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JUNE 1994

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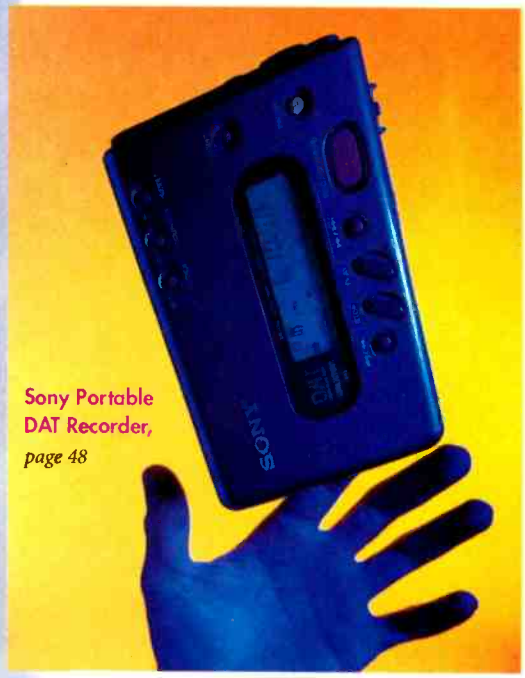
Auto Speaker Polarity, *page 40*



Sony Portable DAT Recorder, *page 48*

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equipment profiles

auricles

departments

recordings

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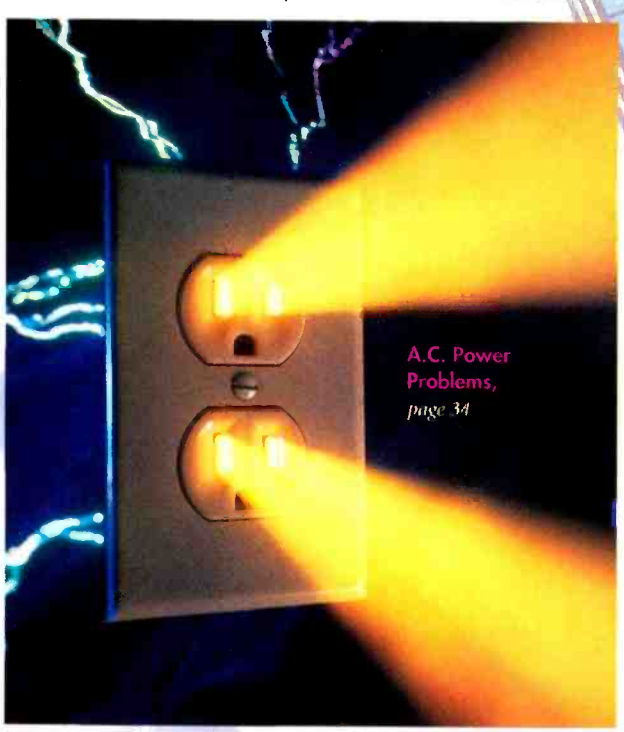

A.C. Power Problems, *page 34*

"There is no other combination of preamp and amplifier on the market for under $1000 that will come closer to the best sound (available at any price) than the Acurus DIA-100."
– Corey Greenberg, Stereophile

"The Acurus DIA-100 Is One of Those One-Of-A-Kind Products That Makes You Wonder Why It's One-Of-A-Kind."

–Corey Greenberg, Stereophile Magazine, Nov. 1993, Vol. 16, No. 11

Since imitation is the sincerest form of flattery, we expect others to attempt copying the unique Acurus DIA-100. In light of this, we have created a list of questions to help you determine if you are looking at an imitation of the genuine article.

Is there only one gain block from source input to loudspeaker output?
The DIA -100 has a single gain block from input to output. Some may attempt to fool you by adding a gain stage to an amplifier and not calling it a preamplifier stage. However as Shakespeare said, "A preamp is a preamp by any other name".

Does it have true high sensitivity amplification?
The DIA-100's gain block has 43dB of gain, the same as a high quality preamp and power amp combination, but without all the additional circuitry. Any imposter can easily connect a passive control section to an amplifier of less gain.

Is the noise as low as a better preamp and 100 watt power amp combination?
The DIA-100 has a noise level as low as the best preamp/power amp combinations, so all the detail of the original recording can be heard. A wannabe copy will have worse signal to noise ratio, so it will be inferior to a quality pre and power amp.

Perhaps, someday someone will make a copy of the DIA-100. On that day we will be sincerely flattered. Meanwhile we would like to suggest that you go to your nearest Acurus dealer and flatter us by auditioning the DIA-100. Who knows, you might go home the proud owner of an original.

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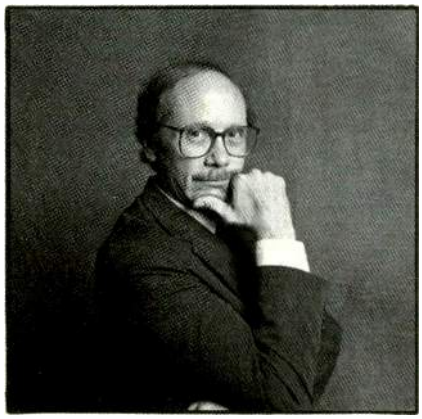
FAST FORE-WORD



We here at *Audio* magazine have lost yet another friend. Our wonderful, musical curmudgeon Bert Whyte died during the afternoon of March 31st from heart failure brought on by complications related to treatment for his diabetes, from which he had suffered for several years. A memorial service was held April 8th close to his Long Island home.

One fond memory I have of Bert was of him in action during a Technics press conference. I have forgotten what the product was, but we editorial types were treated to live music from a quartet playing on a stage in an auditorium which held perhaps 125 people. However, we editors had to earn our musical treat. We had to do a live balancing of four mikes into the house sound system. A couple of guys preceded Bert, making hash of the mix and taking several minutes to do that. Finally, it was Bert's turn. He got up behind the console and in less than 10 seconds the reproduced mix-down had snapped into focus. Where before the sound had been fuzzy and poorly defined, it was now razor-sharp. The entire group erupted in applause, and, it may be obvious, no one wanted to try their hand at the mix after that display of expertise.

Bert was born in Belfast, Northern Ireland on February 22, 1920, and came to the U.S. at the age of four. He began his professional audio career as Director of Sales for Concord Radio in Chicago, and later he became Sales Coordinator and Musical Director for Magnecord, the Chicago maker of open-reel tape recorders. With his lifelong friend David Hollister as partner, he sold quality audio equipment at The House of Hi-Fi in Manhasset, N.Y. Bert co-founded Everest Records with Harry Belock, serving as Recording Director/Engineer and Director of Classical Artists and Repertoire. While there he pioneered the use of 35-mm magnetic film for multitrack stereo recordings. I understand that the Everest recordings are going to be reissued by the Omega Record Group. Bert also did some wonderful recordings for Crystal Clear Records, where he held the position of Recording Engineer and Director of Classical Artists and Repertoire. Two I remember in particular were an organ recording with Virgil Fox and some light classics by Arthur Fiedler and the Boston Pops. Bert joined *Audio* in 1968 and became Associate Editor in 1973.

Several people have asked me how we will replace the big fellow—and Len Feldman, too, for that matter. In several very real ways, we can't, for guys like that, professionals in the best way, just don't come along but once in a lifetime. But we've got to get the reviews done, cover the shows, and tell you folks when we find unusually fine pieces of electronics. Much of Bert's area will be covered by John Eargle in his "Currents" column, though other reviewers, probably ones already with us, will also do some equipment coverage. Len's reviewing of many kinds of electronics will mostly be done by Ed Foster, who wrote similar reports for *High Fidelity*.

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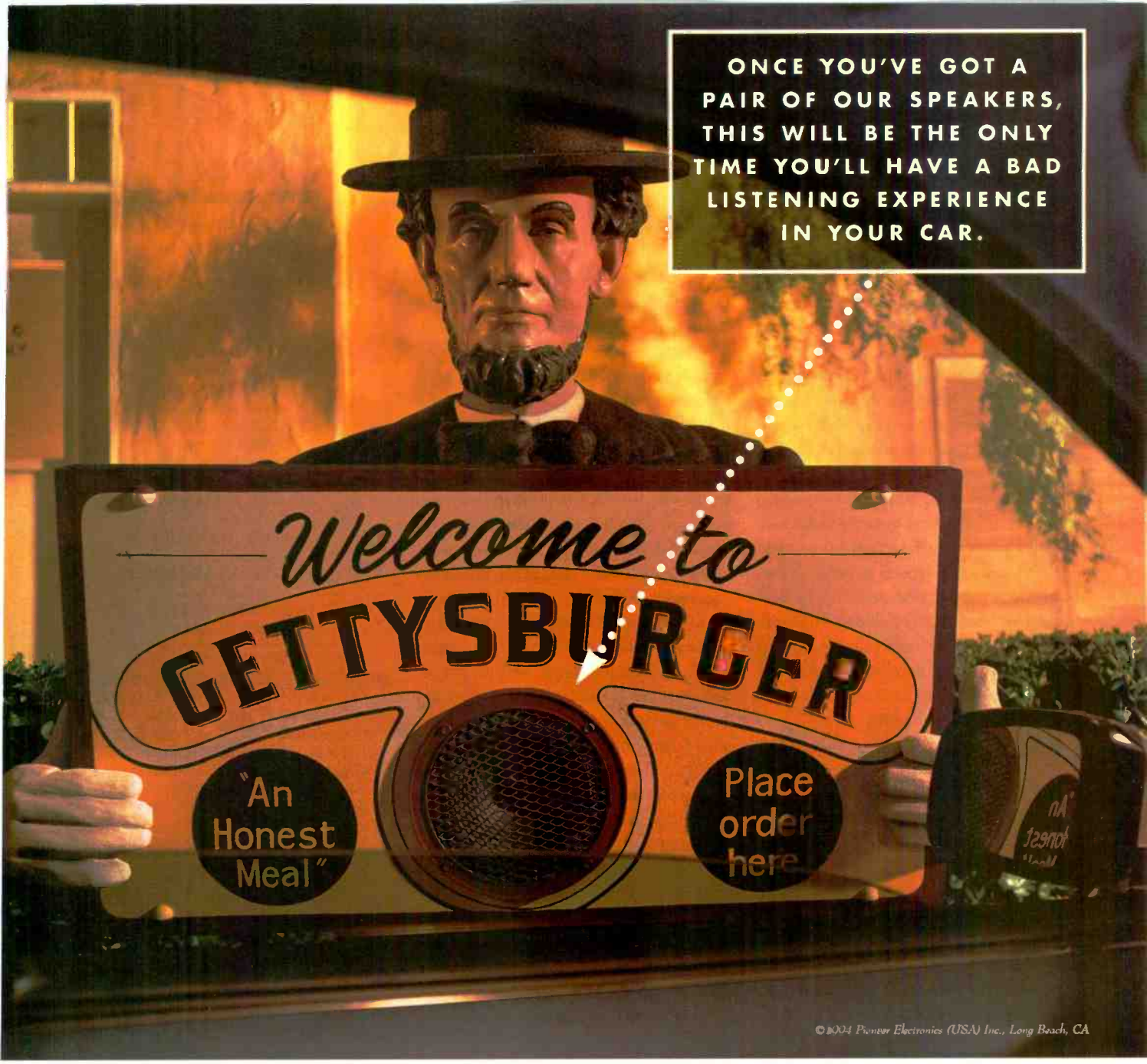

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Reflections on Mr. Hi-Fi

Dear Editor:

I was sorry to be informed of the death of Leonard Feldman. I had talked to him not long ago, and he mentioned having had a serious operation.

For many years I read his various articles in *Audio* and focused on his tuner reports. He was able to clarify and explain in simple words the various parameters being measured. I was surprised that the information I gleaned from those articles was enough to allow me in later years to easily make such measurements myself. In fact, I have often referred to his test reports in order to corroborate my own measurements. In later years, I was excited to be able to work with him briefly at Electronic Industries Association meetings to develop consumer FM and AM measurement standards. I will miss his informative reports.

Mike Stosich
Senior Design Engineer
Blaupunkt Radio
Broadview, Ill.

Dear Editor:

We at The Academy for the Advancement of High End Audio are all deeply saddened by the recent news of Leonard Feldman's passing. This is a terrible loss for *Audio* and the entire audio industry. For years people have relied on Len's insightful and ear-opening observations. For this, and his many other contributions, Len will be missed greatly by both the audio industry and the loyal readers of *Audio*. The Academy wishes to extend its sincere condolences to the Feldman family and the entire *Audio* staff.

Kevin Miller
Managing Director
The Academy for the Advancement of High End Audio
Sea Cliff, N.Y.

The Polarity Quest Goes On

Dear Editor:

In R. A. Greiner and Douglas E. Melton's article, "A Quest for the Audibility of Polarity" (December 1993), there is good new information, but I wonder if some readers might miss the most relevant points to the usual home listening situation.

On page 43 they stated that in preliminary tests the inversion of polarity was not audible in stereo playback of music (as opposed to synthesized test tones). But after the preliminaries, the authors refined their techniques somewhat and concentrated on just a few musical instruments, such as the trombone. When the polarity was then purposely inverted during *monaural, nearly anechoic* playback, the inversion became clearly audible. The bulk of the article was concerned with these various audible effects. Although it is not stated, the reader might infer that by doing things carefully, it is sometimes possible to hear polarity effects in home listening. It is suggested that we "keep track of polarity." Maybe so, but what is not emphasized in the article is the fact that, even after the preliminary tests, the authors and their juries have not been able to hear polarity inversion when recordings were played back in *stereo*, in a normally reverberant listening room.

I confirmed this at the Audio Engineering Society meeting of October 1991, where Prof. Greiner presented these results in a speech. During private discussions with him before the speech, and in a public question-and-answer session after it, I asked whether simple, dry, and monaural conditions were necessary to hear this. He said, "Yes, and even then we didn't have what you'd call a positive result on music." These words can be heard at about 70% of side two on cassette tape 118E-K4, available from Conference Copy, 8435 Route 739, Hawley, Pa. 18428; (717) 775-0580.

Dan Shanefield
Piscataway, N.J.

Curious Omissions

Dear Editor:

R. A. Greiner and Douglas E. Melton's exemplary article on the tricky audibility of acoustic polarity reversal ("The vast majority who don't hear the effect doubt the

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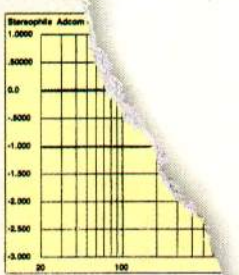

Fig.1 Adcom GDA-600, fr
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channel dashed, 0.5dB/

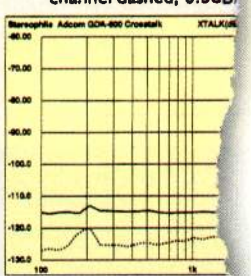

Fig.2 Adcom GDA-600, cr
dashed, 10dB/vertica

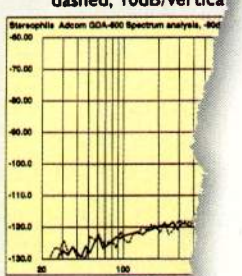

Fig.3 Adcom GDA-60
1kHz tone at –9
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dashed).

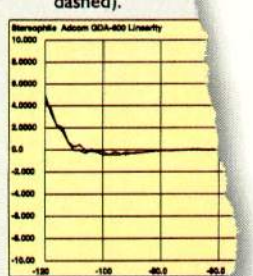

Fig.4 Adcom GDA-600, d
linearity (right chan
2dB/vertical div.).

opinion of those who do," John Roberts has noted), omits several relevant considerations. As one who consistently recognizes what I call "the muffling distortion," perhaps I could be of some help in this discussion.

If it's that clear, then why doesn't everyone else hear it? The answer to that is twofold. Many loudspeakers exhibit abundant phase distortion, which is largely due to high-order crossovers with drivers wired out of phase to reduce adjacent-band cancellation. The results, which Prof. Greiner once termed "the inversion catastrophe," nearly obliterate the sense of polarity. Then we have the fact that discs and records can come either way, so we have become confused and unable to say which is right. On wide-range linear-phase systems, however, I have educated hundreds who, often to their dismay, now easily hear absolute polarity.

The authors also underrate the extensive previous research confirming audibility. Although Greiner and Melton's own results were somewhat equivocal, I think it's predictable given the experimental arrangements. One of their favorably cited studies (Stodolsky, 1970) found "monaural phase effects can significantly affect the quality of perceived sound. . . . At high sound pressure levels, absolute phase [polarity] error is more detectable than 11.5% intermodulation distortion." And Prof. Stanley Lipshitz later went on record in *Wireless World*, *The Audio Amateur*, *Hi-Fi News & Record Review*, and other publications, explaining to various writers how their elusive "change in sound quality observed" should be attributed to incorrect polarity. In the cited *Journal of the Audio Engineering Society* article, he also wrote: "In a double-blind demonstration . . . including musical excerpts, the results on the audibility of polarity inversion of both loudspeakers represented a confidence of more than 99% in the thesis that acoustic polarity reversal is audible."

The authors also most curiously omitted any mention of Richard C. Heyser's powerful article in *Audio*, "Polarity Convention" ("The Forum," September 1979), in which he stated: "Many persons can readily perceive the coloration caused by improper polarity in the reproduced sound. . . . Aware of the distinct audibility of polarity . . . since 1974 . . . I now publicly call upon the entire audio industry . . . to acknowledge polarity as a psychoacoustic parameter." Not one to mince words, the late *Audio* Senior Editor concluded that "there is truly no aspect of the audio industry that lies apart from this first step to providing . . . better sound."

Further effort is needed, as Greiner and Melton indicate, but it needs to be more consistently directed and spoken with the clarity and authority of a Dick Heyser. Only then shall the public be offered convenient and suitable means to "correct polarity to assure the most accurate possible reproduction of the original acoustic waveform."

Also, I'd like to note that my book, *The Wood Effect*, published by the Modern Audio Association (23 Stillings St., Boston, Mass. 02210), is also available from Audio Amateur (P.O. Box 576, Peterborough, N.H. 03458).

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The coaxially mounted drivers of the Canon S-35, a $5^1/_4$-inch woofer and $^3/_4$-inch tweeter, fire downwards at a reflector Canon calls a curved acoustic mirror, to control dispersion. This system, called Wide Imaging Stereo, combines very wide horizontal dispersion (100°) with narrow vertical dispersion (+15° to –10°). Rated frequency response is 70 Hz to 22 kHz (±3 dB), impedance is 6 ohms, and recommended amplifier power is 50 watts. Price: Under $450 per pair.
For literature, circle No. 100

conrad-johnson Amp and Preamp

The conrad-johnson PF2 preamp uses a J-FET circuit with no negative feedback. The optional, zero-feedback phono stage has selectable gain of 40, 44, or 48 dB. The MF2300 amp delivers 250 watts per channel. It has a J-FET input stage, MOS-FET output stage, and negative feedback limited to 14 dB, for stability. Prices: PF2, $1,395; PF2 with phono stage, $1,795; MF2300, $2,795.
For literature, circle No. 102

Allen Products CD Stand

The Headliner CD Towers come in the 200-disc model shown and a 400-disc model. Eight up-tilted shelves without fixed dividers simplify sorting and selection; the CT200 comes with one sliding magnetic end support per shelf, the CT400 with two supports per shelf. Hardware is supplied for stand-alone mounting, floor mounting against a wall, or wall mounting. Prices: CT200, $249.95; CT400, $349.95.
For literature, circle No. 104

AKG Microphone

Like many studio microphones, the AKG C3000 is a large-diaphragm condenser model with switchable polar patterns—in this case, cardioid and hypercardioid. Other features include an internal windscreen, internal shock mounts, switchable 10-dB attenuation, and a bass roll-off switch. Price: $699.
For literature, circle No. 103

Terk AM/FM Antenna

The number of LEDs that illuminate on Terk Technologies' AM•FM Q shows the gain setting of its low-noise amplifier when the antenna is in wideband mode. In narrow-band mode, which pretunes the antenna to the desired station frequency, the number of LEDs shows position on the AM or FM dial, while gain setting is shown by the LEDs' overall brightness level. Interaction between the AM and FM sections is reduced by Terk's Non-Coinduction technology. Price: $99.95.
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AUDIO CLINIC

JOSEPH GIOVANELLI

Audio Equipment In Unheated Rooms

Q *What happens to the electrolytic capacitors in the audio/video equipment I leave in an unheated summer cottage for eight months? At turn-on time, should I use a variable transformer to gradually increase the line voltage to the rated 120 V, so as to re-form the dielectrics? Are modern capacitors so good that this is not a problem?*—Name withheld

A Unless you drain the water from your plumbing and add appropriate antifreeze to sink traps, you'll have much more to worry about than damaged audio gear when you return to your cottage.

I have seen equipment stored for longer than eight months with no problems. I suspect that, because of lower d.c. voltages used in most of today's equipment, capacitors don't fail as they did with tube gear.

I do think, however, that it would help to have someone come in and turn on the heat occasionally and run the equipment now and then. I am more concerned about moisture affecting potentiometers and switches than about electrolytic capacitors.

In any case, I do not recommend using a variable voltage in order to reform dielectrics in your capacitors. Some regulator circuits won't come into operation until some critical voltage is reached, after other circuits have come on. These early-starting circuits may be damaged if they depend on the regulated circuitry for operating bias.

Recorder Demagnetization

Q *Do the heads on a DAT deck need to be demagnetized? Does a cassette-style demagnetizer work on a three-head open-reel deck? Do erase heads need demagnetization? What about other part of the mechanism, and do these demagnetizers work on these other parts?*—Joel Pollack, Eugene, Ore.

A There is no need to demagnetize DAT heads. The high-frequency a.c. signals present during the recording process will be more than sufficient to take care of this. Erase heads also don't need demagnetization, for the same basic reason. The strong a.c. signals applied to these heads to do the erasing will also demagnetize them.

Demagnetizers built into cassette shells won't work on open-reel decks. Demagnetizers with probes that you can poke into a cassette well may work, if they develop enough flux between their pole pieces.

Besides the heads, tape guides and any other items that contact the tape and can become magnetized should be demagnetized periodically. A

If you have a problem or question about audio, write to Mr. Joseph Giovanelli at AUDIO Magazine, 1633 Broadway, New York, N.Y. 10019. All letters are answered. In the event that your letter is chosen by Mr. Giovanelli to appear in Audioclinic, please indicate if your name and/or address should be withheld. Please enclose a stamped, self-addressed envelope.

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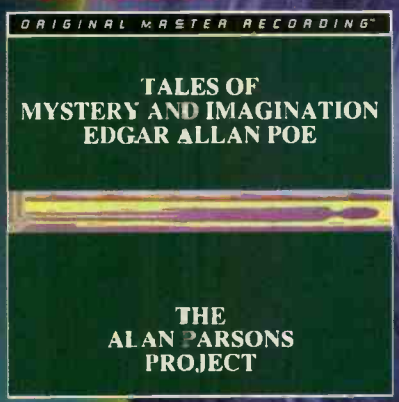

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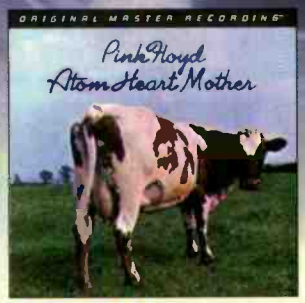

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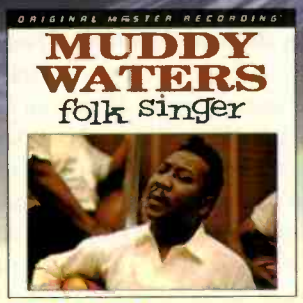

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MFSL 1-199

EDWARD TATNALL CANBY

RADIO RECALL

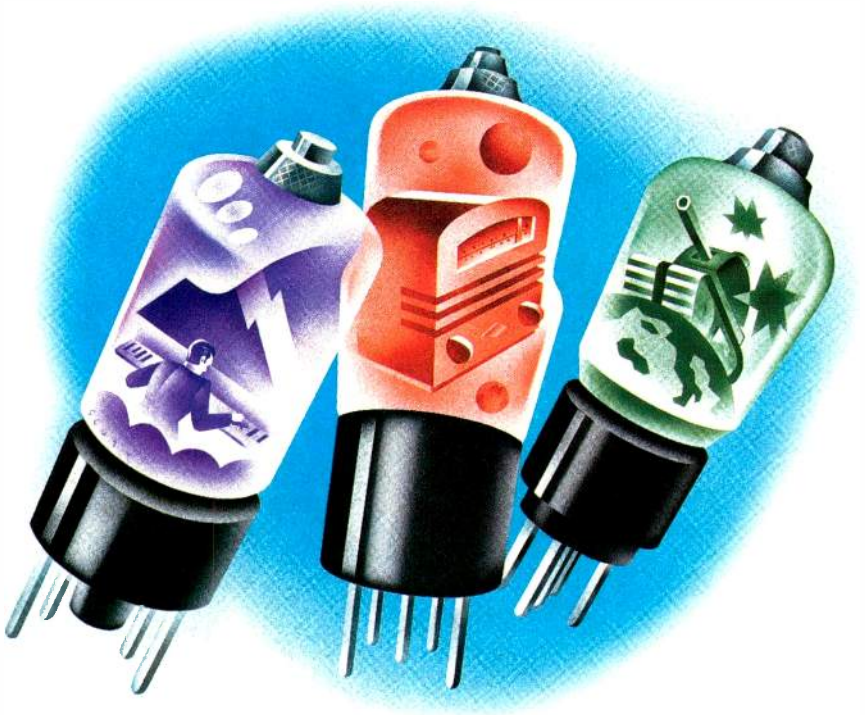


Illustration: Bob Scott

How curious, says this semi-historian, to find oneself writing about the daily facts of life as if no one knew about them. That is, facts from a half century and more ago. Most people still remember the standard console radio/phonograph, and it was, as I've explained, a new thing back in the earliest 1930s—I can still see that remarkable early RCA Victor machine with the hideous grin and the tongue hanging out, as described in an earlier column. Its successor, to my surprise, was in a new configuration, with nice straight lines, a lit window, a round knob for tuning, and the speaker mounted on the back of the front panel, lower half. That standard format came really suddenly, as I now realize. It was a definitive configuration, lasting for decades and to an extent still exists (new "console" models along with numerous old ones still operate in hundreds of homes).

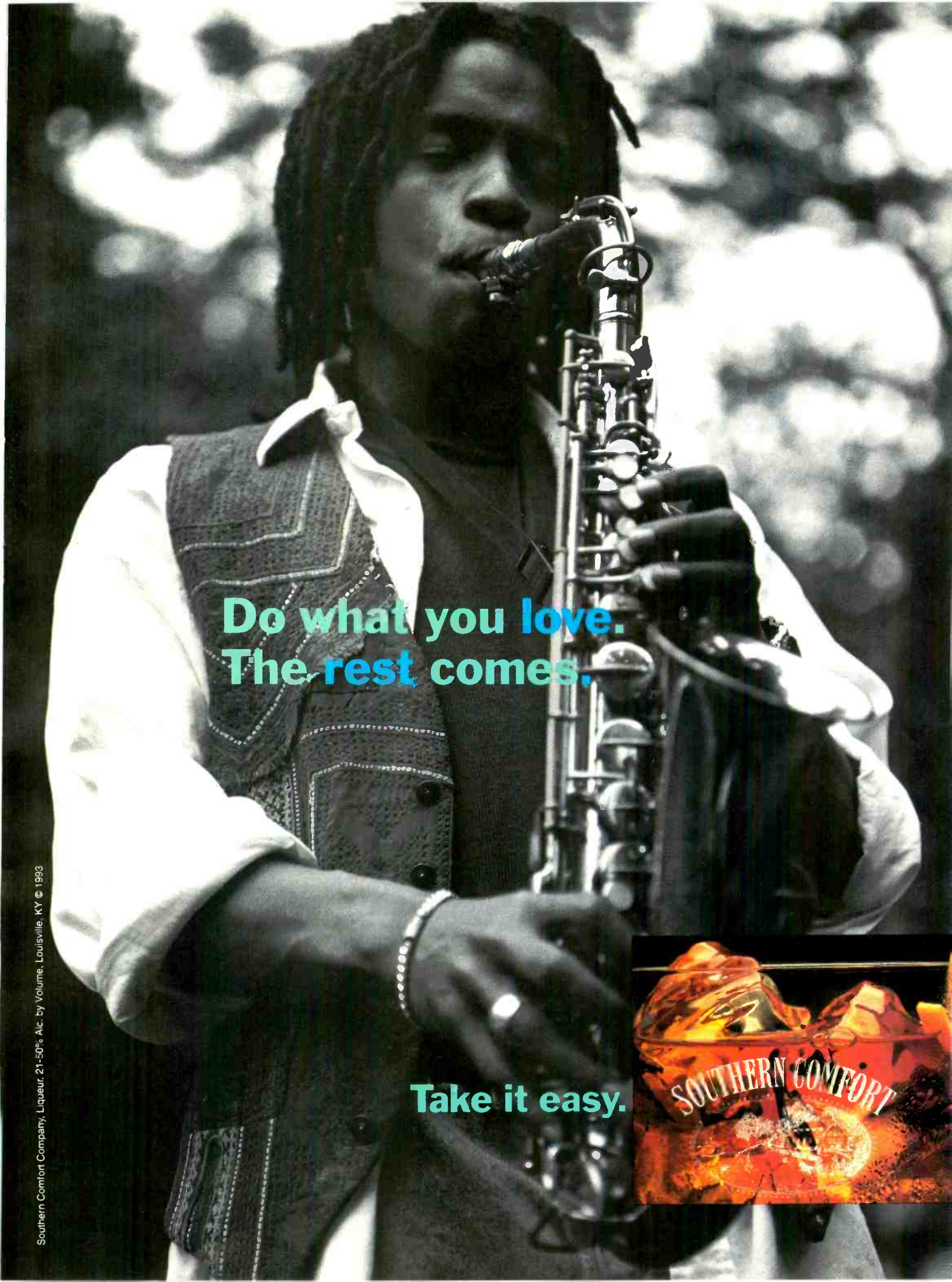
IN 1933 AN AD CAUGHT MY EYE, A SEDUCTIVE, NEW CONSOLE RADIO WITH 16 TUBES AND SHORTWAVE.

From that time on, around 1933, I stuck with this sort of machine, both radio and records, and for quite a while—there was nothing else. Hi-fi? It was not yet for me.

I made a jarring discovery when this machine first played some of my growing 78-rpm record collection. I have mentioned the Bach B Minor Mass in its first and enormous complete 78-rpm recording, part of which I owned, say five or six records. (Most people, especially student types, bought their 78s one by one, in spite of the fancy "complete" albums—purchasing as little as half a movement out of a symphony!) My roommate and I were ever so sophisticated (or so we thought). Our next big purchase, after the Bach, was a set of Handel Concerti Grossi for orchestra, the kind of "baroque" (a word not then in use) that is still very popular today. I got to love those old Handel records, maybe eight or 10 in the set, but the sound, on our first grinning-mouth-and-tongue machine, was awful. At every loud point the bass broke up hideously; the top squealed and buzzed. What dreadful recording, we thought, for such good music! But we played them and played them again, wincing.

When the mouth-and-tongue machine, rented, of course, was turned in for the newer model, the "standard" one (only a year or so newer—things moved fast in those years), we rushed to play everything we owned to see how it all sounded. Among the first items was the set of Handel. To my utter astonishment, the broken-up bass was gone. Replaced by (relatively) clean sound in the resonant, thumpy style of the time. And amazingly, the treble no longer squealed and buzzed! *So it had not been the fault of the recording at all.* It was mainly the speaker. This, you understand, had never occurred to me.

That was an epochal lesson: *Don't blame the wrong thing.* How many must still learn this the hard way?



Then came Hitler. In the summer of 1933 my family took itself to Austria, where that little man Chancellor Dolfuss was holding out valiantly, swamped by illegal Nazi operations years before Hitler took over the country. We saw Nazi swastikas outlined in fire at night on the high mountain slopes. We crossed a small tip of Germany, several times, and the world changed terrifyingly—hordes of German kids in the trains singing Nazi songs, millions of swastika banners, even Hitler chocolate bars. It was a fury of early Nazidom. On my return to college I was, of course, a changed person, though we had no particular thought that *we* might eventually be involved.

So, late 1933, a mail-order ad caught my eye, a new and seductive console radio with *16* tubes and complete shortwave, by which I could keep tabs on Herr Hitler direct from Germany.

