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1-250 MILES
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Hell's heating system frequently disrupted. (Deceased politicians rejoice.)
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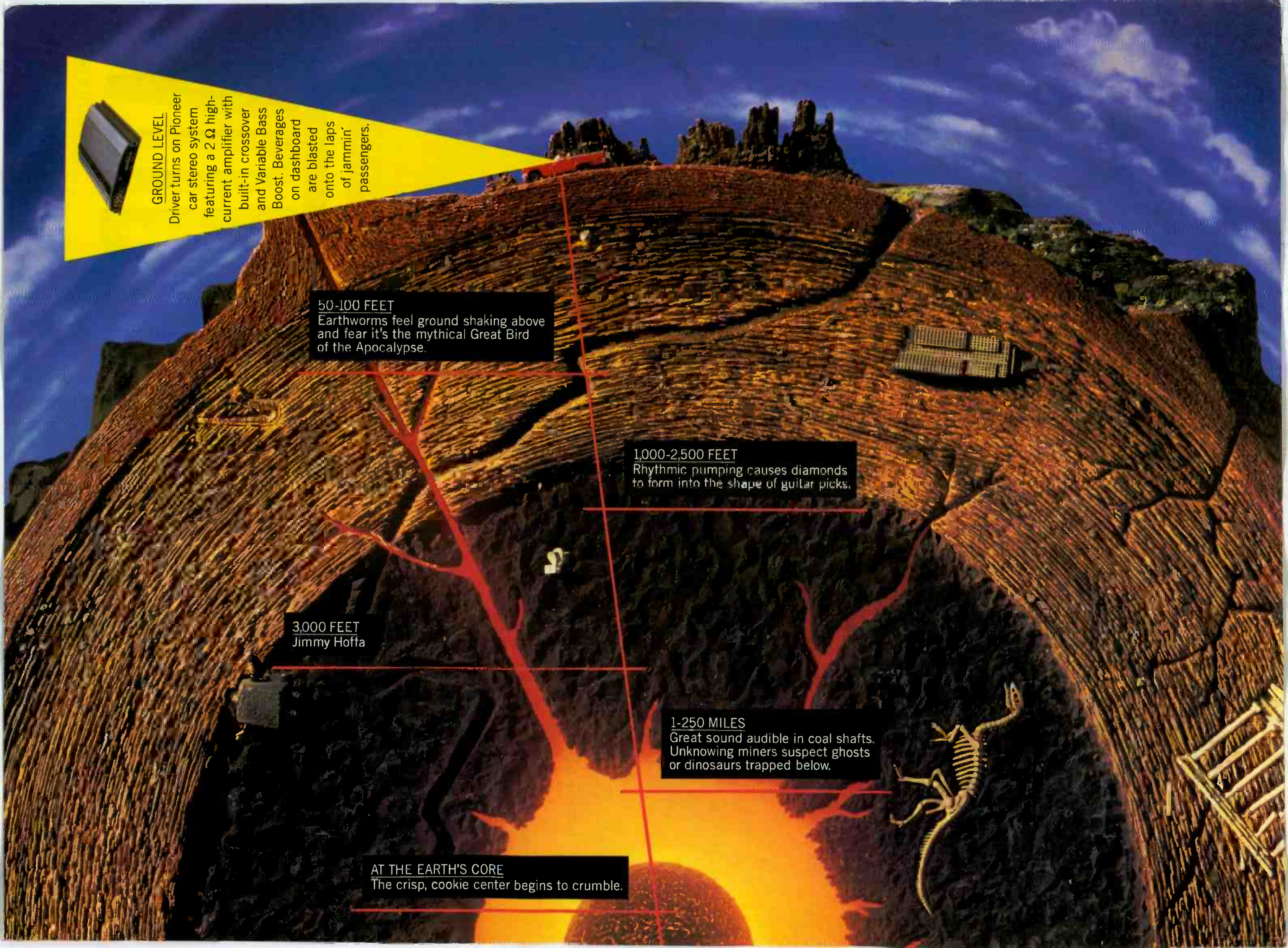
The Art of Entertainment



GROUND LEVEL
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1,000-2,500 FEET
Rhythmic pumping causes diamonds to form into the shape of guitar picks.
3,000 FEET
Jimmy Hoffa
1-250 MILES
Great sound audible in coal shafts. Unknowing miners suspect ghosts or dinosaurs trapped below.
AT THE EARTH'S CORE
The crisp, cookie center begins to crumble.

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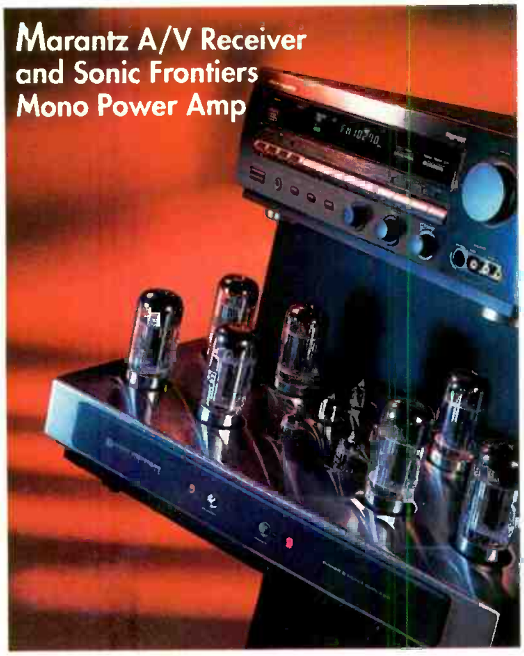

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FAST FORE-WORD

A company is only as good as its people. I'm sure you've heard that before—and you'll surely hear it again, because, like most clichés, it's usually true. That's why it's *become* a cliché. And in the business of communication, where the product is information or ideas conveyed from a small group of people to a much larger group, it's a way of life. Magazines are, in a sense, the people who put them out.

So for us, our people, whether the editorial staff here in the office or the many regular contributors scattered across the country, are extremely important. I was fortunate when I came to *Audio* nine months ago to step into a great team working in a long, proud tradition. But of course, when you have a chance to make things even better, you take it. We've benefited from several such opportunities lately, which I want to mention briefly here.

The first was to make Ken Kessler a more regular voice in the magazine, primarily through his monthly column "Mondo Audio." As the title implies, "Mondo Audio" is intended, at least partly, to bring a global perspective to the table. Ken is an American expatriate in England who manages to get around quite a bit on top of that (I first met him in Japan), making him exceptionally qualified to comment on hi-fi around the world. Beyond that, however, he brings an interesting, individual, and often entertaining point of view to matters audiophilic.

The same can surely be said of Corey Greenberg. If you take the time to read my scribbles here at the front of the magazine, you must have noticed Corey's debut in our pages last month; in this issue he reviews NHT's new SuperOne loudspeaker. He, too, will be a regular contributor. Although the title of his usual column, "Front Row," plays on a home theater theme, its compass will really be quite broad and by no means limited to that topic.

Finally (for now), Alan Lofft is coming to our in-house staff. He will join me and technical editor Ivan Berger in the front lines of planning, assembling, and organizing *Audio*'s equipment and technology coverage. For the last decade, Alan was editor of *Sound & Vision*, Canada's largest audio/video publication. His skill and experience will help us make *Audio* a bigger, better, more exciting magazine.

