about power amplifiers getting hot, about the need to position amplifiers where ventilation would not be a problem, and about how manufacturers employ heat-sinks and fans to keep equipment operating at a safe temperature. I was wondering if dry ice could be used as a coolant. Would it damage equipment by lowering the temperature too much, or would the amplifier operate better than at room temperature?*—Name withheld

A I think that using dry ice to cool a power amplifier is an extreme approach; it should not be used. Chances are you would need a fan to blow over the ice in order to direct the cold air onto the heat-sinks. If you try using dry ice, be sure to protect your hands.

Amplifiers are designed to run warm, somewhat above ambient room temperature. Running the amp at really low temperatures could easily change the output

stage's operating characteristics. This change would likely lower output and increase distortion.

Recording in Your Car

Q *I have sought in vain to acquire a car cassette system that is capable of recording. If I can't buy one, is there a standard outlet on any car cassette system that will allow me to connect a portable recorder to it?*—Jay Wilfong, St. Petersburg, Fla.

A I don't know of any current car stereo units that can record as well as play. Many car systems do have line-level outputs designed to drive external amplifiers, and a portable recorder could be connected to such an output. However, the signal level at these outputs depends on the volume-control setting. If you adjust your listening volume while you're recording, you'll also change the signal level going to the recorder—and if you turn the volume down, there may not be enough signal to drive your recorder to full modulation.

A skilled electronics technician could probably add output jacks that tap the signal before the volume control, and possibly even buffer the new outputs so turning your recorder on or off won't affect the signal you're listening to. But any recordings you make off the air while driving will be affected by interference, fading signals, and other problems common to car radio listening; these problems will become more annoying each time you listen to the tape.

There has always been some demand for car stereo units that record, and manufacturers have occasionally produced them. However, the demand has never been enough for anyone to keep such a model in production very long.

Recording by Timer

Q *I was very disappointed that* Audio's *Annual Equipment Directory issue (October) fails to note whether analog cassette tape recorders have timer-controlled record/playback capabilities. I do lots of off-the-air recording, so, all else being equal, this is a deciding factor in my purchase of a deck. I am concerned that manufacturers will eventually eliminate this feature.*—Ken Massey, Indianapolis, Ind.

A *Audio* does not ask companies about timer recording because the available space must be used for features and specifications of widest interest. However, as long as there's substantial interest in a feature, manufacturers will continue to provide it. (*Editor's Note:* Timer recording would seem to be a more popular feature in Japan, where electronics stores usually carry suitable timers; such timers are comparatively rare in the U.S. However, since most cassette decks come from Japan, the feature seems likely to remain available.—*I.B.*)

I recently worked with a Technics DCC recorder; timer control was a well-implemented feature. Although your concern is analog decks, you should be heartened to see the feature appearing on new designs.

I have found that some machines permit timer control, even when it was not specifically intended. If you have an older deck with a wired remote control whose buttons stay down once they're depressed, plug the machine into your timer, set up for recording, and press the remote's play/record buttons. When the deck starts getting power from the timer, it should begin to record.

The old piano-key decks can also be used this way. However, leaving the idlers and capstan roller engaged while waiting for the timer to start can create flat spots on the idler, causing wow and flutter. It's best only to use this trick for short periods.

The pads or soft-touch buttons on decks with all-electronic control do not remain depressed. I once got around this difficulty by wedging the desired buttons so that they could not pop out. When powered, the deck immediately went into its record mode. This may not work with all machines, and problems might arise if the buttons are still jammed down when the tape comes to an end.

Headphones vs. Subwoofers

Q *My powered subwoofer is connected, as recommended, between my integrated amplifier's pre out and main in ports. This puts the subwoofer's crossover in the path to the headphone outlet. Therefore, when I listen through headphones, I get no bass below perhaps 90 Hz, the subwoofer's crossover point. My attempt to bypass the subwoofer, using two four-pole double-throw switches, worked but gives me a lot of hum. What else can I do?*—Robert A. Keeler, Grand Rapids, Mich.

A You have already partially solved the problem. Actually, the switching can be done with just one four-pole double-throw switch. The switch and its associated tie points and/or connectors should be mounted in a metal project box. The metal will act as a shield.

To minimize the number of phono plugs, I suggest that all wiring to and from the box be "captive cables." In other words, do not mount any connectors on the box. (You could, but I don't recommend it.) Cables will exit the box, and they should be marked as to where they are to be connected: Pre out, main in, crossover in, and crossover out (this last is for the satellites). Of course, you duplicate these cables for the second channel. Be sure to run all grounds through, or you won't have a signal path; you will not be switching grounds. (Your use of the second switch suggests to me that you did just that.) If hum persists, you might try breaking the ground path for *one* channel.

Use two poles per channel (thus, the four-pole switch). We will consider each pole as a separate switch, for ease of discussion here, but we'll just talk about SW1 and SW2, for the left channel; you need simply to duplicate this wiring for the right channel.

The center terminal of SW1 is connected to the pre out cable. The center terminal of SW2 is connected to main in. Position A of SW1 is wired to position A of SW2. Position B of SW1 is wired to crossover in. Position B of SW2 is wired to crossover out. A 1-megohm, ¼-watt resistor is wired between pre out and ground. A second such resistor is wired between crossover out and ground. (The resistors are used to remove the possibility of a transient click when the switch is moved from one position to the other.)

When the switch is moved to position A, the pre out is directly wired to main in. This permits either full-range satellite or headphone listening. When the switch is moved to position B, pre out is wired to crossover in; main in is wired to crossover out. The subwoofer will then be placed in service. A

Build a Class-A 100-Watt Mono Amp

by dr. norman e. thagard

PART II

Continuing this article on building a high-end Class-A amplifier (100 watts into 8 ohms, 0.1% or less THD), I will describe the power supply and output stage. Part I covered the low-level stages and the history and philosophy behind the design.

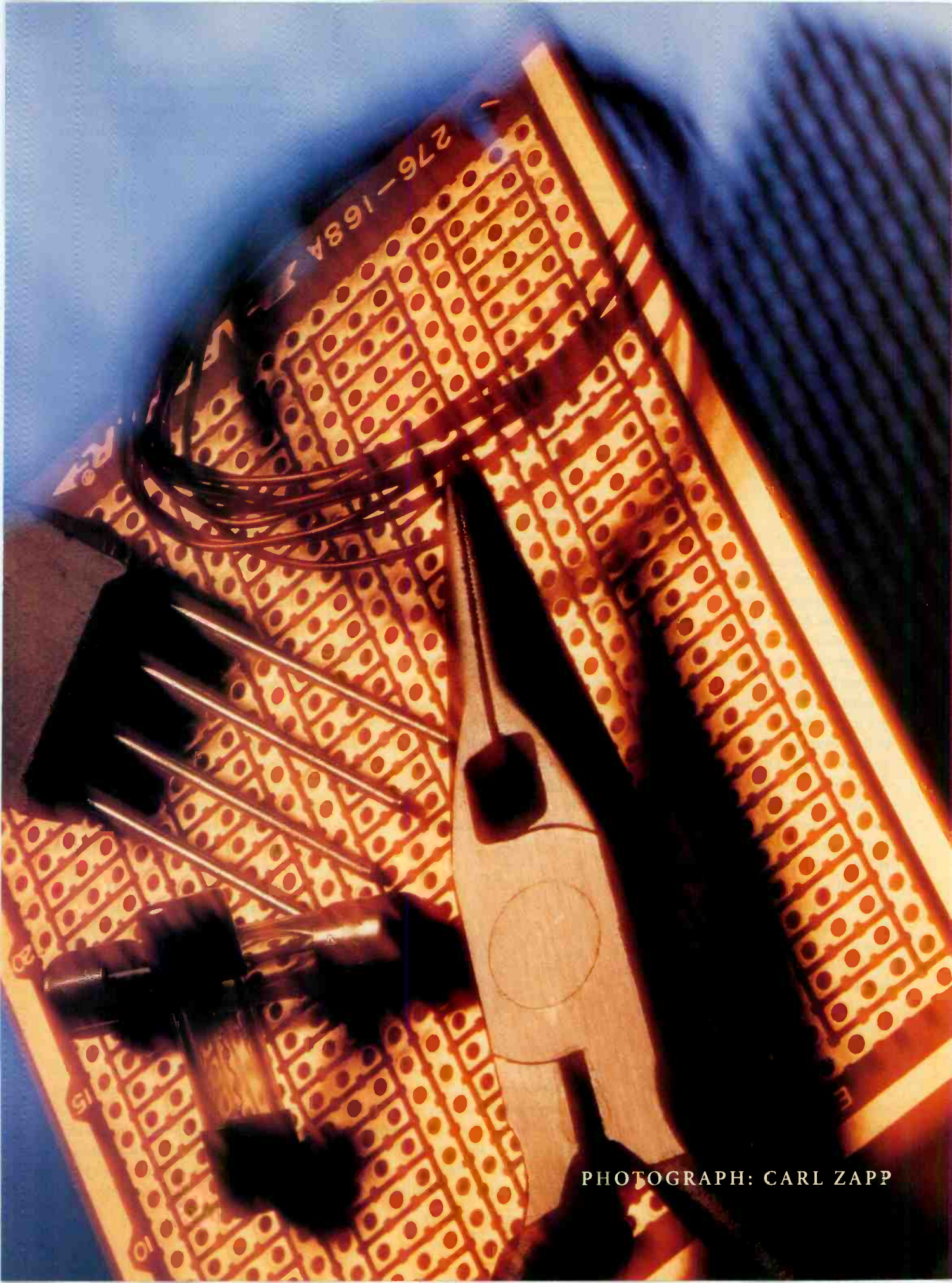
Power Supply

Nelson Pass, a designer of high-end audio equipment who helped me with this amplifier, was concerned that the local feedback scheme might inject noise into the amplifier. He indicated that this objection would be removed if the driver stage were operated from a separate regulated supply. This was good news, because the intent from the beginning was to do this, albeit for another reason: The MOS-FETs used here are all enhancement-mode devices, which means that a gate-to-source voltage of 5 V or so is required to saturate them. If the driver stage were operated from the same supply as the output, the output swing could never be closer than 5 V to the output-rail voltage, which would significantly reduce the amplifier's rated power output. This is even more onerous for a Class-A amp, where the already high quiescent power dissipation would be unnecessarily raised and cause even greater inefficiencies.

The 55-V driver rails allow the output to swing almost the whole 100-V (+50 to –50 V) output power-supply differential. All of my amplifier designs have used half-wave voltage doublers, followed by voltage regulators, to power the front-ends. Such doublers have limited current capability, but amplifier front-ends have current requirements well within that capability. The alternative to the doubler would be an independent supply requiring either a separate power transformer or additional windings on the main power transformer. In my experience, single transformers with the desired additional windings are impossible to come by, and it is difficult to physically locate a second power transformer in the usual cramped chassis.

The emphasis of this article is on the signal circuitry. Even so, I would be remiss to ignore the design of the voltage doubler/regulators. I used information

Norman E. Thagard, M.D., is a NASA astronaut who has been selected as the prime crew member for a three-month flight on the Russian space station Mir this spring.



PHOTOGRAPH: CARL ZAPP

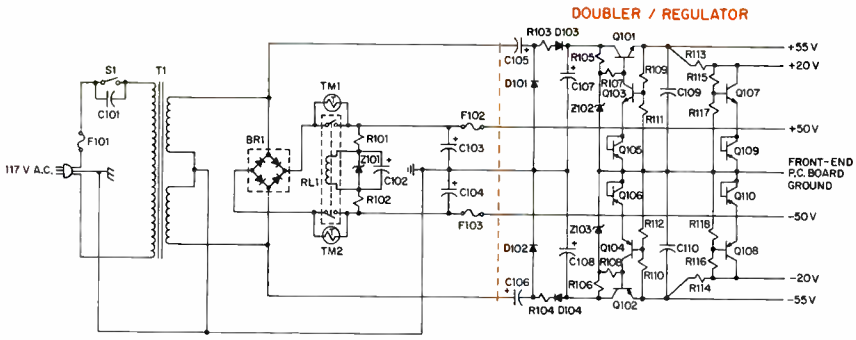


FIG. 2—*Power-supply schematic.*

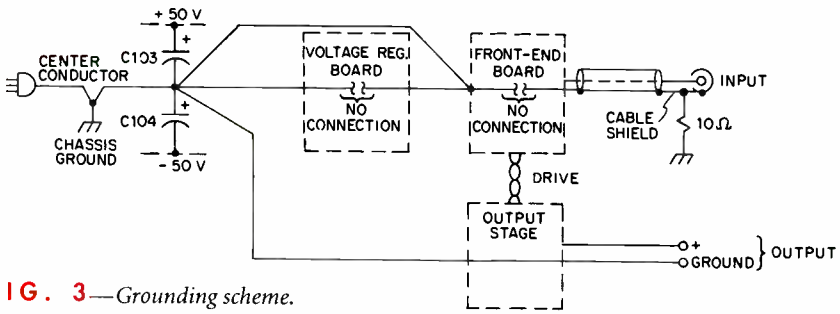


FIG. 3—*Grounding scheme.*

from my 30-year-old electrical engineering text for the doubler design. A description of the positive supplies follows; the negative supplies perform similarly, as can be inferred from Fig. 2.

Initially, C105 will charge through D101 to a level approaching the a.c. peak voltage of the power transformer's secondary, i.e., about 50 V. The D101 anode voltage will drop below cathode voltage as the cycle continues, cutting off D101 and preventing C105 from discharging through that diode. During the next cycle, the positive terminal of C105 will approach 100 V, as its negative terminal will rise to the transformer secondary voltage (remember, the voltage across a capacitor cannot change instantaneously, and C105 was previously charged to 50 V). Because the required voltage rating of C105 is thus seen to be at least 50 V, use a 63-V capacitor. Capacitor C107 will charge through R103/D103 to a level less than twice the peak secondary voltage. Resistor R103 will lessen the charging current pulse amplitude, which will make the voltage at the doubler output (D103/C107 junction) somewhat less than it would otherwise be. You can increase R103 at the expense of that voltage, but the doubler output voltage needs to be 85 V or more to ensure proper operation of zener Z102. If you measure less than 85 V here, reduce the value of R103. Clearly, C107 needs to have a voltage rating significantly greater than 85 V.

The R105/Z102/R107 scheme is sometimes called preregulation. Its use should improve performance of the downstream regulators. A simple discrete series voltage regulator is formed by Q101/Q103, for which Q105 is a stable 7-V reference. Output voltage is set by the formula:

$$\left(\frac{7+0.7}{R_{111}}\right)\left(R_{111}+R_{109}\right)=$$

$$\left(\frac{7.7}{7{,}680}\right)\left(55{,}180\right)=55\text{ V.}$$

The 0.7 V in the formula is the V_{be} for Q103.

The 55-V regulated output is then further regulated down to 20 V by a simple, discrete shunt regulator. This regulator behaves somewhat like a zener in that it will conduct whatever current is required to maintain 20 V at the output. Thus, the function of R113 is to limit that current so that regulator component limitations will not be exceeded. Too high a value for R113 will cause the output to drop below 20 V. Transistor Q107 is the shunt, while Q109 is a 7-V reference. Output voltage is determined from the formula:

$$\left(\frac{7+0.7}{R_{117}}\right)\left(R_{117}+R_{115}\right)=$$

$$\left(\frac{7.7}{7{,}680}\right)\left(19{,}780\right)=20\text{ V.}$$

Here, The 0.7 V of the formula is the V_{be} of Q107.

Seven-volt zeners can be substituted for transistors Q105, Q106, Q109, and Q110. Precision 5-V references are also available, but their use will require changes in the resistor values to give correct voltages for regulator output.

Other Circuitry

The grounding scheme (Fig. 3) is worth a quick comment. The star ground technique, in which a single ground point exists, is employed; all system grounds are returned to this point. I used heavy gauge brass bus bars to connect the ground terminals of the main power-supply electrolytic capacitors, C103 and C104. This is the system ground. The ground trace on the doubler/regulator p.c. board is intentionally broken, that is, the board's input ground is not continuous with its output ground. Instead, the wire lead from the output ground trace goes directly to the front-end's p.c. board ground connection and from there is routed back to the system ground point. This part of the grounding scheme keeps voltage spikes from the half-wave doubler out of the ground bus for the regulators, which results in a cleaner regulated supply rail.

To prevent ground loops, the signal input ground is not continuous with the front-end's p.c. board ground discussed in the preceding paragraph. Instead, only the input components C2/R2 and the feedback resistor R34 have their grounds connected to the ground terminal of the input RCA jack. The jack's ground terminal is connected to the chassis through a 10-ohm resistor. The chassis itself is connected to the system ground from one point only, with a

heavy gauge wire. I have used well-shielded audio cable to connect the RCA jack to the front-end's p.c. board, but this is probably not required.

But I digress, and shall now return to the circuit description. The output MOS-FETs do require biasing for linear operation, so Q21 is at the heart of a variable voltage source that provides the 10 or 11 V from the p- to the n-channel gate. Used as a V_{be} multiplier, Q21 has a collector-to-emitter voltage adjustable by trimpot P2. While a potentiometer could be used directly to provide the gate-spreading voltage, it is not prudent to run much current through one. Therefore, the circuit here—the one used in all but the simplest amplifiers—is designed to give some protection against inadvertent high biases or failures that might fully turn on the output transistors. This arrangement should be a d.c. voltage source and an a.c. short. Capacitor C7 offers some noise suppression and lowers a.c. impedance at higher frequencies.

I mentioned in Part I that no global feedback is used. That is true for the complete amplifier, but the front-end does incorporate feedback from driver to input. Driver output is sampled and fed back to the input via R31 through R34. The closed loop gain is set by the ratio:

$$\frac{\frac{(R_{31} \times R_{32})}{(R_{31} + R_{32})} + R_{33} + R_{34}}{R_{34}} =$$

$$\frac{5k + 16.9k + 1.0k}{1.0k} = \frac{22.9k}{1.0k} = 22.9$$

and is about 20. This sets the amplifier's sensitivity to a fairly typical value. Capacitor C8 is another form of compensation and was used here to shape the square-wave response [5]. The value of 5 pF gave a very slightly overdamped response, which looks very good on an oscilloscope.

Output Stage

In the output stage, Z3/D4 and Z4/D5 form a protection network to safeguard the gates of Q24 through Q35 from damaging overvoltages. With the use of global feedback, a reactive load that lags the output will cause drive voltage to increase as the feedback loop attempts to force the output to follow the (amplified) version of the input. This can easily produce gate-to-source voltages which imperil the output MOS-FETs. While this open-loop amplifier will have no such tendency, it is still wise to incorporate this inexpensive protective network to avoid the cost and trouble of replacing the MOS-FETs.

The most important consideration FOR A CLASS-A Amp at this power level IS THERMAL STABILITY.

Transistors Q22 and Q23 are constant-current sources. Without them, bipolar power transistors Q36 through Q47 would run out of base-current drive as the output voltage approached the supply rails. This, then, is another case where the amp's power rating would be unnecessarily limited if appropriate countermeasures were not taken. As a rule of thumb, I use a bias current that is about 10% of the output bias current, which is almost always sufficient to fully drive the output while not so excessive as to place unreasonable burdens on Q22 and Q23. Since R37 and R38 are 3.9-ohm resistors, bias current is 0.23 ampere (0.9 divided by 3.9), which is about 10% of the 2.5-amp output bias. (The 0.9 in the equation is, of course, the voltage drop across the series diodes D6 and D7, which is about 1.5 V, less the 0.6-V V_{be} of Q22.)

Since the 0.23 ampere flows through R66 (R67), base voltage of the output bipolars is 6.2 V (0.23 times 27), which means a little less than 5.6 V (6.2 minus 0.6) is across the output MOS-FET channels. This is another advantage of cascoding: Devices with lower power and voltage ratings may be used in a critical application. These MOS-FETs are responsible for the thermal behavior of the output, and cascoding them improves performance since they dissipate far less power than if they had the entire supply voltage across them.

The most important consideration for a Class-A power-output stage at this power level is its thermal stability. If biased by a constant-voltage source, a bipolar transistor will exhibit a negative thermal coefficient. Some authors choose to call this a positive coefficient. I use the convention in the International Rectifier *MOS-FET Data Book*, which refers to the effective resistance of the device. As it heats up, the effective resistance of the channel decreases, which results in more current, which results in more heat, and so on. Self-destruction can be the outcome. The output in this design is biased by a constant-voltage source, namely the V_{be} multiplier, Q21. However, no tendency to thermal runaway occurs, because it is the MOS-FETs, not the bipolars, which are so biased.

Now, in spite of what you may have heard about positive thermal coefficients of MOS-FETs, in a linear application such as this, MOS-FETs will also conduct a little more current as they warm up. This happens because the positive thermal coefficient of the channel is more than offset by the thermal behavior of the gate-to-source voltage [6]. For a given drain current, the required V_{gs} drops with increasing temperature. At the high drain currents seen in switching applications, the channel characteristics predominate and the often touted thermal advantages of MOS-FETs do, indeed, exist.

There is no need for alarm. Even in the present application, this increase in drain current with increasing temperature is self-limited, so that thermal runaway will not occur. As a matter of fact, Q21, which is a medium-power bipolar transistor, will experience a drop in its V_{be} as it warms up. Since it functions as a V_{be} multiplier, output MOS-FET bias will drop. The overall thermal characteristic of this amplifier is the desirable one, that is, output bias will tend to fall somewhat as it warms up. Obviously, then, Q21 should be mounted on a heat-sink. Even though a heat-sink is not required for its modest power dissipation, it *is* required to keep the output bias from sagging excessively. (Otherwise, this Class-A amp will degrade to high-bias AB as it warms up.)

I did not match either the MOS-FET or the bipolar output transistors. Nonetheless it is important that the MOS-FETs be reasonably well matched, or they will not equally share the output bias current. For the reason given above, inequalities in current sharing will actually be aggravated as the MOS-FETs warm up. Source-degeneration resistors R52 through R63 will improve the current sharing and improve output linearity; they could be increased to 1 ohm at the expense of lowering damping factor. With carefully matched MOS-FETs, these resistors could also be eliminated, but I like to use them because it would otherwise be difficult to determine the performance of a particular leg of the paralleled output. MOS-FETs from the same lot would likely be adequately matched. Purchasing all of the MOS-FETs from the same vendor at the same time usually gives you transistors from the same lot, which was certainly my experience with this amplifier. The 250-watt bipolar output devices have no choice but to conduct whatever current their cascode partner sends them, so matching the bipolars is unnecessary.

Since power output = (rms current)^2 x load impedance, then the rms current = $\sqrt{\text{power}/8} = \sqrt{100/8} = 3.5$ amperes. Peak current = rms current x $\sqrt{2}$ = 3.5 x 1.4 = 5 amperes. At 100 watts, current will vary from near zero up to the peak of 5 amperes. For Class-A operation, the current must never go to zero (output devices must conduct throughout the cycle), so the output bias must be set to at least 2.5 amperes.

Paralleled MOS-FETs can self-oscillate due to parasitic device reactances. Gate resistors R40 through R51 should prevent such oscillations. Not enough is said about oscillations in power amplifiers; even some commercial amps have had such problems. This was my third scratch-built amplifier, and all three initially had oscillations. (Let me add that the first two scratch-built amps that oscillated were not of my design.) Stray coupling can be the culprit. Keeping input separated from output can help with this, as can ground-plane construction of p.c. boards and grounding heat-sinks (I have seen stray coupling to transistors mounted to ungrounded heat-sinks). I routinely do these things, as is evidenced in this design. Inadequate bypassing of power-supply runs can cause

The damping factor doesn't VARY MUCH WITH frequency, so this Amp IS NEARLY AN IDEAL VOLTAGE SOURCE.

problems, since the power supply should ideally be an a.c. short circuit. There can be enough inductance in the wire carrying power from the supply to the p.c. board to cause onboard problems. Thus, the front-end board in this design allows for power-supply bypassing. Although keeping lead lengths short is desirable, a 100-watt Class-A amplifier has massive heat-sinks, so it is impossible to keep all lead lengths short. The prototypes were built with no concern for layout other than a reasonable separation between the input and output portions of the circuit. Nonetheless, the amplifier has no detectable oscillations; the open-loop topology no doubt contributes to this stability. No series output inductor, of the kind frequently used in power amplifiers to isolate the output from reactive loads, is needed, and the amp has driven capacitive loads with no apparent problems. In this regard, it is an excellent project for those who would like to have assurance that the outcome of their efforts will be successful.