I have mentioned this lovely machine before—a Midwest radio. Console, yes, but far ahead of anything I had heard before, as it turned out. Most important, there was an optional high-power speaker, 12-inch dynamic, that had me entrapped—I *had* to have that speaker. So I bought the Midwest, the works, with super-speaker. And had to buy a new separate record player, by RCA. Lo—that player had two speeds, 78 and 33, in 1933! The latter, for RCA Victor's ill-fated, too-early experiment in the long-playing disc. That, of course, lured me into trying some of the first of these "LPs," an entrancing idea in a time when the longest available play for us was a bit over four

THE MIDWEST CONSOLE MADE A POSITIVE BID FOR REAL ADVANCEMENTS IN QUALITY HOME SOUND.

minutes a side. The RCA "program transcriptions" at first ran a half hour or more per (plastic) side but soon were cut back drastically to less than 15 minutes. It was simply not possible to maintain quality in the necessary copying. I tried a few and quit. In every case, the long-play record was noticeably inferior to the 78-rpm version. They were soon withdrawn—I have just one left.

I should add that the worst thing, musically, about the RCA Victor long-play was not the record but the player. Mine was RCA's own, a nice box with lid and a heavy magnetic pickup. The old 78s played okay on its turntable. But the clumsy hooked "transmission" that grabbed for the 33 speed was hopeless. The sound fluttered and wavered no matter what; the musical sense was dismally altered, often all but destroyed—especially on piano, which became pseudo-guitar. Odd how long it took engineers to devise a simple, steady, slow playing speed! After all, the problems were mostly mechanical and perhaps could have been better solved back as far as in 1900.

When Columbia (CBS) got to its LP of 1948, many crucial years later in audio progress, the LP and 78 releases (before tape) were copied from large lacquer masters at equivalent quality, thanks to improved copying techniques. Equally important, CBS developed a simple LP player ($10,

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believe it or not) that performed remarkably well in terms of steadiness. Interesting to remember. But back to Midwest.

Though it looked much like any other console, that machine actually marked the beginning of our consumer high-fidelity movement, along with several other early brands, perhaps more expensive—the Scott line, the early Fishers. I can hear a chorus of objections on this or that technicality, but the fact is that these machines made a positive bid for real advancements in quality of home sound well before "hi-fi" took off in the postwar years. I do know that the Midwest performed beautifully for me and was the envy of my college friends, who came, if not in droves, at least in frequent bunches to hear records played through that speaker—or to take an audible gander at Hitler & Co. It was prodigal with tubes, four for the main amplifier (this was before the 6L6s, push-pull, and such)—and its shortwave was the best I have ever heard, to this moment. Night after night I would pull in that slick pseudo-American announcer in Germany. I can hear him yet: "Good evening, dear friends and listeners in North America...," with a slight roll of the Rs. Dear friends indeed! The next voice was often Hitler himself at some huge rabble-rousing rally; I can hear *that*, too. The voice was horrible, as were the enormous waves of chanting—hundreds of thousands of people shouting in hoarse, massed

HOW LONG IT TOOK ENGINEERS TO DEVISE A SIMPLE, STEADY, SLOW PLAYING SPEED!

rhythms. All this the Midwest brought in, loud and clear.

That Midwest stayed with me until I met up with some genuine early hi-fi—separate units, often homemade. (I actually built an amplifier!) This via friends in graduate physics at Princeton. There, the Midwest was immediately dissected into its parts. The remarkable speaker (wish I could remember what brand) was placed in the middle of a truly enormous fiberboard baffle, which produced what to me was a perfectly gigantic bass! A veritable subwoofer. That baffle was maybe 7 feet square. (I later had to cut it down.)

And so, you see, in the fall of 1936, along with that speaker, I was introduced into real hi-fi for the first time, and for good. Were you there? A

As virtually every speaker manufacturer rushes to deliver "home theater" speakers to the marketplace, M&K amasses nearly twenty years of experience in the field—dating back to Hollywood screening-room installations in the 1970s.

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M&K speakers *excel* in the reproduction of *all* source material. Accuracy, low coloration, pinpoint imaging, wide dynamic range, and deep-bass reproduction are all critical for music as well as film soundtracks. M&K Satellites and Subwoofers have been acclaimed for these attributes since the '70s.

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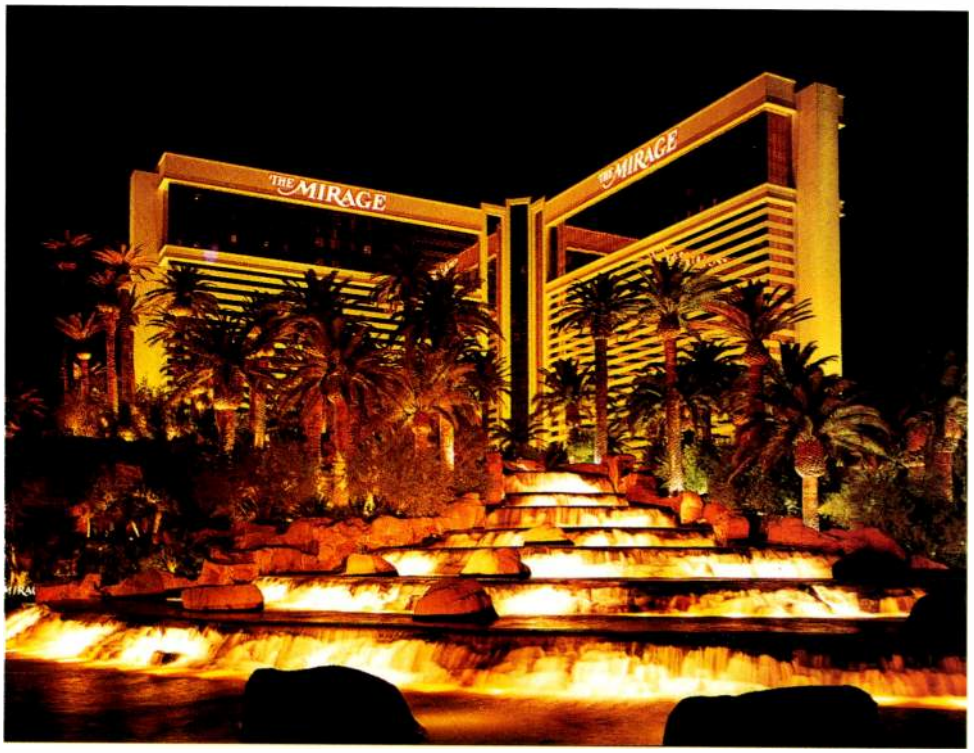
JOHN EARGLE

IS IT REAL OR THE MIRAGE?



A highlight of WCES is high-end video with high-end sound at the Mirage Hotel.

Little more than three years ago, you had to look long and hard in Consumer Electronics Show video exhibits to find a well-tuned video and audio system that really showed the potential of home theater. Then along came line doublers and data-grade projectors, and we now routinely see picture quality that, 98% of the time, is a good (good enough?) match for HDTV, with programs taken from readily available LaserDiscs.

On the sonic side, much of the high-end activity in home theater has been driven by a handful of loudspeaker manufacturers who have concluded that, indeed, a connection exists between big pictures and big sound. There is also the realization that a room that is dedicated to video can usually accommodate large loudspeakers with little objection.

The Winter CES showplace for this segment of the market established its Las Vegas home in the posh suites and ballrooms of the Mirage Hotel a few years back. This venue seems to have given high-end video an importance and focus that the tackiness of most of the older hotels and the institutional look of the Convention Center itself cannot match. As a result, high-end video *plus* big sound now comes across as a major highlight of the winter show.

AT CES, DEMOS REVEAL THE CONNECTION BETWEEN BIG VIDEO AND BIG SOUND.

Three main audio approaches have been taken by the major manufacturers:

Theater sound. The approach here is to use high-frequency horn/driver combinations to cover the range from about 800 Hz upward. The rationale is that accurate reproduction of music, dialog, and sound effects in the home, as well as in the theater, depends on a relatively high ratio of direct-to-reflected sound; horns provide this very well. Any sense of ambience should be that which has been encoded in the source and *not* a result of room reflections. Such a system is not normally considered ideal for standard stereo reproduction, where a higher value is placed on wider sound dispersion.

THX. The THX approach is a general design specification that mandates limited vertical dispersion in the front loudspeakers to maintain a desirable ratio of direct-to-reflected energy. A number of other electronic aspects are also of importance in the THX specifications. Proponents of THX state that front left and right loudspeakers properly designed to meet these specifications will also perform quite well with normal stereo programs.

Traditional loudspeakers. Stated simply, the traditionalists generally feel that what is best for music is also best for video, so there is no need for special models. (The only exception might be a smaller speaker that could conveniently be positioned under the screen for center-channel use.) The traditionalists' view is also the mainstay of the mid- and low-priced home theater market.

Here are my observations of some of the Mirage exhibits:

Tannoy, best known for its broad line of studio and broadcast monitor loudspeakers, was the first company to develop a coaxial loudspeaker with a

Photo: David Noble/FPG International

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The people who work at Cambridge SoundWorks - including our cofounder Henry Kloss (who also founded AR, KLH and Advent) - have been involved with the concept of home theater from the beginning. In 1969 (years before VCRs and cable TV), Henry Kloss founded Advent, the company that introduced the first home theater audio/video systems - complete with big-screen TVs and digital surround sound. We have had an ongoing relationship with the people at Dolby Laboratories, creators of Dolby Surround Sound, since Henry Kloss introduced the *first* consumer products with Dolby noise reduction over 20 years ago. And now at Cambridge SoundWorks we believe we have set a new price-to-performance standard for home theater components.

Because we sell carefully matched and tested home theater speaker systems factory-direct, with no expensive middlemen, you can save hundreds of dollars. We believe the products on these pages represent the country's best values in high performance home theater components. Audio critics, and thousands of satisfied customers, agree. *Stereo Review* said "Cambridge SoundWorks manufactures loudspeakers that provide exceptional sound quality at affordable prices." *Audio* suggested that we "may have the best value in the world."

Our Surround Speakers

Our Center Channel Speakers

Center Channel Speakers

Cambridge SoundWorks manufactures three speakers for use as center channel speakers in Dolby Pro Logic home theater systems. All three are magnetically shielded so they can be placed near a TV or computer monitor. Model Ten-A is a small, affordable two-way speaker. **$75**. Center Channel is identical to a Cambridge SoundWorks Ensemble satellite (but with magnetic shielding). $149. Center Channel Plus uses an ultra-low, ultra-wide design that is ideal for placement above (or, with optional support stand, below) a TV monitor. **$219.**

Surround Speakers

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

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The original Powered Subwoofer by Cambridge SoundWorks consists of a heavy-duty 12" woofer housed in an acoustic suspension cabinet with a 140-watt amplifier and a built-in electronic crossover. *Stereo Review* said it provides "deep powerful bass...31.5 Hz bass output was obtainable at a room-shaking level... they open the way to having a 'killer' system for an affordable price." **$599.** Our Slave Subwoofer uses the same woofer driver and cabinet, but does not include the amplifier or crossover. It can only be used in conjunction with the Powered Subwoofer. **$299.** The new Powered Subwoofer II uses a 120-watt amplifier with an 8" woofer. **$399.**

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

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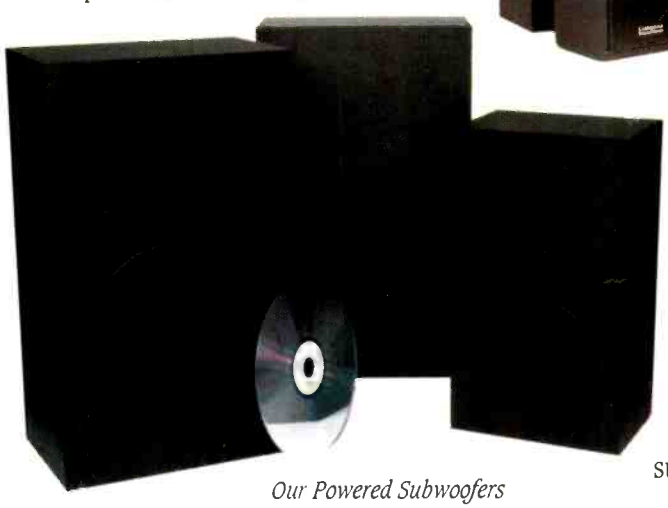

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high-frequency compression driver firing directly into a horn whose flare was actually the low-frequency curvilinear cone. Tannoy's Dual Concentric design is still quite current and forms the basis for its home theater system, giving it a slightly forward sonic aspect typical of the motion picture theater. The system, as demonstrated, had plenty of power reserve throughout the spectrum.

JBL's home theater demonstration emphasized the Synthesis series of high-end video in a theater environment virtually identical to a professional video screening room. In its high-end video systems, JBL provides two modes of operation. In the theater mode, high frequencies are reproduced by horns for precise pattern control, as is done in movie theaters. For music reproduction, the system is electrically switched to a cone/dome array, with its characteristically broader dispersion at high frequencies.

Fosgate-Audionics comes to this market not as a loudspeaker manufacturer but as a specialist in the design of surround sound electronics. Its approach is slightly different. The company's loudspeakers use cones and domes in a THX-approved configuration; however, Fosgate decoders have a number of surround modes intended for music only. In these positions, the Fosgate surround loudspeakers are reconfigured by electrical switching so that they perform as monopoles instead of as dipoles, the configuration specified by THX. In the monopole mode, the surround loudspeakers exhibit an omnidirectional characteristic, as opposed to the "figure-8" dipole pattern that THX specifies for surround applications. As a result, Fosgate's music reproduction modes produce a more uniform feeling of ambience than do most THX configurations, which, of course, are optimized for the movie theater experience.

Snell, one of the earliest THX licensees, demonstrated a new line of loudspeakers based on the D'Appolito symmetrical vertical array. Most loudspeakers of this design have a single tweeter in the middle of the vertical array. Snell has put in three, just to ensure that a narrow vertical angle is maintained to the highest frequencies. As is the case with most THX-approved systems, the new Snell systems sound equally good with video and with music.

At the 1993 Summer CES in Chicago, one of the most ambitious video demos was presented by Cello Music and Film Systems. A similar complement of equipment was used, but in a much smaller room. For my taste, things were too loud, although the HDTV video segment was absolutely superb. The main loudspeakers included large vertical arrays of midrange and high-frequency drivers, all driven by large Class-A amplifiers. Added equipment included an Ampro projection system and a Faroudja line doubler.

Two other video demonstrations, not at the Mirage, are worth mentioning because of the technical statements they made. On the main floor of the Convention Center,

A HANDFUL OF SPEAKER MAKERS ARE DRIVING THE HIGH-END ACTIVITY IN HOME THEATER.

Pioneer demonstrated a LaserDisc encoded with Dolby Surround Digital, a discrete format based on Dolby's AC-3 encoding process. While AC-3 is not the only system in contention for video discrete surround, it is so predominant that we might as well consider it the winner in this race. The use of Dolby Surround Digital in a LaserDisc at this time bodes well for its general acceptance later on. I detected a few very minor dropouts in the audio, but certainly nothing that can't easily be fixed. I must say that the prospect of genuine ambience, conveyed via the front channels and the two surround channels, is a glorious one.

In an off-site location, Lucasfilm presented a six-channel demonstration using a set of THX-licensed B & W loudspeakers. Lucasfilm's aim was to demonstrate the general capability of THX systems for all discrete program sources, whether based on video or not. Film clips with discrete surround channels were presented, as were music examples. All were extremely well done, but I do hold to a preference for four identical channels and loudspeakers for the most uniform reproduction of genuine ambience. A

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

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

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

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

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

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

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

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

" ...prodigious base output and sense of unlimited power and effortlessness", says Stereophile. *And no wonder. It delivers over 90 amps of peak current per channel.*

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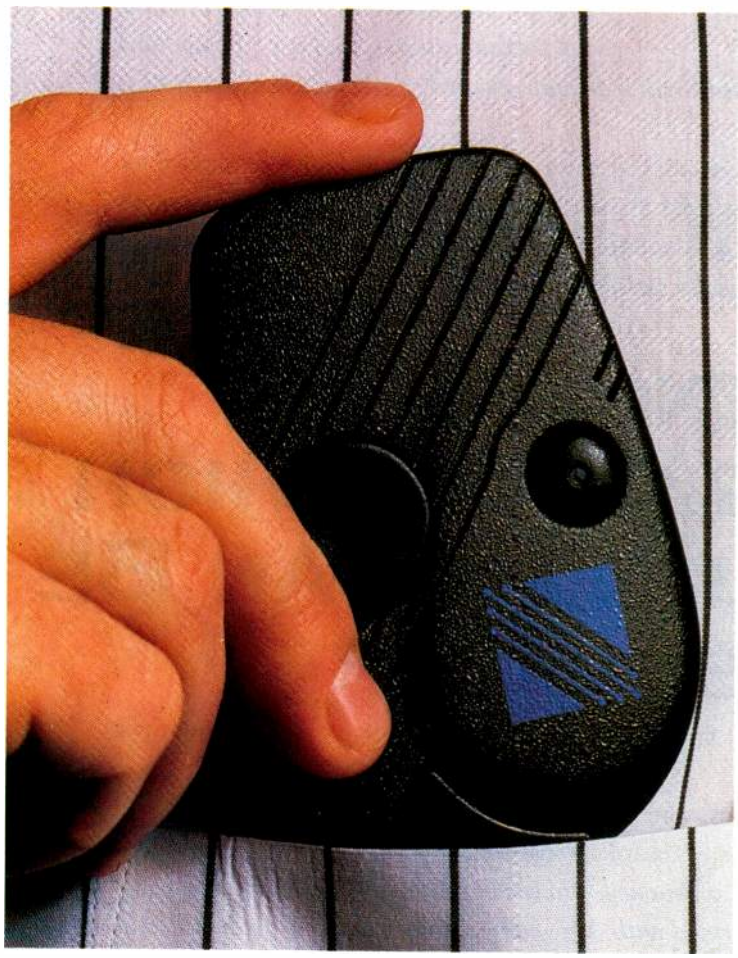

The Flashback system is like a point-and-shoot camera for digital sound.

It's been easy to predict that audio would someday be recorded in solid-state memory by recorders with no moving parts. But when was someday? And where were the recorders?

That someday has come. And if the only sample I've seen was in Elwood G. Norris' shirt pocket, more should be in the stores by the summer.

Norris Communications obviously isn't promoting the $200 Flashback recorder as a music machine. The spec sheet doesn't even mention frequency response, S/N, or distortion, and the system is strictly monophonic. The sound I heard was much clearer and rather less tinny than I expected from a 1-inch speaker. There's hefty data compression going on, too, enough to fit 30 minutes of 16-bit monophonic sound into one megabyte (MB) of memory.

The Flashback system is designed to interface with computers, not hi-fi systems. Its SoundClip storage media plug into computers with PCMCIA interfaces, and standard PCMCIA flash memory cards can be used with the Flashback. SoundClips will cost about $70 at first but should drop below $30 later; 60- and 120-minute versions are yet to come.

The system makes use of digital technology more for its flexibility and convenience than its fidelity. It offers instant playback of any section, with no rewind or fast-forward time, plus insert editing. Another advantage is the ability to speed up speech for faster listening or slow it down for manual transcription, without changing the pitch. (Contact Norris Communications, 12800 Brookprinter Place, Poway, Cal. 92064; phone, 619-679-1504.)

RECORDING ON SOLID-STATE MEMORY IS HERE, AFFORDABLE, AND ULTRA-COMPACT BUT NOT YET HI-FI.

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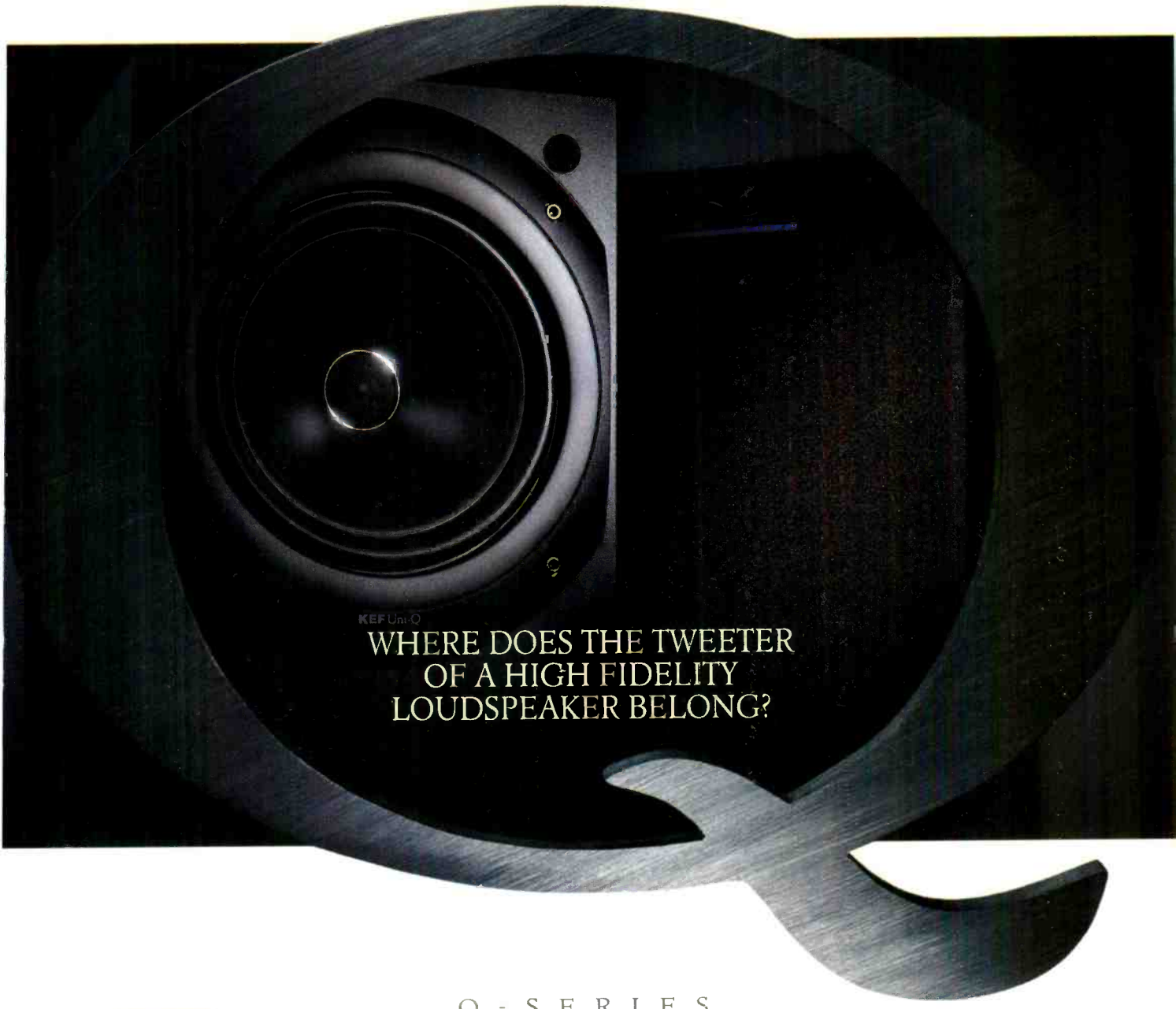
A new high in frequency response should be available from a Pioneer DAT deck now being shown in Europe. Besides the usual sampling rates of 32, 44.1, and 48 kHz, the D-07 deck can sample at 96 kHz. Since the bandwidth of digital audio runs to just under half its sampling rate, that gives the D-07 a potential frequency response up to 44 kHz!

I know of no recorded source or microphone whose frequency content ranges up that high. However, the D-07 could be used for dubbing 30-ips analog master tapes or for live recording with top-quality mikes (and mixers, since the deck seems to have no microphone inputs). It might also be useful for copying top-notch LPs. Unlike CDs, LPs can have some content above 20 kHz, albeit with some noise and roll-off.

Audiophile Audition Goes All-Classical

The syndicated FM program *Audiophile Audition* has shifted its musical focus from a mix of jazz and classical CDs to classical only. Its other content—audio news, hints for listening enjoyment, and other audiophile material remains unchanged. The weekly program, now nine years old, is transmitted from digital masters, via satellite, to more than 135 public radio and concert-music stations. John Sunier, a Contributing Editor of *Audio*, is the show's host.



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BERT WHYTE

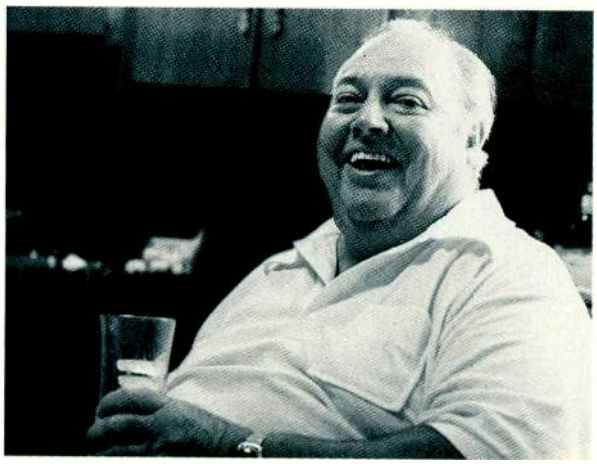
Bert Whyte, Associate Editor of *Audio* and renowned audio critic, died on March 31, 1994 in Centereach, Long Island, New York. A memorial service was held on April 8th.

When Bert was awarded a Fellowship in 1977 by the Audio Engineering Society, his citation read: "For early contributions to stereophonic recording and for continuing audio criticism of a high order." The following biography was written for an *Audio* magazine flyer promoting its editors:

Bert Whyte was born in Belfast, North Ireland in 1920. He came to the United States at the age of four and, after schooling in New York, went to sea. He was assistant to the Director of the British Ministry of War Transport before the U.S. entry into World War II, and later served three years with the U.S. Army Medical Corps.

Mr. Whyte began his professional audio career in 1949 as Director of Audio Sales for Concord Radio in Chicago, continued as Sales Coordinator and Musical Director of Magnecord, Inc. in that city, and then became General Manager of Fine Sound and the Perspectasound Division of Loew's/MGM in New York. He was co-founder with Harry Belock of Everest Records, where he served as Recording Director/Engineer and Director of Classical Artists and Repertoire, pioneering the use of 35-mm magnetic film for multitrack stereo recording. Subsequently, he became Musical Director with RCA Victor Red Seal classical recordings. Mr. Whyte made the first modern classical stereo recordings with Leopold Stokowski in 1951 and the first big-band stereo recordings with Benny Goodman, Woody Herman, and Stan Kenton. After collaborating with Major Edwin Armstrong on special stereo recordings for the development of multiplex stereo FM sound, he continued this work with multiplex FM pioneer Murray G. Crosby. He has made numerous multitrack stereo recordings with major symphony orchestras here and abroad. All this has served Mr. Whyte since 1953 in the added capacity of audio writer/reviewer, record and tape critic, and as Associate Editor of *Audio* magazine.

I first knew of Bert through his articles on sound recording and reproduction in *Radio/TV News* during the mid-'50s, just as the Everest era was getting underway. Along with Mercury, Everest had stolen a march on many of the major American classical labels by launching $7^1/_2$-ips stereo tapes in that day before the stereo disc.



These smaller companies could respond faster to market needs, and under Bert's influence Everest made "stereo history" through a succession of notable recordings in England with such conductors as Eugene Goossens, Adrian Boult, and Leopold Stokowski. Bert's first choices for recording in London were Walthamstow and Watford Town Halls. These naturally live venues permitted placing the orchestra on the main floor, with none of the usual stage constraints. Careful arraying of the orchestra enabled Bert's choice of only three basic microphones to pick up everything in complete balance. In the late '50s, Everest exited the record business, leaving behind a remarkable legacy of fine recordings little known to today's generation of audiophiles.

I became a fast friend of Ruth and Bert Whyte during our years with RCA Records in the mid-'60s. At that time, RCA was involved with the Lear Stereo-Eight endless-loop cartridge, and one of Bert's challenges was to establish guidelines for transferring classical recordings into this tricky medium that too-often called for brute force "chopping" of the program into four equal time segments. After long frustration, Bert decided that this arbitrary division of most programs would never work. He informed RCA of his opinion, suggesting other, more sophisticated procedures. It is to Bert's credit that he stood his ground, and it is unfortunate that he never had the opportunity to supervise any recording sessions at RCA.

As the audiophile movement got underway in the early '70s, many high-fidelity manufacturers and record companies sought Bert's expertise. Notable are the recordings that he supervised which were issued by Crystal Clear. Most of these were done direct-to-disc but with digital backup via the Soundstream recording system. Bert's landmark Fiedler/Boston Pops recordings and Virgil Fox's organ recordings at the Crystal Cathedral are available on CD from Bainbridge and Laserlight. However, the London Philharmonic recordings on Crystal Clear conducted by Morton Gould and Walter Susskind dating from 1977 have yet to be reissued.

Most readers of *Audio* know Bert as a perceptive commentator on current technological events in recording and video, and the releases later this year of CDs made from the original tapes of the Everest sessions may be their first hearing of Bert's recording work. I have heard most of these recordings via first-generation copies from their originals, and they will certainly be the match of any of the RCA or Mercury archival reissues, both musically and technically.

It is virtually common knowledge that Bert was a man of fine tastes and pursued them without compromise. He knew more about French cooking and wines from around the world than anyone I know. He was a chef supreme.

I recall going with Bert and Ruth to The Four Seasons in New York in 1974, as a celebration of my opening a consultancy in Los Angeles. Early in the meal, Bert questioned a mustard sauce and asked the waiter to take it back to the chef. The waiter soon returned, and Bert gave the sauce a

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taste. It wasn't quite right; he then asked the waiter to bring him specific ingredients so that he could finish the sauce himself. Shortly, the waiter rolled up a serving cart, and Bert proceeded with the work at hand. All of this was done with such a civil air of authority that the waiter never questioned a thing. After the meal, the chef came out of the kitchen and introduced himself to Bert.

During the last 15 years Bert had curtailed his recording activities to spend more time writing and consulting. Along with many younger recording engineers, I had long sought Bert's advice and had spent many an evening with Ruth and Bert in their home as guest, student, and colleague. Over the years, we spent literally hundreds of hours listening to new recordings, and I always marvelled at Bert's ability to pinpoint their virtues and defects and sum them up in a few well-chosen words. And that included my recordings, too.

We shall all miss him. He was both best friend and best teacher. *John M. Eargle*

Bert Whyte was a man of principle. To illustrate this, I recall his conviction that smoking was human frailty that should not be tolerated—especially in his home. Many had reported to me that he would not tolerate even the best of friends or business associates to smoke in his presence. And Bert never changed his mind on this principle.

On one occasion, I was invited to his home for dinner, along with the late B. V. Pisha. (I suppose this would have been in the mid-'70s.) During those years, Barney Pisha was a heavy smoker, even though he was a medical doctor and knew better. Bert and Barney argued, debating endlessly, about the evils of smoking time after time, always poking fun at each other for their obstinate ways.

The night of this particular dinner was raining and cold. The festivities included listening to some new products that Bert was evaluating, in addition to the food that was prepared with extreme care and the highest form of culinary art.

I still remember, two or three times during the evening, Barney Pisha slipping out on the front porch, rain slicker and umbrella in hand, to smoke a cigarette. The rumors were true: Not even the closest and most revered friends were allowed to smoke in the home of Bert and Ruth.

As many know, Barney Pisha realized that Bert was right and gave up smoking a few years later. For the remainder of his life, Barney was an advocate of nonsmoking.

Bert had similar influences on others in ways that were a result of his persistent and dogged determination to conform to what he believed, rather than yielding to the pressures of the moment.

It is impossible for those who knew Bert not to remember his great appreciation for good food. And I mean *good* food. He was truly a gourmet in the most strict definition of the word. Many times I joked with him that if he were hungry enough he would eat a Big Mac or a Whopper. As you might expect, he was horrified at the very thought and would deny that he would ever succumb to such a state of life.

Bert was very particular about the restaurants he dined at. Only a few select locations in Chicago and Las Vegas were even considered during his many Consumer Electronics Show voyages. In fact, a certain famous restaurant in Wheeling, Illinois had an understanding that during the Summer CES, Mr. and Mrs. Whyte and guests would probably dine there twice. And the chef knew his tastes and preferences to the same degree that Bert knew how to position a microphone for a recording session.

Of course, not all the restaurant owners and chefs knew of Bert's knowledge of, and insistence on, proper preparation of food. Of the several times I was his host at commercial establishments, about 50% of the time the food was sent back for further preparation or replacement.

AVERY FISHER

Avery Fisher, who died on February 26, less than one week before he would have turned 88, was one of the rare individuals who combined the sensibilities of an artist with the practicality of a businessman. His company, Fisher Radio, did a great deal to define high fidelity and to make the term a familiar one.

