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AUDIO

THE EQUIPMENT AUTHORITY

JULY 1995

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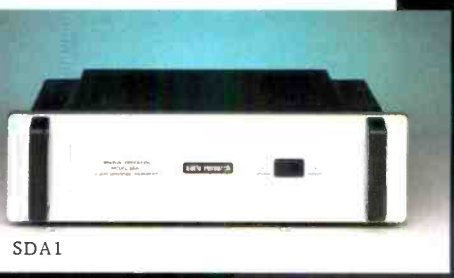

SDA1

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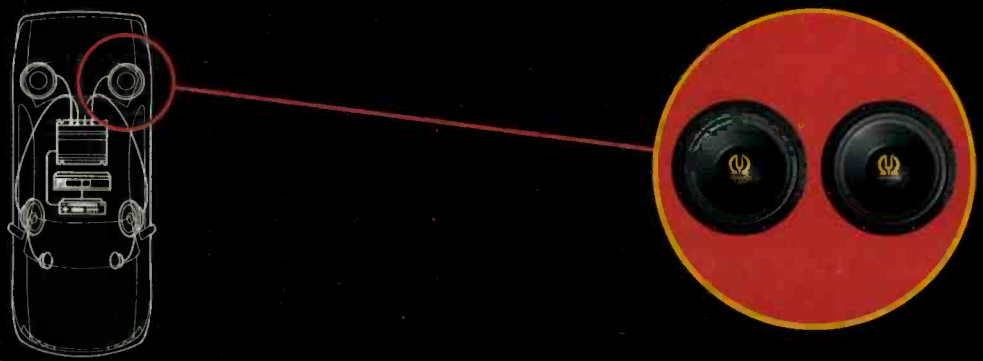
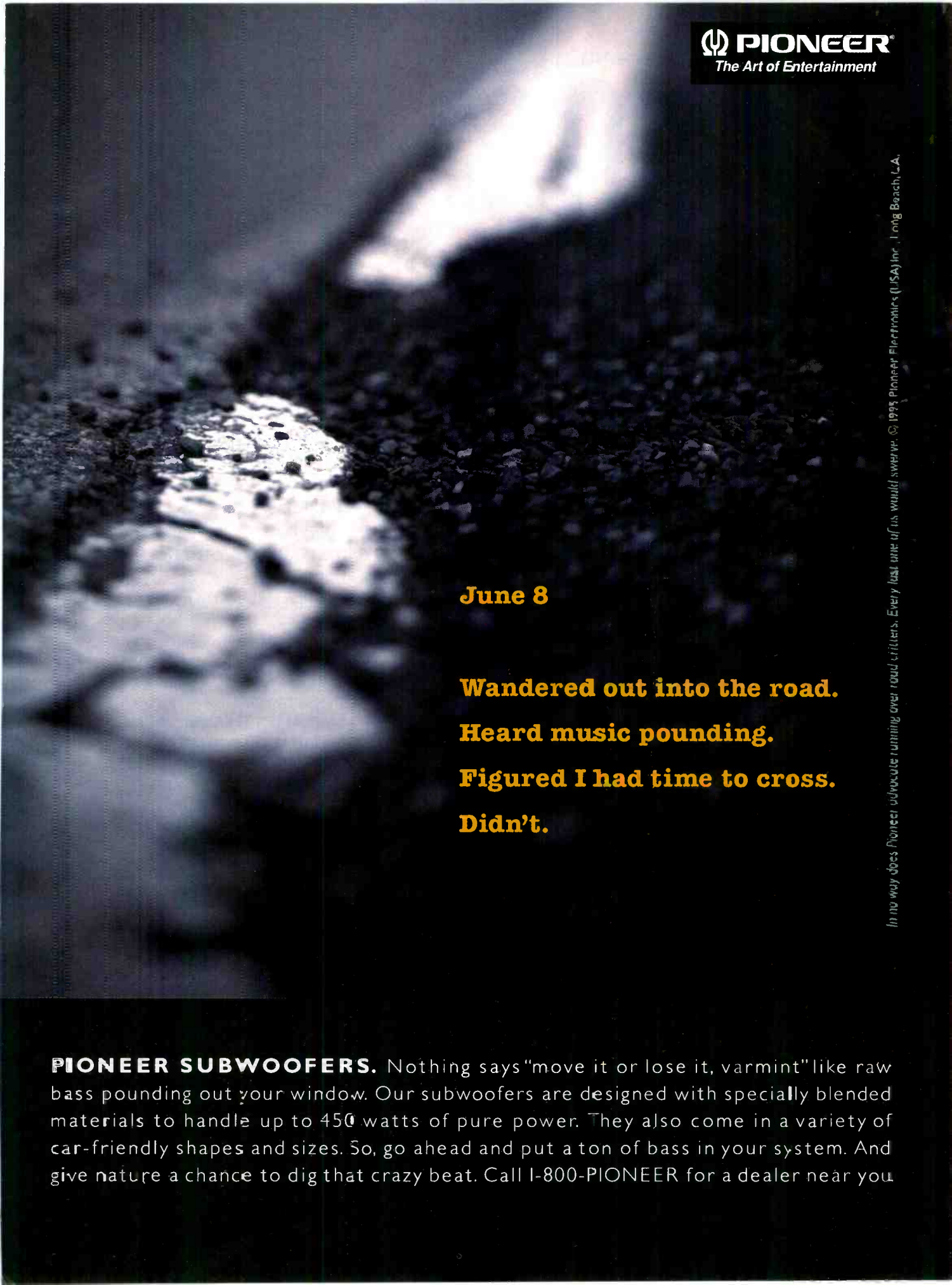
CIRCLE NO. 3 ON READER SERVICE CARD

The Road Kill Diaries





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JULY 1995 VOL. 79, NO. 7

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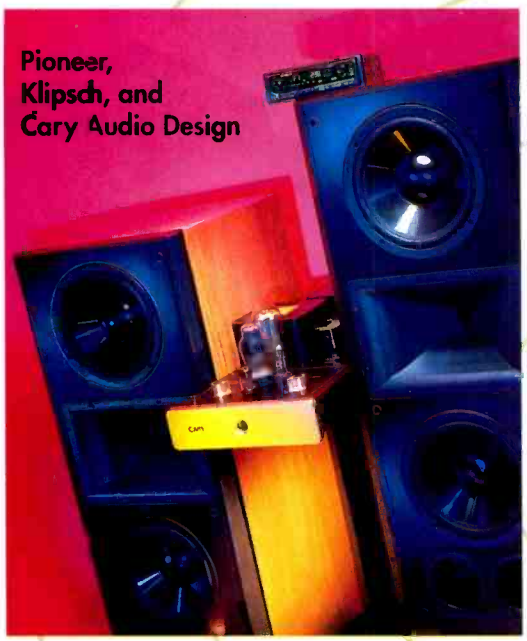

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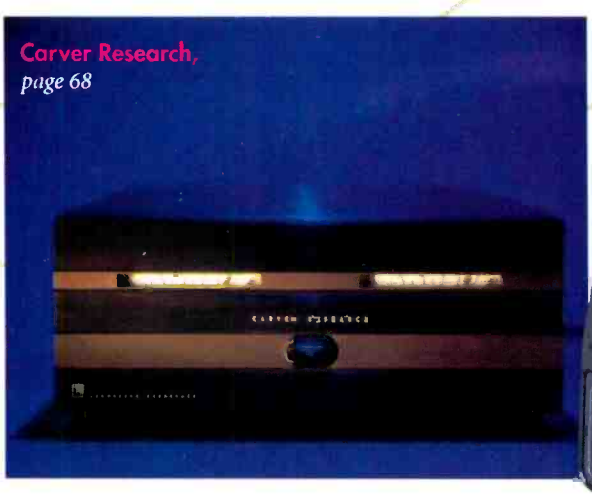

We couldn't have said it better ourselves.

— excerpts from Audio Magazine, by Anthony H. Cordesman

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"In short, the Adcom GFA-5800 stands out even in a world where almost all amplifiers now sound good."

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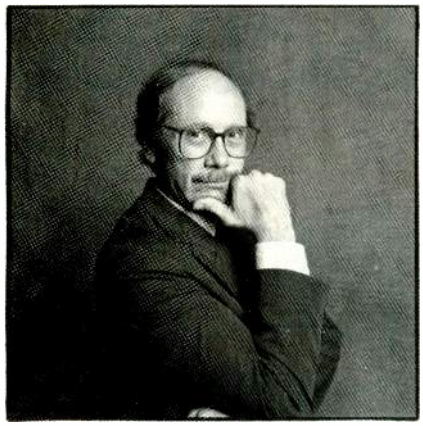

Red House Records is very proud of a recent release that I remember with great fondness from a period of my life when I still had dreams of making my living by playing the guitar. Since I couldn't sing, and still can't, Leo Kottke was the model, though I wanted to play only country blues, rather than become proficient in the breadth of styles and genres Kottke's mastered.

The CD is *Blues, Rags & Hollers* by "Spider" John Koerner, Dave "Snaker" Ray, and Tony "Little Sun" Glover. The nicknames still seem counterfeit to me, as these guys were white, college-educated (or at least oriented), and in their early twenties—just like me, except I didn't have the guitar chops. The Elektra LP was startling to a whole generation of young people. It is wonderful to have that special sound available again, but one thing that makes the Red House reissue truly special is the addition of four tracks not included on the original LP. Because of the wider frequency and dynamic ranges possible in the CD format, this disc sounds better than the original LP ever did.

Another thing that makes this rerelease so special is the new liner notes by Tony Glover. Now, follow this. Originally, the LP wasn't on Elektra but E. D. Nunn's Audiophile Records. Nunn and the Audiophile label can easily be described as audiophile; that name wasn't counterfeit. One of the first alternative, quality-oriented recordists, Nunn had done some Ping-Pong stereo effects recordings, and, says Glover, "His best seller was a whole side of a thunderstorm, with a passing distant train in the night." Nunn also recorded Big Joe Williams and Sleepy John Estes for Bob Koester's Delmark Records. The Koerner, Ray & Glover recordings came about because Nunn had written Paul Nelson of *The Little Sandy Review* asking for "a real authentic folk song group" to record. Says Glover, "He didn't know quite what to make of us, but he trusted Paul's judgment." And a good thing he did, too.

At a lunch break during the album sessions, Nunn and the musicians started discussing album packaging. Glover writes, "Nunn wanted to do some kind of fancy embossed script type cover. Paul [Nelson] replied that he didn't think that was really appropriate to the music. Nunn's face darkened, he began to stab fitfully at this napkin with his knife, almost knocking his plate off the table. We looked at each other, realizing this dude was wound pretty tight."

One of only two promotional copies, bought from Nunn at a discount (no promo freebies!), was sent to Elektra's Jac Holzman, who "was knocked out." (*Billboard* ignored the other promo copy.) However, Elektra thought there were technical problems—namely, the wide stereo spread needed release in mono, and four tunes needed to be dropped to make mastering less difficult.

"Looking back now," Glover sums up, "it's interesting to see that what we'd done was essentially make a CD album. We had 20 songs, almost 52 minutes running time, big dynamic variances, and liner notes in 6-point type. It's fitting that at long last this album is once again available in its original length and in stereo. Who'd have thought we were 30 years ahead of our time?"

AUDIO
THE EQUIPMENT AUTHORITY

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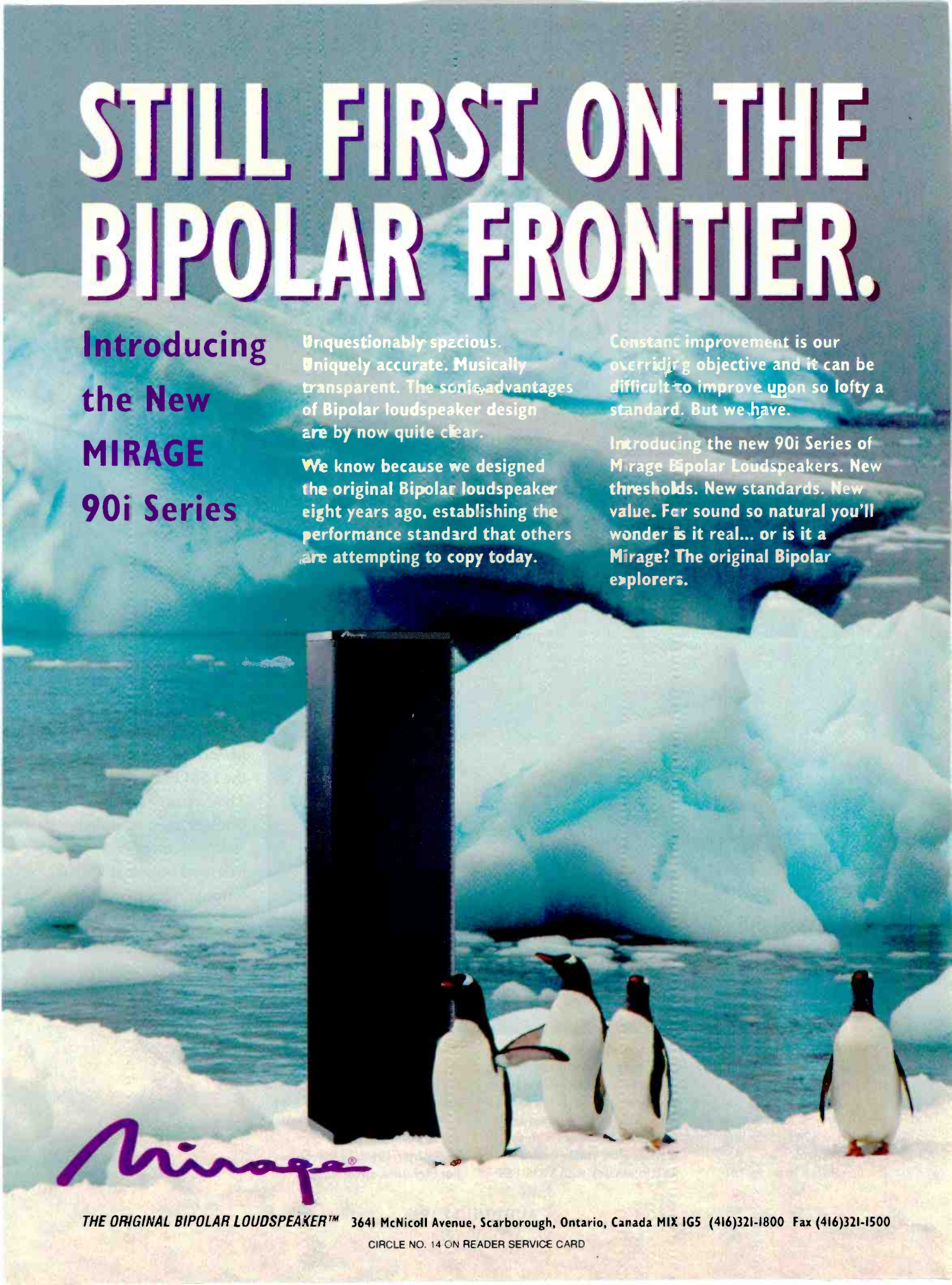

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WHAT'S NEW

Autotek Car Equalizer

Recently updated to include a two-way crossover and dual inputs, the Autotek 7004A provides four equalization bands, centered on 64 Hz, 350 Hz, 2.5 kHz, and 15 kHz. High- and low-pass crossover points can be set separately, permitting overlap or notching. The front-panel input switch lets you use another source, such as a CD changer, in addition to your car's standard head unit. Price: $199.95.
For literature, circle No. 103

McIntosh LaserDisc Player

Obviously a McIntosh, thanks to its front-panel styling (and sizing to match larger McIntosh A/V preamps and amps), the MLD7020 plays both sides of 12-inch CLV or CAV LaserDiscs automatically. Separate one-bit D/A converters with double-step noise shaping are used in each channel, for CD and for LaserDiscs having digital soundtracks. Separate transformers and supplies power the video and audio circuits. The player remembers its place on the disc when powered off during playback, and images are enhanced by advanced digital video processing and noise reduction. Price: $3,500.
For literature, circle No. 100

NAD A/V Receiver

NAD's first audio/video receiver, the AV716, has three audio/video and four audio-only inputs, including phono. Record/monitor switching permits taping one source while listening to or watching another. Used as a straight two-channel stereo receiver, the AV716 is rated at 80 watts per channel into 8 ohms. For home theater use it can supply 55 watts apiece to left, center, and right, plus 20 watts apiece to two surround channels. The surround channels can also be used to drive a remote speaker pair. Price: $749, including remote control.
For literature, circle No. 101

Lamm Mono Amplifier

Pure Class-A operation is the crucial feature of Lamm Audio Laboratory's M1.1 mono amp. Its hybrid circuitry employs a single 6992 triode tube in conjunction with MOS-FET transistors in the output stage. To optimize the latter for the load, Lamm provides switchable bias settings for 4- or 8-ohm loads, to maintain output at 100 watts into either impedance. Price: $6,090 each.
For literature, circle No. 102

Boulder Preamplifier

Among the latest additions to Boulder Amplifiers' M-series components is the L5M line preamp. The circuitry features Boulder's d.c.-coupled "990" circuitry and balanced inputs as well as outputs. This new M (for metal) version matches the styling of the 102M and 500M stereo amps. Price: $4,000.
For literature, circle No. 104

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Five blocks made a cottage, ten a castle, and a hundred your own private empire. With Linn components, it's just that simple. You can start out with the system that's right for you today and, using our building-block approach, improve and expand your system over time in affordable steps. Some steps will improve the performance of your system, others will expand your system throughout your home, but each and every step has one thing in common. It delivers more music.

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WHAT'S NEW

System Analysis Acoustic Panels

Three products from System Analysis are designed to help optimize the acoustics of listening rooms. The Quadratic Theory Residue Diffusor (QTRD, center) uses a series of troughs of varying depth, with their depth based on Manfred Schroeder's quadratic number theory, to spread the sound it reflects in a claimed 180° diffusion pattern. This helps to inhibit standing waves and broaden the soundstage. The Wavelength Absorbing Linear Structure panels (WALS, flanking the Diffusor) absorb sound by a rated 20 dB at certain frequencies to help control early reflections from behind the speakers. The Wavelength Absorbing Panels (WAP, far sides) absorb reflections in the band between 125 Hz and 8 kHz to further control early reflections. Standard height of all units is 5 feet. Prices: QTRD, from $950; WALS, from $1,025 each; WAP, from $675 each (depending on size and finish). For literature, circle No. 106

Discwasher Media Case

Holding 28 boxed CDs, 24 boxed cassettes, or a combination of both, the Discwasher 7410-series cases have padded shoulder straps for comfortable carrying and dual-zipper openings for easy access. The cases are available in black or in combinations of black and teal, turquoise, or purple. Price: $19.95.
For literature, circle No. 105

Coast CD Case

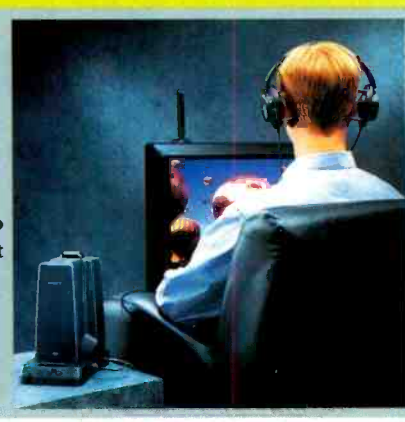
Up to 96 CDs or CD-ROMs can fit in the pages of Coast Manufacturing's CDR-Album, and a refill kit can add capacity for 48 additional discs. The Album's sleeves are made of a nonwoven fabric that's said to help prevent scratches or abrasion to the disc. Prices: Album, $24.95; refill, $9.95.
For literature, circle No. 108

Origin Component Rack

Unusual styling, excellent component ventilation, and easy user assembly are among the features claimed by Origin Design Engineering for its Model AR-1 equipment rack. The rigid, all-metal tower is available in black or white. It stands just over 5 feet tall, an aid in stoop-free loading of CDs, LPs, or cassettes. The shelves measure 22¼ inches wide and 18 inches deep.
Price: $595.
For literature, circle No. 107

SONY WIRELESS HEADPHONES WITH DSP

Sony's VIP-1000 Orbit headphones use digital signal processing to achieve three effects. Like most DSP units, the external processor adds ambience (with a choice of three sound-field settings and three reverb levels). It also simulates a binaural effect that keeps the sound field outside your head. And it works with an inertial sensor in the headset to keep the sonic image fixed in space even when you move your head; when you're watching video, this keeps dialog tied to the screen. Signals can be sent to the processor box (which doubles as a stand for the headset) by a supplied wireless infrared link or through a pair of input jacks. The headset's design holds the earpieces about an inch from the wearer's head.
Price: $649.99
For literature, circle No. 109



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Backdraft	*0559005
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Star Trek III: The Search For Spock	*0201608
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Star Trek VI: The Undiscovered Country	*1001007
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Grumpy Old Men	*1251503
2001: A Space Odyssey	*0844308
The Naked Gun 33 1/3 – The Final Insult	*1286707

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The Shadow	*1297001
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Richie-Rich	*1353705
Priscilla Queen of the Desert Academy Award® Nomination: Best Costume Design	*1345206
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It Could Happen To You	*1332006

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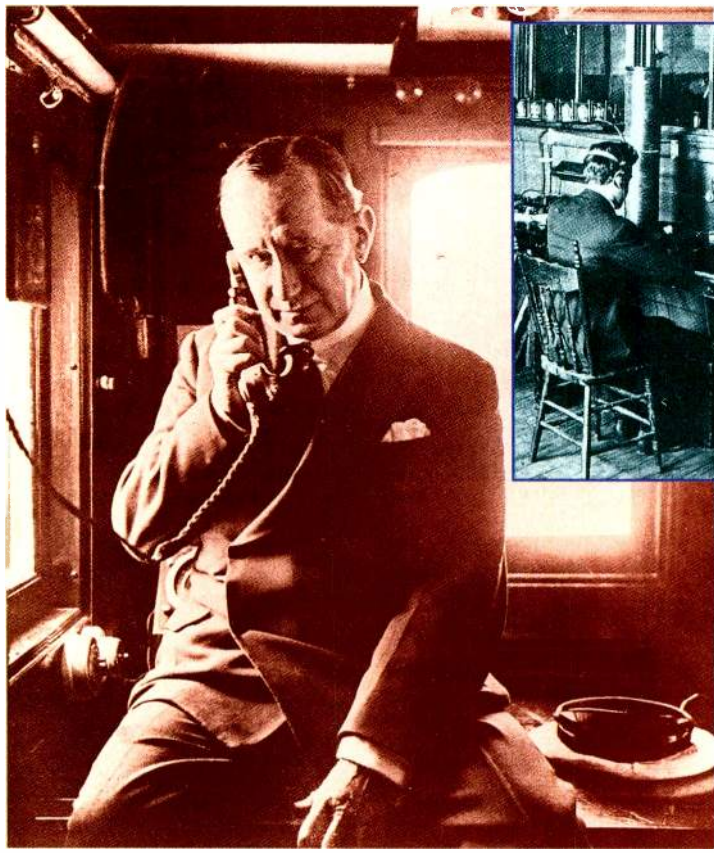
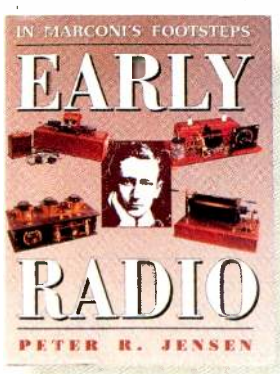


Photos: Archive Photos

A Marconi operator at Glace Bag, Nova Scotia (above) in the early years, and (left) Marconi himself in 1923 aboard the *Elettra*.

I have just read two books remarkably similar in their technique though wildly different in content. One was passed on to me by the Boss Editor, who knew I would be interested. The other was tossed in my direction by a Literary Lady Friend who knows absolutely nothing about audio (though she has a modest "hi-fi" with cute baby speakers).



Boss Editor's book: *In Marconi's Footsteps, 1894-1920: Early Radio* by Peter R. Jensen (VK2, AQJ, and G 4 GZT), published by Kangaroo Press (Australia). Literary Lady Friend's book: *Balkan Ghosts: A Journey Through History* by Robert D. Kaplan, published by Vintage Books (Random House). Two worlds, worlds apart? It would seem so. Yet I discuss them both for good reason.

It strikes me as obvious that a volume of "literature"—whether fiction, journalism, or drama—should be well organized and shaped in the telling. Isn't that what writing is all about, the professional use of language? Yet in this case it is the nonliterary book that has the smoother organization. It comprises six or seven major threads, flawlessly, effortlessly integrated, and all in a mere 176 pages.

The technique used in both these books is familiar enough today. Both involve history, directly compared to the present, and both jump back and forth from just yesterday to the exotic past—a thousand-plus years in the infamous Balkans, and a mere 40 or so (but oh, how long!) in radio. The clincher in this popular style of book, though, is the author himself, who travels in person to the places described, no matter how hair-raising. Both of these authors plunge right in—you might say recklessly, often painfully.

Dozens of authors—mostly, but not always, young and vigorous—go in for this kind of joyful torture. That includes my nephew, Peter Canby (plug), who plunged into the Maya country of "middle America" and wrote about the Mayan people, past and present, village by village. He also managed to get lost in a trackless, unmapped jungle for days (end of plug). Jensen merely got lost in Rome at 4:00 in the morning with his entire family. They had no hotel reservation, and parked in, shall I say, a house of ill fame for the rest of the night!

The pleasure for the reader depends on the literary expertise that depicts these joys and horrors. Kaplan's *Balkan Ghosts* is almost too dismal, if gripping. I think he revels in the Balkan awfulness. Yet his survival ability is prodigious and his story is very gory. (I tired of references to certain English literati, however—Dame Rebecca West, for instance.) If you want to avoid the blues, keep away from *Balkan Ghosts*. (Plug II: My nephew Peter is ever

PETER JENSEN'S *IN MARCONI'S FOOTSTEPS* IS PLAIN CHARMING, EVEN TO THE POINT OF WHIMSICAL IRRELEVANCE.

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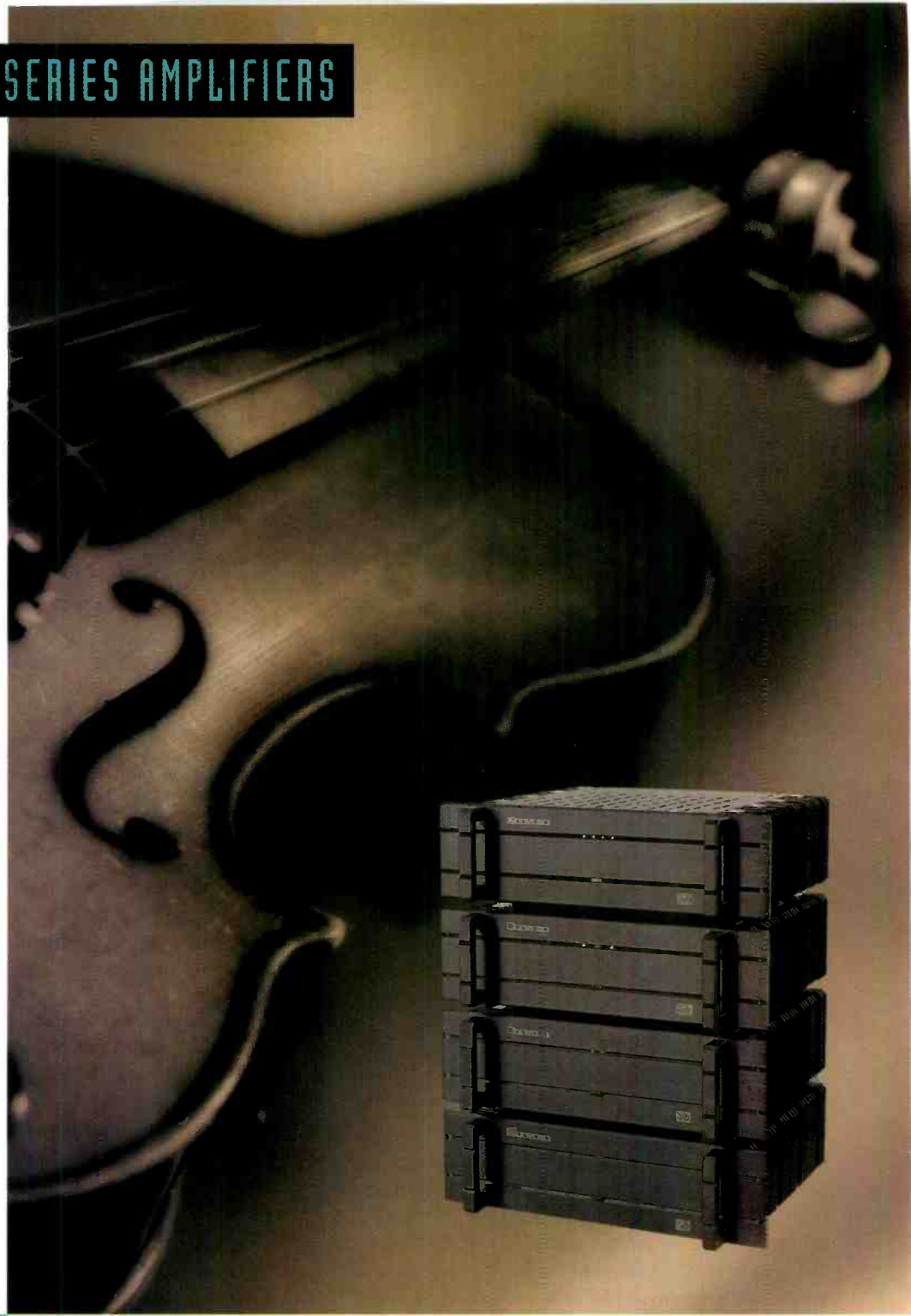

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calm and cool; he wisely lets the reader do the sweating. The gore threatens but is always avoided.)

As for Peter R. Jensen, out of Australia but English-connected, whatever he writes is plain charming, sometimes to the point of whimsical irrelevance. Such disasters! Like the time he took an Italian bus in the wrong direction for dozens of miles, then had to backtrack. He is doggedly persistent in his various Marconi searches. His snatches of biographical and technical information could have proved merely pedantic; instead, he fits them all together in a lighthearted and concise manner. I have seldom seen a short book with such a wealth of easily available information.

Jensen includes many different "books" in his study of Marconi. First, there is the Travelog—right from the beginning. It could stand by itself as a whimsical essay, "The Search for Marconi Leftovers." This continues on and off through the volume, zanily but effortlessly, aided by the second book in my list—"The Marconi Picture Book."

Talk about thorough! For every item mentioned, large and small—vast ocean liners, units of Marconi wireless gear, and the remains of dozens of Marconi installation sites—there are profuse illustrations in monochrome and color. Many of the pictures are startling, notably of every ship that is brought into the text and a few more as well. A photo of the *Titanic* in 1912 shows her unbelievably huge hulk with four great black stacks and tall masts at each end, strung with antenna wiring. Next to that, a stark picture of another, almost identical, monster, the German *Kaiser Wilhelm II*, a peaceful comparison mere months before World War I. There are gorgeous sailing ships: The British royal yacht and, of course, Marconi's own steam yacht, the *Elettra*, out of his days of fame. So—a picture book for your coffee table and a gold mine for ship lovers.

The high point of the volume—let's call it the third book, "Radio Titanic"—is a gripping account from inside the radio room (with all the Marconi wireless equipment) of the *Titanic*'s 1912 sinking after hitting an iceberg. The story was also told by the younger of the two radio men moments after he landed at New York following his rescue (the senior officer was drowned), and there is a fabulous collection of documents on the radio actions of other ships and what their officials had to say at the moment. It is a unique story.

I was most amused by the fourth book, "Marconi Archaeology," Jensen's persistent search for Marconi remains, particularly the long-forgotten sites of those great radio towers and their associated buildings, scattered from Italy and France to England, and then to America. In the process, Jensen tramped miles and miles, maps in hand, looking for signs—and usually found them. He conscientiously took photographs, which border on the absurd, of lovely green English meadows and hills, pretty white clouds, blue sky, and in the foreground a shapeless lump, the base of a Marconi tower! For one big tumulus, now crowned with trees—a sometime Marconi installation—he says, "notice the rooks." And there they are, black spots in the treetops. Another handsome meadow is ornamented with an ugly, rusted relic. A faintly visible island site appears in the distance of a vast and monotonous oceanscape. "Who cares?" one could ask. But somehow these photographs convey a good feeling.

SELDOM DO SHORT BOOKS HAVE SUCH A WEALTH OF EASILY AVAILBLE INFORMATION AS *MARCONI'S FOOTSTEPS.*

As you may infer, Peter Jensen is a radio ham. Enter the fifth book, "A Radio Ham's Paradise of Historic Reference." Here again Jensen displays his excellent, if modest, sense of organization. In the main body of the text is a thorough discussion of virtually every type of equipment in Marconi's continuing, rapid development of wireless telegraphy, with enough illustrations of the actual working transmitters and receivers to inform any technically knowledgeable reader. Also included are color close-ups of reconstructions made by the author.

So the man builds Marconi models! And Jensen has included directions in minute detail for model builders, but wisely placed in a separate section of *Marconi's Footsteps.* Everything is there—enough parts lists and pictures to delight any hobbyist. The only caveat (a mild warning) is that this is all British-based. (Jensen writes of valves, not tubes, although he acknowledges the American usage!) So you will need to check on the availability of parts or on their substitutions. Otherwise, this is the sixth book, "A Complete Modeler's Handbook."

There is so much more. The span of this book, you will see, takes us specifically to the advent of voice radio, which began a totally new era. How different was the old—more so than you may have known or imagined. I myself date back just to the end of that epoch, if you recall my account of a family friend listening for signals from Mars on a crystal set! I can just remember those tall radio towers, always in pairs with long horizontal antennas strung high up between them, in contrast to our taller single TV towers. The long wires were required by the signal's nature: Ultra long-wave, *not* short-wave, or even medium-wave (what we now call AM). This I vaguely knew, but suddenly Jensen has put it in perspective. Of course! Those long antennas went with the long waves.

The theory, it seems, was that the longer the wavelength, the greater the distance that could be covered. It took much time before the capabilities of short-wave began to be understood and utilized. That explains much of the "strangeness" of early radio for our minds today, conditioned as we are by our own technologies.

Even more striking, in the earliest days, was the total lack of selectivity: Just an intermittent spark—a transient with no sustained tone, in audio terms—spelling out code.

Oh, and did you know Marconi was half English? His Italian was lousy. A

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Stereo Review

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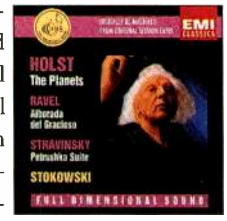
NORTHWEST AIRLINES

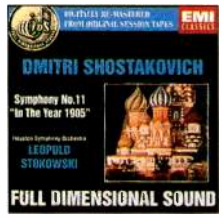
JOHN EARGLE

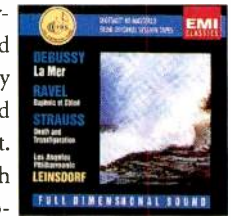
FULL DIMENSIONAL REISSUES

Of the three original American major labels—RCA Victor, Columbia, and Capitol—only Capitol was conceived by its founders as a primarily popular-music label. The others had inherited vast classical catalogs from their forebears and were always active in recording the repertory.

Early in the LP era, Capitol did branch into distribution of foreign classical recordings, most notably with its Capitol Telefunken series. And just a few years later, they decided to get into the business of making their own classical recordings. Most of these were released under the banner of Full Dimensional Sound or, later, Full Dimensional Stereo, each with its familiar FDS medallion logo. The major artists were William Steinberg and the Pittsburgh Symphony Orchestra, Erich Leinsdorf and the Los Angeles Philharmonic Orchestra (often, for these purposes, called the Concert Arts Symphony Orchestra), and Leopold Stokowski as the roving conductor of the Los Angeles Philharmonic, L'Orchestre National de la Radiodiffusion Française, the Berlin Philharmonic, and the Houston Symphony Orchestra. Other artists included violinist and conductor Felix Slatkin, violinist Nathan Milstein, organist Virgil Fox, Carmen Dragon and the Hollywood Bowl Orchestra, and the legendary Hollywood String Quartet.

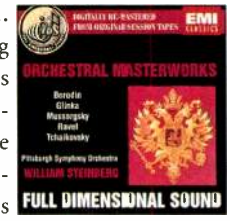






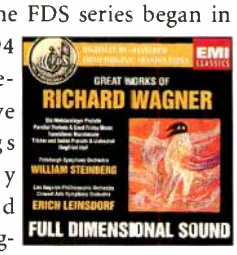
Along with RCA and Columbia, Capitol Classics made up the backbone of the first two-track tape releases (soon to be supplemented by Mercury and, later on, by Everest).

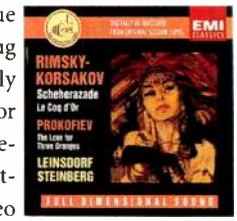
Capitol was ultimately bought by Electrical and Musical Industries of England. So far-flung were EMI's world holdings in the classical music business that many of Capitol's efforts paled by comparison. Eventually, Capitol Classics became the U.S. arm of Angel Records, and gradually, over many decades, Capitol ceased making classical recordings.



Selected items in the Capitol lineup have held their own in the worldwide EMI catalog, most notably a landmark recording of Shostakovich's Symphony No. 11, performed by the Houston Symphony and conducted by Stokowski. But for the most part, FDS's body of work has been largely forgotten, remaining unknown to a new generation of audiophiles and collectors.

Under the auspices of Angel, the rebirth of the FDS series began in March 1994 with the reissue of five recordings digitally transferred from the original two- or three-track master tapes. Some notable people were involved in the reissue project. Doug Sax, probably best known for his famous series of direct-to-disc stereo LPs and one of the industry's best mastering engineers, supervised the transfers of three of the reissues, while Richard King did two others. Michael Gray, who must know more than anyone else about the early stereo era, was in charge of recording research and provided more miking and setup information than any of the other companies that have embarked on reissue programs. Here you find dates, equipment, locations, personnel, and other pertinent session data, along with essays adapted from the original LP liner notes.



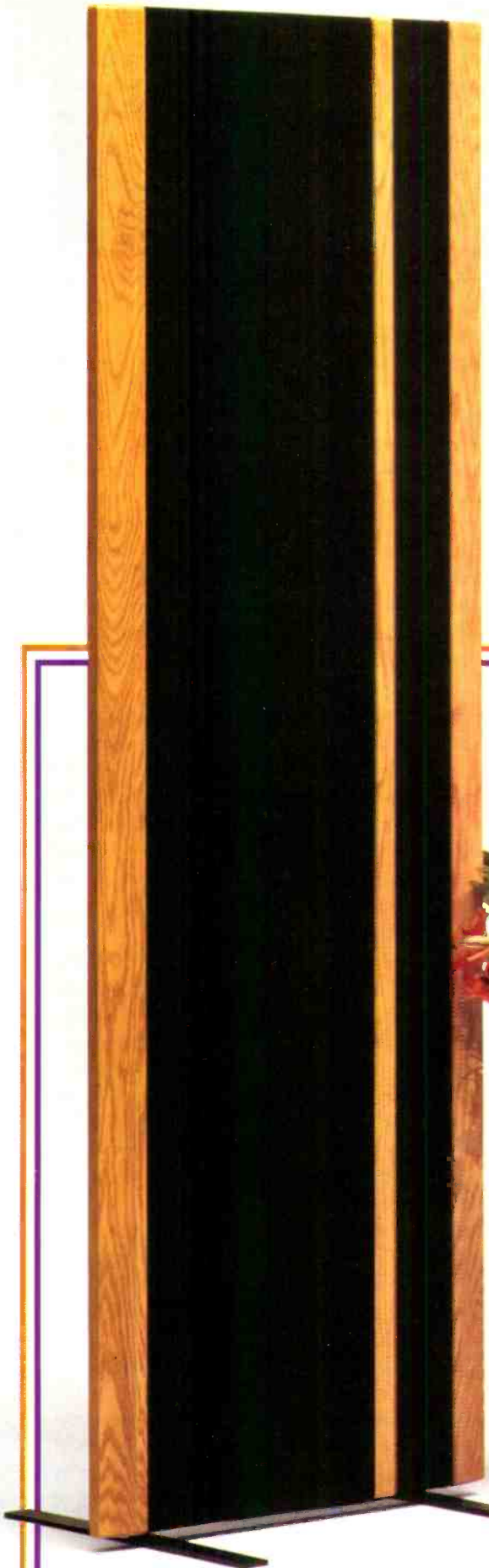


When the next five FDS reissues were released last November, it became apparent that Angel was intent on making this a significant program. Therefore, I contacted Robert E. LaPorta at Angel for more information about the project.