Although these three people have very distinct approaches and outlooks, they share with the rest of us at *Audio* a love of music and a long-standing interest in achieving the best possible sound reproduction. I hope you enjoy their work as much as I do.

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Aragon Answers Back

Dear Editor:

Hey, I've got an idea. Let's start a magazine where you review audio components with a faulty test setup and discontinued speakers engineered a quarter of a century ago. What speaker wire and interconnects should we use? Who cares, we'll just go to a hardware store and get some. Now comes the fun part: Consumers will read the reviews and actually spend their money based on what we say. What! *Audio* Magazine is already doing this? Boy, you no sooner come up with a good practical joke than you find out someone else is already doing it.

I felt compelled to write this letter to compliment you on your comic genius. Especially the subtlety of it. Some people would only do it in the April issue, but that's too obvious. You do it in the June issue, with the Aragon 8008ST amplifier review. I particularly liked where you mention the Allison One was the speaker used for the review but don't say how old they are. That will make your readers go into the *Audio* Annual Equipment Directory to try to find something about them, but they won't be in there. Even if they saved previous Directory issues for several years, they won't find the Allison One speakers listed because they were discontinued 10 years ago. It will make your readers go crazy trying to figure this out. I can hear them now, "Maybe it's a new speaker that's not out yet." Very few will suspect that it came out about a quarter century ago.

It was bad luck that the Aragon 8008ST is also reviewed in the June issue of *Stereophile.* I think people may catch on to the joke. After all, *Stereophile* also used an Audio Precision measurement system to test the amplifier, except their Audio Precision was working properly. Readers will see that *Stereophile* didn't have a problem testing the Aragon and might figure out that your reviewer's Audio Precision test setup has a problem that the wide-bandwidth 8008ST makes evident.

Also, as luck would have it, *Stereophile*'s reviewer didn't listen to the amp on a speaker designed 25 years ago but on the newly released Energy Veritas v2.8. Tom Norton found that on this current design the Aragon "produced one of the best sounding top ends overall."

Because of this, people may start asking questions, so allow me to prepare you with some suggested answers.

Q. We commend you for finally revealing what Ed Foster listens to, but why is it that in previous reviews by Foster, you never gave what associated equipment he listened to during a product review?

A. We weren't trying to hide anything; we just don't think anyone else needed to know because it doesn't matter.

Q. Why would Audio *use speakers that were discontinued 10 years ago as a reference?*

A. Hey, we're the experts, and we say there hasn't been any progress in speakers in the last 10 years. As a matter of fact, these speakers were engineered about 25 years ago, and there hasn't been any progress since then.

Q. Don't you think consumers who trusted Audio *will be upset when they find out?*

A. It doesn't matter, because we're changing the name of our magazine to *Clueless.* Then we're getting all new test equipment and speakers and stuff, and our magazine will have the motto "Clueless, But With New Equipment."

Q. How could the editor let this go on?

A. Don't take things so seriously. Besides, I've been editor for only six months. I ordered new equipment from one of those 800 numbers in the back of *Audio.* They told me they could get me any brand I wanted. Don't blame me if six months later they still haven't delivered anything. They tell me the manufacturer is back-ordered.

Q. What is the date of the last receipt your reviewer has for sending his test equipment back to Audio Precision to be calibrated?

A. Sorry, editor, I couldn't come up with an answer for this question. You are on your own on this one.

Anthony Federici
Mondial Designs
Dobbs Ferry, N.Y.

Author's Reply: That's funny. I don't remember Tony Federici disparaging my speakers, cables, or test setup when I reviewed the Mondial Acurus 200X3 in the February 1995 issue. But more about speakers and cable later. I'm more bothered by Federici's groundless (pun intended!) attack on my test setup.

When the first 8008ST blew a rail fuse, I called Mondial to discuss the amplifier's grounding arrangement because I suspected oscillation. Mondial questioned whether the outputs had been connected to a common ground, since that could cause the 8008ST to oscillate. That was not the case; the loads were independent and the levels were read by the balanced input amplifier of the Audio Precision System One. Mondial said it did not have AP test equipment in its design lab, but the factory used a System One for quality control and had no problem. I gave Mondial the specific settings I use; it was confirmed that the factory settings were the same as mine.

When I remarked about the 8008ST's wide bandwidth and opined that it did not seem to have an input filter, I was told there was a filter and response should be –3 dB at 100 kHz. My response data indicated otherwise, and I suggested that perhaps the filter was missing on this sample, which might explain the oscillation. I shipped the amp back to Mondial, and, to check that nothing had gone awry with my setup, I put a different wideband, high-power amplifier on the bench; it behaved normally in all tests.

Mondial sent a second sample. When it also acted strangely, I was back on the phone. I advised Mondial that there was no 100-kHz filter in this one either and was told the cutoff wasn't really at 100 kHz. So, where was it? Well, I was told my results were probably correct, whatever they were. Hmm! I reconfirmed that the factory did use an AP System One, that it was set the same as mine, and that they did not have similar problems. (This is significant because, if oscillation were induced by the test equipment, the factory should experience similar results.) I asked about the test cables used in the factory, since shield grounding can affect amplifier stability. My cables are designed to avoid

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such problems, but I suggested the factory send me the cables it uses so I could duplicate their setup precisely. I was told they didn't use anything fancy, "just a twisted pair."

At this point, Mondial said it would get a System One on loan and try to duplicate my results in its lab. I put the 8008ST aside. A few weeks later Mondial called back saying it had the answer: The problem was Audio Precision's. Mondial had learned that Audio Precision uses small RF bypass capacitors from the balanced inputs to the chassis. In Mondial's opinion, this provided a feedback path from output to input and caused the 8008ST to oscillate. (I'll not recite the attack on AP in detail; suffice it to say that "stupid" was one of the milder epithets.) Mondial had not gotten a System One and tried the tests itself, however.

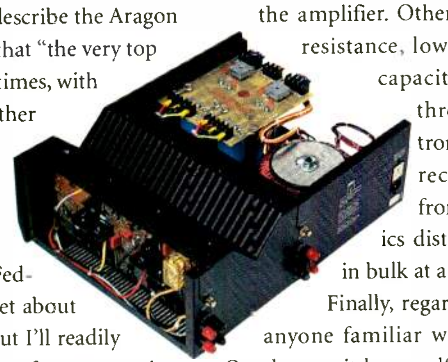
Well, admittedly, this is a possible explanation, but I don't buy it. RF bypassing both sides of a balanced input to chassis is good engineering practice to ensure high-frequency common-mode rejection. Furthermore, tying the AP chassis to the 8008ST chassis with a braided cable (as I did) grounds the presumed feedback path and should eliminate the feedback. Finally, if the oscillation were caused by the AP System One, why didn't the factory have a problem, since it uses the same equipment?

I tried different connection arrangements between the second 8008ST and the test gear and came up with one (described in the review) that gave reasonably consistent results. I gave a few preliminary measurements to Mondial's designer, who agreed that they "seemed about right," so I completed the lab work and went to the listening tests. I approached the listening tests under the assumption that the problems were peculiar to testing and would not occur in a music system, but I did not cotton to the sound of the 8008ST, as is evident in my review.

Federici was less than pleased. In an effort to convince *Audio* to print a retraction, he came up with another explanation of the bench-test problems. Again, it was Audio Precision's fault. The factory had found that some System Ones had a loose ground connection on the power cord and that if an 8008ST were hooked up to one of those it would do exactly what my sample had done when I first turned it on. Well, I opened up my System One, and the ground connection was solid as a rock. Not that a loose connection there would likely cause the problem anyway, since power-line ground is not effective at radio frequencies; it's there for safety reasons.