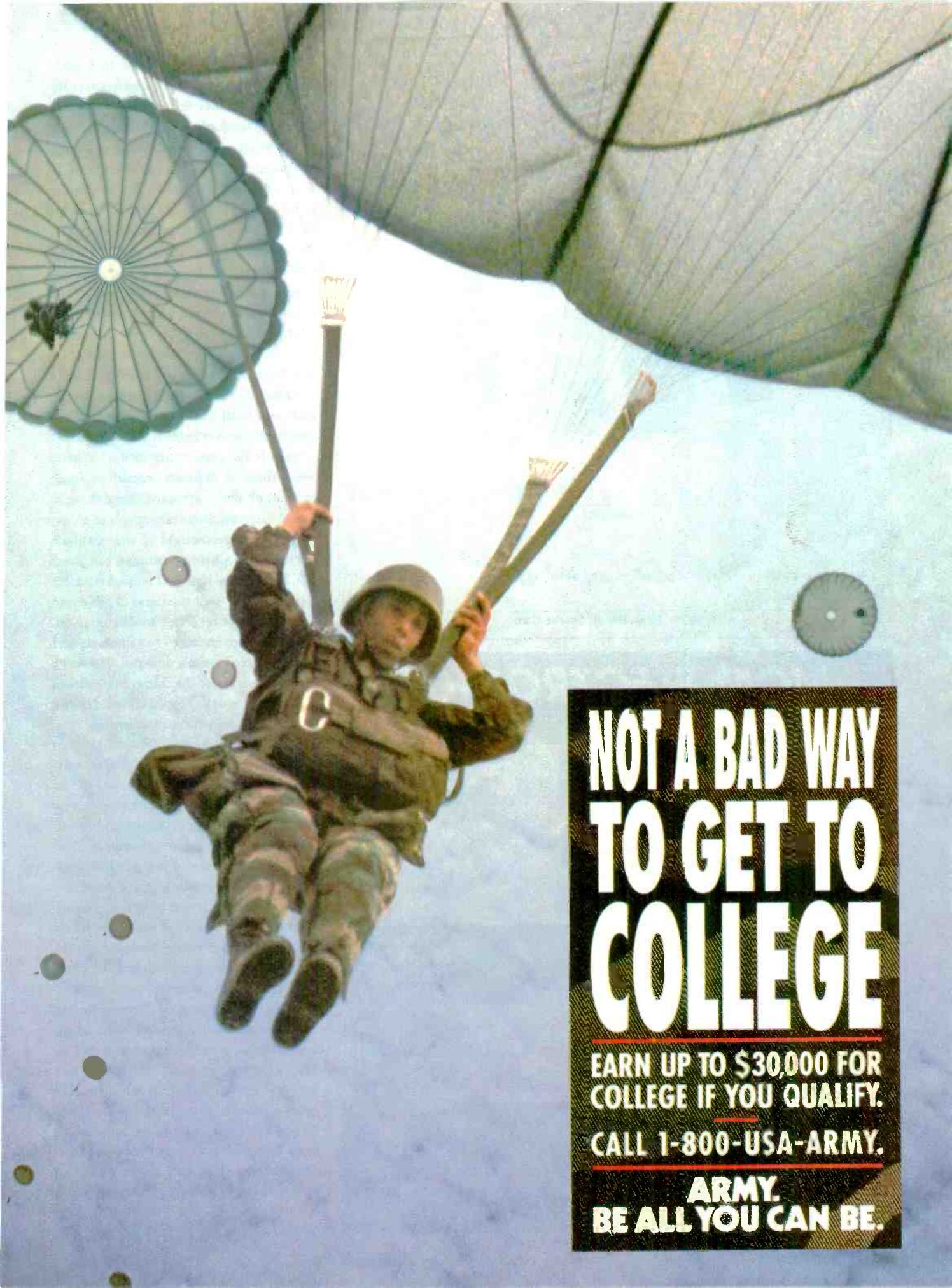
Photograph: Kevin Knight

Fisher Radio was acquired by Emerson Electric in 1969, and, in 1973, its founder gave away more than a third of the $31 million purchase price. The artist in Avery Fisher led him to make New York's Lincoln Center the chief beneficiary of a gift that the press estimated at $10.5 million but was later said by its donor to be closer to $12 million. It was the pragmatic businessman who earmarked 80% of the funds for maintenance of the concert hall that was then named after him.

The same clearsightedness underpins the structure of the Avery Fisher Artist Program, which, in its creator's lifetime, provided grants to dozens of musicians and, in years to come, will help many more. Lincoln Center, which possesses the size and scope that Fisher understood was necessary to such a task, administers the funds.

For all his sophistication, Fisher explained his staunch support of classical music in the simplest terms. He was, he used to say, merely giving something back. In fact, music did far more for Fisher than provide the rationale for his business. The art form was sustenance and seeped to the very core of the amateur violinist who said he liked to think of himself as a musician who, only incidentally, manufactured high-fidelity equipment.

"It is difficult to get the news from poems," wrote poet William Carlos Williams, "yet men die miserably every day for lack of what is found there." Avery Fisher was profoundly aware that the same can be said of symphonies and string quartets. *David Lander*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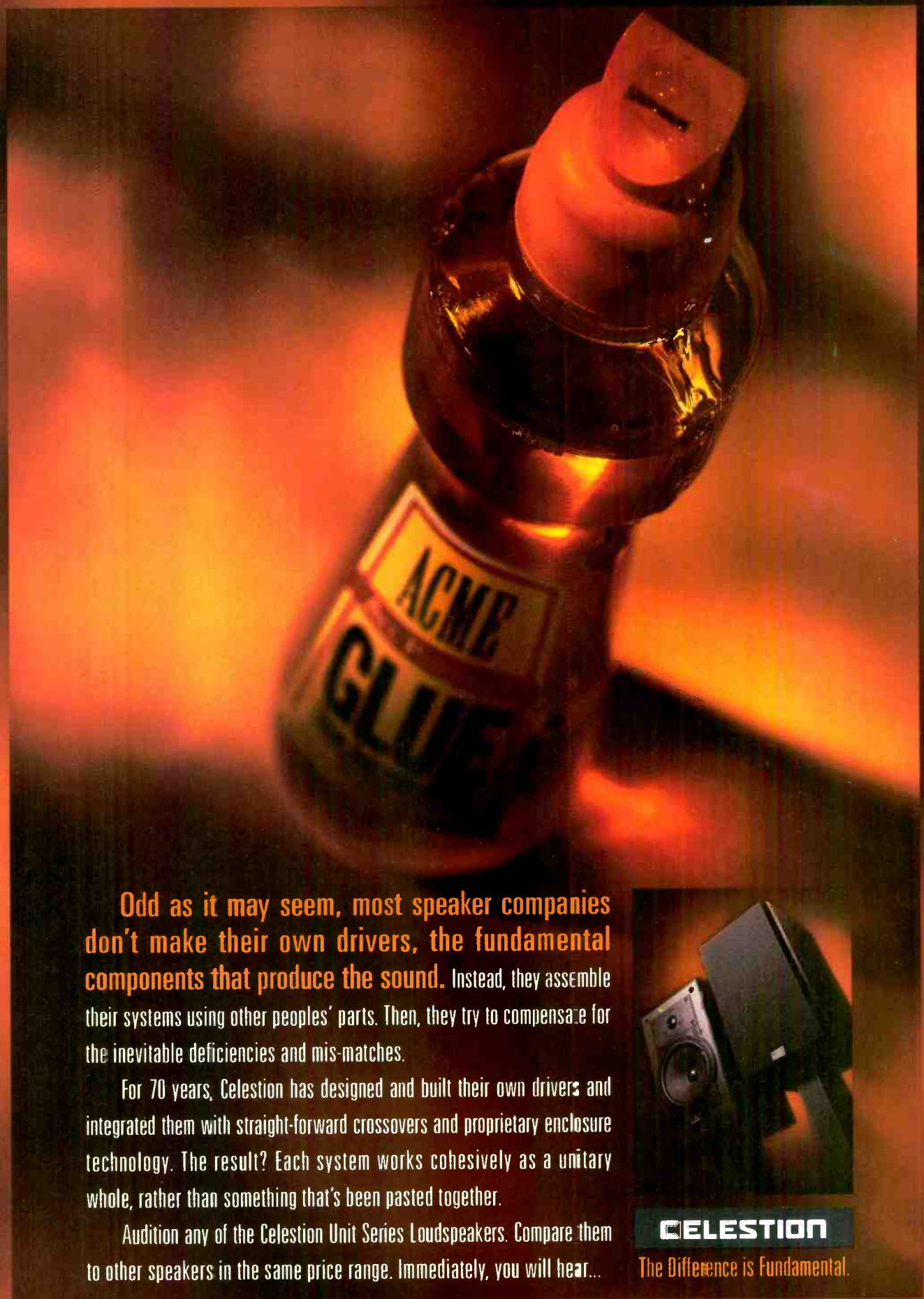
On one occasion we went to a well-known seafood place. The waiter was interrogated, as was Bert's usual approach, about the food and its preparation: Was it fresh? What sauces would be used? What temperature would it be cooked in? And so forth. At this restaurant, the waiter assured him that the fish of the day was indeed fresh and right from the day's delivery. But upon first taste, Bert could tell that it was not what was claimed, even though others at the table were less discerning.

After some debate with the waiter, the chef was called out to the table. Sure enough, after a few minutes of discussion with Bert, the chef agreed that Bert's analysis of the food preparation and that the fish had been flash-frozen were correct. They switched him over to fresh sea scallops.

Such is the personality of Bert Whyte. Some thought of him as eccentric. Some thought of him as arrogant. Some thought him irreverent. Some thought him a perfectionist. Some thought he was obstinate for the sake of being obstinate. But those of us who knew him well know better. He was extremely well-read and experienced in the subjects he chose to discourse on. He had a keen memory for the facts and could recite them on demand. He was a careful observer of the things that worked and didn't work. He was kind to and revered by those who were deserving.

Some say that he was not a religious or spiritual man. But I know differently. True, he did not attend church, nor did he profess any religious convictions, but he was devoted to high principle and to following the course of his conscience in all matters of life. He did not put his precision for audio evaluation in one pocket, so to speak, and his moral philosophy in another. He combined all of life's experiences into the same network of ideas, principles, and passions. When he believed in a loudspeaker or an amplifier or any other piece of audio equipment, it was because he had lived with it, studied it, considered its inherent characteristics, compared it with all others in the class, and concluded, in a comprehensive way, that what he said about it could be justified and demonstrated beyond objectivity alone. He was the same with people. It is not for us to wonder who among us mortals were selected by him to be his friend. *Almon H. Clegg*



Odd as it may seem, most speaker companies don't make their own drivers, the fundamental components that produce the sound. Instead, they assemble their systems using other peoples' parts. Then, they try to compensate for the inevitable deficiencies and mis-matches.

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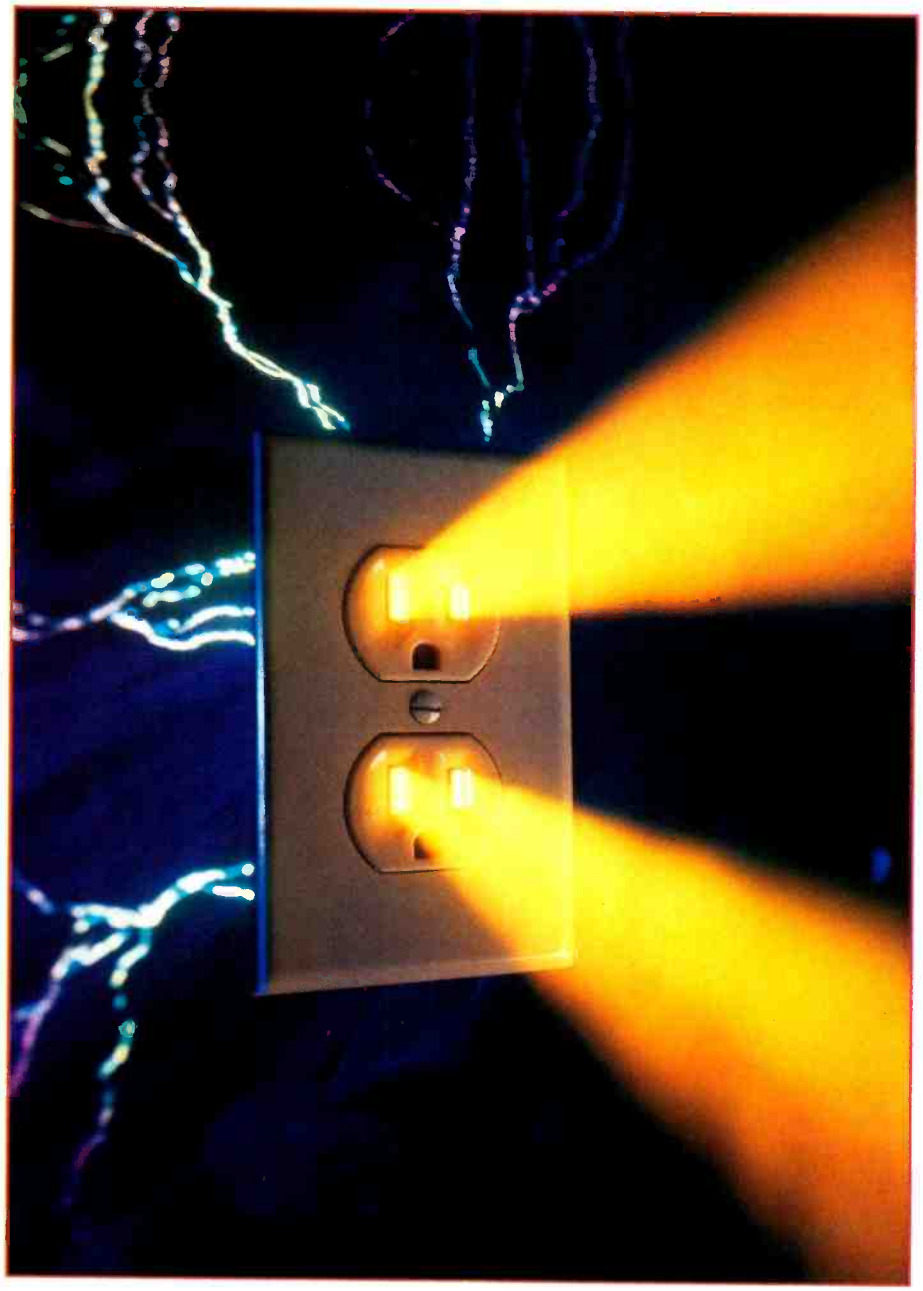


Photograph: Art Montes De Oca/FPG International

THE A.C.

US SOURCE

EDWARD M. LONG

Years ago, before we had the electrical power distribution system that we all take for granted now, everybody went to bed at sundown (except for Abe Lincoln, who used lots of candles). When the first electrical lighting contracts were being fought over, there were proponents of direct current (d.c.) power systems and of alternating current (a.c.) power systems. In the heat of their battle, some really bizarre things occurred. One story involves the decision, by a certain state, to use electricity for capital punishment. Neither the proponents of a.c. nor those of d.c. wanted to supply a system for this use, because the other side could then claim that their system was used to kill people and was therefore more dangerous! Another story relates the tale of a public demonstration involving an elephant. When the elephant was connected to a source of 5,000 volts of d.c. power, it was unharmed; when connected to 5,000 volts of a.c. power, it died! Of course, the proponents of d.c. made sure their system had such a high resistance that only a tiny current flowed through the elephant, while the a.c. system had a very low resistance, with enough current to kill a herd of elephants! Despite such shenanagins, the a.c. system won out and is used by power companies today.

The main reason for the success of the a.c. system is that it can take advantage of power transformers to reduce the high voltage necessary for transmission lines to the lower voltage that we use for appliances. The high voltage used for transmission lines overcomes the loss resulting from the resistance of the miles of wires that are used. If d.c were used, there would be no easy way to increase or decrease the voltage because transformers don't work with d.c. (I will be using technical terms while discussing various aspects of a.c. power lines. If you need a quick review of frequency, voltage, current, power, resistance, and reactance, refer to the sidebar "Electronics Terminology.")

THE A.C. POWER LINE'S QUALITY AND THE AMOUNT OF CURRENT IT SUPPLIES CAN AFFECT PERFORMANCE OF AUDIO EQUIPMENT.

The a.c. power in our homes, offices, and factories is a resource that everyone takes for granted, except when it is interrupted by a natural or man-caused incident. We all have heard horror stories about the damage that lightning can inflict on people and property, but the improper use of a.c. power lines causes more problems than lightning. Inadequate electrical wiring can result in anything from poor performance of appliances to major fires. The popularity of uninterruptible power supplies (UPS) for use with computers is testimony that many of us are more aware of a.c. power-line problems than we were in the past. Unless we are making a recording, a power failure—or even power glitches and spikes—in an audio system may not cause the loss or corruption of information that a computer system would experience. However, the performance of audio equipment *can* be affected by the *quality* of the a.c. power line and the amount of current that it can supply before the

POWER LINE

Electronics Terminology

A normal alternating current (a.c.) power line should provide 120 V rms in the form of a pure sine wave with an alternating current at 60 cycles per second (cps) or 60 Hz. "Hz" is the abbreviation for hertz, the unit of frequency that replaced "cps." The term "rms" stands for root mean square and represents the a.c. voltage required to cause the same heating in a resistance that would be caused by an equivalent direct current (d.c.) voltage. The ampere is the unit of "current" or flow of electricity; 1 ampere is the flow of 1 coulomb per second past a given point in an electrical circuit (a coulomb is a very large number of electrons). It is the combination of the voltage and the current that produces power, measured in watts. The mathematical formula for power is:

$$W = E \times I$$

where W is power (in watts), E is voltage (in volts), and I is current (in amperes). The voltage is the electromotive force that causes the current to flow, and the current causes the electrical appliance to operate. The combination of voltage and current produces power, which is defined as the ability to do work.

How does the current relate to the voltage? If I apply 1 V to a circuit, how much current will flow? The current is regulated by the resistance of the circuit. This relationship is described by the formula:

$$I = E \div R$$

with R representing resistance (in ohms). Translated, this means that if I apply 1 V to a circuit that has 1 ohm of resistance, then 1 ampere will flow.

For a.c. power, another factor, "reactance," comes into play and can complicate things further. The elements in toasters, heaters, incandescent lights, etc. act as if they are pure resistances, but other appliances that have motors—such as refrigerators, pumps, vacuum cleaners, etc.—exhibit reactance. Reactance is similar to resistance in that it impedes the flow of electrical current, but it does this in a different way. If an appliance has pure resistance, the current flow follows the applied voltage exactly and is "in phase" with it. For an appliance that exhibits reactance, the current is not in phase and can lead or lag the applied voltage. Since the a.c. power line is trying to supply current that is in phase with the voltage, and the appliance with reactance is not keeping the current synchronized with the voltage, strange things can happen to the a.c. power line. In severe cases, the a.c. power line's voltage or current can become distorted, which can affect the performance of other equipment or appliances connected to the same power line. *E.M.L.*

line voltage drops to an unacceptable level. Record turntables that have synchronous motors rely on the frequency of the line voltage to maintain proper speed; their performance can also be affected if the waveform of the power is distorted. Power amplifiers and receivers usually require high instantaneous current from the power line to produce high-level sound from loudspeakers, especially in the bass range. Preamplifiers, receivers, and power amplifiers can be susceptible to radio frequency (r.f.) noise from the power line that supplies them. Audio and r.f. engineers are aware of these things and try to make their designs as immune to these problems as possible.

Audio is dedicated to the quest for the best in sound recording and reproduction. The sound quality of audio components is the most important aspect about which this magazine is concerned. If a component doesn't sound good, we probably won't bother to review it even if the specifications might lead us to believe otherwise. We therefore decided that the quality of the a.c. power lines that run our audio systems should be investigated. With this in mind, *Audio* recently conducted a small-scale field test of a.c. power-line quality in six different locations around the country. This was done with the cooperation of Basic Measuring Instruments (BMI) of Santa Clara, California, which loaned a few PowerVisa 100G portable power-line monitoring systems to *Audio*. These instruments were set up in the following locations: New York City; Montclair, New Jersey; Chicago; Dallas; Boston, and San Francisco.

The BMI 100G monitors a variety of a.c. power-line conditions, such as high and low voltage variations, variations in line

frequency, impulse spikes, high-frequency noise, waveshape faults, and even temperature variations during the measurement period. The 100G can be set to print out information automatically at midnight each day or at the end of a week, producing a series of graphs showing different aspects of the a.c. power line. The system can be configured to show the a.c. power waveform at the instant a problem occurs, and even prints out possible reasons for the problem and suggested remedies. (BMI has introduced the 120 PowerSpy a.c. power-line analyzer at $545. It is intended for small professional facilities such as audio and video recording studios, but it might be within the budgets of some amateur audio clubs and audiophiles.)

Figure 1 shows the variation in a.c. line voltage, at one of our test sites, over a 24-hour period from midnight to midnight. The line voltage drops during the day, reaching a low of 106.6 V rms and a high of 121.6 V, a variation of 15 V! A power amplifier designed to put out 500 watts from an a.c. power line at 120 V rms might put out only 395 watts when the line voltage drops to 106.6 V.

Tests at other sites showed other potential power-line problems. Figure 2 shows neutral-to-ground voltage swells lasting for 9.6 seconds that could affect performance of an audio component. Many components have separate signal and chassis grounds to try to eliminate such problems; some professional audio electronics have a switch to allow the signal common and chassis ground to be separated if necessary. At yet another test site, similar voltages were recorded between the a.c. power line's neutral and ground wires. These voltages varied from 0.1 to 6.1 V rms over a 24-hour period (Fig. 3).

Years ago, Bob Fine, the engineer responsible for the famous Mercury Living Presence recordings, told me a story about how distorted a.c. line waveform can cause trouble. He said that George Piros, Mercury's disc mastering engineer, was having problems making acceptable record masters; they just didn't sound right. Larry Scully, the producer of the famous Scully recording lathes, went to Bob Fine's New York City facility and found the problem: The a.c. power line was supplying distorted current to the recording lathe's motors, and this was affecting

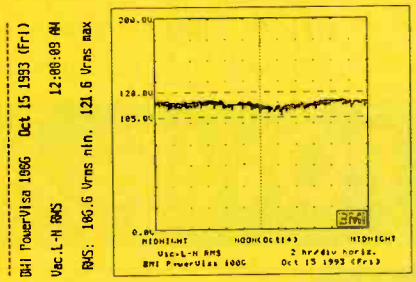


Fig. 1—Variation in the a.c. power line's voltage over a 24-hour period. The variation is 15 V, from 106.6 to 121.6 V.

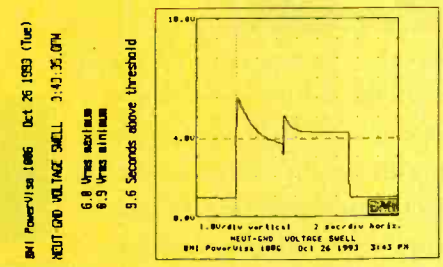


Fig. 2—Neutral-to-ground voltage swell in the a.c. power line over 9.6 seconds. This could increase the line voltage by 5.1 V over the average level.

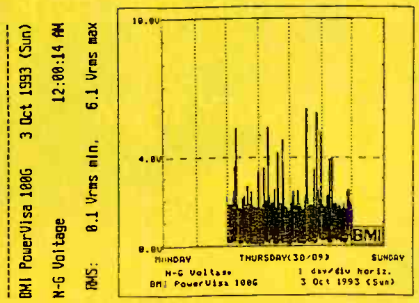


Fig. 3—A series of neutral-to-ground voltage swells in the a.c. power line over a 24-hour period.

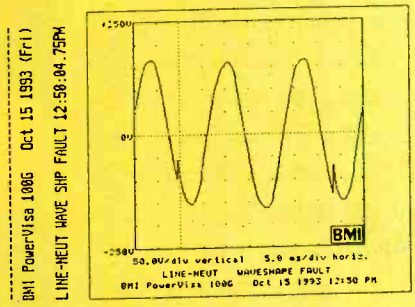


Fig. 4—Distortion of the a.c. power line's sine wave. The glitches in the waveform produce a series of harmonics.

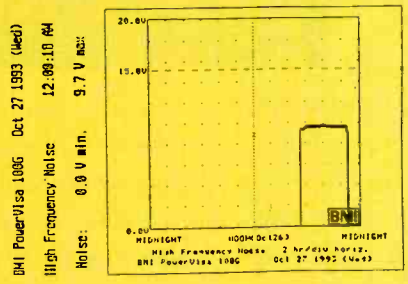
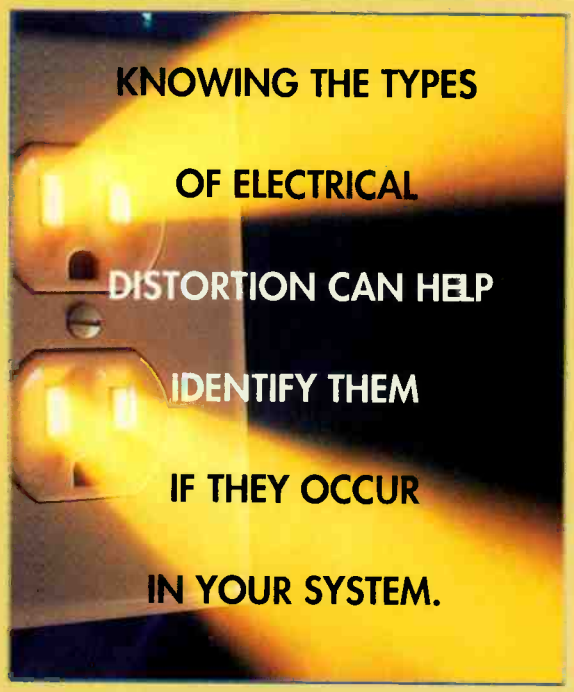


Fig. 5—High-frequency noise added to the a.c. power line's voltage by a lighting dimmer control.

POWER DISTURBANCES



Power disturbances are aberrations (also known as glitches) that pose a threat to the smooth operation of equipment. For electronic equipment, power disturbances are defined in terms of amplitude and duration by the electronic operating envelope. When power falls outside the operating envelope, electronic systems are in danger of being disrupted or damaged, and their life expectancy can be shortened. Several very common power and related disturbances can affect electronic loads. Unfortunately, nomenclature varies throughout the industry. The following is an explanation of some types of disturbances as defined by the Institute of Electrical and Electronics Engineers (IEEE).

Impulses are disturbances of short duration characterized by a very rapid change in voltage. Impulses are caused by capacitors or inductors switching on line, loose wires, lightning, static, and power failures.

Oscillatory transients are temporary rapid fluctuations in voltage or current. They are caused by utility switching, local ferroresonance, lightning-induced ringing, switching of power electronic devices (e.g., uninterruptible power supplies), or when a low-voltage system (e.g., 480 V or less) is excited by impulsive transients coupled from the utility system.

Rms voltage variations are excursions of the fundamental frequency voltage lasting longer than $^1/_2$ cycle. Sags are typically caused by utility faults, motor starts, or momentary excessive load. Swells are typically caused by line-to-ground faults from removal of a load or a wiring error.

Interruptions involve complete loss of voltage for 30 cycles or longer. Momentary interruptions ($^1/_2$ to 3 seconds) and temporary interruptions (3 to 60 seconds) result when an incident stops voltage temporarily (e.g., a lightning strike or a tree limb falling across two conductors and then dropping clear).

Waveform distortion is a steady-state deviation from an ideal sinusoid. There are five categories of waveform distortion: Harmonic, interharmonic, notching, noise, and d.c. offset. Many nonlinear devices inject currents at harmonic frequencies into the system. *Harmonic* currents, and the voltage distortion they create as they flow through system impedances, can reduce equipment operating reliability and, consequently, service life.

Interharmonics refers to high-frequency voltage or current components not integer multiples of the fundamental frequency. Interharmonics result from any nonlinear load whose current waveform is not periodic at 60 Hz.

A *d.c. offset* in alternating current can be introduced by geomagnetic disturbances or by the normal operation of single-phase electronic power supplies using half-wave rectifiers. Direct currents in the distribution system can cause increased transformer saturation and added insulation stress, as well as the misoperation of some electronic equipment.

Notching is defined as a periodic voltage disturbance caused by the

normal operation of three-phase power converters.

Noise is unwanted electrical signals with broadband spectral content lower than 200 kHz superimposed on the power system's voltage or current in phase conductors, or found on neutral conductors or signal lines. Improper grounding and the normal operation of power electronic equipment are the chief causes of noise.

Flicker can arise from voltage variations due to continuous, rapid variations in the current that are caused by the load, particularly its reactive component.

Often, suspected power disturbances turn out to be something else: Operator errors, loose cables, or environmental conditions. When the problem is intermittent, it's most efficient to rule out all other possible causes before troubleshooting the equipment. Disturbances not defined as power disturbances that can have an adverse effect on sensitive electronic loads include temperature, humidity, and radio frequency interference (r.f.i.).

R.f.i. can disrupt sensitive electronic equipment and can be misdiagnosed as power problems. Typical sources include radio stations, public address systems, radio transmitters operated by security personnel, and arcing contacts or motor brushes.

Susan Owen
Basic Measuring Instruments
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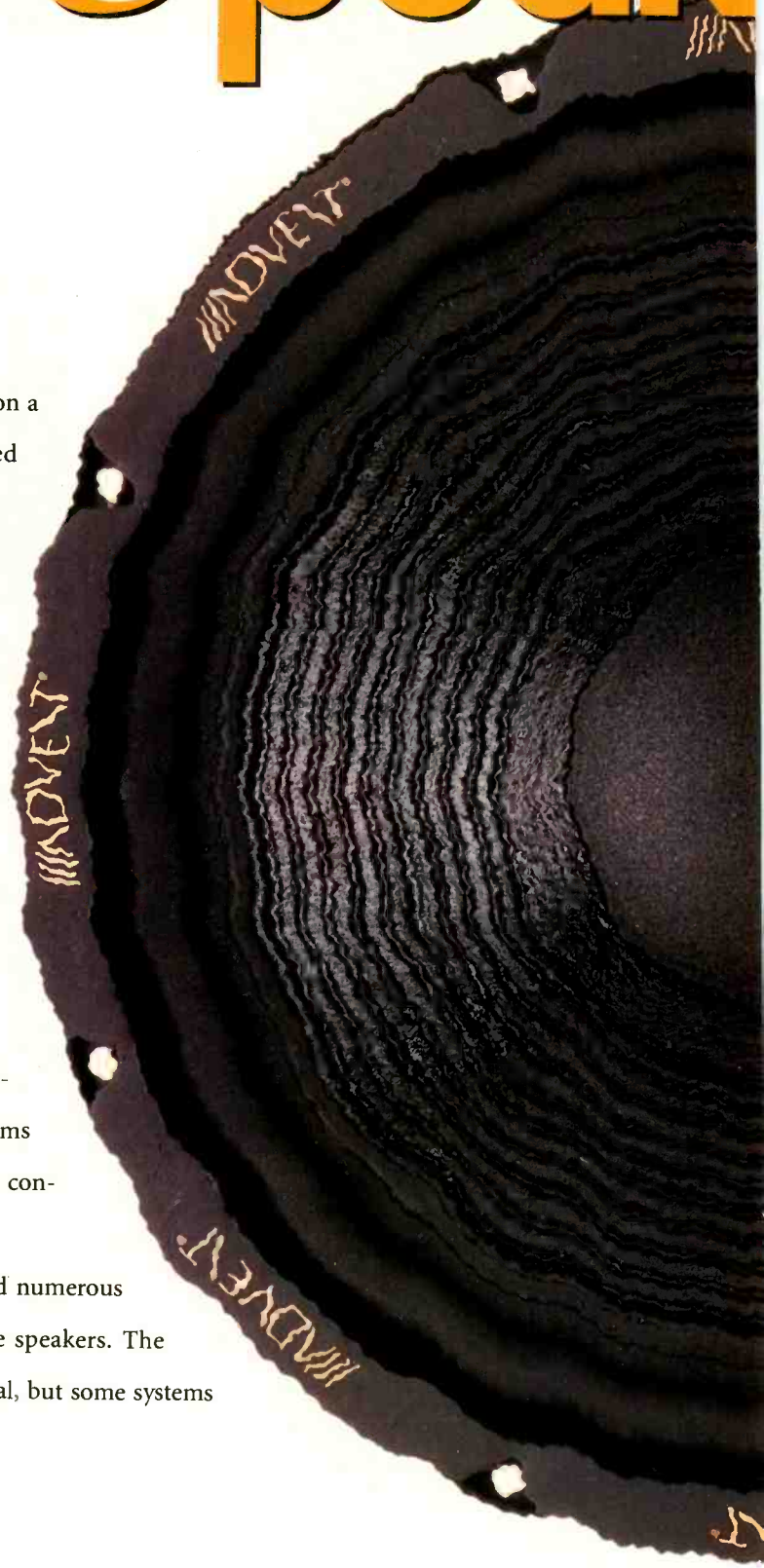
the sound. The power company replaced the line transformer which supplied power to the facility, installing a larger one that could supply more current before it saturated, and the problem was cured. While our field tests didn't reveal any continuously distorted power waveforms, we did capture some momentary problems. Figure 4 shows a graph of distorted a.c. power; it's easy to see the distortion of the sine wave and the glitches. The motor of an LP turntable can be affected by distorted a.c. power, which can result in sound reproduction from records that is not as good as it could be. Of course, open-reel recorders, cassette recorders, and CD players can also be affected.