The RC output filter formed by C13/R39 is ubiquitous in power amps. Although I detect no difference in bench tests of performance with or without the filter, Pass assures me there is a load lurking out there that will require it. The values used for C13/R39 are the most typical.

Diodes D10 and D11 protect the amplifier output from reactive loads which could induce EMFs high enough to reverse the polarity across the output transistors. This could even happen with lower EMFs in this Class-A amplifier, because rail voltage falls rapidly at power off. A reactive load could hold the output well above virtual ground, leading to the polarity reversal. The diodes clamp the output voltage to a magnitude no greater than one diode drop above the rail voltage.

Fuse F1 protects the amplifier from inadvertent output shorts and the load from amplifier failures or problems in signal sources connected to the amp. All amplifiers have failure modes that can result in the output heading straight to the supply rails. To deliver 100 watts into an 8-ohm load, F1 must be rated at 4 amperes or more. In Pass' experience, fuses smaller than 6 amperes sometimes have adverse auditory effects. A 6-ampere fuse may or may not blow if a fault occurs, thus placing the amplifier or its load at risk. You must be the judge of the efficacy of F1.

Some argue that output fuses lower an amplifier's damping factor. Indeed, output fuses can do so, because they increase the output impedance by the amount of their own impedance. In a feedback amplifier, the fuse impedance can be the major contributor to output impedance. That is less likely in this open-loop amplifier, since output impedance is inherently higher. (Feedback has several effects; in addition to lowering THD, it also reduces output impedance by the amount of the feedback). In the rush to extremely high damping factors, the already low absolute value of the output impedance is often overlooked. Of more importance, I think, is the frequency dependence of the damping factor. I measured 45 at 1 kHz, 40 at 10 kHz, and greater than 35 at 20 kHz. Since damping factor is the ratio of load impedance to amp output impedance, the output impedance for the standard 8-ohm load at 20 kHz is 0.23 ohm (8 divided by 35). Looking at this from another perspective, we are less than 0.25 ohm from a perfect voltage source, which is the ideal.

A few words are due concerning the main power supply. If rated output is to be realized, the rail voltage must drop no lower than 46 V in operation. The current required from the supply will be around 3 amperes at that voltage. Rounding off yields a power dissipation of 300 watts. The power transformer, T1, must be capable of providing this kind of power, and a good rule of thumb would be a VA rating of about twice the 300 watts. Since the 300

watts is somewhat conservative, a 500-watt transformer is probably adequate if the amplifier is properly ventilated. A toroid is preferred but not essential.

There is no need to regulate the main power supply, but it must be adequately filtered. I recommend that filter capacitors C103 and C104 be at least 15,000 µF. Their voltage rating should be at least 63 V.

Large filter capacitors will result in welded contacts unless the power switch has a very high current rating or in-rush current limiting is provided. The relay/thermistor arrangement of RL1, TM1, and TM2 used here works well. At power on, the filter capacitors look like a short circuit. The transformer/rectifier doesn't see this short, because the 10-ohm cold resistance of the thermistors is interposed. As the filter capacitors charge toward the 50-V level, the pull-in voltage of the relay is finally reached, which bypasses supply current around the thermistors. There is always a chance that the relay contacts would not close. Even if such a failure occurs, no hazard exists since the thermistors are rated to carry the full supply current. There would be an increase in power-supply output impedance by the amount of the hot resistance of the thermistors, but this is less than 1 ohm.

The final installment of this article will cover construction methods and will include a complete Parts List plus circuit-board patterns and board-stuffing diagrams. A

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Bascom H. King

Switched-On Amps: Power with a Pulse

Switching amps have captured the imagination of many audio pioneers over the past 20 to 30 years. The siren song of this technology has been—and still is—high efficiency, small size, and the potential for more linear operation (or at least a different type of linearity) than that of conventional solid-state amps. Internally, switching amps handle signals entirely as on/off pulses, using pulse-duty-cycle modulation (PDM), or pulse-width modulation (PWM). Therefore, these amps are often referred to as "digital"; they are also sometimes described as Class-D amps. Their downside is the considerable difficulty in keeping r.f. generated by the switching action from radiating out of the amplifier and interfering with one's FM tuner, TV set, and possibly other electronic equipment.

SWITCHING AMPS SING A SIREN SONG OF HIGH EFFICIENCY, SMALL SIZE, AND GREATER LINEARITY.

How do switching amplifiers work? Fundamentally, they consist of three main blocks: An analog input-to-duty-cycle modulator, a switching output stage, and a power supply (Fig. 1). Assuming a bipolar (positive and negative) power supply, the output stage can be in only one of two states: Fully positive or fully negative.

Imagine that the output is switching between these two states at a rate of 500 kHz. With no incoming audio input, the waveform will be a 500-kHz square wave with equal positive and negative time intervals. As shown in Fig. 2, this produces a 50/50 duty cycle: The waveform spends half of its time at the positive rail and the other half at the negative rail. Under these conditions, the net average (or d.c.) output is zero. Now, suppose that the duty cycle were to be proportional to the incoming audio signal's amplitude (a proper supposition, as that is the function of the modulator block preceding the output stage). As the incoming audio waveform goes positive, the duty cycle changes so that the time spent positive is correspondingly greater and the time spent negative is correspondingly less, which produces a net positive output voltage. When the

THIS SWITCHING AMP, USED IN BOSE CAR SYSTEMS, DELIVERS 100 WATTS INTO A 0.5-OHM LOAD.

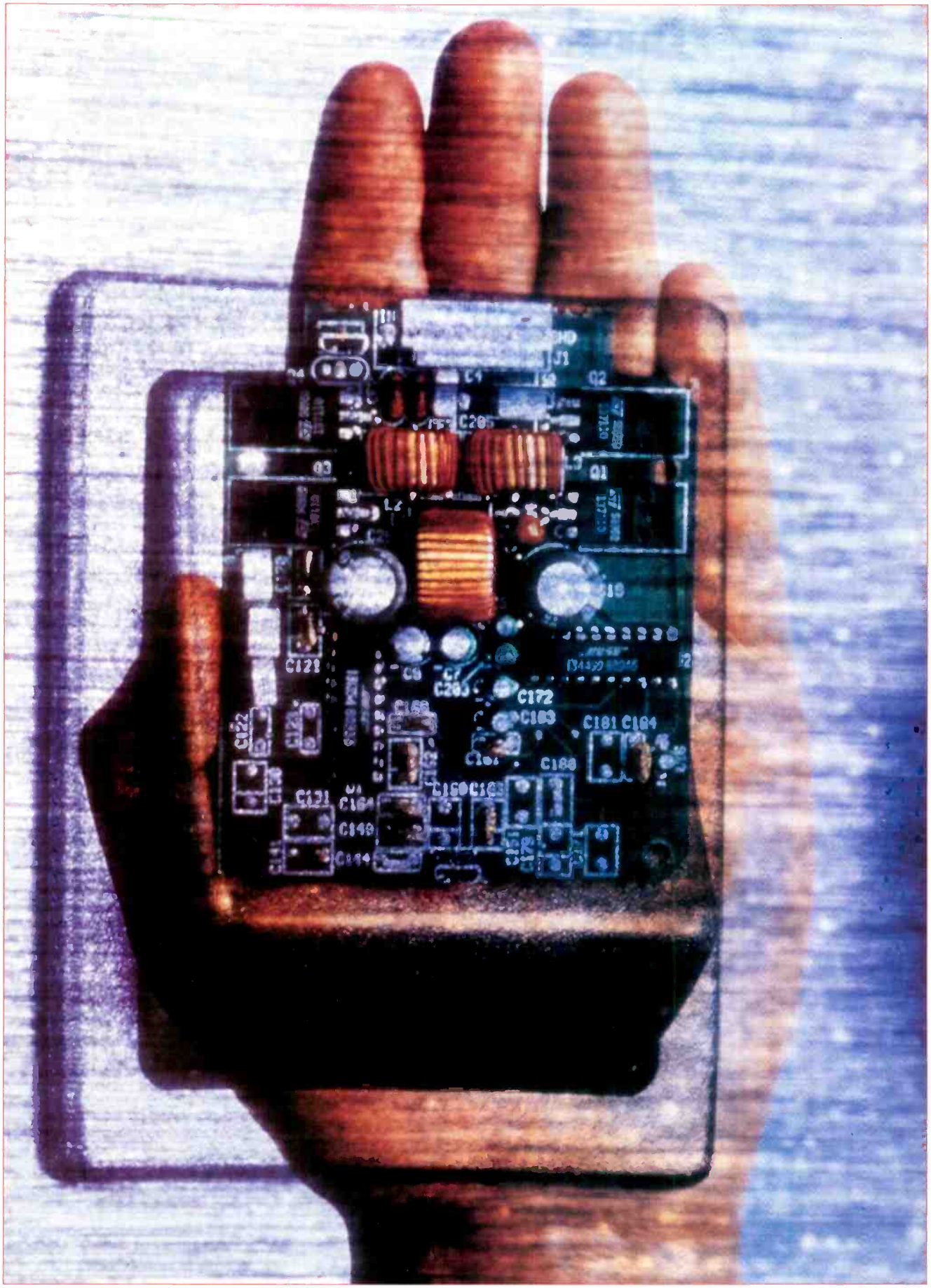


Photo enhancement: David Hamsley

ABOVE, THE ORIGINAL INFINITY SWITCHING AMP.

A SWITCHING DESIGN KEEPS INFINITY'S CAR AMPS, ABOVE RIGHT, COMPACT AND EFFICIENT.

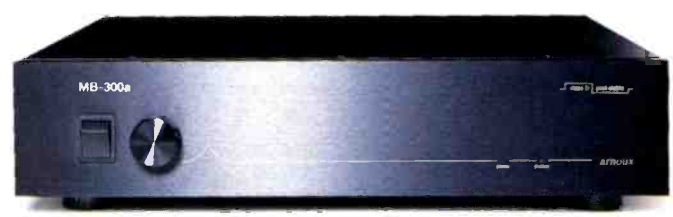
incoming audio waveform goes negative, a similar effect takes place, producing a net negative output voltage. Of course, with real audio signals, all this takes place on an ongoing basis, making the average output of the switching output stage an amplified replica of the incoming analog audio waveform. It is necessary to remove the 500-kHz switching components, so they will not get into the actual output to the outside world; this is the job of a high-level, LCR low-pass filter. The cutoff frequency of these filters is typically around 50 kHz.

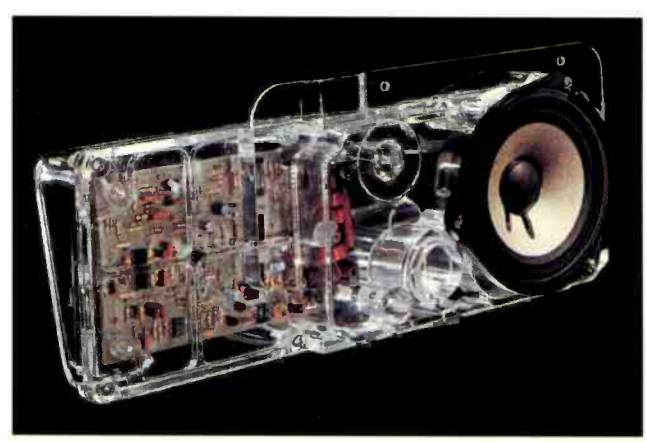
Another way of thinking of all this is as a sampled data system with a 500-kHz sampling frequency. This is a simplified explanation, of course. In actuality, most designs allow the switching frequency to come down for the signal peaks of each polarity as the signal modulation approaches full scale, so as to more effectively allow the duty cycle to approach 0% and 100%. Furthermore, audio-frequency negative feedback is inherent in the operation of most designs, helping to maintain overall input/output linearity.

Historically, I believe Infinity Systems had the first actual switching amp on the market, back in 1976. This unit, informally called the Swamp (for switching amp), had some very impressive characteristics—among them some 300 watts per channel into 8-ohm loads, a switching frequency of 500 kHz, use of a switching regulated power supply, and the use of one pair of fast bipolar transistors per channel in the switching output stage. The designers of this circuit originally thought that it could be small and light, with virtually no heat-sinking. Over time, they learned this really wasn't so, and the final product ended up with a very considerable bulk of extruded aluminum heat-sinks on the rear of the unit. The nemesis of Infinity's Swamp was a propensity for failure that was not consistent from unit to unit. Some units would be quite robust, while others would fail at the blink of an eye. This characteristic persisted despite considerable and ongoing efforts by the designers (I was later one of them) to improve reliability.

BELOW, A 300-WATT ARNOUX AMP.

THE BOSE CAR AMPS, BOTTOM, CAN BE MOUNTED IN THE SPEAKER ENCLOSURE.





Infinity came up with a new design, nicknamed Swamp 2, whose audio circuitry was similar to the original Swamp's but which had a nonswitching power supply. Only a few, if any, of these units were sold. Infinity shortly got out of the switching-amp business.

Around the time Infinity was working on the Swamp 2 (1977 to 1978), Sony came out with a switching amp, the TA-N88, which used two pairs of V-FET devices for the switching output stage. This design also used a switching, regulated power supply. It was a nicely made unit and sounded pretty good, but it was on the market for only a year or two.

In car audio, there have been a number of switching power amplifiers. Around the early to mid-1980s, a deluxe sound system for the more expensive GM cars appeared. These systems, designed and built by Bose, utilized a switching design for the power amplifiers. The amplifiers didn't use a power converter to generate a higher bipolar supply for the output stage; instead, they used a full bridge output stage operated directly off of the battery voltage. This, in conjunction with nominal 2-ohm speakers, produced some 25 watts of power per speaker position. (Today's Bose car amps feed 0.5-ohm loads, to deliver 100 watts apiece.) I have heard that Alpine has also used a similar approach in some of the name-brand car systems that they have been involved with. Yamaha also had a switching amp for cars on the market for a while, in the late '80s.

In the sound-reinforcement field, I understand that a few switching amplifier designs have come and gone over the years.

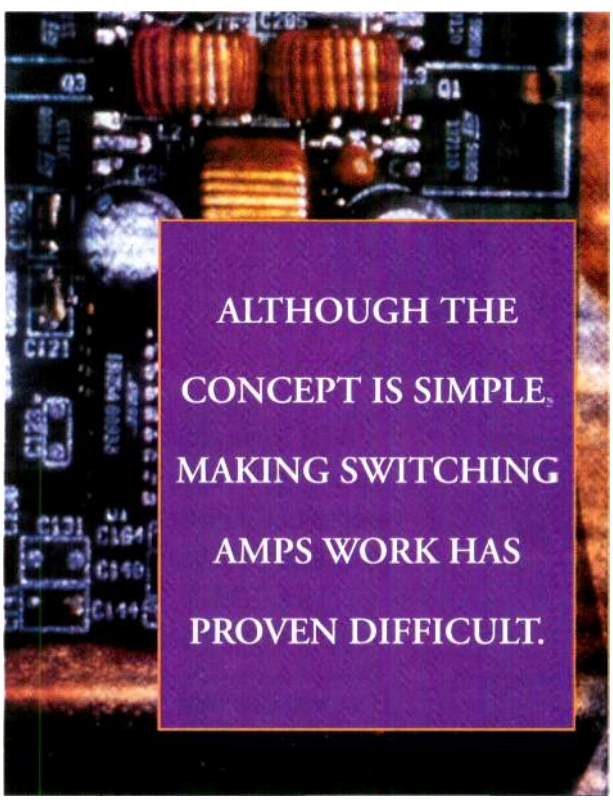


FIG. 1 — BLOCK DIAGRAM OF A TYPICAL SWITCHING AMP.

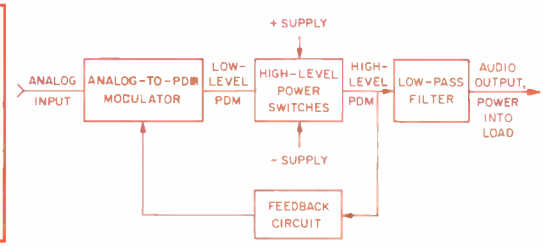
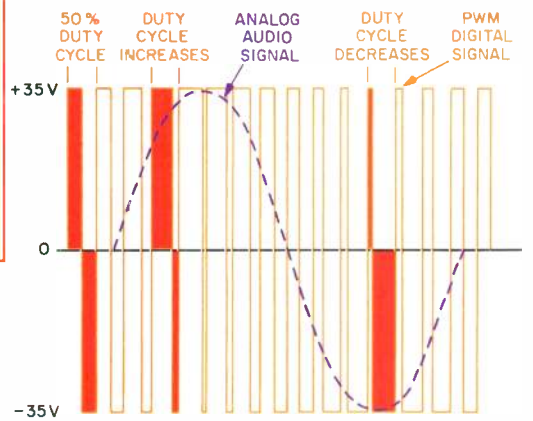


FIG. 2 — PULSE-DUTY-CYCLE MODULATION.



Currently, Peavey and others have switching amplifiers intended for this market.

Infinity Systems has recently gotten back into the switching-amp business, this time with aftermarket amplifiers for car systems. These products have been designed by my good friend and mentor, W. M. (Mack) Turner of Arnoux Corp. I have known about the development of these amplifiers from before Mr. Turner's relationship with Infinity was established. He calls his design "past stable," which really defines a topology whereby the circuit, from a linear systems feedback point of view, is unstable at high frequencies and thus oscillates. Oscillate it does, at about 500 kHz, producing an overall pulse-duty-cycle, frequency-modulation scheme that produces a highly linear overall input-to-output relationship. Infinity is currently selling these car amplifiers in various power levels and configurations.

As a separate effort, Arnoux is readying two models for home hi-fi use, under its own name: The Model 7B, a 60-watt/channel stereo unit, and the MB-300A, a 300-watt mono piece. I have had a lot of listening experience with various versions of the smaller stereo amp, and I must say they sound very natural and satisfactory. One thing I like about the 7B is that it consumes so little operating power, some 7 to 8 watts; I happily leave it on all the time so that it always sounds its best when I use it in my system. The larger MB-300As have an obviously more powerful sound and rival some of the best linear designs in overall reality of sound reproduction. Look for these amps at selected dealers soon (and possibly direct from the factory in Santa Barbara, California).

I wouldn't be surprised to see more activity in switching amps in the near future. Their newfound reliability makes them practical, and their high efficiency has strong appeal in this energy-conscious era. A

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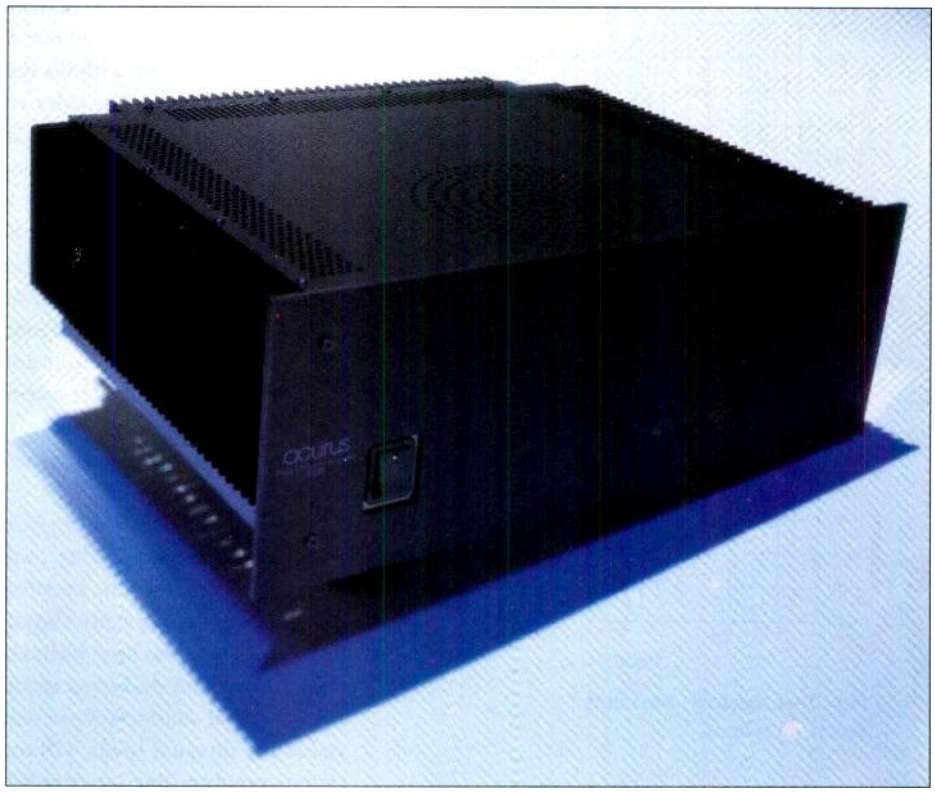
EQUIPMENT PROFILE

ACURUS 200X3 THREE-CHANNEL AMP

Many articles have been written suggesting that the easiest way to "expand" an existing stereo system for home theater use is to buy a top-quality Dolby Pro Logic processor, use your existing stereo amplifier for the rear channels, and buy a three-channel power amp for the front. Sounds logical, until you peruse *Audio*'s Annual Equipment Directory looking for three-channel power amps. In last October's issue, I could find only three of them listed. The first in the alphabetical list is the Acurus 200X3, the subject of this review.

Yes, I know there are plenty of multichannel amps in the *Audio* "bible," many of which can be bridged for three-, four-, or five-channel operation. However, bridging is a mixed blessing, as Mondial, the manufacturer of the Acurus 200X3, correctly points out. When an amplifier is bridged, each half (i.e., each original amplifier channel) sees an impedance equal to half the total. As far as the amplifier is concerned, 8-ohm speakers look like 4-ohm systems, 4-ohm speakers look like 2-ohm models, etc. Under these conditions, each amplifier works harder and typically generates more distortion. Furthermore, when two amplifiers drive the same load, the frequency response anomalies of each combine, as does noise power. Amplifier output impedance doubles too. When an amplifier drives a frequency-dependent load—and all speakers present a frequency-dependent load to some extent—nonuniformity in output impedance can play havoc with overall system response. It's not that bridging doesn't "work"—it does—but performance in bridged operation will invariably be somewhat worse than with unbridged operation. That's the logic behind the Acurus 200X3.



Photos: Michael Groen

SPECS

FTC Power Rating: 200 watts/channel, three channels driven into 8 ohms at no more than 0.06% THD, 20 Hz to 20 kHz.
Output Power: 250 watts/channel continuous, three channels driven into 4 ohms, 20 Hz to 20 kHz.
S/N: 110 dB, A-weighted.
Input Sensitivity: 1.1 V for full output.
Input Impedance: 20 kilohms.
Dimensions: 17 in. W x 7 in. H x 15 in. D (43.2 cm x 17.8 cm x 38.1 cm); 19-in. (48.3-cm) front panel optional.
Weight: 45 lbs. (20.5 kg).
Price: $1,295.
Company Address: c/o Mondial, 20 Livingstone Ave., Dobbs Ferry, N.Y. 10522.
For literature, circle No. 93

Design and Construction

Although I was not provided a schematic with which to confirm my analysis, I'm pretty sure that the Acurus 200X3 is a traditional Class-AB amplifier. That's how it looks, based on a visual inspection of the layout, and that's how it tests. The recent rash of esoteric amplifier topologies might give one cause to question whether Class AB isn't passé. Hardly! There's nothing wrong with a well-executed Class-AB design. In fact, Class H and its ilk were not developed to improve on Class AB's sound quality but to improve on its operational efficiency. Class AB may win no honors here, but its performance is usually more predictable, i.e., without the weirdly shaped distortion curves that characterize many of the newer designs.

From a layout point of view, the three channels of the Acurus 200X3 are identical. The components for each channel, including clip-mounted fuses for each polarity of the power supply, occupy one of three single-sided glass-epoxy circuit boards that make up the system. Four pairs of

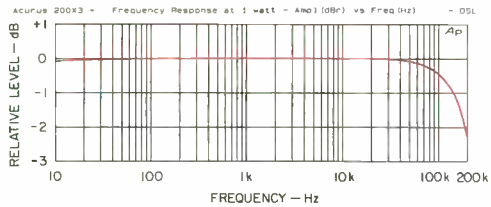


Fig. 1—Frequency response, channel 2.