LaPorta, who joined Angel about a year and a half ago, has co-produced most of the FDS reissues with Anthony Caronia. LaPorta told me that the original idea for the program came up about five years ago, when Angel had completed its move from Hollywood to New York.

The 1994 Los Angeles earthquake delayed production of the second five reissues. A decision was made to consolidate all transfer and production efforts in one location, so all master tapes were sent to Squires Productions in Elmsford, New York; this way, approval cycles would be easier to meet.

An additional five CDs are scheduled for release this fall: Two titles each by Steinberg and Leinsdorf,



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* Stereophile, Vol.17, No. 3, March, 1994, Dick Olsher.

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plus Stokowski's famous *Orchestral Landmarks* album, in which each section of the orchestra is featured independently. Whether or not there will be more reissues down the road remains a question. Much will depend on Angel's marketing considerations—and, of course, the sales figures.

The following are thumbnail reviews of the first 10 FDS reissues. Off to a good start, I would say.

Borodin, Glinka, Mussorgsky, Ravel, and Tchaikovsky: *Orchestral Masterworks*, Pittsburgh Symphony Orchestra/Steinberg; EMI Classics CDM 65204 (recorded in 1958 and 1959). Taped at Pittsburgh's Syria Mosque. Fine sound and playing.

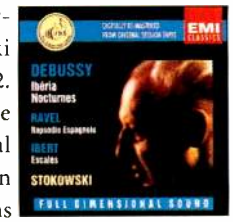
Various composers: *Portraits in Sound*, Concert Arts Symphony Orchestra/Leinsdorf and Capitol Symphony Orchestra/Dragon; CDM 65205 (1958). The sound is that of the typical Hollywood sound stage where this was recorded; it's on the dry side, but with ample early reflections. Excellent playing.

Shostakovich: Symphony No. 11, Houston Symphony Orchestra/Stokowski; CDM 65206 (1958). A famous recording that can musically hold its own against anything in the current catalog. Sonically, it bears up extremely well, reflecting the excellent acoustics of Houston's Jesse Jones Auditorium and the sound of one of our underrated orchestras.

Orff: *Carmina Burana*, HSO/Stokowski (1958); **Stravinsky:** *Firebird* Suite, Berlin Philharmonic/Stokowski (1957); CDM 65207. An excellent study in mike techniques: The Houston recording was done with spaced mikes, while the Berlin engineer experimented with the famous EMI "Stereosonic" Blumlein-derived, crossed figure-eight technique.

Wagner: *Great Works of Richard Wagner*, PSO/Steinberg and Los Angeles Philharmonic Orchestra & CASO/Leinsdorf; CDM 65208 (1956 to 1961). The ambiences of the Syria Mosque and Stage Seven at Samuel Goldwyn Studios don't readily mix, but the playing is what matters.

Debussy: "Ibéria," **Ibert:** "Escales," L'Orchestre National de la Radiodiffusion Française/Stokowski (1958); **Debussy:** *Nocturnes*, **Ravel:** Rapsodie espagnole, London Symphony Orchestra/Stokowski (1957); CDM 65422. You can hear some of Stoky's unusual orchestral seating in the London sessions for the *Nocturnes* and the Rapsodie. You can also hear what a fine, large recording space Abbey Road's Studio One is.



Holst: "The Planets," LAPO/Stokowski (1956); **Ravel:** "Alborada del gracioso," ONRF/Stokowski (1958); **Stravinsky:** *Petrushka* Suite, BP/Stokowski (1957); CDM 65423. A mixture of room ambiences and microphone techniques can be heard on this release. The Holst is outstanding, and the dry quality of the Goldwyn sound stage may even help with the musical delineation. The French and German recordings are made with coincident (not spaced) mikes, and accordingly they provide a somewhat more natural localization.

Rimsky-Korsakov: *Scheherazade*, CASO/Leinsdorf (1960); **Rimsky-Korsakov:** *Le Coq d'or* Suite, **Prokofiev:** *The Love for Three Oranges* Suite (excerpts), PSO/Steinberg (1957); CDM 65424. Leinsdorf and forces pull off the better part of this mixed collaboration, but they could sure use some of the ambience of the Syria Mosque.

Debussy: "La Mer" (1957), **Ravel:** *Daphnis et Chloé* Suite No. 2 (1957), **R. Strauss:** "Death and Transfiguration" (1961); LAPO/Leinsdorf; CDM 65425. All of these recordings were made on Goldwyn sound stages, and all of them could use more ambience. On the plus side, the well-schooled Los Angeles Philharmonic handles the music with ease, and Leinsdorf knows what to do with it.

Various composers: *The Art of Virgil Fox*; CDM 65426 (1959 to 1962). On the Aeolian-Skinner organ of Manhattan's Riverside Church, Fox plays familiar classics, most of them transcriptions of orchestral works, as only he could. Good sound with a real subterranean low end. The CD packaging is first-rate, including the organ-specification listings (unheard of in most reissues) and informative session notes by Robert Hebble, who assisted Fox at all of the sessions. A

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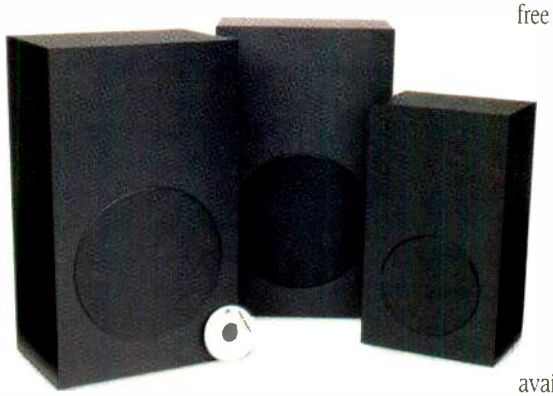

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IVAN BERGER

WALKMANNIVERSARY: SWEET SIXTEEN

Sony's WM-EX1: Smaller, better, and 16 years newer.

To those of us who can remember a world without the Walkman, it may come as a surprise that it's been a decade and a half since Sony introduced the first one—16 years, actually, since it first appeared, in 1979.

We almost didn't know it by that name at all. The product was introduced to the U.S. press under the name of Soundabout, but Sony decided to use the now-familiar name the product carried in Japan. The original model, the TPS-L2, cost $199.95, measured 5⅜ x 3½ x 1⅞ inches, weighed 13.8 ounces, and played for eight hours on a set of batteries. Some of the press saw it for the revolution it was. To others, it seemed like an ordinary pocket tape recorder with its record circuits removed. (It even had a microphone, though pressing the big orange button atop the TPS-L2 sent the mike's signals to the earphones, not the tape.)

Few companies have done as much by adding features as Sony did by removing a few. Since then, 120 million Sony units in 200 different models have been sold—not to mention the millions of similar personal portables available from other companies.

To celebrate the anniversary, Sony has introduced a commemorative model, the WM-EX1. Costing $249.95, it is considerably smaller than the original Walkman, measuring 3⅛ x 4⅜ x ¾ inches and weighing only 5.6 ounces. It also has far longer battery life than the original, playing for 12 hours on each full charge of its nickel-metal-hydride (NiMH) battery, and is able to play for two hours after a mere five-minute charge. An AA alkaline battery lets it play for 24 hours, and the two types of battery can be teamed up to provide a total of 36 hours of uninterrupted playback.

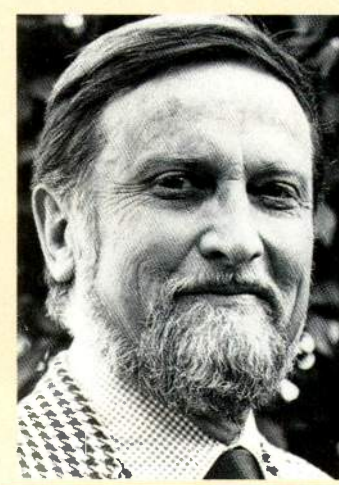
There are also, of course, new features on the WM-EX1. A sliding shutter keeps controls from being accidentally activated, and a basic-function remote control with LCD readout is built into the headphone cord. Correct equalization for normal or high-bias tapes is selected automatically, and intro scan can be used to play the first 10 seconds of each track.

Coda: William H. Thomas

William H. Thomas, a founder and for many years the chief executive officer of James B. Lansing Sound, died on February 28th, at the age of 82. In 1946, he helped loudspeaker pioneer Jim Lansing found JBL. Shortly thereafter, when Lansing died, Thomas inherited the legacy that he was to nurture for some 2½ decades.

Educated as a physicist and groomed as a businessman in the aeronautics industry, Thomas was able to build upon Lansing's work in sound propagation theory. Among those who aided him in applying innovative technology to loudspeaker design was his friend, the late Bart Locanthi.

In 1969, Thomas arranged the sale of JBL to Harman International, headed by Sidney Harman, a longtime industry friend. Thomas then retired and devoted himself to his ranch in Ojai, California, where he died. *Robert Long*



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Tape Rot

Although record companies do not publicize the fact, or even admit it, the new masters for a CD reissue will sometimes now be cut from a pressed CD saved from the first issue. This will happen more and more often in the future.

Tapes, especially from specific production periods, are quite literally rotting in storage. No company has the time and resources to keep checking every spool, every year, and copying any tapes that show early signs of degradation. By the time the rot is discovered, it may be too late to stop it.

Five years ago, the recording-industry grapevine had it that engineers were taking analog tapes from storage and hearing a mechanical squealing noise as they ran through the machine. The recorder then slowed down and eventually stopped, stripping the magnetic coating off the plastic backing. Many of the first "sticky" tapes had been made by Ampex in the period from 1972 through 1984.

Ampex warned that all tape companies used similar chemicals, and very reasonably pointed out that Ampex was in the spotlight only because most studios use Ampex tape. Record producer Gus Dudgeon hit the problem with some of Elton John's master tapes. Other engineers had trouble, one as early as 1983, with tapes of various brands recorded by Bob Marley in Jamaica. Nick Griffiths found master tapes of *The Wall* had gone sticky when he took them from the vaults to stage Roger Waters' live show in Berlin.

Stickiness is caused by hydrolysis (water reaction) of the polyurethane binder used to bond the magnetic oxide coating to the polyester base film. The water comes from the air in storage areas that are not air-conditioned. The polyurethane acts like a sponge, and hydrolysis breaks long-chain plastics molecules down into viscous liquids. After 1984 Ampex insisted on more stable varieties from its chemical suppliers.

When the news of "sticky tape" broke, 3M and Agfa also admitted similar problems. BASF claimed its tapes were safer because it did not use polyurethane binder.

The recording industry has no rights of redress because tape manufacturers always recommend air-conditioned storage, and the record industry routinely cuts corners.

Ampex discovered, in late 1987, that baking sticky tape (at 55° C and 10% to 15% relative humidity for a day) temporarily reforms the binder. Engineers then have a month to make a safety copy onto a new tape. Ampex began baking sticky tape as a free service to past customers. Agfa (now owned by BASF) developed a similar baking system, and IDT of Riviera Beach, Florida now uses it to provide a transfer service, at commercial prices.

Five years ago Ampex made the reassuring announcement that videotapes, as used to store digital masters, were less likely to degrade than analog open-reel tapes, because their coating layers are thinner and thus act less like a sponge. But there are now signs of similar problems with U-Matic videocassettes, as used to store digital audio master recordings. There is no pattern yet of which tape brands are affected.

The University of Minnesota's Charles Babbage Institute (CBI) runs the Center for the History of Information Processing. In 1993 the CBI found that U-Matic videocassettes recorded in 1981, which were still playable in 1990, had suddenly deteriorated to the point of refusing to play. The tapes shed sticky gunge, which clogs the heads within a few seconds. The Institute took advice from the University of Minnesota's Media Resources Center and could find no published work on sticky videotape. The CBI then tried baking the tapes, in an oven, but they still would not play.

Illustration: Beata Szpura

The CBI solved its immediate problem by finding another copy of the same tape. "The episode . . . is particularly disturbing because it indicates that videotape barely 12 years old can become unplayable," says the CBI.

Since the CBI's discovery, the Medical Research Council (MRC) in the U.K. has found that 168 out of 200 data tapes from the 1980s were sticky. The MRC and other users have found that a drip feed of isopropyl alcohol can make the tape playable for copying.

A spot check through one professional recording engineer's store showed that of 10 U-Matic CD master tapes made in the early '80s, six would neither rewind nor play; they just stuck solid in the machine. Four more showed very high error-correction rates. In such cases, remastering from CD pressings is by far the safer, quicker, and cheaper option.

In this test case, storage conditions were not ideal and certainly not within the tape manufacturer's recommendations. Again there would be no legal redress. But less-than-ideal conditions are typical of the record industry.

The record companies must now hope that their stock copies of pressed CDs do not degrade in storage. *Barry Fox*

Brief Notes Brief Notes Brief Notes

•This past season's National Football Conference games were transmitted in Dolby Surround on the Fox network. Why surround, when all the action takes place in front of the viewer? To envelop the audience in cheers and other stadium sounds, increasing the "you are there" effect.

•Vending Intelligence, of Universal City, Cal., has developed a CD vending machine that lets you briefly audition any of the 48 titles it holds. The machine holds 1,000 discs and accepts payment by cash, credit card, or bank ATM card. The machines are now in use in some California grocery stores that also handle general merchandise.

•Want to build your own speaker system from scratch? A book with plans for seven speaker systems of assorted complexity is available free from Audax of America. Written by Vance Dickason, author of the *Loudspeaker Design Cookbook*, the book includes response and impedance curves for each design. Contact Polydax by calling 508/658-0700 (fax: -0703), or write them at 10 Upton Dr., Wilmington, Mass. 01887.

Klipsch Clipping

Dear Editor:

As someone very interested in audio history, I enjoyed Edward Tatnall Canby's "Audio ETC" in the May issue. I would like to, however, clarify some points raised about Paul Klipsch and his speakers.

The Klipschorn is a large speaker, but it protrudes diagonally from its room corner only about 30 inches (okay, only slightly less than an "acre"). The first Klipschorn and those built today are the *same* size.

From the beginning of regular production in 1948, the K-Horn has been an integrated driver/enclosure package. This approach may have been rare in the days after World War II, but not unknown. And the Voigt corner horns from England were integrated consumer products in the 1930s!

When stereo program material for the consumer appeared, Paul Klipsch had already been promoting it for several years. He had designed a "rebel" speaker (small corner horn) that would fit in the back seat of his airplane, so he could carry it to a dealer having a "mono" K-horn and demonstrate stereo with his own recordings.

In 1957, Klipsch designed the Heresy as a *center channel* for use with stereo K-Horns. This three-channel approach was a revival of Bell Labs' practice of the 1930s. Home theater, anyone?

Jim Hunter, Engineering Manager
Klipsch
Indianapolis, Ind.

Manuals Wanted, Data Offered

Dear Editor:

I've been a subscriber to *Audio* since I graduated from college in 1963, and I have all the back issues to that time. I'm primarily interested in playing and enjoying "historic" recordings.

I have become interested in the various noise-reduction systems that were available a few years ago. Specifically, I am looking for manuals on the dbx Model 3BX Series III three-band dynamic range expander, with "impact restoration," and the dbx Model 007 "program route selector." Also, I'd like to correspond with anyone who has experience using the above items, as well as the Teac AN-60 Dolby noise-reduction unit with a reel-to-reel tape recorder, plus anyone with experience in copying 78-rpm records using enhancement techniques.

I have a library on radio and electronics and can supply data from Day One to the early '60s—maybe later. I can supply data on not only old radios, but also tape and wire recorders, hi-fi, and test equipment. Please send an SASE with any requests.

Gary A. Micanek
226 Henry Ave.
Manchester, Mo. 63011

Sony Parts Wanted

Dear Editor:

I've been looking for parts, accessories, reviews, and manuals for Sony and Sony Esprit (ES) equipment, circa 1977 to 1982, such as the TA-N900 mono power amp, TA-N88B stereo power amp (mentioned on page 45 of your February issue, in Bascom H. King's "Switched-on Amps: Power with a Pulse"), ST-J88B FM tuner, TA-E88B preamplifier, TC-K88B cassette deck, and PS-X75 turntable with Biotracer tonearm.

For the TA-N900 amp, I need a top cover, four rack mounts (2¾ inches high x 1 inch wide), a TAC-90 wooden cabinet, and an FW-90 sound base. For the TC-K88B cassette deck, I need a pinch roller (X3565-40400), a belt (356579800), a take-up clutch motor (83500500), and remote controls (RM-50, RM-65, RM-80).

I'm also trying to find a Sony Esprit TA-D88B electronic crossover and a PS-X800 turntable to complete my system.

Macgregor Small
8 Bellside Dr.
Markham, Ont., Canada L3P 7B8

Editor's Reply: By the time you read this, you should have received copies of reviews we did on the TA-N900 amp (June 1983) and the PS-X800 turntable (December 1981). As for the other items you desire, we're printing your letter and address in the hope that some of our readers will contact you with more information.—*K.R.*

Erratum: Amp Project

Dear Editor:

Dr. Norman E. Thagard's "Build a 100-Watt, Class-A Mono Amp" (January, February, and March) is just in line for a project I am considering, namely a self-powered subwoofer. In reviewing the schematics and the parts list, I seem to be missing a section in the output stage area. The items are resistors R27, R35 to R38, R66 to R68, and R101 and R102; diodes D1 and D6 to D9; capacitors C7 and C101 to C104; zener Z101; and Q22, Q23, and Q36 to Q47. These all seem to be on one end of the circuit board. There are also two resistors labelled R33: One seems normal size, but the lower one is very large, as if it was mislabelled.

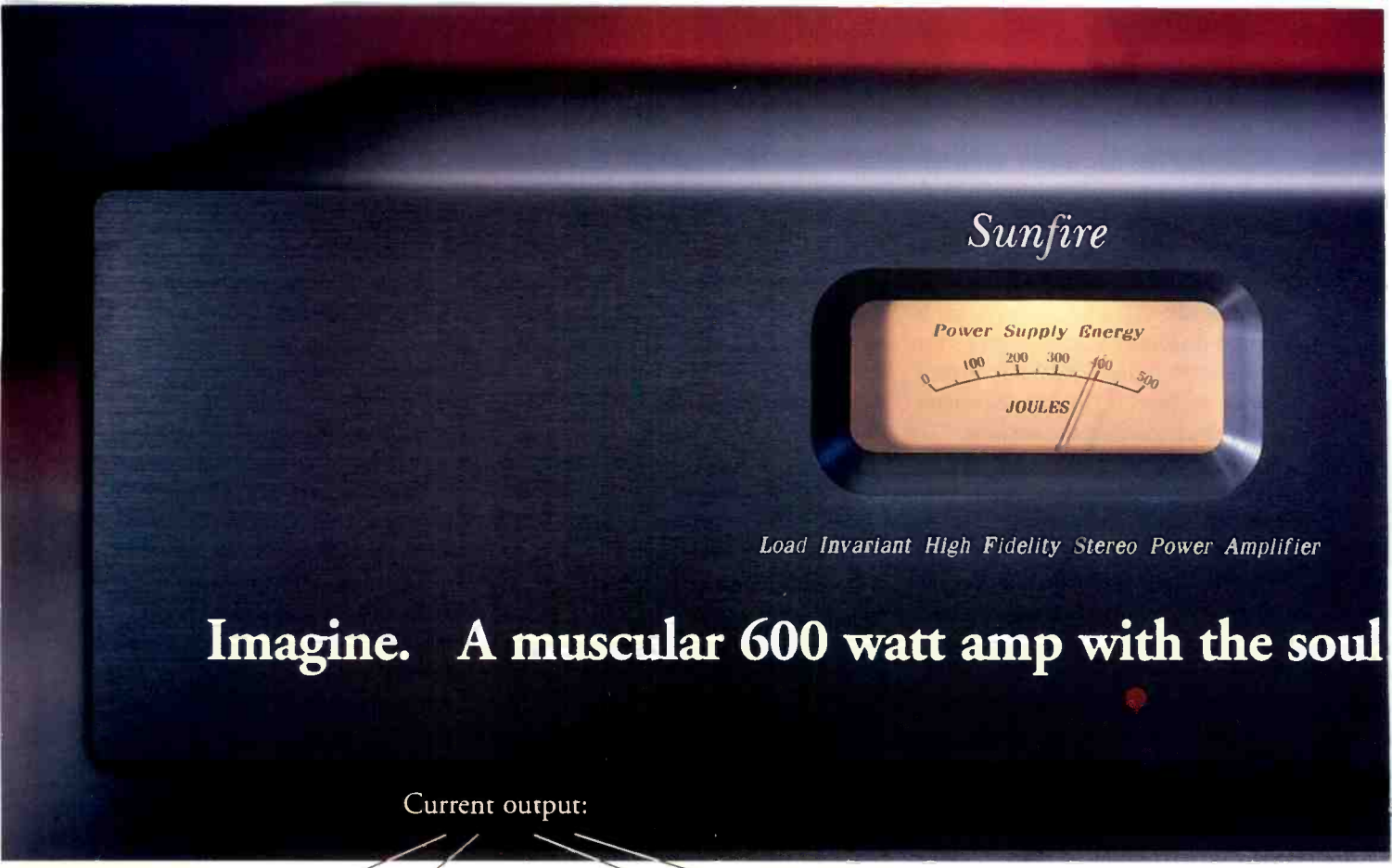
I hope you can help. I'm not great at reading these things but felt that something was missing.

Leonard Shedler
Folsom, Cal.

The Editor-in-Chief's Reply: Thank you for your note. You are the first to point out the error of the two resistors labelled R23 (not R33, as mentioned in your letter). The large one, at the bottom of the front-end board in Fig. 4A (March), is actually R27. It mirrors the R28 at the top of the board and is a 2-watt resistor, as opposed to the 0.25-watt resistors used elsewhere.

Insofar as the other items go, they are hand-wired in between the major boards (or elsewhere) for which we gave patterns. While you might use Vero-board, some of them you might just let "hang in space," so long as you've got them in the right part of the circuit. However, I think you are expecting that there is a board location for all of the parts, which isn't true. Refer to the schematics in Figs. 1A (January) and 2 and 3 (February) for the locations in the circuit of the other parts.

We hope to offer kits combining the boards and various groups of parts. It seems this is one of your first projects, and if my inference is correct, then I suggest you be very cautious about this, as it is easy to go astray. I think, too, that there may be commercial amps that are better for your subwoofer add-on, ones at least as cost-effective.—*E.P.*



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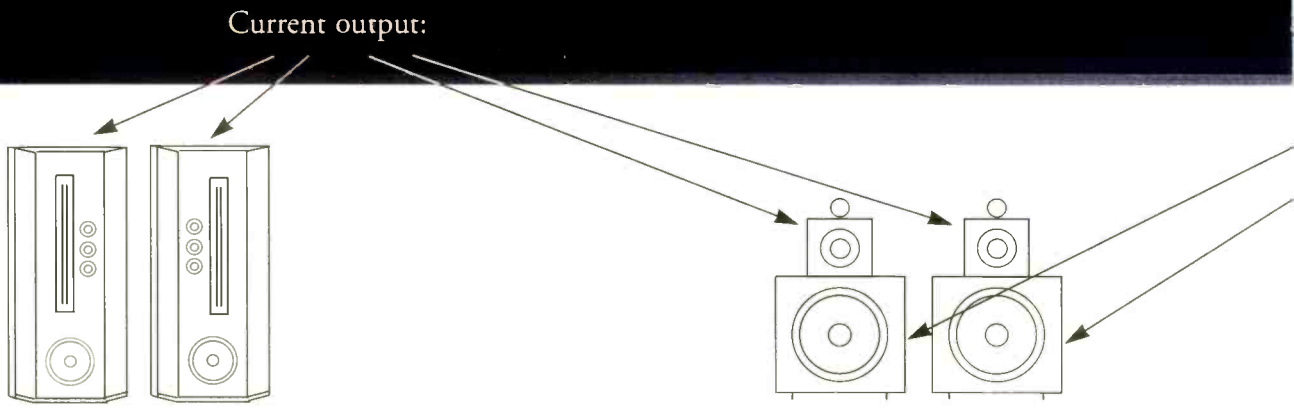


The new Sunfire stereo amp: sonic magic by Bob Carver.

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) property of a triode -- the very property that is *the* dominant factor (perhaps ninety percent) of the sonic magic that makes listening to classic vacuum tube amplifiers so much fun. So when you choose our current-source output connections for your system, you'll have a sumptuous high end, and a midrange that positively glows.

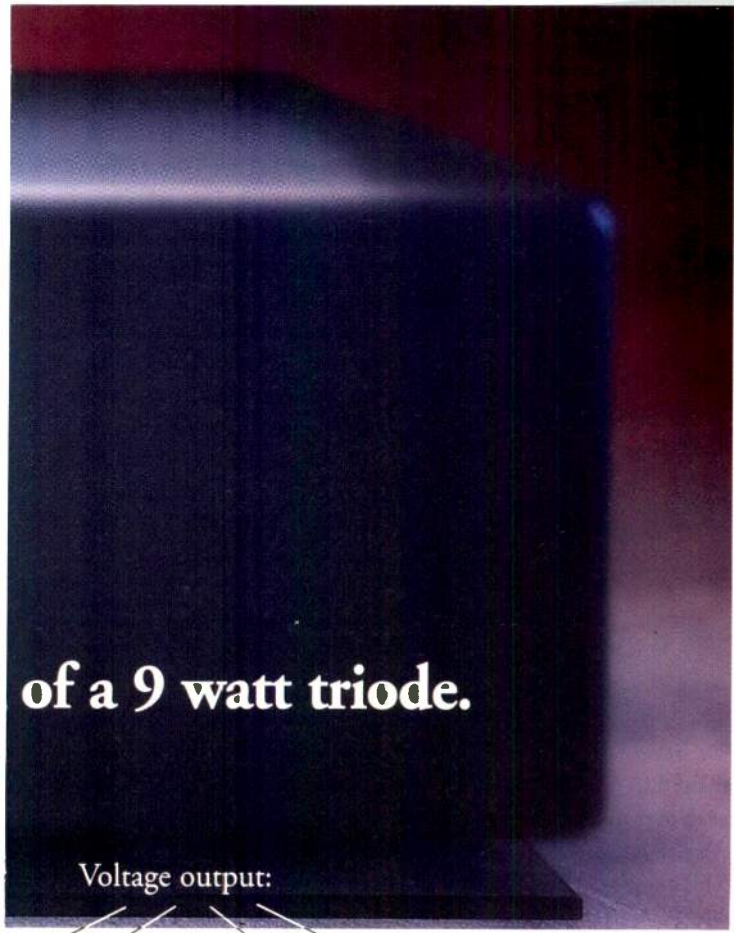
At the same time, the new Sunfire amp, with its uncanny tracking downconverter, has the ability to raise goose bumps with its awesome power. Using 12 herculean International Rectifier Hexfets, it can drive *any* load to *any* rationally usable current or voltage level.

A choice of outputs.

You can connect most speakers to the voltage-source

Sunfire Corporation

.....from the mind & soul of Bob Carver



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 biwire, you may just arrive at the best possible interface: voltage output to woofer for incredible bass whack, current output to midrange and treble for a huge three-dimensional soundstage with detail retrieval so stunning that you will often hear musicians *breathing*.

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 it will 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 for over twenty years with both tube and solid state designs, and he understands the intrinsic subtleties of each.

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 1 ohm on a time-limited basis. Courtesy of 24 massive Motorola triple-diffused output devices, each capable of 20 amperes without taxing current reserves.

Imagine all that in a single amp. Or better yet, visit a Sunfire dealer. That's where you'll hear for yourself how it all comes together.

Price: $2,175

Dealer inquires invited. (206) 335-4748 Ask for Bob Carver.

* F.T.C.: 300 watts continuous per channel, both channels driven into 8 ohms from 20 Hz to 20 kHz with no more than 0.5% THD

Inputs are gold XLR balanced and gold RCA standard.

For more information on the Sunfire, and especially the uncanny tracking downconverter, use the reader service card or write to Sunfire Corporation, PO Box 1589, Snohomish, WA 98290

ROAD SIGNS

IVAN BERGER

A FINE MES

AudioControl's System90 Model 50 turns a factory head unit into an amplified system.

While not as well known as the Consumer Electronics Show (CES), the Mobile Electronics Show (MES) gives me a great opportunity to catch up on car stereo gear I miss in the hurly-burly of the Winter CES (which is more than 10 times as big), learn of post-CES introductions, and actually look at some of the manufacturers' sample installations.

This past April, MES was held in Philadelphia's pleasant new Convention Center. Appropriately for the Show's first year under the sole auspices of the Electronic Industries Association (EIA), the big news came not from exhibitors but from the EIA itself: The Association announced a plan that it hopes will triple the number of U.S. stations using the Radio Broadcast Data System by equipping them with RBDS encoders. The other news from the EIA was that it has now taken over the Mobile Electronics Certification Program (MECP). This program administers examinations to mobile equipment installers, certifying their expertise at several levels and in three specialty areas (auto sound, cellular phones, and security).

Kenwood's KRC-901 head unit modestly hides its face when you're not playing it.

Prowling the floor, I had a chance to look not only at equipment but at installations. Since the MES is attended mostly by car installers, the emphasis was on the practical instead of the spectacular. As Robb Limbaugh of Polk pointed out to me, "People who lease their cars need a 'stealth' installation that will leave no holes when the time comes to return the car." The system in Limbaugh's Eagle Vision had Polk ES speakers in the car's stock locations (though the 3½-inch "full-range" drivers in the dash were replaced with tune-up tweeters to raise the image and soundstage). The subwoofers were in a box wedged tightly behind the rear seat but removable for cargo. The factory stock head unit was replaced with an Alpine ("which made a large difference in the sound," Limbaugh said). Its output fed two Linear Power amps in the trunk, through wires simply run under the car's carpet. The amps were mounted to a wood base, which was secured to a crossmember by screws; the carpet will close up over the screwholes when the amps are removed. Trim panels were made of fiberboard ("and cardboard," laughed Limbaugh), covered in fabric to match the trunk's liner. The result looked built-in but will readily come out.

PEOPLE WHO LEASE CARS, INSTEAD OF BUYING THEM, NEED "STEALTH" STEREO INSTALLATIONS.

AudioControl also had a stealth installation, in a Pontiac Bonneville SSEI. The Pontiac's stock head unit, with controls on the steering wheel, was left intact. However, its speaker outputs were fed to a System90 four-channel amp/equalizer/crossover in the trunk; System90 units can accept inputs of up to 5 V, allowing them to be driven from speaker outputs such as these. With the System90, there was sufficient power to drive better sounding but less efficient speakers, again located in the factory positions.

Along these same lines, KEF had an installation in a Honda SRS, using KEF Uni-Q speakers in the factory locations, plus a pair of its 10-inch free-air subwoofers mounted under the rear deck. While not quite a "no-hole" installation, the only modifications required were perforating the rear deck in a neat pattern for the subs and reinforcing that deck with medium-density fiberboard (MDF). "If you've leased the car, you could leave the MDF in place when you return it," said KEF's Joel Rosenblatt. "And you don't have to turn your trunk into a ninth-order multibandpass enclosure or fill it with a box that takes away your trunk space." The Uni-Q car speakers (available in 5¼-, 6½-,

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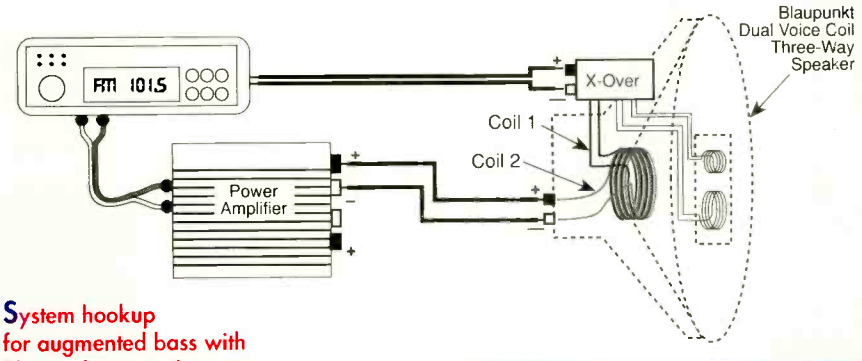

System hookup for augmented bass with Blaupunkt's new three-way speaker.

and 6 x 9-inch sizes) allow both a midwoofer and a tweeter to be mounted in a car's factory speaker cutout, without the time-coherence problems that are known to afflict regular coaxials or systems that have separate tweeters. The sound is smoother with the Uni-Q systems, according to Rosenblatt, "though the factory locations don't let you get the kind of imaging you do with separates."

Another Honda installation, this time in a Del Sol, was the subject of a multiple-choice guessing game at the Jensen booth. Listeners were asked what kind of equipment they thought was in the car; the questionnaire (and the sound) implied the presence of multiple large subwoofers, sub-bass synthesizers, equalizers, and the like. The correct answer was . . . none of the above. The system used a Jensen in-dash CD player, two stereo amplifiers with built-in crossovers, upgraded speakers in the stock locations, plus an 8-inch Jensen woofer that was housed in a fourth-order bandpass enclosure built for this car. By setting the gain of the amplifier's subwoofer channel high, Jensen ensured that the bass would have all the whoomp it needed. Deep fundamentals weren't there, but your ear fools you when you hear the harmonics—especially on the road, where road noise would mask those fundamentals anyway. The installation, by Jensen engineer Phil White, included a Hafler (L – R) connection to the rear speakers, for extra spaciousness and to help keep the image up front.

Blaupunkt's contribution to stealth installation at the MES was the VPD-693, a 6 x 9-inch three-way speaker whose woofer has dual voice-coils. By feeding bass from a separate amp to the second voice-coil, an installer can extend and enrich the speaker's bass output. If the second voice-coil is fed front-channel bass, then bass response will still be slightly augmented and won't grow weak when the sound is faded to the front channels, whose speakers are normally smaller.

Kenwood applied the stealth concept another way. Its KRC-901 and KRC-801 cassette receivers have featureless covers that automatically hide the front panel when the system's not in use. A

TRAVELLERS' AIDS

As mentioned in my story on the Mobile Electronics Show (MES), the Electronic Industries Association (EIA) plans to equip 500 FM stations, in the 25 largest U.S. markets, with encoders for the Radio Broadcast Data System (RBDS). The EIA will swap the encoders for $5,000 worth of advertising time per station, and will use the ad time to inform listeners about RBDS. (But will they explain why radios designed to decode RBDS signals are marked "RDS"?)

Photo: Archive Photos

Denon, which has been lavishing encoders on Public Radio stations, will help fund the program, as will Delco Electronics (the world's largest car radio manufacturer) and Pioneer. The participation of Denon and Delco is no surprise, as they're the major purveyors of "RDS" radios in this country (though Grundig makes RDS portables, Onkyo has RDS receivers, and Philips Car Systems has RDS car radios). But Pioneer, which does sell RDS radios in Europe, does not yet sell them here. At the MES, Pioneer nevertheless did exhibit a European model whose only noticeable difference from the DEH-P815 sold here (and tested in this issue) is the use of RDS instead of ID Logic.

Both RDS and ID Logic help you find stations by format, even while you're travelling. An RDS radio identifies stations by special subcarrier signals; an ID Logic radio identifies them by checking an internal database. Naturally, RDS can only identify stations that carry its subcarrier signals, and it can't identify AM stations at all. But it automatically corrects for changes in station call letters or formats, and can carry such real-time information as traffic or emergency announcements. The ID Logic system only works if you tell the radio your current (or initial) location. It can't update itself when station names or formats change, but it can work with all FM, AM, and even shortwave stations. The RDS Standard therefore includes provisions for combining both systems in one radio (with RDS setting the ID Logic system's location points and updating its database, while ID Logic handles AM). However, I know of no manufacturer that actually has done this.

In Europe, RDS is *very* big. Car radios with RDS are available from most of the major OEM and independent makers, all of whom can and will bring their RDS technology over here as soon as they feel the market's ripe. (About 300,000 RDS car radios are already out on U.S. roads.) The system is used by broadcasters in at least 16 European countries, with about a half dozen more due soon. And quite a few car makers (including Audi, BMW, Fiat, Ford, Jaguar, Mercedes, Opel, Porsche, Saab, Volkswagen, and Volvo) offer factory-installed RDS radios.

SOUND CHECK

Alan Parsons & Stephen Court

The Professional Audio Test Disc

Mastered by Mobile Fidelity Sound Lab

Sound Check was designed as a universal tool, one which *anyone* with a serious interest in sound—whether amateur or professional—would find beneficial and easy to use.

Originally released in Europe in 1993, *Sound Check* is now considered an indispensible aid by sound engineers, record producers, hi-fi enthusiasts, musicians, broadcasters, equipment installers, sound reinforcement personnel—the list goes on.

What's on the *Sound Check* disc? A total of 92 essential tracks in all: Test tones—yes—but also dry, unprocessed instrumental and vocal recordings, sound effects (one or two of some repute—the *Chieftain Tank* recording brought down the ceiling at one demonstration), some of the best-sounding finished products to be found, along with utilities like time code and a musical tuning reference.

Sound Check is available at your local record, audio and hi-fi store. To locate a dealer near you or, if you prefer to order direct, call 1.800.423.5759

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- Alan Parsons & Stephen Court

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KEN KESSLER

CHINA'S AUDIO REVOLUTION

A shop-lined street in Pan Yu, the wholesale audio district of Canton.

Witnessing a revolution—heavy-duty stuff for one whose misspent youth involved being part of one. A mere 10 days in the People's Republic of China was enough to convince me that something's happening there, and what it is ain't exactly clear; I'm still reeling. And however much future sociologists might want to conclude that a strong communist (with a small "c") element featured heavily in the "revolution" of the 1960s, they'll be hard pressed to ignore the utter rejection of it by the Chinese in the 1990s. The Chinese want *toys*, and there's no stopping them.

My—what?—*hundredth* hi-fi show took place in Canton, admittedly one of the more liberal cities in mainland China. Still, nothing could prepare me for the force with which China is poised to enter the 20th, if not quite the 21st, century. Nearly 1½ billion possession-hungry citizens, more than adequate cash from who knows where, a lust for Things Western: Levis, mobile phones, Swatches, and yes, even hi-fi. Drab is out, and China is going to be a market like no other. But let me try to give you some impression of the size of what might be the hi-fi market in China for the balance of this decade.