BMI PowerVisa 100G portable power-line monitor, used in six test sites.

Light dimmers and fluorescent lights can cause problems that could affect the quality of sound reproduction, albeit in a more indirect and hard to analyze manner. They produce high-frequency noise that is radiated directly as r.f. energy and is added back to the a.c. power line. Light dimmers, which have become very popular, have a good side effect that many people don't realize: If you operate an incandescent bulb at even a just noticeably lower light level, the bulb can last 10 or more times longer than it would at full voltage. However, the method employed by most light dimmers to reduce the power available to the bulb can cause problems. They use a solid-state device to turn the a.c. power on abruptly at some point in the a.c. cycle. When they turn on early in the cycle, more power is provided than if they turn on later. It is the fast rise-time of the turn-on that generates noise energy all the way to the AM radio frequencies and higher. Years ago, I was an engineer at a company that produced wall-mount light dimmers; I designed dimmer switches and controllers and even designed a full-wave controller for fluorescent lights. Because I knew that dimmers would not only radiate r.f. noise but also put it back on the a.c. line, I designed them to have r.f. choke coils between the dimmer circuit and the a.c. line and to be put inside a metal case. The choke coils reduced the steepness of the a.c. turn-on, which reduced the level of high-frequency noise, and the metal case helped to trap the remainder. Competitive pressure has caused manufacturers of light dimmers to eliminate r.f. chokes and metal cases, and I haven't seen any high-quality light dimmers like this in years. However, r.f. noise filters are available as separate items. To derive the maximum benefit of such a device, plug it into a nearby a.c. socket on the same line as the noise source that you are trying to eliminate and as close to that source as is possible. A quick and easy way to find the source of r.f. noise from light dimmers, fluorescent lights, or anything else, for that matter, is to use a small transistor AM radio as a tracing device. Place the radio close to a suspected source of r.f. noise, and tune it between stations at the low end of the frequency band. The noise will increase the closer the radio is to the source. Figure 5 is a graph of the r.f. noise from a light dimmer connected to the same a.c. line as the BMI 100G measuring instrument. The noise level is 9.7 V maximum, and this could pose problems for any audio component not designed to deal with it.

Our brief study of a.c. power-line quality at six test sites around the country found problems at each of them. I hope that this report will spur interest in the audio community to perform further investigation. I also hope that this article will help you better understand how the mysterious source of power can affect the quality of your audio system. A

Auto Speak



Speaker polarity has a significant effect on a stereo system's imaging and perceived frequency response. Given the intimate surroundings of a car's listening environment, speaker polarity could have a more noticeable impact there than in your home system.

Establishing the polarity of home stereo speakers is simple. The connections are all in the open and you wire them yourself, following clearly labelled connectors. In your car, it can be quite a different matter. Car stereo systems are frequently factory-installed, and some are prewired with a manufacturer-installed wiring harness. Since these systems are installed by the car's maker, they must be connected correctly, right?

Not necessarily. Over the years, I have heard numerous car stereos with polarity reversals among the speakers. The most frequent mistake is a front-to-rear reversal, but some systems

er Polarity

Fred E. Davis

have left-to-right reversals as well. Even if you install your own system and follow the installation directions to the letter, you may not end up with the results you expect!

Like your home speakers, car speakers need to be phased properly so that their cone movements produce pressures of the same polarity at the listener's ear. This means that two speakers would both produce increasing pressures with the same signal source. If the polarity of one speaker was inverted (Fig. 1), it would produce a decreasing pressure at the listener's ear while the other was producing an increasing pressure, resulting in a lower effective sound level. Polarity reversal can be caused by several problems (Fig. 2). The simplest and most likely is reversing the two wires to a speaker. In more complex systems, with separate amplifiers for front and rear speakers, the two amps may have different polarities. (There is no standard

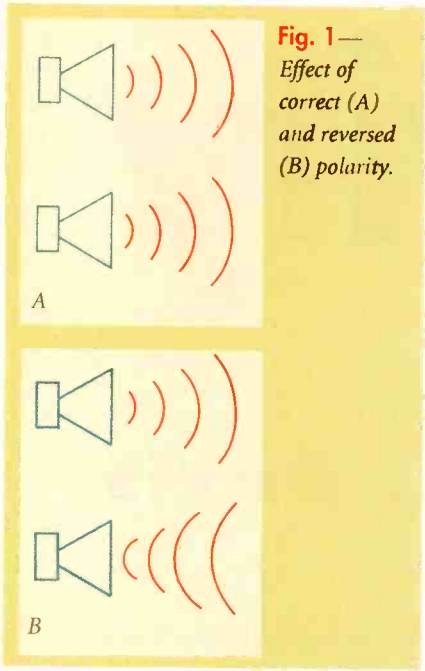


Fig. 1— *Effect of correct (A) and reversed (B) polarity.*

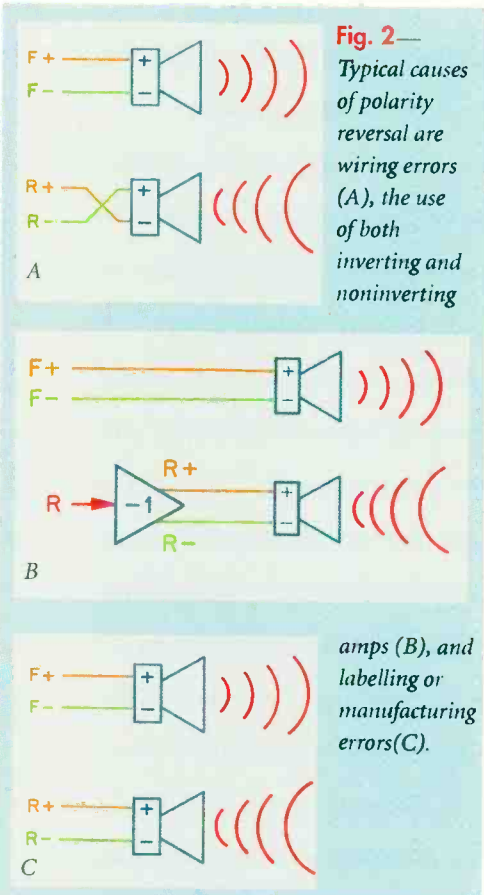


Fig. 2— *Typical causes of polarity reversal are wiring errors (A), the use of both inverting and noninverting amps (B), and labelling or manufacturing errors(C).*

for amplifiers to be inverting or noninverting.) You could wire everything "correctly" and *still* have a reversed-polarity problem. Another possibility is that the electrical polarity of different speakers might be reversed, unlabelled, or mislabelled.

My first experience with reversed polarity in auto speakers came in 1985 with a Saab 900 Turbo. The Saab 900 series has a factory-installed wiring harness: All cables for front and rear speakers, amplifiers, and antenna are installed in every car, even if optional components are not. Since the front and rear speakers in this car had very similar responses, the polarity reversal was immediately apparent. Both front speakers had the same polarity and the rear speakers were also polarized alike, but the rear pair's polarity was the opposite of the front pair's. Simply reversing the two wires at each rear speaker cured the problem and improved the sound substantially, especially in the bass. Since then, I have auditioned *many* Saab 900s; all of them had reversed front-to-rear polarity.

My latest experience was with a 1993 Saab 9000 CSE Turbo. It seemed as though the problem had been corrected, but I was having a very difficult time setting the graphic equalizer for a satisfactory response. Given my prior experience, I decided to make a simple polarity-reversal test switch to see if the problem was more than simple tonal imbalance.

The first time I tried it, there was an obvious difference. The opposite of the factory wiring greatly improved the sound with every CD. The stereo image was tightly focused, hall sounds improved, male voices had more "chest," and some percussion instruments suddenly had more "body."

IN A CAR'S INTIMATE LISTENING SPEAKERS CAN SOUND WORS

The reversal had not been immediately apparent to me because of the difference in size and response of the 9000's front and rear speakers.

The switch box in use.

I then conducted blind listening tests with numerous subjects ranging from 5 to 75 years old; the subjects included audio novices as well as professionals. The difference was clearly heard in every case, with the reverse of the factory wiring selected as sounding best.

I measured the frequency response below 1 kHz using third-octave warble tones and a sound level meter at both ear height and above the headrest (Fig. 3). The dip in response from the upper bass to midrange in the "original" (factory) position of the switch can clearly be seen. This situation improves considerably in the "corrected" (reverse) position.

The problem can affect any car stereo. Domestic rental cars on business trips have also shown their share of problems, including one with the front speakers out of phase (left to right). A friend, an experienced engineer, installed his own system. Even though he followed the stereo manufacturer's directions exactly, the front-to-rear polarity was reversed.

All that is needed to test proper polarity of your auto speaker system is a simple switch, music, and your ears. The switch will reverse speaker connections, allowing a quick comparison of polarity. Rear speakers usually have the easiest access and therefore are the best choice to switch. You will need a

ENVIRONMENT, MISPOLARIZED THAN THEY WOULD AT HOME.

four-pole, double-throw switch (4PDT) or two double-pole, double-throw (DPDT) switches (such as Radio Shack 275-1533, which requires no soldering). A rotary switch can be used, but make sure it is a "break-before-make" or "nonshorting" type. For convenience and safety, mount the switches in a plastic box.

The switches are connected to four pairs of wires (typically 18 AWG) about 10 to 15 feet in length. Bundle the wires into four pairs, as shown in the photo below, and label them to eliminate mistakes when installing. Each pair is terminated with insulated, male and female "quick-disconnect" connectors (such as Radio Shack 64-3049). The insulated type of connector should be used, to ensure against short circuits to the car's chassis.

Next, cut the wires about 6 inches from each rear speaker. It should not be necessary to label the speaker wires, since they are usually color-coded. Attach quick-disconnect connectors to the stripped ends of these wires. Use female connectors on the amplifier end and male connectors on the speaker end. This allows you to easily insert the reversing switch and later reconnect the speaker to amplifier.

The switch box. Note how the wires are bundled.

To install the switch, connect the L.AMP+ wire from the switch to a wire from the left-channel amplifier, and the L.SPKR+ wire to the left-speaker wire with the same color as L.AMP+, as was shown in Fig. 4. Connect both the L.AMP– and the L.SPKR– wires as above, then the right-channel speaker in the same manner. Route the wires so that you can sit in the driver's seat with the switch; close all windows, doors, and the trunk lid.

For your listening test, choose several music selections with strong upper bass and midrange, such as pop, piano, or male vocalist. Sit in the driver's seat, and begin with the switch in the "normal" position. Adjust the front-to-rear balance for equal volume. Without moving your head, switch the polarity. If you have two switches, try to operate both at once. If you don't hear a substantial difference, try a different type of music. One position should give a clearly better sound and stereo imaging. When the polarity is reversed, the sound gets quite "thin" where the cancellation causes a dip in the response, and the stereo image will go from a focused center image to a diffuse image with a "hole-in-the-middle" sound. If you don't find one position noticeably better, there may be a left-to-right reversal. Using independent switches will permit you to check one speaker against its mate.

In a system with multiple speakers, the task is a little more difficult but not more complicated. The trick is to compare only two pairs of speakers at a time. For example, if you have four bass/midrange speakers in the front, you must first phase these properly before checking all of the other speakers in the system.

Once you find the best sound, note the position of the switch and then disconnect it. Reconnect the speakers to the amplifier according to the switch position, either "normal" or "reverse."

Having a super factory-installed sound system and a fancy car (or even a modest car with a simple stereo) doesn't always ensure proper speaker connections. By using a simple switching scheme, you can easily determine the correct wiring for your system and listening position. A

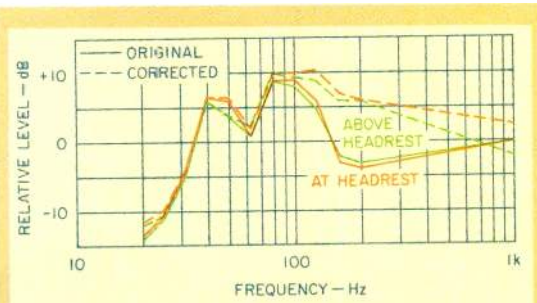


Fig. 3—*Response of car sound system with original, factory-inverted polarity and with polarity corrected.*

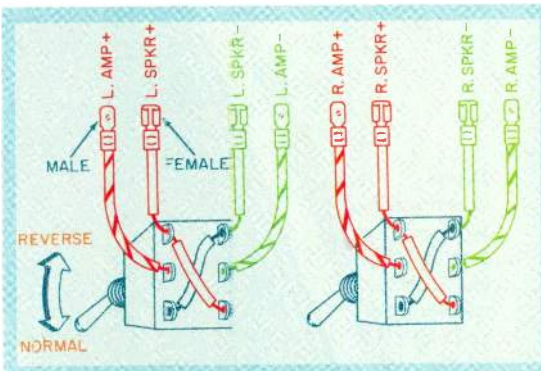


Fig. 4—*Wiring diagram for the polarity-reversal test-switch setup*

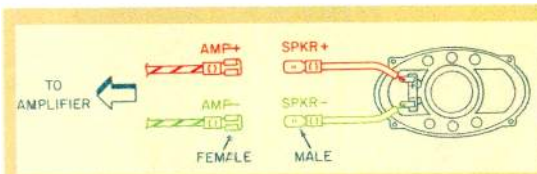
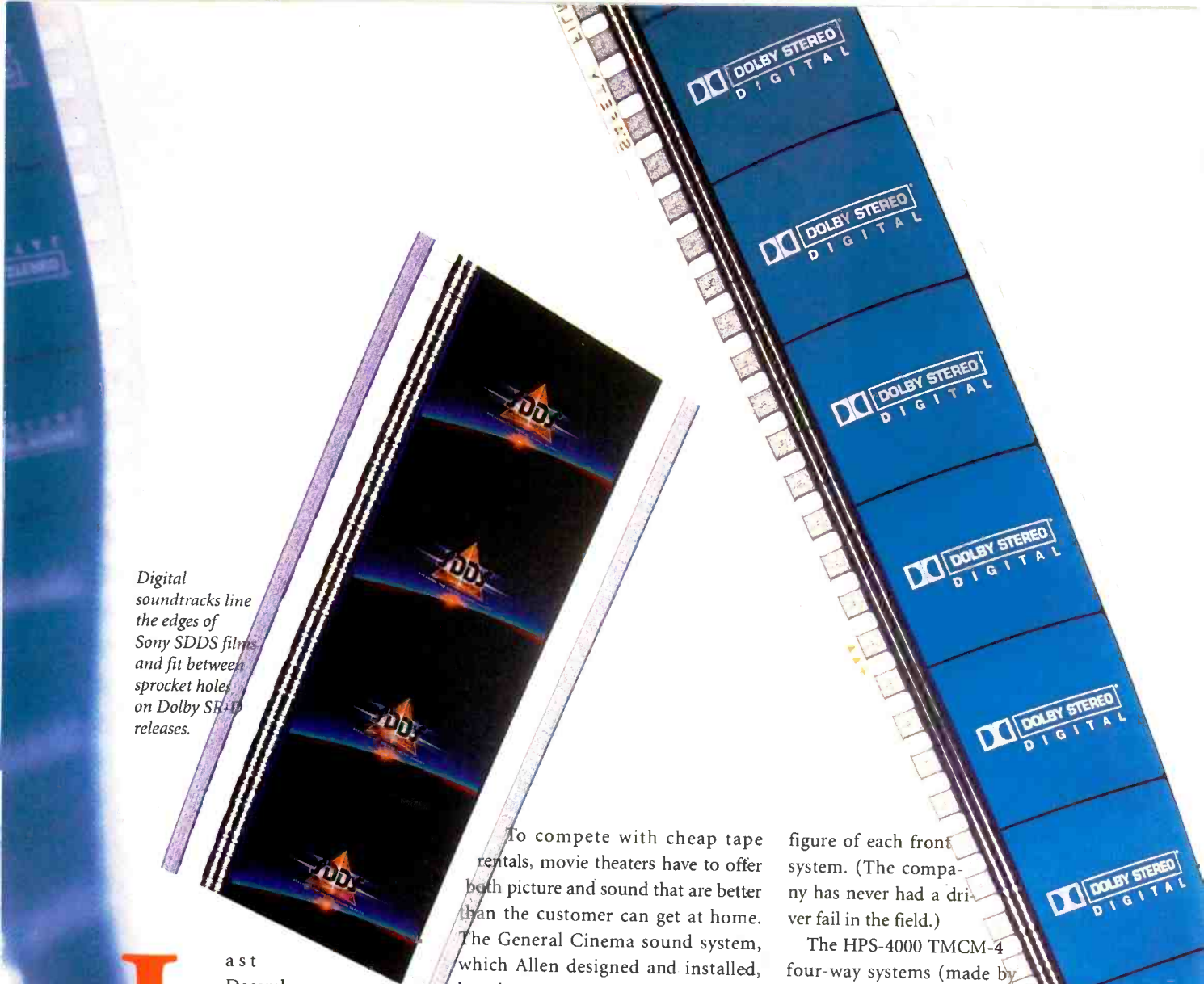


Fig. 5—*Connectors added to speaker wires.*



Digital soundtracks line the edges of Sony SDDS films and fit between sprocket holes on Dolby SR-D releases.

Last December, John F. Allen gave one of his always-popular theater sound meetings for the Boston Audio Society and several other audio-oriented groups. As usual, his presentation was a lecture with numerous movie excerpts. We heard one of the best analog soundtracks and two digital movie systems currently in major use in this country, DTS from Digital Theater Systems and Dolby's SR-D. A third system, Sony's SDDS (to be rolled out this summer), was described but not demonstrated, due to lack of available hardware.

E. Brad Meyer is a Boston-area audio consultant and recording engineer, and current President of the Boston Audio Society.

To compete with cheap tape rentals, movie theaters have to offer both picture and sound that are better than the customer can get at home. The General Cinema sound system, which Allen designed and installed, has three main loudspeakers behind the screen (left, center, and right) that are entirely horn-loaded, including the woofers.

Allen is a partisan of horn-loaded speaker systems, in particular those made by Paul Klipsch, because of their high efficiency and low distortion. He is also what audiophiles call a bass freak. His presentation emphasized his system's high undistorted output of approximately 710 acoustic watts, equivalent to the sound power of 10 symphony orchestras. The standard requirement for film sound is for peak levels of 103 to 105 dB SPL for the first arrival of the sound, in the middle of the room. Allen likes to provide a safety margin of about 6 dB; his systems can attain this without biamplification, thanks to the 109-dB sensitivity figure of each front system. (The company has never had a driver fail in the field.)

The HPS-4000 TMCM-4 four-way systems (made by Klipsch) are used for the left, center, and right channels. The tweeters almost touch the rear of the screen; they were designed with narrower dispersion than were the other horns. The screen spreads the beam at the high frequencies so that the tweeter's radiation pattern, as installed, is a close match to the other drivers.

The surround speakers in the HPS system are placed according to a coverage program Allen developed; he claims the response is even throughout the theater, within ±0.5 dB.

We began our serious listening with perhaps the best, and best-known, multichannel analog film mix: The beach invasion scene from reel three of *Apocalypse Now*. (Allen got hold of Francis Ford Coppola's personal

Photograph: Robert Lewis

RATED S FOR SOUND

70-mm print.) The six-channel magnetic sound on this aging analog production was still impressive and provided a good reference for the remainder of the program.

Next, while the very capable projectionist was changing from 70 to 35 mm, came Sony's presentation, given by vice president of exhibitor relations in the Sony Dynamic Digital Sound (SDDS) division, Dan Taylor. All four SDDS prototype playback units were in use at the time of the demo, so we had to be content with a technical description. Installation in U.S. theaters will begin in July 1994.

The Sony and Dolby systems both require the printing of digital bits on the film, in the form of light and dark pixels. In the Sony system these are placed on both sides of the film, between the outer edges and the sprocket holes. In the SDDS, Dolby, and DTS systems the existing two-channel analog tracks remain untouched.

All of these systems share certain advantages over analog recording: They give wider frequency response with lower distortion and noise than analog soundtracks. Also, because the multiple channels are not matrixed together into two, as with current Dolby Stereo soundtracks, the systems have much improved channel separation. And they deliver this improved quality without the careful calibration of the theater's equalization required for each 70-mm magnetic film.

But where do you put the digital data? You can store digital ones and zeroes on film as light and dark pixels, but the number of bits required to store many channels of CD-quality audio exceeds the ability of conventional photographic prints to resolve, or optical sensors to read, amidst the rapid and sometimes irregular motion of the film through the projector. All three systems accordingly use some form of data reduction, of which the DTS system's is the least aggressive; Sony's algorithms are based on professional psychoacoustic compression similar to that used for the consumer MiniDisc. Dolby SR-D uses a proprietary compression system called AC-3, which makes clever use of the redundancy between channels to reduce the number of bits.

E. BRAD MEYER

The SDDS digital information is read in a separate "penthouse" reader, which is mounted on top of the projector through which the film is threaded. (Because the projector at this demo was equipped for two digital systems and 70-mm magnetic film, it was very tall.) The data from the reader goes to a processor, where the digital information is delayed until the film enters the projector gate. The information is then decoded into eight discrete channels, of which five are behind the screen: Left, left/center, center, right/center, right, left surround, right surround, and subwoofer.

Next, Terry Beard, president and system designer of Digital Theater Systems, told us about the DTS approach. This system uses a separate CD-ROM drive slaved to the film by means of time code imprinted on it. Time code on film is an old, reliable technology, requiring few bits and no special attention to print quality. DTS got a big head start when it was chosen by the makers of *Jurassic Park;* as of December 1993, it had been installed in over 1,300 theaters worldwide.

The CD-ROMs containing the soundtracks go in a small rack-mounted player with two drawers. The projectionist puts the discs in the drawers and runs the film; whichever disc is appropriate is played and synchronized to the film automatically. There is even an identifier on the film to

make certain the right movie is playing. DTS offers a six-channel system (three front channels, two surrounds, and subwoofer) and uses the least data compression of the three—a four-band digital compander that fits up to three hours and 20 minutes on two CD-ROMs.

It is easy to imagine that a separate sound carrier must entail greater complication than printing the sound on the film itself. But the DTS hardware is no larger than the outboard boxes for the other two systems and is simpler to set up and operate. The unit has only two CD drawers, open/close buttons, and an on/off switch. There are no other controls.

One big advantage of DTS is the ease with which DTS movies can be shown in foreign markets. The print is the same for all languages; only the CD-ROMs are different. The DTS theaters in Paris show some American movies in English in the morning and play them in French for the remainder of the day.

We saw a DTS demo reel containing a brief presentation by two Digital Theater Systems engineers and then three movie excerpts. First came the very loud industrial-fire scene from *Backdraft*; this was followed by the whisper-quiet scene from *Far and Away* where the two stars pad softly through a fancy house whispering to each other. The scene segued with a big jolt to the battle scene from *Born on the Fourth of July*. The dynamic range of both the DTS system and the playback chain was amply demonstrated. Finally, we watched a tyrannosaurus rex savage the jeeps and their occupants in reel four of *Jurassic Park*.

While the equipment was being changed over, John Allen stood in for Dolby Laboratories representative Ioan Allen and described the Dolby Stereo Digital (SR-D) system. As of last December, Dolby's hardware, which is considerably more expensive than the DTS package, had been installed in about 200 theaters in the U.S.

In the Dolby system, the digital information is encoded in a rectangular array of dots and is placed in between the sprocket holes. Like the other two systems, it is fully compatible with existing analog soundtracks. Dolby "5.1-channel" AC-3 encoding has the same channels as the DTS system, with the subwoofer channel counted as 0.1 due to its limited bandwidth.

After the lecture we heard several SR-D demos: The desert cave scene from *Aladdin*; the SR-D trailer, with massive, artificially enhanced locomotive sounds; the opening reel of *Pure Country*, and the train wreck scene from *The Fugitive*.

The sound in the theater was very clean, without noticeable strain or distortion. Although the sound levels were carefully set to a standard that is supposed to reflect the intentions of the producers, many at the meeting thought the sound was too loud on many of the excerpts. (The spectacular and even violent nature of the excerpts that seem inevitably to be chosen for these demos didn't help either.) There was also what sounded like too much bass in many examples, and a persistent brightness and hardness in the upper midrange on some of the dialog and effects.

As always, the big question in these situations is, are we hearing effects from the playback system or is it the source material? Allen said that the system was reproducing the various mixes accurately, so that we were, in effect, complaining about the original material.

Fortunately, I was able to borrow a DAT recording of some of the audio, made from the output of the hearing-assistance system, which combines all the front channels. With this recording, I had the rare opportunity to check the frequency balance of the source material on my own very familiar monitor system (Snell A-IIIs with large subwoofers) in my listening and editing studio.

Sure enough, the results were very similar to what I had heard in the theater, with the same huge bass and occasionally strident upper mids and highs. This result, of course, tends to absolve the theater's playback system. It also suggests that those who edit and equalize most movie soundtracks, even digital ones, are still making their decisions with the average theater system in mind, dialing in equalization that may sound overdone on the best theater or home theater systems.

Home theater is part of this equation for several reasons. Dolby's AC-3 has already been named as the standard sound transmission method for future American HDTV multichannel sound. An American chip manufacturer, Zoran, will have single-chip AC-3 decoders available by the time you read this. And a scheme for putting AC-3 audio on LaserDiscs was demonstrated at the 1994 Winter Consumer Electronics Show.

THREE DIGITAL SOUND SYSTEMS ARE COMPETING FOR THE WORLDWIDE MOVIE THEATER MARKET.

So we may eventually be able to buy as good a replica of the original multichannel digital film mix as the CD provides for a stereo digital master. Already, the question of treble balance is being addressed in current home theater decoders by the inclusion in many models of a selectable top-end roll-off. As for the bass, relatively few theaters yet have the low-frequency capability of the biggest HPS-4000 speaker system, and only the largest home theater setups can equal their low-frequency response. With luck, corrective measures can be found to enable us to enjoy the superior separation and clarity of digital film sound without paying a penalty. A

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EQUIPMENT **PROFILE**

SONY TCD-D7 PORTABLE DAT RECORDER

For all the attention garnered by the new Digital Compact Cassette (DCC) and MiniDisc (MD), Digital Audio Tape (DAT) remains the only commercially available format offering full 16-bit recording capability and CD-quality sound. With that in mind, Sony has come up with a successor to the TCD-D3, its first portable DAT recorder. Ergonomically, the TCD-D7 should prove to be a delight for recording enthusiasts who prefer linear digital recording over other digital formats. I found its fast-forward, rewind, and cue/review functions to be faster than on the TCD-D3 I've been using.

The TCD-D7 is supplied without batteries, because, unlike the previous Sony DAT portable, it works on four ordinary AA alkaline batteries. An optional a.c. adaptor and car battery cord can also power the TCD-D7, but the only accessory supplied is a carrying case.

Recording level for the TCD-D7 can be adjusted manually or automatically. Date and time are automatically registered when making a recording and can be displayed during playback, fast winding, and cue/review. An LCD window indicates the current operational mode and battery status. As is true of all consumer digital audio recorders, the TCD-D7 has the Serial Copy Management System (SCMS), which permits first-generation digital-to-digital copying from other program sources (such as CDs, DCC tapes, or MiniDiscs) but prevents the machine from making digital copies of the copies.

It's easy to see why Sony chose to call this portable unit a DAT Walkman: The TCD-D7 is smaller, and weighs less, than many portable analog cassette players I have operated over the years!

Control Layout

The TCD-D7's top panel is mainly devoted to the display and the main operating controls. At the front of this panel, flanking the "Stop" and "Play" bars, are small buttons for forward and reverse tape motion. Depending on the operating mode and the number of times these small buttons are pressed, they control cue and review (fast winding while monitoring the sound), finding tracks, or fast forward and rewind. A large, red "Rec/ID Write" pad is just to the right, with a small "Pause" button a bit behind and to the right of it. Farther back is a button that will illuminate the display. Three buttons for controling the counter and clock are in the right rear corner.

Controls on the front of the unit include a selector switch for standard and long-play recording, volume up/down buttons for the headphone output, and a switch that selects headphone listening with or without an ear-protecting volume limiter ("AVLS") or the line output. A "Hold/Open" switch opens the cassette compartment or prevents you from accidentally actuating a control during recording or playback.

The right side of the TCD-D7 carries a rotary "Rec Level" control and a "Phones/Line Out" mini-jack, a "Rec Mode" switch, mini-jacks for line and microphone input, and a mike sensitivity switch. The "Rec Mode" switch can be set to "Manual" or to either of two modes for automatic level control. In "Music" mode, this control circuit has a longer time constant so as not to squash musical dynamics; the "Speech" mode has quicker operation.

The left side edge of the unit houses a seven-pin digital input/output jack; it accepts optional adaptors that connect to fiber-optic or coaxial jacks on other digital

components. An optional wireless remote control can also be plugged in here. The power input jack is on the rear panel, while the battery compartment is accessible from the unit's underside.

The display has a multimode counter and indicators for peak recording level, LP mode, program number, day and time, start ID, operating status, remaining battery power, automatic ID mode, and moisture warning.

Measurements

When I first tested a DAT recorder several years ago, I created a digital test tape by copying the contents of my CBS CD-1 test CD to DAT. I used this test tape to measure the TCD-D7's playback performance. Then I made record/play measurements, using analog and digital test signals from my Audio Precision test system.

Figure 1 shows the frequency response curves I obtained. For playback of my previously recorded test tape, response is down 0.25 dB at 20 Hz and is up 0.65 dB at 20 kHz. For a sweep signal fed through the analog line inputs, response is down by 0.3 dB at 20 Hz and 0.65 dB at 20 kHz. For the microphone input, high-frequency response is about the same. However, this input obviously has some built-in low-frequency attenuation, for its response is down by 1.0 dB at 40 Hz and more than 3 dB at 20 Hz. For recordings made via the optical digital inputs, response is up by almost 0.5 dB at 20 kHz and is down by just under 0.3 dB at 20 Hz.

Figure 2 shows THD + N as a function of frequency, for recordings made at maximum level. It hovers just above 0.01% over most of the audio spectrum. (This includes both distortion and noise; Sony's published specification of 0.008% in SP mode is for distortion alone.)

Figure 3 shows THD + N as a function of signal amplitude, with 0 dB corresponding to maximum recording level. For levels that are below –10 dB, THD + N is about –83 dB; this corresponds to 0.007%, just a hair lower than Sony's specification. The rise in THD + N for signal levels above –10 dB is obviously the result of a slight increase in distortion in the analog output stages.

An FFT spectrum analysis of a 1-kHz signal at maximum recorded level (Fig. 4) shows that the most significant harmonic distortion component (at 4 kHz) is some 82 dB below reference level. This corresponds to 0.0079% harmonic distortion, almost exactly as specified.

Channel separation at 1 kHz (Fig. 5) is approximately 92 dB for either direction, increasing to between 77 and 78 dB at 125 Hz and to between 77.5 and 79.7 dB at 16 kHz, depending on which channel is measured.

The A-weighted signal-to-noise ratio (not shown) measured 87.9 dB in each channel. A spectrum analysis of residual noise, made using a third-octave bandpass filter, is shown in Fig. 6. Even though I used the optional a.c. adaptor to power up the TCD-D7, there is virtually no evidence of noise or hum components related to the power-line frequency.

Deviation from perfect linearity for undithered signals (Fig. 7) is less than 2.0 dB at –80 dB. However, at –90 dB, the linearity error increases to approximately +8.0 dB.

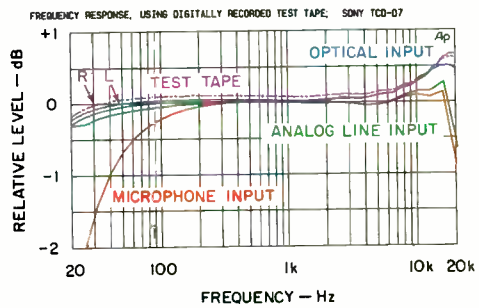


Fig. 1—Frequency responses.

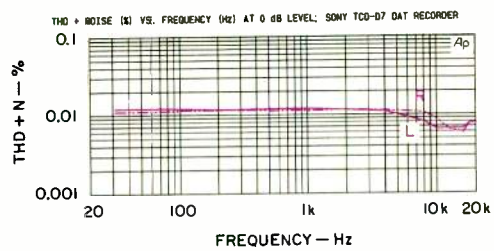


Fig. 2—THD + N vs. frequency.

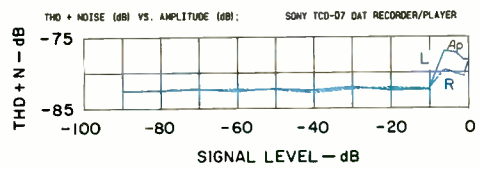


Fig. 3—THD + N vs. signal level.