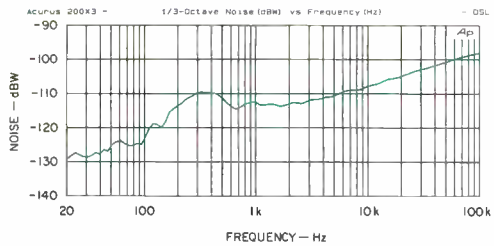


Fig. 2—Noise spectrum, channel 2.

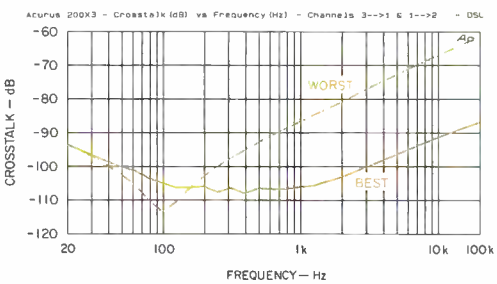


Fig. 3—Crosstalk, best and worst directions.

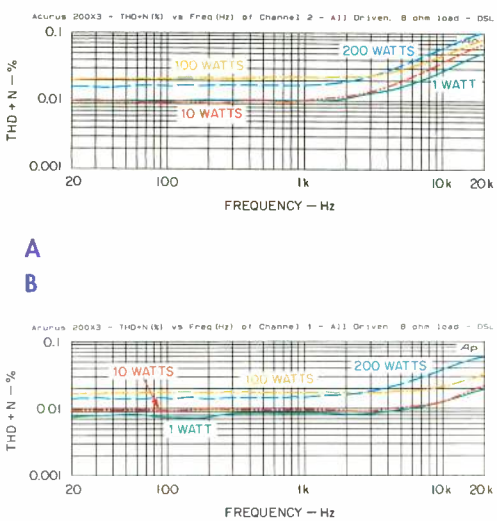


Fig. 4—THD + N vs. frequency with 8-ohm loads for channel 2 (A) and channel 1 (B).

complementary-symmetry output transistors (eight transistors per channel) and their drivers are soldered directly to the board and are physically mounted to a good-sized, 38-fin heat-sink. Each board mounts to its respective heat-sink with screws and spacers.

Each black-anodized heat-sink is 11¾ inches long and 4 inches high, with 1-inch fins. The three heat-sinks form the two sides and rear of the 200X3's enclosure, with the rear sink tied to those on the sides via bent metal pieces and the two sides tied to the front panel. A perforated metal plate ties the sinks together at the top; a bent-metal tray forms the main chassis and ties them together at the bottom. It's a sensible layout that's efficient to manufacture (amplifier channels can be built and tested individually and later assembled into final products) and easy to service by replacing an entire module.

The design is discrete (no ICs) and seems to use top-quality components (1% metal-film resistors, metallized-polypropylene capacitors, etc.). There was no evidence of output protection chokes, so apparently Mondial considers the system stable for unusual loads without sound-compromising series inductors. Board layout is neat, and the soldering looks to be excellent.

Although each channel is physically independent of the others, the three share a common power supply based on a toroidal power transformer, a bridge rectifier, and one pair of electrolytic filter capacitors. I guess that rules out calling the 200X3 a "tri-mono" design, but the commonality seemed to have negligible effect on channel separation in my bench measurements.

The front panel is bare save for a single illuminated power rocker at the lower left. A three-wire detachable power cord and line fuse-holder are on the rear lip of the chassis, directly behind the power switch. Three gold-plated RCA input jacks, each insulated from the chassis, are on the rear ledge, on the far right as you face the front of the amplifier and as far removed from the power cable as possible. Three sets of gold-plated multiway binding posts lie between the inputs and the power cable. The binding posts are on standard centers, so GR-type dual banana plugs can be used; the wiring hole is equally "standard," i.e., will not accommodate heavy-gauge wire.

Measurements

I ran my usual series of bench tests on each channel with both 8- and 4-ohm loads. Although each of the three channels

THE ACURUS IS A GREAT-SOUNDING AMP: FULL, RICH, AND WELL BEHAVED.

performed similarly, channel 2 was marginally the least capable of the set vis-à-vis noise and distortion, so I've used it as the basis for most of the data. Except for frequency response, channels 1 and 3 were almost identical twins on my sample. I've occasionally plotted the performance of channel 1 for comparison with the "worst-case" channel 2 data.

Whether one uses the data taken on channel 1, 2, or 3, there's nothing to complain of vis-à-vis frequency response. In this respect, channels 2 and 3 matched perfectly. Response for channel 2 (Fig. 1), taken at 1 watt with 8-ohm loads, is within +0.0, –0.1 dB from below 10 Hz to 50 kHz. Response is down 1 dB at 140 kHz and down 2.3 dB at 200 kHz. I trust I needn't point out that this is "wideband" performance indeed! The frequency response of channel 1 was even better: +0.0, –1 dB to 57 kHz, –1 dB at 180 kHz, and –1.3 dB at 200 kHz.

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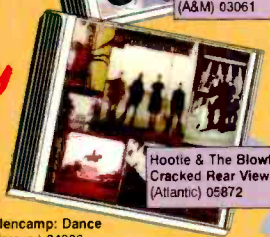

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Richard Thompson: Mirror Blue (Capitol) 02441

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Heavy D. & The Boyz: Nuttin' But Love (MCA) 02525

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John Berry (Liberty) 03095

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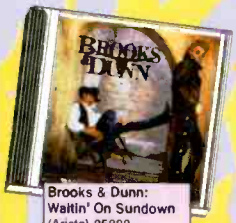

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EBDCC LG MS 528

Channel balance was superb—within ±0.03 dB between any two channels—and sensitivity was, if anything, a trifle higher than is typical for a 200-watt power amplifier. The Acurus 200X3 delivered 1 watt into 8 ohms with an 89-mV input and developed rated power (200 watts) with a 1.26-V input. Input impedance (18.6 kilohms) should not tax any decent preamp.

The noise floor was surprisingly low, especially considering this amp's high output power, high sensitivity, and relatively high input impedance. Many high-powered amps claim a seemingly great signal-to-noise ratio when the noise is referenced to rated output. Yet the great S/N often comes about because of the high power rating, not from a low noise floor. Furthermore, many specs are based on measurements made with a shorted input, which may not be representative of actual use.

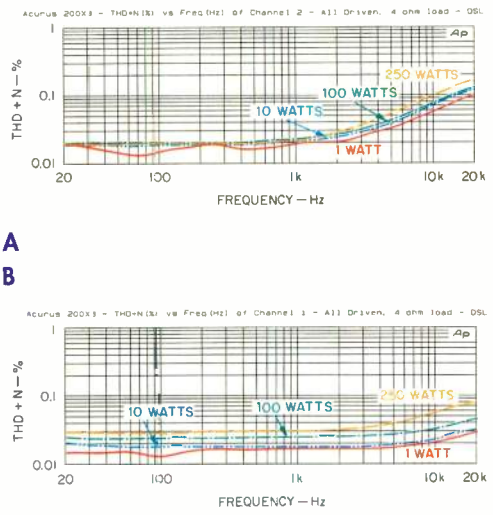
I measured the noise of the Acurus 200X3 using the IHF Standard input termination (1,000 ohms). On an A-weighted basis, it came in at –99.3 dBW, which yields an S/N of 122.3 dB referenced to rated power. The noise spectrum (Fig. 2) is remarkably free of power-line hum components, which, being coherent, can be more audible than A-weighted noise measurements would indicate. The noise spectrum shown is for channel 2, in which there's just barely a hint of hum at 60, 120, and 180 Hz. Channels 1 and 3 had slightly more defined peaks but only because the background noise in the region was otherwise lower than appears on the channel 2 graph.

Despite the common power supply, interchannel crosstalk was very good. Interestingly, this was especially true in the low-frequency region, where a common supply is more likely to cause problems. Best- and worst-case conditions are shown in Fig. 3. Crosstalk is best going from channel 3 to channel 1 and remains below –90 dB from 20 Hz to 12 kHz. Crosstalk at the middle and higher frequencies is worst going from channel 1 to channel 2 but is still under –70 dB to 7 kHz and better than –61 dB at 20 kHz.

Figure 4A shows channel 2's THD + N as a function of frequency at four power levels (1, 10, 100, and 200 watts); the data was taken with all channels driven into 8-ohm loads. Figure 5A shows similar data, taken with 4-ohm loads and with the curve at highest power at 250 watts, the 4-ohm power rating, rather than at 200 watts, the 8-ohm rating. As mentioned, channel 2 proved the least able, vis-à-vis high-frequency distortion, and, in fact, did not quite meet its 0.06% spec (8-ohm load) above 10 kHz. For comparison, the data taken on channel 1 (which did meet spec) is shown in Figs. 4B and 5B. Channel 3 performed just a tad worse than channel 1 (results not shown).

Figures 6 and 7 show THD + N versus output power at three frequencies. The curves in Fig. 6 were taken with 8-ohm loads and those in Fig. 7 with 4-ohm loads; in each case, all channels were driven. Although output power at clipping (which I defined to be 1% THD at 1 kHz) is safely above the continuous power rating on all channels with either load, it's probably higher than the data would indicate. With 8-ohm loads, 1% THD is reached at 235 watts, 0.7 dB above the 200-watt (23.0-dBW) rating. With 4-ohm loads, 1% THD occurs at 300 watts, 0.8 dB above the 250-watt (24.0-dBW) 4-ohm rating. In both cases, all channels clipped at the same point, suggesting that the limiting factor was the power-supply rails and not the output stage.

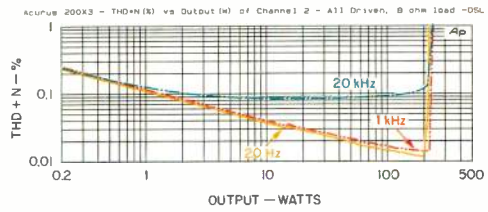
Therein lies the rub. With all channels driven, the power line had sagged to 114 V with 8-ohm loading and to 103 V when 4-ohm loads were used. Had a 120-V line been maintained, I calculate that clipping would not have occurred until the 260-watt level (24.2 dBW) with 8-ohm loads and until 405 watts (26.1 dBW) with 4-ohm loads. To double-check that, I ran a clipping test with one channel driven, so I could maintain a 120-V line. Admittedly this is easier on the power supply than when all channels are driven, but the data—315 watts (25.0 dBW) with an 8-ohm load and 515 watts (27.1



A

B

Fig. 5—THD + N vs. frequency with 4-ohm loads for channel 2 (A) and channel 1 (B).



A

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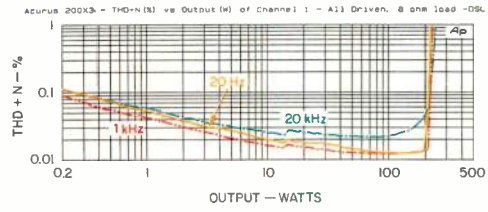
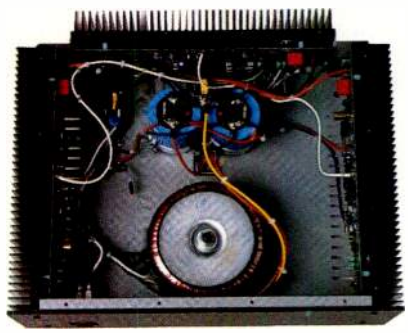


Fig. 6—THD + N vs. 8-ohm output power for channel 2 (A) and channel 1 (B).



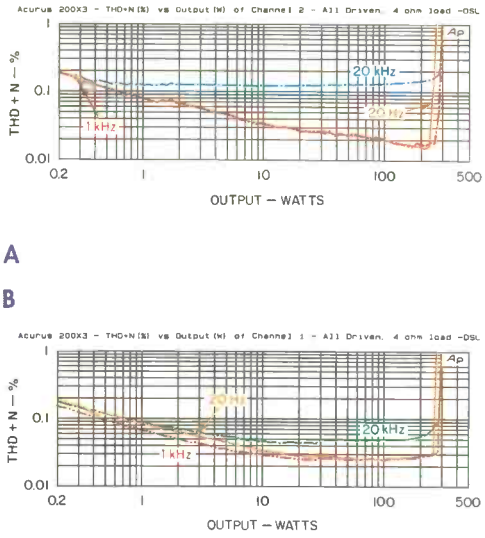


Fig. 7—THD + N vs. 4-ohm output power for channel 2 (A) and channel 1 (B).

dBW) with a 4-ohm load—tends to justify the validity of the calculations cited above.

Dynamic power (again tested with all channels driven, and using a 120-V line) further confirms my supposition. With 8-ohm loads, I measured a maximum output of 315 watts per channel using the IHF tone burst and, with 4-ohm loads, 500 watts per channel. Dynamic headroom, therefore, was 2.0 dB above the 8-ohm rating of 23.0 dBW and 3.0 dB above the 4-ohm rating of 24.0 dBW.

Output impedance data testifies to the absence of output inductors in the Acurus 200X3. Low-frequency damping factor (at 50 Hz) was 760, which is an admirable result but certainly no big deal these days. What I look for is low output impedance across the entire frequency spectrum, and the Acurus amp sure cuts the mustard in this regard. Output impedance measured 11 milliohms at 1 kHz, 14 milliohms at 5 kHz, 20 milliohms at 10 kHz, and only 28 milliohms at 20 kHz. That's probably an order of magnitude better than is typical!

Use and Listening Tests

Over the years, the one characteristic that seems to have distinguished better sounding power amps from also-rans of equivalent power, response, and distortion has seemed to me to be a low, uniform output impedance across the full audio spectrum. This makes a good bit of technical sense, in that high and/or nonuniform output impedance is likely to result in response anomalies when the amp drives a speaker rather than a test resistor. (Response anomalies are arguably more audible than, say, the difference between 0.05% and 0.1% THD at 20 kHz.) The Acurus 200X3, which is characterized by extremely low and unusually uniform impedance, confirms my past experience.

This amp is great-sounding—full, rich, and well behaved; I heard no strident strings, no ear-piercing winds. And it has great definition, image depth, and solidity. It's very smooth, very civilized—and very quiet! The 200X3 is an amp that's easy to recommend—for home theater as well as for music.

Edward J. Foster

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EQUIPMENT **PROFILE**

DANA AUDIO MODEL 1 SPEAKER

What costs only $199, weighs 24 pounds, and sounds pretty darn good? Answer: A pair of Dana Audio Model 1s. The Model 1 is a straightforward two-way design using a small metal-dome tweeter and a 6½-inch woofer mounted in a 0.4-cubic-foot (11.3-liter) sealed enclosure. Dana Audio sells the Model 1s only by mail order through its store in Knoxville, Tennessee (walk-ins are allowed too). Dana Audio's whole speaker line consists of just two products, the full-range Model 1 and the Sub-1, a tubular-style ported subwoofer that sells for only $295. Although only the Model 1 system is reviewed here, I was sent a Sub-1, which I used in some of the listening tests. Early this year, several new speakers will be added to Dana Audio's line.

Dana Audio was founded in 1989 by John and Dana Fish to market the Model 1. In 1992, they contracted with Prof. James Carroll, founder and owner of Applied Physics Labs (a full-line speaker manufacturer that has been around since 1972), to design an inexpensive subwoofer. This collaboration resulted in the Sub-1 being added to the line in September 1992. In May 1994, the company was purchased by Carroll and is operated completely separately from APL. (Carroll is a physics and mathematics teacher at Roane State Community College in Harriman, Tennessee.)

The woofer of the Model 1 is a high-excursion design sourced from KSC of California and manufactured in Mexico, while the tweeter is a titanium-dome version of an off-the-shelf Audax unit, made in France. The Model 1's crossover is a first-order electrical design using driver-impedance compensation on both the woofer and the tweeter. The impedance compensation essentially flattens the system's impedance throughout the whole audio range, except for the system's closed-box bass resonance below 100 Hz. The crossover contains eight components (three resistors, two inductors, and three capacitors). All air-core inductors are used, with good-quality capacitors. The parts are wired point to point and hot-melted to a board that is mounted to the bottom of the enclosure. All connections are soldered. A pair of five-way double-banana jacks mounted on the rear of the cabinet accomplish the input connections; bi-wiring is not supported. Large wire, up to 5 mm (0.2 inch) in diameter, can be accommodated.

THE DANA MODEL 1 GIVES MUCH MUSICAL ENJOYMENT, ENHANCED BY ITS LOW COST.

The cabinet of the Model 1 is quite rigid and constructed with ⅝-inch medium-density particleboard. No bracing is used in the cabinet, which is small enough to be rigid without it. The cabinet is available only in a textured black laminate finish. The grille, which is composed of black cloth covering a ½-inch-thick fiberboard frame, attaches to the front panel with four plastic projections that mate with recesses in the front panel. The drivers are surface-mounted on the front panel of the cabinet. Speaker stands for the Model 1s are available separately from Dana Audio.

The bottom-ported subwoofer companion to the Model 1, the Sub-1, contains a high-excursion 8-inch driver mounted on

Photo: Michael Groen

the top of a tube that is 38 inches high and 10 inches in diameter. The subwoofer is passive but requires that the power amplifier output connect directly to the woofer, with the Model 1 satellites in turn being driven from output connections on the woofer. The subwoofer contains 80-Hz low-pass filtering for itself and high-pass filtering and a three-position level adjustment for the satellites. The vented-box tuning of the Sub-1 is a low 25 Hz, which qualifies it as a true subwoofer.

Measurements

The 1-meter anechoic frequency response of the Model 1 is shown in Fig. 1, along with the effect of the grille. Measurements were taken at 1 meter on box axis (which is very close to the woofer axis, the manufacturer's design point), with a signal voltage of 2.83 V rms (1 watt into the rated 8 ohms). The curves are 10th-octave smoothed. The response below 400 Hz was derived from ground-plane measurements. The overall curve, with grille off, fits a tight 5-dB window (+1, −4 dB, referenced to 1 kHz) from 70 Hz to 20 kHz. Major features include a moderate plateau between 400 Hz and 1 kHz and a slight downward trend above 1 kHz, with some roughness evidenced by dips at 5 and 12 kHz. Below 80 Hz, the response rolls off at the 12-dB/octave rate exhibited by all closed-box systems.

The grille affects the response only above 2 kHz, where response deviations of only +1, −1.5 dB are evidenced in narrow bands. The system can be critically listened to with the grille on. Averaged from 250 Hz to 4 kHz, the sensitivity of the Model 1 measures 85.5 dB, about 1.5 dB below Dana's 87-dB rating. The right and left units were matched within a close ±1 dB above 1.6 kHz but were not as close between 900 Hz and 1.6 kHz, where the response of one unit was about 1.5 to 2 dB higher than its mate's.

The phase and group-delay responses of the Model 1, referenced to the tweeter's arrival time, are shown in Fig. 2. The phase rotates only an additional 206° between 1 and 10 kHz. The group-delay curve above 800 Hz indicates that the midrange lags the tweeter by an insignificant 0.1 to 0.15 mS. The large dip in the group delay at about 190 Hz corresponds to the effects of a minimum-phase dip in the frequency response in the same frequency range. If equalized flat in this range, this group-delay dip would disappear.

The Model 1's axial energy/time response is shown in Fig. 3. The test parameters emphasize the response from 1 to 10 kHz, which includes the crossover region. The main arrival, at 3 mS, is quite slender but widens significantly at levels 15 dB below the peak. Additional peaks are noted, trailing the main peak some 21 to 23 dB down.

Figure 4 shows the horizontal "3-D" off-axis responses of the Model 1; the bold curve at the rear of the graph is the on-axis response. Because the on-axis response ripples are carried over into the off-axis curves, the horizontal coverage is very good. The horizontal high-frequency coverage is particularly even because of the small size of the tweeter. Response

SPECS

Type: Two-way, acoustic-suspension, bookshelf system.
Drivers: 6½-in. cone woofer and ¾-in. titanium-dome tweeter.
Frequency Response: 63 Hz to 20 kHz, ±3 dB.
Sensitivity: 87 dB at 1 meter, 2.83 V rms applied.
Crossover Frequency: 3.15 kHz.
Impedance: 8 ohms, nominal.
Power Handling: 60 watts continuous, 100 watts peak.
Dimensions: 14¾ in. H x 8¾ in. W x 7½ in. D (37.5 cm x 22.2 cm x 19.1 cm).
Weight: 12 lbs. (5.5 kg) each.
Price: $199 per pair.
Company Address: 8807 Kingston Pike, Knoxville, Tenn. 37923.
For literature, circle No. 94

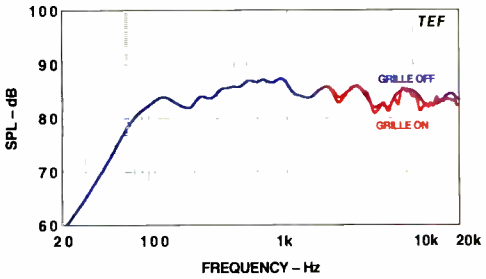

Fig. 1—One-meter, on-axis frequency response.

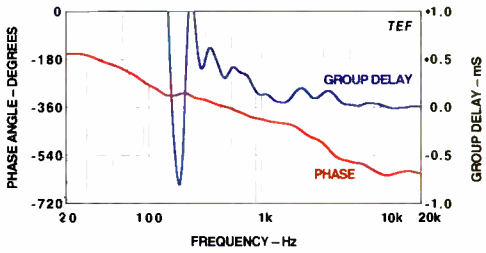

Fig. 2—On-axis phase response and group delay.

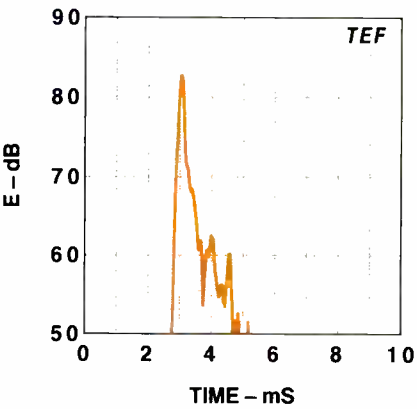

Fig. 3—Energy/time response.

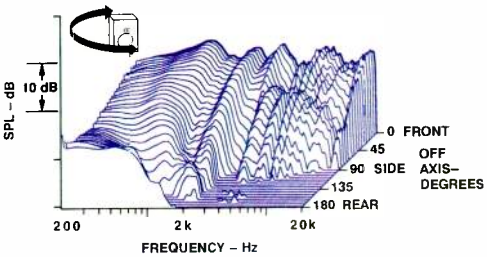

Fig. 4—Horizontal off-axis frequency responses.

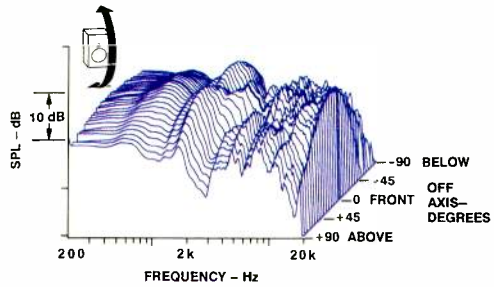

Fig. 5—Vertical off-axis frequency responses.

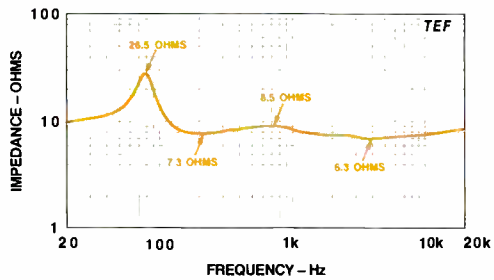

Fig. 6—Impedance.

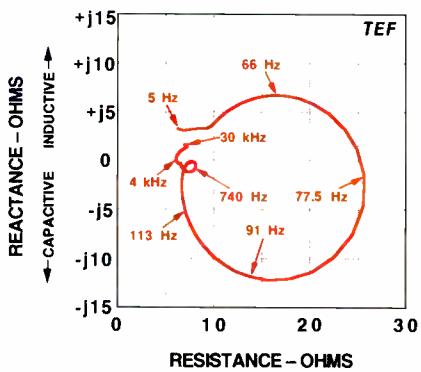

Fig. 7—Complex impedance.