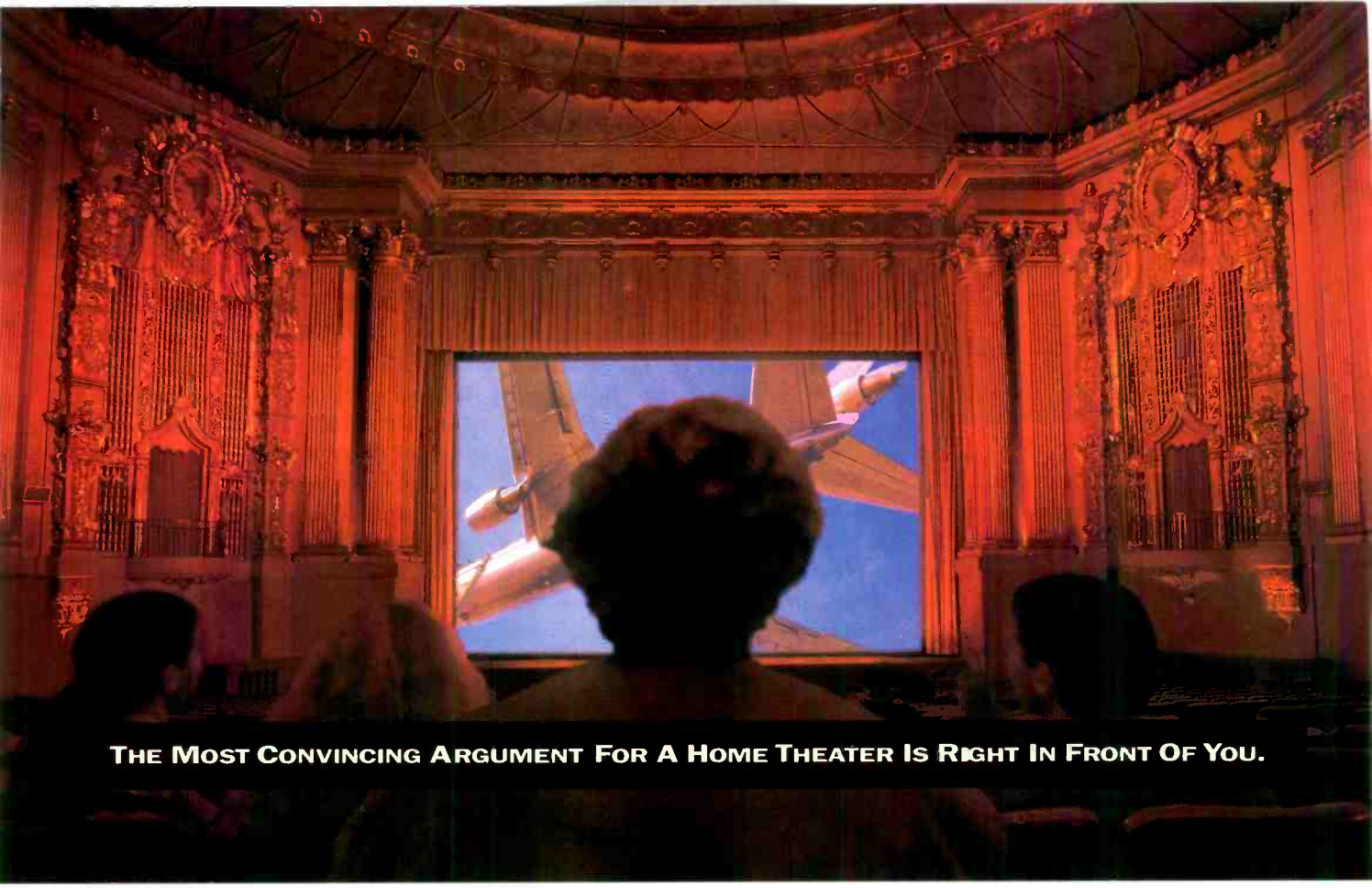
DRAB IS OUT, AND CHINA IS GOING TO BE A MARKET LIKE NO OTHER.

Guangzhou (Canton) hosted the Guangdong International Radio Music Festival '94, China's first-ever all-comers-welcome hi-fi show. Nearly all of its predecessors over the past few years were distributor- or retailer-sponsored and, by definition, featured only a few brands. This festival was, as its full name suggests, truly international, and it attracted enough foreign and local manufacturers and distributors to fill four floors and just under 100 rooms, with one floor devoted to CDs (and a few LPs). That's nearly the size of a specialist-hi-fi hotel at a Consumer Electronics Show.

Better still—if you find tatty, mass-market consumer electronics gimmickry a turnoff—the Guangdong show consisted solely of hi-fi exhibitors, with just traces of home theater and karaoke. It was utterly free of the filler that makes the world's major shows such a chore for hacks lacking any interest in frippery: No cordless phones, no games consoles, no car stereo, no computers. And just to show you exactly how *unjaded* is the Chinese public, the show attracted more than 100,000 visitors. No trade visitors worth mentioning, just *members of the public.* One estimate, probably not all that optimistic, put the number at close to 180,000. Crowded? *Crowded?* I know certain Western show sponsors who'd sell their first born to attract numbers on that scale.

Typically, the arrogance/ignorance of Westerners meant that the number of foreign manufacturers supporting the show with an actual staff presence was minimal, with only the Americans having anything resembling an excuse: The show conflicted with Thanksgiving, and even Europeans who have no idea what Thanksgiving means or commemorates knew that something *serious* kept the Americans away. (Actually, it's a lot of fun, every November, telling my adopted compatriots that 250 million Americans celebrate *escaping* from the United Kingdom.)

As for the rest of the world's hi-fi producers, their failure to support this crucial event might cost them



You've waited in the rain, paid your seven bucks, bought your real buttery-flavor popcorn and snagged the best seat in the house. When somebody decides to sit in the second best seat in the house. You know, of course, the solution is to create the ultimate theater in your home. And as anyone will tell you, a truly moving theater experience is built around sound even more than the picture. But not just any sound. Parasound. You see, we've built our company around the notion that a person shouldn't have to spend a fortune to hear the finest that technology has to offer. And now that we've applied that principle to home theater, the cinematic experience will never be the same. Just look at our remarkable new Dolby Pro Logic® Surround Processor. It combines a high-end preamplifier with all the features that even the most fervent audiophile turned movie buff could ever want. We also offer the widest variety of THX®-certified and six channel amplifiers available, as well as the most powerful and most accurate subwoofer on the planet. So to hear audio that's well above the crowd, head to your nearest Parasound dealer or authorized custom installer. And let someone else deal with the spud with the big head.

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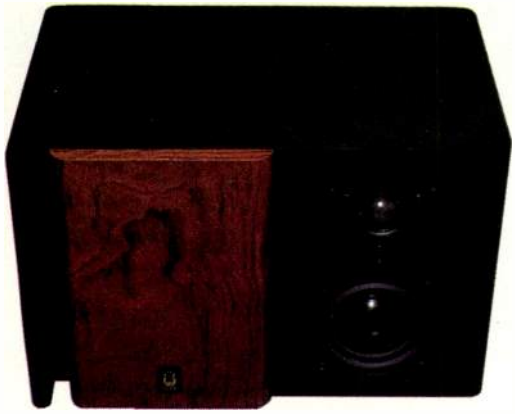

Gospel's Muse B50 CTL speaker.

dearly; it looks like the Chinese market will be secured on a first-come, first-served basis. The Chinese people, having been isolated from the rest of the world for decades, really did appreciate the effort made by those who visited the show, and the brands involved will benefit directly from the personal appearances by their principal players. Hell, Chinese radio and television reporters even interviewed *me*, a lowly scribbler, which should tell you just how desperate they are for news from abroad.

Despite the quasi-virginal state of the Chinese market, its audiophiles have a lot to learn if they're not to be ripped off by slippery merchants selling completely bogus equipment. In both the wholesale and retail equivalents of Tokyo's Akihabara district—Hi-Fi Central, so to speak—any

WHAT DAZZLED ALL FOREIGN VISITORS WAS A FLOOR FILLED WITH CHINESE TUBE-AMP MAKERS.

Westerner will be overwhelmed and disturbed by the profusion of outright fakes, parallel imports (lacking any form of guarantee, of course), obsolete gear, and, well, *rubbish*.

Pan Yu consists of a couple of streets lined with tiny shops, some of which are legitimate retailers selling surprisingly costly high-end components, alongside sleazy operations filled with what looks like the unsalable audio detritus of Hong Kong: Infinity speakers from the days when Arnie Nudell was at the helm, being sold as brand-new, and a slew of Japanese and British electronics so old that they lack inputs marked "CD." Less dubious were floor-to-ceiling stacks of TV sets and LaserDisc players for the vast karaoke market, as well as incredible amounts of pro equipment, such as mixers and PA-level loudspeakers. What's it all for? I can only shudder at the thought of more karaoke bars, mobile discos, and the like. . . .

Why so much karaoke? Simple: The government still restricts the flow of imported films and music. Those A/V karaoke discs that feature approved Chinese performers, though, are okay, making this Japanese cultural export one of the few forms of entertainment available on a completely intervention-free basis.

According to well-informed industry insiders, Pan Yu's 350 shops move in excess of 2 million Hong Kong dollars worth of gear, day in and day out, or approximately $250,000 worth of hi-fi hardware at *wholesale* prices. Or more than $75 million per year, on those two streets alone.

The glossier, retail alternative to Pan Yu is the brand-new Golden Hoi Yan Electrical Plaza, a modern, two-story hi-fi mall also containing both legitimate high-end establishments and seedier outfits selling cheap knockoffs. The lack of respect for trademarks is blatant: "Aiwa" becomes "Anwa," "Sony" becomes "Suny," "Technics" becomes "Tenoaics." I even saw a rip-off of a B & W speaker that doesn't actually exist in B & W form; it was more of an "impression" of a B & W.

How can these obvious surrogates be marketed so freely? Alas, intellectual property still seems too abstract a concept for many in the Far East. And the appeal is not just because of price (e.g., $550 for a pair of pseudo B & W 800s). As for the hoodwinking, well, think about how easily you'd be scammed if you were shown two Chinese products and only one letter was changed in the name (assuming that you don't read Chinese, that is). Would you know which product was genuine and which was a fake? Apparently, English characters look just as alien to the Chinese who don't read English, despite the far less ornate nature of English lettering, so a change from "Aiwa" to "Anwa" is an effective bluff.

There is, however, an undercurrent of righteous indignation, especially among the high-end distributors in partnership with Hong Kong-based importers, and they're opening their own high-end shops. Encore Electrical, for example, distributes Harbeth, Restek, Proton, and others, and it owns shops in both Pan Yu and Golden Hoi Yan. If you know a distributor's range, you can pretty much identify who owns which shop—not unlike the situation in Hong Kong. As well as traditional selling methods, such as switching comparators that control 50 or more pairs of speakers, Encore has lavish showrooms with proper speaker demonstrations, designed to sell real high-end systems.

Silsonic's SAP-50T integrated amp.

With the majority of goods on sale in China being imported—and the major Japanese companies have wasted no time in establishing themselves before everyone else—it was no surprise to find that the top three floors of the show were filled with Western hi-fi equipment. Brands seemed to do well according to their presence in Hong Kong. This is not surprising, since Hong Kong seems to be the conduit between the West and China. And the media representatives I met mentioned a preference for ProAc, Harbeth, ATC, and anything connected to the BBC. Infinity, JBL, B & W, and Bose appeared to have the initial grip on mass-market loudspeakers. Electronics? The Japanese, of course.

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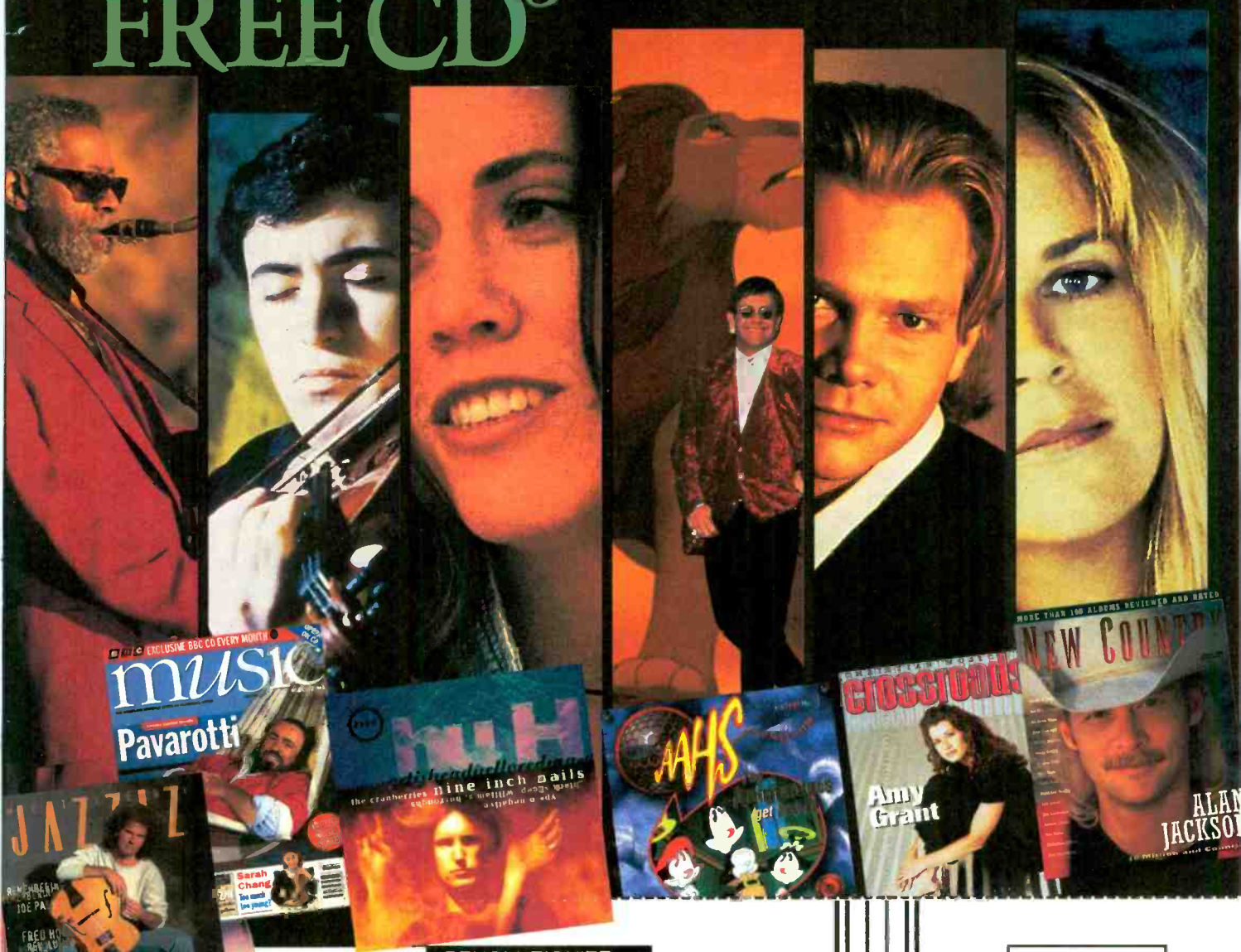

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No one suggested that there was any form of protectionism at play, so the Chinese brands will have to compete with the imports on merit and price. Among homegrown speakers displayed at the show was Paradise's lineup of mini-monitors with stepped baffles and gorgeous burled-walnut finishes, and Shifa's range of speakers includes one with curved sides reminiscent of Sonus Faber's Guarneri. Master Audio is a new brand making speaker systems solely for sale in the Chinese market, alongside a range of drivers for the OEM market, including a selection of dome tweeters and a line of woofers, one with a carbon-fiber cone. Scitech has a small two-way speaker in the Totem or LS3/5A class, while Gospel Audio's Muse division showed a fascinating two-way transmission line speaker called the B50 CTL; it measures only 16¼ x 11½ x 10⅝ inches, with horizontal mounting on stands or for use on a bookshelf. Compact's nine models include floor-standing and bookshelf two-way systems of a quasi-British nature. Xindak has a range of speakers obviously inspired by Meridian and Celestion, plus an integrated amp that could have come from the U.K., too. Xuandu also looks to be Anglophilic, with small two-way systems prominent among its 10 models.

Other local products included China's first digital converters, the 18-bit DAC-1 and 20-bit DAC-2 from Huayon, as well as Tianlang's CD players, ME's Model 550 power amplifier, and SGK's bizarre karaoke mixer. Genesis—not the American firm—has a massive 200-watt power amp and what is probably China's first homegrown mains filter. Scitech showed an off-the-wall digital filtering box, and the company also produces a cylinder that, fit between the uprights of a speaker stand, is said to reduce resonances. Scitech also makes cables and pointy feet.

But that's the obvious stuff. What dazzled all of the foreign visitors was a floor filled with tube-amplifier manufacturers. And we thought the Chinese only made the actual tubes themselves. Oh, were we wrong. . . .

Baroque was demonstrating a small two-box tube preamp, while Paradise showed a line of black-glass-fronted integrated amps, fetchingly trimmed with green or orange lettering. Hong Deng showed a slick line-level tube preamp, while VAS has a line including preamps, phono stages, and power amps. Shenzen, one of the bigger brands, filled a room with a vast line including stereo and mono amps and an amp kit for under $250. Shifa offered something for everybody, including monoblocks containing 40—yes, *forty*—EL34s, another monoblock containing 18 63P3s, a selection of integrated amps, single-ended triode designs, 300B-equipped amps of every stripe—it was overwhelming. Even more shocking was the realization that the amps cost less in China than an amp's complement of tubes would cost in the West.

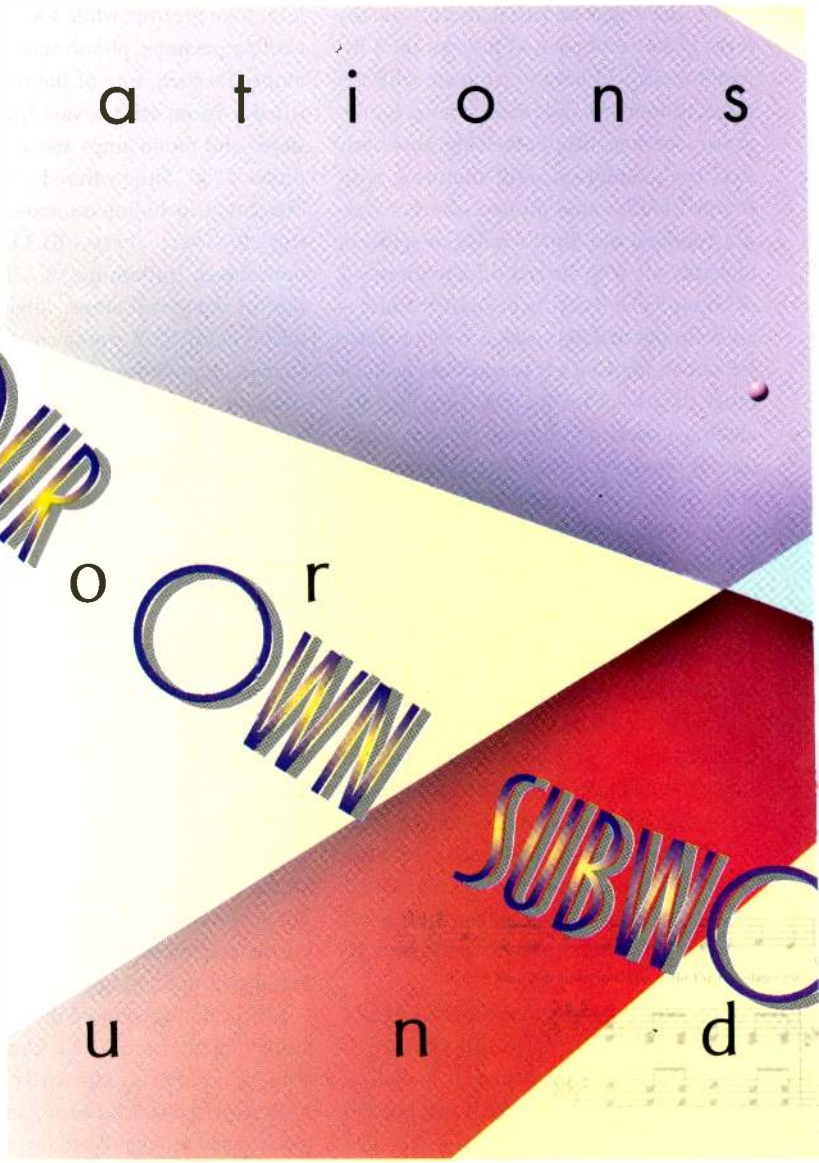
Orpheus, too, had a selection of separates and integrated units, including power amps reminiscent of old Dynacos. Opera has a handsome two-chassis preamp so well built as to appear American, driving the company's own stereo power amps and monoblocks. PEAK uses EL34s in its stereo amp, as does Silsonic in its integrated amps. Spark rivalled Shifa for sheer product selection, with 300B-equipped monoblocks, integrated amps, preamps, and stereo power amps, all looking very Western. And then there were the brands not at the show but which I learned about on the grapevine: Panda, BOM, Hong Da, Elegancia, Audio Monitor, Unistar. . . .

A brief impression of the Chinese tube amps? They are unusual, clever, and, in some cases, even sonically stunning. They're priced to sell cheaply in China, but quick calculations put off any visitors with thoughts toward distribution abroad when they learned that adding duty, tax, and the requisite margins would set the Chinese hardware up against the more affordable native product on its own turf, like Sonic Frontiers in the U.S. or Audio Innovations in the U.K. So, even with the seemingly low prices of Chinese-made amplification, import status always manages to mitigate against bargains.

Then there is build quality. Trying not to discourage these brave innovators, I have to say that the Chinese tube-amp makers still have a bit to learn about construction, if less so about aesthetics. But when they do figure out how to drill and mill and assemble to standards acceptable to American, Japanese, and European hi-fi consumers, watch out: Forty EL34s per channel seems mighty tempting to me. A

foundations

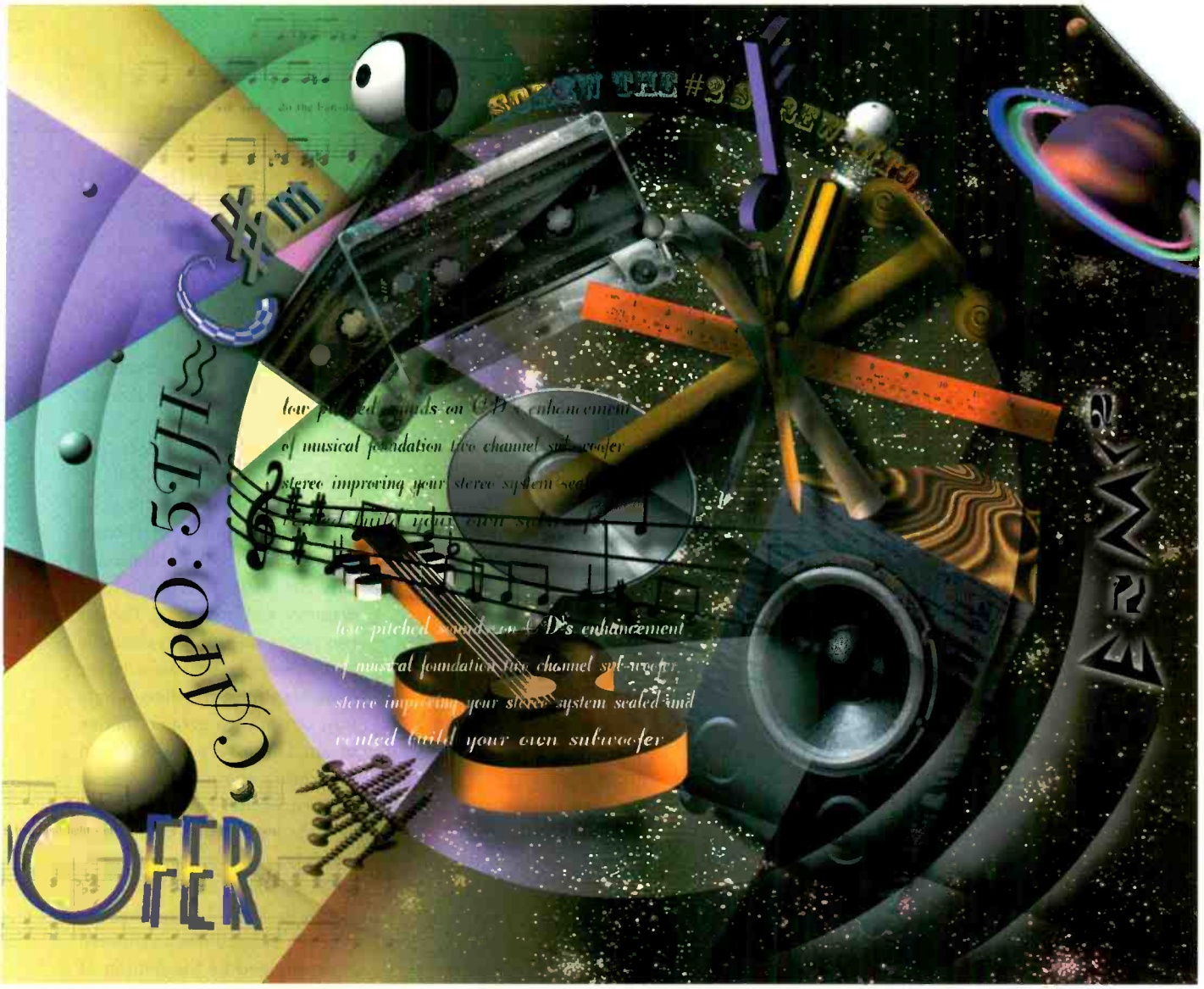
ROLL YOUR OWN SUBWOOFER for sound



by John Sehring

Adding a subwoofer is one of the most effective ways to dramatically improve your audio system. In addition to reproducing specific low-pitched sounds found on many CDs, a subwoofer enhances the overall musical foundation. I recommend the two-channel subwoofer approach, as there is considerable stereo subsonic information on some CDs [1, 2]. Cost is a factor, though, especially if you take the route of stereo subwoofers. So I decided to examine the possibility of building a subwoofer system. Loudspeaker building is a complex undertaking, but I'll show you a path that simplifies the task considerably. It's satisfying to actively participate in improving your audio system—in this case, to learn about, build, and enjoy your own subwoofer.

There are essentially two types of loudspeaker enclosures—sealed and vented. (There are also variations and combinations of each type.) The sealed enclosure is just that: Air-tight. The vented enclosure has an opening. Each type of enclosure design has certain advantages and disadvantages, and both types are used in widely available, favorably reviewed subwoofers.



I chose the sealed enclosure as the best approach for the first-time loudspeaker builder. It offers the easiest, most tolerant design and construction [3]. We trade the advantages of a vented enclosure for the simplicity of design and construction of a sealed enclosure. It *is* a compromise, but a reasonable one.

In a sealed design, air trapped inside the enclosure acts as an additional spring-like force behind the driver's cone. When this "air spring" is considerably stiffer, by a factor of three or more [3, 4], than the driver cone's own suspension, the air's stiffness dominates. This gives a more even (linear) stiffness to the combination of driver and enclosure than the driver alone can muster. As a result, distortion at low frequencies can be considerably reduced; plus there are other advantages.

System Damping and Q

An important parameter affecting a loudspeaker's performance is damping, which refers to how rapidly energy loss occurs in a system. After a signal is applied to (or removed from) a loudspeaker system, it takes a certain amount of time for the system's response

Illustration: Wendy Grossman

put, damping tells us how quickly that will

ly time-dependent signals, so we can guess
: them significantly. Damping also greatly
system's response at its low-frequency end.
rs use the inverse of damping, which is called "Q." As with all inversely proportional relationships, when Q is large, damping is small (and vice versa). Systems with low values of Q (heavy damping) are associated with a "tight" sound and improved bass details (transients). Such a system might be considered dry or shallow-sounding by some listeners, although it would have the most deep-bass extension. It has the least loudness and power-handling capability.

By comparison, systems with middle values of Q sound fuller, but deep-bass extension and transient reproduction aren't quite as good. However, their bandwidth is greatest, and their loudness and power-handling capabilities are larger.

Systems with high values of Q (light damping) give sound that is fuller and more robust, but lowest bass response is increasingly less. Power handling is greatest; transient response is only fair. With the highest values of Q, a system will sound loose, boomy, woolly, and uncontrolled, and have the least deep-bass response.

Technically, the Q of the loudspeaker *system* (driver installed in a cabinet) is referred to as Q_{tc}. A practical sealed system has a Q_{tc} of anywhere from about 0.5 to 1.5. To simplify our design task, I've restricted the range of values from 0.7 to 1.1 (the actual value will depend on the driver we choose). This will give us a subwoofer system of moderate to small cabinet size, with nearly the greatest power-handling capability (a system with a Q_{tc} of 1.1 has the highest acoustic power output) and satisfactory low-frequency and transient response.

Choosing a Driver

There are many manufacturers of raw loudspeaker drivers (see the list of vendors provided). Some very reasonably priced drivers are available. We'll need certain information about a driver to assess its suitability for our use:

- Diameter.
- Resonant frequency in free air, f_s.

It's satisfying to actively

- Total Q, called Q_{ts} (don't confuse this with *system* Q_{tc}).
- Electrical Q, called Q_{es}.
- Maximum linear voice-coil motion, X_{max}.
- Equivalent volume compliance, V_{as}.

Don't worry if these parameters are unfamiliar to you, as they will be listed in the speaker driver specifications provided by the vendor. And don't let all the abbreviations given here intimidate you either; after all, they are well standardized.

For our sealed subwoofer, we need a driver with a Q_{ts} of about 0.35 to 0.55, preferably with a Q_{es} of not much more, percentage-wise, than the Q_{ts}. We also need to have the lowest possible f_s, large diameter, and large X_{max}. The last two points are especially desirable in a subwoofer because a larger diameter driver, travelling a long way, can move a greater volume of air. That's very important in generating enough loudness at low frequencies [2].

Table I illustrates this point, which is related to the volume of air that a driver can set into motion as its cone vibrates. This volume, V_d (shaped like a cylinder), is determined by the motion of the cone's surface area, S_d, in and out through its maximum linear motion, X_{max}. Area multiplied by displacement equals volume: $S_d \times X_{max} = V_d$. A much greater volume of air needs to be moved at lower frequencies to get significant loudness. Larger diameter drivers can more easily achieve this because of their greater cone area and usually larger cone-motion capability. Output from drivers drops very rapidly as frequency is lowered and as driver diameter is reduced.

Furthermore, a larger driver can couple more of the sound it generates into the surrounding air [5; 6, p. 30]. This happens because a larger driver has a greater sound-radiating area, S_d. Each time the S_d is doubled, we gain an additional 3 dB of *acoustic* radiating efficiency. This has to do with acoustic radiation resistance.

Some manufacturers and vendors offer loudspeaker design guidance and suggest which drivers are most suited for a particular use. Not every woofer is optimum for use as a subwoofer in a sealed enclosure. For example, we need a driver with an air-tight cone

TABLE I

Woofer characteristics and output.

Claimed Diameter, Inches	Estimated Effective Area (S_d), Sq. Meters	Estimated Max. Linear Motion (X_{max}), Millimeters	Approximate Max. Acoustic SPL, dB *At 50 Hz*	*At 20 Hz*
6	0.013	3.2	89	73
8	0.022	4.3	96	80
10	0.033	5.3	103	87
12	0.053	6.6	109	93
15	0.089	8.1	116	100
18	0.130	9.9	121	105

TABLE II

Equations for determining proper enclosure volume for chosen driver.

$$EBP = f_s \div Q_{es} \quad (1)$$

$$V_{box} = V_{as} \div 3 \quad (2)$$

$$Q_{tc(min)} = 2 \times Q_{ts} \quad (3)$$

surround (rubber is excellent in this regard) because we certainly don't want to have any uncontrolled air leaks.

Driver Meets Enclosure

What we need to do now is calculate the correct enclosure volume for the chosen driver, using the equations in Table II. Note that these equations are far from all-encompassing; there are many additional driver and system parameters that can be considered (see sidebar, "Sub Plots"). However, the equations are sufficiently accurate for our purposes, as the sealed enclosure design is quite tolerant. Though we have traded away some accuracy and flexibility for ease of calculation, the equations will get us well into the ballpark of a satisfactory subwoofer design.

In equation 1, EBP (Efficiency-Bandwidth Product) tests driver suitability for our use. This figure of merit was described by Richard Small [3, 4].

In equation 2, V_{box} gives enclosure volume necessary to get a system of $Q_{tc(min)}$.

In equation 3, $Q_{tc(min)}$ is the minimum system Q_{tc} that we can achieve with a particular driver in a sealed enclosure of volume V_{box}.

Our design path is:

A. Pick a driver whose Q_{ts} is in the range from 0.35 to 0.55.

B. Check the driver's EBP using equation 1 from Table II. It should be no more than 50.

C. Calculate the necessary enclosure volume using equation 2. The volume will have the same units as the driver's V_{as}. (To convert volume from liters to cubic feet, divide by 28.3. To get the dimensions of a cube, take the cube root of its volume.)

D. Calculate the minimum system $Q_{tc(min)}$ using equation 3.

What we're doing is picking a suitable driver (with appropriate EBP, low f_s, Q_{ts} in the right range, and of large diameter and with large X_{max}) and then calculating the correct cabinet size for it. This simplicity is an advantage of sealed-enclosure design. As a sealed system is so tolerant, it's pretty hard to go wrong!

If you find it necessary, repeat this process with different drivers. For example, you may find that the enclosure needs to be too large for your domestic requirements. You could select a driver that has a smaller V_{as}, but that might compromise other desirable characteristics.

When you are calculating the enclosure's *internal* volume (width x height x depth, inside measurements), you should invariably err on the plus side to be safe. You can always reduce an enclosure's volume by filling it with some solid material, but it doesn't work the other way around!

Bear in mind that any solids that are inside the enclosure (including wall thickness) will reduce the volume available for air to occupy. Therefore, don't forget to include the volume of braces and, yes, the driver itself when you are dimensioning the enclosure. Filling an enclosure with the right kind of acoustic material will let

SUB PLOTS

For purposes of this article, I've simplified the design process a great deal. What we're doing is designing a system with an alpha (the ratio of the stiffness of air trapped in the enclosure to the stiffness of the driver) fixed at three, which is the lowest acceptable value for sealed system use. This will give us the lowest possible system Q_{tc} for a given driver.

Since I've specified that the driver for this project should have a Q_{ts} of between 0.35 and 0.55, we'll wind up with systems having a Q_{tc} in the range from 0.7 to 1.1 (see Table II, equation 3). This will give us a subwoofer with sufficient cone-motion control at infrasonic frequencies, adequate low-frequency and transient response, and good loudness and power-handling capabilities.

It will not, however, give us the smallest possible enclosure volume. This may be inconvenient, but nevertheless, we do achieve a system with the lowest –3 dB frequency (f_3) for a given driver, as Q_{tc} is always equal to or greater than 0.707. This also helps to insure that V_d won't exceed a very small fraction of the box volume. Both of these points are especially important in a subwoofer.

Remember, we need a driver with the lowest possible f_s; this will give us a system with the lowest potential f_3. Choosing a large-diameter driver with a large range of cone-motion ability (X_{max}) will help to insure it can play loudly.

If you want to delve further into system design, Vance Dickason's book [6] contains many additional equations you can use to predict, before building, how a sealed system will play, allowing you greater design flexibility. This a powerful way to design a loudspeaker.

I reduced these equations (and many more) to a computer program; I could then more quickly and more fully explore the performance of different driver-and-enclosure combinations. The program is based on the Thiele-Small loudspeaker system models. The software computes sealed system parameters through a Q_{tc} range of 0.5 to 1.5. It generates tables and plots small-signal amplitude, displacement, phase, phase intercept, group delay, transient response, and large-signal SPL versus frequency response. The acoustical effects of enclosure-stuffing are taken into account.

I am making available a program that runs on any IBM-compatible PC having VGA or better video capability, with MS-DOS 2.1 or later. Documentation is included on disk. It can be provided on either a 1.2M (high-density) or a 360K (low-density) 5¼-inch floppy disk; please specify. The cost is $20, postpaid. Write to me at P.O. Box 373, Baker, Mont. 59313.

us reduce the needed volume. This fools the driver into thinking that the enclosure is bigger than it actually is. You can reduce the enclosure to about 60% of its originally calculated size, while maintaining the same Q_{tc}, when using fill.

Good materials to use in an enclosure are common fiberglass insulation (R19, with a density of 1 pound per cubic foot) and polyester fiberfill. Fill the enclosure completely but loosely; do not compress the material. Keep the material away from immediately around the sides and back of the driver.

Construction Tips

A good, dense material to use for building the subwoofer enclosure is ¾-inch (or thicker) medium-density fiberboard (MDF). Avoid plywood; it's more difficult to build a stiff, nonvibrating enclosure from it.

Use lots of screws when you build; particleboard screws seem best. Pre-drill each hole, and use paraffin as a screw lubricant. Use nonbrittle wood glue to put it all together.

A sealed enclosure *must be* air-tight. You don't want leaks anywhere, as they will easily upset the system's performance. Carefully seal all seams from the inside with silicone-based caulk.

Install the woofer from the *outside* of the enclosure. Put a thin rope of putty under the woofer's rim for a good, tight seal. And do not forget about air leaks where wire connections enter the cabinet.

Having a stiff enclosure is important. The parallel sides will tend to flex in opposite directions due to the high internal air pressure that is generated. Cross-bracing between roughly the opposite centers of parallel surfaces is a good idea [7].

After installing the driver, check for excessive panel vibration. Run your hand over the enclosure's surfaces while playing music that has a lot of bass, or use an audio frequency sine-wave oscillator or the low-frequency bands found on test CDs (at both high and low volume), to check for problems such as rattling, buzzing, and so on.

The basic idea is to start with individual panels that are inherently (or can be made to be) stiff and well damped. As a do-it-yourselfer, you have the luxury to make the enclosure strong!

Coupling to the floor is an effective method of providing an improved dissipation path for the vibrational mechanical energy in the enclosure, especially at low frequencies. This will increase the effective mass of the system, against which the moving driver cone can react. Sharply pointed (spike-shaped) mounting feet can also be used to improve coupling.

Crossovers

I haven't yet brought up the subject of loudspeaker crossover networks. This is because I prefer to use an extra amplifier just for the subwoofer channel(s), a practice known as biamping.

Surprisingly, I've found that a subwoofer amp needn't be very powerful, as even sealed subwoofers can be fairly efficient. A 35-year-old, 50-watt/channel tube amp (a Fisher Model 50, which had been gathering dust) was powerful enough to easily shake the walls of my listening room, whose dimensions are 18 x 20 x 8 feet.

Filters are easier to design and install in an amp's tape loop (or between preamp and amp) than as input to the speakers. I use a passive, low-pass filter, so only subsonic information reaches my stereo subwoofers; it's in my subwoofer amp's tape loop [8].

Driver Vendors

Most of these sources provide a variety of brands of drivers. The list is by no means comprehensive.