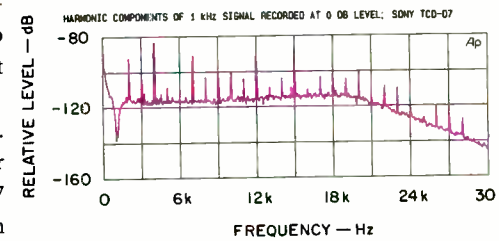


Fig. 4—Harmonics of 1-kHz, 0-dB signal.

SPECS

Recording Time: Standard, 120 minutes; long-play, 240 minutes.
Sampling Frequencies: 48, 44.1, and 32 kHz.
Frequency Response, ±1.0 dB: At 48-kHz sampling, 20 Hz to 22 kHz; at 44.1-kHz sampling, 20 Hz to 20 kHz; at 32-kHz sampling, 20 Hz to 14.5 kHz.
S/N: Greater than 87 dB.
Dynamic Range: Greater than 87 dB.
THD at 1 kHz: Standard play, less than 0.008%; long play, less than 0.09%.
Input Levels: Line, 80 to 500 mV; microphone, 0.4 mV minimum.
Output Levels: Line, 500 mV; headphone, 5 mW/channel.
Headphone Output Impedance: 32 ohms.
Power Requirements: 6 V d.c., 1.2 watts.
Approximate Battery Life: With monitor on, 3½ hours playback, 3 hours recording; with monitor off, 4 hours playback, 3½ hours recording.
Dimensions: 5¼ in. W x 1½ in. H x 3½ in. D (13.3 cm x 3.7 cm x 8.8 cm).
Weight: 1 lb., 1 oz. including batteries (0.5 kg).
Price: $699.95.
Company Address: Sony Dr., Park Ridge, N.J. 07656.
For literature, circle No. 90

In the fade-to-noise test (Fig. 8), made using dithered signals, linearity of the Sony TCD-D7 is excellent all the way down to approximately –100 dB. The EIA dynamic range, derived from this plot, was approximately 98 dB. Using the EIAJ method to determine dynamic range, I came up with a figure of 87.7 dB for the left channel and 88.0 dB for the right. Master-clock frequency was accurate to within 0.0033%, which is better than I've measured for most CD players!

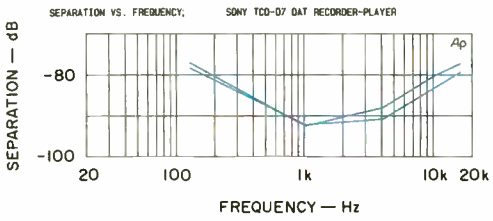


Fig. 5—Separation vs. frequency.

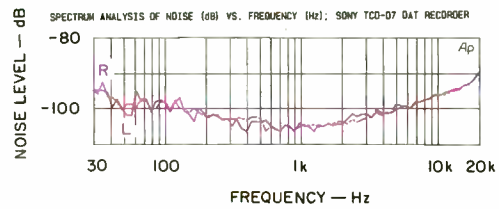


Fig. 6—Spectrum analysis of residual noise from "no-signal" track.

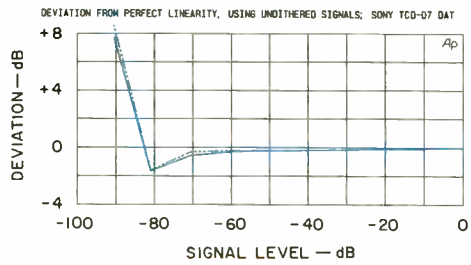


Fig. 7—Deviation from linearity.

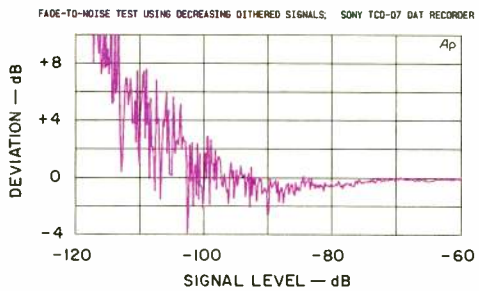


Fig. 8—Fade-to-noise test.

Finally, I fed a digitally generated signal of gradually diminishing amplitude to the optical inputs of the TCD-D7 and recorded the results. During playback, I plotted output versus input (not shown). Deviation from perfect linearity was again less than 2 dB all the way down to –100 dB.

Use and Listening Tests

All the buttons and controls on Sony's second-generation portable DAT recorder were just where I expected them to be. Using them properly required almost no reference to the generally well-written owner's manual. When either volume-control button is pressed, the new level is shown numerically in the display; this makes it simple to restore preferred volume settings.

I transcribed several CDs onto DAT cassettes through the analog line inputs and found that the automatic record level control caused some noticeable compression in dynamic range during playback, but far less than I expected. When I recorded this same material by using the manual record level control (making sure never to exceed 0 dB on the fast-acting display of peak level), neither I nor others who listened were able to tell the difference between the sound quality of the original CD and that of the resulting DAT. This, of course, is as it should be, since both formats use full, linear 16-bit recording. But it also attests to the sound quality of the TCD-D7's A/D, D/A, and analog sections, all of which produced flawless, crystal-clear sound.

In terms of price, the Sony TCD-D7 has a long way to go before it can be considered a practical substitute for the ubiquitous analog cassette Walkman. Still, Sony personnel tell me that the TCD-D7 has been selling beyond their expectations since its introduction about a year ago. Generally speaking, the DAT format has been a resounding success in the professional audio world but not in the world of consumer audio. Perhaps Sony's TCD-D7 may change this a bit. I know that, while testing the TCD-D7, I wished I had waited for this second-generation DAT portable instead of opting for the earlier model more than two years ago. That, I suppose, is the penalty an enthusiastic product reviewer must pay. I always seem to want to be the first guy on the block to own the newest advances in audio technology, only to regret not having waited when "new improved" versions were introduced later on.

Leonard Feldman

THE TCD-D7 IN THE FIELD

The Sony TCD-D7 is the second DAT portable I've owned and about the eighth I've tried. But it's the first that seems designed for live field recording, where you're rarely sure of how loud the signal will be or how long you'll be recording it and you haven't time to search for controls or label tapes as you finish them.

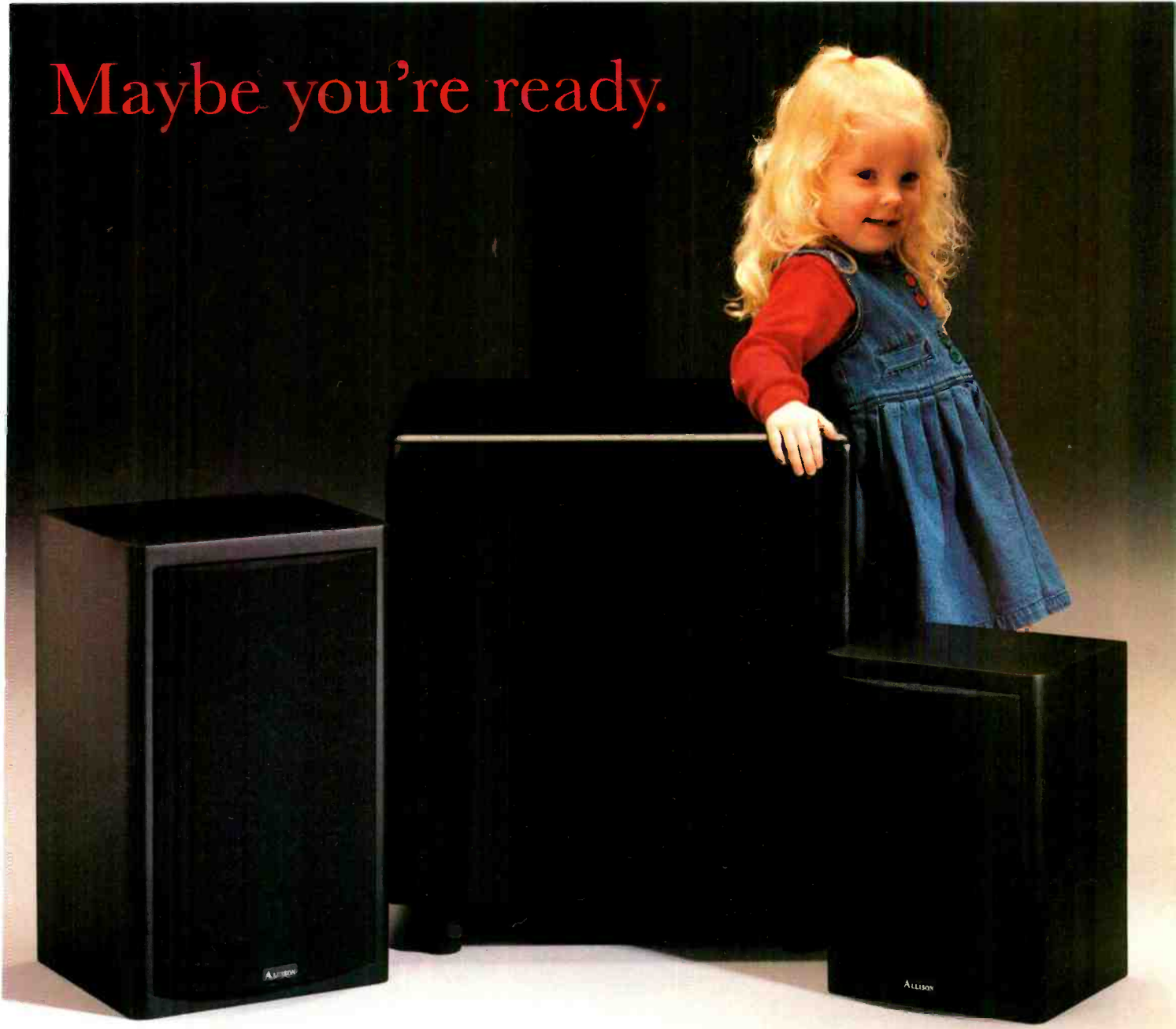
The TCD-D7's automatic record level control ensures against recording overload, and its earphone limiter keeps you from blasting your ears. If the event you're recording looks like it will run longer than your tape, you can switch to LP mode, getting doubled recording time at the expense of FM-like frequency response.

Using alkaline batteries instead of rechargeables yields longer recording times, better charge retention on the shelf, a battery meter that actually warns you before it's too late—and the ability to run out and buy fresh batteries, almost anywhere, in far less time than a battery charge would take. You can stretch battery life a bit by turning off the TCD-D7's headphone amp.

All the controls are so clearly demarcated by size, shape, and placement that it's impossible to confuse them. The automatic time/date stamping lets you sort your tapes out afterwards, even if you didn't label them.

However, the fixed bass attenuation in the mike input (see Fig. 1) was a major disappointment to me. It means that field recordists won't get all the deep bass DAT can provide, no matter how good their mikes, unless they go through a mixer or external mike preamp. There are reasons for having such a roll-off, but I sure wish it was switchable—and Sony certainly should mention it in the manual and spec sheet!

Ivan Berger



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EQUIPMENT PROFILE

M & K S-5000THX SATELLITE AND MX-5000THX POWERED SUBWOOFER

From its start in 1978, Miller & Kreisel has been associated with the film and recording industries, supplying speaker systems for film scoring and recording studios. Later on, engineers and producers started taking M & K systems home to hear their recordings the way they sounded in the studio. So the company entered a market where "home theater" meant projecting film, not playing video recordings.

For this review, I was provided with two M & K S-5000THX front-channel satellite speakers and two MX-5000THX powered subwoofers. These are the top models in Miller & Kreisel's satellite/subwoofer line, and they have a combined price of $6,380.

The company was one of the first (in 1992) to get speakers certified by Lucasfilm for use in THX home theater systems. To be certified for use in home THX audio systems, components must meet stringent performance requirements intended to make the home sound match that heard in a film dubbing studio through a Professional THX Sound System. For loudspeakers, THX requirements include the ability to play loudly and cleanly, particularly in the low bass, and specific coverage patterns for the front and surround speakers. For the front speakers, horizontal coverage must be wide, but vertical coverage must be restricted; Lucasfilm says this enhances dialog clarity and sound localization by focusing the sound energy toward the listener and reducing unwanted reflections from the ceiling and floor.

In the M & K S-5000THX satellite speaker, the restriction in vertical coverage is accomplished by the use of a vertical array of two tweeters located between two woofers. (This is similar to the D'Appolito

SPECS

Satellite

Type: Two-way closed box.

Drivers: Two 6½-in. polypropylene cone woofers and two 1-in. soft-dome transmission-line tweeters.

Frequency Response: 72 Hz to 20 kHz, ±2 dB.

Impedance: 4 ohms.

Recommended Amplifier Power: 25 to 400 watts per channel.

Dimensions: 24 in. H x 11⅝ in. W x 12 in. D (61 cm x 29.5 cm x 30.5 cm).

Weight: 55 lbs. (25 kg) each.

Price: $995 each; available in oak or black oak, with black grille.

Powered Subwoofer

Type: Dual-driver, push-pull, closed-box subwoofer with built-in power amplifier.

Drivers: Two 12-in. cone woofers.

Frequency Response: 18 to 125 Hz (low-pass filter adjustable from 50 to 125 Hz).

Amplifier Power: 400 watts continuous.

Distortion: Less than 0.03% at full power.

Input Impedance: 15 kilohms.

Dimensions: 23¼ in. H x 15½ in. W x 26 in. D (59.1 cm x 39.4 cm x 66 cm).

Weight: 115 lbs. (52.3 kg) each.

Price: $2,195 each; available in oak or black oak, with black grille.

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As the audio world moved from mono to stereo and now multi-channel stereo, the term Hi-Fidelity seems to have been forgotten. If you want to be trendy, you could now call it UltraFidelity - but whatever you call it, AudioQuest audio, video and digital cables will give you more of it!

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tweeter-between-two-woofers vertical array, but with two tweeters instead of one.) Placing the speakers symmetrically about the enclosure's horizontal center line makes the vertical coverage inherently symmetrical.

Placing two tweeters one above the other makes the vertical coverage extremely narrow above 10 kHz and causes severe off-axis lobing. In the S-5000THX, the problem is solved by placing small blocks of absorptive foam between the two tweeters to control their off-axis radiation at high frequencies. Additional pieces of foam are added to the front panel to block or reduce cabinet edge reflections.

Another innovative feature is the use of tweeters with transmission-line rear loading. This is said to completely absorb the energy from the back of the tweeter dome and thus eliminate destructive reflections from inside the tweeter that can produce audible coloration and time-domain smearing. The tweeter transmission lines actually protrude about 0.6 inch beyond the rear of the cabinet and might be mistaken for woofer port or vent tubes. A parabolic front plate assembly is said to increase the tweeter's directivity and reduce the sonic influence of the cabinet's baffle. The tweeters are flush-mounted on the baffle, which further reduces edge reflections. Magnetic damping fluid is used to increase the tweeter's power handling.

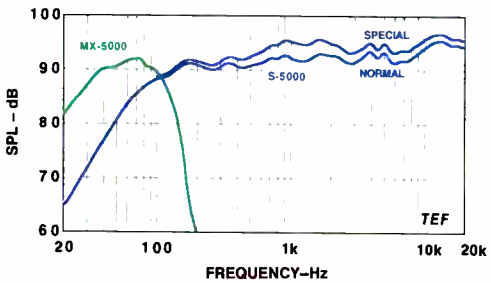

Fig. 1—Anechoic frequency response.

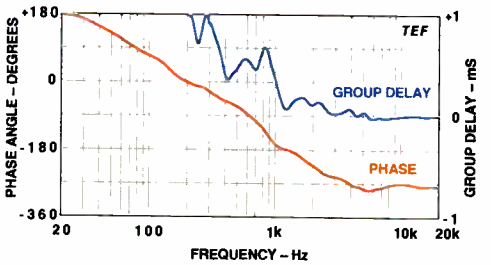

Fig. 2—Satellite phase response and group delay.

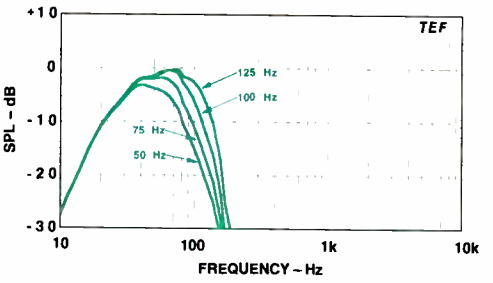

Fig. 3—Subwoofer frequency responses.

The crossover of the S-5000THX uses audiophile-grade components, including all air-core inductors and polyester-film capacitors. A second-order, 12-dB/octave, low-pass filter drives the parallel-connected woofers, while a third-order, 18-dB/octave high-pass drives the parallel-connected tweeters. Resistor-capacitor impedance-correction networks are used in parallel with the drivers. The crossover frequency is not stated, but Ken Kreisel (the "K" in M & K) indicated in a telephone conversation that it is placed quite low, in the range of 1 or 2 kHz.

A rear-mounted DPDT switch, marked "Normal" and "Special," controls sensitivity in the upper range. When used well away from room boundaries, the S-5000THX is flattest in the "Normal" switch position, while the "Special" position increases the sensitivity above 200 Hz to compensate for placement near bass-enhancing boundaries.

The satellite's crossover contains 12 parts, not including the switch: Two inductors (one tapped for use with the switch), six capacitors, and four resistors. Bi-wiring is not supported. Biamplification, however, is automatic, since the separate subwoofers have their own amps.

The S-5000THX's cabinet is trapezoidal, with the front about 1 1/2 inches narrower than the rear. This shape is said to smooth the response through the important mid-bass region and to strengthen the cabinet.

The MX-5000THX powered subwoofer has two 200-watt amplifier modules that share a common heat-sink at the rear of the cabinet. Each feeds a separate, long-throw, 12-inch driver. The cabinet is divided into two chambers, a sealed enclosure and a smaller chamber with a large opening near the bottom of the cabinet's front baffle. One of the unit's two 12-inch drivers is conventionally mounted on the front of the cabinet. The second driver is mounted within the cabinet, its cone aimed into the enclosure and its magnet side pointing down into the smaller cavity; the cavity's opening, except for its large size, could easily be confused for a port. However, this opening is too large to act as a port below the 125-Hz upper cutoff of the MX-5000THX's low-pass filter, and the cavity has no effect on response. Acoustically, both drivers operate as if they were mounted on the outside of the box.

The one significant detail is that the bottom driver faces the inside of the box, rather than facing out. Since the bottom driver radiates from its rear, it is physically 180° out of phase with the normally mounted driver. This is compensated for by reversing the polarity of the bottom driver's connections to its amplifier module.

THE SATELLITES NEEDED TIGHT VERTICAL DIRECTIVITY FOR THX CERTIFICATION.

But while the signals produced by these two drivers are in phase, the even-order harmonics (second, fourth, sixth, etc.) they generate remain out of phase, acoustically and mechanically. So, this "push-pull" mounting arrangement effectively cancels even-order distortion components. (I had to think about this one for a while; it really works! M & K is not the first to do it, however.) The company states that the woofers'

push-pull mounting arrangement also improves driver stability during extreme (large-amplitude) transient excursions. A designer can also use two drivers to double efficiency and raise acoustic output by 6 dB (quadruple acoustic output power), if the box size and power are also doubled; I don't know if this is the case with the MX-5000THX.

The rear of the cabinet has variable controls for "Bass Level" and "Low-Pass Filter" frequency, with the filter control calibrated from 50 to 125 Hz. There are also switches for "Subwoofer Phase," "THX/Normal," and for matching output level to the number of subwoofers used in THX mode. In THX mode, the level and filter controls are bypassed, fixing the gain and crossover frequency at the values mandated in the THX Standards. The level switch, which only operates in THX mode, compensates for the 6 dB of additional output from a second subwoofer by reducing gain accordingly. There are no speaker-level inputs, but two phono jacks ("Left/Mono" and "Right") are provided for line-level input. The inputs sum to a common output.

THE INNOVATIVE TWEETERS HAVE TRANSMISSION-LINE REAR LOADING.

Both the S-5000THX satellite and the MX-5000THX subwoofer are magnetically shielded and thus can be used near video and computer monitors and equipment.

Measurements

Frequency responses of the S-5000THX satellite and the MX-5000THX subwoofer are shown in Fig. 1. Satellite responses are shown for both the "Normal" and "Special" positions of the rear-mounted switch. The subwoofer was set to the maximum low-pass setting of 125 Hz, the setting used in THX mode.

The satellite's curve is for 10th-octave-smoothed, 1-meter, on-axis anechoic response with an input of 2 watts (2.83 V rms). Near-field measurements were utilized for the subwoofer curve and to derive the low-frequency response of the satellite. Because the powered subwoofer's output level can be adjusted, it was set to approximately match the satellite's midband level.

In the "Normal" position, the satellite's response is quite well behaved, fitting a tight 3.5-dB window from about 140 Hz to 10 kHz. Above 8 kHz, the response rises to a broad peak at 13 kHz; this peak's level exceeds the top of the 3.5-dB window by about 2 dB. Above 20 kHz, the response (not shown) fell smoothly and rapidly and exhibited no dome resonances. At the low end, the response starts a gentle roll-off at about 150 Hz and falls at 12 dB/octave below 60 Hz.

In the "Special" mode, the response is about 1 dB higher than in "Normal" mode at 300 Hz and 12 kHz, with even more boost (reaching a maximum of about 3 dB at 1.2 kHz) between those frequencies. In the "Normal" configuration, the satellite exhibits a high sensitivity, 91.9 dB, averaged from 250 Hz to 4 kHz. The sensitivity is an even hotter 93.9 dB in the satellite's "Special" configuration.

Right/left matching between the S-5000THX satellites was close. The right unit was about 1.5 dB hotter than its opposite in a narrow range between 1 and 2 kHz and was about 1 dB more sensitive between 3 and 5 kHz.

The satellite's grille is formed of black grille cloth wrapped around a space frame made mostly of metal rod, 1/8 inch thick, with some sheet metal. This frame holds the grille cloth 2 inches from the surface of the cabinet. Two diffraction-reducing pieces of foam are held in the sides of the grille. If the grille is not used, separately supplied foam pieces should be attached to the front of the cabinet to take the place of the ones attached to the grille. Measurements taken with the grille on and off revealed that the grille had minimal effect, causing changes of less than 1 dB in the response, and then only in some narrow frequency bands. For serious listening, the satellites can be used either with or without the grilles.

The acoustic crossover characteristics and interdriver phase responses of the satellite were investigated by reversing the woofer leads on both woofers and then comparing axial response curves for correct and reversed polarity. When polarity was reversed, the satellite exhibited a reduction in response covering a two-octave range centered at 1.4 kHz, with a maximum reduction of about 10 dB. These measurements indicate that the apparent crossover frequency is quite low as compared to other systems.

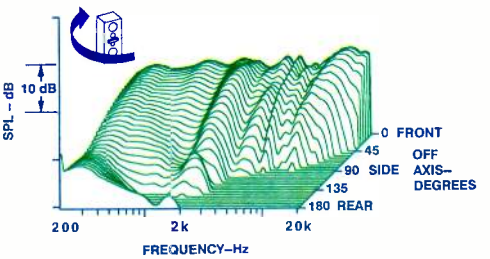

Fig. 4—Satellite horizontal off-axis frequency responses.

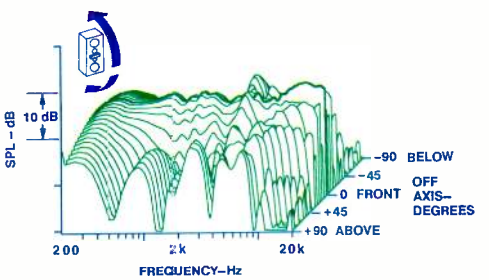

Fig. 5—Satellite vertical off-axis frequency responses.

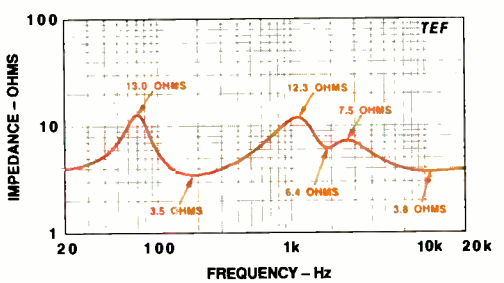

Fig. 6—Satellite impedance.

The moderate 10-dB reduction in level indicates that, when connected in correct polarity, the tweeters and woofers of the S-5000THX are somewhat out of phase through the crossover region. If these drivers were quite close in phase, the reversed-polarity level reduction would be much greater. Fortunately, this moderate phase

difference will not cause lobing (skewing of the vertical coverage in the crossover region), due to the symmetrical up/down arrangement of the satellite's drivers on the front baffle.

Set to a 125-Hz low-pass frequency, the MX-5000THX subwoofer's response reaches a maximum at 70 Hz and is 3 dB down

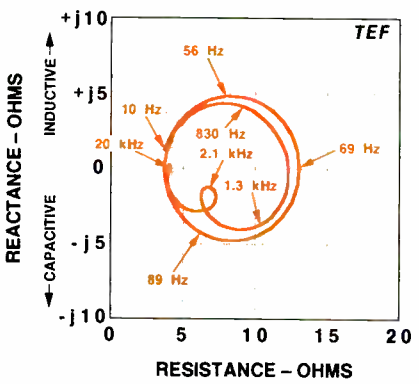

Fig. 7—Satellite complex impedance.

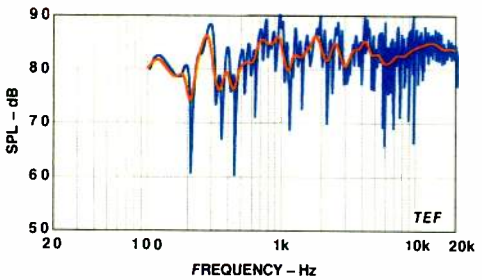

Fig. 8—Satellite 3-meter room response.

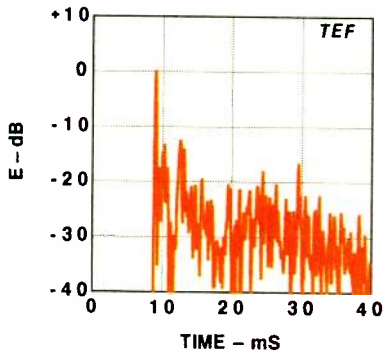

Fig. 9—Satellite energy/time response.

at about 35 and 104 Hz. Below 30 Hz, the response rolls off at about 12 dB/octave. Above 130 Hz, the response decreases very rapidly, at about 36 dB/octave. (A complete set of subwoofer response curves is shown later, in Fig. 3.)

The phase and group-delay responses of the satellite, referenced to the tweeter's arrival time, are shown in Fig. 2. The phase curve rotates only about an additional 235° above 1 kHz. Because the crossover of the S-5000THX is quite low, at about 1.5 kHz, the group delay only starts significant increases below this frequency. Remember that the group delay approximately reveals the arrival timing of different portions of the audio spectrum. A perfect speaker would have a group delay of zero at all frequencies (linear phase). This means that low and high frequencies would reach your ears at the same time. Studies have shown that midband delays on the order of 0.5 to 0.8 mS are just barely audible. Richard Heyser, *Audio*'s former senior loudspeaker reviewer, emphasized that the group delay only precisely predicts the timing of energy arrivals for an all-pass system, i.e., a system with perfectly flat frequency response at all frequencies. Speakers in general do not have perfectly flat responses, and thus some of the group-delay variations are due to the non-flatness of the frequency response.

The 1-meter energy/time response of the satellite (not shown, but see the 3-meter energy/time room curve in Fig. 9) indicated a very compact main arrival, with a peak amplitude of 92 dB SPL. The only significant later arrivals were three peaks of roughly equal amplitude, about 21 dB down, at delay times of 0.41, 0.64, and 1.05 mS behind the first arrival. These arrival delays correspond to distances of roughly 5.5, 8.6, and 14.1 inches.

Figure 3 shows subwoofer frequency responses with the rear-mounted, low-pass frequency control set to indicated values of 50, 75, 100, and 125 Hz. The maximum point on the 125-Hz response curve was normalized to 0 dB. The other curves were run by changing only the low-pass frequency setting, not the setting of the bass level control. If all the curves were normalized so that their maximum values were at 0 dB, their band-edge (–3 dB) frequencies would be as shown in Table I. The measured low-pass adjustment range was 68 to 104 Hz, a bit narrower than the stated 50 to 125 Hz.

The horizontal "3-D" off-axis responses of the S-5000THX satellite are exhibited in Fig. 4. The bold curve at the rear of the graph is the on-axis response. The horizontal off-axis curves are very uniform, with fairly broad high-frequency coverage. The horizontal uniformity of response in the ±15° main listening window is extremely good, with essentially no high-frequency roll-off up to 16 kHz.

The vertical off-axis "3-D" curves of the satellite are shown in Fig. 5. The bold curve in the center of the graph (front to rear) is on axis. The above-axis coverage is shown at the front of the graph. When I viewed the curves from the back, to see the below-axis responses (not shown), up/down coverage was very symmetrical, as would be expected.

The vertical curves clearly show much tighter vertical directivity than is usual in conventional speakers for music. Note the rapid reduction in off-axis response for angles of ±20° or greater. The vertical off-axis response, though much reduced in level, is not flat and shows considerable lobing for extreme angles. Note that the –5°, 0°, and +5° responses are quite flat. At ±10° the response is only flat to about 8 kHz but exhibits rapid roll-off and lobing at higher frequencies. At a listening distance of 10 feet (3 meters), a ±5° vertical window is approximately 21 inches (53 cm) high. This means that your ears must be within this vertical region for flat frequency response. For seated listeners (and you are, of course, normally seated when viewing entertainment in a home theater), this is not a problem.

EVEN AT EXTREMELY HIGH PEAK SOUND LEVELS, THE SATELLITES PRODUCE FAIRLY CLEAN BURST WAVESHAPES.

Figure 6 shows the satellite's impedance reaching lows of 3.5 ohms at 180 Hz (in the upper bass) and 3.8 ohms just above 10 kHz. Maximum values of about 12 to 13 ohms are exhibited at 70 Hz and 1.1 kHz.


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The 70-Hz peak marks the low-frequency closed-box resonance.

Between 20 Hz and 20 kHz, the curve has a max/min variation of about 3.7 to 1 (13 divided by 3.5). This significant variation, coupled with fairly low minimum impedance, means that the S-5000THX will be sensitive to cable resistance. Cable series resistance should be limited to a maximum of about 0.056 ohm to keep cable-drop effects from causing response peaks and dips greater than 0.1 dB. For a typical cable of about 10 feet, you should use 14-gauge (or larger), low-inductance cable.

THE TIMBRE AND SPECTRAL BALANCE OF THE M & K SYSTEMS WERE QUITE NEUTRAL.

The satellite's complex impedance, shown in Fig. 7, is well behaved and indicates no extraneous resonances. The impedance phase (not shown) reached a moderate maximum angle of +35.3° (inductive) at 48 Hz and a moderate minimum of –35.8° (capacitive) at 91 Hz. With a fairly low minimum impedance but only moderate phase angles, the S-5000THX will not be a problem for any amplifier rated at 4 ohms.

When subjected to a high-level sine-wave sweep, both satellite and subwoofer systems exhibited no significant cabinet wall vibrations. The satellite's woofers have maximum peak-to-peak excursion capability of approximately 0.35 (±0.175) inch, while the peak-to-peak excursion of the subwoofer drivers is about 0.6 (±0.3) inch. The combined equivalent cone area of the subwoofer's two 12-inch drivers almost equals the area of an 18-inch woofer.

Figure 8 shows the 3-meter room curve of the satellite, with both raw and sixth-octave smoothed responses. The satellite was in the right-hand stereo position, on the subwoofer (this raises the tweeter to a 36-inch height), and was aimed toward the main listening position; the test microphone was at ear height (36 inches), at the listener's position on the sofa. The system was driven with a swept sine-wave signal of 2.83 V rms (corresponding to 2 watts into the rated 4-ohm impedance). The direct sound and 13 mS of the room's reverberation are included.

What is immediately evident in the 3-meter room curve is the low level of "grass" or rapid up/down fluctuations in the unsmoothed curve, especially between about 700 Hz and 5 kHz. This is a direct result of the satellite's tight vertical directivity in this frequency range. The smoothed curve is well behaved—particularly above 500 Hz, where the curve fits a 6-dB window. Even though three room-related dips are evident in the response below 500 Hz, the amount of response reduction from them is quite moderate compared to other systems with less vertical directivity.

To investigate more fully the effects of the THX-specified restricted vertical coverage, I took 3-meter energy/time response measurements at the listening position for the M & K satellite (Fig. 9). The test parameters accentuate the response from 1 to 10 kHz, mostly the tweeter output. What is immediately apparent is the unusually low room response in the S-5000THX's energy/time plot. The first two peaks after the direct sound, which are the floor and ceiling reflections, respectively, are about 6 to 8 dB lower than in comparable, non-THX systems!

The sound from THX systems will be significantly less affected by the room than that from ordinary loudspeakers. This is, of course, exactly what is desired for the front channels in a home theater system, which must reproduce such critical material as dialog. In a home theater setup, room and environmental effects are specifically reserved for the surround speakers.