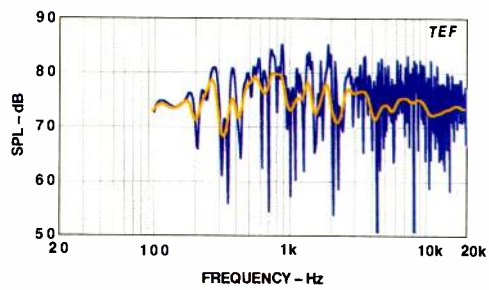

Fig. 8—Three-meter room response.

is down only about 3 dB at 12 kHz at 45° off axis.

The vertical "3-D" off-axis curves of the Model 1 are shown in Fig. 5. The bold curve in the center of the graph (front to rear) is on axis. Excellent high-frequency coverage is evident above 5 kHz. Some narrowing of response is apparent in the crossover range of 2.5 to 6 kHz. The 0° and ±5° curves are very uniform, but for greater angles the response is depressed in the crossover region (not clearly shown in the graph). A broadening of response in the region from 1.5 to 2 kHz is evident from the off-axis ridge at 1.8 kHz.

Figure 6 shows the Model 1's impedance from 20 Hz to 20 kHz. Other than an impedance maximum of 26.5 ohms at the closed-box resonance frequency of 78 Hz, the impedance is very well behaved. A minimum impedance of 6.3 ohms occurs at 4 kHz. Above 130 Hz, the impedance varies only from a minimum of 6.3 ohms to a maximum of 8.5 ohms!

Over the whole audible range, the impedance has a max/min variation of about 4.2 to 1 (26.5 divided by 6.3). Cable series resistance should be limited to a maximum of about 0.10 ohm (100 milliohms) to keep cable-drop effects from causing response peaks and dips greater than 0.1 dB. For a typical run of about 10 feet, cable of 16 gauge or larger should be used. However, if only the response above 130 Hz is important (which includes the important midrange), the impedance has a max/min variation of only 1.35 to 1 (8.5 divided by 6.3). Cable series resistance in this case can be allowed to rise to the quite high level of 0.30 ohm (300 milliohms) for the same 0.1-dB response tolerance. In this situation, very small cable, in the range of 22 to 24 gauge, could be used!

Figure 7 shows the complex impedance of the Model 1, from 5 Hz to 30 kHz. Most activity takes place in the bass range, at the closed-box resonance at 78 Hz, where a single circular loop is evident. A much smaller loop is evident at about 750 Hz. Above 113 Hz, all the complex variation of impedance occurs in a very small window ranging from 6.3 to 8.4 ohms on the real axis, and –j5.6 to +j1.4 ohms on the imaginary axis!

The impedance phase (not shown) reached a maximum of +23° at 60 Hz and a minimum of –44° at 100 Hz. Even if used in parallel, Model 1s should be no problem for any power amplifier or receiver.

The cabinet did not exhibit any significant wall vibrations when the system was driven by a high-level sine-wave sweep. Some activity of the front and sides was evident at and near 350 Hz but did not cause any consequential problems.

The 6½-inch woofer had a maximum excursion capability of about 0.35 inch, peak to peak. Higher input levels resulted in increased third-harmonic distortion but with no bad sounds. The system could handle up to 20 V rms at any frequency in the bass range without harm. There was no dynamic offset evident at any input level or frequency.

The 3-meter room response of the Model 1, with both raw and sixth-octave smoothed data, is shown in Fig. 8. The speaker was in the right-hand stereo position, sitting on a 28-inch stand that raised the middle of the box to about 36 inches. The system was aimed at the listening position, with the test microphone placed at ear height (36 inches), at the listener's position on the sofa. The speaker was driven with a swept sine-wave signal of 2.83 V rms (corresponding to 1 watt into the rated 8-ohm load). The direct sound and 13 mS of the room's reverberation are included.

Excluding a dip at 330 Hz, the averaged curve fits within a fairly tight, 9-dB window. No major anomalies are evident in the averaged curve except for general roughness over the whole range and a raised response between 500 Hz and 1 kHz.

Figure 9 shows the B_1 (61.7-Hz) bass harmonic distortion spectrum of the Model 1 at input power levels from 0.05 to 50 watts (20 V rms into the rated 8-ohm load). The second harmonic reached 8.1%, while the third reached a high 24% at full power. Higher harmonics were 2% fourth, 3.6% fifth, and 1.4% sixth. Uncharacteristically, both the third and fifth harmonics

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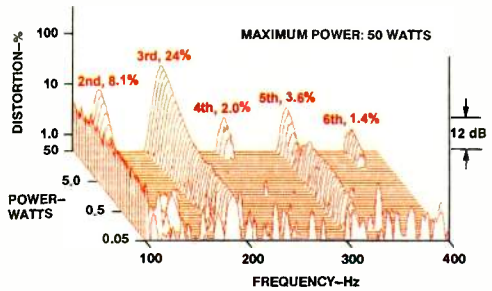

Fig. 9—Harmonic distortion for B_1 (61.7 Hz).

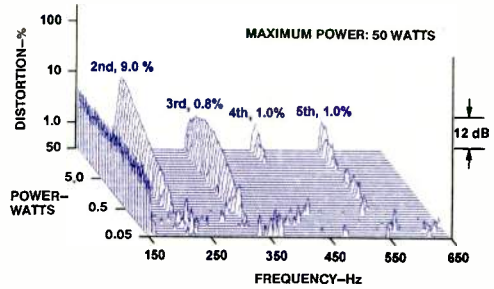

Fig. 10—Harmonic distortion for A_2 (110 Hz).

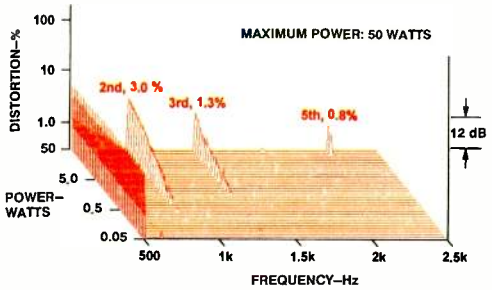

Fig. 11—Harmonic distortion for A_4 (440 Hz).

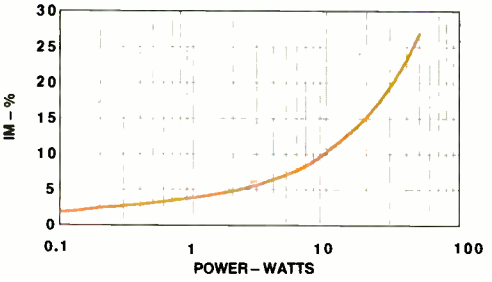

Fig. 12—IM distortion for A_4 (440 Hz) and B_1 (61.7 Hz).

started out at fairly high values and maintained approximately the same distortion values over a wide power range of about 0.05 to 5 watts. At this frequency, the system did not sound very clean at any power level. With 50 watts input at 61.7 Hz (B_1), the system reaches 96 dB SPL at 1 meter.

The higher frequency, B_1, note was chosen instead of the usual lower E_1 (41.2 Hz), due to the small driver size of the Model 1 and its reduced low-frequency capability. A test at the lower, E_1, frequency, with 50 watts applied, resulted in very high distortion values of 13.3% second, 90% third, 9% fourth, and 20% fifth harmonic.

Figure 10 shows the A_2 (110-Hz) harmonic data. At full power, the second harmonic reached a moderate 9%, while the remaining harmonics are 1% or lower. With 50 watts input, the system reaches a quite usable 100 dB SPL at 1 meter at 110 Hz. The A_4 (440-Hz) harmonic data is shown in Fig. 11. The second-harmonic distortion reached only 3% at full power, with the third much lower, at 1.3%, and the fifth at a low 0.8%.

Figure 12 shows the Model 1's IM generated by tones of 440 Hz (A_4) and 61.7 Hz (B_1) of equal power, covering the range from 0.1 to 50 watts. The IM distortion reaches a high level of 27% at 50 watts.

The Model 1's short-term peak-power input and output capabilities are shown in Fig. 13 as a function of frequency, measured using a 6.5-cycle, third-octave bandwidth tone burst. The peak input power was calculated by assuming that the measured peak voltage was applied across the speaker's rated 8-ohm impedance.

The peak power handling starts out at about 17 watts at 20 Hz, rises to 70 watts at 63 Hz, reaches a plateau of 1,200 watts between 125 and 315 Hz, and then increases to about 3,200 watts above 800 Hz.

With room gain, the maximum peak output SPL of the system starts at 80 dB at 20 Hz, rises rapidly to the mid-110s between 100 and 315 Hz, and then increases to the 120-dB range above 400 Hz. In the bass range with room gain, 110 dB is attained at about 90 Hz, and 120 dB is not reached until 450 Hz. The peak output of the Model 1 in the bass range places it in the bottom third of the systems I have tested, but ahead of some other small-format systems.

Use and Listening Tests

Initial listening to the Model 1 disclosed a well-balanced and smooth sound but with a lightweight low end. However, the low-end output of the system competed well with, and sometimes surpassed, a number of other small systems I have listened to and tested. Although the Dana's low-bass output was nil, it was not easily overloaded even by material with lots of low end. Even though the system did not shake the walls on pipe-organ material, it still had a satisfying level of bass. The Model 1's sensitivity was essentially equal to that of my reference B & W systems.

Listening equipment included my Onkyo and Rotel CD players, Krell's KRC preamplifier and KSA-250 power amp, and Straight Wire Maestro cabling plus the B & W 801 Matrix Series 3 speakers as references. The Model 1s were set up on

28-inch-high stands, which placed the system's axis (the center of the box) about 36 inches high, and were aimed at my listening location. They were placed in my usual locations, well away from the side and rear walls of my listening room. The speakers were separated by about 8 feet, and listening was done from my couch, 10 feet away. Some listening was done with the systems assisted by the Sub-1 subwoofer, which was located midway between the Model 1s but closer to the wall. With the subwoofer

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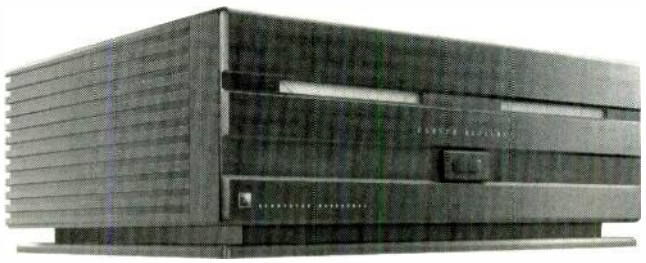

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installed, low-frequency power handling and output were much improved. My usual speaker positions, far from the walls, are not conducive to getting all the available low end out of small systems such as the Model 1. With the Danas placed much closer to the rear wall, the bass response improved, but this was at the expense of imaging and response smoothness, which were directly affected by the higher level reflections from surfaces immediately behind the speakers.

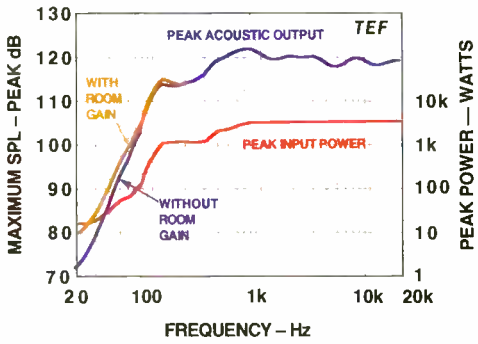

Fig. 13—Maximum peak input power and sound output.

The operating instructions for the Model 1 are on a very brief, single 8½ x 11-inch page printed on both sides. Speaker placement information consisted essentially of the sentence "All speakers, including the Model 1, will exhibit better imaging, soundstaging, and tighter bass if mounted on stands at ear level and located away from the back and side walls." The instruction sheet did mention that the Model 1 is not as cable-sensitive as most loudspeakers, and suggested that the user experiment with double runs (two positive, two negative) of 20-gauge, solid-core cable. In my installation, the Straight Wire Maestro cables were significantly more expensive than the loudspeakers to which they were connected!

First serious listening was done with the London Brass playing Spanish compositions from *¡Viva España!* (Teldec 9031-76990-2). Here, the CD did not have any heavy bass (nor did the material require it), and thus was well matched to the capabilities of the Model 1s. On this program material, the Model 1s did surprisingly well compared with the B & W systems, producing a quite realistic brass sound, at near lifelike levels, coupled with a quite pleasing overall balance. The sound of the percussion and castanets on track 2 was nearly indistinguishable from the B & W's reproduction. The African drums and Indian percussion sounds on the world music CD *The Goat Also Gallops*, by Natraj (Doria Discovery DIS-80124, highly recommended for those into jazz with an African/Indian influence), were also rendered quite realistically by the Dana Audio speakers.

On the pink-noise stand-up/sit-down test, the Model 1s did quite well and exhibited only moderate midrange tonal changes on stand-up. Horizontal coverage on pink noise was excellent. Although the Model 1's pink-noise spectral balance was quite close to the B & W's, the Model 1 speakers had much less bass and some lower midrange emphasis. Some tonality was also evident, which indicates a non-smooth response. On third-octave band-limited pink noise, the Dana Audio systems generated no usable bass output from 20 to 31.5 Hz. Some fundamental output was noted at 40 Hz, with slightly more at 50 Hz. It was better at 63 Hz, with full output only available at the 100-Hz band and higher. Placing these speakers much closer to the rear wall significantly increased the low bass output.

On wideband pop and rock material, the Model 1s could be turned up quite loud but sounded somewhat congested when the material had any high-level bass. On classical male and female vocal material, such as *Bach: Secular Cantatas* (Dorian DOR-90199), the Model 1s did quite well and presented a clean, full-bodied but somewhat up-front sound. Mid/high balance, however, was quite accurate and quite close to that of the B & Ws.

The Model 1s should seriously be considered as the main speakers in a low-budget situation or as a second system for a bedroom, etc. With bass augmentation, such as Dana Audio's Sub-1 or a good separate subwoofer or two, an excellent system can be put together that competes well with much higher priced contenders. The Model 1s provided much musical enjoyment, and considering their cost, the enjoyment was much multiplied. Give them a listen.

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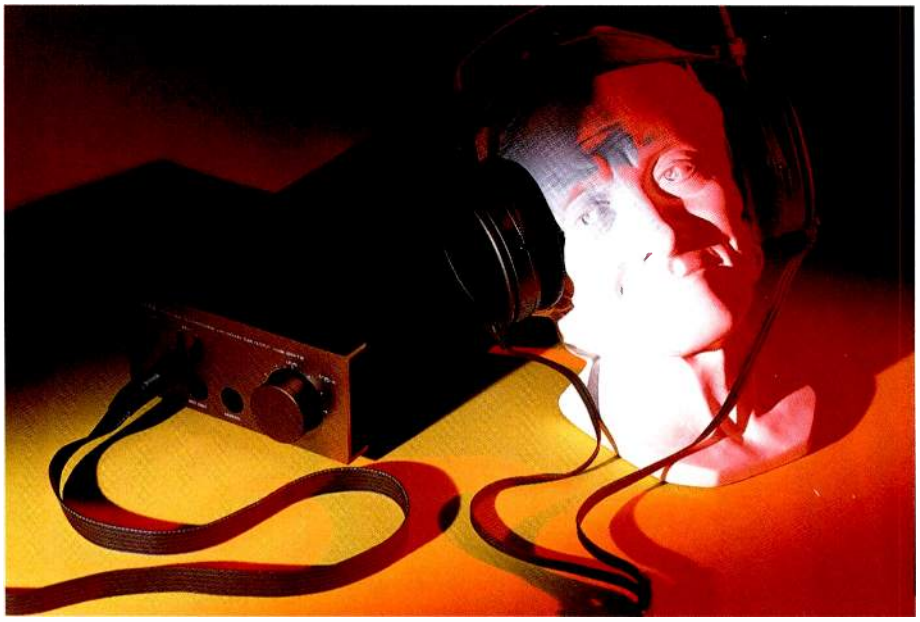

I was very interested in testing and evaluating the Stax SR-Omega electrostatic earspeakers to find out how they compare to the SR-Lambda Pros, which I have been using for nearly four years (see "Auricle," April 1991) as the reference when I have members of my listening panel judge the sonic qualities of earphones I am testing. (To avoid confusion, I must explain that "earspeakers" is the name Stax calls its earphones. I use the term "earphones" rather than "headphones" because it covers all types, including those you wear on your head as well as those you place in your ears.) Correlating the comments of panel members with the measured performance of earphones is very challenging. With the Stax SR-Lambda Pros, which are considered by many audiophiles to be among the best earphones available, the task is made easier.

Stax feels that the SR-Omegas improve upon the SR-Lambda Pros in three ways. The diaphragm has been enlarged and made circular, rather than rectangular. The fixed, gold-plated electrodes are more transparent to sound. And the six-strand, PC-OCC (Pure Crystal Ohno Continuous Casting) cable is 1½ times wider, which reduces its resistance and capacitance.

As opposed to dynamic earphones, electrostatic earphones require no voice-coil. (The motion of the diaphragm is caused directly by electrostatic force.) This makes the diaphragm lighter, which usually improves transient performance and extends high-frequency response. Electrostatic earphones require a high source impedance, high a.c. signal voltage, and high d.c. voltage bias. Accordingly, they cannot be operated directly from the earphone jacks on audio components but instead must be routed through a drive amplifier that meets their special requirements. I used the SR-Omega earspeakers to compare two Stax earphone amplifiers, the hybrid (FET and tube) SRM-T1S and the older, solid-state SRM-1/MK2. The former has a slight edge in clarity and detail, so I used it for the technical measurements and listening panel evaluations of the earspeakers. (I must caution anyone who might want to make the same comparison of amps: The SRM-1/MK2 inverts the absolute polarity of the sound, while the SRM-T1S has the correct polarity.)

The SR-Omegas are larger than many earphones I have tested, but they feel rather light despite their 13.4-ounce weight; maybe it's because they are so very comfortable. These earphones are designed to be circumaural and open to outside sounds. As I have mentioned in previous reports, I prefer circumaural earcushions that completely encircle the outer ear rather than pressing against it. Pressure against the outer ear is the main contributor to discomfort, even more so than earphone weight. That said, the large synthetic-leather earcushions on the SR-Omegas

SPECS

EARSPEAKERS

Transducer Design: Electrostatic.
Coupling to the Ear: Circumaural.
Frequency Response: 6 Hz to 41 kHz.
Impedance: 145 kilohms at 10 kHz.
Capacitance: 110 pF, including cable.
Sensitivity: 99 dB SPL at 100 V rms.
Maximum Output: 120 dB SPL at 400 Hz.
Bias Voltage: 580 V d.c.
Cable Length: 8.2 ft. (2.5 m).
Weight: 13.4 oz. (380 grams) without cable.
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Gain: 60 dB.
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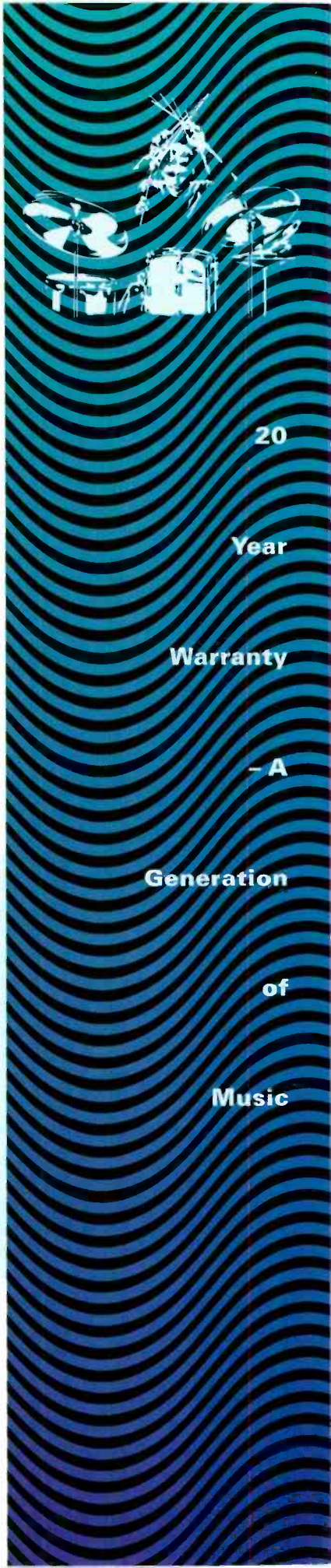

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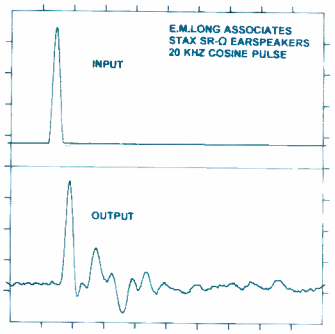

Fig. 1—Cosine-pulse test.

are among the best I have ever used. They not only encircle the outer ear completely but are very comfortable for long-term listening. Because the SR-Omegas don't exclude outside sounds, they might not be suitable in noisy locations or for monitoring recordings when you have to be in the same room with the musicians.

The earcups are 4¾ inches in diameter, and the earcushions are deep enough to keep the cloth barrier that covers the transducer from touching your outer ear. A metal screen protects the outer side of the earphones (as opposed to the plastic grille of the SR-Lambda Pros). The chamois-like headband is anchored by plastic sliders that move up and down in a plastic yoke; unlike some other earphones, the SR-Omegas have a continuous adjustment, with no detents. The thin metal bails and the swivels on the bottom of the yoke also contribute to easy adjustment and good fit.

The wide ribbon cable has six conductors that run 7 feet from the special amp-input plug to a plastic clamp, which separates the cable into two three-conductor cables, each 15 inches long. A connector plugs into each earcup, allowing for replacement of the cable.

The SRM-T1S earphone amp can drive any of the Stax electrostatic earspeakers, supplying the necessary 580 V d.c. for the Pro Series earspeakers and 230 V d.c. for the standard models. The amp's hybrid design uses dual FETs and twin-triode 6FQ7 vacuum tubes in a direct-coupled circuit topology that is balanced from input to output; there are no capacitors or transformers in the signal path. The vacuum-tube output provides an ideal, high a.c. signal voltage and a high impedance to drive the electrostatics. The balanced 100-kilohm and unbalanced 50-kilohm input impedances are high enough that they will not cause loading problems with any program sources. The SRM-T1S has plenty of output and can drive the SR-Omegas to very loud levels.

The amp has two pairs of gold-plated phono-input jacks and a pair of XLR three-pin balanced inputs. Three earspeaker outputs are on the front panel; two are five-pin outputs for the Pro Series, which includes the SR-Omegas, and one is a six-pin output for other Stax models. The volume control, configured with four potentiometers on a dual shaft, sets the signal levels for each channel; the concentric knobs are friction-coupled and can be turned separately to adjust channel balance.

The acoustical design of the SR-Lambda Pros requires separate electronics to achieve a diffuse-field characteristic; the SR-Omegas appear to have a diffuse-field characteristic without separate electronics. My measurements of frequency response tended to verify this; the response was very smooth and extended beyond 20 kHz, except for a sharp dip at 6 kHz and a corresponding phase glitch. The output versus time response of the SR-Omegas (Fig. 1) shows a delayed response that may be the cause of the 6-kHz dip. The main output pulse is almost identical to the input pulse, which verifies the excellent high-frequency response; it also shows that the absolute polarity is positive (whereas the polarity of the SR-Lambda Pros is negative).

Before I had the panel members listen to the SR-Omegas, I spent some time listening to them using both the new and old earphone amps. I was quickly convinced that the SR-Omegas are superior to most earphones in just about every category.

Owing to their diffuse-field characteristic, the SR-Omegas have a more recessed sound than the SR-Lambda Pros do, which enhances the sense of space and depth. On the Strauss Violin Sonata in E-flat from *Strauss & Dvorák* (Sheffield Lab 10039-2F), the Omegas place the violin and piano back in the acoustic environment; the Lambda Pros bring the instruments more forward. The percussion instruments on "O Grande Amor" from Double Image's *Open Hand* (dmp CD-503) have a more pleasing sound when they are placed back, while retaining the transients of the mallet hits. Organ music played by Gillian Weir on *Scherzo* (Koss Classics KC-1013) sounds marvelous, with a great sense of acoustic space.