So Federici wrote a letter and forced this reply. I am reluctant to comment on another reviewer's measurements, but when Federici says "[*Stereophile*'s] Audio Precision was working properly. . .[and that]. . .Stereophile didn't have a problem testing the Aragon," I'm left no choice. Obviously, I wasn't present at *Stereophile*'s test, so I can't be sure, but I find its published distortion curves on the Aragon 8008ST peculiar. Figure 9 (distortion versus output) shows abrupt shifts in "distortion," which suggests that *Stereophile*'s System One was responding similarly to mine. Apparently their tester didn't question the validity of the measurement; I did.

Federici goes on to say that *Stereophile* reviewer Tom Norton found that the Aragon "produced one of the best sounding top ends overall." Federici does not tell you that this was Tom's "first reaction" and that Tom goes on to say he "would not describe the Aragon as sounding 'sweet'" and that "the very top could turn slightly dry at times, with a trace of added zip." Other comments in the review could be interpreted as suggesting something was not quite right with the 8008ST's top end—Federici was particularly upset about my calling it "bright"—but I'll readily agree that Tom's review was far more positive than mine. I respect Tom Norton's integrity, but we do not listen to the same type of music nor do we necessarily listen for the same things or in the same way.



This brings us to listening, which, given the limitations imposed on reviewers, is necessarily subjective. If one is to impose any "science" on listening tests, one must try to apply the basic rules of scientific experimentation, one of which is to lock down all variables except the one under test. When reviewing a power amplifier, this means all other components in the system must remain the same and be well known to the observer.

If the speakers are changed from review to review, you don't know whether any difference you hear is caused by the amplifier, the speaker, or the interface. The most that can be said is that one combination sounds better (or worse) than another. Since the sound character of loudspeakers varies more than that of other components, I believe it is imperative that the speaker be maintained constant in the evaluation. That's why I use Allison Ones. They're not perfect, but I'm utterly familiar with their strengths and weaknesses. To me, on the types of music I use to judge other equipment, they reveal differences remarkably well.

I'm looking to replace the Ones—not so much because the design is old (they're still good speakers) but because, eventually, they're going to leave me for the great beyond. Then I'll need replacements, but until I've lived with a speaker for many months, I don't consider it fair to review other equipment with it. So I'm looking. When I find speakers as self-effacing yet revealing (to me!) as the Allison Ones, they'll go. So far, I haven't.

Regarding speaker cable, if the Aragon 8008ST requires magic wire to function well, may I respectfully suggest it be packed with the amplifier. Otherwise, I'll use low-resistance, low-inductance, low-capacitance copper wire through which electrons flow in both directions! Mine came from a major electronics distributor who sells it in bulk at a sensible price.

Finally, regarding calibration, as anyone familiar with the AP System One knows, it has a self-diagnostic routine that checks its performance.

The strangest thing about this whole affair is that nowhere does Federici question my numbers. In some respects, the 8008ST performed better on my test bench than on *Stereophile*'s. What really bothers him is my calling his amplifier "bright." And this with a speaker that, if anything, is rather "laid back" in the treble. Oh well!—E.J.F.

Editor's Note: Ed Foster was elected a Fellow of the Audio Engineering Society in 1980 "for contributions to audio measurement technology." He is a member of the Board of Editors of the *Journal of the Audio Engineering Society* and currently serves as the AES Vice President, Eastern United States/Canada. Foster was chairman of the IHF/EIA amplifier and tape recorder measurement stan-

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dards committees and was principal author of both those standards. He serves on numerous other measurement standards committees and is Deputy Technical Advisor to the United States National Committee to the IEC, the international standards-setting organization. He holds advanced degrees in Physics and Business Administration.—*M.R.*

Professin'

Dear Editor:

How can D. W. Fostle's "objective" comparisons of digital systems ("Digital Deliverance," April) have any meaning without listening to the analog signals from which the recordings were made? Certainly he should have discovered imperfections in his all-digital master "reference" system. Others, including me, who make recordings are very familiar with the sound of microphone signals and are all too aware of digital artifacts during playback. I can only presume from editorial comments and other statements that the dull and brittle timbre, up-front sound, and space-collapsing tendencies of digital systems must be a way of life. While focusing on small artifacts, the author, not having a suitable reference, appears to be unaware that the HDCD system has removed major annoyances. He then criticizes performances closer to analog feeds as sounding different from another digital system and labels these differences incompatible.

The late Richard Heyser clearly described self-centered objectivity when he wrote: "It is a foolish person who will draw conclusions about the 'audibility' of certain technical flaws in the physical reproduction based on limited 'listening' tests and ignorance of the possible differences in the frames of reference." This statement appeared in *Audio*'s March 1978 issue. The article, "Hearing vs. Measurement," should be read by all equipment reviewers.

Important engineers now operate HDCD systems for productions by top artists. These people know, use, and live by equipment chosen from exhaustive comparisons. Their observations are like my experience at recording sessions. Timbre neutrality, harmonic integrity, and balance—as well as reproduction of minute details within complex sound—are all second to none. Someone at *Audio* should have carefully listened to analog signals from tape recordings made for comparisons. He would have experienced richer, more mellow sound that is "wetter than conventional [digital] recordings." With live analog comparison, the "aggressive and obvious" limitations and sonic character of your digital "reference" system should be revealed.

A major part of HDCD system technology corrects sampling-rate consequence and achieves timbre neutrality where "traditional" systems fail badly. The author is unaware. It is a shame that the EAD and Proceed players were criticized for synthesizing mellow analog-like sounds, moving instruments back, and presenting hall ambience. Fostle's preferences may have been for dry, spoon-feed multimono with centered, close-miked, chronic mezzo-forte solos; however, in the "Moonglow" example from Reference Recordings, the trumpet plays loud behind instruments and the recording was made in an auditorium. Hence, the much-criticized three-dimensional staging presented by HDCD players is correct. It matches the analog signals making the recording.

Many times at sessions and trade-show playbacks, we have interchanged conversion methods and have observed listener anxiety, attention loss, and the sense of anguish that occur from compromised digital sound. During compromised playback, people talk more, feel head pressure, and sometimes observe harder attack transients and faster rhythm. Some call this crisp digital sound; we label such discordant suborder distortions "head drill." To assure complex sounds remain full-bodied and defined, Pacific Microsonics has developed unprecedented part-per-million conversion accuracy. Performance from transient attack and complex signals found in music is far better than anything done previously. Whether decoded or not, HDCD recordings are virtually free of added artifacts causing hard sound, agitation, and incorrect rhythm perception. Pace is not exaggerated by hard brittle sound, as the author and other reviewers not using analog references have observed and sometimes prefer. HDCD playback, decoded or not, matches sound and rhythmic time experienced from signals making the recording. It is correct and compatible.

Technical misconceptions can be misleading. Clearly, the author has narrowed his thoughts and field of observation to limitations of companders and other noise-reduction devices that operate by frequently altering levels and equalization. HDCD A/D converters have no programming to change equalization, and they will not operate on signal levels unless program dynamics prevent an accurate fit to CD standards. Without intervention, sonic problems are virtually guaranteed when dynamics won't fit 16-bit coding. Then the only option other than catastrophic overload is to reduce recording levels, thereby subjecting more of the entire program to dither limitations. High frequencies become lost as signals drop below LSB (least significant bit) resolution limits. This fundamental shortcoming of dithering and 16-bit coding dulls the decay of room sounds and instrument harmonics. Noise shaping, supersonic dithering, and after-the-fact processes are not going to recover lost information.