Satellite bass harmonic distortion was measured for the musical notes of A_2 (110 Hz) and A_4 (440 Hz), with an input power of 100 watts (20 V rms into a 4-ohm load). These measurements are not shown. At 110 Hz, distortion reached a moderate 8.8% second harmonic and 3% third harmonic; higher harmonics were only 1% or less. At 440 Hz, distortion was very low, with second harmonic at 0.5% and all higher harmonics below the noise level of my measuring gear.

Figures 10, 11, and 12 show bass harmonic distortion versus input level for the MX-5000THX subwoofer, at test frequencies of 32.7, 41.2, and 61.7 Hz (which correspond to the musical notes C_1, E_1, and B_1, respectively). The maximum input level to the woofers was set at 30 V rms, as measured across the bottom woofer.

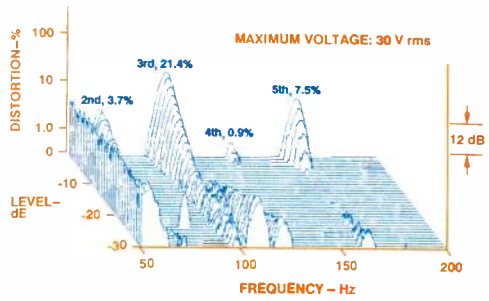


Fig. 10—Subwoofer harmonic distortion for C_1 (32.7 Hz).

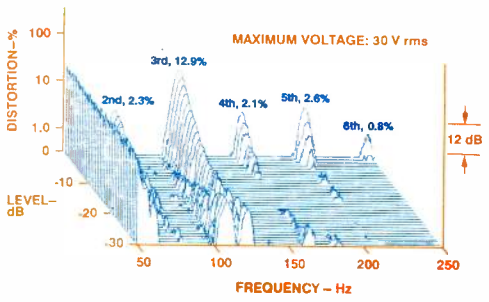


Fig. 11—Harmonic distortion for E_1 (41.2 Hz).

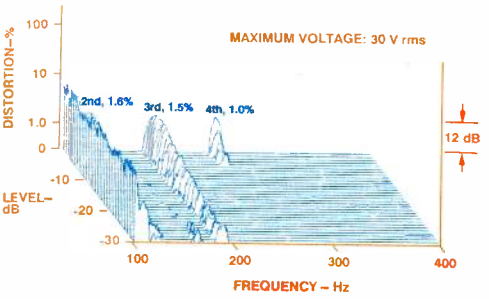
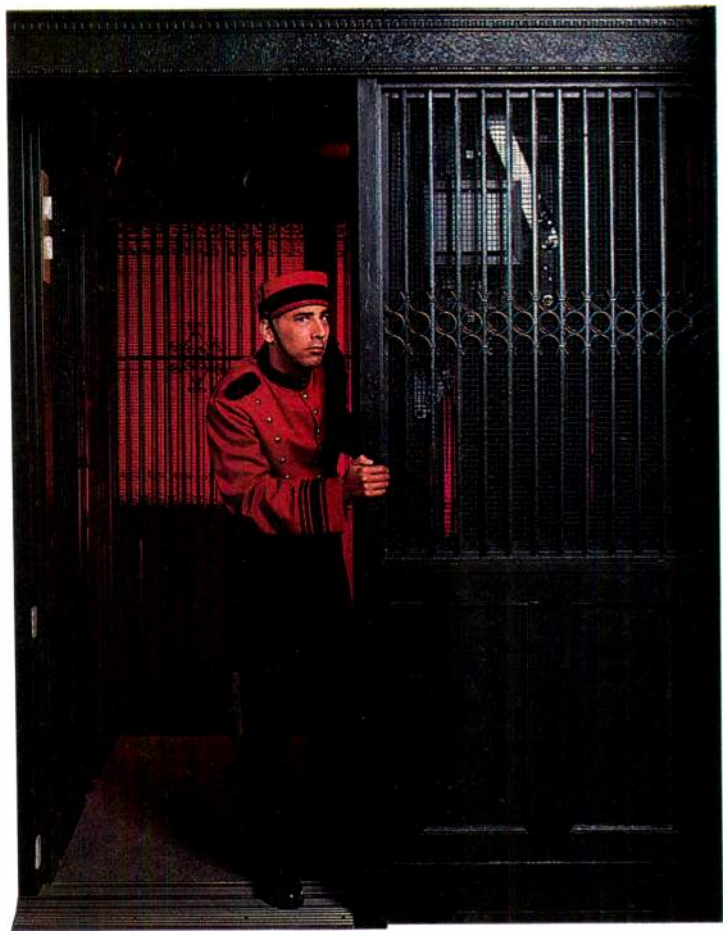


Fig. 12—Harmonic distortion for B_1 (61.7 Hz).

Measurements of drive voltage to the woofer indicated that the internal power amplifiers are set to limit at about 32 to 36 V rms, depending on frequency. At this



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limit, higher amplifier drive inputs do not result in higher voltage to the woofers or increased distortion or clipping of the signal applied to the woofers. A woofer drive level of 30 V rms corresponds to a total power of about 225 watts into 4 ohms or 300 watts into 3 ohms (150 watts into each driver); the actual power depends on the drivers' impedance, which I did not

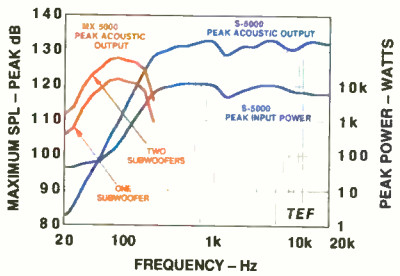


Fig. 13—Maximum peak input power and sound output.

measure. The drivers' input voltage level was increased in 1-dB steps over the range from 0.95 to 30 V rms, a 30-dB range. Levels are indicated on the left of each graph, with –30 dB equal to 0.95 V rms and 0 dB equal to 30 V rms. Measurements were taken on the ground plane, with the subwoofer on its side and the microphone placed 0.25 meter in front of the rectangular opening. This location was approximately equidistant from each driver.

A frequency response measurement of woofer drive voltage (not shown) at a low-pass setting of 125 Hz revealed that it rose at 12 dB/octave from very low frequencies, reached a maximum at 25 Hz, fell at about 6 dB/octave to 125 Hz, and then rolled off rapidly at 36 dB/octave. With the bass level control at maximum, and at an input frequency in the middle of the subwoofer's passband, the MX-5000THX is quite sensitive; it required only 50 mV or less at the line inputs to drive it to full output.

The C_1 (32.7-Hz) bass harmonic distortion is shown in Fig. 10. The second and fourth harmonics are quite low, at 3.7% and 0.9%, respectively. However, the third and fifth harmonics are significantly higher, at 21.4% and 7.5%. Even though the distortion was quite high, the sound was not subjectively harsh. At this level in my lab, everything loose in the room was vibrating, including the doors and my filing cabinets!

Figure 11 shows the E_1 (41.2-Hz) bass harmonic distortion. The second, fourth, and sixth harmonics are quite low, at 2.3%, 2.1%, and 0.8%, respectively. The odd harmonics are higher, at 12.9% and 2.6%.

The B_1 (61.2-Hz) bass harmonic distortion is shown in Fig. 12. The harmonic distortion levels at this frequency are all quite low, with second at 1.6%, third at 1.5%, and fourth at 1%. At these three frequencies and maximum power levels, the subwoofer generates very loud and fairly clean bass!

The short-term peak-power input of the satellite, and the maximum output of the satellite and subwoofer, are shown in Fig. 13. The peak input power assumes that the measured peak voltage was applied across the satellite's rated 4-ohm impedance. Peak outputs of the subwoofer were measured at 0.5 meter on the ground plane and then referenced to 1 meter in free field. The maximum subwoofer SPL curves include correction for typical room gain—8 dB at 20 Hz, 4.5 dB at 50 Hz, and 2 dB at 100 Hz.

The peak input power of the satellite starts strongly, at 42 watts at 20 Hz, rises slightly to 70 watts at 50 Hz, and then rises rapidly above 300 Hz to the 10,000-watt range (±200 V peak)! At higher frequencies, a reduction to about 5,000 watts at crossover and 6,000 watts above 10 kHz is noted. These are very respectable numbers! (Believe it or not, 99% of the systems I've tested suffer no ill effects from these seemingly brutal peak power levels.)

The satellite's peak acoustic output rises very rapidly, from about 82 dB SPL at 20 Hz up into the 130-dB range above 200 Hz. Very loud! Even at these extremely high peak sound levels, the S-5000THX produced fairly clean burst waveshapes, as observed on the oscilloscope. However, the speaker's peak SPL capabilities in home listening situations will depend on the amplifier power available to drive it, probably less than I get from the bridged-mono Crown Macro Reference I use for these tests.

The peak acoustic output of the MX-5000THX has been plotted for both one- and two-subwoofer setups. If two subwoofers are used, they must be located close together for the indicated 6-dB increase to occur. If they're separated, the output increase will be less. For these tests, the low-pass filter was set to 125 Hz, and the input bass level control was set at its maximum.

For a single subwoofer, the peak output starts strongly, at 106 dB at 20 Hz, rises to 113 dB at 32 Hz, hits 117 dB at 40 Hz, and reaches a maximum of 122 dB at 80 Hz. At higher frequencies, the maximum output falls, reaching 110 dB at 200 Hz. At 50 Hz and above, maximum output was limited by the internal electronics and amplifier modules. Below 50 Hz, the output was limited by the excursion capability of the woofers.

THE M & Ks TOOK EVERYTHING I COULD THROW AT THEM, MORE THAN MY EARS COULD HANDLE.

If the maximum output of a single MX-5000THX subwoofer is compared to that of the subwoofers I evaluated in the November 1992 issue, the M & K comes out at or near the top. Between 40 and 160 Hz, its maximum output equals or exceeds that of all the woofers measured earlier. Below 40 Hz, the M & K's maximum output exceeds all the previously tested models except one. Although the MX-5000THX has higher peak output than the previously measured Velodyne F-1500, its distortion is much higher (or looking at it the other way, the Velodyne's distortion level was uncommonly low).

Use and Listening Tests

The M & K satellite/subwoofer system was significantly more complicated to set up than a conventional all-in-one speaker.

The additional freedom of having separate woofers is both a help and a hindrance. It's a help being able to locate the subwoofers separately from the satellites to optimize the response and smoothness of the bass, but it's a hindrance having to hook the whole darn thing up and find that additional optimum location!

The operating manuals for the satellite and subwoofer are very detailed and useful. The 10-page satellite manual extensively covers placement, hookup, phasing, biamplification, control settings, THX and non-THX operation, and avoiding speaker damage. There's an excellent general exposition on home theater audio, with specific emphasis on THX setups. The subwoofer manual, although printed on smaller pages, is even more extensive, running 20 pages! Because of the versatility of the subwoofer and its application in many different types of setups, the manual needs to be this long. In the THX mode of operation, all the subwoofer settings are fixed (gain, low-pass frequency, etc.); you only have to select whether you have one or two subwoofers. In the normal mode, which I used, all the settings can be adjusted to match your system needs. The manual goes into detail about describing what I call the reciprocity method of determining where to place a subwoofer. Using this method, you place the subwoofer at your listening position, and then walk around with bass material playing and determine where the bass sound is best. You then locate the subwoofer there and listen from your normal location. Beats moving the subwoofer around!

IT'S GREAT FUN TO HAVE SYSTEMS THAT CAN PLAY LOUD AND CLEAN IN THE BASS!

Although I did some listening with the subwoofers located in other parts of the room (not near the satellites but near the rear of the room and closer to corners, etc.), most of my listening was done with them located under the satellites themselves, with the systems in my usual listening positions. This placed them significantly away from the rear and side walls of the room, about 8 feet apart, and with the satellites aimed in towards my position at the couch.

My listening equipment consisted of the Krell KRC preamp and KSA-250 power amp, driving the S-5000THX's satellites through Straight Wire Maestro cabling. My reference speakers were the B & W 801 Matrix Series 3 speakers, while Onkyo and Rotel CD players provided source material.

Even though M & K supplied its LP-1S high-pass filter, I was not able to use it in my setup. The filter needs to be placed between the preamp and amplifier, to high-pass the satellites, while simultaneously providing a flat line-level feed to the powered subwoofers. My preamp-to-amp connections are balanced XLR, which prevented me from using the RCA unbalanced connections on the filter. The 15-kilohm input impedance of my amps was also lower than recommended for the passive filter. Operation of the filter in the preamp's tape loop was also not possible, due to impedance mismatch.

I used the same setup as in the 1992 subwoofer shootout. This included a 125-Hz, first-order, high-pass filter in the preamp's tape loop. A corresponding RC passive inverse filter drove the subwoofers, undoing the effect of the satellites' high-pass filter and thus providing a flat drive for the subwoofers (at least down to 10 Hz). This filter was then driven by the speaker-level satellite drive. My setup automatically switches the subwoofer on and off when the satellite is selected by the A/B speaker switcher box. The tape monitor also has to be switched in and out when the M & K system is selected (which is easy with the Krell KRC's remote).

First listening was done with the *For Duke* big-band CD (M & K RealTime RT1001), which M & K had supplied to me. This disc demonstrated the very wide dynamic range of the satellites and subwoofers and this system's ability to play loud and cleanly in all frequency bands. The reproduction of the trumpet on "Take the 'A' Train" was extremely realistic, with a very up-front and close-in sound.

The restricted vertical coverage of the satellites was immediately evident when compared to the sound of my B & W reference speakers. No matter what I played, the

sound was always relatively dry and analytic compared to the references. On orchestral selections such as Mozart's Piano Concerto No. 19, Symphony No. 29 (Perpetua Records PR 7013, another disc supplied by M & K), the M & K system would transport me from a mid-hall listening location to a front-and-center location, whether I wanted to be there or not! This was quite desirable on some material and not on other material.

When I attend live concerts, I prefer close rather than distant seats. Therefore, the M & Ks' up-front character was mostly quite pleasing; this is a matter of personal preference. Notwithstanding this up-front character, the timbre and spectral balance of the M & Ks were quite neutral.

TABLE I—*Normalized band-edge (–3 dB) frequencies for different settings of the MX-5000THX subwoofer.*

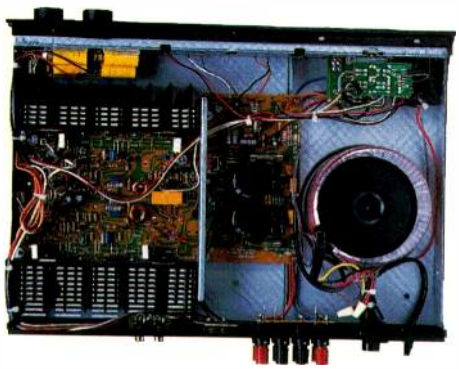
Low-Pass Setting	–3 dB Points	
	Lower	Upper
125 Hz	34.6 Hz	103.7 Hz
100 Hz	34.0 Hz	84.9 Hz
75 Hz	30.7 Hz	77.5 Hz
50 Hz	28.7 Hz	68.3 Hz

The M & Ks' restricted vertical coverage does, however, improve their imaging capabilities. This was evident on the LEDR test sequences on the ProSonus Studio Reference Disc (ProSonus SRD); the M & Ks did significantly better than my references on the up-and-over test. Remember that most recording studio monitors are set up

Continued on page 66

EQUIPMENT PROFILE

AUDIOSOURCE AMP ONE



The Amp One started out as a very affordable amplifier that delivered 60 watts or more per channel, but AudioSource has recently upgraded it from 60 to 80 watts per channel in stereo and from 170 to 200 watts in the bridged, or mono, mode. (The owner's manual supplied with my sample, however, still had the old specs.) So this amp, which was so affordable to start with, has now become an even better value.

A low-profile, high-output toroidal power transformer helps the Amp One to achieve its compact layout while delivering high current, even to low-impedance loads. Soft-clipping circuitry can be switched in to prevent audible distortion if the amplifier is momentarily driven beyond its power output capability.

An unusual feature for a power amp, the Amp One provides two pairs of inputs, each with a different sensitivity. The amp can be used either with a preamp connected to its "Line In" jacks or with a high-output digital source connected to the less-sensitive "CD In" jacks. (No input switching is provided.) In addition, the unit has front-panel level controls in case a directly connected CD player lacks controls for its output level.

Control Layout

At the lower left of the panel is a tiny red "Power" button. Nearby is a pair of buttons for speaker selection, with red LEDs to indicate which sets of speakers have been activated. Above the speaker selectors are a "Meter X0.1" button (which increases the sensitivity of the analog power output meters) and a "Soft Clip" button (which activates circuitry to minimize overload distortion or the potential of damage to speakers caused by amplifier overload when playing at high volume levels). As with the speaker selectors, a red LED indicates when the "Soft Clip" circuit is activated. A headphone jack is to the right of the speaker selectors.

Twin analog output level meters glow softly when the amplifier is first turned on. After several seconds, the meters become brightly lit, indicating that the Amp One's protection circuitry and power supply are fully stabilized. The meters then provide a constant readout of average power output in watts (referred to 8-ohm loads) for each channel and in dB (still calibrated for 0 dB at 60 watts, in my sample).

The two input level controls, at the extreme right, would normally be set to their maximum positions, for maximum input sensitivity. But when a CD player is connected to the Amp One, they can be used as volume controls. Since each channel has its own control, they can also be used for channel balancing if a program source provides unequal signal amplitudes for the left and right channels.

The rear panel of the Amp One carries the "Line" and "CD" inputs. A slightly recessed mono "Bridging" switch is just to the right. For bridged operation, the right-channel input must be used (instead of the more usual left input), and the speaker load must be connected between the two positive (red) binding posts of either the "A" or "B" speaker terminals. Color-coded speaker terminals at the far right complete the layout.

I CAN'T THINK OF ANOTHER HIGH-QUALITY AMP THAT DELIVERS SO MUCH FOR SUCH A LOW PRICE.

Measurements

The frequency response of the Amp One from 20 Hz to 20 kHz is shown in Fig. 1. The response is virtually ruler flat, with no more than 0.15 dB of attenuation at 20 kHz.

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Audio, Feb. 1993

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Figure 2 shows how THD + N varies with signal frequency. Even if you take into account the noise contribution, these results confirm AudioSource's claim for the upgraded version: With output regulated at a constant 80 watts per channel for all test frequencies, THD + N remains just under 0.04% from 20 Hz to 20 kHz. In the bridged mode, with output at a constant 200 watts, THD + N is about 0.045%. That's a bit higher than the spec, but I can hardly fault the amp on this score.

Figure 3 is a plot of THD + N versus power for test frequencies of 1 kHz, 20 Hz, and 20 kHz; note the close match of the three curves. For all of these frequencies, clipping occurs at approximately 80 watts per channel or just a bit higher. These tests were done with "Soft Clip" deactivated.

To separate actual harmonic distortion components from residual noise, I used FFT spectrum analysis, applying a constant 1-kHz test signal and adjusting the output of the amplifier to exactly 80 watts per channel with both channels driving 8-ohm loads (Fig. 4). The major distortion component is the second harmonic (at 2 kHz), 70 dB below reference level. This corresponds to a THD percentage of 0.0316%, well within the manufacturer's spec of 0.04%.

Figure 5 is a plot of SMPTE-IM distortion versus power output for 8-ohm loads. Clipping does not occur until an output level equivalent to nearly 90 watts per channel is reached. However, even at levels well below clipping, SMPTE IM measures between 0.1% and 0.2%, as against the spec of 0.04%.

Figure 6 is similar to Fig. 3 but is for bridged mono mode. Clipping occurs at just over 200 watts for a 1-kHz signal and just below this level at 20 Hz. At 20 kHz, the clipping point is slightly lower, around 186 watts.

Since this amplifier has input level controls, it was possible to measure its signal-to-noise ratio in accordance with EIA Standards. These require that the input signal level be adjusted to 500 mV and that the level controls be adjusted to produce a 1-watt output into 8-ohm loads. Under these conditions, A-weighted S/N was 91.66 dB for the left channel and 91.83 dB for the right. These are excellent results for any amplifier. AudioSource chose to quote the Amp One's S/N ratio relative to rated output (and presumably with level controls set to maximum), so I also measured S/N using that method. My readings of 114.32 dB for the left channel and 114.40 dB for the right channel easily bettered the manufacturer's claim of 110 dB.

The frequency distribution of the Amp One's residual noise is shown in Fig. 7. Even the 60-Hz a.c. frequency component, which usually dominates such graphs, is more than 100 dB below reference level in stereo mode and nearly 110 dB down in bridged mode. This attests to the amp's excellent layout and design.

Sensitivity of the line-level input was almost exactly 0.8 V for

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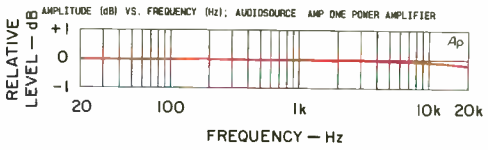

Fig. 1—Frequency response.

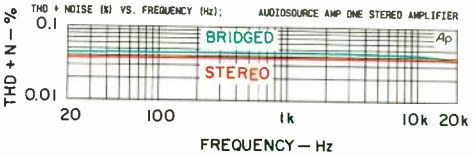

Fig. 2—THD + N vs. frequency.

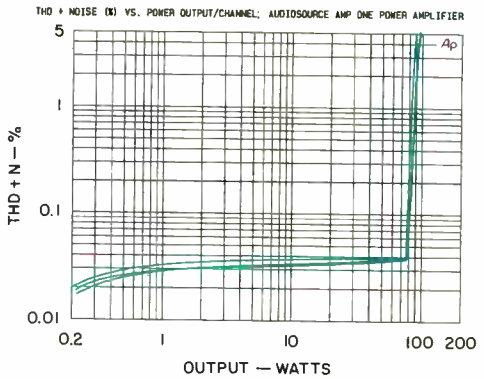

Fig. 3—THD + N vs. power output per channel, for three test frequencies.

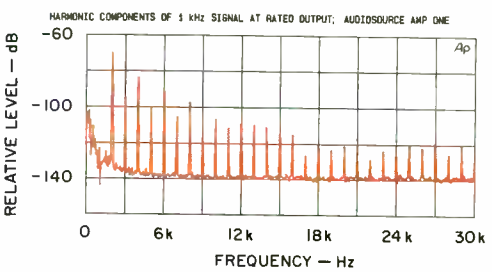

Fig. 4—Spectrum analysis of 1-kHz signal at rated output.

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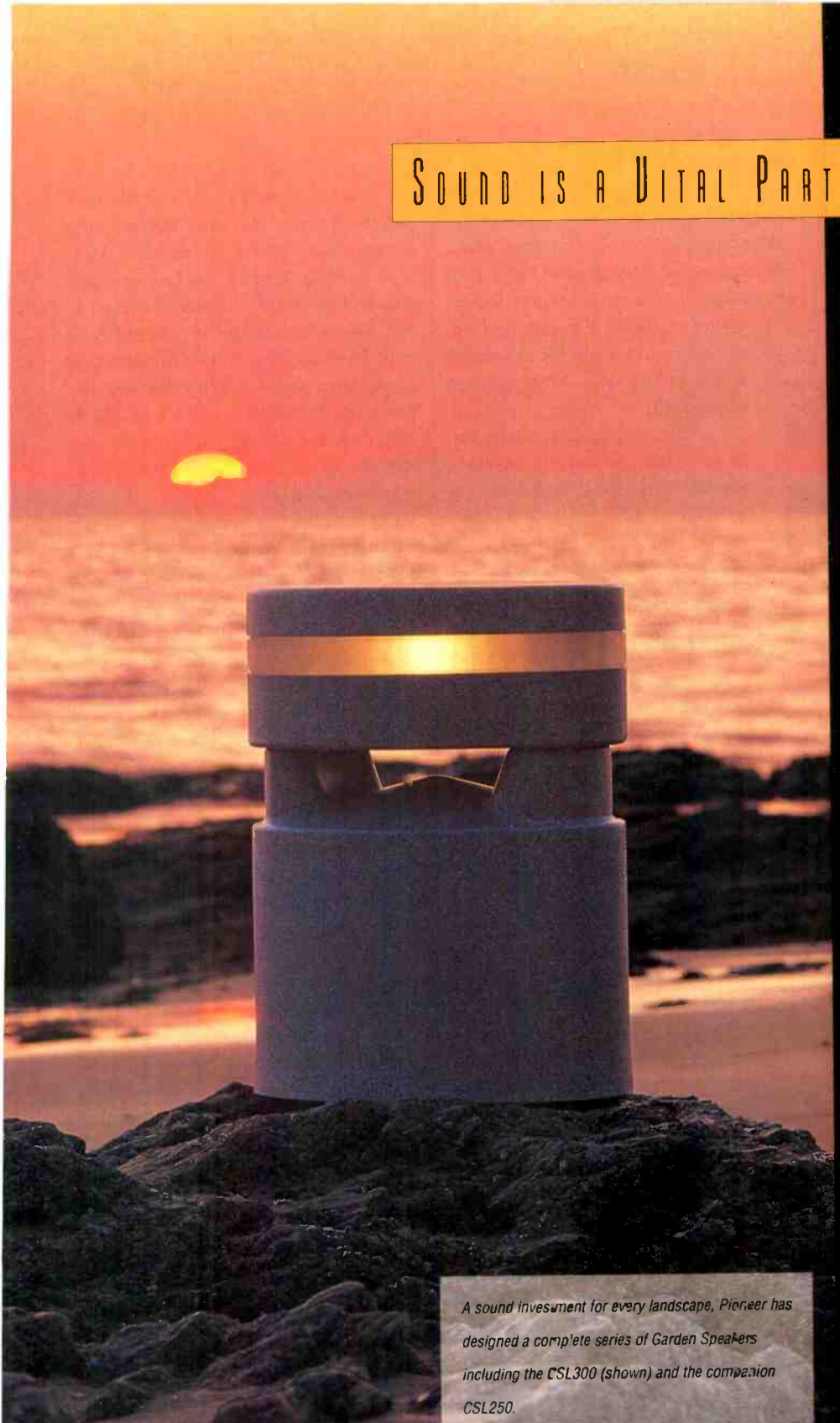

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rated output, as claimed, while the "CD" input required just over the specified 1.3 V to produce rated output. Damping factor was greater than 100, referred to 8-ohm loads.

Dynamic headroom, using 1-kHz pulses of short duration (20 mS) followed by 480 mS of "no-signal" condition, measured almost exactly 2.0 dB, as claimed. This suggests that, with most music, short power peaks of nearly 130 watts per channel could be handled without noticeable clipping, even if "Soft Clip" is not activated.

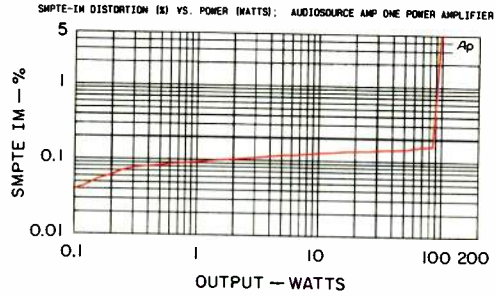

Fig. 5—SMPTE-IM distortion vs. power output, for 8-ohm loads.

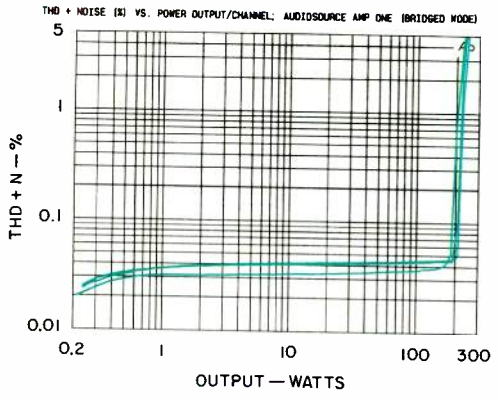

Fig. 6—THD + N vs. power output in bridged mode for three test frequencies; bottom curve is for 20 kHz.

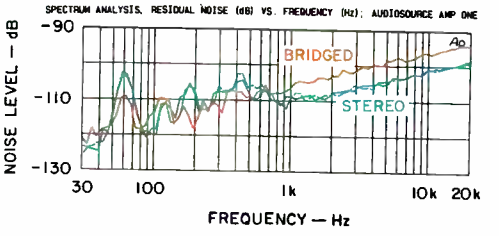

Fig. 7—Spectrum analysis of residual noise.

Use and Listening Tests

Hooking up the Amp One took only a few minutes and was simplified by the clear wiring diagrams in the brief but adequate owner's manual. I would urge AudioSource to update the manual to reflect the upgraded performance of the amplifier.

For my listening tests, I substituted the Amp One for my reference amplifier and fed it both from my reference preamp (using the line-level inputs) and directly from a CD player. My KEF Model 105 Mk.II reference loudspeakers are not noted for high efficiency, yet the Amp One was able to drive them to more than adequate listening levels without any evidence of overload or clipping.

I used several of my favorite CDs as program sources, including the musical selections found on the third disc of the Denon Professional Test CDs that I reviewed in the January 1994 issue. I was particularly impressed when I compared the sound quality with the CD player connected through the preamp and with it connected directly to the Amp One. If you can possibly use this direct connection (with the Amp One dedicated to one source), by all means do so. The sound was tighter and more controlled when I used this approach. The difference was subtle, to be sure, and apparent only when I quickly switched from one connection mode to the other, but it was definitely there!

Perhaps the most impressive aspect of the AudioSource Amp One is its value. I can't think of another high-quality power amplifier that delivers this level of power and performance at such a low price. Whoever said that high-end audio components must be synonymous with high price had better take a good look at this U.S.-manufactured little amplifier from AudioSource!

Leonard Feldman

M & K, *continued from page 61*

to emphasize the direct sound in the same manner as the M & Ks.

I had much fun with the M & Ks' loud and clean capabilities, their effortlessness, and the vast quantities of clean bass they can generate. I had to get out all my standard test CDs for bass (including organ, concert bass drum, and sound effects) to fully exercise the subwoofers. The M & Ks essentially took everything I could throw at them. I even played rock 'n' roll at live concert levels, including the bass (102 dB, A-weighted, and 112 dB, C-weighted), but only for about 30 seconds, which was all my ears could take!

On the pink-noise stand-up/sit-down test, the M & K satellites presented a very different sonic picture to standing listeners than to seated ones. The main effect was a significant reduction in perceived level when standing. Fortunately, the spectral balance did not change drastically at the standing position; only the mid and high levels were reduced. It was very evident, however, on both pink noise and music, that you must be seated to listen to these systems properly.

On third-octave, band-limited pink noise, with both subwoofers operating, the M & Ks could walk all over the B & Ws in clean, low-bass output. At 20, 25, and 32 Hz, the B & Ws suffered from much port wind noise when played at high level. The M & K subwoofers could play louder and cleaner at all these frequencies.

It's great fun to have systems that can play this loud and clean in the bass! It's also nice to have independent control of bass level. My son loved playing a rap single, Jazzy Jeff & Fresh Prince's club version of "Boom! Shake the Room" (Jive 01241-42107-2), and the M & Ks did too!

Material actually intended for theatrical playback, such as the "Jaws" theme from *The Spielberg/Williams Collaboration* (Sony Masterworks SK 45997, a super CD!), sounded exceptional on the M & Ks, much better than I remember it in the theater.

If you prefer an up-front, rather dry and analytic sound, and extremely good performance, particularly in the bass, this system is for you. If you also have a home theater and need very high-performance speakers, the M & K system is one of the best. I recommend it.

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VMPS FF-1 SPEAKER

VMPS is a company with a distinctive personality: Brian Cheney. Brian Cheney loves bass, but not just any bass. He loves deep, deep bass. He loves bass power, and he loves bass detail and control. As a result, VMPS has become somewhat famous in the audiophile community for offering the best bass per buck of any loudspeaker manufacturer around. If you really want to hear subwoofer bass at moderate prices, bass that is properly integrated with the midrange and treble, and bass that provides musicality instead of boominess, VMPS is a key place to look.

The FF-1 Focused Field Array speaker, however, is a major departure for both Cheney and VMPS. The FF-1 is not an attempt to provide outstanding bass at a reasonable price; rather, it is an assault on the state of the art. It sells for $6,800 a pair, it is 68 inches high, and it weighs 350 pounds. It is intended as a speaker for audiophiles seeking to test the limits of their systems.

The VMPS FF-1 may embody the most determined effort to control cabinet vibration of any speaker system to date. The front baffle is made of 3-inch medium-density fiberboard. It uses four large H-braces and a heavy damping compound called Soundcoat. This is a ceramic plate-damping compound originally invented to control low-frequency sounds like those in marine engine rooms. The end result is the most inert speaker I've ever encountered.