I also had panel members listen to "Time Alone" by Freyda & Acoustic AttaTude on *Midnight at Cabell Hall* (Red House RHR CD 55; phone, 415/457-9052). The SR-Omegas did an excellent job with this binaural recording, which was made using an Aachen Head. The vocalist is placed back in a realistic space, and the sound of the strings is smooth and articulate. The final test was "Salve Regina" from a new recording of Gregorian chants, *Angelic Voices* (Renaissance Endeavors CD-102; phone, 800/747-7486) by The Daughters of Mary. The SR-Omegas place the choir back in a reverberant environment while still bringing out the clarity of the voices; this is often an impossible combination to achieve, and its success here is a tribute to the SR-Omegas and the good articulation of the choir.

I recommend the Stax SR-Omega earspeakers to anyone who is serious about earphone listening. *Edward M. Long*

EARPHONE EVALUATION

PARAMETER	RATING	COMMENTS
Overall Sound	Excellent	"Excellent bass," "Very smooth," and "Spacious"
Bass	Excellent	"Deep and full" and "Good timbre"
Midrange	Very good	"Slightly recessed" and "Very good articulation on voice"
Treble	Excellent	"Very extended" and "Very clear"
Overall Isolation	Low	"Outside sounds are easily heard"
Bass	Low	"Low sounds are easy to hear"
Midrange	Low	"Conversation is easy"
Treble	Fair	"Some reduction of treble sounds"
Comfort	Excellent	"Very light feeling" and "Easy to adjust"
Value	Good	"Top quality at a high price"

GENERAL COMMENTS: Excellent sense of spaciousness. Very good with binaural and conventional stereo recordings. Excellent bass. Clear and articulate on voice. Good value.

A speaker good enough to be appreciated by almost no one.

The new Infinity Reference Standard Epsilon is designed to appeal to an exceedingly small segment of the population: the impossible to please, highly critical, uncompromising listener. Revolutionary in design, Epsilon performs in a league previously occupied only by the most exotic, and much larger, multi-enclosure systems. An entirely new generation of Infinity's unique EMIM,™ EMIT,™ and L-EMIM™ planar drivers respond instantaneously to even the most complex musical passages. And Epsilon's new Servo-Controlled IMG woofer, acoustically isolated within the enclosure, delivers exceptional low-frequency response. For a personal demonstration, visit your Epsilon dealer or call 1-800-8EPSILON.

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EQUIPMENT PROFILE

AUDIO ALCHEMY DTI•PRO JITTER REDUCER AND RESOLUTION ENHANCER

In the continuing quest to reduce the dreaded jitter in digital playback systems, Audio Alchemy has introduced a new jitter-reducing device, the DTI•PRO, an improved version of its trend-setting DTI (which stands for Digital Transmission Interface). Jitter is inconsistency in the timing of a digital signal's edge transitions. It is measured in the time domain, either peak to peak or rms, and is expressed in picoseconds (pS) or nanoseconds (nS). However, the time measure of jitter doesn't tell about the jitter's frequency content (whether it's random or periodic, what the jitter frequencies are, and so forth), which can be looked at in the frequency domain with the use of a spectrum analyzer.

In a CD playback system using a CD transport and separate D/A converter, jitter can be generated in the CD transport itself, in the cabling between the transport and D/A converter, in the D/A converter's input receiver, or in the circuitry between the input receiver's decoded outputs and the input to the DAC chip inside the D/A converter unit. Of the three or four signals that feed the DAC—the digital audio data itself, the master clock, the bit clock, and the left/right, or "word," clock—it is the word clock whose jitter affects the converted audio signal. Error in either the timing of the conversion (caused by jitter on the word clock) or the amplitude of the digital words going into the DAC can have the same effect on the recovered audio: An error in the audio output amplitude for that particular sample time.

It seems obvious that delivering a jitter-free signal to the DAC requires an input receiver with both low intrinsic jitter-generation characteristics and the ability to reject the incoming jitter. These go together with careful circuit design and layout in the circuitry which follows the input receiver.

AUDIO ALCHEMY'S DTI•PRO IS AN IMPROVED VERSION OF THE ORIGINAL DTI JITTER REDUCER.

Audio Alchemy's original DTI took in an S/P DIF signal (from a CD transport, DAT, or satellite receiver) and fed it into a low-jitter interface receiver, a Crystal CS8412. The digital outputs of the receiver were fed into a Crystal CS8402 transmitter chip and back out as an S/P DIF signal to pass on to one's D/A converter. The idea was to reduce incoming jitter by using the receiver device with the lowest jitter then available. The overall result could, in theory, be better than going straight into a D/A unit whose receiver had poorer jitter rejection than the Crystal CS8412 in the DTI. One problem, however, was that the CS8412's jitter-reduction corner frequency

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is about 25 kHz—that is, it will only attenuate jitter frequencies higher than 25 kHz. As is now well known, many jitter-modulation frequencies are related to, and in many cases the same as, the audio frequencies encoded as the digital data. Therefore, a 25-kHz jitter-reduction corner frequency is not low enough. Nonetheless, many users reported sonic improvements, or at least sonic changes that were considered improvements, when using the original DTI; some even went so far as to say that they could not stand to listen to digital without it.

Enter the DTI•PRO. This device, like the original DTI, acts as an in-line jitter reducer. However, its action is different in two major ways. First, its clock recovery system is enhanced by a second, crystal-referenced, phase-locked loop (the first PLL is in the CS8412 receiver chip), utilizing a precision voltage-controlled crystal oscillator (VCXO) with the very low jitter-cutoff frequency of about 5 Hz. Great pains were taken in the design to make sure that any jitter added by this second PLL was extremely low. This addition of a second PLL, with a much lower jitter cutoff frequency, should seriously reduce jitter in the incoming S/P DIF signal over most of the audio frequency range. The second difference is that a resolution-enhancement function has been added. This is a post-process or stand-alone enhancement, not a complement to some process preceding the DTI•PRO—such as High-Definition CD (HDCD). The resolution-enhancement circuit uses a Star Semiconductor SPROC1400 DSP chip, running at 40 MIPS (million instructions per second), to run an intelligent adaptive interpolator algorithm. This is said to increase resolution by more than two bits. Program instructions for the DSP are contained in a socketed EPROM (erasable programmable read-only memory). This allows for possible user updates of the DSP program in the future by installing a new EPROM chip.

THE DTI•PRO'S ENHANCED RESOLUTION COULD MAKE DIGITAL SOURCES SOUND EVEN BETTER.

How does this process work? How can you really get more meaningful bits out than coming in? Audio Alchemy claims that an analysis of a long sequence of time samples can be used by the interpolator to correctly predict the resolution removed at the CD recording stage, i.e., the information lost by limiting the CD process to 16 bits. The catch is that this only works at low to medium frequencies. However, the adaptive nature of the algorithm permits the resolution gains in the low and middle frequencies to be realized, which, in itself, is a potentially significant improvement that could make digital sources sound even better than they do.

Thanks to an external power supply, the Power Station 4, the DTI•PRO is small enough to sit atop a CD transport or to be tucked away behind other equipment. The interconnecting cable on the Power Station 4 is long enough to place the contained power transformer away from any components sensitive to transformer hum.

Control Layout

Looking at the rear panel first, we find optical, coax, and AES/EBU inputs and outputs. The AES/EBU connections are via XLR jacks, and the coaxial jacks are BNCs, with adaptors provided for the more common phono-plug connections. The optical output is an AT&T (ST) type, while the optical input is normally a Toslink type, with AT&T optional. An I²S output is also available for connection to other current and future Audio Alchemy products. (At present, this jack can be used to feed the DDE V3.0 and XDP D/A converters; connected this way, the DTI•PRO would function as a superior digital front-end to the converter.) The d.c. power input is via a six-pin female DIN connector that accepts the matching male connector on the Power Station 4's interconnect cable.

The front panel has 10 LED indicators, arranged in four vertical groups, plus two momentary-contact pushbutton switches. At the left side of the panel, red, yellow, and green LEDs next to the input selector indicate which input has been chosen. Next are three red "Power" LEDs for the unit's "Receive," "Transmit," and "DSP" sections. Toward the right are two LEDs, one green and one red, to indicate when the "Primary" and "Secondary" PLLs are locked. Finally, one red LED and one green LED, next to the "Phase" button at the right, show the relative signal polarity of digital audio in the outgoing data stream. If the "Phase" button is held in, pressing the "Input" button sets the output word length and dither (to 16 bits without added dither or to 18 or 20 bits with appropriate dither added).

SPECS

Resolution: 24-bit internal processing.
Jitter: Less than 25 picoseconds, rms, broadband.
Inputs: Coaxial, AES/EBU, and optical (Toslink standard, ST optional).
Outputs: Coaxial, AES/EBU, optical (ST), and I²S.
Power Supply: ±8 V and ±18 V, from external supply.
Dimensions: 8½ in. W x 2 in. H x 6 in. D (21.6 cm x 5.1 cm x 15.2 cm).
Weight: 2 lbs. (0.9 kg), including power supply.
Price: $1,295; with ST input, $1,445.
Company Address: 31133 Via Colinas, Suite 111, Westlake Village, Cal. 91362.
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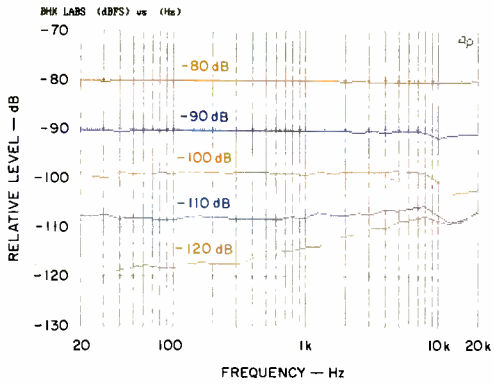


Fig. 1—Frequency response, measured in the digital domain, vs. signal level.

The whole interior of the DTI•PRO is taken up by a multilayer p.c. board, fully populated with components. All of the input/output connectors and front-panel LEDs and switches are mounted to this p.c. board, on which the Crystal CS8412 receiver and CS8402 transmitter ICs are also plainly visible. Eleven voltage regulators are employed to effectively isolate the various functions of the circuitry. All in all, this is a nicely made unit.

The amount of power dissipation in all this circuitry makes for rather hot running. It is advisable to allow for good ventilation around and above the DTI•PRO when it is in operation.

Measurements

There are several ways to measure a device that operates in the S/P DIF signal domain, as Audio Alchemy's DTI•PRO does. One way is to measure various properties of the device in the digital domain. Another is to feed the digital output to a D/A converter, to see the device's effect on the recovered analog audio output. I used both of these methods during my bench tests.

I first looked at a fundamental property of any audio component, its frequency response, as a function of level. This was done in the digital domain. Digital signals from my Audio Precision System One's S/P DIF output were fed into the DTI•PRO via coax cable. Coax output of the DTI•PRO went into my Audio Precision System One's S/P DIF digital input. Figure 1 shows a series of responses, at input levels from –80 to –120 dB full-scale (dBfs) in 10-dB steps, with the Audio Precision's word length set to 16 bits and the DTI•PRO set to a 16-bit output word length. Since the DTI•PRO's output is digital, response was measured using a digital-domain tracking bandpass filter.

Changing the output word length on the DTI•PRO had only a small effect on the way the frequency response looked between 8 and 20 kHz (not shown). The curves in Fig. 1 are interesting, in that they show a mild aberration in the range from 8 to 20 kHz as the level drops below –80 dBfs. Further, the response at –120 dBfs is not flat, but rises with frequency. I am not sure how these deviations in response, as such, would affect the sound of a system with the DTI•PRO in operation. You might think of these curves as a source of data on input/output linearity as a function of frequency.

I next resurrected a crude jitter generator that I had used in past investigations. This device operates by frequency modulating the voltage-controlled oscillator (VCO) in a PLL circuit operating in conjunction with a Philips SAA7274A input receiver. The I²S outputs of this receiver are fed into a Crystal CS8402 transmitter chip to be converted to an outgoing S/P DIF signal. This arrangement permitted me to pass an S/P DIF signal (either from my Audio Precision digital generator's output or from a CD transport) through my jitter modulator to add jitter to the signal before feeding it to a D/A converter under test. The PLL in my jitter modulator fights the external modulation at low to medium frequencies, where the PLL loop gain is high, but allows good jitter modulation near and above its jitter cutoff frequency.

THERE WAS A NOTICEABLE IMPRESSION OF INCREASED SPACE AND RESOLUTION WITH THE DTI•PRO.

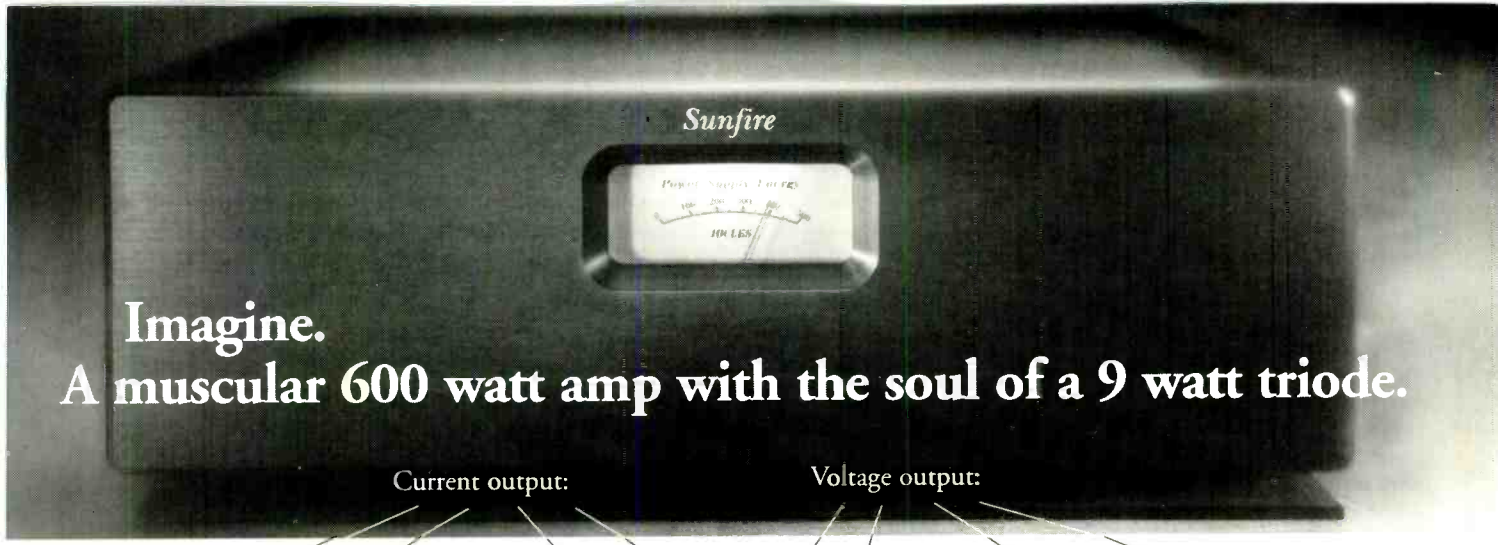
For this jitter test, I used a jitter-modulation frequency of 10 kHz. Looking at the word-clock output of the SAA7274A input receiver, I raised the external modulation level until the time variation at the end of the word-clock period was 100 nS, peak to peak. This was done by using my oscilloscope's delayed sweep to magnify the end of one period of the word clock, up to 100 nS per division. I then set my Soundtech distortion meter to show the external modulation level as 100%. When I dialled in arbitrary amounts of jitter at levels below 100 nS, the meter indications corresponded to jitter, in nanoseconds, which I could then read directly.

Figure 2 shows the effect of this generated jitter on the recovered analog output from an inexpensive D/A converter. The test used a full-scale, 1-kHz digital signal fed into the jitter modulator's S/P DIF input and a peak-to-peak equivalent period deviation of 5 nS at 10 kHz in the jitter modulator's word-clock output.

Figure 2A shows a spectral output of the harmonic distortion residue from the test D/A converter with the test signal's jitter modulation set to zero. Not world-class, perhaps, but not bad. The principal second harmonic is at 0.0019%, and other harmonics are at or below 0.001%. Figure 2B shows the result when jitter was increased to 5 nS. The predominant effect is that 9-, 10-, and 11-kHz frequencies now appear that don't show with the jitter modulation set to zero. Now for the good part. With the DTI•PRO interposed between the jitter modulator's S/P DIF output and the test D/A's S/P DIF input, glory begorrah! These artifacts are essentially eliminated, as you can see in Fig. 2C.

I also used the jitter test signal to look at several other D/A converters, including an original PS Audio Digital Link, a Crystal Semiconductor CDB4328 development board, an Audio Alchemy DDE V1.1, and a Sonic Frontiers SFD-2. All these converters showed less effect from the injected jitter than the converter used in Fig. 2B; with some of the converters, I could increase the jitter modulation to 50 nS, peak to peak, and the DTI•PRO would still eliminate the jitter sidebands.

Admittedly, 5 nS may be a lot of jitter, but for now, I think this sequence of tests nicely illustrates the effect of jitter reduction from a device like the DTI•PRO. It would certainly be nice to check out all this



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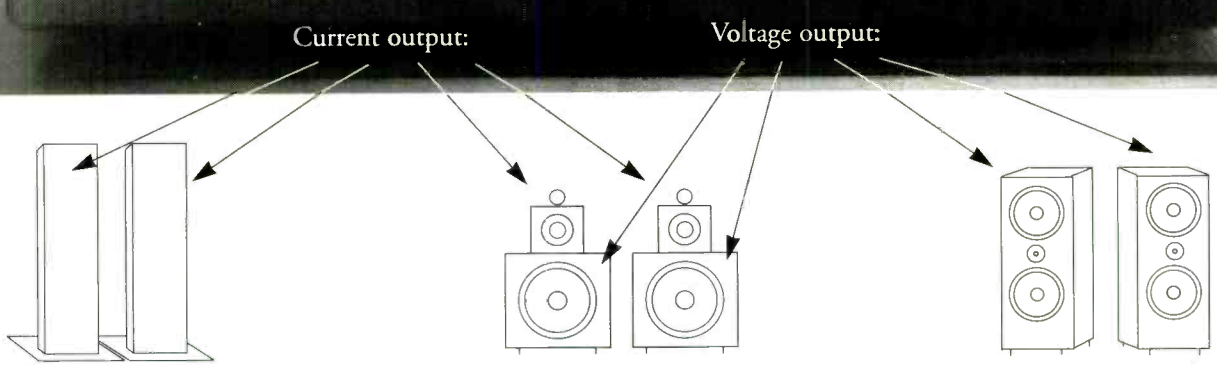

Presenting the new Sunfire stereo amp by Bob Carver.

It's not a 9 watt triode of course, and we wouldn't want it to be, but it does share a very important characteristic with one. It incorporates the current-source (high output impedance) properties of a triode. This enables you, when you choose the current-source output connections for your system, to have a sumptuous high end, together with a midrange that positively glows.

At the same time, the new Sunfire amp, with its uncanny tracking downconverter, has the ability to raise goose bumps with its awesome power. Using 12 herculean International Rectifier Hexfets, it can drive *any* load to *any* rationally usable current or voltage level.

A choice of outputs.

You can connect most speakers to the voltage-source output, with its near zero impedance, to experience the powerful dynamics and tight bass you've always wanted more of.

Or let's say you own electrostatic, planar magnetic or ribbon speakers, then connecting the higher impedance current-source output can coax forth a sensuous, delicately detailed musical voice associated with low powered classic tube amplifiers.

Or if you're able to bi-wire, you may just arrive at the best possible interface: voltage output to woofer for incredible bass whack, current output to midrange and treble for the subtle cues of reality. Your options even include gold RCA standard or XLR balanced inputs.

Each choice will reveal the delicate musical soul that complements this amp's astonishing muscle and control. And each will lead to a multilayered soundstage so deep and wide and three-dimensional it'll take your breath away.

Performance that's difficult to believe.

The basis for all this is designer Bob Carver's versatility. He's worked successfully with both tube and solid state designs, as the path towards musical truth dictates.

For the new Sunfire, he insisted on an enormous 138 ampere peak-to-peak output current capability with 600 watts rms per channel continuously into 4 ohms* and 2400 watts rms into one ohm on a time-limited basis. Courtesy of 24 massive Motorola triple-diffused output devices, each capable of 20 amperes without taxing current reserves.

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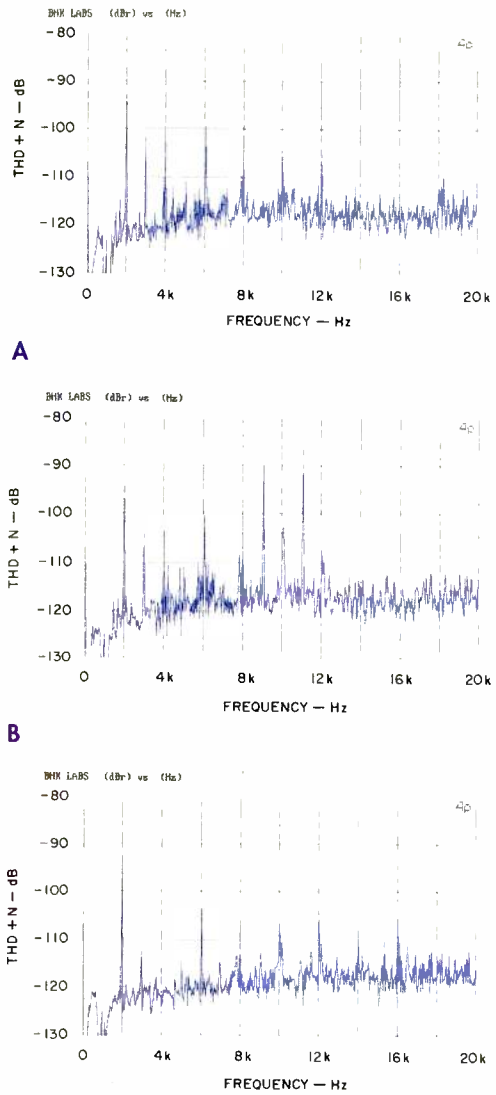

Fig. 2—THD spectra for 1-kHz signals at –90 dBfs with jitter modulation at zero (A), with 10-kHz jitter modulation at 5 nS, peak to peak (B), and with 5-nS, 10-kHz jitter and DTI•PRO between jitter modulator and test D/A converter (C).

as a function of jitter-modulation frequency and check the effects of different jitter amplitudes as well. I hope to acquire the instrumentation to do these things and, additionally, to measure the amount of jitter directly in S/P DIF signals—and at D/A converters' word-clock outputs—in the near future.

To see if noise levels were somehow improved by going through the DTI•PRO, I looked at the spectrum of recovered signals, using the Sonic Frontiers SFD-2 D/A converter. A 1-kHz, 16-bit signal from my Audio Precision was fed to the SFD-2 directly, and through the DTI•PRO. I used coax cable for the direct feed; when the DTI•PRO was in line, I used an ST cable from the DTI•PRO's output to the ST input of the SFD-2. Figure 3 shows the amplitude spectra of the SFD-2's balanced outputs for a –100 dBfs, 1-kHz signal fed straight into the SFD-2 coaxial input and through the DTI•PRO. The shape of the noise spectrum was slightly different for the different output word lengths. The curves shown are for 18- and 20-bit words; the curve for 16-bit output words (not shown) was similar to that for 20 bits. However, the relative levels of noise (measured from 10 Hz to 22 kHz by notching out the fundamental with my test system's THD function) didn't show any appreciable difference with the DTI•PRO in or out.

I next wanted to see if the DTI•PRO's output word lengths did indeed correspond to its front-panel control settings. For calibration purposes, I set up an arrangement whereby my Audio Precision's S/P DIF digital output was coupled to the input of the Crystal CDB4328 development board. I then monitored the data output of the onboard CS8412 input interface receiver to check for data word length. When I varied the word length coming out of the Audio Precision, it was easy to count bits and see perfect correlation with the data word length. I then put the DTI•PRO between the signal source and the CDB4328, set the Audio Precision's word length to 16 bits, and set the DTI•PRO's word length to 16, 18, and 20 bits. It was not quite as easy to count bits, but the data word lengths seemed to agree with the DTI•PRO's settings.

The a.c. line current drawn by the Audio Alchemy DTI•PRO was about 200 mA. While I was operating the unit with its cover removed, I discovered that most of the heat was coming from several of the larger (TO-220) voltage regulators. One of these regulators didn't have a heat-sink and, in my opinion, was too hot. The DSP chip got fairly hot in operation, too, although not excessively so.