To overcome this well-known sonic shortcoming, HDCD systems can provide a few inaudible top peak truncations, as well as boosts to smallest signals jeopardized by dither compromise. These processes are turned on only when dynamics will not fit the CD and are never used for middle levels, as erroneously described and presented many times in the article. When HDCD processes are used, higher program levels and a boost to smallest signals restore timbre neutrality of subtle information for both decoded and compatible playback. Much literature supports inaudibility of the sparingly used HDCD high level process. Smallest-signal LSB restoration can make a more reverberant playback from very good equipment, as the author has observed. However, the less sophisticated filtering, D/A conversion, and time-base performance always found in practical equipment will truncate smallest signals and frequently add substantial hash and spike noises. The fragile live-sound illusion is damaged by such losses and distractions, which combine to reduce "wetness."

A situation like this is very clearly shown in the author's three-dimensional spectrograms, Figs. 10 and 11 (on page 32 of the April issue). Unless something has been doctored, an unprocessed recording described as having correct sound, but hopefully not the "reference" one, is full of mid-scale hash and noise during final decay. I would be very

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concerned, as these distractions are many times larger than the kinds of things criticized and are probably strong enough to create speaker awareness to pull the recording forward. Add to this an inevitable dither compromise reducing ambience and decay harmonics, and you have the sound preferred by the author. (A dull, uninteresting recording comes out better.) The HDCD example is virtually distortionless and will obviously sound ("aggressively"?) different.

Someone should have observed that many nondecoding machines playing back HDCD recordings sound closer to the originating analog signal than they have any right to do. Instead, the author made a seriously wrong assumption that HDCD is a compander. Prejudice dominates, as Fostle invalidates his technical assessment by manipulating data to show companding action where none can possibly exist. Other errors abound, ranging from misinformation and sonic speculation to other examples of flawed measurements with preconceived interpretations. Without analog comparisons, the author has focused on preserving an up-front, bright reproduction stripped of spatial cues. (Audiophiles and recording engineers usually complain about such occurrences.) Infrequent events in the musical program are given undue emphasis. Real audibility of such isolated events is unlikely, because program conditions rarely need intervention and HDCD processing's select logic prevents such rapid-fire activity.

The technological witch hunt begins by comparing room and microphone noise in a 16-bit HDCD recording with noise from a 20-bit A/D converter without input signals. What does this show? Certainly a reader quickly glancing through the article will get a bad impression. Incorrect statements create more confusion. (Reference Recordings does not use analog tape recorders for HDCD production, and sampling rates are much, much higher than 88.2 kHz.) Clearly no inference of dither spectrum, noise, or any consequence to music reproduction is possible from this misinformation.

Spectrum plots showing variances between Sony and HDCD recordings are wrongfully interpreted as large differences in frequency response. Uncorrelated spectral shapes at upper frequencies of the "Moonglow" samples can be observed. High-frequency portions won't merge when placed on top of one another, suggesting distortions or information differences are present. One tries to avoid these uncertainties by calibrating on the most identifiable, infrequent, highest peaks from the two recordings. This works when the systems being compared have similar waveshape responses and distortion is low. Since HDCD recordings were not decoded for these plots, the tops of infrequent, largest peaks sought out for calibration purposes may be compressed. Since these events seldom occur, sound is not changed. However, reference conditions have changed, and the remaining analysis will be

unpredictable. This is evident from text descriptions and observing varying high-frequency differences from one plot to another. Clearly one event causing small changes between two systems is not a different frequency response throughout the recording.

Other factors concerning spectrograms should have been discussed. Large plots of dynamic range, like those shown in Fostle's article, are very sensitive to distortions and hash-like quantization noises found in older digital systems, such as the Sony 1630. Increased high-frequency energy from these distortions is revealed when strong signals have few upper harmonics or decay quickly. It should be obvious that the HDCD system, showing less high frequencies from added distortion, should sound better. However, from the author's frame of reference the soundstage exhibited "warpage." Also, waveform response differences of anti-aliasing filters can become part of a spectrum plot. Quick-settling HDCD filters can put more of the event-related waveform in the analysis window, while the smallest responses from other filter designs can fall outside that window and become lost. These and other small-signal changes with tape-motion variations from one setup to another might account for heavily criticized measurement variations.

Very misleading interpretations are given to high-treble piano spectra. The highest frequency, smallest-signal portion shows dither noise at the same frequencies but lower amplitude than from a converter that the author likes and documents earlier. The prototype HDCD processor making the recording didn't have gain controls, so to be safe for the live recording, I set levels approximately 5 dB below optimum. Piano plots show this, but in no way do they show changing equalization, peak limiting, or the like. One can also see in the unprocessed, 16-bit conventional recording a spike anomaly only 30 dB down from signal. Hopefully this is not a recording used for sonic comparisons.

Energy-versus-time plots might show added "wetness" for compatible playback and its removal upon decoding. HDCD and 16-bit renderings in the article look the same to me. Had someone from *Audio* asked us or communicated with us before this article was published, we would have suggested using logarithmic coordinates to reveal these smallest signals before and after sub-LSB preservation. A front-panel control on the HDCD converter allows the recording engineer to make that choice. I think most recordists and engineers prefer the full process.

How can peak levels from two Jimi Hendrix CD releases that were mastered by different engineers, with different equipment, with different equalization, and possibly with different analog tapes be compared? How can a peak variation of 1 or 2 dB between these recordings have relevance? Maybe one could find out by examining the analog signals making the recording.

Maybe in an "alternative future," sound from every serious monitoring facility will reveal a recording system whose playback will be "perfect" enough that everyone of all ages, experience, and sonic preference can forgo live analog-signal evaluation. HDCD is a step closer to this ideal. Those proposing audio DVD, and most of the professional audio industry, also know that conventionally recorded CDs are not reference-capable. The only conclusion I can draw from Fostle's article is that there was a lack of scientific method and an unwillingness to open the mind to many things others hear: Subtlety, nuance, involvement, more sense of the artist, and possibly an experience. These things are bankable. They are also very important.

Keith O. Johnson
Technical Director
Reference Recordings
San Francisco, Cal.

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Author's Reply: Mr. Johnson entirely misses the point in talking about "analog feeds." The telling reference is not the "analog feed," but the actual sound of the instrument. Having written a 703-page book on Steinway, the family, and the piano's history and design with a specific chapter on its acoustical behavior in comparison to that of other pianos, I believe I am qualified in the matter of piano sound.

On this basis, it is my view—one substantiated by the data presented in the article and by listening tests with multiple persons skilled in the art—that HDCD, particularly undecoded, has pronounced negative effects on piano sound.

If, as Johnson claims, HDCD removes "major annoyances," it introduces others. Specifically, HDCD falsifies the bass of a Steinway grand and, through its manipulation of low-level system gain, distorts the natural sustain and modifies the piano's tone throughout its compass. At best, the process exchanges one form of offensive small-signal behavior for another. This might be called the "grunge-for-goo-tradeoff."

I suggest that anyone interested compare an HDCD recording of a Steinway to the readily available real thing and any conventional digital or analog recording. The HDCD timbral alterations, both bass and treble, as well as the amplified sustain, will be apparent, as documented in the spectrograms on page 32 of the April *Audio*.