ACI
Audio Concepts, Inc.
901 South Fourth St.
La Crosse, Wisc. 54601
608/784-4570
Fax, 608/784-6367

A & S Speakers
3170 23rd St.
San Francisco, Cal. 94110
415/641-4573
Fax, 415/648-5306

Gold Sound
P.O. Box 141
Englewood, Colo. 80151
303/789-5310
Fax, 303/762-0527

Image Communications
4301 West 69th St.
Chicago, Ill. 60629
312/585-1212
Fax, 312/585-7847

Madisound
P.O. Box 44283
Madison, Wisc. 53744
608/831-3433
Fax, 608/831-3771

MCM Electronics
650 Congress Park Dr.
Centerville, Ohio 45459
800/543-4330
Fax, 513/434-6959

Meniscus
2575 28th St. S.W., Unit 2
Wyoming, Mich. 49509
616/534-9121
Fax, 616/534-7676

Parts Express
340 East First St.
Dayton, Ohio 45402
513/222-0173
Fax, 513/222-8404

Radio Shack
700 One Tandy Ctr.
Fort Worth, Tex. 76102
(Drivers are available at the company's retail outlets.)

Solen
4470 Thibault Ave.
St. Hubert, Que.
Canada J3Y 7T9
514/656-2759
Fax, 514/443-4949

Speakers, Etc.
1828 West Peoria
Phoenix, Ariz. 85029
602/944-1878
Fax, 602/371-0605

The Speaker Works
1021 East Camelback Rd.
Phoenix, Ariz. 85014
602/230-0344
Fax, 602/230-8533

Zalytron
469 Jericho Tpke.
Mineola, N.Y. 11501
516/747-3515
Fax, 516/294-1943

The sealed-enclosure approach offers the easiest, most tolerant design and construction.

If you want to take full advantage of a subwoofer, then you must make an effort to keep subsonic energy out of the main loudspeakers. Excessive low-frequency signals can muddy up the main speakers' reproduction of the midrange. The cure can be as easy as inserting a large-value (say, about 200 µF), nonpolarized capacitor in series with each main loudspeaker. This forms a simple first-order, high-pass filter that rolls off the low-frequency end of the main speakers' response [6, Chapter 7; 9, 10].

Polarity

It's important to get the subwoofer working correctly with the main loudspeakers in the low-frequency range where their responses overlap. We want both subwoofer and woofer cones to move in and out together, as much as possible. If their relative polarity is not correct—i.e., out of phase by 180°—they will tend to cancel each other at certain frequencies. This will lead to an uneven frequency response of the combination.

Be prepared to experiment by reversing the connections to either the subwoofer or the main speakers (but not both), and listen to the result. You may find that the low-frequency amplitude response is better with one connection, but that the low-frequency transient response is better with the other.

Room Effects

Not to be ignored is the interaction of the subwoofer with the listening room. A room's resonant modes and boundary effects strongly color a loudspeaker's perceived sound quality. They selectively boost certain frequencies, especially the lowest ones, depending on room dimensions [11].

The amount of perceived boost from room modes depends on the location of both the loudspeaker *and* the listener. A corner location for a speaker is best for fully exciting all of the lowest room modes, but this may lead to boomy response as well as to anomalies from stereo sources. I suggest that you center stereo subwoofers along the front wall of your listening room, on the floor. Position them about 30% of the room's width apart from each other [1, 12].

"Room gain" also occurs due to the boundary effects of room surfaces. It increases with the number of, and closeness to, wall surfaces adjacent to the loudspeaker—that is, it's highest in the corner. Room gain also increases as frequency is lowered [13].

Final Check

If your subwoofer doesn't seem to play loud enough or overloads easily, or the driver bottoms out a lot on bass-heavy material, simply reduce the enclosure's volume a bit at a time, in small, about 10%, steps. This will increase the system's Q_{tc} and will work best for drivers with a Q_{ts} of less than 0.55. You can do this by filling the enclosure with an acoustically inert object, such as a piece of wood—a quick remedy at the end of your project. A

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SURROUND

TOMLINSON HOLMAN

Multichannel sound has clearly taken off as a major medium of expression for sound artists. The 5.1-channel discrete system is already in widespread use in movie theaters and is now on its way to homes first on LaserDisc. High-definition television systems for the U.S and Europe will have the same audio-channel capability. Specifically, 5.1 comprises left, center, and right front; left and right surround, and an added low-frequency channel.

Meanwhile, amplitude/phase-matrix encoded Dolby Stereo and Ultra Stereo movies, and Dolby Surround CDs, provide an input for multichannel amplifier and loudspeaker systems that can be carried within the two channels found on current media. Dolby Pro Logic decoders turn the two source channels back into the left, center, right, and surround channels encoded during mixes. Home THX systems additionally process the single surround signal to produce two decorrelated surround channels, and extract a low-bass signal

Tomlinson Holman advances entertainment technologies as president of TMH Corporation. He designed the Advent 300 receiver and the Apt/Holman preamplifier, and he developed the Lucasfilm THX business. He holds six audio and video patents, lectures worldwide, and teaches sound at the University of Southern California School of Cinema-Television in Los Angeles. Mr. Holman dedicates this article to the memory of Joseph A. Appolito, sound editor of Top Gun.

SPEAKERS

CONFUSION, DIFFUSION, AND RESOLUTION

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to supply to one or more subwoofers. In the case of the 5.1-channel system, the "0.1" channel is an added low-frequency-only effects channel. All the other five channels are wideband, containing bass as well. Hence, it is possible either to extract the low bass from all of the channels and add the "0.1" channel's content to it, for playback over one or more subwoofers in mono, or to have multichannel low bass, with a subwoofer on each channel.

A great many installed systems are playing current software over 5.1 playback channels. Therefore, supplying a "pipeline" for discrete multichannel sound to those systems is just a matter of time. The difference between these two modes, discrete 5.1-channel and matrixed 4:2:4-channel sound, is a matter of spatial definition; the discrete system can represent more complex spatial content from more directions simultaneously without as much smearing of the sound images. All in all, on dense program material, one can audibly distinguish more simultaneous sources with the discrete system than with the matrixed system. Interestingly, though, there may be plenty of existing material on which an A/B comparison would show little or no difference, because the program material does not challenge the directional decoding capabilities of the matrix system.

An exception to this rule is the surround formats. Soundtracks for films made in stereo surround, such as *Apocalypse Now* and many contemporary films, exist in discrete multitrack masters with two surround channels. The 5.1-channel system has two discrete

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THX and the Surround Dipole

Surround loudspeakers that meet THX requirements are all of the general kind described in the main part of this article—that is, they reduce the direct field and stimulate the room more than the listener directly. The typical way to do this is to build the loudspeaker as a dipole, having a figure-8 radiation pattern, and point the null of the figure-8 at the listening position. Interestingly, though calling it a "null" perhaps may make it sound like a critical process, such loudspeakers are, in fact, easier to place and aim than conventional ones. After all, with little direct sound pointed toward the listening area, it is unlikely that the location of the surround loudspeaker will be revealed audibly.

Courtesy of MCA/Universal Home Video

The best location for the surround loudspeakers is to the sides of the listening area, and they may be a little in front or in back of the main listening seats. In any case, it is useful to have the surround speakers elevated above the listening plane, as this promotes uniformity of the surround across the listening space and has been found preferable in tests.

If the main listening area is up against a wall, first consider moving the listening area out into the room. This can alleviate some problems:

- Bass from all the channels "piles up" at the walls, due to standing waves, and it may well sound exaggerated.
- It is difficult for any surround sound system to produce an enveloping sound field for a listener who is up against a wall. (The same is true in concert halls!)

However, if you simply cannot move the listening seat away from a wall, putting the surround speaker out at least 3 feet from the wall behind the listener, and with the null pointed toward the main seat, will also work. Additionally, if the loudspeaker does not have a wall, such as in an open plan, the surround speakers may be mounted on the ceiling, so long as the sound field for each is largely coming from one side of the listening area. (Overhead is a bad idea, as it tends to make the surround more monaural.)

surround channels, so it can handle a sound panned to left surround without having it appear in the right surround at all.

With multichannel sound comes the need for more loudspeakers, which makes it a good time to ask what special requirements loudspeakers for multichannel sound might face. Two-channel stereo requires speakers to reproduce two principal components of the stereo sound field, imaging and envelopment. Imaging refers to the ability to locate sounds in space, and to hear them as point or diffuse sources. Envelopment refers to the sensation of being immersed in a spacious, surrounding sound field, literally being in the environment of the recording. A proper balance between these two fundamental factors has been shown to be essential to good concert hall acoustics [1].

The trade-off between imaging and envelopment for two-channel stereo may be seen in the marketplace, where speakers run the gamut from very broadly radiating models, with multiple drivers pointed in different directions, to models (usually multiway horn systems) that radiate over a very narrow area. While loudspeakers designed with extremely wide dispersion may be said to produce an excess of envelopment and little in the way of a focused sound image, loudspeakers at the other extreme produce a very sharp sound image but little sense of enveloping space. It is interesting that most people buy loudspeakers that fall somewhere between these extremes. Purchasers seem to sense that a compromise between imaging, on the one hand, and envelopment, on the other, is right for them with most program material. (The front loudspeakers of home THX systems fall slightly on the directional side of this imaging/envelopment continuum. This is because they have quite wide dispersion horizontally and controlled dispersion vertically, to allow for the effects of specific room reflections on sound quality.)

Now, let's suppose we could vary the trade-off between imaging and envelopment in a two-channel system by providing a special knob to vary performance continuously between the extremes. (Owners of Apt/Holman preamplifiers will recognize this as a description of the "Mode" control on their units. An alternative would be to build a loudspeaker with variable directivity.) What we would find on a given pair of loudspeakers is that different program material would require different settings for the best effect; there is no one correct setting.

Part of what is going on here is that the dispersion pattern of your loudspeakers is unlikely to match that of the monitors in the studio where the sound was recorded. If the studio monitors exaggerate sound imaging at the expense of spaciousness, for instance, the program producer may well ask for more reverberation. If you then play this program at home over loudspeakers that emphasize the reverberant component of your own listening room, the sound can easily become too "swimmy."

I had a related experience recording "Messiah" years ago with the Handel and Haydn Society of Boston for Advent tapes and Sine Qua Non records. During the first day of recording, a control room was improvised in a chapel connected to the church where the performance was taking place. I eagerly took the tapes home after the first session, only to find that the recorded sound was too dry—that is, lacking reverberation—because I was listening and balancing in a reverberant control-room space. I had made the recording too dead in trying to compensate for the overly reverberant listening conditions. (For the next session we moved the monitoring to a conventional living room next door, and things went smoothly from then on.) So the conditions of monitoring affect the recording, even though nothing of the monitor system is directly in the recording path.

There is a better way to liberate the two sound-field requirements, imaging and envelopment, from each other. In multichannel systems, the front loudspeakers normally provide the principal sound image. We usually turn to face the source of a sound that interests us, and recordings—even multichannel ones—therefore put the most important content in front. The surround loudspeakers, free from the task of producing pinpoint sound images, can then emphasize envelopment. For the surround part of the equation, this thinking led to the idea of the THX Surround Loudspeaker, a

speaker that emphasizes the production of a diffuse sound field over the direct sound.

There are many examples of the utility of such an approach. To cite an obvious example, the spatial character of concert hall acoustics on a classical recording can only be accurately reproduced by playing the recording's reverberant-field component through diffuse-field loudspeakers. Actual reverberation in a concert hall surrounds and envelops the listener, since it is, by definition, isotropic (i.e., energy is just as likely to flow in one direction as in another). By contrast, the sound image of reverberation from a conventional loudspeaker puts a window frame around the reverberation, as though we were hearing the reverb in a hall next door, through a window into that space. Upon fair comparison testing of the two surround approaches, diffuse-field-dominant versus conventional speakers, both sophisticated and naive listeners hear the diffuse-field-dominant loudspeaker to be superior at reproducing reverberation. This is because the reverberation is less likely to be localized at a loudspeaker, destroying the illusion.

While home THX equipment provides electronic decorrelation, which also helps improve the reverberance in stereophony (and the stereophonic surround capability of well-made 5.1-channel recordings can be expected to help), listening tests demonstrate that the directional properties of the surround speakers are still important.

So far, only experimental recordings have been made of classical music using the surround loudspeakers to reproduce reverberation. But a good example of this technique on a film soundtrack occurs in *Jurassic Park*, in the scene near the beginning when an animated film is shown to visitors entering the park (THX LaserDisc, side one, 24:04 to 25:15).

Although this sequence is one of the most clear-cut examples of the utility of the diffuse-field loudspeaker, there are many others. A good source of examples can be found in the digital audio LaserDisc of *Top Gun*, which has been widely used as a good demonstration of surround sound. On the other hand, many listeners may not be aware how well it illustrates a wide variety of surround sound effects; it is well known for its jet fly-bys, but there are other fine surround-channel uses as well. Some of these examples can be heard especially well if the front loudspeakers are disconnected or if just the center-channel loudspeaker is disconnected. Once the speakers are restored to normal, it then is easier to hear just what the spatial component of the sound field provides to these scenes. Also, it is important that the surround sound level be correct, which can be checked by switching on the rotating noise generator of a Pro Logic controller or receiver and making sure that the surround level is matched to the front level. This accomplished, some good examples of the use of surround in *Top Gun* are shown in Table I. (The timings given are for the second edition of the LaserDisc, with digitally mastered audio. Timings are different in an earlier edition, which was mastered using multiple analog generations. Thus, copies that match the timings shown in Table I better demonstrate the surround effects.)

Adding surround speakers lets us provide imaging and environment in a single speaker.

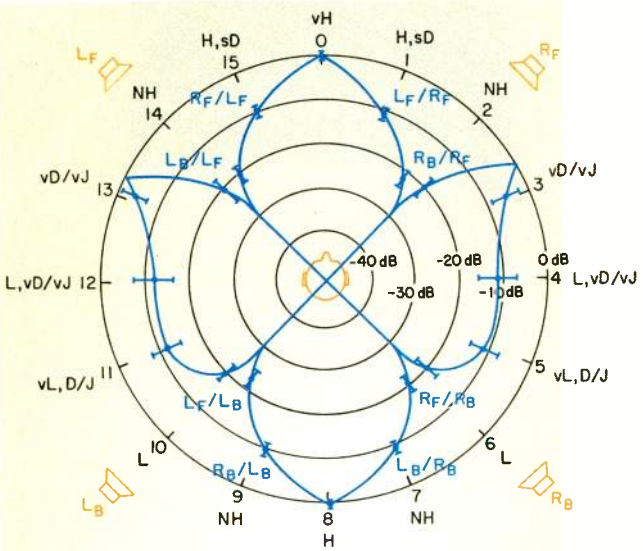
Top Gun has incredibly sophisticated uses of surround sound that complement its better known jet fly-bys. In cases 2 through 4 in the Table, the surround is used to bring the listeners into the action by enveloping them in ambience, to "break" the edges of the screen. Cases 5 and 6 are interesting because the singing starts with the character Maverick alone, center screen, with only ambience in the surrounds, but the singing grows with the entrance of a chorus,

THX, AC-3, and Surround

Dolby Laboratories' low-bit-rate coding scheme for 5.1-channel sound is known as AC-3. It is a multichannel "pipeline" through which the program material is delivered. The program material supplied through the pipeline is not encoded "in THX." Rather, a THX sound system is a means of playing back all multichannel material under a standard set of conditions that help the listener hear the program material as the program's producer intended them to be.

The diffuse-field-dominant surround loudspeakers described in this article are just as suitable for discrete multichannel sound as for matrixed surround. For both matrix and discrete soundtracks in movie theater use, a diffuse surround sound field is supplied by using many surround loudspeakers. The theater surround arrays are divided into left and right halves for discrete playback, with many loudspeakers for each half. The dipole surround loudspeaker systems work the same way, supplying a diffuse sound field that still has left/right separation. In a THX demonstration at 1994's Winter CES, 5.1-channel program material of many types was played, and expert listeners informed us that the dipole surround loudspeakers clearly worked well for the discrete system. Among the items in that program were audiophile quality music recordings, heavily processed pop recordings, and movies. In particular, the pan of the carriage from screen into surrounds during the arrival of the protagonist at the castle in *Bram Stoker's Dracula* dramatically illustrated how well the dipole surrounds work in this application.

Left/right separation of the two dipole surround loudspeakers is easy to demonstrate. Home THX controllers produce "rotating" filtered pink noise that stops at left, center, right, left surround, right surround, and subwoofer. By stepping through these tests, you can easily hear the left/right surround separation.



LEGEND

I	EXPERIMENTAL RESULT SHOWING STANDARD DEVIATION
D	DIFFUSE
H	HIGH
J	JUMPY
L	LOW
NH	NORMAL HEIGHT
s	SLIGHTLY
v	VERY

Fig. 1—Effects on spatial imaging caused by a square symmetrical array of four loudspeakers, based on an illustration in [2]. An "interchannel level difference" of 0 dB between left and right front or back produces the expected centered phantom image. However, at the sides, the "centered" sound image is pulled far forward, and there is a large standard deviation, showing large listener-to-listener differences. Side "images" are also very diffuse and "jumpy," changing dramatically for small movements of the head.

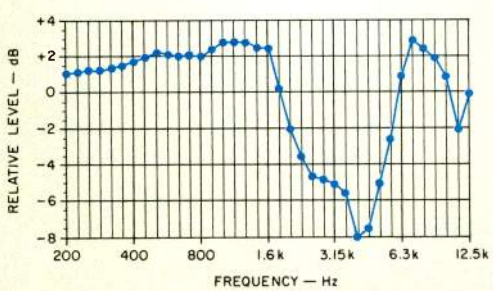


Fig. 2—The difference in frequency response between the direct sound for a reference loudspeaker located 30° to the right of straight ahead in the conventional stereo position and one located 120° away from straight ahead. After Shaw [5].

which envelops the listener—a wonderful effect. Case 7 is somewhat similar. Here, a jukebox starts to play, strictly monaurally, center screen. (This is known in the trade as "source music"—that is, music originating from a source shown in the scene.) The music on the jukebox is used to alert Maverick to the fact that the woman he's interested in is nearby. He turns, has several lines of dialog with her, and then steps toward her definitively. At this moment, the music swells into spatial stereo and becomes not source music, but score. The music's definition changes in the middle, as it expands into the left and right and the surrounds.

In most of these diverse examples, the diffuse-field-dominant surround loudspeaker is superior in blind comparisons compared to conventional loudspeakers. This is probably due to the diffuse-field nature of most of the sources and the match between it and the directivity of the surround loudspeaker.

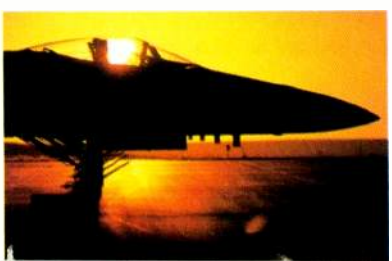
That leaves the case of the fly-bys. Are these better reproduced by a conventional loudspeaker or by a diffuse-field-dominant one? With a conventional loudspeaker, the fly-bys seem to originate at the screen, then jump quickly to the surround speaker location, fading out there. The surround part of the stereo sound field sounds as though it is passing through a hole in space, on its way to extinction, with the speaker location forming a kind of sonic black hole. With the diffuse-field-dominant loudspeaker, the sound originates at the screen, then pans *past* the listener's location and recedes into the distance. This gives the listener more of a sense of the surround passing by on its way somewhere than with the conventional system. The conventional loudspeaker "focuses" the surround image more, but that draws your attention to the loudspeaker and therefore distracts from the overall experience.

Thus, for four primary uses of surround sound—reverberation, ambience, enveloping music, and transient effects passing to and from the screen—a diffuse-field-dominant loudspeaker has advantages. Why is it, then, that five matched loudspeakers are undesirable? Isn't it true that four matched systems in the room's four corners can produce sound images everywhere (with the fifth providing center fill for the front)? There are several problems with the thinking that prompts these questions.

The main problem is that what works in front and back does not work on the sides. Hearing is not symmetrical—we don't have four ears, one each on the left and right and the front and back sides of our heads—to perceive phantom images panned midway between, say, right front and right back, the same way we do for front phantom images.

Here's what happens to a panned sound. Let's say it starts in the center, moves to the right, and then goes to the right surround. As the pan originates at the center loudspeaker, and at the moment when it arrives at the right speaker, the directional perception is perfect for all listeners. (With only one speaker producing sound, every listener in any practical situation will hear the loudspeaker location as the direction of the source.) With the half-right position between these two front channels, a decent phantom image forms, and is reasonably free from changes in perceived location when the listener moves. (Even this phantom is subject to pulling toward the

A sound panned around a circle aurally moves in a misshapen cloverleaf pattern.



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front loudspeaker that is closer to us if we sit off the central axis. But the problem is greatly reduced, compared to two-channel stereo, because the center channel "anchors" the center of the sound image.)

What about continuing the pan from the right-front speaker to the right-surround one? The BBC studied this question in 1974 and produced the graphic shown in Fig. 1. They said:

> However, if one looks at the generation of phantom images between pairs of loudspeakers arranged around a listener in a square format, very variable and uneven results are produced. Whilst front- and back-quadrant results are rather similar, the side-quadrant images show a strong tendency to be drawn to the front of the listener and are very unstable with head movement. There is also a noticeably diffuse quality to the side images, making it less certain just where they are located. Thus, the use of surround sound as a way of giving to the listener directional cues from all directions is not only an unproven technology, but is also unproven as being both necessary and desirable.

The above quote is from [2], an article by D. J. Meares. He is with the BBC Research Department; he was reporting on earlier work, documented in [3]. Also, German researchers in the quad era [4] found:

> . . . an "all round effect" cannot be produced with the usual quadraphonic loudspeaker arrangement. . . . [An experiment] shows that a uniform distribution of phantom sources lateral to the listener, with [a square arrangement of loudspeakers] is not possible. It shows that even small level differences between the loudspeakers lead to large angle changes and that localization jumps here and there between loudspeakers at the front and back.

Thus, when sounds are panned along one side from the front to the surround channels, we first hear not one moving source, but a "split" source, which spreads apart as the pan continues and then comes back together when we reach the destination loudspeaker. The exact effect will, of course, depend on the distance between the listener and the two loudspeakers, and on their relative levels. But the phantom image panned halfway between right front and right surround does not work because the two source directions have different head-related transfer functions. That is, the paths from right speaker to right ear, and from right surround speaker to right ear, have different frequency responses (see Fig. 2). This means that for sound panned in between the two, different frequency ranges will be heard as originating at one loudspeaker or the other—not in between, as desired. The sound image splits up spectrally into multiple components, localized at different positions. (The paths to the left ear are also different but are not nearly as significant for a right-originating sound field.)

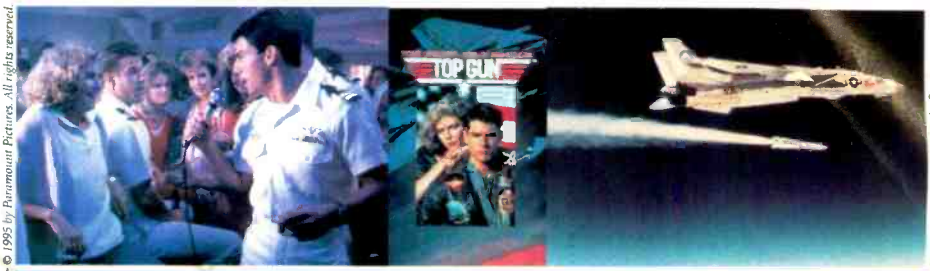

TABLE I—Top Gun *surround sound examples, with locations on the LaserDisc version.*

Case No.	Location on CLV LaserDisc	Scene and Sound Description	Surround Sound Use
1	Side 2, 1:00 to 1:05	Four jets come at the camera and disappear overhead	Transient fly-by from screen to surround
2	Side 2, 3:56 to 5:20	Shower water running under a dialog scene	Nonlocalized ambience to establish space for the action to occur (the fact that the sound is designed to be spacious can be heard, because the ambience is recorded in left and right front as well as surrounds)
3	Side 2, 0:40 to 0:44	Interior, fighter cockpit, dialog and ambience	Ambience extends into surround to bring the listener into the action—it is meant to be enveloping
4	Side 1, 23:38 to 25:04	Dialog scene in bar, with surrounding voices and music	As above
5	Side 1, 22:31	Pete Mitchell (Maverick) starts singing, center screen	We don't hear him in the surrounds, but as soon as the next item comes in, the singers surround the listener
6	Side 1, 22:49 to 23:38	The crowd of men around the camera take up the singing	An extension of the item above; placing the chorus of men in the surrounds envelops the listener in the chorus
7	Side 2, 47:18 to 49:40	Music identifying entrance of Charlie, starting as source music on a jukebox, then becoming "score"	Jukebox music starts in center only, then expands to sides and surrounds when Maverick and Charlie step toward one another—the music makes a transition from "real" in-scene source to out-and-out score

Courtesy of MCA Universal Home Video

What works in front and back does not work at the sides, because hearing is not symmetrical.

This problem troubled the original developers of quadraphonics. One of them recently told me that the loudspeaker array was considered a given, with no existing psychoacoustic foundation; all the work on quad went into methods of delivery—matrixed versus not matrixed, etc. There was no clear experimental proof for the efficacy of the symmetrical array, and quad suffered as a result of employing it (besides confusing the marketplace with a standards war). He emphatically said, when asked, that it was well known in the 1970s that phantom imaging did not work in between front and back channels. (Interestingly, phantom images may work across the back just as they do in front, but there is a potential problem called "front/back confusion," which is taken up by a lot of research on headphones with out-of-head localization.)

Several other problems plagued quadraphonics, to the extent that *IEEE Spectrum* published an editorial in its November 1983 issue entitled, "Whatever Happened to Four-Channel Stereo?" In it, *Audio* magazine's John Eargle is quoted as saying, "Producers really did not know what to do with the new medium that made musical sense." The piece then quotes Warren Rex Isom of RCA, who stated that four-channel stereo "became a vehicle for showing off great mathematical and analytical skills as well as electronic ingenuity to emphasize directionality on playback rather than the *reproduction of the acoustical reality of the original recording* [emphasis added]. With its gadget-loaded playback systems, it wandered without direction or vision." Emil Torick of CBS furthered matters, saying, "It [surround sound] has exciting potential for television sound." Eargle concluded with, "There exists the potential, however slim, that quad may try for a comeback."

The last two statements were certainly prophetic, predicting the whole home theater movement. But the issues embodied in the first two quotes must be faced squarely now that this new medium is being introduced. For the time being, it is dominated by film-mixing practices, since those are the most evolved, with the film industry having by far the most experience with multichannel sound. In the future, however, as new media start using multichannel sound, let us hope that producers *do* worry about making musical sense in this new medium, and about applying the better developed psychoacoustics of today's systems.

Since our current psychoacoustic knowledge points us toward the use of diffuse-field-dominant loudspeakers, the question arises of what frequency response such speakers should have. Because little sound is directed toward the listener, what kind of measurement makes sense? For a diffuse-field speaker, the proper measurement is its power response—its response at all angles, summed together. While the importance of power response compared to axial speaker response has been debated long and hard with respect to conventional loudspeakers, here the case is clear. It is the reverberant-field component of the sound that should be used to characterize the frequency response of a diffuse-field-dominant surround loudspeaker. This can be measured in two ways. One is to put the speaker in an anechoic chamber and run many response curves around the speaker, in sufficient numbers to fully represent its response at all angles, and then to sum all the curves. The other method is to put the loudspeaker into a reverberation room (the opposite of an anechoic chamber) and measure the response. The two methods yield similar results. These measurement environments may also be modified, if the boundary for loudspeaker mounting is known, by including the relationship between the loudspeaker and its mounting surface in the measurement. For example, a speaker designed for in-wall mounting can be placed in a wall constructed as one surface of an anechoic space, and the measurements proceed all around the front hemisphere of the speaker.

In THX systems, it is the power response of the surround loudspeaker that is made flat, not frequency response at any one particular direction, because it is the power response that radiates into the room to form the enveloping surround sound field. An added circuit in THX controllers called "Timbre Matching" accounts for the difference in response of the sound fields between front and surround loudspeakers, to minimize the shift in timbre as sound is panned.

The 5.1-channel system is expected to play an ever larger role in the future of recorded sound, as audio/video media continue their expansion into more forms, extending their film-based roots into other areas of recorded sound. Along with this expansion, specialization of loudspeaker functions—differentiated, in the case of surround speakers, by the factors discussed here—will likely play a greater role. A

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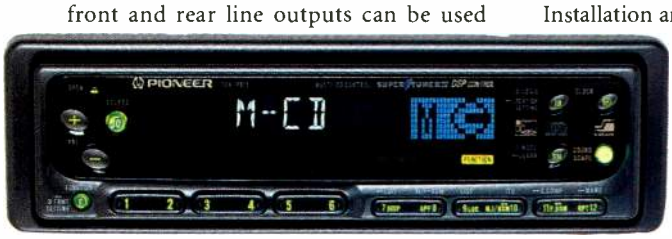
EQUIPMENT PROFILE

EDWARD J. FOSTER AND IVAN BERGER

PIONEER DEH-P815 CAR STEREO

Pioneer's DEH-P815 is a sophisticated car CD/receiver with versatile expansion possibilities. It contains a front/rear power amplifier, along with line-level outputs to drive front, rear, and subwoofer power amps. All of the amps are activated by the same signal line that triggers relay control of a powered antenna. A second signal line can interface with a cellular phone and mute the receiver when the phone is active. A multipin connector on a short cable (the "IP-Bus") interfaces with one to four CD changers, which Pioneer will be happy to supply at extra cost should you find the DEH-P815's single-disc capacity limiting.

Depending on how the "Main In" slide switch is set during installation (it's on the underside of the DIN-mount chassis), the front and rear line outputs can be used either with an external equalizer or with Pioneer's DEQ-P800 "Hideaway DSP" processor. In this case, the output lines are unavailable to feed external front/rear power amplifiers, so you must rely on the internal amps. These are rated for a minimum of 15 watts/channel into 4-ohm loads with no more than 5% THD over the range from 50 Hz to 15 kHz. Since the DEQ-P800 processor passes the subwoofer signal through, you can use a separate subwoofer amplifier. When the DEQ-P800 is used, remote CD changers can be daisy-chained through it to the head unit, via the IP-Bus.



USING ID LOGIC, THE DEH-P815 CAN FIND STATIONS BY PROGRAM FORMAT AND SHOW THEIR CALL LETTERS.

Installation and usage can get complex; I would have appreciated clearer instructions and better English than is provided in the wiring diagram and owner's manual. I found it easier to use the DEH-P815 from its wireless remote control than from the generally small and rather confusing panel buttons, which can't access some functions.

Certain functions, however, *must* be controlle d from the panel. For example, to load a CD, you press the button at the upper left of the panel. This causes the whole panel to swing down; while it's down, you can remove it for storage by squeezing a release bar at the front edge. This "two-step" security approach prevents releasing the panel accidentally (a problem I have with other designs), but the door/panel release button is very tiny and quite close to both the volume-up pad and the source selector, directly to its right. (The volume-down pad is diagonally below the up pad.) If you don't remove the panel within 5 seconds of switching off the ignition, the DEH-P815 beeps a warning. You can cancel the beeper by pressing station-preset 3 while you turn the ignition off and on; you restore the warning beeper in like manner.

From the panel, sources are selected (and the DEH-P815 turned off) in round-robin fashion by pressing the source button multiple times. The sequence is: Internal CD player, tuner, CD changer, and off. It's simpler from the remote; a "Tuner" button switches the tuner on and off, while a separate "CD/MCD" button cycles from the internal player, to the external changer, to off. If you don't use a changer, you can delete that option from the selection by holding down preset 8 and turning the ignition from off to on. A similar process (using preset 7 instead of 8) adds an AUX mode to the front panel's source selection (but not the remote's). This choice, which slips in between "Multi-CD" and "Off," is used when equipment is connected to the IP-Bus.

Adjustments to the fader, balance, and tone controls from the remote are somewhat unusual, in that they are controlled by mode-selector button "A" and a four-key multifunction pad. The volume keys on the remote are dedicated exclusively to that

Photos: Len LaGrua

function. When the fader/balance mode is chosen with the "A" key, the upper and lower buttons in the four-way array fade the sound to the front or rear while the left and right buttons in the cluster shift it from left to right. That's rather nice. In the tone-adjustment mode, the left and right keys select whether you will adjust bass (left) or treble (right) while the up/down keys affect response in the chosen region.

The "A" button also permits you to access adjustments in subwoofer crossover point and output level. The "A" button is pressed repeatedly until you reach the subwoofer mode; you then keep it depressed for 2 seconds to turn the subwoofer on. (It's turned off in like manner.) Once you've activated the subwoofer output, the left/right buttons mentioned earlier shift the crossover point (50, 80, or 125 Hz), while the up/down keys adjust the level.

The loudness contour is switched on and off in a somewhat similar manner. By repeatedly pressing "A," you access the loudness mode; holding it down for 2 seconds toggles the circuit on and off. When active, subwoofer and loudness legends appear in the display, together with the choice of subwoofer crossover, but the legends are small and rather difficult to see.

The DEH-P815 features "SLA," Source Level Adjustment, for matching sound from different sources. While this shouldn't be necessary for sources built into the receiver, the DEH-P815 can accommodate an auxiliary input. The FM tuner is used as the norm to which other sources are adjusted.

More day-to-day control functions are on the DEH-P815's well-designed remote than on its front panel.

You listen to an FM station, switch to the source you wish to adjust, press the "A" key for 2 seconds to switch to the SLA mode, and use the up/down keys of the four-button array to make the adjustment. The DEH-P815 also has an attenuator that drops sound level by 90%.

The tuner has ID Logic, a database containing information on all AM and FM stations in the United States (and on stations in some areas of Mexico and Canada). The database, which is built in and does not depend upon the station transmitting an RBDS signal, contains the call sign, frequency, and type of programming for each station. Should the station change its program format or call letters, the database can be manually updated.

Once you tell the ID Logic system where you are, it uses its database both to show the call letters and formats of stations you tune in and to find stations of any desired program type. Like earlier ID Logic radios, the DEH-P815 has a "compass" function that lets you tell the radio, every 30 miles or so, which direction you've driven in. But Pioneer has also added automatic location finder functions to set the city area once the state is known; it works by checking the incoming FM signals to see which city would receive that particular signal mix. On the road, positions can be updated by pressing a single button, and can even update themselves during CD play. I'll leave it to Ivan Berger, *Audio's* Technical Editor, to comment on the usefulness of ID Logic.

Of course, the DEH-P815 also provides the mundane tuning modes—manual, seek, and preset—and has presets for 24 FM stations (in two banks of 12) and 12 AM stations. There's also means to load the 12 strongest stations in the area ("BSM," or Best Station

SPECS

FM TUNER SECTION
Usable Sensitivity: 8 dBf.
50-dB Mono Quieting Sensitivity: 13 dBf.
S/N: 70 dB, A-weighted.
Stereo Distortion: 0.3% for 65-dBf signal at 1 kHz.
Frequency Response: 25 Hz to 15 kHz, ±3 dB.
Stereo Separation: 40 dB at 65 dBf, 1 kHz.
Alternate-Channel Selectivity: 70 dB.

AM TUNER SECTION
Usable Sensitivity: 18 µV for 20-dB S/N.
Adjacent-Channel Selectivity: 50 dB.

CD SECTION
Frequency Response: 5 Hz to 20 kHz, ±1 dB.
S/N: 94 dB, A-weighted.
Dynamic Range: 90 dB at 1 kHz.

AMPLIFIER SECTION
Continuous Power Output: 15 watts x 4 into 4 ohms, all channels driven, 50 Hz to 15 kHz, with no more than 5% THD.
Maximum Power Output: 35 watts x 4, per EIAJ Standard.
Load Impedance: 4 ohms (4 to 8 ohms allowable).
Line Output Level: 500 mV.
Line Output Impedance: 1 kilohm.
Tone Controls: Bass, ±12 dB at 100 Hz; treble, ±12 dB at 10 kHz.
Loudness Contour: +10 dB at 100 Hz, +7 dB at 10 kHz, with volume at –30 dB.
Subwoofer Crossover: 50, 80, or 125 Hz (selectable); slope, 12 dB/octave.

GENERAL SPECIFICATIONS
Power Source: 14.4 V d.c. (10.8 to 15.6 V allowable).
Grounding System: Negative type.
Maximum Current Consumption: 8.0 amperes.
Dimensions, DIN Mount: Chassis, 7 in. W x 2 in. H x 6⅛ in. D (17.8 cm x 5 cm x 15.7 cm); front panel, 7⅜ in. W x 2¼ in. H x ⅝ in. D (18.8 cm x 5.8 cm x 1.6 cm).
Dimensions, ISO Mount: Chassis, 7 in. W x 2 in. H x 6⅜ in. D (17.8 cm x 5 cm x 16.2 cm); front panel, 6¾ in. W x 1¾ in. H x ⅜ in. D (17 cm x 4.6 cm x 1.1 cm).
Weight: 3.7 lbs. (1.7 kg).
Price: $750; DEQ-P800 DSP unit, $300.

Company Address: P.O. Box 1760, Long Beach, Cal. 90801.
For literature, circle No. 90

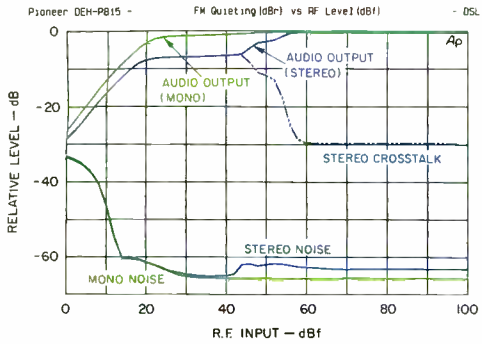


Fig. 1—FM quieting characteristics and stereo separation.

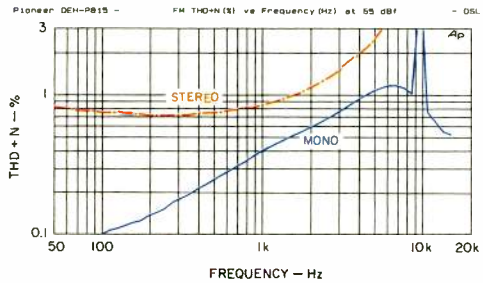


Fig. 2—THD + N vs. frequency, FM section.

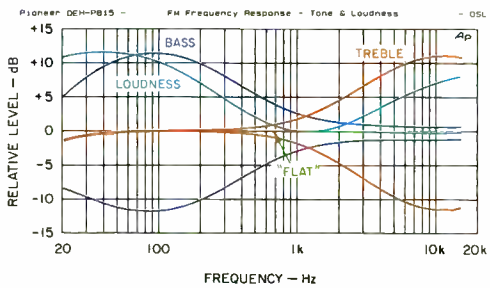


Fig. 3—FM frequency response and range of tone and loudness controls.

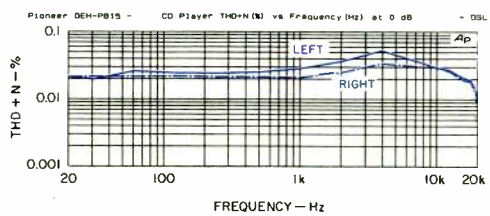


Fig. 4—THD + N vs. frequency, CD section.

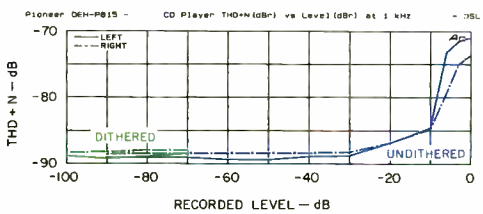


Fig. 5—THD + N vs. level, CD section.