From the measurements discussed above, it appears that the DTI•PRO does remove jitter from the data stream. However, I wasn't really able to demonstrate its resolution-enhancement properties to my satisfaction. To be thoroughly convinced that the resolution was enhanced, I would have to observe a less noisy low-level output signal in a measurement setup with the DTI•PRO connected ahead of a monitoring D/A converter.

THE DTI•PRO MADE MY OLD TRANSPORT SOUND BETTER THAN IT HAD A RIGHT TO.

Use and Listening Tests

Digital equipment used during the review period included Counterpoint DA-11A and PS Audio Lambda CD transports feeding a Sonic Frontiers SFD-2, a Parasound DAC 1000, and other (experimental) D/A converters. Preamplifiers used included a unit from Quicksilver Audio and a Forssell balanced, tube line driver. When a D/A converter was fed directly into a power amplifier with input level controls, I used no preamp at all. Power amplifiers on hand were a Crown Macro Reference, Quicksilver M-135s, and a pair of Quicksilver experimental 50-watt triode units. Loudspeakers used were B & W 801 Matrix Series 3s, augmented from 20 to 50 Hz by a pair of subwoofer systems, each using a JBL 1400Nd driver in a 5-cubic-foot ported enclosure.

I can remember listening to the original DTI in my system about a year ago. At the time, I remember thinking that it made the

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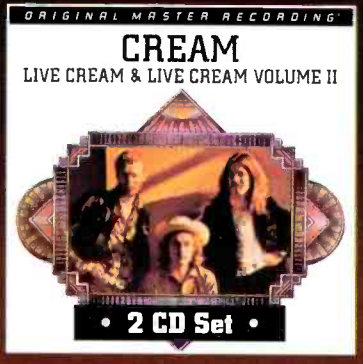

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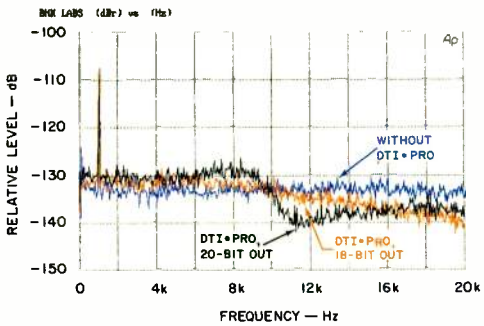


Fig. 3—Spectral response of 1 kHz, −100 dBfs signal without DTI•PRO and with DTI•PRO set for 18- and 20-bit output.

sound a little bit more palatable and smooth—possibly more realistic in *that* sense. However, after listening with it in and out quite a bit, I finally decided that it took a little too much definition away, and opted not to use it.

In the case of the DTI•PRO, I first tried it out using the Counterpoint DA-11A transport in combination with the Sonic Frontiers SFD-2 D/A converter. In this setup, I fed the DTI•PRO with an AES/EBU balanced cable from the transport and fed the SFD-2 with an ST glass-fiber cable from the ST output of either the DTI•PRO or the transport. This, in effect, put the DTI•PRO in or out of the circuit. I used various combinations of my favorite preamps and power amps in these listening sessions. There was a noticeable impression of increased space and resolution with the DTI•PRO in circuit. I could hear the boundaries of the recorded space more clearly, and the overall impression of instruments playing in space was improved. The musical rhythm and pace seemed to be more involving also.

THE SOUND BECAME MORE EXCITING, DETAILED, AND DIMENSIONAL WITH THE DTI•PRO IN LINE.

With this as reference-grade reproduction, I connected a coaxial cable (that I've used a lot for S/P DIF interconnection) from the coax out of the DA-11A to the coax in of the SFD-2. Oh! The imaging became flatter, and the texture or tonality became more irritating. I then plugged this cable into the coax input of the DTI•PRO and again used the ST cable between the DTI•PRO and the ST input of the SFD-2. Ahh! The sound became more like the reference but not quite as good. This suggests that the AES/EBU cable and connection are better than this coax cable and that the DTI•PRO is doing something to improve or isolate the coax cable's sonic effects.

I decided to try a few other combinations of CD transport and lesser grade D/A converters, with and without the DTI•PRO between the transport and D/A converter. I first tried my old Magnavox 560 CD player, which I formerly used as a transport. Comparing what I heard with the abovementioned coax cable from the 560 directly to the SFD-2 and with the DTI•PRO connected between that cable and the SFD-2, I felt that the sound with the DTI•PRO connected was better than it had a right to be with that particular transport. Without the DTI•PRO, well, the 560 goes back to the lab for use in testing, where it belongs.

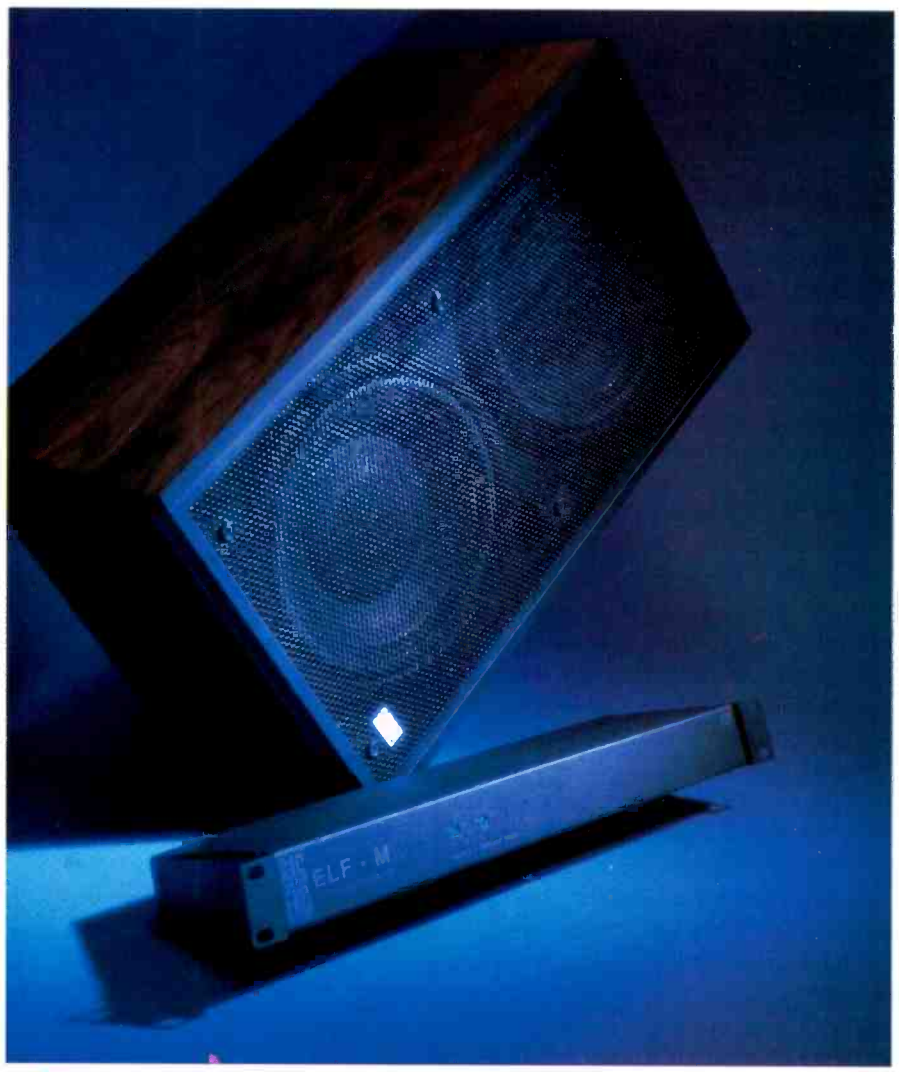
Finally, I tried an Audio Alchemy DDE V1.0 D/A converter with the Counterpoint DA-11A transport. Again, I used the same piece of coax cable from the transport output into the D/A input or into the input of the DTI•PRO. When the DTI•PRO was in the line, I used another short piece of coax, which I have used in the past with good results, to connect the output of the DTI•PRO into the DDE V1.0 D/A. Without the DTI•PRO, the sound was a bit unexciting (but palatable) and less dimensional, with less detail and, paradoxically, with a bit of irritation. With the DTI•PRO in line, the sound simply got better in all of these regards.

In conclusion, Audio Alchemy's DTI•PRO seems to do its thing with considerable effectiveness. I would heartily recommend that you go get a demonstration and judge this device for yourself.

Bascom H. King

EQUIPMENT PROFILE

BAG END D10E ELF SUBWOOFER AND ELF-M INTEGRATOR



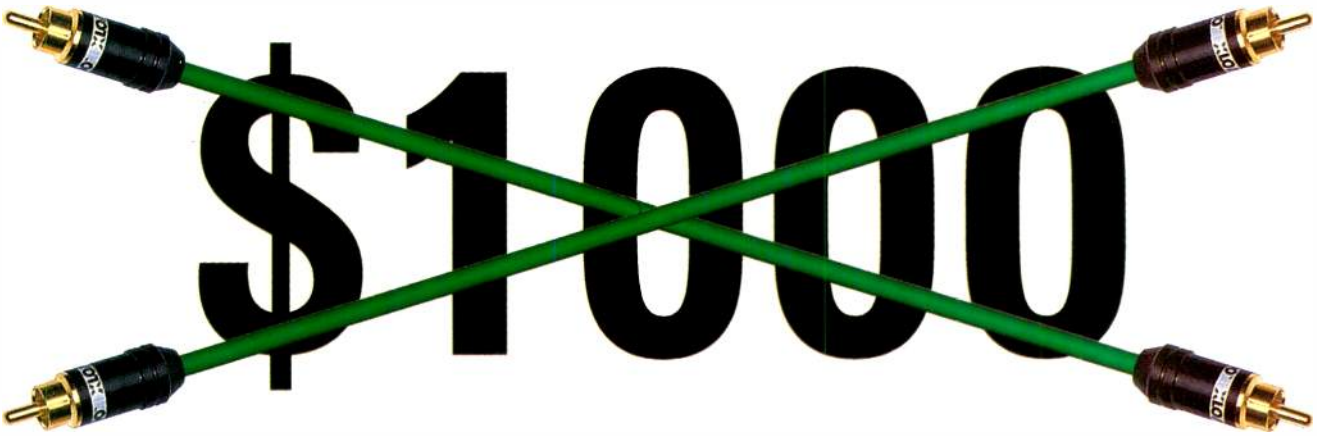
Photos: Michael Groen

Bag End is the home of Bilbo Baggins in J. R. Tolkien's book *The Hobbit*. I do not know what this has to do with speakers except that, as a company name, Bag End evokes a psychedelic-era, offbeat image. This may be appropriate for several reasons. First, all Bag End loudspeakers are designed primarily for professional applications. Also, Ron Wickersham, who co-developed the technology embodied in Bag End subwoofers, designed a legendary sound system for The Grateful Dead in the '70s. Last, the designs of the Extended Low Frequency (ELF) loudspeaker and crossover are indeed somewhat unorthodox. In the case of the small D10E subwoofer reviewed here, this approach results in response claimed to be flat down to 18 Hz. (*Editor's Note:* The main difference between Bag End's and most other companies' subwoofer systems is the use of patented ELF, or Extended Low Frequency response, technology. The patent is available for license, and Bag End has obtained a license to use it in subwoofer systems. The patent is owned jointly by Ronald J. Wickersham, president of Alembic, famous for its bass guitars, and Edward M. Long, owner of E. M. Long Associates and a Senior Editor of *Audio*. Long was not involved in the specific design of the Bag End D10E or in the decision to review it; that decision was mine.—*E.P.*)

The D10E, a sealed box housing two 10-inch woofers, is the smallest of Bag End's ELF series of subwoofers. The "Studio" finish on my review sample (D10E-S) is a matte black laminate on the subwoofer's ends and bottom, with walnut veneer on its top surface. The front is covered with a perforated metal grille. It is attractive, but perhaps not sufficiently housebroken for every living room. Connection is via double-banana binding posts on a recessed panel on the back.

The ELF-M Integrator is the associated signal processor that is patched in ahead of the amplifiers. It feeds them high-pass signals and derives a mono sum feed for the subwoofer amplifier. Any decent power amplifier rated at 100 watts or more into 4 ohms should work fine. The ELF-M has a sturdy little rack-mount chassis with a remote wall-plug power supply. For stacked component systems, the ELF-M is too shallow to fit in, except on top. Front-panel screwdriver-adjust controls are subwoofer "ELF Gain" and "Concealment Threshold," an overexcursion protection circuit. LED indicators show power on and activation of Concealment. Rear-panel connectors are professional XLR types.

The manual goes into some detail regarding the philosophy of the ELF system. It seems to be based on achieving flat and extended frequency response, low phase shift, and freedom from resonance. That these lofty goals lead to the optimal design for music reproduction is pretty much taken for granted. I don't wish to argue with this, but things can stray pretty far from theory in the real world. Essentially, the D10E's woofers are operated below their resonance of 70 Hz in their sealed box. This produces an expected 12-dB/octave roll-off below this frequency, which Bag End calls "dual differentiation." The ELF technology supplies a dual integration to the input signal, effectively cancelling the



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low-frequency roll-off and continuing up to replace a low-pass filter above 70 Hz. A high-pass filter at 18 Hz keeps the low-frequency boost from continuing downward.

Certainly, this arrangement of filters is unique, but the result is a system frequency response similar to that of other electronically assisted systems. Examples are Allison speakers with the Electronic Subwoofer processor, KEF speakers with their KUBE processor, M & K powered subwoofers, and Velodyne servo subwoofers. This is a highly pedigreed pack, with which any manufacturer should be delighted to run.

An ELF system has no acoustic resonance near its cutoff frequency, which is 18 Hz for the D10E. This can be a benefit to transient response, but it places great demands on the inherent linearity of voice-coil and magnet of the woofer to avoid distortion. As with all conventional subwoofer systems, the ELF ends up being a compromise between small size, low-frequency cutoff point, efficiency, and maximum acoustic output.

SPECS

SUBWOOFER

System Type: Sealed box.
System Resonance: 70 Hz.
Drivers: Two 10-in. woofers.
Frequency Response: 18 to 100 Hz, ±3 dB.
Sensitivity at 1 Meter for 2.83 V In, Measured in Half-Space: At 80 Hz, 96 dB SPL; at 40 Hz, 86 dB SPL; at 20 Hz, 74 dB SPL.
Nominal Impedance: 4 ohms.
Dimensions: 13 in. H x 22 in. W x 13 in. D (33 cm x 55.9 cm x 33 cm).
Weight: 49 lbs. (22.3 kg).
Prices: $629 each with walnut top and black sides, $638 each with black paint finish, or $828 each with oak finish.

INTEGRATOR

Crossover: High-pass section, –3 dB at 130 Hz and –6 dB at 97 Hz (internally adjustable); ELF section, dual-integration rise at 12 dB per octave.
Input/Output Configuration: Balanced or unbalanced input, unbalanced output; XLR connectors.
Gain: High-pass, 0.0 dB; low-pass, variable from +10 to –10 dB.
Dimensions: 19 in. W x 1¾ in. H x 5½ in. D (48.3 cm x 4.4 cm x 14 cm).
Weight: 6 lbs. (2.7 kg).
Price: $898.

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Measurements

Certain assumptions were needed to test the D10E. The first was that it would be used with normal power amplifiers, which have about 26 dB of gain. This works out to about 2.0 V input for full power. The gain of the satellite-feed portion of the ELF-M Integrator is unity, so we can figure 2.0 V as an input and output maximum. For the woofer-feed portion, gain varies with frequency. I used the front-panel "ELF Gain" adjustment to make this section unity gain at 50 Hz. This is very close to its "0" setting.

Anechoic frequency response of the ELF system (Fig. 1) meets the claimed extended low frequency, although not quite Bag End's claimed 18 Hz for the D10E. The fall-off above 100 Hz is almost exactly the slope predicted from dual integration. The intended crossover point is 97 Hz, where the response is supposed to be –6 dB from both the subwoofer and the satellites. In a perfect world, meaning no room reflections, these speakers add, in phase, to produce a seamless splice. Of course, that is not the case in our real-world listening rooms. A crossover control to "finesse" the overlap by ear would be welcome.

Figure 1 seems to show a sensitivity of about 87 dB for 1 watt at 1 meter, but this is only true at 50 Hz, where 2.0 V is applied to the speaker. Near 25 Hz, the ELF-M Integrator applies 8.0 V, or 16 times the power into a 4-ohm load. At 100 Hz, 0.5 V is applied, for one-sixteenth the power. A sixteenfold increase in power consumption at 25 Hz would seem to dictate a gonzo amplifier; however, this is not necessary because the woofer will only handle so much. Preventing excessive power input at low frequencies is the duty of the Concealment circuit. With Concealment, a 160-watt amplifier is safe and will extract all of the clean acoustic output available from the D10E subwoofer.

Figure 2 shows how much clean acoustic output is available. The top curve is the effect of the Concealment limiter, as I set it.

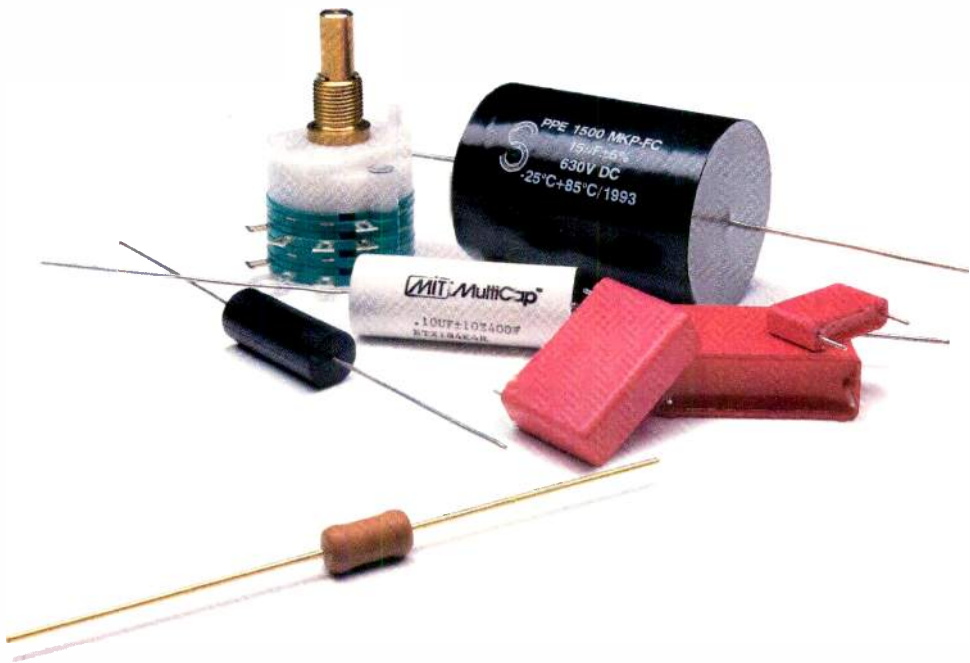
BAG END'S UNORTHODOX APPROACH YIELDS A SUBWOOFER RATED DOWN TO 18 Hz.

This circuit limits the low-frequency signal to the power amplifier, which limits the drive to the speaker. I set the limiter to allow almost 20% harmonic distortion around 20 Hz. This results in a maximum output of 92 dB SPL at 1 meter at 20 Hz. At 31 Hz, 98 dB SPL is available. The other curves show the SPL when the woofer is driven to just 3% or 10% harmonic distortion; I consider 3% to be very low distortion for a woofer and 10% to be acceptable on peaks. Note that my setting of the "Concealment Threshold" control allows a maximum of 10% distortion at 40 Hz and 3% at 63 Hz. Concealment could be adjusted to allow no more than, say, 3% distortion at any frequency, but this would reduce the maximum output at low frequencies considerably.

Use and Listening Tests

The ELF-M Integrator's professional XLR-type connectors are likely to present the greatest difficulty to the hi-fi enthusiast. These high-quality connectors must be adapted to the lowly RCA connector with which we are familiar. Bag End's instruction manual shows how to do this for quarter-inch phone connectors, which are electrically similar to RCAs. To do it yourself, I suggest purchasing three female XLRs, two male XLRs, and three RCA-to-RCA interconnects. (All this will cost about

THE ICING ON THE CAKE.



This is a handful of resistors, capacitors and a rotary selector switch shown along with circuit schematics and circuit board layouts created by Sonic Frontiers. These parts represent just a small sample of the high quality components that Sonic Frontiers has chosen to execute their innovative circuits. Every part in every Sonic Frontiers product excels in quality - premium grade components from industry leaders such as MIT, Vishay, Caddock, Electroswitch, Wima, Solen and Kimber. Each part is selected through rigorous testing to fulfill exacting objective, as well as subjective parameters; anything less than this would sacrifice sound and quality.

Attention and effort like this, directed toward the smallest details, is a philosophy Sonic Frontiers applies to all facets of design and production. Whether it is choosing a sonically critical resistor or a custom wound, wide bandwidth output transformer, our design team makes their decision based on the strictest criteria. This level of parts quality and innovative circuit design combines with superior build quality to offer today's discriminating audiophile consumer a rare level of quality, performance and value.

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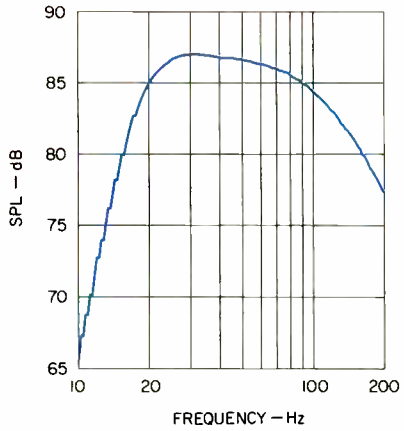


Fig. 1—Frequency response.

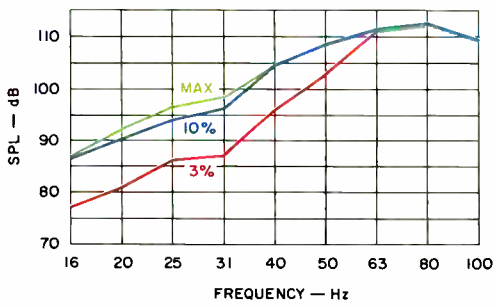


Fig. 2—Output at 1 meter; see text.

$25, according to Radio Shack's catalog.) Cut the three RCAs in half, throw one of the halves away, and strip and solder the remaining five to the XLRs. Then you are ready to go. (A dealer will probably provide this service for a small charge.)

The ELF-M Integrator is patched in just ahead of the power amps that feed your satellites. A summed ELF output is intended to feed a mono subwoofer amplifier. Since there are two 8-ohm woofers inside the D10E cabinet, it would have been convenient if both had been brought out to terminals on the box. This would have allowed a parallel-fed stereo power amplifier rated at 8 ohms to feed each driver with its own channel. I advise turning the gain of most power amplifiers to maximum to give the ELF-M Integrator enough headroom. If you use a receiver to power your satellite speakers (and wish to drive them through the Integrator's high-pass), your receiver must have connectors for preamp out and power amp in.

For my listening tests, I started with the D10E cabinet placed midway between a pair of Celestion SL-700 satellite speakers. I used one channel of a modified Hafler DH-220 amp, which is good for over 200 watts into the subwoofer's 4-ohm load. The sealed-box Celestions respond flat down to 60 Hz, with a smooth and gradual roll-off below this frequency. It seemed wasteful to high-pass them at 120 Hz with the filters in the ELF-M Integrator, but this would theoretically result in less phase shift and a smoother crossover. When I fired up the rig, I found it necessary to turn down the ELF system's gain to best match the relatively inefficient Celestions. This was good news, because I was now less likely to activate Concealment at very low frequencies.

At first, I was not satisfied with the blend of the subwoofer to the satellites. My favorite test for this is "You Look Good to Me" on the Oscar Peterson Trio's *We Get Requests* (Verve CD 810 047 2); the acoustic bass is played and recorded with an evenly full sound for each note up and down the scale. I heard a variation in this fullness, causing some notes to be scratchy and others to be boomy. After some experimentation, I ended up with a good blend by placing the D10E 2 feet back—against the wall, behind the Celestions and off center. Also, I reversed the polarity of the woofer speaker cable. These and other techniques, when they are feasible, should always be tried when interfacing a subwoofer to a room and to satellites. A critical ear is required; neither a "technically correct" system nor test instruments are the answer.