The same effects are also audible on the Testmasters CD, (see May *Audio*, page 75), which provides a convenient comparison of several digital processes, two versions of analog, and HDCD as recorded by Johnson. In sum, the reference was not digital, but the real piano, other recording processes, and HDCD with measurements.

There was no adverse criticism of Proceed or EAD converters. Their presentation in comparison to the respected and widely-used "pro" Apogee DA-1000 converter was simply reported. The makers of the Proceed, with whom I have spoken, expressed no objection to the report, and the EAD was favorably reviewed in the March issue of *Audio*, an assessment with which I generally concur. For the record, I will state my belief that the use of other "pro" converters, such as those from Prism, DCS, or dB Technologies, would not have materially altered the report. This is not to say these devices sound the same.

Notwithstanding any of this, those concerned should listen for themselves and, having done so, make up their own minds. The cautious will undoubtedly want to wear a Kevlar helmet to fend off the dreaded "head drill" of which Johnson warns.

Moving briefly to the concrete, HDCD reduces the gain on peaks during recording and increases it on playback. That's companding, no matter what the process's promoters say. HDCD raises low levels on recording and leaves them there, unless one of the miniscule number of expensive decoders (compared to tens of millions of conventional CD players) is available. That's envelope distortion and is exactly what was heard, measured, and reported in the article. Johnson tells us that "program conditions rarely need intervention." His patent states that the process is doing something several times per second, "at most." Which of these statements is true?

The word "equalization" does not appear in the article. Also, as noted last month, the lower, reference noise floor (red curve) shown in Fig. 5 on page 30 of the April issue is not the raw output of a 20-bit A/D converter, but rather the output of such a converter dithered down to 16-bit via a Meridian 618 processor.

There is no "mid-scale hash" shown in the spectrograms, just the standard depiction of a whitish noise floor. As to the "sound preferred by the author," I have not expressed to Johnson—or anyone else—what my preferences in recorded sound are. And while maligning my taste, he fails to note my favorable comments on his own Mike Garson recording. Or is that disc an example of "dry, spoon-feed multimono with centered, close-miked, chronic mezzo-forte solos"?

As to HDCD's sampling rate and the statement on analog sources, both these representations were made by the president of Pacific Microsonics, Michael Ritter. Likewise, the comparison of HDCD and "20-bit" Hendrix recordings was suggested by Ritter, who provided the HDCD version and stated the master tapes were the same for both. Mike and Keith, you need to talk.

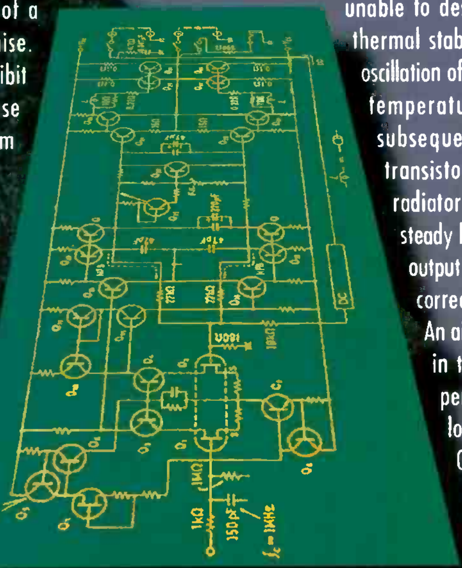
Regarding Johnson's comments about "a peak variation of 1 or 2 dB" on the Hendrix comparison, as Fig. 8 on page 31 clearly shows, the maximum variation is 4 dB. He also refers to a spike that is "30 dB down from signal." The only spike is plainly visible in Fig. 14 in the noise floor and is cited in the text. The same is barely perceptible in Fig. 10 where, by referring to the key on page 28, it can be seen to be roughly 50 to 60 dB below the leading edge of the signal.

In fairness, graphs like Figs. 10 and 11 are unfamiliar to most people in the audio industry; Pacific Microsonics, again according to Ritter, was entirely unaware of Maximum Entropy Spectrographic Analysis before I brought the method to their attention. The software, originally developed by Bell Labs, with contributions by Massachusetts Institute of technology and others, is in use at hundreds of research facilities world-wide. Pacific Microsonics' response to the results may stem, in part, from the fact that they had not made measurements with actual music but instead used "complex tones."

And is anyone else bothered that nowhere in the Johnson letter does a single specification appear, nor is any clear statement made about the HDCD process, other than what it is not? Regardless of what one may think of conventional digital processes, at least we know how they work.—*D.W.F.*

Non Negative Feedback: The **Real** Solution to IM Distortion

Practically all amplifiers, regardless of price, employ a design technique called Negative Feedback (NFB) to ensure wide bandwidth, stable operation and generally low distortion. NFB amplifiers handle back-EMF reactance from the load by introducing a canceling signal at the input. Great stuff. Downside, however, is that the benefits of NFB are at the expense of lower open-loop gain. In other words, if an amplifier is based on the concept of NFB, it is based on the concept of a correcting mechanism that introduces compromise. The result? For starters, a NFB amplifier will exhibit higher IM distortion. In addition, NFB loops lose control at maximum power conditions, and perform particularly poorly near clipping. Bad deal.



At Onkyo, we wanted to avoid NFB altogether and find an ultimately smarter way to handle load back-EMF reactance and minimize IM. So we invented a revolutionary new Non-Negative Feedback (NNFB) circuit. NNFB seems logical, but without feedback you have to lower distortion and output Z in the amp section itself. To address this, our engineers scrapped the typical emitter-follower connection, and came up with a two-level inverted Darlington circuit with a multi-level connection to an inversion amp with emitter ground. Very slick. Because the circuit is inverted, only the initial level Vbe is output, and the circuit retains A-grade operation. This pays off with lower Vbe-Ic distortion and lower output Z than any other Darlington circuit. Instead of 100% local feedback to each emitter-follower level, Onkyo uses a two-level connection of emitter-ground inversion amps, each with its own gain. This way, we can add two levels of current boosters to the emitter followers. Quite revolutionary. Thus we achieve lower output Z, and since an inverted configuration is used, we entirely avoid the collector current nonlinearities of regular Darlingtons. That was the easy part.

Our competitors choked. Their engineering departments were unable to design inverted Darlingtons with the necessary thermal stability for solid bias current and an absence of oscillation of the phase margin. Not us. We designed separate temperature compensation for the first driver and subsequent levels, strengthened the compensation transistor mounting and designed an aluminum heat radiator with a small time constant. The result: Rock-steady bias. Next, to prevent the oscillation caused by an output impedance peak at 20-30 Mhz we induced phase correction at the base of the output level transistor. An air-core coil works, but we found that ferrite beads in the jumper wire are far better (high magnetic permeability at low frequencies, low Q, and high loss at the 20-30 MHz point). Perfect. Bottom line: Grand Slam. We nailed NNFB. All of the obvious benefits. None of the drawbacks.

Our NNFB amplifiers are not based on a principle of performance compromise. They attack the underlying problems of amplifier design directly. Our research has led us to identify and solve the challenges that other designers retreated from. The innovative design of our NNFB amplifiers provides exactly what you need from a power amplifier: wide bandwidth, stable operation, and very low distortion. High performance, without compromise.