Memory) or to limit the selection to those stations with the same music format as the one you've currently chosen ("F.BSM," or Format Best Station Memory). When "format tuning," you have a choice of two modes: "Wide" searches in a radius of approximately 90 miles; "Narrow" confines the search to stronger stations within about 30 miles from your position.

The CD section offers track search and track scan (provided you're in the "MANU" mode), as well as one-track repeat, disc repeat, intro scan (Pioneer calls it "Scan Play"), and random play. If one or more changers are connected, the repeat, random, and intro-scan features can be expanded to include all discs in the magazine or in the system. Playback also can be paused, a feature not always available on car players.

When using one or more CD changers, an "ITS" (Instant Track Selection) function lets you program and play specific tracks. Up to 100 disc titles also can be stored for display, if you have the stamina to enter the titles character by character with multiple key presses per letter. Finally, the CD section offers two levels of dynamic range compression ("COMP") and two levels of "D.B.E." (Dynamic Bass Emphasis). Since evaluating the performance of such circuits is more subjective than objective, I'll rely on Ivan Berger for his comments.

Measurements

To avoid endless recitation of numbers in the text and to aid you in digging out the data you need for product comparison, I've gathered as much of the numeric data as possible into a "Measured Data" Table. Some data is best described by graphs or words, so I'll concentrate on those and point out tabulated figures only when I believe they are significantly better or worse than average. I strongly advise you to peruse the Table with care; much of the real meat is there.

Mono and stereo FM quieting curves (including 1-kHz stereo separation) are plotted in Fig. 1. From these you can see that the DEH-P815's tuner is very sensitive and reaches 50-dB quieting at low r.f. input. However, stereo separation remains essentially nil to a fairly high signal level (45 dBf), after which it rapidly "opens up" to stereo. The shapes of the curves suggest that performance should be relatively noise-free over a wide range of signal conditions, as the noise remains below –60 dB on all signals stronger than 14 dBf (albeit at the sacrifice of true stereo reception on marginal stations).

The tabulated data shows that, compared with a home tuner, the Pioneer's capture ratio has been sacrificed to some extent for better selectivity; this is a common and probably wise trade-off for good on-the-road performance. Image rejection, the ability to ignore a station 21.4 MHz (two i.f. frequencies) higher than the one selected, is rather modest. However, I've never been convinced of its importance; you should seldom encounter a strong transmission at a frequency 21.4 MHz above the desired station. The AM rejection, which—along with capture ratio—affects sound quality under multipath reception conditions, is quite good.

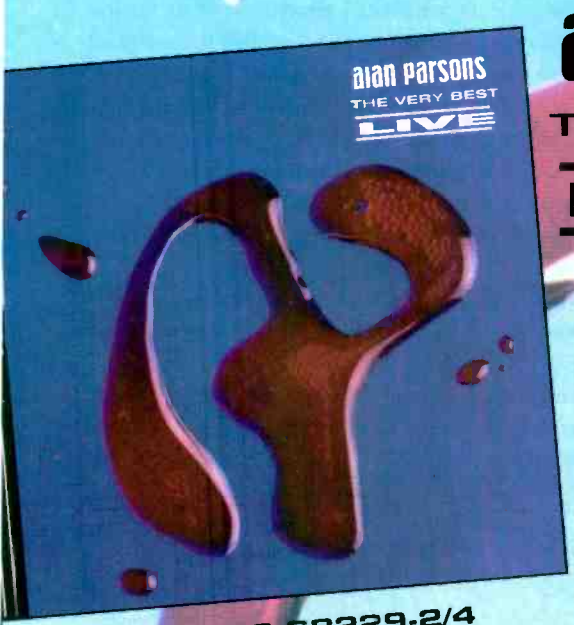
Figure 2 shows THD + N as a function of frequency with a 65-dBf input. I judge the stereo characteristics as average to a bit better than average for a car tuner; mono distortion is exceptionally low over much of the audible range. The peak in mono distortion at 9.5 kHz is probably a measurement anomaly. Apparently, there's just enough second-harmonic distortion at 9.5 kHz to be mistaken for a stereo "pilot" at 19 kHz (the second harmonic of 9.5 kHz); during the test, the "Stereo" legend blinked on as the frequency swept past this point. I doubt this would occur on a real broadcast, because there's not likely to be much sustained energy at so a high a frequency.

The FM-stereo crosstalk was unusually uniform over the full audio range, similar in the two directions, and should be more than adequate for car use. Except for a slight bass roll-off below about 50 Hz, the FM tuner's frequency response (Fig. 3) is flat, and the two channels are reasonably well balanced. The AM tuner response was typical—which is to say, not very exciting.

His work on Let it Be, Abbey Road and Dark Side of the Moon is legendary

The music he made with the Alan Parsons Project remains timeless

Now
FOR THE FIRST TIME EVER
he's LIVE and on the road to America



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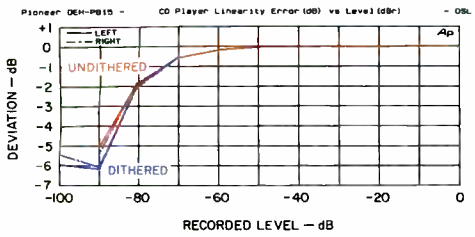


Fig. 6—Linearity error.

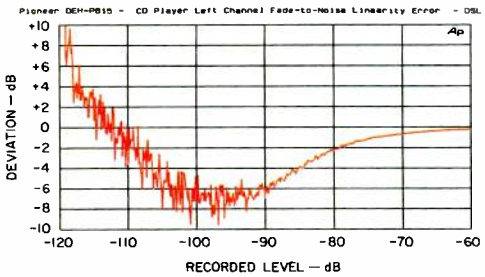


Fig. 7—Fade-to-noise test.

The high end collapsed above 4 kHz, and the bass was rather weak. The AM section of the DEH-P815 was not quite as sensitive as some tuners that have passed my bench recently.

The tone controls have adequate range and are quite symmetrical (Fig. 3). Rather than shelving below 100 Hz, as many bass-control circuits are designed to do, those in the DEH-P815 exhibit maximum range in the octave between 70 and 140 Hz, with less range at lower frequencies. The treble-control action is more typical. The loudness contour boosts both bass and treble substantially, and its bass boost is maintained down to 20 Hz (this data was taken with the volume control adjusted to deliver 30 dB of attenuation).

The CD section's response rolled off slightly at both frequency extremes, but I don't believe you'll be able to hear this deficiency in a car; the channels were balanced somewhat more closely than the tuner's. The CD channel separation, shown in the Table for the worse case, was excellent. The THD + N at maximum recorded level (Fig. 4) is negligible across the entire audio band. As shown in Fig. 5, THD + N at 1 kHz drops even lower at recording levels below –10 dB.

The fly in the ointment is excessive linearity error, especially at recorded levels below –80 dB. The effect can be seen both in the graph of linearity error (Fig. 6) and in the fade-to-noise plot (Fig. 7). For both of these, I was forced to use a deeper vertical scale than usual to accommodate the curves. (The fade-to-noise plot was taken on the left channel, but the right was essentially similar.) In a home player, you might hear these anomalies as a loss in ambience; in a car, the background noise may well mask them. Spectrum analyses, of a 1-kHz recording at –60 dB and of "digital silence" (not shown), were typical of those from "oversampled one-bit" converters; the noise rose rapidly above 100 kHz, but there was very little 44.1-kHz sampling noise present. *E.J.F.*

Behind the Wheel

Once you get past the barriers imposed by the instruction manual (and find the more helpful reference card that's also packed with the unit), the DEH-P815 turns out to have truly sensible ergonomics. This becomes much clearer once you realize that the remote is not the usual afterthought, but is integral to the unit's operation. Without it, you cannot perform such basic tasks as muting, manual and seek up/down tuning, controlling bass and treble, fading, balancing, switching tuner bands and CD tracks, or controlling the optional DSP unit or CD changer. The remote is meant to be attached with hook-and-loop fastener strips to an easily reached place on your console, and its sculptured controls are far easier to operate by touch than those on any front panel I can recollect.

THE REMOTE'S SCULPTURED CONTROLS ARE EASIER TO OPERATE BY TOUCH THAN FRONT-PANEL BUTTONS.

The front panel does give you another way to control volume, select preset stations on the current band, and switch between tuner, CD, and power off. But its main uses are for ID Logic and setup. Once I became accustomed to this control system (which I'd seen before in Sony's ES car stereo system and Pioneer's Optical Digital Reference System), I used the remote about 95% of the time.

Getting used to the controls is complicated by a manual that never says "Press the APF button" when it can say "Press button (8) of [10]." As a result, you don't just refer back and forth between the manual and the unit but must refer to the manual's text, the unit, and the diagram—all at once. The reference card works much better, but you still need the manual for some features.

The row of six station buttons, normally a minor ergonomic pitfall, works. That's because they are not buttons but rockers, so you're really dealing with three elements instead of six. The rockers carry tiny labels identifying their tuner functions, while equally tiny labels for CD functions are printed just above. However, only the tuner labels illuminate, even in CD mode.

As mentioned above, you must tilt the front panel down to remove the faceplate for security or to reach the CD eject button. Having a button that opens and ejects in one go, and another that pops the faceplate off directly, would be more convenient. (On the other hand, I never found the panel-open button easy to press by accident, as Ed Foster feared.)

I found ID Logic useful in two ways: It told me what stations I was tuning in, and helped me find stations with a given program format. Since it cannot read this information from the stations' own signals (as RDS does), a radio's ID Logic system needs to know where the car is.

The big difference between this Pioneer and earlier ID Logic radios is that the DEH-P815 can calculate location changes based on the signals it's receiving. With earlier models, you had to manually update north/south and east/west changes in the car's position. You can still do this (the "compass" function Ed Foster described), but you no longer have to. Just set the name of the state you're in, press a button, and the radio calculates the current location by comparing the signals it can then receive to the stations in its database. When you're travelling, you can push a button every so often to update the location setting; if you're listening to CD, the ID Logic system even updates its location setting automatically.

Without proper location data, ID Logic does not work. Parked between Plainfield

and Newark, New Jersey, I could find stations of any desired format, using either city as the system's location setting. But with the location set to Middletown, about 25 miles to the southeast, it could not find them. This was unfortunate, since the DEH-P815's automatic positioning systems kept identifying Middletown as the car's location, even when I was a half-mile from the Plainfield border. Similar errors of about 15 to 30 miles occurred throughout the area.

Figuring these errors were due to the signal-crammed air of the New York City area, I set the location as "Newark" (the center of the area I drive around in), then drove down to Philadelphia, about 90 air miles away. I'd expected the system to identify intermediate locations between the two (such as Flemington, Princeton, or Trenton), but it kept insisting it was still in Newark, long after any stations that could be picked up there had faded away. Only a few miles from the Philadelphia city limit did the system finally correct its location setting. (Pioneer tells me that the system would have changed its location setting sooner if both cities had been in the same state.) The automatic position-sensing systems in Pioneer's ID Logic are definitely a big advance over the first ID Logic system I tested, but they still need work.

Aside from ID Logic, the tuner gave me slightly better reception than my reference Alpine on reasonably strong FM stations and noticeably better performance and longer range on marginal stations. The Pioneer also had slightly better AM reception. The DEH-P815 sounded sweeter and clearer than the reference on FM, with a hair less warmth and a greater sense of high-frequency extension. On the road, the Pioneer's higher stereo threshold did not so much give the feeling I was hearing mono as that I was closer in to the music; the Alpine presented more of a slightly distanced soundstage. This was probably due to the programming I heard; stations carrying symphonies and other programs that would have highlighted the difference were all strong enough to be heard in full stereo on both radios. The Pioneer's AM sound was a bit more muted in the treble than the reference unit's.

I liked the adjustable local-mode tuning threshold, which I've seen on other Pioneer head units. I did not like having to figure out that you can only switch between manual and seek tuning when the "FUNC" light is on; the manual doesn't mention this.

As with most car stereos, there was a difference in level between radio and CD sound. Since the mismatch was mild, and I only had the Pioneer for a few weeks, I did not bother with "SLA" (Source Level Adjustment). If the Pioneer were a permanent companion, I'd find "SLA" useful.

On CDs, the DEH-P815 and my reference sounded virtually alike, with the Pioneer perhaps a hair clearer and cleaner. There's also a SoundScape function, which allows CD sound to be heard as background to the radio, but I saw no need for it. The milder setting of the compressor, which only works with CD, was useful in combatting road noise; the stronger setting was too much, even with the car windows open. I could hear no difference from the Dynamic Bass Enhancer, another CD-only enhancement.

There seemed to be no need to use the bass and treble controls, which says good things about the overall sound, so I can't comment on their curves. I did try the loudness compensation; its aggressive treble boost put a nasty edge on the sound.

I liked the DEH-P815 a lot. Performance was definitely good, and the ID Logic (despite glitches) was immensely useful. But the real plus was the sculptured remote, the most convenient control system I've ever used with a car stereo. *I.B.*

MEASURED DATA

FM TUNER SECTION

Mono Sensitivity: IHF usable, 13.1 dBf; 50-dB quieting, 13.0 dBf.

S/N Ratio at 65 dBf: Mono, 65.4 dB; stereo, 62.1 dB.

Frequency Response in Stereo: 50 Hz to 15 kHz, +0, –0.3 dB; 20 Hz to 15 kHz, +0, –1.5 dB.

Channel Balance: ±0.21 dB.

Channel Separation, 20 Hz to 15 kHz: Left to right, greater than 31.1 dB; right to left, greater than 32.2 dB.

THD + N at 65 dBf and 100% Modulation: Mono, 0.1% at 100 Hz, 0.40% at 1 kHz, and 1.18% at 6 kHz; stereo, 0.76% at 100 Hz, 0.86% at 1 kHz, and 3.36% at 6 kHz.

Capture Ratio at 45 dBf: 2.8 dB.

Adjacent-Channel Selectivity: 25.2 dB.

Alternate-Channel Selectivity: Greater than 78 dB.

Image Rejection Ratio: 45.0 dB.

AM Rejection: 58.0 dB.

AM TUNER SECTION

Sensitivity: 5.2 µV.

Frequency Response: 100 Hz to 4 kHz, +1.0, –6 dB.

CD SECTION

Frequency Response: 30 Hz to 20 kHz, +0, –0.42 dB; 20 Hz to 20 kHz, +0, –0.76 dB.

Channel Balance: ±0.13 dB.

Channel Separation, 125 Hz to 16 kHz: Left to right, greater than 75.6 dB; right to left, greater than 71.4 dB.

THD + N at 0 dB, 20 Hz to 20 kHz: Left, less than 0.053%; right, less than 0.034%.

THD + N at 1 kHz: Left, less than –70.9 dB from 0 to –90 dB, less than –84.5 dB from –10 to –90 dB; right, less than –73.6 dB from 0 to –90 dB, less than –84.7 dB from –10 to –90 dB.

Linearity Error: Left, –0.20 dB at –60 dB recorded level, –0.60 dB at –70 dB, –1.92 dB at –80 dB, and –5.16 dB at –90 dB; right, –0.20 dB at –60 dB recorded level, –0.60 dB at –70 dB, –1.87 dB at –80 dB, and –5.52 dB at –90 dB.

A-Weighted S/N at Infinity Zero, re: 0-dB Recorded Level: Left, 92.6 dB; right, 91.2 dB.

Dynamic Range: Left, 97.3 dB unweighted, 100.0 dB A-weighted; right, 96.3 dB unweighted, 98.8 dB A-weighted.

Quantization Noise, re: 0 dB: Left, –83.5 dB; right, –83.8 dB.

PREAMP/POWER AMP SECTION

Line Output Level: Tuner mode, 1.08 V for 100% mono FM modulation, 0.30 V for 30% AM modulation; CD mode, greater than 1.53 V for 1 kHz at 0 dB.

Line Output Impedance: 775 ohms.

Tone-Control Ranges: Bass, +11.5, –11.6 dB at 100 Hz; treble, +11.2, –11.4 dB at 10 kHz.

Loudness Contour: +11.5 dB at 50 Hz and +8.0 dB at 15 kHz, with volume at –30 dB.

Subwoofer Crossover Frequencies: –3 dB at 62, 88, or 125 Hz.

Crossover Slope: Approximately 12 dB/octave.

Attenuator: 20.1 dB.

Output Power at Clipping: 17.4 watts/channel into 4 ohms, two channels driven.

EQUIPMENT PROFILE

BASCOM H. KING

CARY AUDIO DESIGN CAD-805 MONO AMP

For some time, I have been watching the reemergence of single-ended tube power amplifiers. Currently there are several commercial single-ended triode tube amps on the market, as well as a smaller number of kits. Remembering the comment of my mentor, Gordon Mercer, that the sound of a single-ended 845 triode amp he built in the '40s was one of the best he had heard, I have long wanted to sample some of this nirvana. Happily, the Cary Audio Design CAD-805 mono amp came into my life. This is a high-power unit, for single-ended triode technology. Most such amps put out 5 to 20 watts, whereas the CAD-805 is rated at 50 watts (albeit at about 10% distortion, I find). This is definitely enough power to run my reference system's B & W 801 Matrix Series 3 speakers.

A standard intellectual argument against single-ended Class-A operation is that it is less efficient than push-pull operation. Theoretically, its efficiency is 25% (in practice, somewhat less), whereas that of push-pull is 50% or higher, depending on the class of operation. This means that, for a given tube's plate-dissipation rating, the amount of output power attainable is very limited, typically 3 to 10 watts. Used in push-pull, the same tubes could deliver perhaps 12 to 25 watts. In addition, single-ended operation lacks push-pull's cancellation of spurious even-order harmonics, so distortion will be considerably higher. Lastly, the high continuous quiescent current in a single-ended stage causes d.c. magnetization of the output transformer's core, which causes added distortion and limits low-frequency power delivery. An output transformer that can mitigate these effects has to be quite large and expensive.

Given all the disadvantages of single-ended operation, why would anybody put up with its limitations of low power and high distortion? The answer is in the sound of music processed by such an apparently illogical mechanism. Many reviewers feel these amps deliver a certain quality of musical ease and believability—a certain midrange magic, if you will—that other design approaches seem unable to match.

SPECS

Type: Single-ended Class A.
Power Output: Class A_1, 24 watts; Class A_2, 50 watts.
Frequency Response: 20 Hz to 20 kHz, ±0.5 dB.
Noise: 80 dB below rated output.
Feedback: Adjustable, 0 to 10 dB.
Sensitivity: 1 V for full output, with feedback at zero.
Input Impedance: 150 kilohms.
Output Impedance: 4, 8, and 16 ohms.
Tube Complement: One 6SL7, one 300B, and one 211, plus 6U5 indicator.
Power Consumption: Operating mode, 230 watts; standby mode, 76 watts.
Power Requirements: 100, 110, 117, 220, or 240 V (factory selected); 50 to 60 Hz.
Dimensions: 12¼ in. W x 10 in. H x 24 in. D (31.1 cm x 25.4 cm x 61 cm).
Weight: 80 lbs. (36.3 kg) each.
Price: $7,995 per pair.
Company Address: 111-A Woodwinds Industrial Court, Cary, N.C. 27511.
For literature, circle No. 94

Photos: Michael Groen

SELF-BIASING IS THE KEY TO THIS AMP'S EXCEPTIONALLY HIGH OUTPUT FOR ITS TYPE.

The shape of the CAD-805 is more elongated than that of most other designs: With the front panel facing out, the amp is unusually deep. Still, it is a very attractive piece, sporting two very large transformers (main power and output), four filter capacitors, and the three tubes. The latter are lined up by ascending size, from the input 6SL7 to the mighty 211 output tube. An interesting decorative touch is that the two knobs (also in the top plate) for setting the "Feedback Output" tap and "Feedback Level" have green "jewels" in them. The front panel is a thick piece of aluminum, anodized in an attractive gold color. In what I consider a humorous twist, Cary uses an old tuning-eye tube, a 6U5, as a relative output indicator on the front panel. (Cary's Dennis Had once told me that they like to have fun doing their thing. I think they must be doing just that.) Two toggle switches on the top surface, near the front panel, select power on/off and standby/operate. The rear panel has three pairs of Edison-Price dual binding posts (for 4-, 8-, and 16-ohm speaker connections), an IEC a.c. power-cord socket, two fuse-holders (one for the a.c. line, the other for a cathode-current fuse for the 211), and a high-quality RCA jack for signal input. On the top surface, near the rear, are a ¼-inch phone jack and potentiometer used in setting the plate current of the 300B driver tube.

Looking inside, we find that the CAD-805 is wired the old-timey way: Point to point, with lug strips for tie points. Much of the wiring itself appears to be Teflon jacketed. Also traditional is the technique of grounding various components directly to the chassis, rather than having a separate ground bus tied to the chassis at only one point. Parts quality is generally excellent, using mostly Kimber Kap film capacitors, Dale RN65D-series metal-film resistors, and several Dale RH-25 chassis-mount power resistors. The main coupling capacitor between the first and second stages is a 0.22-µF, 600-V oil-filled unit. I was surprised (but certainly not dismayed) by the use of a Radio Shack power transformer to deliver the filament supply to the front-end and driver tubes. Wiring is neat and workmanlike. All in all, a very competent, solid, and well-made piece.

Circuit Description

The design utilizes a "King of the Triodes" 211 tube (or the equivalent VT-4-C), which is like the 845 but with a higher amplification (mu) factor. These tubes are wonderful and impressive output devices, having a carbon plate rated for a dissipation of 100 watts and a thoriated-tungsten filament that glows yellow (like an old light bulb) when running. I have had a long-term love affair with this kind of tube; I made a pair of push-pull 845 power amps some 30 years ago that had the honor of driving the Infinity IRS midrange/tweeter panels in their Chicago CES introduction about 10 years later.

Normally, a single-ended 211 would put out some 20 to 25 watts in Class-A operation. (Single-ended amps have to be run Class A, by definition.) How does the CAD-805's circuit achieve about twice this power? The secret is that the design employs a driver transformer (oh, horrors, another *transformer*?!). One end of the secondary winding is directly connected to the 211's control grid, and the other end is grounded. Cathode- or self-bias is utilized, with the filament supply "center tapped" through 20-ohm resistors from each filament lead; the common connection of the two resistors goes to ground through another, larger power

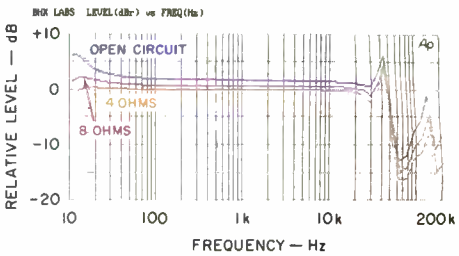


Fig. 1—Frequency response of amp B (see text) at 8-ohm tap, feedback control at mid-rotation.

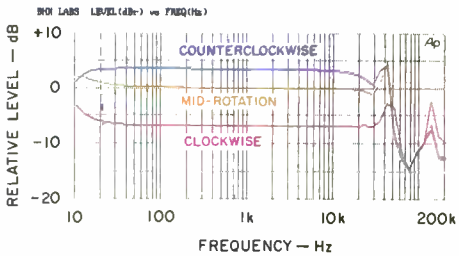


Fig. 2—Frequency response of amp A vs. feedback setting.

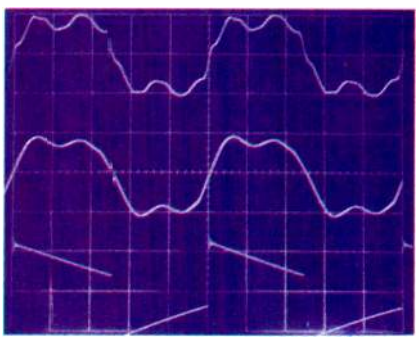


Fig. 3—Square-wave response, 10 kHz into 8 ohms (top), 10 kHz into 8 ohms and 2 µF (middle), and 40 Hz into 8 ohms (bottom).

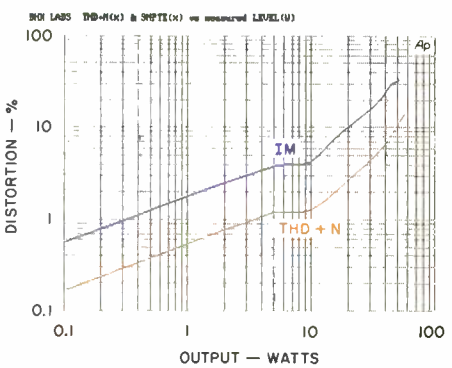


Fig. 4—THD + N and SMPTE-IM distortion vs. output.

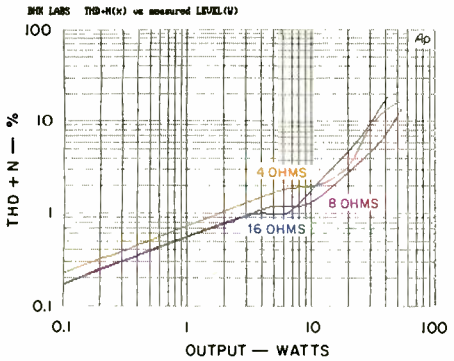


Fig. 5—THD + N at 1 kHz vs. output at the 8-ohm tap.

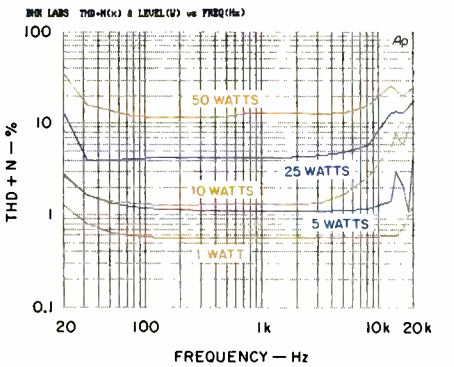


Fig. 6—THD + N vs. frequency.

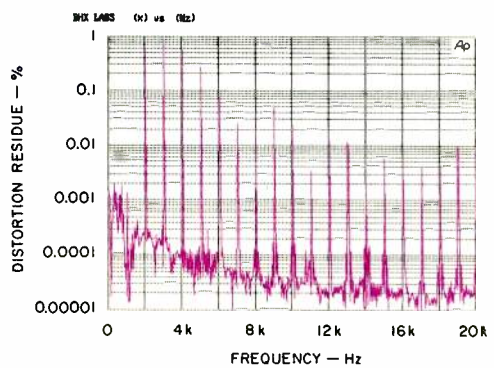


Fig. 7—Spectrum of 1-kHz harmonic-distortion components at 10 watts.

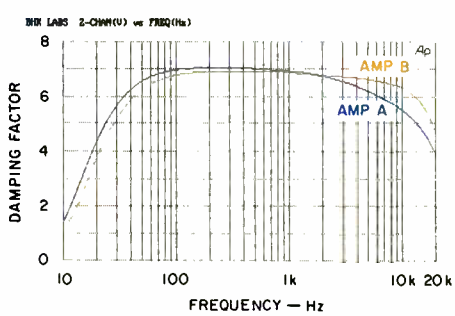


Fig. 8—Damping factor vs. frequency.

resistor bypassed with a large electrolytic capacitor. The driver transformer permits the 211's grid to be driven positive, resulting in Class-A_2 operation. When the grid goes positive in respect to the cathode (in this case, the filament), its impedance drops dramatically.

To pull this off, the CAD-805 needs power from the preceding driver stage. This is handled by a 300B, one of the best-sounding power triodes and often used as an output tube in many triode amps. The result of driving the output tube's grid positive is that the plate bottoms more (comes closer to zero), permitting a greater plate voltage swing and higher power.

Front-end honors in the CAD-805 go to a 6SL7, a nicely linear octal-base, hi-mu dual triode. This tube is connected in a series arrangement, where the bottom tube acts as a common-cathode voltage amplifier and the upper tube functions as a semi-constant current source load for the lower tube. The upper tube's cathode is capacitor-coupled to the grid of the 300B driver.

Overall adjustable negative feedback is taken from the selected output tap (chosen via a three-position switch) to a potentiometer used as a feedback series resistor and back to the cathode of the input stage. The feedback resistor is wired in series with its built-in, two-position rotary switch. In the counterclockwise position, the switch is open and there is no overall feedback. As the control is rotated clockwise, the switch closes and the series resistance starts to decrease. Maximum clockwise rotation results in maximum negative feedback.

The power supply has one main, potted power transformer and a small auxiliary transformer. Output of the main high-voltage secondary winding is rectified by a full-wave bridge and applied to a filter bank comprising three 100-µF, 450-V capacitors in series. A series filter choke leads to a final filter element of three 1,200-µF capacitors in series. The series connection of the filter capacitors is necessary to handle the supply voltage, which is in excess of 1 kV in the standby mode. The operating B+ for the 211 output tube is about 950 V, applied to the primary of the output transformer. A lower voltage B+ source (some 475 V), for the driver and front-end tubes, is taken from the center tap of the high-voltage secondary winding. The aforementioned "center-tapped" filament supply for the 211 is derived from two secondary windings in series on the main power transformer. This winding is full-wave rectified and filtered, providing d.c. voltage for the 211 filament.

SINGLE-ENDED AMPS HAVE UNMATCHED MUSICAL EASE AND BELIEVABILITY.

The auxiliary power transformer's secondary winding is full-wave rectified and capacitor filtered to provide d.c. voltages to the 6SL7 and 300B filaments.

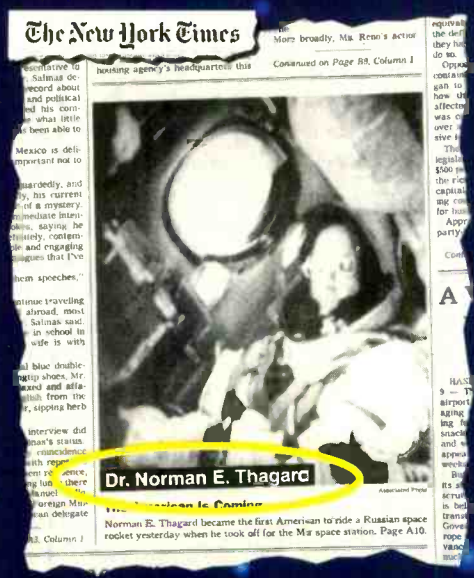
Measurements

I used a pair of CAD-805s, which will be referred to as amp A and amp B. Measurements quoted are for amp B unless otherwise stated. Voltage gains and IHF sensitivities, for the 8-ohm taps loaded with 8 ohms, are listed in Table I for the middle and full counterclockwise positions of the feedback control.

Figure 1 shows frequency response for open-circuit, 8-, and 4-ohm loading on the 8-ohm output tap, with the feedback control set at mid-position. The ultrasonic response is not very well behaved, exhibiting resonances at about 40 and 130 kHz. It is difficult enough to properly enclose one transformer in a feedback loop, let alone two. One might expect the amp to oscillate at the 40-kHz resonance with the feedback turned up more. That is exactly what happened with the feedback control set past about three-quarters rotation. Not so good. Amp A was high-frequency stable to full rotation of the feedback control. The change

What do NASA and AUDIO Magazine have in common?

Dr. Norman E. Thagard



On March 14th, astronaut ***Norman E. Thagard*** *became the first American to launch into space aboard a Russian rocket, en route to the Mir space station.*

Both a medical doctor and Marine Corps fighter pilot, Dr. Thagard is also an avid electronics enthusiast and AUDIO reader. While not orbiting the Earth, Dr. Thagard writes articles on electronics design. His most recent effort was a 3-part feature for his fellow electronics enthusiasts in AUDIO Magazine. The subject: how to build your own mono 100-watt class A amp!
(Audio 1/95 - 3/95)

Congratulations Dr. Thagard
and thanks for taking us to new heights!

AUDIO
THE EQUIPMENT AUTHORITY

Table I—Gain and IHF sensitivity.

	Gain, dB		Sensitivity, mV	
Feedback Setting	AMP A	AMP B	AMP A	AMP B
Mid-Rotation	24.0	24.8	178.5	162.0
Fully Counterclockwise	27.4	28.2	120.9	110.5

Table II—Output noise levels. The IHF S/N figures for amps A and B were 87.7 and 86.5 dB, respectively.

	Output Noise, μV	
Bandwidth	AMP A	AMP B
Wideband	842.3	853.5
22 Hz to 22 kHz	837.2	854.5
400 Hz to 22 kHz	63.7	84.5
A-Weighted	117.1	133.2

of gain with feedback-pot rotation was not very linear. When the pot was rotated from its counterclockwise position and the switch clicked on, the gain dropped about 3 dB. From this position to about three-quarters rotation, the gain dropped only about 1 dB more, with most of the gain change taking place in the last quarter of rotation. Of interest (and something one seldom sees in modern amplifiers) is the peaking in the region between 10 and 20 Hz, which is a function of load. The main effect of this low-frequency peaking would be large, possibly excessive, woofer excursion in ported enclosures whose lower impedance peak happens to be in this frequency range.

Frequency response of amp A is shown in Fig. 2 as a function of the feedback-pot setting, with 8-ohm loading on the 8-ohm output tap. With full feedback applied, the low-frequency stability becomes marginal, in my opinion.

Square-wave response is shown in Fig. 3. The 10-kHz frequency, used for the top two traces, is kind to the amplifier; a wickedly chosen frequency with third or fifth harmonic at 40 kHz would show a lot more ringing. In fact, for the 40-Hz waveform (bottom trace), high-frequency ringing is plainly visible. The top trace is for a resistive load of 8 ohms on the 8-ohm tap, with the feedback control at mid-rotation. Rise-time is a bit difficult to define for a waveform that doesn't attain steady state in the half-cycle time, but it would appear from the figure to be on the order of 8 to 10 μS. In the middle trace, the addition of a 2-μF capacitor across the 8-ohm load seems to stabilize the amp and to roll off some of the higher frequencies. The degree of tilt in the 40-Hz trace is a bit excessive and portends probable rapid roll-off below the low-frequency resonance.

Both THD + N (with a 1-kHz signal) and SMPTE-IM distortion are plotted in Fig. 4 as functions of power output, with 8-ohm loading on the 8-ohm tap. As you can see here, the distortion reaches some pretty outrageous numbers, by modern standards. (I also measured THD + N versus power for 4-ohm loading on the 4-ohm tap, and for 16-ohm loading on the 16-ohm tap, and got essentially identical results.) The ratio between IM and THD is a little more than 3 to 1, nearly classical behavior for a simple device. Note that the simple second-harmonic-dominant behavior of the amp starts to change at about 5 watts output—which, I believe, is the onset of the grid-current phenomenon, even though grid-to-cathode voltage has not yet reached zero. The positive polarity of the drive signal to the 211 tube matches the "cathode voltage" (i.e., 0-V potential between grid and cathode) at about 8 watts output. Note that these two power levels flank the flat portion of the curve for THD + N in Fig. 4. Another note: The tuning eye closed at about 15 to 20 watts, although the operating manual says that it closes at "full output." The a.c. line current drawn by the amp was substantially constant up to 50 watts, a classic sign of Class-A operation.

Figure 5 shows the effect of 4-, 8-, and 16-ohm loading on the 8-ohm tap. Load tolerance is very good, with very similar results attained for each condition over most of the power range.

Figure 6 shows THD + N as a function of frequency and power, for an 8-ohm load on the 8-ohm tap. Interestingly, the 10-watt curve has the steepest rise in distortion in the high frequencies, and in the 50-watt test my Audio Precision test gear dropped out of regulation at constant power near the frequency extremes.

As a final look at distortion, a spectrum of a 1-kHz signal at the 10-watt level (with 8 ohms on the 8-ohm tap) is plotted in Fig. 7. Things look quite complex at this power level for a simple Class-A amplifier, to be sure. At the 1-watt level (not shown), the spectrum was much simpler. There was about the same amount of second harmonic, but the third was down to about 0.015% and all remaining harmonics were less than 0.002%.

Damping factor versus frequency is shown for both amplifiers in Fig. 8. The drop in damping below 100 Hz is unusual. This could well cause the bass characteristics of the CAD-805 to sound different from those of an amp with a more consistent low-frequency damping factor, all other things being equal.

Table II shows output noise as a function of measurement bandwidth, with the amp's feedback pot set to its midpoint.

Dynamic and clipping levels were substantially the same, about 56 watts, depending on one's interpretation of the 'scope waveforms at the clipping level. There was no amplitude droop during the 20-mS tone burst in the dynamic test—another sign of Class-A operation, since the power-supply current drain is constant with power level. The a.c. line current was 0.76 ampere in the standby state and 2.4 amperes when the CAD-805 was fully operational.

I WAS IMPRESSED BY THIS AMP'S EASY SOUND, WHICH SOON BECAME QUITE ADDICTIVE.

Use and Listening Tests

Signal source equipment used in my system during the review period included an Oracle Audio turntable fitted with a Well Tempered Lab tonearm and a JVC X-1 moving-magnet pickup, playing via my own tube phono preamp or a Quicksilver

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Audio preamp. Also, Counterpoint DA-11A and PS Audio Lambda CD transports were used to drive the Sonic Frontiers SFD-2 and other (experimental) D/A converters. Other signal sources included a Nakamichi ST-7 FM tuner and 250 cassette recorder, as well as a Technics open-reel recorder. Preamplifiers included a DGX Audio DDP-1, a Quicksilver Audio unit, Forssell tube line drivers, a First Sound II passive model, and my own passive signal selector/attenuator. Other power amplifiers used were a Crown Macro Reference, Quicksilver M135s, and a pair of VAC PA160 tube mono amps. Loudspeakers were B & W 801 Matrix Series 3s, augmented between 20 and 50 Hz by my subwoofer system, using a JBL 1400Nd driver in a 5-cubic-foot ported enclosure for each channel.

I must admit I was quite impressed with the sound of the CAD-805s when I first got them going. There was, indeed, an ease to the sound that made it a pleasure to listen to music with these amps. In fact, as they broke in a bit more, they became quite addictive! Resolution and space were very good. As I got used to them, I did start to hear certain things that other amplifiers do better. Bass, for instance, although nicely defined and musical, didn't always have the low-frequency extension and impact of some other similarly powered amps of more conventional design. And, of course, the power limitation, and the large amount of distortion that does occur as that power limit is reached, tend to make the sound congested when the CAD-805s are pushed. Don't get me wrong, though, because these amps play most of the music I like, at the playback levels that I customarily use, with no apparent problem. After experimenting with the setting, I found I had a distinct preference for no negative feedback.

The two units operated flawlessly during the review period. Given the operating margin in their design, I would expect them to continue reliably doing their thing for many years to come.

I definitely liked Cary Audio Design's CAD-805s very much and strongly recommend giving them an audition if your musical tastes, speaker efficiency, and playback levels are compatible with them. But in any case, give them an audition to see what all the current interest in single-ended amps is all about. A

EQUIPMENT PROFILE

D. B. KEELE, JR.

KLIPSCH CF 3 SPEAKER

Klipsch, Inc. has been making audiophile speakers since 1945. The Klipschorn design (see Dick Heyser's review in *Audio*, November 1986) has remained virtually unchanged for almost 50 years—a record no other company even approaches. Still led by founder Paul Klipsch, now 91, the firm continues to develop new designs.

I recently tested the next-to-the-top model in Klipsch's Epic series of four two-way floor-standing speakers. These models all utilize vented-box direct-radiator woofers in a D'Appolito configuration (two drivers in a vertical array flanking a tweeter) with a sizable constant-directivity midrange/tweeter horn. Klipsch's constant-directivity horns are based on tractrix flare theory (see *Audio*, March 1991), which the company designates "Controlled Focus Technology" in its literature. As with most Klipsch designs, high efficiency and sensitivity are emphasized.