On symphonic music, the Bag End subwoofer simply became an extension of the Celestions' natural presentation down to the lowest audible tones. An example is the organ and orchestra duet in the adagio movement of the Saint-Saëns "Organ" Symphony (Telarc CD-80051). The lowest organ notes accompanying the lush strings are simply not audible on ordinary loudspeakers. With the D10E subwoofer, I became aware of these pure tones rather than hearing them. This is musically as it should be; any emphasis or distortion that would call attention to the tones or their harmonics would be a distraction.

I mounted a laser displacement transducer to the front of the D10E's cabinet to measure woofer displacement while I was listening. Cone motion was monitored on a calibrated oscilloscope. Playing low bass at high level turned the Integrator's Concealment indicator on. This always occurred with a peak displacement close to ±4 mm, which is not considered to be a lot of linear travel for a subwoofer. The indicator did not turn on during the "Organ" Symphony or other classical music.

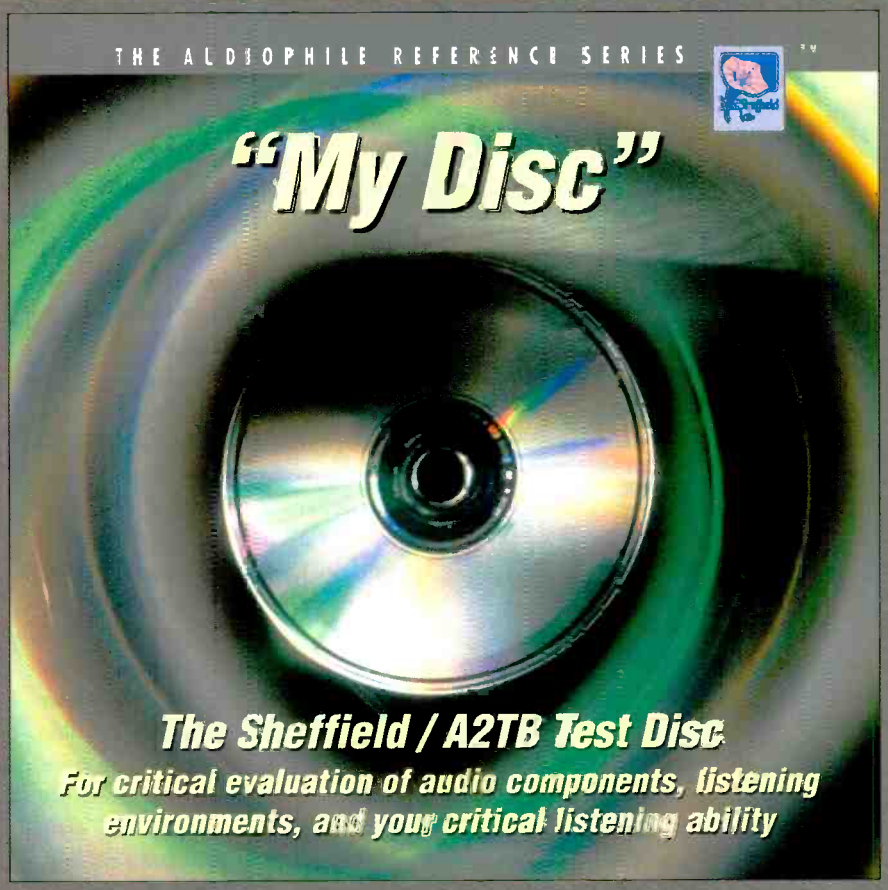
With rock and "sonic spectacular" music, the D10E maintained its composure but failed to deliver all of the punch expected at high levels. Let us remember that we are dealing with two 10-inch sealed-box woofers in a very compact system that has distortion-prevention circuitry. "The Places You Find Love" from *Back on the Block*, produced by Quincy Jones (Warner Bros. CD 9 26020-2), was reproduced at moderate levels with awesome deep bass. But played at rock SPL, the bass became a victim of the Concealment circuit. A turn of a screwdriver fixed that. With the setting of "Concealment Threshold" raised, the cone excursion increased to as much as ±10 mm and was accompanied by some audible distress. Now the D10E sounded more like an ordinary subwoofer.

On bass-extravaganza discs and movie soundtracks, the D10E doesn't cut it unless you like your explosions on the quiet side. With Concealment engaged, this subwoofer never makes a rude noise; it just doesn't get loud enough. An example is the entrance of T-Rex on the *Jurassic Park* LaserDisc. I could hear the approaching footfalls, but I was not scared and shaken.

In summary, borrowing the ELF technology from professional systems and adapting it to home subwoofer use works like a charm. You get clean, deep bass. If you need more bass than a single D10E can deliver, buy more of them or look into other Bag End models, which go up to a pair of 18-inchers. That should be a match for T-Rex.

David L. Clark

New Sheffield Test Tool Allows Serious Listeners to Evaluate Their Own Critical Listening Ability!



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KRELL REFERENCE KPE MC PHONO STAGE

One of the ironies of high-end audio is that the sound quality of analog phono equipment continues to improve just as fast as that of digital equipment. While this may be an anachronism to some, it is the twilight of the gods for others. Having good phono reproduction not only means access to decades of great analog recordings but also access to the superb new discs being pressed by an increasing number of small firms including Chesky, Mobile Fidelity, and Sheffield Lab.

Company Address: 45 Connair Rd., Orange, Conn. 06477. For literature, circle No. 95

The Krell KPE moving-coil phono preamp is an outstanding example of the new equipment brightening this twilight of the gods. The Reference KPE is a fairly compact phono preamp for moving-coil cartridges; it retails for $1,350 as a stand-alone unit designed to be powered by a Krell preamp or for $1,850 with one of the heftiest separate power supplies I have seen for a separate phono stage. The same circuitry is available for $850 as a p.c. board to be inserted into the Krell KRC and KSL-2 preamps. There are also a Standard KPE and a Standard board, which handle both MM and MC cartridges and sell for $500 less than the MC-only Reference versions.

THE KRELL KPE IS ONE OF THE QUIETEST PHONO PREAMPS I'VE HEARD TO DATE.

The KPE provides both phono gain and equalization for low-output moving-coil cartridges, and can be used with any line-stage preamp or replace an older Krell preamp's phono stage. The stand-alone unit's only apparent feature is a pilot light. The Reference KPE can, however, be adjusted internally to suit virtually any low-output moving-coil cartridge. Switches allow you to select gain of 58, 64, 70, or 76 dB, and cartridge loadings of 10, 25, 47, 100, 249, 475, 825, or 1,000 ohms. Frequency response is specified at ±0.1 dB from 20 Hz to 20 kHz. Crosstalk and signal-to-noise ratio are specified at less than 80 dB (A-weighted), and THD at less than 0.1% from 20 Hz to 20 kHz.

The Reference KPE uses a four-layer printed-circuit board. As much gain as possible is placed early in the circuit, amounting to 59 dB, while only 17 dB of gain is in the output portion. Krell claims that each channel in the high-gain portion of the circuit uses three of the lowest noise bipolar transistors available, in a parallel configuration, to reduce noise by a further 3 dB. According to Krell, these transistors are optimally biased for low-impedance moving-coil cartridges. This early section also has Mumetal shielding, which will reduce 60-Hz hum by another 20 dB, according to Krell. The output from this section is also fully buffered from the equalization/output stage of the phono system. The RIAA equalization uses a passive network for the high-frequency corner and an active circuit for the low-frequency corner. The Reference KPE's RIAA accuracy is specified at ±0.05 dB.

Photo: Michael Groen

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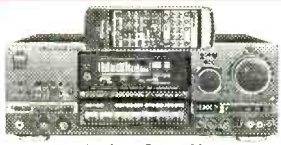

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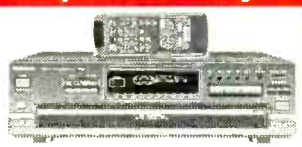

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Regardless of how good a phono preamp may be in other respects, I feel a key requirement of any such unit is that it be silent in terms of hum and hiss. There are some audiophiles who will listen through a considerable amount of phono-preamp noise for the special qualities of warmth, soundstage, or transient detail. I simply am not one of them. I find that noisy phono preamps mask low-level musical detail and dynamics, color the sound by changing the timbre of some aspects of the music, and increase listening fatigue.

It is much easier to claim a good signal-to-noise ratio or meet some technical standard than it is to deliver a unit that is truly silent to the ear. The Krell KPE, however, is not only the quietest Krell phono front-end so far—which is considerable praise—but also one of the quietest phono preamps I have heard to date. This superior real-world signal-to-noise ratio improves the sound of all low-output moving coils, especially the new generation of very low-output moving-coil cartridges that attempt to trade a reduction in output for lower moving mass and better detail.

Cartridges with very low output are anything but a blessing for most phono gain stages. Any added detail is provided at the cost of added noise or the apparent collapse of musical dynamics and of the soundstage. The KPE is so silent, however, that it can be used with the most demanding moving-coil cartridges I know of, including the lowest output Audio Notes, Benzes, and Ortofons. In fact, I found that the KPE's apparent signal-to-noise ratio was limited more by the grounding and shielding in the cartridge and tonearm than it was by the circuitry in the phono preamp itself.

What may be more important to most users is that the KPE combines this improved signal-to-noise ratio with improved openness, transparency, and dynamic life. I use the Krell KRC as one of my reference preamps, and I have always regarded it as having an excellent phono gain stage, although limited by its signal-to-noise ratio to moving-coil cartridges with normal output. However, the KPE not only allowed me to use very low-output cartridges with the KRC, it also opened up the sound of all moving-coil cartridges. It did a far better job than the KRC's phono unit of allowing the sound of music to emerge without the usual trace of electronic haze; it provided more information on the sonic characteristics of the hall in live recordings as well as the ambience and subtle imaging detail that are among the joys of the best analog recordings.

The Krell KPE provided similar sonic improvements over the phono stages in several otherwise excellent preamps from other manufacturers. It did so with very open and detailed upper midrange and treble, something missing in many phono preamps that have low noise but have problems with dynamics and life. At the same time, the KPE provided the kind of smooth and highly musical upper octave performance that I associate more with the moving-magnet gain stages in tube preamps than I do with transistor moving-coil gain stages. This combination of dynamics and sweetness in the upper octaves gave many discs new life and musicality. For some reason, it also made tape hiss, surface noise, and clicks and pops–still the occasional price of analog records–less harsh and fatiguing.

SUCH DYNAMICS AND SWEETNESS IN THE UPPER OCTAVES GIVE MANY DISCS NEW LIFE AND MUSICALITY.

One of the pleasures of any unit like this is that it gives me an excuse to review my collection of LPs. The Krell did a superb job of reminding me that analog is still a very real rival to the very best of digital. I have heard only one other moving-coil preamplifier that has a comparable apparent signal-to-noise ratio, and none that competes directly with the KPE in musicality. I was particularly struck by the way the Krell KPE opened up the soundstage, dynamics, and musical details in older recordings and in remasterings like the Chesky recordings of *The Reiner Sound* (RC11) and *The Power of the Orchestra/Mussorgsky* (RC30). The reproduction of full orchestral dynamics and bass in *The Power of the Orchestra* was truly outstanding. This was also true of Reference Recordings' much newer *Pomp & Pipes* (RR-58), quite possibly the finest recording of the sheer power of orchestra and organ ever made, and the Krell KPE gave it all the energy and life it deserves.

The KPE did an equally good job of getting more air, transient life, and low-level information from many recordings. This came through quite clearly in outstanding new pressings like the blues of Mobile Fidelity's *Muddy Waters: Folk Singer* (MFSL1-201), the Sheffield recording of jazz on Pat Coil's *Just Ahead* (LP-34), and the AudioQuest recording of chamber music on *Trio Galanterie* (AQ-LP1005). The KPE also did an excellent job in getting the best out of old Deutsche Grammophon, EMI, Columbia, RCA, and Everest recordings. It did wonders for a variety of opera recordings; it takes a superb unit to get the best out of tenor and soprano voice or to allow baritone voice its full richness without adding warmth or color. The KPE was a real pleasure with harpsichord recordings, and it allows you to get the best a given cartridge and record can provide. Some phono preamps warm Bach, while many make his harpsichord music a bit hard and analytic. The KPE is also the kind of unit that can make you reach beyond Mozart and enjoy it.

If you are seeking to upgrade the sound of your existing phono gain stage or to add moving-coil gain capability to any existing line-stage preamp, I believe you will find the KPE to be one of the best options available, one fully compatible with tube as well as transistor line stages. It is the most musically exciting moving-coil preamp I have yet heard. Do, however, experiment with the gain settings on the KPE to find the one that sounds best with your cartridge and preamp. Finding the right setting can do wonders in terms of openness, dynamics, and soundstage. You should also try the 1,000-ohm loading as well as various lower impedance loadings to find the one for your specific cartridge. The high-impedance setting may sometimes take away a bit of control, but it can also sometimes do wonders in opening up the soundstage and in adding a touch of dynamic life. The low-impedance setting will normally be best for strict musical accuracy.

Anthony H. Cordesman

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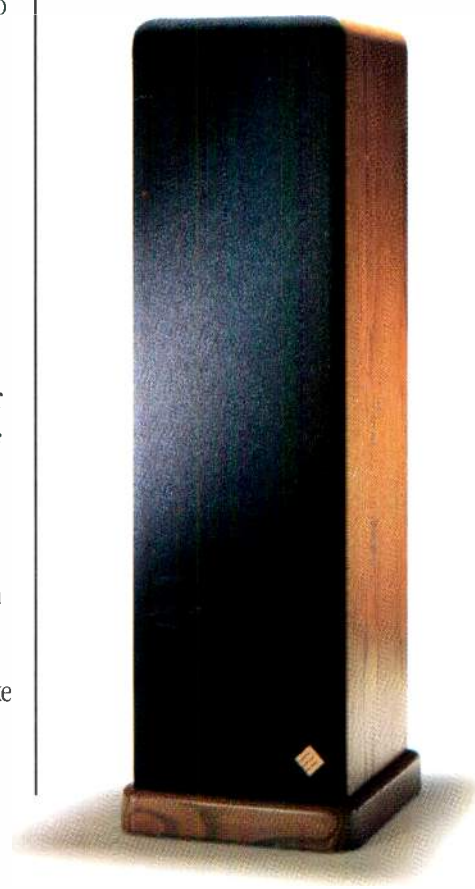

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AURICLE

THETA DIGITAL DS PRO GENERATION V D/A CONVERTER

Digital technology is evolving so fast that it is difficult to keep track of improvements and the resulting changes in product lines. This is particularly true at the top of the high end, where each improvement in one manufacturer's products leads to a competitive innovation in others. Theta Digital's new top-of-the-line D/A converter, the DS Pro Generation V, is a good case in point. There are some significant changes in this unit, and I was a bit stunned to see that it is claimed to have 125 million instructions per second (or MIPS) of computing power, more than most computers had in the days when NASA was still capable of putting a man on the moon.

Company Address: 5330 Derry Ave., Suite R, Agoura Hills, Cal. 91301.
For literature, circle No. 96

The Generation V, which sells for $5,595, differs significantly from other Theta D/A converters in a number of ways. Advances in the analog stages of D/A converters and CD players have proved to be as important as advances in their digital technology, and the Generation V is the first Theta product to use fully discrete, Class-A analog circuits, with very fast rise-times and low settling times.

Theta indicates this change to discrete components was not easy. IC-based and op-amp-based designs have inherent advantages in the analog circuits of digital audio components. Because of smaller geometries, the best of the IC-based designs are faster and tend to settle more quickly. This is particularly important in the current-to-voltage converter stage following the DAC chip. For example, the UltraAnalog DAC, which is well known in the industry for its resolution and performance, uses ICs for current-to-voltage conversion.

The other advantage of IC-based designs is d.c. precision. It is possible, using premium ICs, to design circuits that use no blocking capacitors or servos to keep the output at 0 V d.c. The cost of such circuits is that they normally have very high open-loop gain and require a great deal of feedback—which, in turn, sacrifices soundstage openness, air, apparent transient speed, upper octave detail, and sometimes midrange warmth.

With the Generation V, Theta believes it has overcome the shortcomings of discrete designs. The circuit topology uses a current-feedback amplifier for the current-to-voltage stage and discrete buffers for the filter/output section. The new analog section uses a balanced differential design throughout the whole

THIS IS THE FIRST THETA PRODUCT TO USE FULLY DISCRETE, CLASS-A ANALOG CIRCUITS.

Photos: Michael Groen

unit, as well as a new and much better circuit board. The analog circuit is Class A, to eliminate crossover distortion, and it uses a current-feedback design with a very large open-loop bandwidth and very low feedback. Theta claims this yields ultra-fast slew rates and extremely low peak error and settling time.

The Generation V has balanced as well as single-ended outputs. As is usual with Theta, the balanced outputs are derived from two DACs per channel. Theta feels this is the best (albeit most expensive) means of generating a balanced analog signal. Furthermore, the single-ended output is summed from the balanced signals, which means that these outputs also have the advantage of using two DACs in each channel.

THE GENERATION V IS AMONG A HANDFUL OF TOP D/A CONVERTERS DEFINING THE BEST IN DIGITAL SOUND.

Much of the digital section from Theta's Generation III has been retained because the company found, after considerable experimentation, that it could not do much to improve performance without spending so much money that the retail price would rise to $15,000 or more. The Generation V does, however, use the latest Crystal Semiconductor EBU receiver and proprietary jitter-reduction circuitry. It has three digital signal processors and uses Theta's own digital filter algorithm to reach 20-bit resolution. It also uses a process Theta calls "digital domain balancing." Unlike most D/A converters, which provide a balanced analog output by balancing the signal in the analog domain, the Generation V creates a balanced signal in the digital domain. Eliminated is the "inversion stage," which normally comes after the main analog stage and which reduces sound quality because the negative phase of the signal goes through two analog stages while the positive phase goes through only one. In contrast, the Generation V creates the positive and negative signals in the digital domain and passes them on to a separate DAC chip for each phase of each channel; as a result, the analog output is symmetrical for each channel and phase.

The Generation V has a new power supply that uses 14 regulators. It delivers twice the peak-to-peak voltage swing of the supply in the Generation III, and the analog portion is dual mono. All this is said to greatly increase dynamic range and channel separation. There are four separate power transformers to help isolate each stage.

As for features, you have a "Phase" switch and front-panel selection of three inputs, an AES/EBU input and two RCA coaxials. One of the main RCA inputs can optionally be replaced by an AT&T, a Toslink, or Theta's proprietary single-mode fiber-optic input. You also have separate digital tape inputs and outputs plus monitor switching. The single-mode digital input, incidentally, can only be used with Theta CD transports having the optional single-mode output. Theta feels this connection offers a significantly cleaner transfer of information than the conventional AT&T variety.

So much for the manufacturer's technical rationale. What do you actually get in terms of sound quality? The answer is a considerable refinement over that of the Generation III. The sound of the Generation V has the musical sophistication of top-of-the-line Krell and Mark Levinson D/A converters, although it is different in dynamics, timbre, harmonics, transients, noise floor, and many other qualities.

Past Thetas had more apparent upper octave energy and more aggressive dynamics than many competing D/A converters but at the cost of a slight aggressiveness and hardness. The Generation V has the sweetness, superior harmonics, and air that are associated with the best Class-A circuits, and its sound is distinctly sweeter and more refined. This change may at first seem a step backward to those who are used to the punch of the Generation III, but extended listening will reveal that the new model is more realistic in its string, piano, and guitar sound, as well as in fine percussion detail such as skin sounds and cymbal.

The bass, for example, is now much tighter and better controlled. This initially may seem like *less* bass, but it is actually

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bass that is more musically correct. In terms of sheer bass energy, the Generation V is somewhere between the high levels of units from Krell and Wadia Digital and the slightly leaner sound of Mark Levinson units. The differences, however, occur only in the deep and mid-bass and can vary according to signal source. As to which of these bass sounds is "right," well, what is the "right" seat in the concert hall? Buy according to your taste.

The Generation V still has a bit more apparent upper midrange and treble energy than most other top-of-the-line D/A converters, and this preserves the dynamic and involving character of previous Theta units. Yet massed strings and winds are now cleaner and subtler, and the soundstage has expanded to the rear. You get a more natural mix of musical detail and a more open hall. There is far less tendency to move the apparent listening position slightly forward. Guitar, harpsichord, soprano voice, and complex musical passages are all more realistic. The Generation III had a slight tendency to exaggerate low-level dynamics, which was exciting but not accurate; the Generation V corrects this, and major shifts in musical dynamics are now more natural. At the same time, peak orchestral and rock passages open up, and there is more information and subtlety.

Without question, Theta Digital's DS Pro Generation V is one of a handful of top-of-the-line D/A converters that currently define the best in digital sound. I can assure you that the Generation V is much better than the Generation III in terms of musical realism, and the Generation III was very good. *Anthony H. Cordesman*

CHOOSING A D/A CONVERTER

The choice between the best D/A converters is highly personal. Although I do hear more similarity in sound between top converters than I have in the past, there remain subtle differences in harmonics, dynamics, air, and soundstage that define the musicality of each unit. These differences are most readily apparent with guitar, piano, violin, and other familiar solo instruments with complex harmonics. You can also hear the differences on the bands of various Chesky and Opus 3 test CDs that demonstrate depth, imaging, and low-level resolution, and they will show up as well during prolonged listening to orchestral or choral music or to acoustic rock or jazz. The problem is that all of these different sounds are now musically credible.

My suggestion is that you audition a range of top units carefully over time. Try to avoid listening to dramatic musical events or audiophile spectaculars. Concentrate on CDs you know well, zeroing in on the sound of solo instruments, the comparative resolution of soft passages, and the way each unit handles the soundstage, particularly in terms of depth and hall effects. If you are on a budget, listen to middle-of-the-line D/A converters by top manufacturers as well. Digital technology has improved to the point where many of these units come very close to the sound of the outright best ones, and there is no point in paying for diminishing returns at the cost of imbalances in the relative quality of your other components.

I also caution you to use CDs from different labels and to do your auditioning with your particular CD transport (or try different models). There also are subtle sonic differences in the interactions between particular D/A converters, transports, connections, and sometimes cables, as well as the A/D processing in given source material. You need to be sure of cause and effect, and that you will hear the same differences at home that you hear in a dealer's showroom. The best approach may be to contact your dealer and either bring in your transport and cable or arrange a loan for auditioning in your home system. Above all, be sure to audition the sound you will actually get in your system if you are concentrating on choosing between nuances in the best digital equipment. *A.H.C.*

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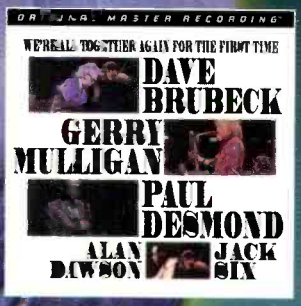

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CLASSICAL RECORDINGS

Prokofiev

Prokofiev: Piano Concertos Nos. 2 and 4; Overture on Hebrew Themes
Yefim Bronfman, piano; Israel Philharmonic Orchestra, Zubin Mehta; Giora Feidman, clarinet; Juilliard String Quartet
SONY CLASSICAL SK 58 966
CD; 64:38

Photograph: Carol Friedman

What Prokofiev would have made of this recording, I wonder. His acerbic early-electric recording of the Third Concerto is nothing like these effulgently romantic readings. Traditionally, Prokofiev's dissonances have been treated more or less as an aspect of his wit, as the piquant sauce that brings out the full flavor of his musical meat. Zubin Mehta and Yefim Bronfman both chomp down directly on these dissonances, treating them as a glorious, integral part of the musical fabric. The emotional impact of it all in this excellent Sony SBM (Super Bit Mapping) pickup is at times overwhelming. Above all, the bass range of the musical scale gets an astonishing workout, with the growling of the trombones and the pounding of the timpani matched by the power and richness of the piano's bottom end.

Prokofiev's Second Piano Concerto dates from only a few years later than Rachmaninoff's. Particularly in this performance, we are reminded how recently the considerably younger Prokofiev (at 21) had been a student of Glière and Rimsky-Korsakov. Yet both musically and emotionally, he goes so far beyond these models as to make the Rachmaninoff sound more like a Mendelssohn.