More good news: We also chucked known transformer technology, and perfected our own design—no more messy clean-ups after embarrassing flux leakage! More importantly, we've got EM induction noise down to seriously low levels. To the point: You get leakage from both the perimeter of the power supply transformer (no signal) and center core (signal present). Particularly bad is a sudden increase in leakage (and noise) at maximum output. The proprietary Dual-Core AEI transformer radically improves on traditional toroidal units, and even tweaked-up toroidals. We designed a new type of core, with peripheral and opening ratios larger than before. This allows an increase in the number of coil windings. The hybrid uses a wound core system (low leakage with no load) and a coil around the center part (low variation with or without load). Works great—with one problem. Production

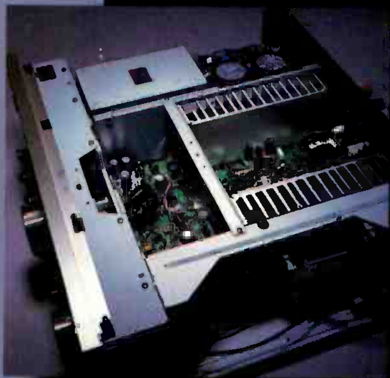
The **Real**ities of Audio Transformer & Capacitor Design

told us it would be tough to automate the process of winding the center coil. We solved this with a bobbin mounted where the two cores are joined. We can wrap the coil by rotating the bobbin. No sweat. Even better, the bobbin allows heavier gauge wire because of less stress during winding. The result? Lower resistance, which means greater efficiency when providing power to the circuit. For the listener, the new AEI transformer means pure musical signals, essentially free of any induced transformer noise. Thus the very low distortion levels achieved by our NNFB design are not compromised.

But, there's more. Onkyo went one step further and designed its own Audio Tuned Reference Capacitors. Not only do they provide greater power delivery at low frequencies, they give you tremendous continuous power reserves that last as long as the music demands them. How do we know? We conducted listening trials with over 900 different capacitors. Exhaustive research but we've ended up with the best sounding capacitors ever. Very expensive, but worth it.

Power To Spare Comes Only From **Real** High Current Drive

Finally, our engineers got extremely aggressive about Integra's current drive capability. The other guys keep bragging about their reserve power capabilities, but they always measure into a wimpy 8 ohm load. Not exactly high-end quality. Onkyo's ability to handle low impedances is based on 6-ohm loads and lower—delivering measured results that set us apart from the rest of the pack.



Non-Negative Feedback architecture. Dual-Core AEI transformers. Audio Tuned Reference capacitors. Discrete output stages. Hand-selected resistors and transistors. A modular chassis. All Onkyo hallmarks that add up to serious levels of reserve power and torque—just what's needed to handle the most demanding musical passages.

When you buy a power amplifier, the design and manufacturing techniques, measured specifications, and developmental testing are all critically important. But what is most important is the amplifier's ability to consistently deliver high power levels into low impedance loads, with the greatest possible transparency. The drive capability of Integra amplifiers in your listening room is one of our proudest accomplishments. And our competitor's worst nightmare.

That's about it. With NNFB, new AEI transformers and Audio Tuned Reference caps, the new Integra line is simply incredible. True golden-ears products. In short, if they weren't the best, we wouldn't put the Onkyo name on them.

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WHAT'S NEW

—HARMAN KARDON—

HOME THX RECEIVER

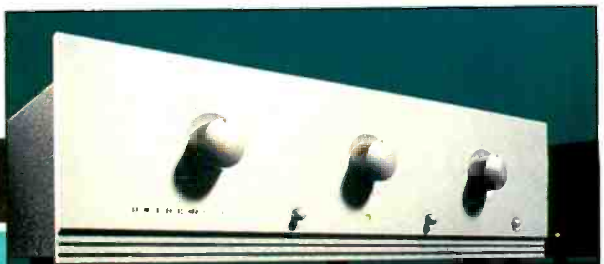
One of the few receivers with Home THX certification, the AVR80 is rated to deliver 85 watts into each of its three front channels and 50 watts into each surround channel. A Dolby Pro Logic decoder with Home THX processing is built in, as is an AM/FM tuner with 30 station presets. Seven audio and four video inputs are provided (the latter with both composite-video and S-video connections). Direct inputs for all channels enable the addition of a Dolby Digital AC-3 or other 5.1-channel decoder; the AVR80 also has preamp outputs for all channels and amplifier input connections for all except the subwoofer channel. Price: $1,699. For literature, circle No. 100

ANTHEM PREAMP

An all-tube design, the Pre-1 has its power supply on an outboard chassis. Soft-start circuitry avoids turn-on surges. The phono stage can accept MM or MC cartridges; overall gain for each cartridge type is set by selecting low or high gain for the line stage, an unusual touch. Price: $1,495. For literature, circle No. 102

Napa Valley Box CD Racks

Solid-wood Rocket racks can be stacked up to three modules high; each module has two shelves whose angles can be adjusted. The Rocket "1" accommodates up to 140 CDs or 56 videotapes, and the Rocket "2" (shown) has double that capacity. Prices: Rocket "1," $39.99; Rocket "2," $69.99. For literature, circle No. 103