The driver array includes a 12-inch, slot-loaded, down-firing passive radiator to provide sub-bass. It is mass-loaded and has user-adjustable damping. The low bass comes from two 12-inch woofers with carbon-filled polypropylene cones, butyl surrounds, damped baskets, and 3-inch phase plugs. The VMPS FF-1 is the first loudspeaker I know of to use phase plugs on its low-frequency drivers since Lowther, a British manufacturer, used them in the early 1960s. Phase plugs can sharply reduce the amount of midrange information and distortion produced by the dust cap at the center of the speaker, and can improve focus and clarity. Their disadvantages are that you need an airtight spider, which is hard to make, and this raises manufacturing costs.

The rest of the drivers in the VMPS FF-1 include dual 5¼-inch midranges with cones made of woven carbon fiber and surrounds of

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This vertically symmetrical driver array controls imaging and dispersion.

butyl rubber; these also have phase plugs. There are dual 1-inch soft-dome tweeters and a single leaf-type ribbon supertweeter. The passive radiator, woofers, and midranges are all made by VMPS; the soft-dome tweeters are Morel MST33s, while the ribbon supertweeter is a Philips design.

All of these drivers are laid out in a fully symmetrical array. This array, centered 39 inches above the floor, has a number of advantages. First, it provides a precise apparent-point-source image. The height of the array minimizes interaction problems with carpeting and furniture, and slightly elevates the soundstage perspective for a seated listener. While driver height may seem like a minor detail, it is one I find to be of critical importance when considering a speaker in a real-world listening room. Many floor-standing speakers, and most smaller speakers on manufacturer-supplied stands, are in my opinion simply too low to produce best results.

The FF-1 uses an outboard crossover. Cheney feels that crossover parts are microphonic and that using an external crossover has a major impact in improving sonic purity. The FF-1's crossover uses top-quality components, including Wondercap/MIT multicaps, bobbin-less "perfect lay" coils, and solid-core midrange and treble wiring (both inside and outside the crossover) that is silver-plated and insulated with Teflon. The basic design of the crossover is a quasi-second-order filter with slopes of 6 and 12 dB. Unlike most systems in this price range, this crossover design allows the FF-1 to be driven by one amplifier and cable per channel. It can, however, be biamped as well as bi-wired.

The VMPS FF-1 has an unusually large number of user adjustments. You can alter bass energy by mass-damping the passive radiator. You can electronically adjust the separate midrange, treble, and supertweeter controls on the outboard crossover. This flexibility does have a potential disadvantage, in that a "bad" ear can make major adjustments that are musically unnatural. Fortunately, the manufacturer's recommended settings are clearly marked on the crossover. On the other hand, a "good" ear can make minor adjustments that compensate for most interaction problems in the listening room and for legitimate differences in musical taste.

Few designers are more accessible by telephone than Brian Cheney. You can thus count on a good starting point in setting up the FF-1, receiving help in locating the speaker and on how to damp the bass to get the best response in your particular listening room. This assistance can be vital with any speaker that really probes the depth of the deep bass. Problems with standing waves and room interaction increase exponentially as you enter the deep bass, so you need to work hard to get the best such a speaker can deliver.

With proper adjustment and placement, the VMPS FF-1 is capable of remarkably natural, almost holographic sound. It provides a smooth and natural timbre from top to bottom, and has an exceptional soundstage. The true quality of the FF-1 is only clear, however, when you analyze its sound character in detail.

I know of no speaker under $10,000—and few above $10,000—that can equal the FF-1's ability to provide every possible bit of bass detail and energy in the music. You can hear *all* the bass, and you can get an astounding emotional and musical impact out of bass spectaculars. I realize that the FF-1 cannot possibly go down to d.c., but it can certainly reproduce everything else. Yet there is no bass overhang or loss of detail. There is a tight transition from the low bass through the mid-bass to the midrange. This transition is a bit warmer than usual—regardless of how the crossover is set—but it complements the lack of warmth in many CDs, and the bass does not overwhelm the midrange in any way.

The midrange is fast and detailed. Some slight frequency colorations were apparent in my listening room, but none significantly affected instruments or voice. The midrange has exceptional speed and life without sacrificing low-level resolution, detail, or air. I have reviewed a number of speakers over the years that are capable of superb bass and dynamics but which lack midrange subtlety and have to be played loudly to perform at their best. The FF-1

VMPS IS FAMOUS AMONG AUDIOPHILES FOR OFFERING THE BEST BASS FOR THE BUCK.

does as well in reproducing the softest midrange details as well as the loudest, and no shifts in timbre or transparency take place as the signal level rises.

At this point I come to a difference in taste between designer and reviewer. The argument over what response is "flat" in loudspeakers is an old one and familiar to most readers of *Audio*. Cheney prefers less treble and upper midrange energy than I do, and he also prefers more energy in the deep bass. I found myself turning up the midrange controls, adding notably more upper octave energy than Cheney prefers, and damping the deep bass slightly to avoid any masking of the upper octaves. Even with these adjustments, the FF-1 never produced the amount of upper octave energy that I hear from loudspeakers like the B & W 801 Matrix Series 3 or Thiel CS-5. As a result, I suspect that the upper octaves of the FF-1 may sound slightly rolled off to some audiophiles but sound natural to others.

I had no problem at all, however, in getting the FF-1 to provide a musically natural

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balance of upper octave energy at my listening position, and in getting an overall timbre of solo instruments and voice with a natural concert-hall sound. The treble was detailed and sweet even before I made adjustments. The FF-1 did a particularly good job of reproducing solo tenor and soprano voice, and such sounds as triangle or bell.

There is little I can say about this speaker's dynamics except that they are superb. The VMPS FF-1 handles dynamic changes at every level from the softest notes to the loudest peaks of orchestral music and rock concerts. The FF-1 can handle anything from solo piano to grand opera without a hint of compression. I could not find a limit to the FF-1's dynamics remotely relevant to listening to music, and if there is such a limit, it will have to be determined by someone else, someone who likes having his ears bleed.

The transparency of the VMPS FF-1 is very good. It may not match the fastest and most detailed full-range ribbon speakers, but it does an excellent job of resolving musical detail. This came through quite clearly with massed organ voices, my recordings of Mahler's Eighth Symphony, and a variety of chamber music. The FF-1 does a solid, accurate job of reproducing musical nuance, and it is one of the few speakers that can do this both with very soft passages and with the most demanding crescendos.

The FF-1's soundstage—by itself—is good enough to justify a journey to a dealer just to hear this one aspect of its performance. The FF-1 does not add anything to a recording. If the soundstage isn't on the record or CD, you won't hear it through this speaker. Yet if you are listening to a recording that has a lot of natural soundstage data, you will get outstanding imaging, a wide left-to-right soundstage, and a great deal of natural depth and sense of being in the hall. The FF-1s do a great job of reproducing the Dorian recordings made in the Troy Music Hall, my old recordings of chamber music made on the Accent label, and the best Proprius recordings. They give you a real sense of being there. The imaging is relatively wide and stable across a wide range of listening positions. At the same time, the FF-1s are focused enough to minimize reflections from the side walls, ceiling, and floor.

When you buy a reference monitor of this quality, you do not invest in an ordinary box. You invest in a design that provides unique sound qualities which reflect the manufacturer's taste. The VMPS FF-1 very definitely reflects Brian Cheney's taste, and I would suggest that you carefully listen to its balance of upper octave energy and detail.

Few speakers at any price provide the combination of sound qualities available in the FF-1. I do not know of any speaker that does not rely on separate subwoofers or woofer towers that can match the FF-1's bass performance; only a handful of speakers of any kind rival the FF-1 in this respect. The FF-1 is a speaker that deserves great respect. It does not favor one kind of music over another or make trade-offs that emphasize one aspect of sound quality. If your goal in shaping your system is to feel you have walked into the middle of a concert hall, the VMPS FF-1 will take you there about as convincingly as any speaker available. *Anthony H. Cordesman*

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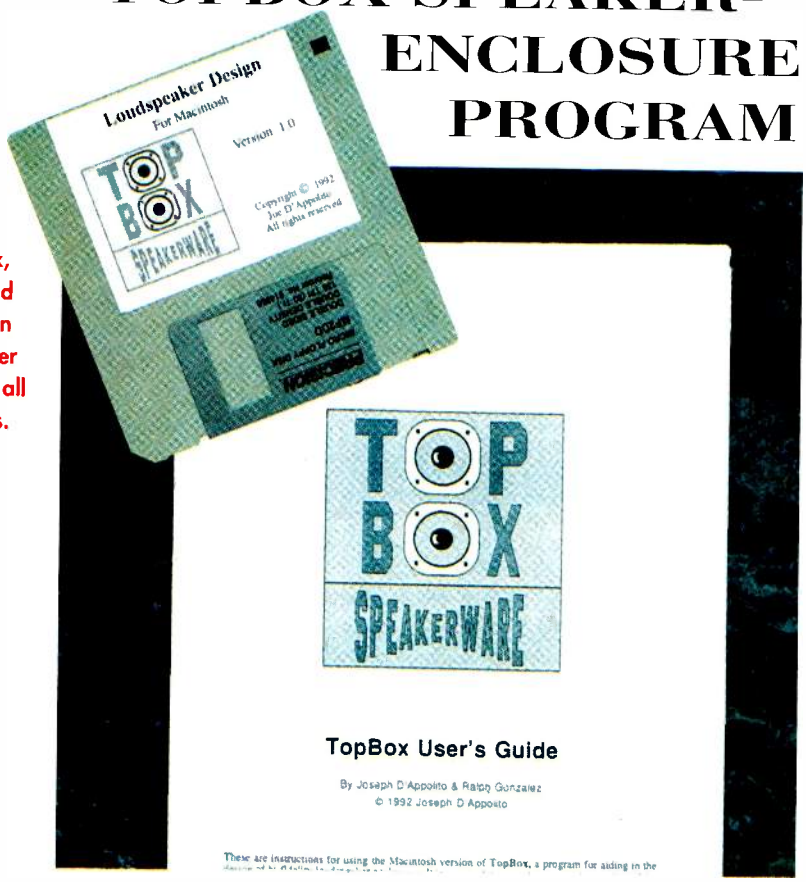

There was a time when loudspeaker box design was regarded as a little-understood black art whose primary tool was time-consuming trial and error. This was true not only for amateur speaker builders but for professional design engineers as well. However, as the mathematics of this complex electroacoustic system became more and more detailed (through the published works of Olson, Beranek, Novak, Thiele, Benson, Small, and others), the possibility of accurately designing speakers through computer simulation became a reality. As a result of this and the proliferation of home computers, the last four years has seen a burgeoning number of computer-simulation programs for loudspeaker enclosure or crossover design; at last count, I have reviewed more than 20 loudspeaker-related programs in *Voice Coil*, a newsletter for loudspeaker manufacturers. These programs range in price from as little as $50 to over $1,000, bringing them well within the reach of the casual experimenter and giving access to this powerful design technique to anyone who knows how to use a computer.

TopBox, distributed by Orca Design and Manufacturing, is a good example of a powerful, easy-to-use, and moderately priced enclosure-design program. It was written by Joe D'Appolito, Ron Warren, and Ralph Gonzalez. D'Appolito, a well-known engineer, has presented numerous papers at Audio Engineering Society Conventions, is a contributing editor for *Speaker Builder* magazine, and is responsible for several commercial loudspeaker designs (including models for Swans Speaker Systems and Orca's Aria series). He is, however, best known as the first loudspeaker engineer to formally describe in a public forum the currently popular loudspeaker baffle layout (usually referred to as the D'Appolito configuration) which places the tweeter between two woofers or midrange drivers [1]. Working from D'Appolito's program outline, Ron Warren wrote the software for the DOS version of TopBox, and Ralph Gonzalez coded the program for the Apple Macintosh.

Both the DOS and Macintosh versions of TopBox perform the same calculations and produce virtually the same results. The differences are primarily in the screen layout; the DOS version uses a series of dialog-box menus, while the Macintosh version uses Apple's familiar "window" format with pull-down menus. To operate the DOS version, you need a PC or compatible with at least a 286 processor and an EGA or VGA graphics card. The Macintosh disk includes a version that will run on any Macintosh with at least 512 kilobytes of RAM, plus a version that runs faster but requires a Macintosh IIci or higher.

TOPBOX IS A POWERFUL, EASY-TO-USE, AND MODERATELY PRICED PROGRAM.

TopBox will help you design sealed, vented, and bandpass (sealed rear-chamber) enclosures. While this is typical of almost all box-design programs, TopBox also offers design options that call for the use of passive first-order and active second-order preamp-level filters with closed and vented boxes, and a

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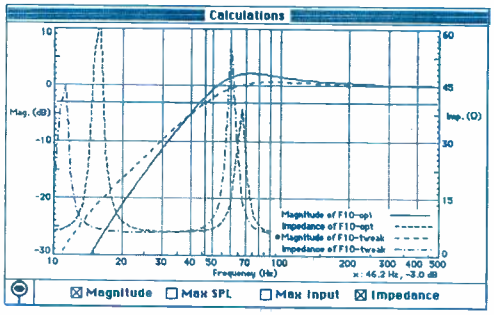

Fig. 1—Impedance and response curves, Macintosh version.

combination of first-order passive high-pass and low-pass crossover elements for bandpass enclosures.

Each of the filter options can be used to alter or augment the speaker's natural response. With closed and vented speakers, adding a passive first-order high-pass filter (a simple series-capacitor and parallel-resistor circuit) between your preamplifier output and amplifier input reduces infrasonic cone motion, especially in vented boxes (where cone excursion increases dramatically below the vent tuning frequency). For closed boxes, the addition of this simple filter also allows the designer to obtain a maximally flat response using drivers with a very high Q_{TS} of 0.5 or more. Choosing the second-order active filter option permits the designer to actually extend the low-frequency response of a closed or vented speaker by nearly one octave. For example, a speaker with a low-frequency roll-off at 50 Hz could be modified through the addition of an underdamped active filter circuit so that it reaches down to nearly 25 or 30 Hz.

This approach, however, is considerably more complicated and requires you to design and build an IC op-amp filter circuit (guidelines are provided) and to provide the required power for its operation. For bandpass enclosures, the program has a passive crossover option that adds a first-order high-pass series capacitor and a first-order low-pass series inductor to create symmetrical third-order bandpass slopes. (This combination of filter and enclosure is sometimes referred to as a sixth-order bandpass speaker.) The primary benefits of this additional circuitry are to attenuate the bandpass enclosure's typical spurious high-frequency information above the upper roll-off and to decrease cone excursion below the speaker's low-frequency cutoff [2].

Designing speaker boxes with TopBox is very straightforward and proceeds in a logical manner that is well thought out. The process begins when you select the desired enclosure type, with or without one of the filter options. TopBox then asks you for the woofer's Thiele/Small parameters. The speaker's operating parameters can be entered individually by hand, or the data can be called up from a parameter set stored in memory. (For convenience, TopBox comes with a substantial library of parameters for drivers made by Focal, Cabasse, Vieta, Vifa, SEAS, Peerless, ScanSpeak, and others.)

THE PROGRAM HELPS YOU DESIGN ENCLOSURES AS WELL AS FILTERS TO AUGMENT THEM.

When parameters are entered manually, the program requires the speaker's resonant frequency (f_S), electrical Q (Q_{ES}), mechanical Q (Q_{MS}), volume of air matching the driver's compliance (V_{AS}, in liters), voice-coil resistance (DCR, in ohms), power-handling capacity (in watts), and usable piston area (S_D, in cm^2). This data can usually be obtained from the speaker's manufacturer or by direct measurement [3], the latter being the preferred method if you have the time, equipment, and patience to accomplish the task.

Once a woofer's parameters are entered, the program will ask if you wish for a box to be designed. Hitting the "Y" key prompts TopBox to immediately calculate the required set of specifications for the box type and filter option selected. Regardless of the type of enclosure chosen, TopBox will initially calculate a maximally flat design for the woofer specified. If this does not appear satisfactory, TopBox provides the alternative of modifying the design by changing either the box volume (in the case of closed and vented boxes) or the upper and lower cutoff frequencies (for bandpass enclosures). Should the speaker's parameters be inappropriate for the currently selected enclosure type, the program will stop and prompt you to go back and restart the process.

For closed boxes, the program calculates f_3 (in Hz), sensitivity (referenced to 2.83 V at 1 meter), box/speaker Q (Q_{TC}), box resonance (f_C), and the amount of response peaking at the roll-off frequency (if any). TopBox will automatically design closed boxes with a Q_{TC} of 0.71, which fulfills the maximally flat criterion (but note that it does not compensate for box stuffing, which must be taken into account manually according to criteria set out in the program's documentation). If you wish to alter the volume and produce a box with a different Q_{TC}, the software always offers the opportunity to designate a new box volume, again immediately recalculating and presenting the new results. This same procedure applies to vented and bandpass enclosures, except that the program also provides essential port-tuning information plus the option to have TopBox calculate the appropriate port dimensions.

Once you achieve a satisfactory box configuration, including any port-tuning or filter-design data, the program can then display the results in your choice of tabular or graphic format. Whichever format is selected for display, TopBox translates the accumulated information, including the woofer parameters and box specifications, into four plots, each incorporating 51 data points between 10 and 500 Hz. These plots include curves for frequency response (referenced to 0 dB), maximum output SPL (based on the speaker's excursion capabilities and power-handling capacity), maximum input power (in watts), and speaker/box impedance. These four graphs give you an accurate profile of the enclosure's

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real-world performance in terms of its bottom frequency, expected maximum output level, and box/speaker impedance characteristics. For comparison purposes, TopBox will also allow you to save previous designs and to plot multiple curves of different designs on the screen simultaneously (two, in the DOS version, or six, in the Macintosh). Both versions include cursor readouts on the graphs.

Although TopBox produces identical results for either the DOS or Macintosh version, there are some distinct differences. In addition to its slick "window" format and greater ability to compare multiple curves on a single graph (see Fig. 1), the Macintosh version can directly print and export the various graphs. The DOS version does not incorporate its own print routine. Users of DOS 5.0 and higher can print out the graphs by loading GRAPHICS.COM before TopBox, and for users of older DOS versions, the documentation suggests employing a good third-party screen-print utility. However, in terms of designing loudspeaker enclosures, the DOS version's relative limitations are not a major drawback, and both versions perform admirably well, especially at the modest price of $99.95 for either one. *Vance Dickason*

DESIGNING WITH TOPBOX IS STRAIGHTFORWARD, LOGICAL, AND WELL THOUGHT OUT.

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2. D'Appolito, Joseph A., "Designing Symmetric Response Bandpass Loudspeakers," AES Preprint No. 3205, 91st AES Convention, Oct. 1991.
3. Dickason, Vance, *The Loudspeaker Design Cookbook, Fourth Edition*, Audio Amateur Press, 1991 (available from Old Colony Sound Lab, P.O. Box 243, Peterborough, N.H. 03458; 603-924-6526). I recommend the method described on page 133 of my book.

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The digital revolution has finally reached high-end audio. Thanks to major advances in the sound quality of digital equipment and recordings, digital sources have become a standard part of high-end systems. Recognizing this, PS Audio has brought out the Reference Link LS, which combines a multiple-source preamp with D/A and A/D converters.

The $4,795 price of the Reference Link LS is high for audio equipment yet low in terms of capabilities per dollar. Consider the features and specifications. You get five digital inputs: AES/EBU, coaxial, coaxial tape monitor, AT&T optical, and Toslink optical. There are five additional analog inputs and an analog tape monitor loop. Also, there are two sets of balanced or unbalanced outputs per channel. A front-panel display indicates volume, input selection, sampling frequency, if the digital or analog tape monitor is in use, if polarity is inverted, and if the de-emphasis is on. The unit's remote control allows you to select all features, including balance, on/off, and even the brightness of the fluorescent display.

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The digital-to-analog conversion system begins with an NPC SM5803 digital filter with eight-times oversampling and 20-bit output. This signal feeds an UltraAnalog-based 20-bit D/A converter that passes the signals to a three-pole, modified Bessel filter to minimize noise and distortion and maximize phase linearity. The low-noise, Class-A, balanced output buffer can feed any load. The phase response of the filter is within ±3° at 20 kHz—a long way from the days when digital sound had major phase changes at high frequencies. Decoding is done with a Crystal 8412. The frequency response is ±0.3 dB from 20 Hz to 20 kHz.

The A/D converter is a proprietary 18-bit type with 64-times oversampling and a highly sophisticated, low-impedance power supply. The internal A/D crystal oscillator keeps the clock jitter within the 10-picosecond range, well below the jitter level of most studio equipment. The anti-aliasing A/D filtering is performed in the digital domain with linear phase response, 0.01-dB passband ripple, and 80-dB stopband rejection—again, better performance specifications than most studio equipment.

The digital line-stage preamplifier section shows the same attention to detail as the D/A and A/D converters. Analog sources pass through a high-current, low-noise, Class-A buffer stage into the A/D converter. The digital inputs are also buffered, which helps prevent noisy digital sources from affecting the performance. All signals then pass through the D/A converter, which has the same 10-pS specification for clock jitter.

The Reference Link LS digital preamp has no mechanical switches in the signal path, and all remote-control functions are handled by a Motorola 16-bit microprocessor. All switching between analog inputs is

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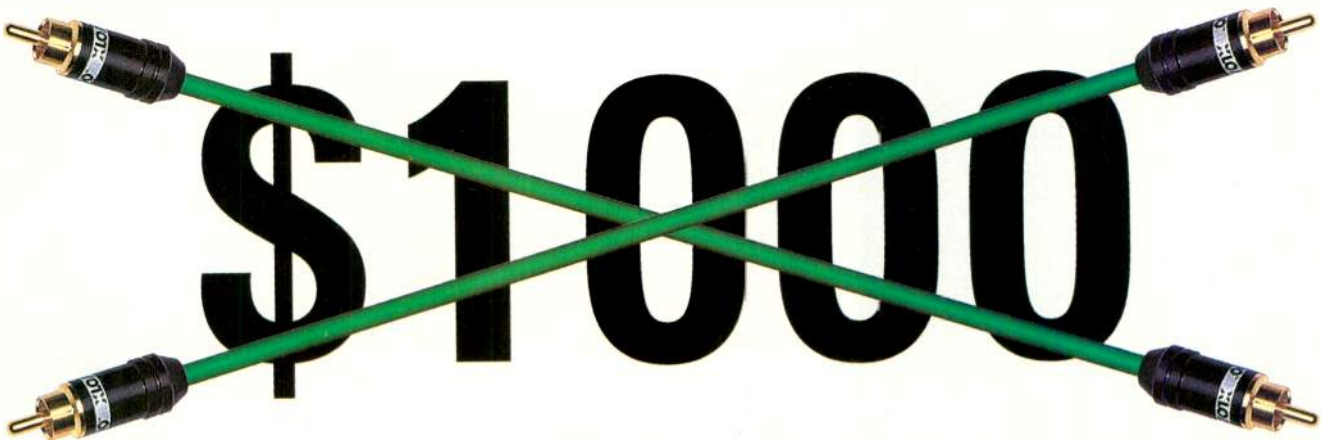
at or near the input jacks. The computer-grade circuit boards have an exceptionally clean and well-organized layout and are 0.093 inch thick, about 50% thicker than those in most audio equipment. The volume control works digitally with the D/A converter, but without the adverse effect on sound quality at low volumes found in many other digital volume controls.

There are three separate power transformers inside the unit, with isolated multiple-secondary windings, and 14 separate stages of voltage regulation. If you miss the more conventional signs of high-end circuitry you find in analog equipment, you will be happy to know that the power supply has 50,000 µF of filtering capacity and approximately 100 film bypass capacitors.

Features, circuitry, and specifications mean nothing without sonic performance, and the PS Audio Reference Link LS performs very well indeed. There are, however, several introductory cautions I should note. First, the unit requires at least 24 hours of burn-in, with a signal constantly passing through it, before it begins to show what it really can do. The technical explanation for the burn-in requirement is that it allows the clock to more firmly lock in, but my experience has been that all transistor and tube equipment requires several days of burn-in to perform at its best. The second thing to note is that the analog overload threshold is 1.25 V. This will work well with virtually all analog sources, but a few tuners with variable outputs and a number of CD players have outputs that are too high. I have no idea why you would buy the Reference Link LS and feed the analog outputs of a CD player through it, but if you do, check the player's output. You may need to use resistors to lower the peak voltage. Third, the Reference Link LS is a digital device designed for state-of-the-art, high-end systems built around digital sources. If what you want is simply a line-stage preamp for an analog-oriented system, it does not make sense to buy the Reference Link LS; PS Audio and many other companies make very good phono and line preamps. Further, the Reference Link LS does not provide all of the transparency through its analog inputs that you get with a top analog preamp.

Don't get me wrong, though. The sound quality with analog inputs is excellent. I put the unit into the tape monitor loops of both my Krell KRC and Classé Audio DR-6 reference preamps, set the gain to match the reference preamp, and found it difficult to hear the difference. In fact, the difference simply didn't matter with tuner and cassette inputs.

Most audiophiles today listen to digital sources, and the Reference Link LS does a superb job in handling digital signals. If you do any digital recording at all—with DAT, DCC, CD-R, or MD—this is the device for you. The Reference Link LS did a superb job of converting analog signals to digital for recording on my Sony DAT unit and produced my cleanest live recordings to date. Although I make no claim to do anything but fiddle with live recording, I find that drumhead and cymbal are among the most difficult musical sounds to record digitally, and the Reference Link LS handled them superbly. The same was true of solo soprano voice. Digital sound is not always kind to solo voice or choral groups; the Reference Link LS was not merely kind, it was rich and musical.



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I normally use my DAT deck only to record passages of different CDs for use in screening equipment (consumer-quality digital recorders like my DAT are simply not good enough for the most demanding listening). However, when I used my DAT with the Reference Link LS to record from my LPs, I got far cleaner transcriptions from them than I had ever gotten before. This is probably the ideal setup for backing up an analog collection or recording LPs you have to borrow because they are out of print.

It is with digital signals, however, that the Reference Link LS is most likely to be judged. Today's audiophiles use CDs for virtually all their serious listening, and if you like the sound the Reference Link LS provides, the best way to get it is to feed it directly to your amp. I could not find a preamp that did not make some difference in sound when inserted between the Reference Link LS and the amplifier.

THE REFERENCE LINK LS WAS FUN TO REVIEW AND MAY SET A PATTERN FOR HIGH-END AUDIO.

I think you will like the sound of the Reference Link LS. It is fast and clean, with a great deal of dynamic energy. It makes musical transients and changes come alive, and it does so without hardness or the dulling of the upper octaves and low-level passages, something all too common in the last generation of D/A converters. With a really clean CD transport feeding the AES/EBU or AT&T inputs, the Reference Link LS opens up the sound to provide air and ambience.

I have already praised its performance with voice and percussion, but the Reference Link LS does just as well with piano, acoustic guitar, strings, woodwinds, and brass. It is interesting to hear how much better some of my early chamber music CDs sound with this state-of-the-art unit and how much better CDs have gotten with time.

Listen to the resolution of percussion on track 1 of Cody Moffett's *Evidence* (Telarc CD-83343) or the low-level detail on track 1 (minutes 7:00 through 8:00) of Eduardo Mata leading the Dallas Symphony on Shostakovich's Symphony No. 7 (Dorian DOR-90161). Also listen to the mix of piano, percussion, and bass in "Contrition" on the Bruce Katz Band's *Crescent Crawl* (AudioQuest AQCD-1012). If you've felt CD can't cope with complex mixes of alto, tenor, soprano, and bass voice with the musical sweetness of analog, try Pomerium's recording of Antoine Busnoy's *In Hydraulis* (Dorian DOR-90184).

Like all audio units, the Reference Link LS does have its own sonic personality. There are times when life and energy are given more emphasis than subtlety and depth. The bass is powerful and detailed, living up to the promise digital technology makes in terms of specification but often fails to deliver in practice. I would like, however, just a touch more richness in the upper bass and lower midrange. The apparent soundstage is slightly forward and a bit wider than I believe is totally neutral. However, the fact that digital sound gets better and better does not mean that top manufacturers are converging on the same mix of sound qualities, so you might want to audition Krell's Reference 64 and Studio or the Wadia D/A converters to hear strikingly different interpretations of how to get the best from digital sound.

The PS Audio Reference Link LS was a great deal of fun to review. It may be expensive and is tailored to the needs of digital-oriented high-end audiophiles, but it delivers amazing value for money in terms of sheer technology. Its overall sound quality is excellent, and the features and remote-control capabilities are well chosen. This unit may indeed set the future pattern for high-end audio. Since we are going digital, it makes sense to integrate D/A conversion and preamp functions. If you buy the Reference Link LS, you may well come to consider it an investment in the digital future. *Anthony H. Cordesman*

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CLASSICAL RECORDINGS

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Bach: Concertos for Piano and Orchestra, Nos. 1 through 5 and No. 7
Glenn Gould, piano; Columbia Symphony Orchestra, Leonard Bernstein and Vladimir Golschmann
SONY CLASSICAL SM2K 52 591 (2)
CD; 69:42 and 38:08

Bach: The Six Partitas, Selected Preludes & Fugues
Gould, piano
SONY CLASSICAL SM2K 52 597 (2)
CD; 74:08 and 73:48

Bach: Concerto No. 1 for Piano and Orchestra; Beethoven: Concerto for Piano No. 2
Gould, piano; Leningrad Conservatory Orchestra, Ladislav Slovák
SONY CLASSICAL SMK 52 686, CD; 53:07

Bach: Prelude & Fugue in E Major and F Sharp Minor from The Well-Tempered Clavier II; Handel: Four Suites for Harpsichord
Gould, harpsichord
SONY CLASSICAL SMK 52 590
CD; 55:11

Glenn Gould's unique piano approach to Bach eschews the sustain pedal, attempting to achieve a more precise sound, closer to that of the harpsichord, as can be heard on three of these four recent volumes from Sony Classical's continuing Glenn Gould Edition. Gould even had his recording studio piano adjusted to a shallower and more responsive action for Bach, comparing it to "an automobile without power steering." The fourth volume is a collection of Gould actually performing on a harpsichord.

The Partitas were only Gould's second recording project for Columbia after his brilliant Goldberg Variations. The quirky pianist was also interested in studio and recording processes; it was discovered in preparing the originals of these solo pieces for remastering that the first and last movements of the Partitas 5 and 6 (included here) had been recorded in stereo, though this was a year before the first commercial stereo discs.

The volume of the six "piano" concertos begins with an early mono session of Bach's Concerto No. 1 in D Minor, with the Columbia Symphony Orchestra conducted by Leonard Bernstein in 1957. The other five concertos in this set also present Gould with the Columbia Symphony Orchestra but under the direction of Vladimir Golschmann. Of these five stereo sessions, all except Concerto No. 5 were recorded over a decade later than the D Minor, and in all the sound is considerably improved.

The same year that he recorded the D Minor Concerto with Bernstein, Gould

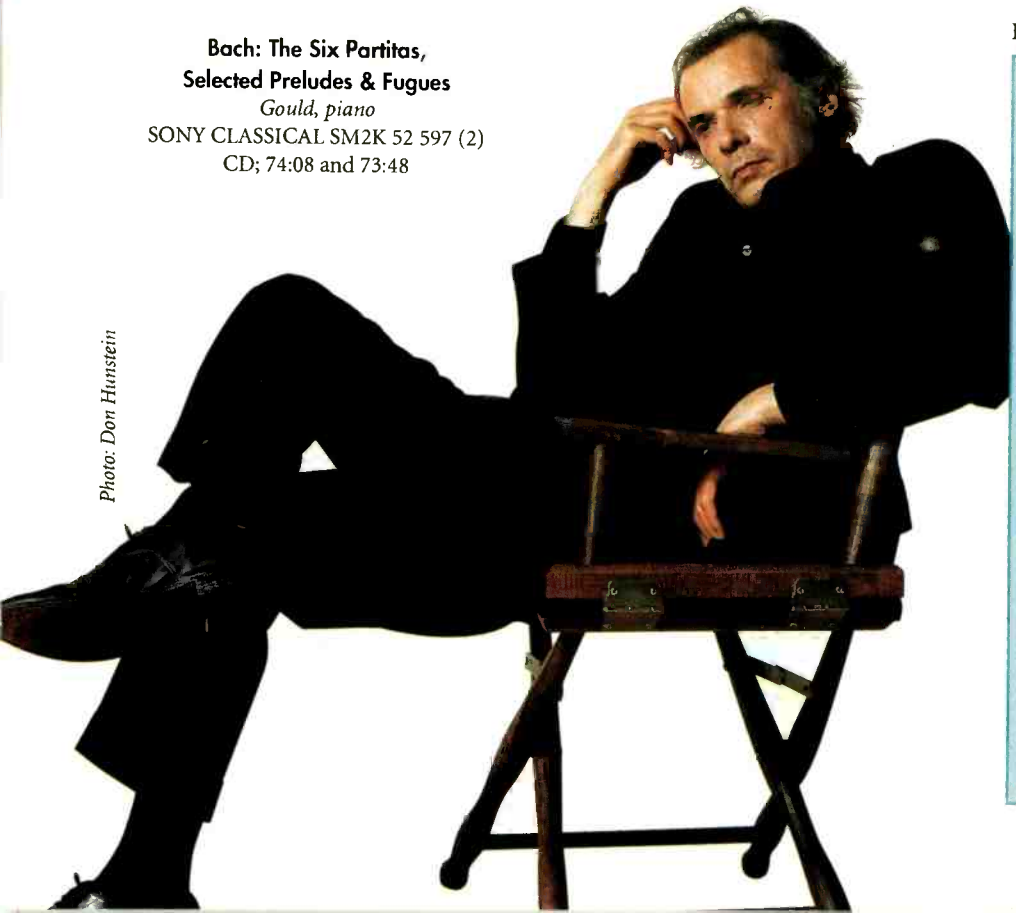

Photo: Don Hunstein

Romances

Robert Bonfiglio, harmonica; Bruce Ferden, conductor
HIGH HARMONY HHCD 1001
CD; 60:34

Virtuosi such as Larry Adler and John Sebastian, Sr. have demonstrated that the lowly harmonica can, believe it or not, function as a lovely solo instrument in more serious concert music. Robert Bonfiglio continues the courageous effort here, and to my ears he succeeds admirably. Bonfiglio also did most of the transcriptions. Besides Vaughan Williams' Romance for Harmonica, Strings, and Piano, many are chestnuts—"The Swan" from Saint-Saëns' *Carnival of the Animals*, Ravel's "Pavane for a Dead Princess," and Sondheim's "Send in the Clowns"—giving a pops concert feel.