The Fourth Concerto, like Ravel's for the left hand, was written for Paul Wittgenstein, who had lost his right hand in the First World War. For whatever reason, he never played either masterpiece. And I'm increasingly persuaded that the Fourth *is* a masterpiece, though there is evidence that Prokofiev himself had mixed feelings about it. Bronfman's seemingly impetuous virtuosity makes you forget that these galaxies of notes are being played by a single hand.

The filler (and it *is* that) is the Overture on Hebrew Themes, scored for chamber group—here with Bronfman and the Juilliard Quartet and recorded at Princeton University (the concertos were recorded in the Mann Auditorium, Tel Aviv). It's a nice piece, and clarinetist Giora Feidman gives a deliciously klezmer feel to the proceedings. But it's so different in texture and emotional weight that it's a letdown after the concertos; better to have placed it as an interlude between them.

Brahms: Clarinet Sonatas, Op. 120; Jenner: Clarinet Sonata, Op. 5
James Campbell, clarinet; Leonard Hokanson, piano
MARQUIS CLASSICS ERAD 125
CD; 65:32

Both sonatas from Brahms' Op. 120 and the G Major Sonata by Gustav Jenner are included here in performances that are as fresh as they are fluent. Jenner, a Brahms pupil who was not up to his master's extremely high standard in this coupling, is nonetheless an appropriate companion. The recording is an all-Canadian project. The sound, captured in a Toronto church, is marred by excessive reverberation that is more unkind to the piano than to Campbell's wonderfully supple clarinet line, which more than compensates for some jangly climaxes.

Robert Long

The obvious comparison in Prokofiev's Fourth Concerto, which completes a Bronfman/Mehta set begun on an earlier CD, is to the Berman and Järvi on Chandos, which is very fine and has the advantage of the Concertgebouw—both the hall and the orchestra. On every count, Chandos is a bit more staid. Its genuine-sounding ambience may have been captured with few microphones, whereas Sony's sonics strongly suggest close multi-miking and careful mixing. Chandos thus is truer to the concert reality, but the Sony is so thrilling, in both sound and performance, that I must admit I prefer it. *Robert Long*

Stones, Time, & Elements: A Humanist Requiem (Text, Kurt Vonnegut; Music, Edgar David Grana)

Soloists; Manhattan Chamber Orchestra; Magic Circle Opera Ensemble; Richard Auldon Clark, conductor; Kurt Vonnegut, reader
NEWPORT CLASSIC NPD 85573
CD; 46:21

Curious that most contemporary sonic art—from musicals to jazz, pop, film, "New Age," Third Stream, Humanist, and more—lists the composer(s) last, not first as in conventional classical music. Suppose a certain big symphony were known as the Schiller Ninth, not the Beethoven Ninth? This CD is "The Vonnegut" Requiem. Nevertheless, its music is very much "classical" and, in spite of the commentary, distinctly conservative in a good way, a distillation of techniques of the 1960s, which once may have been radical but are now simply useful. I found it surprisingly attractive (I feared the worst!), quite aside from the text.

This music by Edgar David Grana is impeccably professional, beautifully written for voices, solo and choral, and for orchestra, including such no longer radical instruments as the sax (originally intended for classical music back in the 19th century!), the marimba, and some species of "electronic instrument." Indeed, two solo meditations, wordless, for sax alone, are the musical high points of the work, absolutely first-rate and very moving.

The rationale of text is fortunately not my business, so if it annoyed me it may please you. Kurt Vonnegut has rewritten the classic Latin requiem, set by so many composers for a number of centuries, into a "humanist" parallel. For instance, the Latin *Domine*, "O Lord," is constantly rendered as "O Cosmos," a clumsy salutation if you ask me. (*Domine* does mean "master" or "Lord," as in our

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These recordings have been made from the original three-channel, 35-mm film masters. These are the ones you read about in Bert Whyte's "Behind the Scenes" column so many times. John Eargle (1994) says, "These recordings remain models of how symphonic music should be recorded," while **Stereo Review** (9/94) says, "These recordings are still considered to be among the very best ever made," and **Stereophile** (11/94) comments, "Superbly transferred . . . they can hold their own with the best from RCA or Mercury CD reissues."

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word "dominant.") Vonnegut reads his own new text for some six minutes at the beginning—immersed paradoxically in a church resonance that merely makes him hard to understand. All this is lengthily discussed in the booklet—though, oddly, the printed Vonnegut and the spoken differ at many points. The payoff is a new translation back from Vonnegut into church Latin. Why? Fortunately, it is printed but not read.

So—start with track 2 if you wish to ignore the above. The rest is music. As anyone who knows a few big oratorios and Masses, not to mention requiem settings, is aware, the actual words are often unintelligible. It is the symbolic and familiar freight of meaning that counts. I did not determine which version these singers use, Vonnegut in English or in ersatz Latin, though such familiar and inspiring words as "hosanna!" came through—good in any language. The work flows continuously, but the familiar requiem segments persist and are easily discernible. Thus the work fits into an easy listening pattern.

The predominant chorus here is excellent, dedicated, and passionate, even if the abrupt Hindemith-like jumps are sometimes momentarily hesitant in pitch. Not bad, and better than the vocal soloists, who are very professional but not too accurate. Particularly, of course, the lead high soprano, who has a powerful voice—notably in the top range, as might be expected today. Not unpleasant! You'll sense an inner harmony here, in that the composer himself surely expected and wrote for just such a voice. He is unusually good at providing solos and duets, both vocal and instrumental, as a lively contrast to full chorus and orchestra. Even the separate choral parts have frequent "solos." Clearly a very gratifying work to perform and for listening. I might add, it could easily be adapted to either the conventional Latin text or an English translation. *Edward Tatnall Canby*

Rachmaninoff: Rhapsody on a Theme of Paganini, Op. 43; Brahms: Concerto No. 2 in B Flat, Op. 83

Van Cliburn, piano; Moscow Philharmonic Orchestra, Kiril Kondrashin
RCA VICTOR RED SEAL 09026-62695-2
CD; ADD; 75:48

Van Cliburn has long since recorded both these works with American orchestras, the Rachmaninoff with the Philadelphia under Ormandy and the Brahms with the Chicago under Reiner. These present performances date from a return tour to the U.S.S.R. in 1972, 14 years after his first prize in the inaugural International Tchaikovsky Competition made him, at the age of 23, the first serious musician honored with a ticker-tape parade down Broadway. It also made his recording of the First Tchaikovsky Concerto the first classical disc ever to sell more than a million copies.

In spite of their comparative age, these new releases in the U.S., of recordings previously available only in Russia, have convincing qualities to recommend them: They brought Cliburn back together with his old Moscow buddy Kiril Kondrashin and the orchestra with which he had scored his greatest triumph, and they also confirm many people's contention that Cliburn never played so well as when "inspired" (his term) by his beloved, adoring Russian public, whom he always tried to reward by pouring out his musical heart without reservation.

To get the only partially bad news, especially for audio sticklers, out of the way first, this note from the leaflet: "The [Soviet-made] analog recording source for this Compact Disc was made before noise-reduction methods such as Dolby were available. In the digital remastering, some effort to minimize the inherent tape hiss was made; radical methods have not been used in order to preserve the full-frequency content of the original recordings.

Therefore, some noise may be experienced in reproduction on wide-range equipment." Well, music-lovers, in my opinion you can forget that. Just relax, and revel in this superb music-making.

As one who heard Cliburn live in 1958 repeatedly, not only in Moscow but also on tour in Leningrad and Riga, I always marvelled at this most incredibly gifted pianist's ability to combine a blazing, transcendental technique—more than equal to any difficulty—with a musically indispensable ability to *take his time.* After the Carnegie Hall replication of that prize-winning Moscow program, more than one New York critic hailed Cliburn as a rare surviving exemplar of the "grand manner" of Romantic pianism, established by Rubinstein and Liszt and carried into our own era by Hofmann, Rachmaninoff, Lhévinne, Horowitz, and only a few others. Under Cliburn's extraordinary hands (like Rachmaninoff, he can play 12ths), the piano not only sings, it also breathes. In contrast to so many present-day steely fingered young artists, nothing hurries him—and the music benefits from it vastly.

Too much, too soon drove hapless Cliburn, 20 years after his Moscow sensation, to withdraw from all public performing. That hiatus lasted nine years, and not until 1994 did he return to anything like regular concertizing—RCA's obvious reason for issuing this CD. Once and for all: Van Cliburn, in spite of limited repertoire and some musical deficiencies, will go down in history as one of the greatest pianistic talents of this century. His playing of these two masterpieces—glorious both musically and technically—bear incontrovertible witness to that, and for that we must rejoice.

Paul Moor

Night Prayers

Kronos Quartet
ELEKTRA NONESUCH 79346-2
CD; DDD; 78:55

The latest from Kronos, the leading string quartet for new music, presents seven recent compositions that display the varied voices of composers coming from many different cultures of the former Soviet realm. A unifying musical aesthetic is also found here—a spiritual feeling of deep lament shaped by strife.

The influence of traditional ethnic music on these composers is also a joining element.

This album's title comes from the Georgian composer Giya Kancheli, and like several of the other works, it includes a vocal part, here a male choir with boy soprano. Dawn Upshaw is heard in Dmitri Yanov-Yanovsky's "Lacrymosa," a cantor is part of Osvaldo Golijov's "K'vakarat," and the unique sounds of the Throat Singers of Tuva are heard in the traditional "Kongerei" from Western Siberia. On one of the shortest and lightest works, "A Cool Wind Is Blowing" by Tigran Tahmizyan, Djivan Gasparian plays the duduk.

The low-noise-floor studio of LucasFilms' Skywalker Sound was the site of this recording session, and the astonishingly wide dynamic and emotional range of the Kronos was captured perfectly. *John Sunier*

Positively Golden

Ruth Ann Swenson, soprano; The London Philharmonic, Nicola Rescigno
EMI CLASSICS CDC 0777 7 54827 2 0
CD; DDD; 52:39

Once in a while along comes a great opera singer, and Ruth Ann Swenson, a marvelous, young American soprano, has arrived.

Swenson was born on New York's Long Island, to parents who have operatic voices. She decided at age eight to become an opera singer. After studying at the Hartford College of Music and the Academy of Vocal Arts in Philadelphia, she entered the Merola Program for young singers of the San Francisco Opera. Her big break came with the San Francisco Opera when she replaced an ill soprano as Despina in *Così Fan Tutte* in 1983. Her Metropolitan Opera debut came in the 1991 to '92 season as Zerlina in *Don Giovanni.* She has sung with top opera companies in the U.S. and abroad. In 1993, she received opera's prestigious Richard Tucker Award.

Swenson will thrill you with the effortless way she reaches the very high notes in these coloratura arias. I would say she truly has a golden voice.

Here, she presents four classic arias of the bel canto period and four from the great age of French grand opera that immediately followed it. In Donizetti's "Regnava nel silenzio...Quando, rapito in estasi" from *Lucia di Lammermoor,* Swenson's voice is light and airy and soars beautifully to the heights. Her exceptional Juliette in Gounod's "Je veux vivre," from *Roméo et Juliette,* is one you will never forget. Finally, as Dinorah in "Ombre Légère, qui suis mes pas" from Meyerbeer's *Dinorah,* Swenson makes you see her dancing with her own shadows.

The recording engineers achieved a very good balance between Swenson and the London Philharmonic, conducted by Nicola Rescigno. This is a magnificent CD, one every opera lover must own. If all opera singers were as good as Ruth Ann Swenson, I would always be at the opera. *Ruth Whyte*

See Part I of the exam on page 83 and Part II on page 85 .

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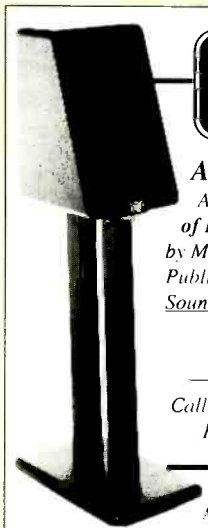

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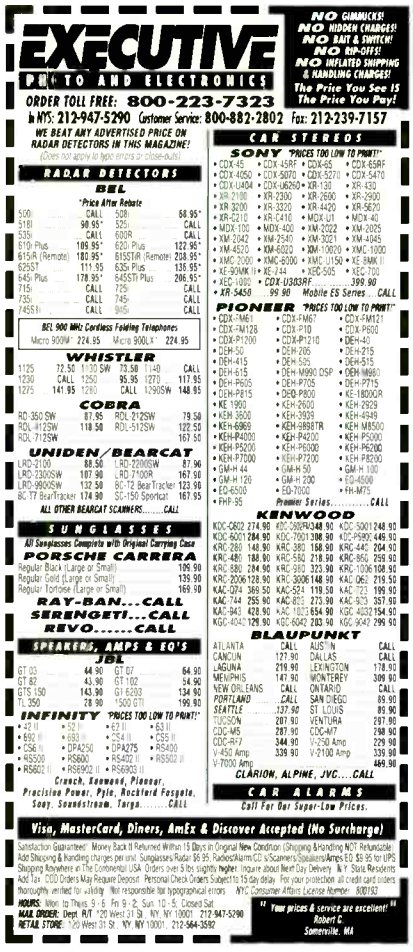

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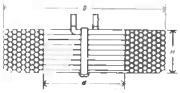

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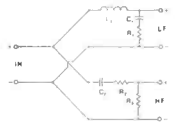

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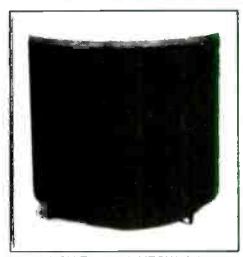

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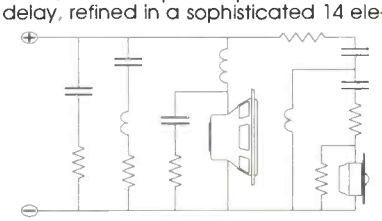

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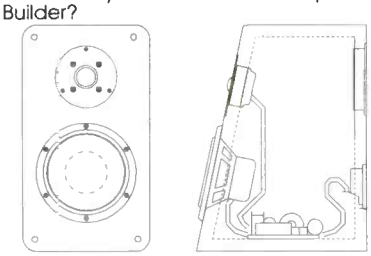

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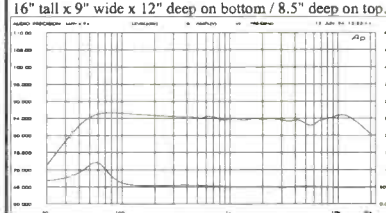

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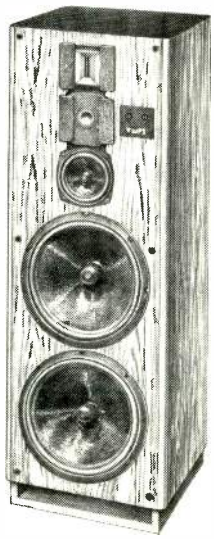

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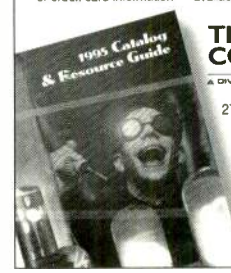

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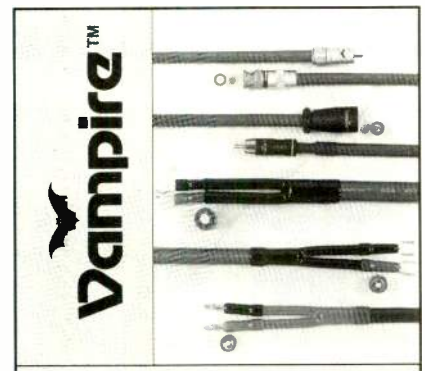

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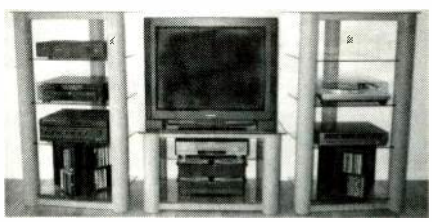

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AD INDEX

*Regional Ad

PlayBack

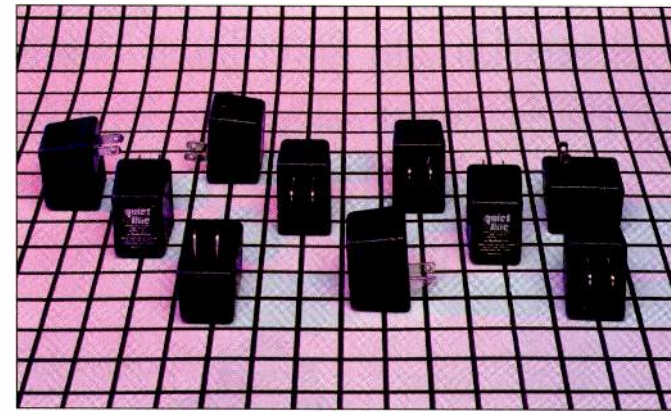
CHESKY TEST DISC

Although I have a large collection of test CDs, the only ones I have found to be consistently useful for home setups are the Opus 3 series (now dated in sound quality) and the Chesky series. While the Chesky discs mix music and test bands, and Volumes 1 and 2 include technical test bands that are really useful only with instruments, they also offer a range of listening tests that combine valuable setup information with a tour of some of the most important differences in digital systems and analog recording techniques. *Best of Chesky Classics & Jazz and Audiophile Test Disc, Volume 3* (Chesky JD111) gives you new test bands for eight different miking techniques, as well as bands that demonstrate the effects of instrument placement, natural versus artificial space, compression, different kinds of distortion, and 16-bit versus 20-bit A/D conversion. There are three useful bands for testing low-level resolution. For anyone who is interested in audio, the disc is well worth its $14.98 price. **A.H.C.**

GRADE: B

For literature, circle No. 120

AudioPrism
QUIET-LINE A.C. LINE FILTER



If you have a problem with noise on your a.c. power line, you can reduce or eliminate it with the Quiet-Line filter. Each filter is 2 x 1⅜ x 1½ inches and weighs 2 ounces. Rated voltage range is from 100 to 250 V a.c., which allows the filter to be used in countries that have different a.c. line voltages. Each filter has a U.S.-standard two-prong plug that allows it to be plugged into a standard a.c. wall outlet.

GRADE: A

Many appliances—such as computers, microwave ovens, hair dryers, refrigerators, light dimmers, etc.—put noise back on the a.c. power line, and this noise can get into your audio system. Since there are so many sources of a.c. line noise, AudioPrism packs 10 Quiet-Line filters in each box. It is always best to place the filter as close to the noise source as possible. If the appliance is plugged into a dual-outlet receptacle, you can plug a Quiet-Line into the other socket and reduce or eliminate the noise completely. Reducing the noise from a light dimmer can be more difficult, as there may not be an a.c. outlet close to it. Try to find a wall outlet on the same power line, and plug in a Quiet-Line filter; this will at least reduce the noise.

I tried some experiments to determine how well the Quiet-Line filters perform, and I was very impressed. At $199.95 for 10, I recommend them highly. **E.M.L.**

For literature, circle No. 121

"PlayBack" mini-reviews are the result of short, sweet, and sometimes deadly testing by our all-too-experienced editors and writers. These hands-and-ears-only write-ups may look like new product announcements, but the grades and text reflect what the reviewer thought after less than an afternoon's "honeymoon."—*E.P.*

Mondial Isolation Circuit

If you have hum problems with your audio/video setup, try MAGIC—the Mondial Antenna Ground Isolation Circuit. For $99.95 you can often instantly eliminate the hum caused by the remote or improper grounding of many cable systems, as well as hum in some satellite and roof antenna installations. (If the hum goes away when you disconnect the r.f. signal feed from your system, the MAGIC should work; if the hum does not go away, you have a problem that this device won't fix.) The MAGIC worked well in three different installations I tried (one of which had previously involved several service efforts where the hum was blamed on the VCR). There was no apparent signal loss, and the MAGIC did not blur the picture or otherwise reduce picture quality. **A.H.C.**

GRADE: C

For literature, circle No. 122

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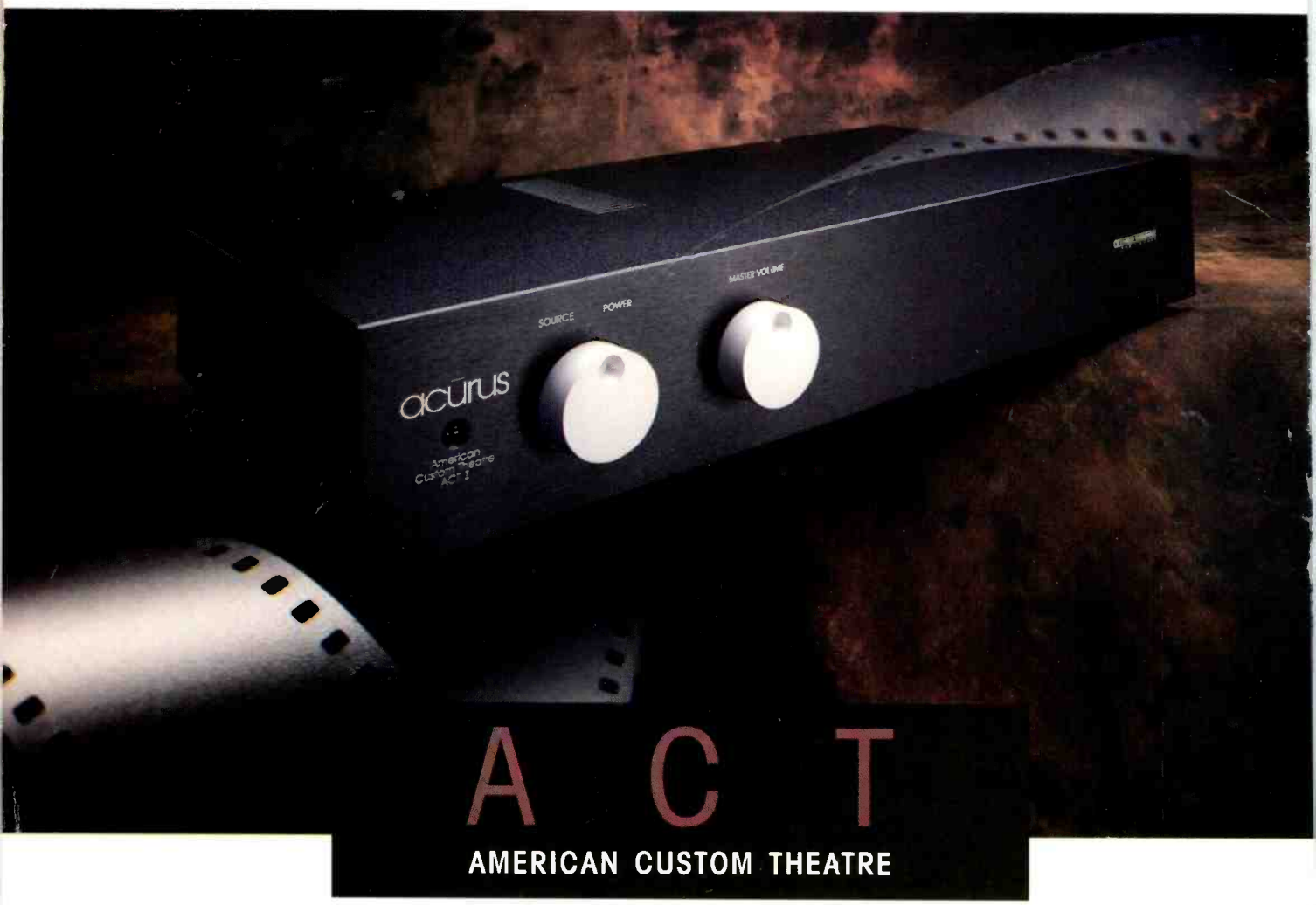

A C T

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On-screen programming makes the ACT I as easy to use as your TV. Hand crafted in America, it has separate glass epoxy circuit boards for the three input audio section, three input video section and power supply. Utilizing 1% metal film resistors and the most advanced surround sound processing integrated circuit, the Acurus ACT I has a smooth and refined sound that surpasses processors costing several times the price. Brought to you by Mondial Designs Ltd., acclaimed in Europe, Asia and America for engineering the best value in quality audio components.

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