Including the Epic series, Klipsch's extensive home line comprises 33 models, including the Heritage line (which includes such classics as the La Scala, the Heresy, the Belle Klipsch, and the Klipschorn), home theater THX products, subwoofers, and architectural (in-wall) speakers. These systems range in price from the KG .5, at $250 per pair, up to the Klipschorns, at $4,000 per pair. Klipsch's industrial-strength professional line is also quite extensive and is used by many touring rock groups and motion picture theaters. (I was chief engineer at Klipsch for one year starting in 1976, working primarily in the commercial-professional area.)

Klipsch apart, the use of horns in home systems is quite rare these days. Particularly rare is the use of constant-directivity designs to reproduce mid and high frequencies. This type of horn is used very extensively in high-level commercial and professional sound applications—and particularly in film theaters, where its use is mandated in THX installations. Well designed constant-directivity horns exhibit very uniform but highly directional coverage that changes little with frequency, and their frequency response is nearly independent of direction. (I am well acquainted with such horns, because I hold three patents on their design—one issued while I was employed by Electro-Voice in the early '70s, and two in the early '80s, while I was working at JBL.)

The CF 3 utilizes a large-mouth (13 x 9-inch) tractrix-based, constant-directivity molded horn providing 90° horizontal x 60° vertical coverage. This dispersion is wide enough to completely cover the listening area yet still sufficiently restricted to greatly reduce interfering side-wall and floor/ceiling reflections. An aluminum-diaphragm, high-frequency compression driver, utilizing a rare-earth neodymium permanent magnet, is attached to the rear of the horn and is used to provide sound above 1.5 kHz. The term "compression" refers to the fact that the area of the horn's throat (which is actually inside the driver) is usually five to 10 times smaller than the driver's radiating diaphragm area. The sound waves can be thought of as being compressed as they travel from the diaphragm's surface through the much smaller horn throat.

All frequencies below 1.5 kHz in the CF 3 are reproduced by two 10-inch woofers with neodymium magnets, mounted in a

Photos: Michael Groen

vented-box enclosure. The very high magnetic strength of neodymium, which is some 10 times more powerful than an equivalent size or weight of ceramic magnet, allows a much smaller magnet to be used in the woofer. The magnet is so small, it is actually located *inside* the voice-coil assembly. The rear of the woofer looks like an old speaker that uses an alnico magnet with an iron pot covering the rear of the woofer (and a quite small pot at that). A side benefit of neodymium is that it allows an inherently magnetically shielded structure. This makes the CF 3 attractive for home theater applications.

The woofers of the CF 3 are deceptively light for the performance they provide. When I first removed one of the woofers from the CF 3, I thought, "This woofer can't be a serious driver; it's too light!" The woofer's cone material is a blend of Santoprene (a Monsanto rubberized plastic material that has a high strength-to-weight ratio), graphite, and polypropylene. This composition is said to provide a rigid, light cone, one that provides unusually clear, resonance-free lower midrange and bass.

The high-frequency driver and the woofers of the CF 3 are all designed and manufactured by Klipsch. The company now has a facility in Hot Springs, Arkansas, that provides manufacturing capability in addition to that of the original plant in Hope, Arkansas.

The CF 3's cabinet is very well braced and embodies sophisticated construction techniques. The top, sides, and rear are made from ¾-inch MDF panels. The front panel is a rigid 1¼ inches thick, composed of 1-inch flake board clad with ¼-inch-thick foam. The front panel is supplied to Klipsch in ready-to-use form; all driver cutouts, recesses, and cosmetic features are already molded in. Two circular ports, 4 inches in diameter and 2½ inches long, are at the bottom of the front panel. The molded plastic grille attaches to the front panel with six projections that mate with rubber-grommeted holes in the front panel.

THE CF 3, LIKE MOST KLIPSCH DESIGNS, EMPHASIZES HIGH EFFICIENCY AND SENSITIVITY.

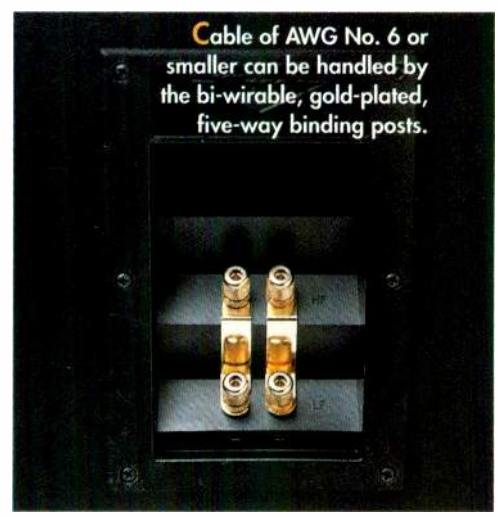
The CF 3's crossover is on two p.c. boards, mounted one over the other and attached to the system's input-terminal cup. One board contains the low-pass components, while the other is dedicated to the high-pass parts. Electrically, the parallel-connected woofers are driven by a third-order low-pass filter (two series inductors with a capacitor to ground), with a series RLC impedance compensation network in parallel with the woofers. Similarly, the tweeter is connected to a third-order high-pass filter, with two series RLC impedance networks connected in parallel with the compression driver. An autoformer (a single-winding transformer with no secondary), with a voltage gain of about 6 dB, is used in the high-frequency part of the network; it raises the tweeter's level and compensates for the compression driver's high-frequency power roll-off.

The crossover contains 17 components (four resistors, six inductors, six capacitors, and the autoformer). Only high-quality parts are used. The inductors are all iron- or ferrite-core. Connections between crossover and speakers use heavy-duty, 14-gauge stranded wire. All drivers are connected in positive polarity. Input connections are via a bi-wirable pair of gold-plated, five-way binding posts mounted in a cup on the bottom of the cabinet. Large cable up to 0.2 inch in diameter (AWG No. 6 or smaller) can be handled by the posts.

Measurements

I measured the on-axis anechoic frequency response of the Klipsch CF 3 at a distance of 2 meters from the front of the cabinet, on the horn's axis (Fig. 1). The input was 5.66 V rms (equivalent to 2 watts into the rated 8-ohm impedance), referred back to 1 meter with an input of 2.83 V rms (equivalent to 1 watt into the 8-ohm impedance). A combination of ground-plane and elevated free-field measurements was used to derive the curves. The primary curve (grille off) was averaged with a 10th-octave filter.

The on-axis response curve, shown in Fig. 1, is reasonably flat and fits a fairly tight 6-dB window (+2, –4 dB referenced to 1 kHz) over the wide bandwidth from 40 Hz to 20 kHz. Except for a slightly higher low-frequency limit (40 Hz, rather than 35 Hz), the curve essentially coincides with Klipsch's ±3 dB rating. The most obvious feature is the roughness above 4 kHz. (High-Q peaks at 5.6, 10, and 18 kHz have been visually reduced in level and


Cable of AWG No. 6 or smaller can be handled by the bi-wirable, gold-plated, five-way binding posts.

SPECS

Type: Two-way, floor-standing vented-box system.
Drivers: Two 10-in. cone woofers with neodymium magnets and a high-frequency driver with aluminum diaphragm driving a constant-coverage tractrix horn.
Frequency Response: 35 Hz to 20 kHz, ±3 dB.
Sensitivity: 100 dB at 1 meter, 2.83 V rms applied.
Crossover Frequency: 1.5 kHz.
Impedance: 8 ohms, nominal.
Recommended Amplifier Power: Up to 250 watts per channel (1,000 watts, peak).
Dimensions: 41 in. H x 17 in. W x 17 in. D (104.1 cm x 43.2 cm x 43.2 cm).
Weight: 102 lbs. (46.3 kg) each.
Price: $2,000 per pair; available in whitewash, light oak, medium oak, cherry, walnut, or black satin finish.
Company Address: 8900 Keystone Crossing, Suite 1220, Indianapolis, Ind. 46240.
For literature, circle No. 91

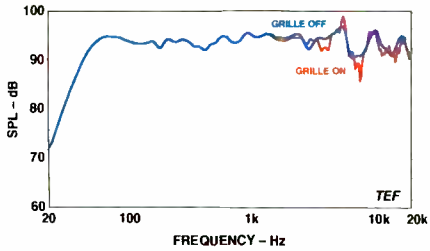


Fig. 1—One-meter, on-axis frequency response.

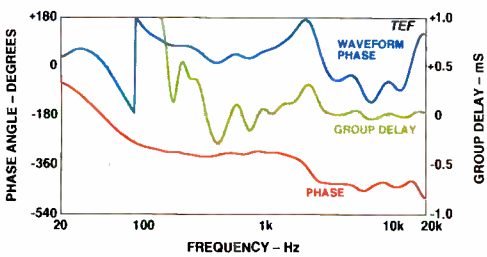


Fig. 2—On-axis phase response, group delay, and waveform phase.

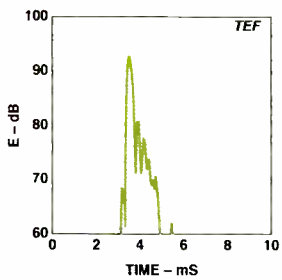


Fig. 3—Energy/time response.

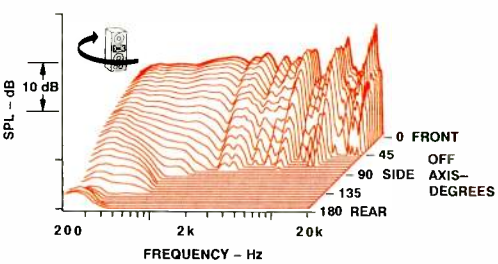


Fig. 4—Horizontal off-axis frequency responses.

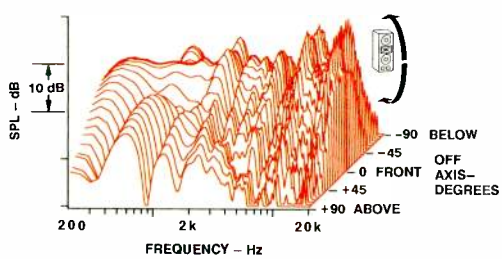


Fig. 5—Vertical off-axis frequency responses.

sharpness by my 10th-octave smoothing. Without this, the curve only fits a 12.5-dB window, primarily due to this high-frequency roughness.)

Averaged from 250 Hz to 4 kHz, the sensitivity of the CF 3 measured a very high 94.3 dB, a significant 5.7 dB below Klipsch's 100-dB rating. The right and left systems matched within a close ±0.75 dB from 100 Hz to 8 kHz. Above 8 kHz, however, the match was much looser: About ±2 dB, with narrow, high-Q peaks beyond this envelope, at 9 and 17.5 kHz. The grille causes significant response deviations above 3 kHz.

Figure 2 shows the phase and group-delay responses of the CF 3, referenced to the tweeter's arrival time. Also shown is waveform phase, a new test that directly indicates whether waveshapes will be preserved in specific frequency ranges. The phase curve is quite well behaved and decreases only 120° between 1 and 10 kHz, and only 140° above 100 Hz! When analyzed and averaged above 300 Hz, the group-delay curve indicates that the woofers and horn tweeter are all essentially in acoustic alignment.

The waveform phase curve indicates that waveshapes will not be preserved, because the phase values are not at or near 0° or ±180° except at isolated, discrete points. The waveform phase does fluctuate much less than in other speakers I've tested, but this has no audible effect.

Figure 3 shows the CF 3's energy/time response. The test parameters accentuate response between 1 and 10 kHz, which includes the tweeter's crossover region. The main arrival, at 3 mS, is fairly compact, but is followed by several delayed responses, down only about 13 to 20 dB. Because the crossover frequency is rather low, the delayed responses are primarily in the horn's range and may indicate problems in the horn or compression driver.

Figure 4 shows the horizontal off-axis responses of the CF 3; the bold curve at the rear of the graph is the on-axis response. The off-axis horizontal responses are quite uniform all the way to 20 kHz, which indicates minimal narrowing above 10 kHz. However, because the curves were not smoothed, as Fig. 1 is, the full extent of the high-frequency roughness is evident in the high-Q peaks and dips.

The vertical off-axis responses of the CF 3 are shown in Fig. 5. Within ±10° of the axis, the curves are quite uniform. Beyond ±15°, however, the response falls off in the octave between 900 Hz and 1.8 kHz, actually dropping deeply at both endpoints of that octave. This narrowing of vertical response is due to the rather large vertical spacing of the two woofers. If the system is aimed straight ahead, with its axis parallel to the floor, standing listeners (who are 12° to 13° above axis) may notice a moderate hole in the response at crossover. To minimize this effect, Klipsch recommends that the speaker's axis be tilted upward slightly, by raising the front of the cabinet with spikes. Not clearly visible in the graph is the high degree of up/down symmetry in the responses. This is an inherent characteristic of the D'Appolito configuration. Generally, the vertical off-axis responses are quite well behaved, although the high-frequency roughness is still seen above 5 kHz.

I IMMEDIATELY NOTICED POWERFUL BASS, HIGH SENSITIVITY, GOOD IMAGING, AND A VERY FORWARD SOUND.

In Fig. 6, the CF 3's impedance magnitude versus frequency, you can see, below 100 Hz, the two peaks and a dip that are characteristic in the bass range of a vented box. The dip to 4.3 ohms at 38 Hz indicates the approximate location of the vented-box tuning. An impedance high of 46 ohms is reached at 3.1 kHz, about an octave above crossover. Minimum impedance occurs at 13 kHz, where the impedance drops to a low level of 2.9 ohms.

The CF 3's max/min impedance variation between 20 Hz and 20 kHz is a high

15.9:1 (46 divided by 2.9). This means that the cable's series resistance should be limited to a low maximum of about 0.036 ohm to keep cable-drop effects from causing response peaks and dips greater than 0.1 dB. For a typical run of about 10 feet, 12-gauge (or larger diameter) low-inductance cable should be used.

Figure 7, the complex impedance, is plotted over the frequency range of 5 Hz to 30 kHz. The well-behaved curve is dominated by a large impedance loop just above crossover. Two smaller loops are in the bass range, above and below the 38-Hz vented-box tuning. The speaker may be a difficult load for some amplifiers, due to its low impedance at high frequencies. Fortunately, the high-frequency content of most program material is modest.

A high-level sine-wave sweep revealed a quite rigid cabinet except for some minor front- and side-wall activity at and near 140 Hz, and some horn-wall resonances (upper and lower walls primarily) between 380 and 400 Hz. The 10-inch woofer had a very long travel, about 0.8 inch peak to peak, and made no harsh sounds when overdriven. No dynamic offset distortion was evident.

The vented box worked very well and reduced the cone excursion at box resonance by a significant two-thirds (x 0.33), comparing behavior with the port open to that with it closed. Minimum woofer excursion occurred at 38 Hz, the vented-box resonance. Port wind noise was quite low at high power in the bass range.

Figure 8 shows the crossover voltage drives, which I measured at the input terminals of the system and at the terminals of its woofer and its tweeter. The woofer drive response is well behaved and has a sharp drop-off at the 1.5-kHz crossover frequency. The tweeter drive shows rapidly rising response commencing at 1 kHz and reaching a boost level of 6 dB at 15 kHz. The tweeter's response shows that its drive voltage actually exceeds the system's input voltage above 8 kHz. The crossover's autoformer provides this boost, and also is the cause of the low input impedance of the system above 10 kHz. The rising response in the tweeter's range is required to effectively equalize the horn and driver response so that the combination is flat to 20 kHz.

Figure 9 shows the 3-meter room response of the CF 3, with both raw and sixth-octave-smoothed curves. The system was in the right-hand stereo position, aimed at the test microphone, which was placed at ear height (36 inches) at the listener's position on the sofa. The front of the speaker was raised by about 1¾ inches, so that the CF 3's axis was aimed upward by about 6°, toward the test microphone. The system was driven with a swept sine-wave signal of 2.83 V rms (corresponding to 1 watt into the rated 8-ohm impedance). The direct sound plus 13 mS of the room's reverberation are included.

If you overlook the dips at 330 Hz and 14 kHz, the averaged curve is fairly well behaved and fits a fairly tight window of 10 dB. Distinguishing features include a depression between 200 and 800 Hz, a peak at 2 kHz, and roughness above 6 kHz. The room response closely follows the high-frequency peaks and dips seen in the axial response. An additional room response (not shown) taken with the spikes removed, so that the speaker was no longer angled upward, was rougher through the crossover region.

Figure 10 shows the E_1 (41.2-Hz) harmonic distortion of the CF 3, with input power ranging from 0.1 to 100 watts (0.283 to 28.3 V rms into the rated 8-ohm load). The second harmonic only reaches a low 6.7%, while the third rises only to an even lower 2.4%. Higher harmonics are 0.55% or less at full power, though the fourth rises to an intermediate higher level of about 1% at 20 watts. At 1 meter in free space, with an input of 100 watts, the system generates a very loud 112 dB SPL at 41.2 Hz.

The A_2 (110-Hz) harmonic distortion (not shown) rose only to 3.1% second harmonic at full power. Higher harmonics were below the floor of my test gear. The A_4 (440-Hz) harmonic distortion (also not shown) was very low, reaching only 0.6% at full power.

The curve for IM versus power created by tones of 440 Hz (A_4) and

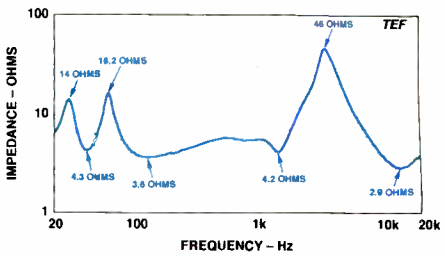


Fig. 6—Impedance.

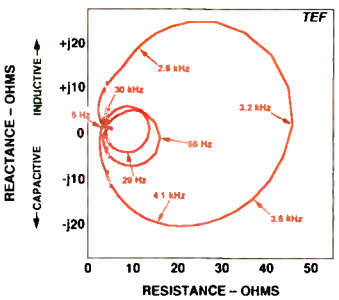


Fig. 7—Complex impedance.

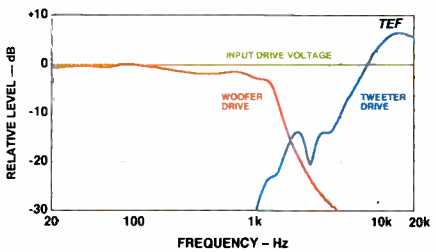


Fig. 8—Frequency responses of crossover voltage drive.

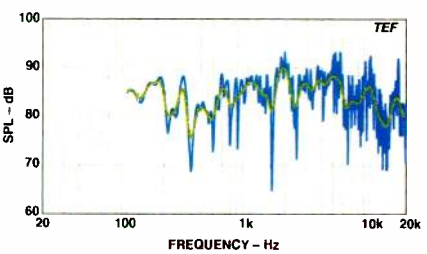


Fig. 9—Three-meter room response.

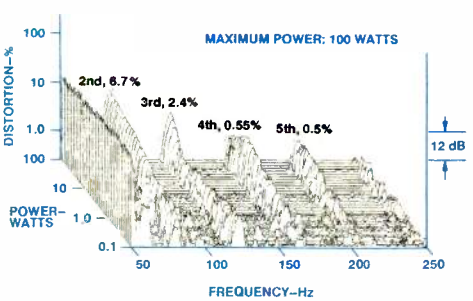


Fig. 10—Harmonic distortion for E_1 (41.2 Hz).

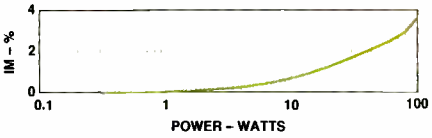


Fig. 11—IM distortion for A_4 (440 Hz) and E_1 (41.2 Hz).

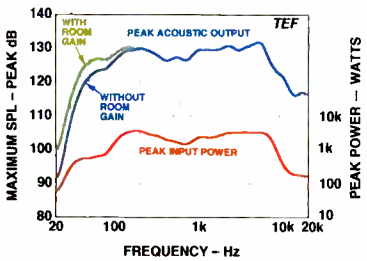


Fig. 12—Maximum peak input power and sound output.

41.2 Hz (E_1) of equal power is shown in Fig. 11. At full power, the IM rises only to 3.6%. This is quite low for a system that reproduces both tones from the same driver.

The short-term, peak-power input and output capabilities of the CF 3 are shown in Fig. 12. The peak input power was calculated by assuming that the measured peak voltage was applied across the rated 8-ohm impedance.

The peak input power starts fairly high, at about 60 watts at 20 Hz, rises to the 700-watt range between 40 and 70 Hz, reaches a peak of 4,000 watts at 180 Hz, falls somewhat to 1,700 watts at 700 Hz, and rises to 4,000 watts at 5.5 kHz; it then falls abruptly at 7 kHz, to about 225 watts above 16 kHz. The one significant feature of the curve is this rapid fall above 7 kHz. Presumably, it is partially due to the boost provided by the crossover's autoformer. At higher levels above 8 kHz, the high-frequency burst sounded harsh and exhibited a distorted, triangular waveshape. Also noted was considerable ringing in the 8-kHz bands and higher. During the peak-power tests, one woofer developed a buzzing dust cap while being tested at 400 Hz. A replacement woofer did not exhibit the problem.

With room gain, the CF 3's maximum peak output SPL starts at a healthy 100 dB at 20 Hz, rises rapidly into the range of 125 to 130 dB between 40 Hz and 7 kHz, and then falls to about 117 dB above 13 kHz. Although its output is falling above 7 kHz, the speaker can still be played very loud in this range. In most of the frequency range, the CF 3 can generate some very impressive peak sound levels, much louder than most program material demands or our ears can safely accept.

The peak output crosses the 110-dB SPL level at a low 26 Hz and then crosses the 120 dB SPL level at an impressively low 35 Hz. In terms of the powerful low-frequency output, the CF 3 places second on the list of all the systems I have tested (behind only the Legacy Convergence speaker reviewed in the February 1993 issue).

Use and Listening Tests

When I first unpacked the CF 3s, they didn't seem to weigh quite as much as their bulk suggested (though they do weigh a substantial 102 pounds apiece). I assume this is due to the very low weight, relative to magnetic performance, of the neodymium magnets used in all the drivers. In any event, the speakers were relatively easy for me to move around alone.

The CF 3s were supplied in a very attractive light oak finish. All four sides (top, sides, and bottom) are finished. The front and rear panels are black, including both woofers and the horn. Construction and fit were top-notch.

The bottom contains four threaded inserts for spikes or feet. As supplied, both front spikes were mounted and set to the proper height to tilt the speaker so that the axis of the tweeter horn was aimed toward a seated listener. Initially, I removed the spikes so the speakers could be moved simply by rocking them, but I restored the spikes for my listening tests.

THE KLIPSCH CF 3'S HIGH SENSITIVITY MADE MY AMPLIFIER SEEM FOUR TIMES AS POWERFUL.

The instruction manual was not specific to the CF 3 or even to the Klipsch Epic series. It consisted of a four-page, letter-size multilingual folder. Due to the Spanish, French, and German translations, the English text amounted to about three-fourths of a page. Topics included safety warnings, loudspeaker placement, amplifier guidelines, system connections, and care of wood surfaces.

A photocopied typewritten page included in the packing was specific to the CF 3. In three short, numbered sentences it commented about the front spikes, the speaker spacing (which should be closer than normal and some one-half to two-thirds the distance from the listener), and how the speakers should be "toed in" so that their axes intersect at the listening position. Two dealer/sales personnel memos given to me included additional information on setup and use; this information was quite useful and I think should have been included with the user documentation.

The CF 3s were quite easy to hook up, thanks to the large and quite accessible input-connection cup on the bottom rear of the cabinet. All of my listening was done in standard (not bi-wired) mode. I listened with a reference system that included Onkyo and Rotel CD players, Krell's KRC preamp and KSA250 power amp, Straight Wire Maestro cabling, and B & W's 801 Matrix Series 3 speakers.

One of the memos stated that the "D'Appolito design will not have proper mid-bass performance if the speakers are placed too far apart in relationship to the distance to the listening area." To find the best location, I experimented by placing the speakers in various positions, all closer together than my usual 8-foot separation. I ended up with no clear preference for any of the closer spacings, and thus did most of my listening with my usual separation. All speaker locations were far from the side and rear walls. I oriented the CF 3s toward my listening position and aimed them upward, so that my ears were on axis of the system's horn. The Klipsch memo stated that, for optimum soundstage reproduction, the horn should be aimed at the ears of the listener.

First listening established several CF 3 properties: Powerful bass; very high sensitivity; a forward, up-front character that greatly minimized room sound; excellent peak dynamic capability, and very good

imaging and soundstaging. Compared to my B & W reference systems, the CF 3s were fully 6 to 8 dB more sensitive. This effectively quadruples the power of an amplifier—or allows the use of an amplifier with one-fourth the power to generate the same acoustic levels.

The Klipsch systems did particularly well on program material that profits from high playback levels, such as dance and rock music, big band, full symphony orchestra, and sound effects. I found myself getting out all my CDs in these categories and listening to them again over the CF 3s. The horns on the Bob Mintzer Big Band CD, *Incredible Journey* (dmp CD-451), were just incredible; the bite and blatt of the horn section were re-created with much authority. Does it take a horn to reproduce a horn accurately at high levels?

THE CF 3'S BASS WAS ALWAYS FULL-BODIED, EXTENDED, POWERFUL, AND CLEAN.

The new digital remastering of *Highway to Hell* by AC/DC (ATCO 92419-2, originally released in 1979 on the Atlantic label) was reproduced in all its bass-thumping, bad-boy, noisy, hard-rock glory at high levels. Ron Tutt's rim shots on *The Sheffield Track/Drum Record* (Sheffield CD 14/20) sounded as though he was playing right in my listening room.

Further listening uncovered a tendency toward harshness and emphasis of sibilants on vocals, and an unevenness in high-frequency response. Discs that exhibited these characteristics included Holly Cole's voice on her trio's *Musical Truth* (Alert Music DPRO-240, a promo disc from Energy Loudspeakers), Brooks & Dunn on *Hard Workin' Man* (Arista 18716-2), and the title track on *The Sign*, from Ace of Base (Arista 18740-2).

The CF 3s' bass response was always full-bodied, extended, powerful, and clean when the program material demanded it. Program content below 30 Hz was the only range slighted by the CF 3s—which could, however, handle this high-level infrasonic material without intermodulation of higher frequencies. And on powerful pipe-organ pedal notes, the Klipsch speakers could easily dislodge knickknacks from my listening room wall!

On third-octave band-limited pink noise, the Klipsch CF 3 generated no usable bass output in the 20- and 25-Hz third-octave bands, but it exhibited quite usable output at 32 Hz and very strong, clean, powerful output at all higher bands, from 40 Hz up. Port wind noise was very low, much lower than the B & W 801s produced at these frequencies.

The CF 3s did extremely well on the stand-up/sit-down test with pink noise, exhibiting very little tonal change. They equalled the excellent performance of the 801s on evenness of vertical and horizontal coverage. Octave-to-octave spectral balance on pink noise was quite acceptable; I noticed only minimal tonality. The Klipsch systems did, however, exhibit a voicing that was tilted somewhat toward the high frequencies, with slightly less lows and greater highs than the reference B & Ws.

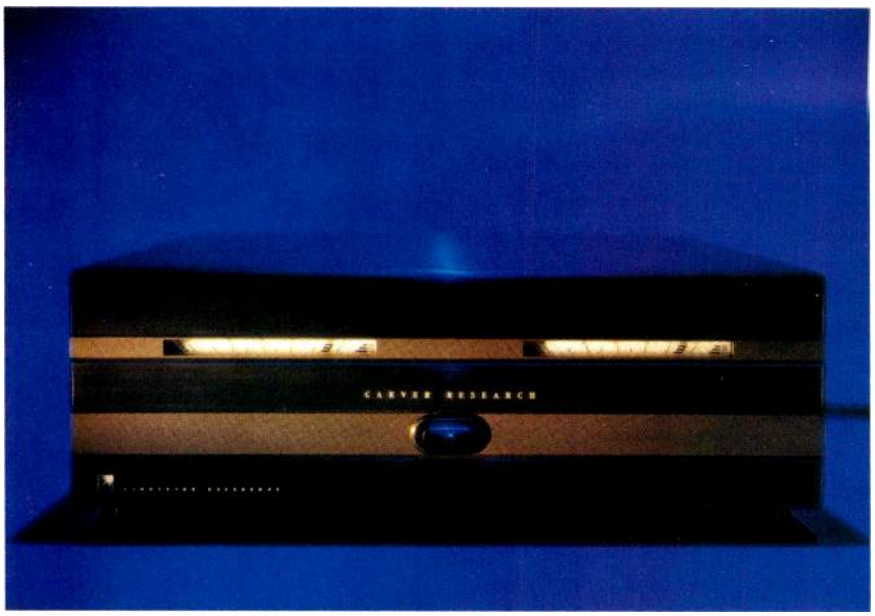
The CF 3s' fine soundstaging, imaging, and high-level large-orchestra reproduction demonstrated very well by *John Williams Conducts John Williams: The Star Wars Trilogy* (Sony Classical SK 45947). On this material, the CF 3s made me think I was in a finely tuned THX film theater, actually watching *The Empire Strikes Back*! The constant-directivity horn in the CF 3 effectively maximizes the direct field by minimizing wall, ceiling, and floor reflections. By reducing these reflections, the speakers, in effect, move the listener closer to the sound field without physically changing the listening position.

Except for a moderate tendency toward high-frequency harshness and roughness, the CF 3s performed admirably in all areas. They could play loudly and cleanly, re-create an excellent soundstage, and shake the walls with powerful bass. Due to their very high sensitivity, they were effective with relatively low-power amplifiers. In addition to being a very good choice for speakers in a standard stereo system, the CF 3s would make a fine addition to any home theater setup, because of their fully shielded configuration and ability to minimize boundary reflections. Subwoofers are not a requirement with the Klipsch CF 3s! A

EQUIPMENT PROFILE

BASCOM H. KING

CARVER RESEARCH LIGHTSTAR REFERENCE AMPLIFIER



The Lightstar Reference embodies Carver Corporation's latest thinking on power amplifiers. (Carver Research is a division that has been set up to introduce the corporation's more advanced technologies.) A number of interesting features sets this amp apart from most other designs. Foremost among these is its "digital transformer" power supply, which performs three major tasks. First, it regulates the d.c. voltage supplied to the amplifier output stage to counteract changes in the incoming a.c. line voltage. This allows the amplifier to deliver a constant amount of power to the load despite changing a.c. line input, and it permits the maximum power output to more nearly double as load impedance halves. Second, the primary rectified d.c. supply preceding the digital transformer stores more energy, at a higher voltage, than in most other amplifiers. This is said to make more energy available for high-current peaks when the a.c. line voltage sags. These two features permit the amplifier to put out full power down to 10 Hz, something that most conventional designs cannot do. Finally, the digital transformer dynamically adjusts the voltage supplied to the output stage during each cycle so that it is no higher than it need be for a particular signal being passed. This greatly increases the safe area of the output devices, and allows the small-signal rail voltage supplied to the output stage to be a small fraction of the peak voltage available for large signal swings. It also makes the amplifier more efficient than if the supply rails were at a constant, higher voltage. This circuit approach is said to permit low-impedance operation into loads of less than 1 ohm.

THE LIGHTSTAR'S "DIGITAL TRANSFORMER" HELPS IT PUT OUT FULL POWER DOWN TO 10 Hz.

Other aspects of this amp's design include dual-mono construction (with a separate a.c. line cord and power switch for each channel), switchable-gain inputs (29 or 41 dB) for use with active or passive preamps, two pairs of multiway speaker binding posts per channel, and protection circuitry for over-temperature and/or short circuits.

Front-panel attributes include two illuminated output level meters and an elegant touchplate for silent switching between standby and operate modes. On the rear panel are input and output connectors (RCA for unbalanced, XLR for balanced), two toggle switches for setting each channel's gain, a.c. line-cord connectors, and a.c. power switches for each channel. A pair of handles on the rear panel assists in maneuvering the unit.

The Lightstar Reference is most unusual looking—in essence, it's a box sitting atop a platform. It somehow reminds me of Darth Vader—black, and very powerful. It certainly is heavy enough, weighing in at some 72 pounds. It appears that a single long extrusion is machined so it can be bent at the rear corners, thus forming the side and rear panels.

The power transformers, main filter capacitors, and audio circuit boards are on the top plate of the amplifier. All of the output transistors are mounted to this plate and use it as a heat-sink. A power-supply circuit board is atop the four main filter capacitors. The main rectifier bridges are on this board, near the top plate, and are coupled to it with angle brackets, heat-sinking the rectifiers and providing additional support for the power-supply board. Circuitry for each channel's digital transformer is on boards mounted inside the chassis side panels. This circuitry is shielded from the interior space of the amplifier by perforated screens. The open bottom of the amplifier lets air enter through the slot between it and the bottom plate; perforated screening over this opening helps to prevent r.f.i. from escaping. The top plate is raised about a quarter of an inch above the sides and the rear extrusion piece, so heated air can escape. All in all, a most interesting and unusual packaging job.

Photos: Michael Groen

Circuit Highlights

Carver Research sent me schematics of the Lightstar Reference, but several areas were blanked out because of pending patents. Excluded were the audio input circuitry and the control circuitry for the digital transformer regulators.

The circuitry following the input amplifier seems conventional enough. A complementary pair of transistors is biased positive for the NPN and negative for the PNP by separate voltage dividers from regulated +12 and –12 V, with the "ground end" of the dividers tied together and not grounded. This "ground" point is driven from the input circuitry. The aforementioned transistors are actually level translators to convey the signal from the input circuitry to the last voltage amplifier (LVA) transistors. The LVA transistors are a complementary bipolar pair referenced to the output-stage supply rails. The collectors of the LVA transistors are linked together through a bias-spreading regulator and thus deliver the drive signals to the output stage.

Configured as a complementary Darlington arrangement, the output stage has five pairs of output transistors. The single pair of driver transistors is of the same type as the outputs. Overall feedback is taken from the output back into the input circuitry.

Separate power-supply circuitry is provided for each channel, complete with individual a.c. line cords. Each channel's power transformer has multiple secondaries. The main secondary is full-wave rectified to +125 and –125 V, using filter capacitors rated at 3,300 µF and 150 V. The energy stored in this power supply is about the same as that found in a normal power amplifier—say, one with +80 and –80 V, with 8,000-µF filter capacitors. The digital transformer's switching regulators consist of five MOS-FET switching pass elements, in parallel, for each polarity's regulator. The switching elements are connected between the appropriate polarity of unregulated 125 V and the supply-rail point for the LVA and output stage.

Drive for the switching elements is from suitable comparator and bipolar circuitry powered by a floating, 12-V regulated supply driven from one of the power-transformer secondaries. These floating supplies (one for each polarity of regulator) are opto-isolated from the proprietary control circuitry that translates the amplifier input voltage into appropriate

SPECS

Power Output: 300 watts per channel into 8 ohms, 10 Hz to 20 kHz, at 0.2% THD; 600 watts per channel into 4 ohms; 1,200 watts per channel into 2 ohms.
THD: Less than 0.2%.
Full-Power Bandwidth: 10 Hz to 20 kHz.
Frequency Response: 20 Hz to 20 kHz, ±0.5 dB.
S/N, A-Weighted: Low gain, 107 dB re: rated power, 82 dB re: 1 watt; high gain, 98 dB re: rated power, 74 dB: re 1 watt.
Gain, ±0.5 dB: Low, 29.0 dB; high, 41.0 dB.
Sensitivity for Rated Power, 8 Ohms, at 1 kHz: Low gain, 1.74 V rms; high gain, 0.43 V rms.
Crosstalk: Greater than 60 dB at 1 kHz.
Damping Factor: Greater than 200.
Output Impedance: Less than 0.04 ohm.
Input Impedance: 50 kilohms.
Slew Rate: Greater than 50 V/µS.
Power Consumption: At idle, 60 watts/channel; with musical program material, 250 watts/channel; nominal continuous, 1,440 watts.
Dimensions, with Handles: 19 in. W x 17.8 in. D x 6.9 in. H (48.3 cm x 45.2 cm x 17.5 cm).
Weight: 72 lbs. (32.7 kg).
Price: $3,995.
Company Address: P.O. Box 1237, Lynnwood, Wash. 98046.
For literature, circle No. 92

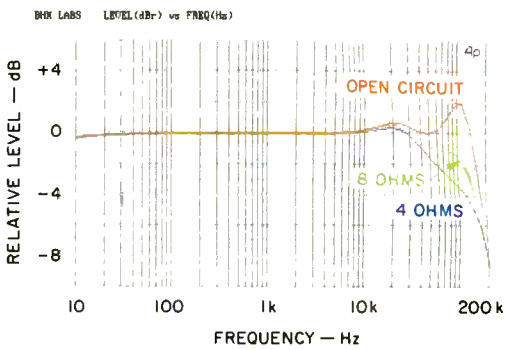


Fig. 1—Frequency response.

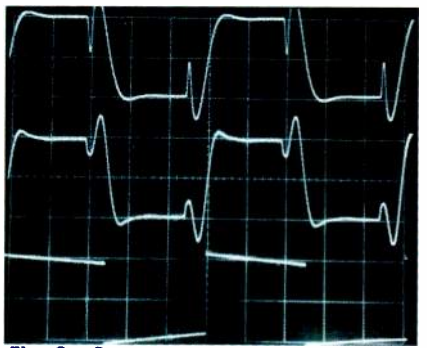
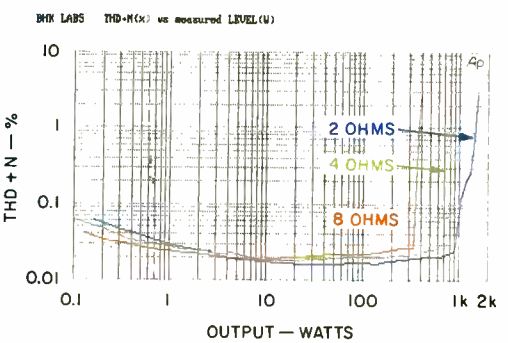
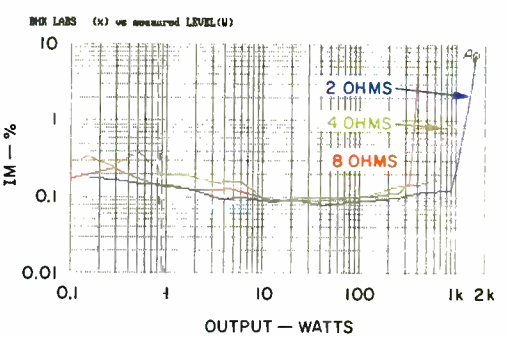


Fig. 2—Square-wave response for 5 kHz into 8 ohms (top), 5 kHz into 8 ohms paralleled by 2 µF (middle), and 40 Hz into 8 ohms (bottom).



A



B

Fig. 3—THD + N at 1 kHz (A) and SMPTE IM (B), vs. power.

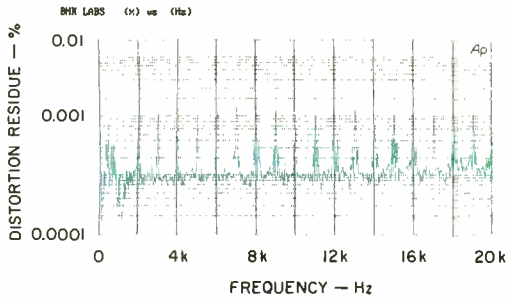


Fig. 4—Spectrum of distortion residue for 1-kHz signal at 10 watts into 8 ohms.