John Sunier

made a trip to the Soviet Union and recorded the work again, with the Academic Symphony Orchestra of the Leningrad Conservatory conducted by Ladislav Slovák. The sonics are inferior to the New York version, but the diminished orchestral backing places Gould's piano more in the spotlight. Beethoven's Second Concerto from the same live concert in Russia is also included here.

Lastly, we have a volume with the only recording Gould ever made on the harpsichord. In early 1962 he had prepared a grand piano with steel pins for a CBC-TV concert, calling it a "harpsipiano." Then a piano shipped to Toronto for a recording of Handel's four suites was damaged in shipment. Gould suggested a real harpsichord. He had earlier played one on another CBC program, in two Bach preludes and fugues, which are included on this CD in their first release.

Gould used a Wittmayer harpsichord, which he stated was the only one he could play because its touch and keyboard width were as close to the piano as one can get. This particular instrument (I happen to own one) is regarded by early keyboard specialists as a sort of Edsel of harpsichords. However, the results are fine and make one wish that Gould had "pretended I'm not playing the harpsichord at all" at other recording sessions.

Beethoven: Variations ("Diabelli," Op. 120, and others)

Theo Bruins, piano
CANAL GRANDE CG 9324, CD; 65:30

How many "classical" music listeners realize that the variation form is sometimes at the very top as the most profound format in Western music, even more compelling than the string quartet or the piano sonata? I suspect that big record companies and press people distrust such variations (unless they have a Glenn Gould to help)—too highbrow. Better a good, solid concerto any day, any recording session.

If you want your music background-style, if you prefer not to have to think too hard when you listen, the big companies are right. But not for *this* kind of variation. Not really difficult, even though in Beethoven the very top of his musical genius is here, as in a number of other huge, astonishing, unsettling, enormous variation sets the composer sprang upon an unsuspecting world. The publisher, Diabelli in this case, composed a simple-minded but clever little waltz (it is ideal for variation-making) and paid a considerable number of composers to write variations for him, for a published collection. Beethoven was loath, but in the end, no doubt after considerable badgering, overwhelmed Diabelli with this enormous work ("Well, then he shall *have* variations!"). There are other, similar, overwhelmingly big Beethoven sets—the "Kakadu" Variations ("I am the Tailor Kakadu"), the 32 Variations, and the "Eroica" Variations (later written into the "Eroica" Symphony)—as well as an astonishing number of standard variations of no great consequence, on all sorts of tunes, arias, and whatnot. Beethoven was never loath to write semi-corn, as most standard variations were then, when the money beckoned.

The Diabelli set is the very last of the Beethoven piano works, the top of his final, or "Ninth Symphony," period. The only other big composer to recently achieve this sort of enormous impact was Bach, with his similarly profound Goldberg Variations. (*Not* for piano; specifically for double-keyboard harpsichord.) But there have been plenty of followers, from Haydn to Brahms and on to today—including plenty of jazz, basically the same form.

Theo Bruins, recently deceased, was a powerful all-Dutch pianist, definitely '60s-style, as any ear can hear. Emphatically, he is not of the younger musical generation, though the recording is 1989. He was clearly a dedicated big-time concert performer; at mike distance his blows are all trip-hammer precision, his technique effortless, brilliant, and very dry—almost no pedal, everything pointy and sharp. An overpowering impact—but no neo-Romance here! It is all Beethoven the grizzly bear. Compared to Artur Schnabel, the most *thinking* pianist of this century (if no great technician), Bruins plays a strong but not very profound Diabelli. There is much that he is unwilling to hear, or portray. Nobody, however, will get *all* of the top Beethoven into one performance—this one is strong enough in its own fashion, Schnabel or no, and it won't disappoint.

Two of the lesser "normal" sets of Beethoven Variations round out the CD, both workmanlike if nothing profound. One is on a tune from a Salieri opera, the other based on "Rule Britannia." There is a companion set on "God Save the King (or Queen)," known in the U.S. as "My Country 'Tis of Thee" as well as being the anthem of several other countries. That one would have been fun to hear. In these lesser works the Bruins pianism is perfection.

Edward Tatnall Canby

Alessandro Scarlatti: Toccate per Cembalo

Rinaldo Alessandrini, harpsichord
ARCANA/WDR A3, CD; 73:25

Though Alessandro Scarlatti, Domenico's father, is best known for his many operas and oratorios, he also wrote some harpsichord works. The wild, all-hands-on-deck passages of many of these dozen pieces might almost make one think these are *later* than Domenico's 550-odd sonata collection. The harpsichord was already falling into disfavor early in the 18th century, and Alessandro upped the virtuoso quotient, attempting to attract more buyers to his music! Underneath the fireworks is a more conservative musical style than the crossed hands and clashing harmonics of son Domenico.

The Linn Numerik A/D processor was used in production; sonics are close-up but especially clean in low-level details.

John Sunier

As with all of the Gould series, Sony's Super Bit Mapping high-definition remastering process brings out clarity and depth, even in mono recordings, that far surpass the earlier CD reissues.

John Sunier

Antoine Busnoys: In Hydraulis & Other Works

Pomerium, Alexander Blachly
DORIAN DOR 90184, CD; 72:01

Bus Nose, we used to call Antoine Busnoys in my student days. Seen but not heard. Music before the late 16th century was for musicologists. Purely mathematical, not expressive like *real* music. Perhaps we heard a few notes of Busnoys incongruously on the piano. Totally useless.

Now all is different. Busnoys (how *do* you pronounce him? My best guess is Beuhnway) represents one of the great mature periods of European church and secular music, elegantly complex and sophisticated yet easily transparent (and communicative) in its audible sound—assuming a transparent performance not on the piano. It is still built largely on spaced-out Gregorian chant or popular melody (even in sacred music) but not yet, as we might say, wedded to musically "speaking" words. That welcome development came later, as well as necessary simplification, as we know in 16th-century music.

But to an earlier time this was irrelevant, and is so still. Busnoys died in the Columbus year, 1492. A few musicians even celebrated his 500th. As here.

This type of revival requires a whole new vocal approach, parallel to the use of period instruments, if the music is to be intelligible to the modern ear. Opera wobbles, vibrato, and high-pressure loudness are out. It needs smaller, more accurate and blending voices. Today there is a small wave of the future building fast in this area, to bring a whole new music again into play after 500 years. Pomerium, out of New York, is the type. Try, and you will hear. I am proud that Alexander Blachly, in his college days, sang briefly in my own Canby Singers, so to speak, en route.

Yes, at first all this Busnoys will sound more or less alike. Don't worry about that.

Edward Tatnall Canby

New World Guitar Trio

TMR 9 93TMR-6, CD; 55:44

While the trio is a fairly common ensemble, rarely does one consist of the same instrument, and even rarer is music written for such a form. The New World Guitar Trio solves this by relying on transcriptions, although this is certainly no detriment to the program. Four of Debussy's preludes for piano (Nos. 3, 6, 8, and 12) are lovely, delicate *impressions* often played on guitar—especially "La fille aux cheveux de lin" (No. 8)—and the reading is sweet and buoyant. Beethoven's trio Serenade in D Major, Op. 25, is a bolder effort, full of sparkling arpeggios and sprinting scales that translate remarkably well to the crisp attack of the guitar. And the shimmering, dancing harmonic lushness of Shostakovich's three fugues for piano (Nos. 2, 3, and 7) from Op. 87 is enlivened with tonal variety, despite the similarity of the instrumental voices.

This excellently recorded set is rounded out by two works for guitar trio by Dutch composer Chiel Meijering that exploit percussive techniques and guitaristic vocabulary such as blues bends. Indeed, what's remarkable about this debut is how fluidly and fluently David Patterson, Thomas Noren, and Dean Harada make this program seem idiomatic to three guitars, while providing a refreshing new perspective on the music itself.

Michael Wright

Transcendental Bach: Elaborations on the Solo String Works of J. S. Bach by Rachmaninoff, Godowsky, and Busoni

Thomas Labé, piano

DORIAN DISCOVERY DIS-80117

CD; 70:27

The popularity of transcriptions of this sort has gone through many ups and downs over the years. Franz Liszt (1811 to 1886) made piano transcriptions of Beethoven symphonies not only as vehicles for his own legendary virtuosity but also as a means to take them to provincial audiences beyond the reach of a symphony orchestra. Purists continue to sniff at them. Personally, I get a tremendous, unashamed, unapologetic kick out of the good ones—especially when performed with the dash and verve Thomas Labé brings to these.

Leopold Godowsky (1870 to 1938), one of history's greatest pianists and teachers, had the rare *chutzpah* to take works Bach had composed for a single stringed instrument and transform them into virtuoso piano works that exploit every resource of a modern concert grand. Dorian has sumptuously recorded these performances in the exemplary acoustics of upstate New York's Troy Savings Bank Music Hall, a venue that in its own way is also something of a legend.

Paul Moor

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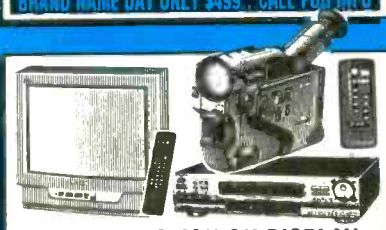

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TORI AMOS

SARAH McLACHLAN

Under the Pink
Tori Amos
ATLANTIC 82567-2, 56:52
Sound: A-, Performance: A-

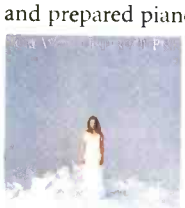
Fumbling Towards Ecstasy
Sarah McLachlan
ARISTA 18725-2, 55:01
Sound: A-, Performance: B+

After a week of immersion in these two very challenging albums, I woke from a disturbing dream—a *Straw Dogs* sort of blood-splattered thriller that was scored with songs from Tori Amos' *Under the Pink*. The album itself hadn't suggested this grisly imagery from listening to it, so it must have worked on some weird subconscious level. I suspect that Ms. Amos would be very pleased to hear this.

Both *Under the Pink* and Sarah McLachlan's *Fumbling Towards Ecstasy* are albums that make strong demands of the listener. Neither works very well as a passive listening experience; you must make an effort to reach them. Amos is the more opaque of the two artists. A vocal style that stretches and twists the syllables makes it difficult to understand what a song's about. Lyric sheets without punctuation don't make things easier.

In contrast, Amos throws herself into her songs with the abandon of a method actor, virtually living out the scenarios before you. Some melodies are tortuously complicated, while others, such as "Pretty Good Year" and "Past the Mission," are intoxicatingly pretty. The finale, "Yes, Anastasia," reveals itself as the psychological profile of the fabled daughter of the Czar.

The way Amos builds tracks is somewhat unconventional. She always records voice and piano first and then either adds complementary elements or lets the unadorned song stand alone. Some pieces receive subtle string arrangements, others get only bass and drums, and still others get a full band and/or an occasional "guest" vocalist. One song, "Bells for Her," is just her voice and prepared piano sounding something like a fuzzy celeste.



The influence of Kate Bush on Amos is undeniable. She sometimes sounds more like Kate than Kate does. Equally clear is the confidence and pride Tori has in her own work. She revels in the fact that her work isn't "easygoing." With her albums, this and the previous *Little Earthquakes*, the listener's effort brings just rewards. Fans are advised to look for her generously bonus-tracked CD-5s.

Nova Scotia's Sarah McLachlan's chief influence is Peter Gabriel, as

Photo: ©Loren Hayes

she has often stated in her interviews. Her voice has an inescapable aura of sadness, and her songs veer toward romance in a classical poetry sense.

As with her previous album, *Solace*, the recording is a collaboration with Pierre Marchand, a producer/musician with ties to Daniel Lanois. Marchand's greatest contribution is the Lanois-like mysterioso atmosphere that envelops McLachlan's songs and deepens them. Guitarist Bill Dillon is also an essential component.

McLachlan's palette is narrower than Amos', but she always operates with an open throttle on her heart. "Ice Cream" provides a welcome, whimsically sweet change of pace. Among her strongest songs is "Possession," which bookends the album—fully produced in the beginning, and reprised much later as a hidden (you won't find it mentioned anywhere) piano and vocal interpretation seconds after the album's final and eponymous track.

Nobody ever said that the good stuff would always hit you between the eyes. Sometimes—and Amos and McLachlan are good examples of this—the quality of the work is obvious, but to appreciate it fully, you have to become part of the creative process—a partnership that can potentially result in art.

Michael Tearson

Brutal Youth

Elvis Costello
WARNER BROS. 9 45535-2, 57:24

Here, to the surprise of many, Elvis Costello and his former backing band through his glory years, The Attractions (Steve Nieve, Pete Thomas, and Bruce Thomas), are reunited despite well-documented acrimony. Erstwhile producer Nick Lowe participates, as does Elvis' more recent producer Mitchell Froom. The resulting 15 songs here are reminiscent of vintage Costello, musically dense and verbally loaded like *Imperial Bedroom*, from 1984. *Brutal Youth* isn't easy sledding. In fact, it might take several listens plus the help of a lyric sheet to "get" these songs. But Costello fans will welcome this album as a long-hoped-for return to form.

Michael Tearson

Sinatra and Sextet: Live in Paris

Frank Sinatra
REPRISE 9-45487-2, 74:07

"Man, what happened to those jokes?" quips the greatest pop vocalist in the universe as his onstage patter is noticeably bombing. It's part of a strange rapport between Mr. Blue Eyes and his Paris audience during the 1962 charity performance on which *Sinatra and Sextet* was put to tape. Strange, because his audience is more like a makeshift morgue—unresponsive, staid, minimally applauding, and almost never laughing at Sinatra's sometimes funny/sometimes truly tasteless outbursts of wit. But with able assistance from his touring sextet, Sinatra brings the roof down on 'em.

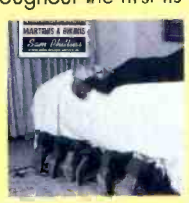
In 1962, The Voice still had his voice, and it was a marvelous instrument—a textural baritone with incredible breath control and a knack for turning a phrase like nobody else. Whether sentimentalizing on "Moonlight in Vermont" or reaching for high notes with insurmountable *joie de vivre* on "Come Fly with Me," Sinatra, at his peak, infused his songs with emotion like no other singer. But hey, he'll always be an emotional guy. Just ask anybody he's punched out over the years. A marvelous duet with his guitar player on "Night and Day" is the icing on the cake.

Mike Bieber

Martinis and Bikinis

Sam Phillips
VIRGIN 8 39438 2, 46:13

Sam Phillips' third Virgin album may be her most seductive yet. Produced as always by spouse T-Bone Burnett, ornate and vaguely Beatle-esque touches enlighten Phillips' songs that are, by turns, cautionary and yearning. Often, I couldn't help singing along throughout the first listen. Burnett's production also integrates some psychedelic touches, such as a sitar and the backward tape effects in the irresistibly catchy "Baby I Can't Please You." On careful listening, some arrangements seem to be based on specific licks: "I Need Love" recycles the George Harrison riff from "If I Needed Someone," and the closer, a clangy jump-rope rhythm take of John Lennon's "Gimme Some Truth," is offbeat and lots of fun. But you could say the same about the whole album. Key players include David Mansfield and XTC's Colin Moulding.

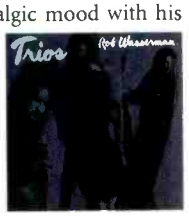


Michael Tearson

Trios

Rob Wasserman
MCA/GRP MGD-4021, 57:16

In the follow-up to his 1988 Grammy-winning *Duets* album, bassist Rob Wasserman has opted for songs over performance and interaction. Sam Phillips contributes an eerie paean to Brian Wilson, which is sung by Wilson's daughter Carnie and Wilson himself, who chips in a chorus that sounds like pale ghosts of Beach Boys harmonies past. Elvis Costello is also in a nostalgic mood with his old-timey rendition of "Put Your Big Toe in the Milk of Human Kindness," with guitarist Marc Ribot participating as well. Unfortunately, many of the songs on *Trios* are throwaways. Neil Young and Bob Weir pull one off the dust heap for the sloganeering "Easy Answers," and Edie Brickell and Jerry Garcia are charming but hardly revelatory on their pair of tunes.



Throughout, Wasserman gives some spirited performances. He has a wonderfully melodic and earthy bass sound, and *Trios* shows he is as comfortable in a classical improvisation with Kronos Quartet cellist Joan Jeanrenaud as he is playing with the late blues legend Willie Dixon.

John Diliberto

FAST TRACKS

The Wishing Well: *Connie Dover* (Taylor Park Music TPMD-0201, 48:46). Dover's second album is a lovely, luminous set of Celtic music with two cowboy songs thrown in for spice. It was recorded in Edinburgh with many of the genre's best musicians supporting her, among them producer/multi-instrumentalist Phil Cunningham, guitarist Manny Lunnus, and fiddle ace Aly Bain. (P.O. Box 12381, North Kansas City, Mo. 64116.) **M.T.**

Bad Boy: *Larry Williams* (Specialty SPCD 7002, 51:46). The Beatles cut his "Dizzy Miss Lizzy," "Bad Boy," and "Slow Down," and The Stones did "She Said Yeah." But Larry Williams is at best a cult figure. However, once you hear Williams interpreting his own songs, even John Lennon's versions sound like mere cover records. Only Little Richard and Jerry Lee Lewis can rival Larry Williams for pushing rock's limits. **J.&S. T.**

JAZZ-BLUES RECORDINGS

Charlie Musselwhite is possibly the best living player of amplified blues harp.

Photo: ©David Gahr

In My Time
Charlie Musselwhite
ALLIGATOR ALCD 4818, CD; 62:43
Sound: A–, Performance: B+

With the arguable exceptions of James Cotton and maybe Delbert McClinton, Charles Musselwhite III is the finest amplified blues harp player alive. It's just that simple. If you're too late to have witnessed Little Walter or Big Walter on stage, Musselwhite, on a good night (and he has a lot of them), is as close as you'll ever come. If not in their league as innovators, he blows his harp with an overwhelming instrumental mastery and soaring solos that are pure aural adrenaline for his fans.

A contemporary of Paul Butterfield, Musselwhite couldn't, or wouldn't, duplicate his friend's crossover success. Specialized blues magazines ignored the records of a young white kid in a black blues world. With his recorded output scattered among a handful of small labels, soon only fellow musicians appreciated the range of his talents.

However, upon signing to Alligator in 1990, Musselwhite finally came into his own. *In My Time*, his third Alligator album, looks back on his roots, offering three distinct sets that reflect his musical development from a young Delta bluesman to his current status as reigning blues harmonica hero. An accompanying booklet containing rare photos from Musselwhite's own scrapbook will add further enjoyment for fans.

IN MY TIME SHOWS MUSSELWHITE'S DEVELOPMENT FROM YOUNG DELTA BLUESMAN TO HARMONICA HERO.

Four songs capture Musselwhite on his first instrument, guitar, and his solo Delta blues are as tasty as you would expect. Vocal group The Blind Boys of Alabama join him on two of these numbers.

Next, Musselwhite and sympathetic West Coast bluesmen re-create the blues of '50s Chicago. The musicianship is first-rate throughout, but Musselwhite's own bands left a more distinctive stamp on similar material.

The best tracks feature Musselwhite with his current group. Like Little Walter, Musselwhite favors a driving trio that can quickly get out of his way when he catches fire. "Moving and Groovin'" showcases his signature licks with dazzling runs.

In My Time isn't Charlie Musselwhite's most exciting album (try *Ace of Harps* on Alligator or *Takin' My Time* on Arhoolie). It is, however, a rewarding change of pace with something for everyone.

Roy Greenberg

The Key Players
The Contemporary Piano Ensemble
DIW/COLUMBIA CK-57754, 69:43

Five pianists around four pianos: A game of musical chairs? Hardly. When James Williams gathered Mulgrew Miller and Donald Brown (fellow Memphis State University alumni), Geoff Keezer (honorary Memphian), and Harold Mabern (a fellow Memphian) in a recording studio, the agenda was part Memphis piano summit, part tribute to Phineas Newborn, Jr., and part plain old house party.

The laughter and cheers are left in the mix, which itself succeeds in allowing each grand piano to be audible and distinct. Liner notes list who plays what (Brown substitutes on three tunes for everybody except Miller), including melodic trades, duo and ensemble sections, and flights of solo improvs that reveal as much about the participants' approaches as they do about the music's roots. A particular highlight is a fascinating read of Bobby Timmons' "Moanin'" by the four ex-Jazz Messengers (all except Mabern). The excellent accompaniment is provided by drummer Tony Reedus and bassist Christian McBride.

Larry Blumenfeld

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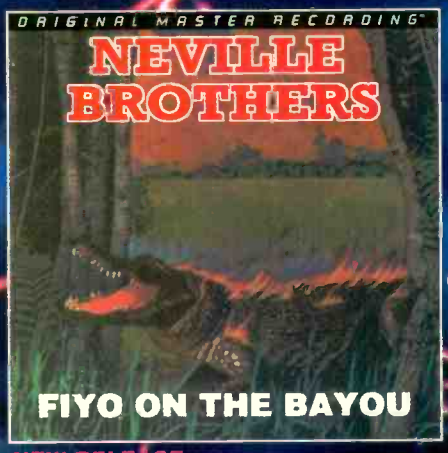

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Spirits

Gil Scott-Heron

TVT RECORDS TVT 4310-2, 56:34

During his '70s heyday, Gil Scott-Heron combined his wordsmith talent with Miles Davis-inspired jazz/fusion. Now, some 20 years later, young British soul boys are retreading this concoction as "Acid Jazz," and everything old—Fender Rhodes pianos, Adidas warm-up suits, Roy Ayers—is new again. Arguably, it's this retro '70s wave that has allowed Scott-Heron to make a new album after 12 years, and his music remains largely unchanged—same instrumentation, same voice. But it's Gil's near-legendary Afrocentric polemic that, on *Spirits*, has been toned down, with black empowerment sharing the bill with all-encompassing themes of global reparation, and he's also become something of a "luurve" man. Sorry, no "Whitey on the Moon" here, but believe me he still vents. And as an artist whose talents as a singer don't hold a candle to what he does with the spoken word—thankfully captured on *Spirits*—it's pretty obvious why he survived the '80s by doing poetry readings. *Mike Bieber*

A Celebration

The Modern Jazz Quartet with solo guests

ATLANTIC 82538-2, 71:23

With 42 years together, the Modern Jazz Quartet is one of the longest running partnerships in jazz. This longevity actually stretches to 50 years if you consider eight years with the previous drummer. Throughout its existence, the MJQ has added interest to its work by experimenting in varied musical environs, and *A Celebration* expands this diversity. Here, the renowned quartet performs with a bevy of guest artists who were also responsible for choosing material. The program consists of standards, except for two MJQ originals. Highlights include Wynton and Branford Marsalis on two tunes each, and Bobby McFerrin interpreting "Bag's Groove" with assistance from the phenomenal vocal group Take 6. Harry "Sweets" Edison, Illinois Jacquet, Jimmy Heath, and Freddie Hubbard also participate. *John Sunier*

I Can See Your House from Here

John Scofield & Pat Metheny

BLUE NOTE 7 27765, 69:03

Guitarists John Scofield and Pat Metheny first met at the Berklee School of Music in Boston. In the 20 years since, each has forged his own musical path to success, built along lines of improvisations. Sco's has been a jagged one, marked by raw, quirky invention. Metheny's glows with a bright, sculptured beauty. The collaboration is remarkable for the perspectives the two bring to each other's signature styles. It's not difficult to match the angular groove of "Everybody's Party" to Scofield or the structural elegance of "Message to My Friend" to Metheny. But with support of bassist Steve Swallow and drummer Bill Stewart, Scofield and Metheny find a common ground that often reveals fresh territory. *Larry Blumenfeld*

FAST TRACKS

Tigerman: *Kim Wilson* (Antones ANT 0023, 45:49). The Fabulous Thunderbirds' singer and harmonica ace has his first solo album, and it's a sizzler. Mastered hot, with in-your-face sonics from the first note, this is a blues album to savor. **M.T.**

Going Home: *Elvin Jones' Jazz Machine* (Enja 7095-2, 59:48). The legendary drummer shows plenty of taste and finesse leading and backing his septet, which includes saxist Ravi Coltrane and pianist Kent Jordan. **J.S.**

Paulistana: *Eliane Elias* (Blue Note 7 89544 2, 51:14). Brazilian keyboardist Elias leads an infectious jazz samba session featuring Eddie Gomez, Jack DeJohnette, Nana Vasconcelos, and others. Her lyrically swinging piano is matched by her lilting vocals on three tracks. **J.S**

Fast Life: *David Murray Quartet + 1* (DIW/COLUMBIA CK 57526, 60:50). The prolific World Sax Quartet member delivers a more "inside" effort that includes longtime cohorts John Hicks and Ray Drummond. The "+ 1" is Branford, who fits on two of six cuts but is otherwise more for show than tell. **J.W.P.**

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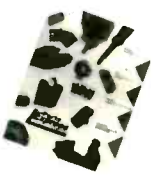

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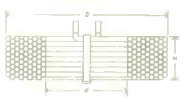

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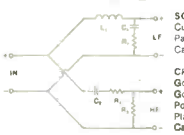

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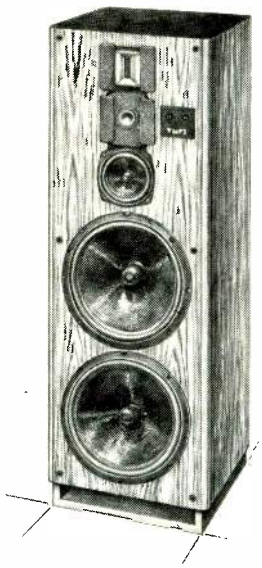

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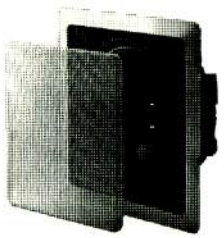

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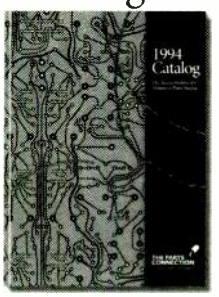

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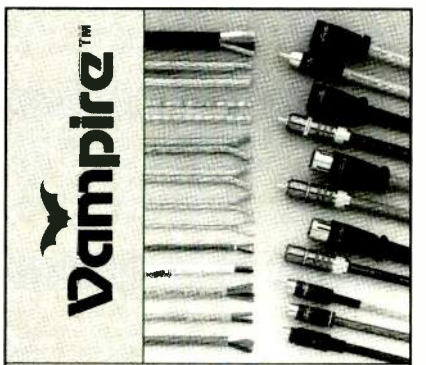

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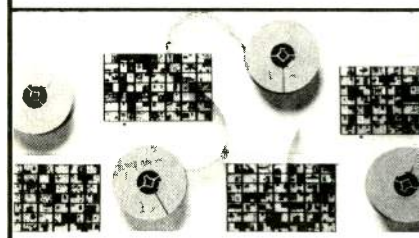

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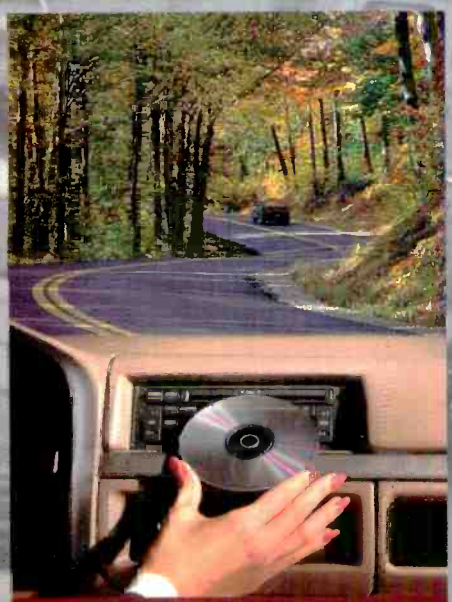

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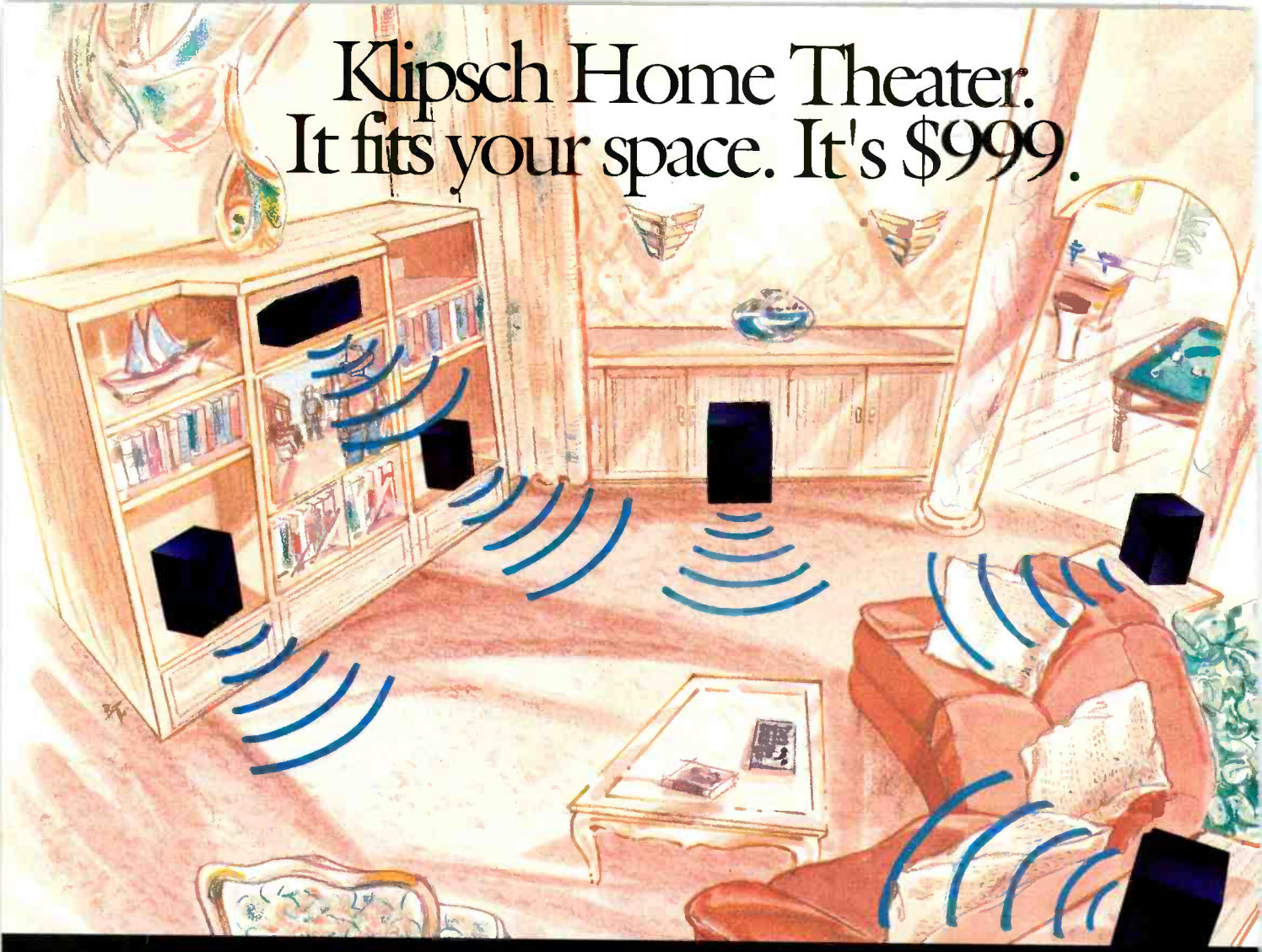

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