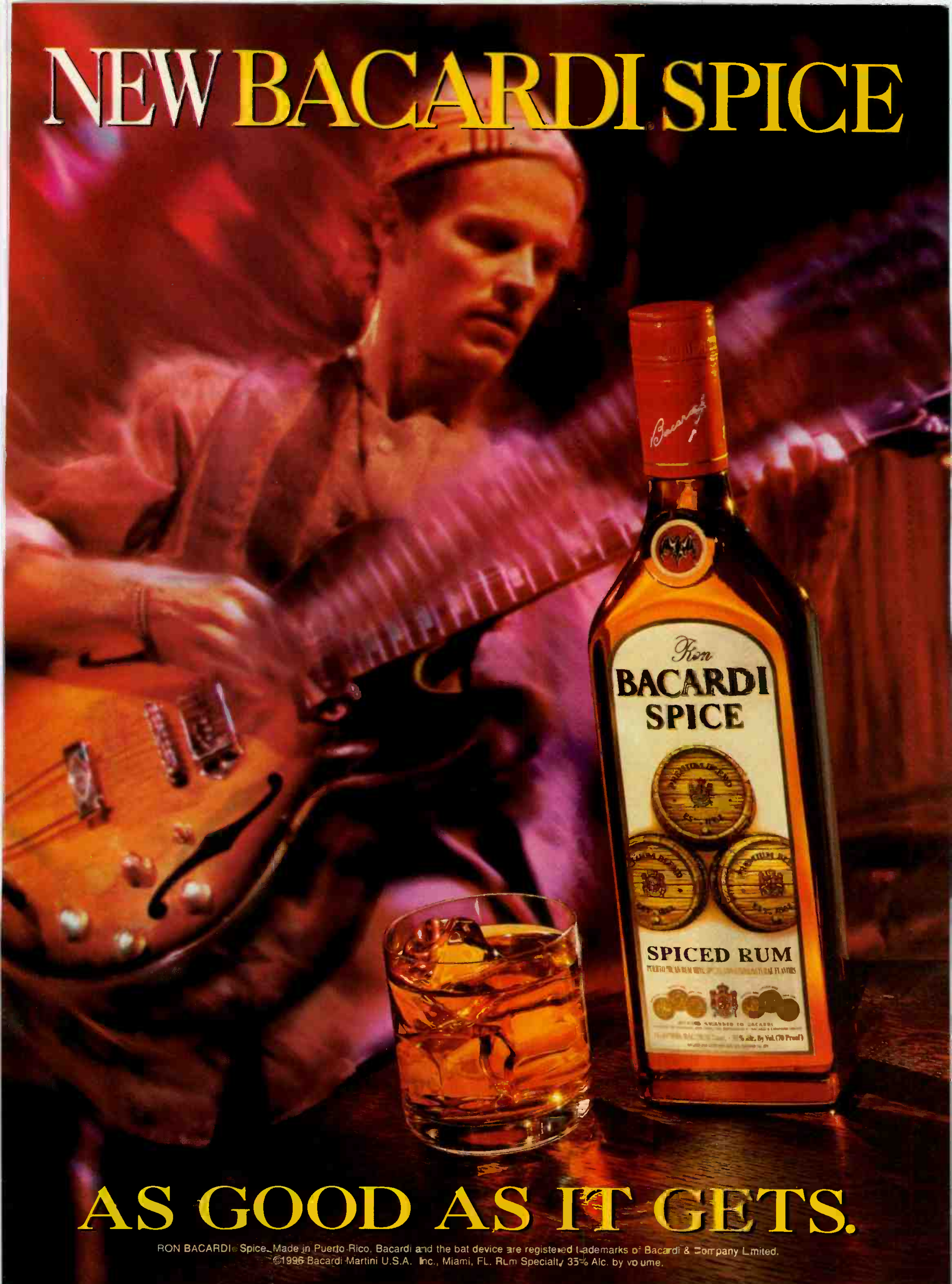


NAD INTEGRATED AMPLIFIER

Amplifiers whose power is modest but whose other specs are not constitute an NAD tradition, exemplified in the 312 integrated amp. Its power is rated at 25 watts per channel into 8 ohms (from 20 Hz to 20 kHz at no more than 0.03% THD), but its dynamic power is 50 watts into 8 ohms, 60 watts into 4 ohms, and 75 watts into 2 ohms. A switchable soft-clipping circuit reduces distortion when the amp is being pushed to its limits. The 312's features include preamp-out and main-in jacks, six line inputs (including provision for two tape decks), and tone controls that act only on the frequency extremes and can be switched out of the circuit. Price: $299. For literature, circle No. 101

PARASOUND CD TRANSPORT

Like many a turntable, the Model C/BD-2000 CD transport uses belt drive for smoothness and high-inertia rotating parts for speed stability. (The inertia results largely from a ¾-pound hold-down disc clamp.) The programmable transport has repeat play and remote control. Outputs are coaxial digital and balanced AES/EBU; an AT&T glass-fiber ST output is optional. Prices: transport, $1,550; ST output, $225. For literature, circle No. 104



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WHAT'S NEW

PETRAS CAR SIGNAL PROCESSOR

The QS1 has a number of features uncommon in car stereo. Its spatial-restoration processor, for example, is designed to enhance image width and depth. Its 80-Hz subwoofer crossover feeds a parametric bass EQ whose level, "Q," and center frequency are all adjustable; an automatic sliding infrasonic filter is said to reduce destructive motion of a subwoofer's cone. Outputs to the main speakers can be full-range or crossed over at 80 Hz; the adjustable mono center-channel output crosses over above 250 Hz. Price: $209. For literature, circle No. 106

Stinger Electronics Car Fan Controller

Car amplifiers rarely get much ventilation, and cooling fans can generate noise and add to the load on a car's electrical system. The SFC fan controller turns fans on only when your amp needs cooling. It sits on the amp and starts your fans when it senses the amp has reached a preset temperature, which is adjustable from 90° to 130° F. Fans are not included. Price: $34.95. For literature, circle No. 107

Alpine Car CD Head Unit

The CDA-7832 comprises a tuner, CD player, CD changer controller, and amplifier. Tuning, source-select, and other buttons surround its control knob; the knob can also be used for fairly rapid entry of disc titles. The unit can control up to six CD changers. Its tuner has two six-station memory banks for FM, one bank for AM, and one for an FM/AM mix. The amplifier delivers 35 watts x 4, and there are preamp-level outputs for left and right channels and a subwoofer. Price: $630. For literature, circle No. 108

Designed for car stereo use, 4-Channel Interlink 401XLN cables comfortably fit tight spaces. Their twisted construction, intended to reduce inductively coupled noise, is said to yield 40 dB greater noise rejection than other cables. The RCA plugs have gold contacts and a Turbine shield that grips jacks securely. The cables are available in seven lengths, from 0.5 to 6 meters, and in bulk. Prices: 0.5 meter, $59.95; 6 meters, $129.95; bulk, $4.50 per foot. For literature, circle No. 105

JVC CAR CD CHANGER & AMP

It's easy to add CD changers to car head units, but many of those head units don't have enough amp power to make the most of CD sound. The KD-MA1 12-disc changer therefore has an amp rated at 30 watts x 4, which is in a hideaway controller box. The amp accepts two-channel speaker-level signals from a head unit and then delivers them to your car's four speakers; fading is controlled by the KD-MA1's wireless remote, which also controls volume, balance, bass, treble, and the changer functions. Price: $499.95. For literature, circle No. 109


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AUDIO CLINIC

JOSEPH GIOVANELLI

Resist Those Resistors

Q *My A/V receiver has a switch that must be thrown when using 4-ohm loudspeakers in the front channels. The receiver's directions say that I should use 8-ohm loudspeakers when using surround. Will I ruin the receiver by using 4-ohm speakers? Would putting 4-ohm resistors in series with these speakers save the day?*—Mark D. Mina, Costa Mesa, Cal.

A You do stand a chance of damaging your receiver's amp section by using 4-ohm loudspeakers when the owner's manual calls for 8-ohm speakers. You can probably get away with it, if you don't drive the receiver anywhere near its maximum power. Also, it may be that the manual is indicating only that the surround-channel speakers must be 8 ohms. Double-check that before you do anything else.

Placing 4-ohm resistors in series with each loudspeaker will indeed give the amplifier an 8-ohm load it can be happy with. But half your signal will be lost in the resistors, so you may be unable to get enough volume or may have to drive the amp so hard that it clips, perhaps damaging your speakers. You may also find that the bass sounds mushy or boomy because the resistors effectively increase the amplifier's output impedance.

In the long run, it might be a better idea to replace your present loudspeakers with 8-ohm models or replace the receiver with one that can accept lower load impedances.

Adding Amplifier Level Controls

Q *I am going to biamplify my loudspeaker system with two tube power amplifiers. I need to add input level controls to these amps. What resistance should the controls have? And should I remove the 470-kilohm grid resistor from each input?*—Robert W. Clifford, Lancaster, Cal.

A You might not need to remove the amps' input resistors. If you drive your amps from a solid-state crossover, the resistance of the required potentiometers will be so low that the 470-kilohm resistor will effectively be out of the circuit. You'll be able to keep the input resistors and use potentiometers that have about 50 kilohms of resistance for the level controls.

If you use a tube crossover, you might wish to maintain your amps' high input impedance. In that event, remove the grid resistors and use 470-kilohm pots. You should keep the cable runs between the wipers of the pots and the amplifiers' input grids as short as possible. If you hear diminished treble, especially when the controls are near their center positions, you probably need to use low-capacitance, shielded cables between the pots and the grids.

With either approach, be sure to buy audio-taper pots.