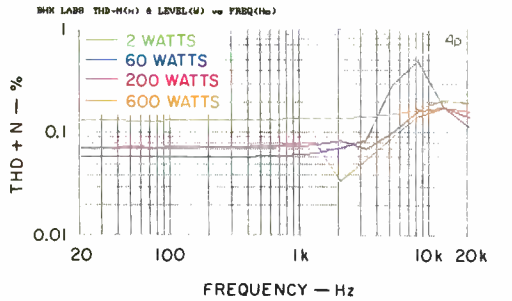


Fig. 5—THD + N vs. frequency with 4-ohm load.

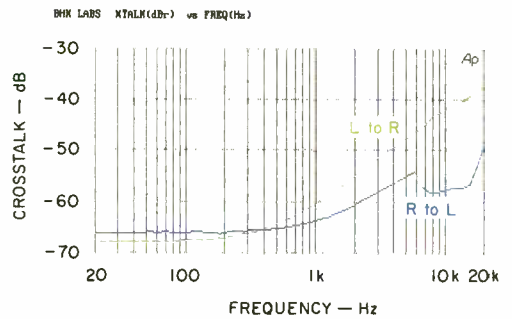


Fig. 6—Crosstalk.

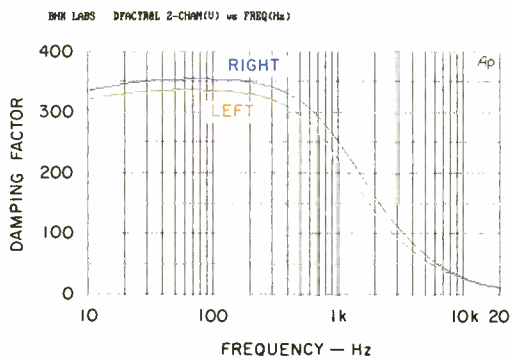


Fig. 7—Damping factor.

signals for the regulators. Two more IC voltage regulators for each amplifier channel supply +12 and –12 V relative to signal ground, for the front-end circuitry.

Measurements

The measurements that follow were all made through the unbalanced inputs. For the most part, however, the amplifier's performance was about the same whether the balanced or unbalanced inputs were used.

Voltage gains into 8-ohm loads for the normal-gain setting were 29.13 dB for the left channel and 29.17 dB for the right. At the high-gain setting, they were 40.91 and 40.93 dB. Corresponding IHF sensitivities were 98.8, 98.4, 25.5, and 25.4 mV, respectively.

Frequency response at an output of 2.83 V (1 watt into 8 ohms) is shown in Fig. 1 for open-circuit, 8-, and 4-ohm loading. As the curves demonstrate, response in the highest octave and beyond is strongly influenced by the load. It appears that there are two resonances, one at about 20 kHz and the other at about 100 kHz. This kind of response appears in hardly any other kind of amplifier except, possibly, tube models that have poorly designed circuits or output transformers. What's going on here? It turns out that Carver has put what appears to be a second-order all-pass filter into the input circuit to delay the signal going through the amplifier. This lets the undelayed input signal drive the control circuit for the digital transformers immediately—so it can gain some lead time over the actual output stage's rail-voltage demands. All-pass filters have a flat frequency response but a phase shift that increasingly lags as frequency rises. They are generally used as equalizers to flatten the group delay (improve the phase linearity) of a system. In a modern solid-state amplifier, whose inherent phase shift generally is neither complex nor excessive, such a filter would degrade the phase characteristics. However, it should be noted that the phase shift of a first- or second-order all-pass filter is not generally considered to be audible. Regardless of the Lightstar Reference's phase characteristic, since its frequency response from about 5 kHz upwards varies with loading, one might expect the response in this range to be somewhat speaker-dependent in a working system.

For Fig. 2, a square-wave frequency of 5 kHz was chosen, to show what the all-pass filter phase characteristic does to the waveshape of the Lightstar Reference. For the middle trace, a 2-µF capacitor was paralleled across the 8-ohm load. This does change the waveshape, reducing out-of-band response, but it doesn't seem to cause much ringing. In the bottom trace, for 40 Hz, the moderate tilt in evidence relates to the response below 10 Hz.

YOU DON'T USUALLY SEE POWER OUTPUT STAND UP SO WELL TO SAGGING A.C. LINE VOLTAGE.

Figure 3A shows 1-kHz THD + N as a function of power output with 2-, 4-, and 8-ohm loading. Figure 3B shows SMPTE-IM distortion versus output with the same loads. For 4- and 8-ohm loading, both channels are operating. Results are plotted for the right channel, as it had a little more distortion than the left. Since I don't have two high-power 2-ohm loads, I used all four of my Dale 250-watt, 8-ohm resistors in parallel for the 2-ohm loading of the right channel. Close scrutiny of Figs. 3A and 3B shows that the attainable power at 1% distortion pretty much doubles as impedance is changed from 8 to 4 ohms. (The 2-ohm harmonic distortion and IM curves, however, begin to rise at power levels that are less than double those in the 4-ohm curves.) This performance is pretty impressive and surely illustrates the effects of a regulated supply.

Considerable out-of-band switching noise from the modulated-rail power supplies shows up in harmonic-distortion

measurements made beyond the 22-kHz bandwidth limit used in Figs. 3A and 3B. The out-of-band noise actually inflated the distortion readings by a factor of 3 with the 80-kHz bandwidth and of 10 at the 500-kHz bandwidth. A spectrum of the distortion residue for a 1-kHz signal running at 10 watts into 8 ohms is shown in Fig. 4.

In Fig. 5, THD + N is shown as a function of frequency and power level into 4-ohm loads. The unusual change with frequency for power levels of 60 watts and above suggested that something might be amiss at high power levels and frequencies. I investigated this phenomenon by restricting my tests to the range from 1 to 20 kHz and by changing the sweep direction (instead of sweeping from high to low, my normal practice, I swept from low to high). This revealed surprising differences between the results for each sweep direction. All of these tests were performed with the amp powered from my stiff, high-current line direct from my a.c. subpanel. Later, when I was warming up the amp at a 50-watt level into 8 ohms and it was powered from my variable transformer, I swept the test signal's frequency manually from 1 to 20 kHz and got quite a surprise again: The a.c. line current varied as a function of signal frequency! From 1 to 7 kHz, line draw was 3.2 amperes; it then became 4.6 amperes at 10 kHz, 8.9 amperes at 15 kHz, and 9.1 amperes at 20 kHz. Holy smoke! Some circuitry in this amp was latching up at higher signal frequencies and drawing *much* more current than it did at lower frequencies! No wonder the amp got so hot in the distortion testing, even though the length of time that it had to put out high power was short. Engineers at Carver informed me that this is not a flaw but a deliberate circuit attribute: The regulators are latched fully on when the steady-state signal frequency gets above 8 kHz or so and the level is sufficiently high. This insures that there is always enough supply voltage for any expected amplifier signal. The Carver engineers say that they never saw the Lightstar Reference go into this state under music-test conditions, and I personally suspect that this situation would not occur in normal or even stressful music reproduction.

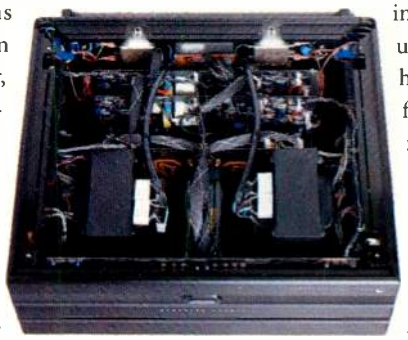
Even though the amplifier appears, from the schematic information that I have, to be dual mono, substantial channel-to-channel crosstalk can be seen in Fig. 6. Carver must be aware of this, as its owner's manual specifies crosstalk only as greater than 60 dB down at 1 kHz.

Damping factor versus frequency is plotted for both channels in Fig. 7. The damping factor stays quite high up to several hundred hertz and then starts to fall off, as it does in so many power amplifiers.

Table I lists output noise as a function of measurement bandwidth and gain setting. The readings in the wideband mode are mostly from digital-transformer switching noise plus some a.c. hum. Within the passband of 400 Hz to 22 kHz, the amount of noise is satisfactory in the low-gain mode. However, some hiss may or may not be audible in the high-gain mode with sensitive speakers.

Table I—Output noise levels. The IHF S/N ratios with the normal-gain setting were 80.4 dB for either channel; with the high-gain setting, they were 73.2 dB for the left channel and 72.4 dB for the right.

	Output Noise, mV	
Bandwidth	LEFT	RIGHT
Normal Gain		
Wideband	2.3	2.5
22 Hz to 22 kHz	1.2	1.2
400 Hz to 22 kHz	0.38	0.36
A-Weighted	0.27	0.26
High Gain		
Wideband	3.7	5.5
22 Hz to 22 kHz	2.6	4.4
400 Hz to 22 kHz	0.81	0.84
A-Weighted	0.62	0.68



CONTROL OF DISTORTION INTO 8-OHM LOADS IS IMPRESSIVE—THANKS, PRESUMABLY, TO THE POWER-SUPPLY DESIGN.

While I was measuring clipping behavior and dynamic headroom, the effect of supply regulation became evident. Clipping power levels for 8-, 4-, and 2-ohm loads were 360, 713, and 1,400 watts, respectively. Although not exactly doubling for each halving of the load impedance, this is pretty darn close! Since the Lightstar Reference is rated at 300, 600, and 1,200 watts into these loads, the corresponding clipping headroom figures were 0.79, 0.75, and 0.70 dB. With the IHF tone-burst signal, the equivalent sine-wave power levels attainable at the visual onset of clipping were essentially identical to the power levels for steady-state clipping. Further, the attainable amplitude at the onset of clipping during the burst did not sag off, as with a conventional capacitor-input power supply. I looked at how well the amplifier maintained power output as a function of a.c. line voltage: With one of its channels powered and driven to produce 360 watts into 8 ohms, I could reduce the a.c. supply to 100 V before output began to sag. For 700 watts into 4 ohms and 1 kW into 2 ohms, the corresponding a.c. line voltages for regulator dropout were 105 and 108 V. You don't see this kind of amplifier performance every day, folks.

A few final notes: The a.c. line current with the amplifier active was 1.2 to 1.3 amperes, depending on the unit's temperature. Standby a.c. line current wasn't much less, about 0.92 ampere. The d.c. offset was –1.1 mV in the left channel and –9.6 mV in the right. Though not included in the manual's specifications, input impedance is said to be 48 kilohms for the unbalanced inputs as well as for each leg of the balanced inputs. My measurements confirmed these values.

Use and Listening Tests

Phono equipment in my system during the review period included an Oracle

Continued on page 74

AURICLE

ANTHONY H. CORDESMAN

POLK AUDIO M5, CS250S, M3II, AND PSW200 A/V SPEAKERS

A major challenge that audiophiles face in creating an audio/video system lies in choosing and setting up speakers to perform well with both home theater and music. No longer is the fundamental choice one of home theater versus stereo: Music recordings encoded with Dolby Surround are on the market, and some of the latest classical recordings from Delos indicate that a Dolby Pro Logic system can contribute improved ambience and realism to music, with few traces of the coloration and musical degradation common to the various "hall," "concert," and "jazz" settings on most A/V preamps and receivers.

With this in mind, I asked Matthew Polk of Polk Audio what complement of speakers he would use to test how well a reasonably priced system could do in reproducing both music and home theater. The speakers he suggested do not make up a Polk "system" that is normally sold as an integrated set. (Polk does sell considerably cheaper, dedicated A/V speaker systems as well as much more expensive and sophisticated systems.) The speakers chosen were meant to provide high performance in reproducing both music and home theater sound, and to do so at reasonable cost. The specific models we discussed are the Polk CS250S center-channel speaker ($299), the M5 as left- and right-front speakers ($199 each), and the M3II as rear speakers ($139 each).

These three models have several important features in common. First, they provide a close match in timbre, which is absolutely essential to good home theater and music reproduction. A system that mixes speakers from different manufacturers—or even speakers with different timbre from the same manufacturer—inevitably compromises performance. Second, these models offer a relatively low-cost way to take advantage of Polk's joint research with Johns Hopkins University, which used full-field laser interferometry to study dynamic distortion modes in loudspeaker drivers. This technique has allowed Polk to make precise and rapid predictions of how various driver materials and shapes, magnet structures, and suspensions will perform. That knowledge has led to new composite cones, surround geometry, and vibration-control caps, and also to other design changes in what Polk calls its Dynamic Balance driver line.

The models I auditioned are good examples of small, affordable monitor speakers that have good full-range performance for their size, good freedom from coloration, and wide, smooth dispersion.

Since small self-powered subwoofers are becoming common in home systems, I also used the Polk PSW200 ($799), which has a built-in, 125-watt amplifier. Its 10-inch driver has extremely high mass and uses a very small bandpass enclosure. This enclosure has an extended internal port tube with a diffuser (making up what Polk calls PowerPort technology); the company says this system sharply reduces the wind noise commonly caused by port turbulence. The combination of these driver and enclosure technologies reportedly allows a 30% reduction in box size. In addition to the usual

Company Address: 5601 Metro Dr., Baltimore, Md. 21215.
For literature, circle No. 97

gain control, the PSW200's internal crossover has a polarity switch and a control for setting the crossover frequency anywhere from 50 to 150 Hz. This mix of controls provided exceptional flexibility in blending the subwoofer with the full-range drivers in the M5 speakers.

The PSW200 does not offer all the dynamic range, dynamic transients, deep bass extension, or sheer bass power of larger drivers and enclosures. However, it does provide considerable output at frequencies below 35 Hz, as well as unusual bass definition and power output for the price. Additionally, you can set the crossover frequency low enough to avoid excessive overlap between the woofer's output and that of the vast majority of small to medium-sized speakers. Such overlap creates a mix of output from the subwoofer and main speakers that thickens or warms the mid-bass and reduces definition and transient response. This can be tolerable with certain movie soundtracks and the simpler forms of rock, but it dulls the sound of classical music, jazz, and demanding rock, and it takes the excitement out of soundtracks that have sudden bass transients and passages where bass detail is as important as bass boom.

This mix of Polk components delivered outstanding performance for the money, but proper setup presented the same challenge as setting up the far more expensive audio/video speaker systems I have reviewed in the past. Further, using small monitors added some new setup problems.

The PSW200 subwoofer proved the easiest to set up and place. Subwoofers often present major placement problems, particularly if the crossover frequency is high enough to betray the unit's location. Yet once I set the PSW200's crossover to 50 Hz and adjusted the polarity control for maximum output, it was exceptionally easy to find a location where a simple gain-control adjustment provided good performance with both music and home theater. (In particular, the PSW200 does not seem to overdrive rooms the way many costlier subwoofers do.) I also found that corner placement often worked very well.

There are several additional issues involving setup of the subwoofer that you should be aware of. While I'm primarily addressing the Polk, these issues affect virtually all small self-powered subwoofers. First, a higher gain setting may be needed for home theater than for music, and raising subwoofer output on soundtracks often yields better sound than using a bass-boost function in the preamp or receiver. This means experimenting to find the gain settings that are best for each medium and marking them on the subwoofer's gain-control dial. Second, relatively small adjustments of the PSW200's gain control caused major shifts in output. I would have preferred a control with increased adjustment precision and repeatability. Third, some experimenting will be needed to determine whether or not to feed the M5s via the high-pass filter built into the PSW200's crossover. I normally use the high-pass filter in such systems, to minimize the warmth and other problems caused by interaction between the subwoofer and the main speakers. Because of the M5's well-behaved low-frequency roll-off and the PSW200's adjustable crossover frequency, the high-pass filter was not needed with this combination.

TO GET GOOD MUSIC AND HOME THEATER SOUND, IT IS ESSENTIAL THAT THE SPEAKERS' TIMBRE CLOSELY MATCH.

The CS250S speaker was also relatively easy to set up. Unlike a number of supposedly shielded center-channel speakers, it induced no color-shift problems when I placed it atop my 35- or 40-inch monitor—the preferred position, because placing the speaker under the monitor can cause its output to interact with the floor, changing the timbre and smearing the sound. The shape of the CS250S also made it easy to ensure that the front edge of the speaker extended far enough in front of the TV so that reflections off the edge of the monitor were kept to reasonable limits.

The main setup problems came with the M5s as main front speakers—problems that are common to all such speakers, regardless of brand. I had to experiment to find the best distance between the left and right speakers. There is no "correct" distance between them, or between each speaker and the center channel. With home theater and TV, the sound image will always be bigger than the visual image unless you are using a large-screen projection television or will settle for very constricted stereo.

If you are as interested in music as in home theater, you may prefer the lateral distance between speakers that gives you best performance with music. In this case, I recommend that you begin by setting your A/V preamp or surround processor to the stereo (bypass) position. Then play a regular CD or LP, and alter the distance between the left and right speakers to the width you find best for stereo imaging.

Finding the best distance between the M5s was only the beginning. For starters, I mounted them on stands and kept them away from the walls and corners; this let me put them at roughly the same height as the CS250S center speaker—and high enough so that reflections from the floor and furniture did not affect their imaging and timbre. Using stands also let me set the M5s a bit forward of the center channel, so that the three front speakers were in a slight arc, all at the same distance from the listening position. (Otherwise, the center channel's sound would have been overemphasized due to its relative closeness to the listener.) And finally, I tilted the M5s to the angle that let their timbre match that of the center channel. This alignment is difficult with some small monitors but was easy with the M5s, because they have good vertical dispersion and their tweeters do not have "hot spots," or beam. On the other hand, the M5s have an irregular cabinet shape that doesn't lie flat on speaker stands. The cabinets need to be aligned so the tweeter will face the listening position at approximately the same angle as that of the center-channel speaker. There are two ways to accomplish this. One is to put a book or some other object under the rear of the M5, so the line down the sides of the speaker points toward a seated listener. A preferable technique is to use mono white or pink noise (or a mono music signal) to align all three speakers for the same upper octave sound at the listening position.

I would like to see a better mounting bracket and dedicated stand for the M5. This would make adjusting the speaker much easier. Admittedly, problems in adjusting speaker angle are equally serious

with most conventional box speakers. Many do not sound their best at the listening position when their cabinets are parallel to the floor, even if they are placed at optimum height. Most speaker stands make this problem worse, because neither their height nor the speaker angle is adjustable. A small monitor at a fixed height has only a random chance of suiting the listening conditions.

Setting up the M3IIs for the rear channels also required considerable experimentation. It confirmed my prior experience that there is no single correct way, and that the choice is a question both of the specific room and system and of personal taste. In one room with relatively little furniture near the room boundaries, I found that leaving the M3IIs on the floor, angled to face the rear wall for highly dispersed sound, worked well with home theater and music. In other rooms, with more furniture, I got better results by mounting the M3IIs on the stands that Polk provided—which offered excellent height adjustment but did not allow adjustment of angle.

You must decide whether to position the rear speakers so that only reflected sound is heard at the listening position or to position them on stands (or on the walls) so that they face each other on either side of the listening position, emphasizing the direct signal. (Polk provides diagrams explaining these setup differences in more detail.) With the latter setup, the M3IIs had the same wide dispersion and smooth frequency response as the M5s and avoided the problem of treble beaming, which makes some speakers unsuitable for rear-channel use. This made the M3IIs good speakers to use in emphasizing discrete surround effects. Still, I preferred positioning them in ways that emphasized reflected sound. There is very little discrete information in most soundtracks, and diffuse sound seems to produce more convincing ambience in movies and music recordings.

I do suggest that you experiment. Begin by playing only the rear channels, using soundtracks that have a lot of ambient information and using Delos Dolby recordings, such as Tod Wilson's organ recording, *In a Quiet Cathedral* (DE 3145, two discs), or *Beyond Chant: Mysteries of the Rennaisance* (DE 3165), by Dennis Keene and Voices of Ascension. Learn what sounds actually come out of the rear channels (you may be surprised), and listen to differences you hear with the two main ways of positioning the rear speakers. Then add in the sound from the three front speakers, and, again, listen to the differences. But remember that a little ambience goes a long way, and adjust final levels accordingly.

I can assure you that with good Dolby Pro Logic receivers, you will hear the benefits of the speaker setup techniques I have been describing. Just don't expect miracles with home theater.

My experience with the M3IIs, M5s, the CS250S, and the PSW200 has shown me that good setup can greatly improve home theater. At the same time, I found that combining good speakers with good setup is far more important for stereo recordings. After proper setup, I got much better musical performance out of the Polks than I had heard in many demonstrations using much costlier speaker systems.

I compared a pair of the M5s set up for stereo, both with and without the PSW200 subwoofer, against the full five-channel system using the M3IIs, M5s, the CS250S, and the PSW200. And I tried a number of different processors, signal sources, and amplifiers. Sometimes, I preferred to listen only to the M5s—particularly when I listened to solo instruments and small musical groups in recordings that had a great deal of natural ambience. But I often got better results using the full five-channel mode when I listened to orchestral music, big bands, opera, organ music, and choral music. I certainly heard nothing to indicate that home theater and stereo are incompatible. In fact, it was clear that stereo and home theater can coexist with considerable grace—provided that the speakers are set up to deliver good musical performance.

The tested Polk collection provides exceptional value. While much will depend on your choice of electronics, and on your willingness to apply to home theater speakers the same demanding setup standards you apply to stereo, you can spend a great deal more on speakers and get a lot less music and a lot less fun. Of course, if you are the kind of audio purist who hated FM, the LP, stereo, the transistor, and the CD, you may want to stick with your Edison system and continue to curse the process of change! A

CARVER *from page 71*

turntable fitted with a Well Tempered Arm and JVC X-1 moving-magnet pickup, with my own tube phono preamp or a preamp from Quicksilver Audio. For digital discs, Counterpoint DA-11A and PS Audio Lambda CD transports drove a Sonic Frontiers SFD-2, a Resolution Audio Reference 20, and other (experimental) D/A converters. Additional signal sources in my system were Nakamichi's ST-7 FM tuner and 250 cassette recorder and a Technics open-reel recorder. Preamplifiers that I used included a DGX Audio DDP-1, a Quicksilver Audio unit, Forssell tube line drivers, a First Sound II passive preamp, and my own passive signal selector and attenuator. Other power amplifiers on hand were a Crown Macro Reference, Quicksilver M135s, and a pair of Cary Audio CAD805s. The loudspeakers I utilized were B & W 801 Matrix Series 3s, augmented from 20 to 50 Hz by my subwoofer system (which was one JBL 1400Nd driver, in a 5-cubic-foot ported enclosure, per side).

At first encounter, the Lightstar Reference sounded a bit obscure and unclear. After using it all day, things improved considerably. Amplifiers do need to warm up and break in when new. In any case, the Carver Research amp operated flawlessly throughout the testing, with no pops or blaps to scare a trusting reviewer.

After measuring the unit and beating up on it in the lab, I returned it to my system for more listening. Again, I got a sense that the sound wasn't quite as clear and defined as from the best of my reference amplifiers; the bass wasn't as defined and dynamic. It didn't have the kind of impact in the lower registers as, say, the Crown Macro Reference. I don't think this is a question of power capability, though, as I was playing at levels well within the amp's abilities.

Overall sense of space and dimension was reasonably good, while irritation and edginess were relatively low. On the whole, the sound of the amp was actually pretty good, though it just didn't involve me with the music as much as I would have liked.

The Carver Research Lightstar Reference is an innovative, cleverly designed amplifier that is just what some audiophiles would probably like to have for their own systems. So go give one a listen and see what you think. A

LISTENING WITH SAM

SAM TELLIG

LINAEUM LFX SPEAKER

What's better: To fall in love slowly or to fall in love fast? Fall in love slowly, and you may end up staying in love longer. I don't know how that works for relationships, but sometimes it works for equipment. The Linaeum LFX speakers are a case in point. I first received these nearly two years ago.

"Don't be in any hurry to review them," said Steve Nelson, product manager at Linaeum. "Take your time."

I did.

"How do you like the little speakers?" Steve would call every two months or so to inquire.

"All right. Yes, they're very nice—but . . ."

"Take a while longer."

My biggest mistake was taking the speakers over to the lair of Lars, early on in the game. I should have known by then not to seek approval from my dear friend Lars.

"The top end is rolled off. Nice, if you like a rolled-off top end," said Lars. "But still, they have good resolution, nice tonal quality. Yudging by what I heard, these are very nice speakers for the money, these linoleums."

"Linaeums," I corrected. "Linoleum is a floor covering. Linaeum is a registered trademark of the Linaeum Corporation. Actually," I said rather pompously, "Linaeum is Latin for line, and these are line-source speakers."

I took the speakers home, boxed them up, and stashed them in the closet. You see what the opinions of fellow audiophiles can do for you?

But just as I was preparing to send the Linaeums back, I recalled that Lars' speakers at the time had what I considered to be a very insistent, if not aggressive, top end. Maybe Lars, in optimizing his listening room, his interconnects, his cables, etc., unduly tried to compensate. Argue about the interconnects and cables if you will, but Lars certainly did have a lot going on in the way of room treatment—acoustic panels and the like. I set up the Linaeum LFX speakers again in my own listening room, and this time, I had a much more favorable impression.

In some respects, I found these speakers to be the equal of my far more expensive Quad ESL-63s. Like the Quads, which are electrostatic panel speakers, the Linaeums can disappear. They produce a spacious, seamless, absolutely open soundstage. What's more, they have, like the Quads, a very pleasing way with harmonics. There is nothing edgy or strident about the sound they present, unless, of course, a recording is atrocious, in which case the LFX speakers, unlike many audiophile-faved models, won't make the sound worse.

THE LINAEUMS SOUND LIKE WHAT I HEAR IN CONCERT HALLS: MORE LIKE LIVE MUSIC, LESS LIKE HI-FI.

What we have here, I thought, is a poor man's pair of Quads, for only $600 per pair, plus stands. (A version of these speakers in Corian, a kind of fake marble, is available for $1,200.) Okay, a good pair of 24- or 28-inch stands will run you another $300 or $400, bringing your total outlay closer to $1,000.

Now, as it turns out, you can get a pair of Linaeum-designed speakers for half this price—a mere $299 for the Optimus PRO LX5 speakers at Radio Shack, an astonishing hi-fi bargain if there ever was one (see review in the April issue). Still, audiophiles might want to check out Linaeum's own little speaker, the LFX, which offers such goodies as bi-wiring capability and a slightly larger woofer. If you can live with this speaker's limitations, you'll enjoy high-end sound on the cheap: Superb soundstaging,

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For literature, circle No. 96

imaging, and resolution, plus the kind of detail and harmonic delicacy that one normally has to pay over $2,000 for.

The LFX speakers are tiny; they're only 7 inches wide, 7 inches deep, and 10 inches tall with their grilles on. The woofer is a 5¼-inch Peerless unit that handles frequencies from 2,700 Hz down. This is fitted into a medium-density fiberboard enclosure that has two small forward-facing ports. What's unusual is the Linaeum's high-frequency drive unit. Hard to call it a tweeter; it's not a ribbon, but it looks like one. What it is, though, is a diaphragm formed from two loops of polypropylene, both driven by a printed-circuit voice-coil. (The voice-coil is dual-sided and is placed between dual magnets, to provide balanced drive.) The dual-loop design gives the tweeter very wide dispersion.

The optimum listening angle is between 15° and 60° off axis, by the way. When you set these speakers up, start by pointing them straight out; don't cross them so that they intersect 5 inches in front of your nose! (Lars actually gets out his measuring tape and has the distance between the tip of his nose and each tweeter measured by his buddy, Brass Ear. Then he moves exactly 5 inches back. Brass Ear goes him one better: He has a listening chair with a vertical height adjustment, so he can change his vertical listening angle.)

The LFX speakers sound better with the grilles off—more detailed, more open. But this does leave the polypropylene loops vulnerable. It would be very easy to brush against them with your sleeve and snag them.

Steve Geist, the designer, tells me that part of the reason these speakers sound so clear and clean is that there are only two components in the crossover: A 0.68-mH inductor for a low-pass filter and a 12-µF capacitor for a high-pass filter. Geist says one of the benefits is that the speakers exhibit very little acoustical phase shift across their operating frequency band.

THE LINAEUMS SEEM TO DISAPPEAR INTO A SPACIOUS, SEAMLESS, ABSOLUTELY OPEN SOUNDSTAGE.

Especially with the grilles off, the LFX speakers have an openness associated mainly with expensive panel speakers (electrostatics and the like). With a superb recording, such as Shostakovich's Symphony No. 15, with the Cleveland Orchestra conducted by Kurt Sanderling (Erato 2292-45815-2), the soundstage can be breathtaking. This is coupled with excellent specificity of imaging, something you don't always get with a spacious soundstage. There's no specious spaciousness here; it's the real thing. In fact, in terms of imaging specificity, the LFX may beat my Quad ESL-63.

So what about that high end? Does Lars have a point about it being rolled off?

Compared to most speakers I've had in my listening room, these Linaeums *do* sound different. But rolled off? Geist says the speakers are flat at 14 kHz, 30° off axis, and down only 1 to 3 dB at 20 kHz. Listen, and I think you'll agree: The highs are there, just not accentuated the way they are with conventional speakers. Geist says this is due

to subtle differences between the relative arrival times of the high and middle frequencies in systems using Lineaum tweeters and in those using conventional domes: "With domes, the high frequencies are thrust at you; they're accentuated." He also says Linaeum systems are set up for flat total radiated power, rather than flat on-axis response. "Because the horizontal dispersion is so wide, you have to look at it that way."

So much for explanations—what about listening? The more I listen to the LFX speakers, the more I like them. Instead of finding the high frequencies rolled off, I find them more natural than with most other speakers; what I hear is closer to the sound I hear in concert halls. The Linaeum speakers sound different, all right: More like live music and less like hi-fi.

Geist makes the point that most of your favorite CDs or LPs are probably not state-of-the-art recordings. "I could have made the high frequencies more prominent, but I wanted a speaker that makes all your recordings enjoyable, not just audiophile recordings," he says.

At this point, you may be rushing out to buy a pair, so also be aware of the drawbacks. These are small speakers. There's little bass below 70 Hz. Additionally, because of the size of the LFX, it can move only so much air. You can play these speakers just so loud, and then—well, forget it. This means they are far better suited to Shostakovich's chamber-like Symphony No. 15 than, say, to his No. 10. But you can't really play his demon Tenth in your home anyway—not at anything like the levels you would hear in a concert hall.

"WHAT WE HAVE HERE," I THOUGHT, "ARE A POOR MAN'S QUADS, FOR ONLY $600 PER PAIR."

A few more thoughts before Evgeny Pittsovsky (Genya, my editor) pulls the plug. Most of us live and listen in fairly live rooms—no acoustical panels or other room treatments, lots of windows, maybe some bare floors. The Linaeum LFX speakers sound awfully good in my living room, where the only acoustical treatment allowed is books.

Also, because these speakers are so phase-coherent, so clear, so clean-sounding, they put great demands on the rest of your system. No, the Linaeums won't make recordings or cheap equipment sound worse. On the other hand, it would not be a waste to use them in a system comprised of very fine, expensive electronics—or fine, not-so-expensive electronics, for example the Quicksilver GLA amp I reviewed in the May issue.

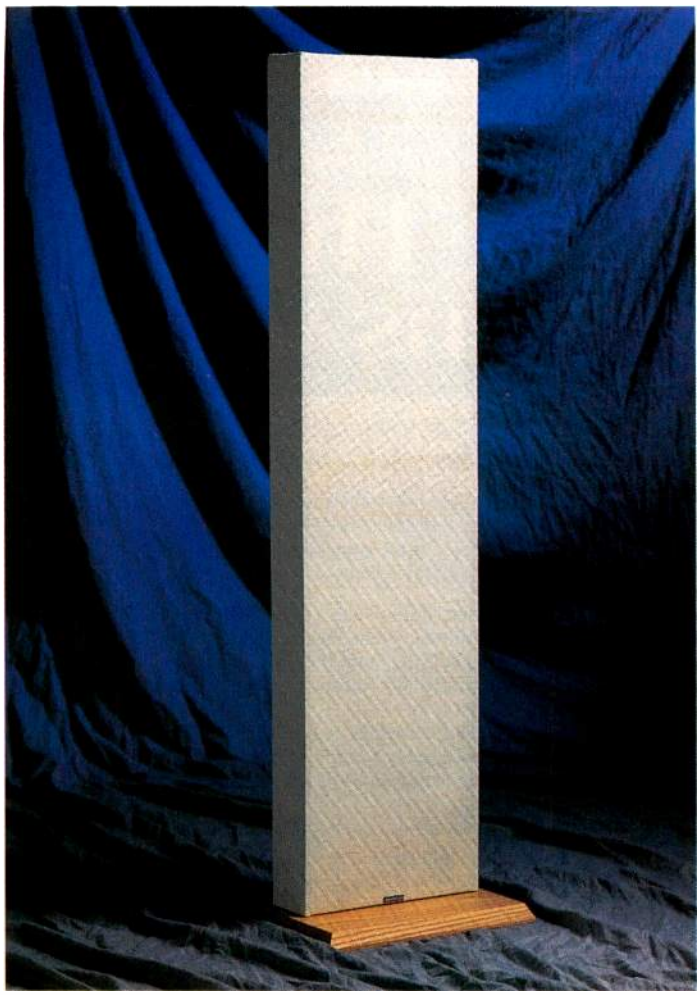
While the sensitivity of these speakers is rated at 89 dB (1 watt/1 meter), and the nominal impedance is an easy 8 ohms, they like a fair amount of power (or yuice, as Lars calls it). These are *not* speakers I would care to run on a 9-watt/channel single-ended triode. The 40-watt/channel Quicksilver GLA was an excellent choice; the 135-watt Quicksilver M135 monoblocks were even better. This is not surprising, because big amps make little speakers sound bigger.

And by the way, I'm keeping the LFX speakers. A

AURICLE

ANTHONY H. CORDESMAN

ROOMTUNE DELUXE ROOM-TREATMENT PANELS



Treating a room to get better sound, by finding the proper loudspeaker and component placement and by locating the best listening area, is as important to the success of a system as the choice of its components. While some room problems, particularly those affecting deep bass, can often be dealt with only by virtually rebuilding a house or apartment, it is relatively easy, on the other hand, to deal with others. For instance, you can damp a live room with heavy wall-to-wall carpeting and heavy or acoustically absorbent furniture. By contrast, you can open up the sonics by removing some furniture or carpets, or you can alter the reflection characteristics of walls by using paintings, tapestries, or acoustic panels. Indeed, many audiophiles prefer rooms with a mix of live and dead walls.

To keep the sound from interfering with, say, a turntable, placement can be dealt with in a number of ways. For example, I keep my components in an acoustically isolated room that has a load-bearing wall between the listening room, where I keep my loudspeaker systems, and the component room. In most cases, audiophiles will keep turntables away from their loudspeakers, out of the listening path, and away from corners. Many also use special racks or shelves to isolate their turntables and electronics from room and acoustic vibrations.

THESE PANELS CAN HAVE CONSIDERABLE EFFECT ON IMAGING AND ON MIDRANGE AND TREBLE CLARITY.

Company Address: c/o Ultra Systems, P.O. Box 570, Point Pleasant, Pa. 18950.
For literature, circle No. 95

Experimenting with placement to get the best out of a speaker system is both a joy and a curse. As a reviewer, I have gotten painfully used to moving furniture around and spending hours making changes in speaker location. It is far too easy for a reviewer or audiophile to judge a speaker more by the effect of its room placement than by its inherent quality. I try to minimize this by using several reference systems in different listening rooms, but am constantly forced to recognize that nothing I do can fully correct for the character my listening rooms impose on the sound I hear. And like virtually every audiophile, I am far from having the "perfect" room.

With some accessories, the end result is to trade one set of vibrations and colorations for another; however, other accessories are available that can reduce the effects of a room on a system. RoomTune offers room-treatment panels that provide a partial solution to some of the problems discussed above, without requiring that you rebuild your house or make massive sacrifices in decor and room function. The RoomTune Deluxe panels sell for $239 per pair and are rectangular in shape (48 inches high, 12 inches wide, and 3½ inches deep). They normally mount vertically on a wood base, but can also be used without a stand by placing them against furniture or a wall. Fortunately, the panels are unobtrusively styled, and are available in a range of colors. Though scarcely invisible, they are relatively easy to set up, to take down, and to move around.

These panels have one absorbent and one reflective side, to give you some control over how much reflected energy you hear. RoomTune recommends using five panels for a typical listening room, with three placed around the speakers

and two or three placed near the listening position. The quantity and placement is highly system- and room-dependent; most audiophiles will want to experiment at length to find out what will produce the best effect. (RoomTunes' distributor, Ultra Systems, offers a complimentary booklet, *Let's Tune Your Room*, which discusses strategies for tuning your listening room and the use of RoomTune products.)

The practical effects of the RoomTune panels will depend a great deal on the particular characteristics of your room and speakers, as well as how much treatment you can afford and are willing to put up with. These panels do not defy any laws of physics, nor do they significantly affect the interactions in the bass between speaker and room. But after several months of experimentation, I have found that the Deluxe panels can have considerable effect on imaging, the soundstage, and the clarity of the midrange and treble at the listening position.

THE ROOMTUNE PANELS DON'T COST A FORTUNE, ARE FUN TO EXPERIMENT WITH, AND ACTUALLY GET RESULTS.

RoomTune panels provide help near the speakers as well as in the listening area. If they are correctly placed, and proper attention is used to positioning their reflective surfaces, they can help control the rear energy reflected by dipole speakers or eliminate excess reflections off of side walls. They can also partially correct for the effect of an asymmetric relation of the listening position versus speakers or for the effect of nearby archways and room cavities. Success will sharply vary according to the nature of a particular room and setup.

Using the RoomTune Deluxe panels near the listening area requires care, but if you avoid placing them where they add too much reflection or overdamp the sound near the listening area, they can often make improvements—in the focus and clarity of the soundstage and in the transparency of the upper midrange and treble. I would, however, pay careful attention to your ears, rather than your eyes. Remember, the panels are light and relatively easy to move; you can always use them in the optimal position for listening and then later on put them somewhere less obtrusive.

Perhaps the best way to put the RoomTune panels in perspective is to say that rather than gilding the lily, they let the rose bloom. But I am not the kind of reviewer who praises accessories in floods of rhetoric. In fact, I generally find passive damping devices to be rubbish, as their only possible benefit to the consumer is as a placebo: The audiophile feels his audio system sounds better because of some form of "medicine," regardless of the fact that the "medicine" has no real effect.

By contrast, the RoomTune Deluxe panels do produce small to moderate benefits of the kind I have described. They are fun to experiment with, they do not require a major investment, and they do not require that you believe in alternative physics or follow some new audio cult. For the practical audiophile, they can be enjoyed rather than worshipped! A

CLASSICAL RECORDINGS

Photograph: Courtesy Epiphany Records

The Young Beethoven
Igor Kipnis, fortepiano
EPIPHANY EP-1, CD; 73:00

For my ears, familiar with Beethoven as played by the great 20th-century pianists, this recording was a major experience. I ended up playing it three times over. Revolutionary! Or perhaps I should say counterrevolutionary: Back to Beethoven himself. Without doubt, this sound and these dramatic and informed interpretations bring us as close as we have ever been to the impact the young Beethoven's music had on his earliest hearers. The "Pathétique" Sonata (1797 to 1798) and especially the "Moonlight" (1801) are overwhelming. The piano here was built in Vienna, in 1793—only two years after Mozart's death, when Haydn was still at the apex of his long career. Could the supposedly delicate piano of those days really render the incredible fury and intensity of a Beethoven? Yes, and yes again!

This fortepiano (or if you wish, pianoforte!) is, in my judgment, the most convincing "restoration" so far in a steady progression over recent years. And it is far more dramatic—and brutal—than any performance on a modern piano! You will not believe what the little instrument can do. Such a variety of tone, from the ethereal to the gross and deliberately ugly. Such utter clarity of inner parts, usually subdued; such fleetness and speed!

Igor Kipnis comes to Beethoven free of the standard mass of present tradition that surrounds the music. His debut was as a harpsichordist, back in the '50s, and Beethoven is not a normal part of the harpsichord repertory. When Kipnis finally added the fortepiano to his performance skills, many years later, he suddenly emerged as the very antithesis of a harpsichordist: A powerful interpreter of early Romantic music, a keyboard dramatist obsessed with the very matters that concerned the early Romantic composers.

FREDERIC RZEWSKI

The People United Will Never Be Defeated! (36 Variations on "¡El Pueblo Unido Jamás Será Vencido!")
Stephen Drury, piano
NEW ALBION NA 063,
CD; DDD; 58:49

Frederic Rzewski, whose teachers have included Elliott Carter, has established himself as the first American composer since the generation of Marc Blitzstein and Elie Siegmeister to take a consistently political view of his world. As a piano virtuoso, Rzewski also championed the works of such leaders of the avant-garde as Boulez, Bussotti, Cage, Feldman, Kagel, Stockhausen, and Wolff.

This brilliantly recorded CD leads off with a live choral performance of Sergio Ortega's militant theme song for Salvador Allende's democratically elected government in Chile—flagitiously done to death in 1973 by our CIA and replaced by the Pinochet military dictatorship. (Rzewski pointedly interpolates Italy's anti-Mussolini song "La bandiera rossa" and Hanns Eisler's anti-Nazi "Solidaritätslied.") The fact that Rzewski has organized his score with dazzling technical complexity need put no one off; even the lay aficionado of innovative piano music will find this riveting. Like almost no other contemporary works, these variations resemble the works of Franz Liszt in permitting the performer to show off, to a glorious extent, and Stephen Drury flamboyantly makes the most of it.

Paul Moor

Even the Kipnis program is dramatic, juxtaposing numerous lighter works, many of them early WoO (Works without Opus number), and also some fine intermediate early works, *with* opus—Beethoven's own designations—as a telling contrast to the two big sonatas. The fortepiano could also play civilized music, and the youthful Beethoven could compose it, too, on demand.

Warning: Many listeners may be upset by this recording. It defies piano tradition; it is indeed often brutal and ugly. That was a part of the game. I can imagine many piano-minded listeners upset at the great crashing jangles of sound. But if you will have the courage to study and to learn, you will be rewarded.

Surely, this *is* Beethoven, impeccably recorded on 24-bit glass-disc masters.

Edward Tatnall Canby

Bartók: Four Orchestra Pieces, Op. 12; Concerto for Orchestra

Chicago Symphony, Pierre Boulez
DEUTSCHE GRAMMOPHON DG 4378262, CD; DDD; 59:59

This pairing neatly juxtaposes an early considerable work by one of this century's greatest composers, Béla Bartók, with a masterpiece he barely completed before leukemia killed him in 1945. At the outset of his composing career, well before he turned into a thorny, expressionistic revolutionary in early midlife, Bartók fell strongly under French musical influences. Later, the impoverished New York end of his life found him reverting to an almost classical purity and simplicity. Enriched by his electrifying genius, his imagination turned to the residue of decades of loving

devotion to his native Hungary's sumptuous Magyar (i.e., non-Gypsy) folk music.

Bartók called this five-movement work a concerto because it permits the orchestra's individual instrumental choirs to take turns in the spotlight, showing off just as the traditional concerto's individual soloist does. Since few orchestras can boast the quality of individual instrumental choirs the Chicago Symphony has long taken for granted, that adds up to an invigorating musical experience.

Pierre Boulez approaches this rich and passionate music with his familiar analytic coolness, but he manages to attain the pellucid aural transparency one expects from him without imposing a chill on the music itself. That results in an exceptionally vivid realization of an established "classic" of the 20th century, plus a welcome reminder of the youthful genius that preceded it. Chicago's Symphony Hall and Deutsche Grammophon's masterful engineers combine to accomplish rare sonic radiance.

Paul Moor

Shostakovich: Symphony No. 10; Mussorgsky/Shostakovich: Songs and Dances of Death

Robert Lloyd, bass; Philadelphia Orchestra, Mariss Jansons
EMI CLASSICS 5 55232 2 CD; DDD; 71:33

These are absolutely compelling readings of two fascinating works. The symphony usually is construed as Shostakovich's ultimate envoi to the recently dead Stalin—a very personal, and personally felt, epilog to frustration and

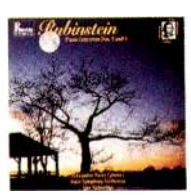
tragedy. The orchestration of the Mussorgsky song cycle pays a very different sort of tribute to a composer whom Shostakovich deeply admired. Lloyd's performance in Songs and Dances is every bit as commanding as Jansons'. Much of the orchestral sound, captured in Memorial Hall in Fairmount Park, Philadelphia, is exemplary, though the beauty of the individual instruments where the writing is spare truly makes me wish for still greater clarity in the tutti climaxes.

Robert Long

Rubinstein: Piano Concertos Nos. 2 and 4

Alexander Paley, piano; (Russian) State Symphony Orchestra, Igor Golovchin
RUSSIAN DISC RD CD 11 360, CD; 76:42

History is such a mess! Especially music history. No, this isn't Artur R., the longtime pianist who played such a moving concerto on TV at age 90. Anybody remember that? This one is Anton Rubinstein, one of the great musical minds of the entire 19th century, piano child-wizard at 10, revolutionary reshaper of Russian music, founder and president of the Moscow Conservatory, enormously prolific



and expert Romantic composer, touring piano virtuoso everywhere—hey, does anybody now know about his tour of the U.S. with the violinist Henryk Wieniawski, for eight months and 215 concerts? That was in 1872 to 1873. How quickly we forget.

In short, Anton Rubinstein was big. No longer. My musical education just talked about him.

The first of these two works is quite astonishing, dating from 1851, the very heyday of early Romanticism. Such expertise and such

absolute security in both piano and orchestral writing! The composer was all of 22, and guilty of a bit of canny imitation—Chopin, Liszt, et al. Why not? His melodies are corny too, and the music isn't that well organized. But I suggest that any Romantic-minded, 22-year-old composer today give a long listen here, and stand back abashed. Really extraordinary for such an early age. As for the No. 4, just 10 years later, Rubinstein had learned a lot, and not all of it to our present taste. A much more bombastic, swashbuckling, all-out concerto, exactly in the style of the day and no longer imitative. Yes, better organized, but I found it noisy, brash, thundering—though I liked the slow music, as I did in the earlier work. There, Anton R. is nicely poetic and thoughtful.

The pianist Alexander Paley is splendid. He has all the technique needed, which is more than plenty. But he is no hard pounder. His playing struck me as pliant. It gives; it is flexible and always musical. You can't help enjoying him, and the piano sound is lovely.

The all-Russian recording is interesting. The venue is, needless to say, the Great Hall of the Moscow Conservatory. It is not an ideal recording hall; there are vaguely unpleasant reverb oscillations, no doubt architectural. The recorded sound overall is not quite up to current Western standards. The piano is admirably captured, but the orchestra does not really surround and encompass it. A bit old-fashioned—nothing serious. All in all, an important historical and musical document.

Edward Tatnall Canby

UV L RTG R NA CV L IA S SLI C ST

I wonder whether Virgin Classics thinks it can score points simply by keeping everybody guessing. The first Ultraviolet CD I encountered was the Humperdinck, which consists of a series of orchestral opera excerpts, only one of which comes from *Hänsel und Gretel.* Being fond of the Humperdinck string quartet, I wanted to sample some of his other music. This disc satisfied the need, though its music, performance, and recording (a 1990 Bavarian Radio co-production) all struck me as pretty routine. The cover art, showing two moppets saying their prayers, is revoltingly cute but marginally apt.

Shortly thereafter, *Audio* gave me the Haydn to review. Anything *but* routine all around; I had admired the Endellion String Quartet's Bartók in these pages some time ago (April 1991), and this recording—a cleanly spacious 1989 pickup—didn't disappoint. But what's this on the cover? A pop-art sculpture of a 1950s automobile? What on earth does this have to do with Haydn's Opus 74? (Oh: Number 3 is called "The Rider" Quartet. Talk about far-fetched!) And what's this in the back of the booklet: Listings of more Ultraviolet offerings, with interesting titles but not one performer mentioned!

When I called the U.S. distributor, EMI, I was told that Ultraviolet is intended as a midprice line for newcomers to classical music. But why the Ultraviolet name and the wildly inappropriate art on the Haydn, and why no performer listings for the other CDs? The answer amounted to: "Who knows! The Brits at Virgin do the packaging; we just sell 'em." EMI also cautioned that not all Ultraviolet titles are available in all countries.

The gauntlet had been thrown down. At the first record store I tried in search of more specifics, I learned that the Berlioz *Nuits d'été* is sung by Janet Baker and that the disc includes some Respighi. And I *thought* I learned that the Nielsen Violin Concerto is played by Menuhin. Looking more carefully, I discovered that he is the conductor.

The Nielsen turns out to be a very good recording. I like Menuhin's view of the Fourth Symphony, but the concerto is what grabbed me. The same kind of vivid, spunky playing and recording, full of up-close bite, that I remember from the wonderful old Tono 78s with Emil Telmányi (Nielsen's son-in-law) as the soloist. The Virgin stereo sound, from Henry Wood Hall in the late '80s, adds space that was sorely missing from Tono's studio acoustics, while Tono's surface noise is missing from the Virgin, of course. A really welcome addition to my library.

Still bothersome was the booklets' avoidance of any specifics about the performers. And, of course, there was my nagging curiosity about the very identity of the performers of many other titles. So I tried a couple more large stores with classical departments. In one, a knowledgeable employee called Ultraviolet a "reissue line." Here I found a couple of Ultraviolets in unsorted "New Arrivals" bins but none under any of the composers. When I asked specifically about the *Nuits d'été* and the Rossini arias, I was told that they were filed under the performers. What help is that when Virgin won't tell you who the performers are?

The Rossini disc, too, is welcome—despite cover art that appears to show an icicle about to puncture a human eye. (Why?!) Katia Ricciarelli's approach is rather old-fashioned: Vocalism takes precedence over characterization or dramatic thrust. But her astonishing combination of power and flexibility makes for fireworks that should satisfy all but the most adamant Callas fans. Again, the 1989 sound is more than adequate. As with the other CDs, if you know nothing of the performer's career and are unaware of Ultraviolet as a reissue line, you could take this recording as representative of current practice.

Still unsampled by me are the Baker *Nuits d'été* and another potentially interesting item: Arleen Auger's recording of Canteloube's *Chants d'Auvergne.* And among others, there's a Falla CD including *El Amor brujo,* whose performers I have yet to ascertain; indeed, I'm not even sure it's available here. The pricing is also confusing, varying from about $7 (at what I perceive as a full-price outlet) to $16 (at a record "club") for the Humperdinck. Midprice at $16? The going New York retail rate seems to be running about $10.

All in all, the Ultraviolet line turns out to be a distinctly mixed bag. But rummage around in it, and you may come up with some treasures.

Robert Long

Humperdinck: Fairy-Tale Music
Bamberg Symphony, Karl Anton Rickenbacher
VIRGIN CLASSICS ULTRAVIOLET
5 61128 2, CD; 55:32

Haydn: String Quartets, Op. 74, Nos. 1, 2, and 3
Endellion String Quartet
VIRGIN CLASSICS ULTRAVIOLET
5 61127 2, CD; 71:27

Nielsen: Violin Concerto; Symphony No. 4
Arve Tellefsen, violin; Royal Philharmonic Orchestra, Yehudi Menuhin
VIRGIN CLASSICS ULTRAVIOLET
5 61136 2, CD; 74:47

Rossini: Arias
Katia Ricciarelli; Lyon Opera Orchestra, Gabriele Ferro
VIRGIN CLASSICS ULTRAVIOLET
5 61139 2, CD; 57:26

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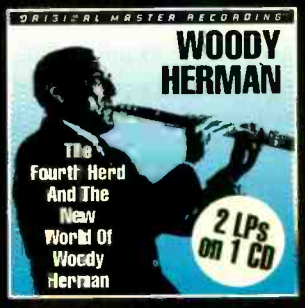

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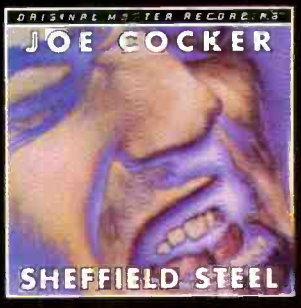

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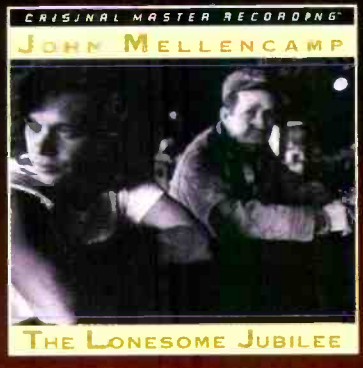

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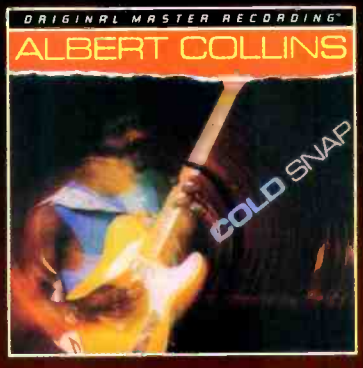

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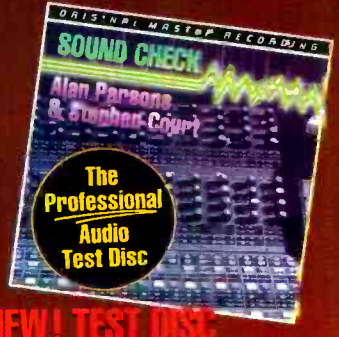

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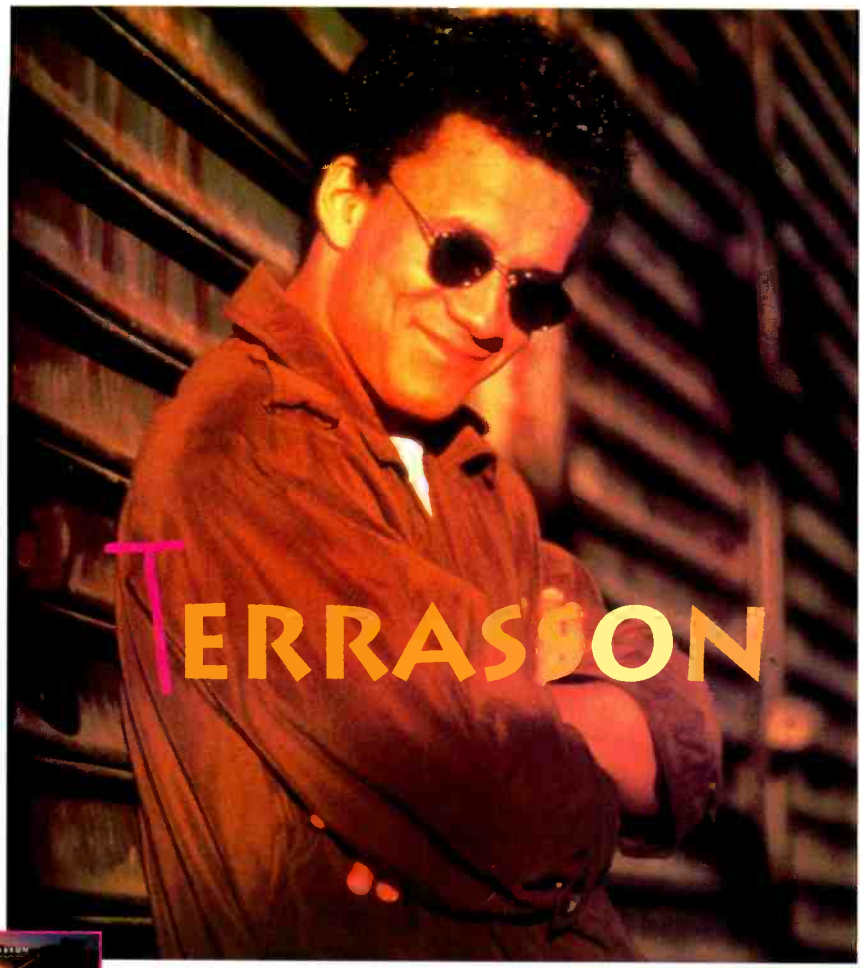


Photograph: Jim Varielle

Jacky Terrasson
BLUE NOTE 7243 8 29351, 55:23
Sound: A–, Performance: B+

From its opening moments, with Leon Parker's bass drum kicks and pianist Jacky Terrasson's dense chord clusters, this debut announces itself as no ordinary trio record. Beneath the hype (is Terrasson's debut really "long-awaited"?) and raised expectations (winning the Thelonious Monk competition has become a double-edged honor) lies not so much a pile of chops but a distinct, well-formed musical personality.

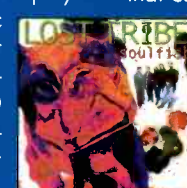
This album, in fact, offers three personalities, but it's Terrasson's—one of elegant invention and even-handed confidence—that proves to be the driving force. The pianist introduces the standard "I Fall in Love Too Easily" with a simple right-handed walk through the melody. He dives into the Stevie Wonder hit "For Once in My Life" atop a Latin rhythm and a torrent of notes from his left hand. The fact that Terrasson possesses a delicate, gorgeous touch is no secret; that he's able to employ this grace to form exquisite statements with his debut's varied material, including several originals, is the real news.

Terrasson's success here is partly due to his rhythmmates, two gifted improvisers at similarly early career stages. Drummer Parker displays characteristic invention, following Terrasson's every indulgence with precision while coaxing more sounds out of a cymbal than seem possible. In tandem, Parker and bassist Ugonna Okegwo form a comfortable and flexible pocket for Terrasson; the construction is tailored uniquely to the young pianist's own tastes, which tend toward the expressionistic. When Terrasson and Parker trade fours in "Bye Bye Blackbird," and

SOULFISH

Lost Tribe
HIGH STREET 10327, 57:58
Sound: A–, Performance: A–

Lost Tribe's breadth of scope comes as a result of talented players combining electric jazz with an urban street sound. Among their contemporaries in the CD bins, this New York quintet represents a high-water mark.



Unusual juxtapositions are key to Lost Tribe's success. They alternate frenetic funk with striking lyricism, while combining rock 'n' roll backbeats with odd meters. Their ballads are surrounded in a spacey ambience that seems to suspend the songs' metronomic time. Through the noise and atmospherics, alto saxophonist David Binney and guitarists David Gilmore and Adam Rogers solo decisively, pacing themselves and using silence at the right moments. They display maturity in a realm that can be unforgiving, especially when caught in the tidal wave that is the group's high-decibel rhythm section.

As if gently emphasizing a point, the last few minutes of *Soulfish*'s final track slip into a more straight-ahead approach, demonstrating Lost Tribe's adaptability but overall unwillingness to pursue a genre that has already been explored by others. *James Rozzi*

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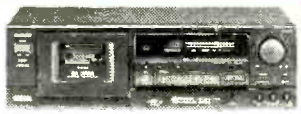

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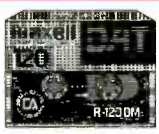

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when they toy playfully with the song's tempo, the trio breathe as one; never are there any of the awkward lurches and lunges that are so commonplace among pianists with Terrasson's abstract leanings.

One of Terrasson's other virtues is his own Zen-like production. This album bucks the current trend of placing guest soloists on major-label debuts, and *Jacky Terrasson*'s overall sound, though clean, is ambient and not antiseptic. Which is to say that this trio's natural sound easily translates to an ingratiating recording. Song sequences, such as the clever transition from "I Love Paris" to "Just a Blues," are thoughtful and affecting—except for "Cumba's Dance," a wonderful coda of a song that dangles off the CD's end. Overall, it's the triumvirate skills and the level on which they combine that fascinate.

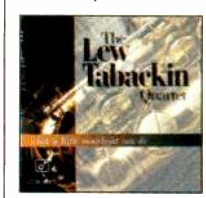
On the album's front cover, Terrasson sits at the piano as the sun sets over a Manhattan waterfront, its colors a rich wash of purplish hues. Similarly, *Jacky Terrasson* freezes a moment in the careers of three gifted young musicians—a moment both fleeting in duration and dazzling with fire. *Larry Blumenfeld*

What a Little Moonlight Can Do

The Lew Tabackin Quartet
CONCORD CCD-4617, 57:07
Sound: B+, Performance: A–

During Lew Tabackin's tenure as a section player with the *Tonight Show* orchestra, his forte went untapped. It's true that his startling command of the tenor saxophone was better heard from within the orchestrated confines of a big band, but his more recent endeavors into looser small-group playing are the only genuine testaments to his personalized prowess.

Surrounding himself with a top-shelf New York rhythm section, Tabackin is exemplary when tackling a diverse repertoire of mostly upbeat standards, as he does on *What a Little Moonlight Can Do*. Forging a path through the thick-toned traditions of Coleman Hawkins and Ben Webster, he's arrived at an approach seeped in the bullish traditions of the past but modernized by more recent harmonic gains.



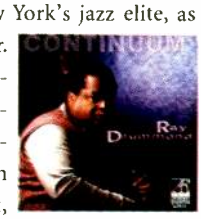
On the album's uptempo title track, decisive linear melodies alternate with unexpected leaps of faith; arpeggiated incursions climb well into the altus. Effective use of multiphonics caps the imaginative cadenza of "Easy Living," one of three beautifully performed ballads. On "Poinciana," Tabackin shows himself to be one of the finest exponents of the classically influenced jazz flute; his tone is clear, with a ubiquitous vibrato.

Strangely, the recorded piano sound at times gives the illusion of being slightly out-of-tune, the only detraction of an otherwise excellent blowing date. *James Rozzi*

Continuum

Ray Drummond
ARABESQUE AJ0111, 67:35
Sound: A–, Performance: B+

Bassist Ray Drummond has worked with the inner circle of New York's jazz elite, as both sideman and leader. With a warm and wood-toned bass, discriminating taste, and an eagerness to play the bottom end of his instrument, Drummond consistently selects the choicest of notes, whether he's playing in ensemble or



Nobody Else but Me

Stan Getz
VERVE 314 521 660-2, 53:53
Sound: A–, Performance: B

For Stan Getz, the bossa-nova craze of the mid-'60s was as musically frustrating as it was economically fruitful. With his megahit cover of "The Girl from Ipanema" dictating his career's direction, Getz formed a spunky quartet, rebelling against cool, breezy Brazilian pop sounds with a hot tempest of hard-blowing jazz.

But for Getz's record company, the bossa was simply too popular to pass up. So cash in they did, recording him in numerous Brazilian settings while *Nobody Else but Me*, an unissued straight-ahead gem, collected dust for over 30 years.

In spite of Joe Hunt's mundane drumming, vibraphone youngblood Gary Burton manages to light a fire under Getz, eliciting an aggression from the saxophonist that's not often heard throughout his expansive discography. Getz gleefully slap-tongues his reed and then climbs well above his normal range, spinning tales of past glories while reclaiming his throne as king of the smooth-toned tenors. *James Rozzi*

solo. *Continuum* finds him assembling eight musicians—among them guitarist John Scofield, trumpeter Randy Brecker, and pianist Kenny Barron—who team up in various combinations for a relaxed, loosely arranged blowing session, with optimal results.

The blues is the most featured song form in this nine-track set of extended jams. The opener, a Drummond original titled "A Blues from the Sketchpad," sizzles to a medium uptempo using the full ensemble. And Drummond's covers are equally compelling displays of taste and audacity. Billy Strayhorn's "The Intimacy of the Blues" is given a decidedly 6/8 feel, the Japanese folk song "Sakura" is expanded to fit an altered 24-bar minor blues, and Oscar Pettiford's "Blues in the Closet" is approached aggressively as a guitar/bass/drums trio. Drummond then sensitively pursues the spirit of Duke Ellington in a duet with vibist Steve Nelson on "Sophisticated Lady."

Contrary to the slickly produced, trendy instrumental music filling the airwaves, Drummond's vision is consistent with a renewed interest in ageless acoustic jazz. *James Rozzi*

Summit Conference

Reggie Workman
POSTCARDS POST1003, 56:48
Sound: B, Performance: A–

Twenty years ago, the musicians who appear on *Summit Conference* would have represented a meeting of iconoclasts. Reggie Workman, Sam Rivers, Andrew Hill, Julian Priester, and Pheeroan akLaff were all at the peak of their creative powers, releasing albums of uncompromising improvisation and conceptual integrity. Twenty years later, they may not be iconoclastic, but the integrity remains.

They've all played with each other in different combinations, but it's hard to believe they

haven't been a unit for years. This isn't free-jazz, but it is collective and spontaneous. On bass and drums, Workman and akLaff play deftly off each other, wielding machetes through the rhythmic thicket. The muscular playing of akLaff gives these knotty compositions, as it did for Rivers years ago, a sharply etched edge.

Rivers himself is in remarkable form, switching from throaty, bluesy tenor sax to sinewy, overblown soprano runs. Priester's plunger trombone solo on the drunkenly loping "Estelle's Theme" harkens to an earlier jazz era without paying obeisance. Pianist Hill's odd harmonic turns and distended clusters provide a fertile landscape for improvisation.

Summit Conference is one of those recordings that will inspire excitement about jazz and a yearning for the days of collective vision, not re-vision. *John Diliberto*

Live in Montreux

Chick Corea, Joe Henderson, Roy Haynes, and Gary Peacock
STRETCH/GRP STD-1112, 73:13
Sound: B+, Performance: A

In the summer of 1981, Chick Corea mounted a post-bop dream quartet with tenor sax great Joe Henderson, the brilliant bassist Gary Peacock, and the amazing drummer Roy Haynes. This sizzling disc documents a special evening with it at the Montreux Jazz Festival.

Corea and Haynes have had a long musical relationship that dates back to their 1967 stint with Stan Getz's group, and a year later with Haynes' contributions to Corea's classic *Now He Sings, Now He Sobs*. Adding Peacock and Henderson was an inspired notion indeed.

The spirit of Thelonious Monk hovers over *Live in Montreux*'s kinetic opener, "Hairy Canary," as Henderson's robust tenor flows mightily over Corea's quirky comping and Haynes' conversational drumming like a bridge between Charlie Rouse and John Coltrane. On the solo piano intro to Monk's "Trinkle, Tinkle," a tune that Haynes had recorded with Monk back in 1958, Corea dips into his more experimental Circle bag before giving way to the tune's eccentric sway. The uptempo version of Cole Porter's "So in Love"

and Corea's swinging original "Folk Song" both surge from the power of Haynes' drumming, and Henderson matches his rhythmic intensity with some Herculean tenor work.

Peacock showcases his incredible solo skills on Corea's "Quintet #2" and his own lyrical ballad "Up, Up and . . ." while Corea turns in a pianistic tour de force for the solo intro to his funky 3/4 romp "Psalm," another fierce blowing vehicle for Henderson.

Some 13 years after it was recorded, this set still resonates with exhilarating energy and speaks of an uncommon chemistry on the bandstand. *Bill Milkowski*

FAST TRACKS

King of the Delta Blues Singers: *Robert Johnson* (Columbia CK 52944). The best of all the Johnson albums, by far! Yes, this stuff is in the Grammy-winning box set, but two sentences at the end of the liner copy give the game away: "Producer's Note: This CD has been mastered from newly discovered, mint condition test pressings. These test pressings were struck from the original metal parts." There is guitar work on this CD that doesn't exist anywhere else, not to mention the clean, clear sound, which seems to have been recorded in the '60s. **E.P.**

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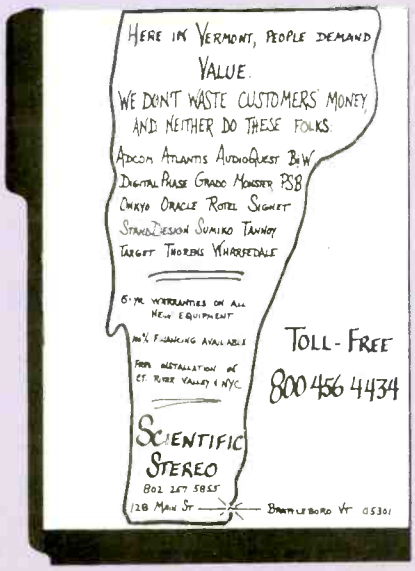

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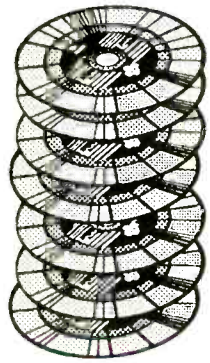

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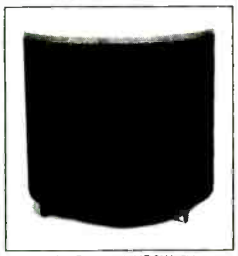

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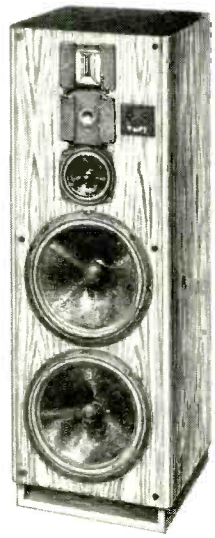

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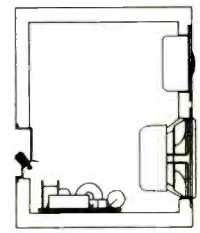

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Nominal Impedance: 8 ohms
Frequency range ±3dB: 80 Hz to 35 KHz - Sealed

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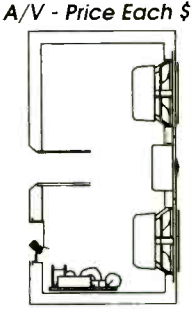

H - 18.5"
W - 8"
D - 10.5"

Nominal Impedance: 8 ohms
Frequency range ±3dB: 40 Hz to 35 KHz - Vented

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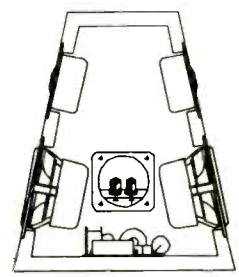

H - 14"
W - 8"
D - 12"

Nominal Impedance: 8 ohms
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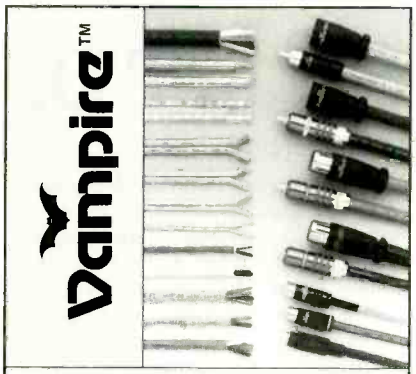

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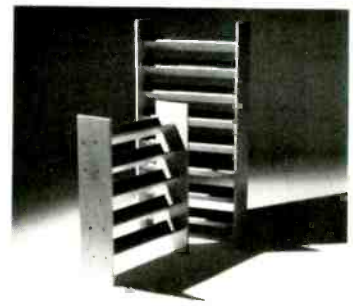

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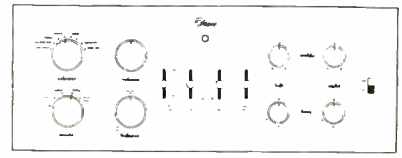

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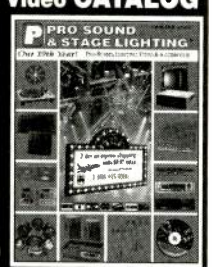

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AD INDEX

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PlayBack

Recoton W500

Wireless Headphone System

Unlike infrared headphone systems, which require a line of sight between transmitter and receiver, headphone systems like the Recoton W500 ($149.95) use radio frequencies around 900 MHz to deliver stereo sound anywhere in or outside the house for audio or video applications, even through walls. The Recoton 'phones have comfortable earcushions and a range of up to 150 feet indoors, more outdoors. The transmitter/charger has an adjustable disc antenna; when the 'phones are not in use, a cable connects them to the transmitter for recharging the headset's nickel-cadmium batteries, which provide about eight to 10 hours of operation, depending on how loudly the 'phones are played. Tuning is more involved than with infrared headphones. The Recoton W500 headset and transmitter each have a level control and a frequency adjustment control; all four controls need to be carefully adjusted for the cleanest, most noise-free signal at the desired level. Without accurate frequency adjustment, you can get whistles or swishes if you're moving. But with patient efforts in positioning the antenna and tuning the operating frequency, you can achieve rather decent sound with the W500. **John Sunier**

GRADE: B

For literature, circle No. 120

RADIO SHACK Digital Sound Level Meter

The rise of home theater, with its setup complexities, has increased the utility of hand-held sound level meters. Now Radio Shack has added a $59.99 digital-display companion (Catalog No. 33-2055) to its long-familiar, $31.99 analog version. Like the older model, the new one is hand-held and has selectable A- or C-weighting, selectable fast or slow response, tripod sockets, and seven ranges that measure 50 to 126 dB SPL through a built-in electret microphone. The digital version can also show long-term minimum, maximum, and average sound levels, and freeze any reading. It comes with its own carrying pouch and 9-V battery. The digital meter, with its very readable liquid-crystal display, makes it easy to balance a home theater's front, center, and rear channels. As the owner of an outboard surround processor and multiple amplifiers and speakers, I found the meter extremely helpful in adjusting levels for proper surround. For a test tone, I recorded FM interstation hiss onto cassette at –20 dB. My system does not have center-channel steering, so I set the center channel 3 dB hotter than the left and right front speakers, as measured by the meter, to keep dialog in the middle. The Radio Shack meter can also be used to determine room acoustic problems and possible cures (such as EQ or placement changes) and to monitor ambient noise levels. Overall, it's a must for your audio toolbox. **John Gatski**

GRADE: A

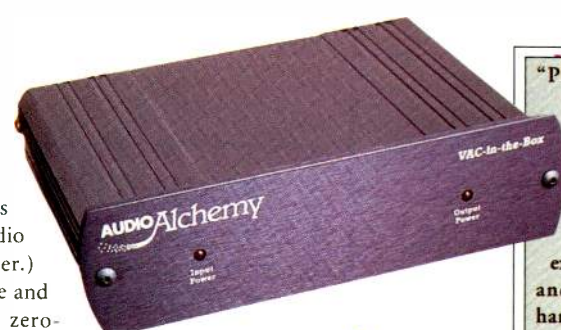
For literature, circle No. 122

AUDIO ALCHEMY

VAC-in-the-Box Phono Preamp

My first question was: What is a VAC? Logically, it stands for vinyl-to-analog converter (and plays off the name of Audio Alchemy's very successful DAC-in-the-Box D/A converter.) VAC-in-the-Box joins the company's long list of innovative and reasonably priced products. This phono preamp has a zero-feedback differential FET input stage; passive and active RIAA EQ; adjustable gain of 32, 50, or 60 dB; variable cartridge termination, and an external power supply. Both MM and MC cartridges are supported.

RIAA equalization accuracy was about 1.0 dB. Resistance to overload was good at 1 kHz but diminished above 2 or 3 kHz. Hooking up the VAC-in-the-Box for an aural spin, I set the unit for 32-dB gain and 47 kilohms with 100 pF. It gave a reasonable account of itself, though wasn't up to my ultimate sonic standard. Yet for its purpose, I think it is a great little product. And, at $259, it's a good deal. **B.H.K.**



GRADE: B

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.*

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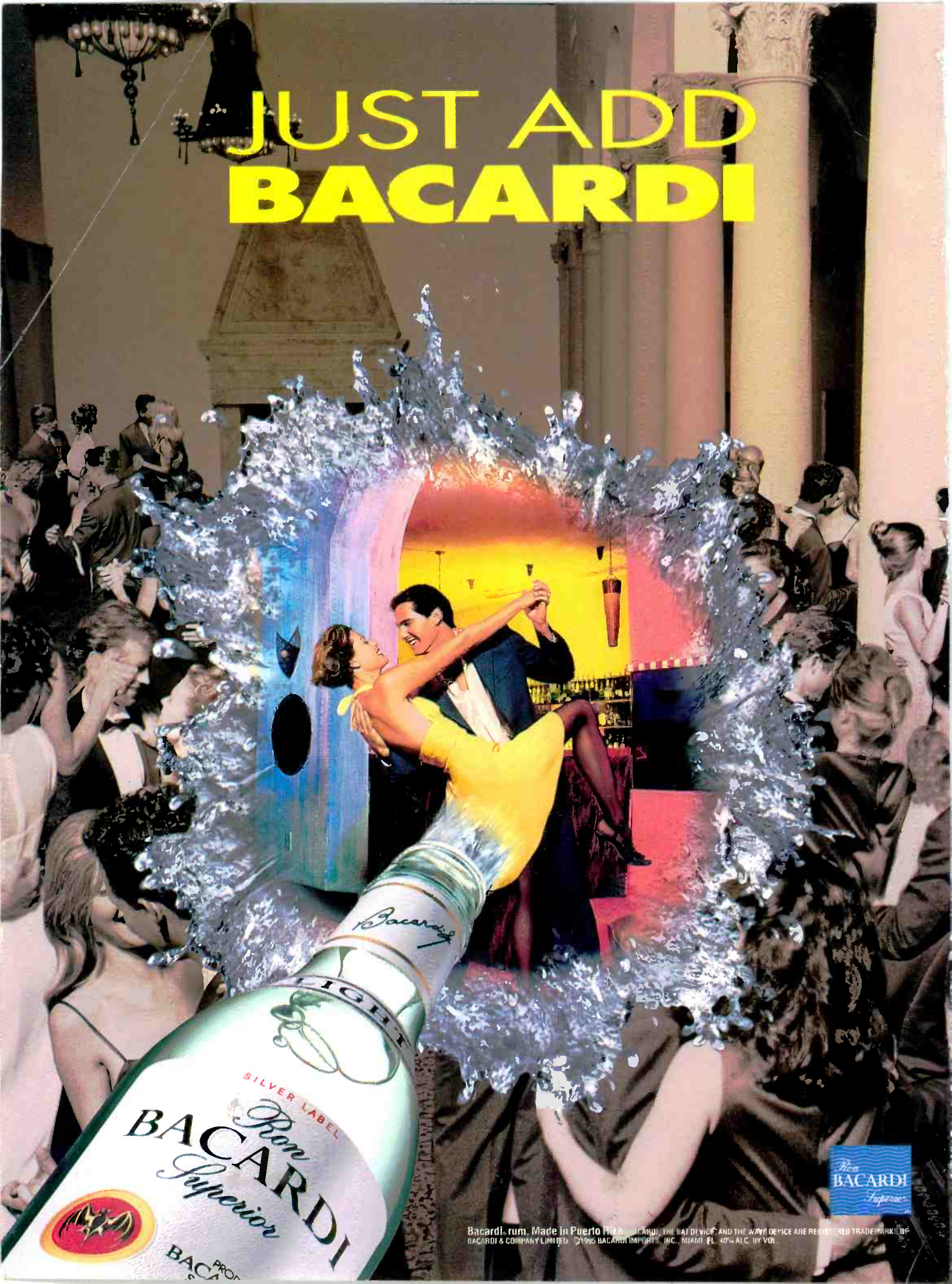
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