Effects of Oversampling

Q *What effect do sampling rates and oversampling have on digital audio's sound quality?*—Name withheld

A Digital recording works by sampling a signal's voltage many times a second and then storing the numerical value of each sampled voltage. The number of samples per second sets the maximum possible frequency that can be recorded, which is just under half the sampling rate; the CD sampling rate of 44,100 times per second (44.1 kHz) allows frequencies up to 20 kHz or so to be recorded.

The recorded signal's sampling rate and frequency content cannot be changed. But most D/A converters work at higher sampling rates than the rate on the recording, mainly to enable use of digital filters.

The unfiltered output from a D/A converter contains the frequencies originally recorded as well as ultrasonic artifacts of the sampling process. This ultrasonic noise must be filtered out of the signal fed to your system, lest it overload amps and tweeters or cause other problems. Removing everything above 22 kHz by conventional means without appreciably rolling off audio frequencies (20 kHz and below) requires a very steep analog filter, which can cause high-frequency phase shift and frequency response ripples in the audio signal. Oversampling, on the other hand, enables use of a digital filter between the audio band and the much higher oversampling frequency, followed by a shallow analog filter. This approach makes it much easier to get flat phase and frequency response in the audio band. And 1-bit, or delta-sigma, converters require rapid oversampling in order to work at all.

An oft-repeated myth, by the way, is that oversampling improves error correction by reading each sample on the disc multiple times. This is completely untrue; oversampling is an entirely mathematical operation.

Turning a Subwoofer Off

Q *The receiver in my home theater system does not have a line output for a powered subwoofer, so I use a passive sub. But when I'm listening to music, I often prefer the sound without my subwoofer. Is there an easy way for me to connect the system so that I can easily turn the subwoofer on and off?*—Tom Gebbia, Lynbrook, N.Y.

A If your satellite loudspeakers operate full-range, with none of their bass rolled off by crossover networks, all you need is a switch in line with the "hot" leads of the subwoofer's voice coil. If your subwoofer has a dual voice coil, you will need a double-pole single-throw (DPST) switch for this; otherwise, a single-pole single-throw (SPST) switch will do. But get a switch that has a fairly high current rating (5 to 10 amperes will probably suffice).

If your satellites are fed from a crossover, you need a way to bypass the crossover as well as to turn off the subwoofer; just turning the subwoofer off will eliminate all bass. Your switch will now have to do two jobs: It must divert signals from the crossover and subwoofer so that they feed the satellites instead, and it must cut the connection between the satellites and the subwoofer.

You could do this with a double-pole double-throw (DPDT) switch and a double-pole single-throw (DPST) switch. Feed your amplifier to the center terminals of the

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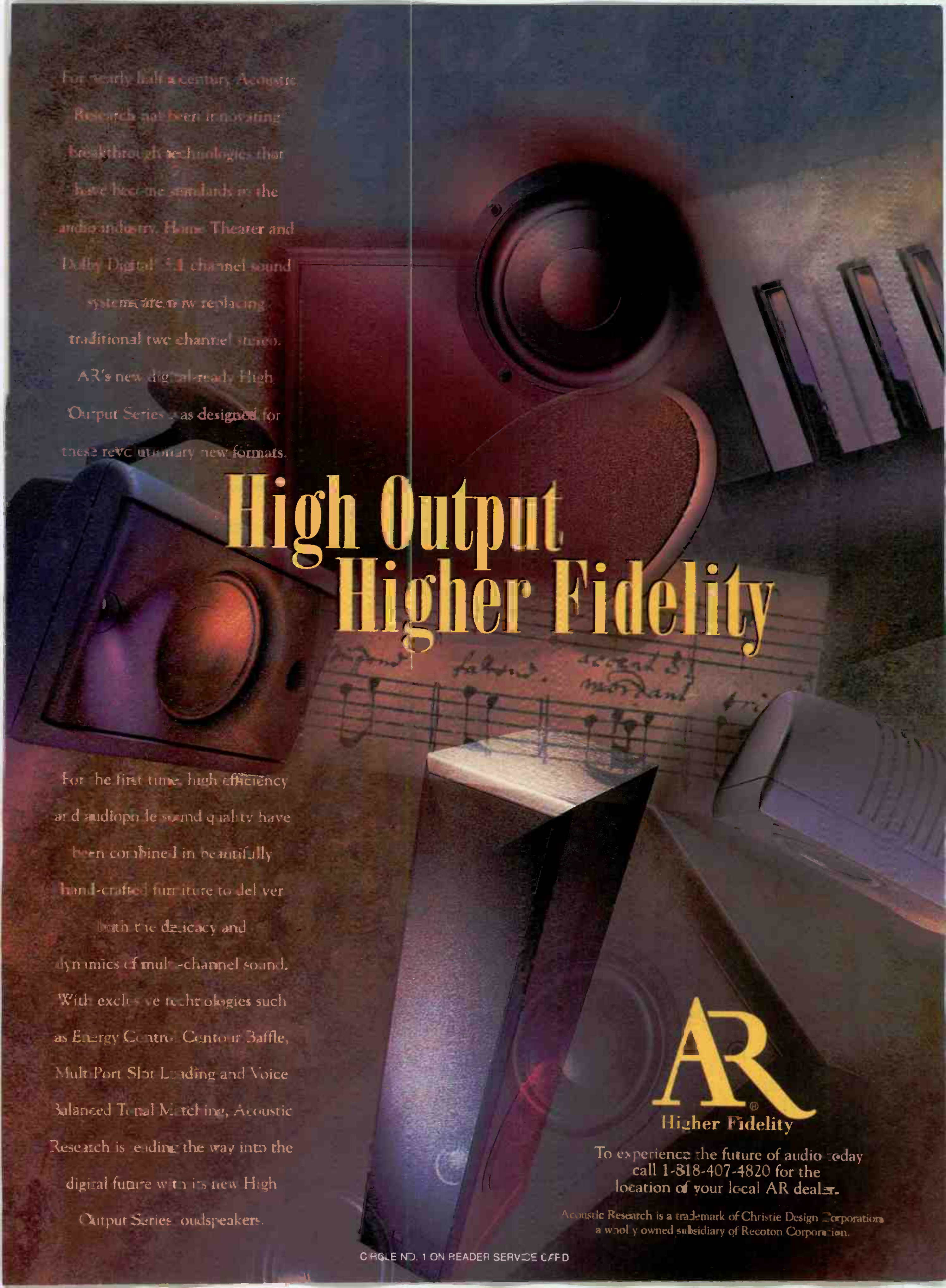
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DPDT, connect the terminals on one side of the switch to the satellites, and connect the terminals on the switch's other side to the subwoofer. Put the DPST switch into the line between the subwoofer and the satellites. Align the switches on some kind of panel so that both point the same way when you have them set properly; better yet, link them physically with a bar so that you automatically operate both switches simultaneously. It would be simpler still to use a four-pole double-throw (4PDT) switch, but they're hard to find.

Disappearing Left Channel

Q *Every so often, the left channel of my preamp cuts out. Sometimes I can fix this for a while by playing around with the controls or switching the unit on and off. The longest-lasting fix I've found is to unplug the cables between my preamp and my electronic crossover, plug them into the opposite channels, and then put them back as they were originally.*—Agim Perolli, White Plains, N.Y.

A The problem might lie with either your preamplifier or your crossover. But since the problem goes away when you unplug and replug your cables, I think it's caused by a defective cable, by a dirty or oxidized connector, or by loose connector contacts.

Unplugging and replugging cables tends to wipe dirt and oxidation off both plug and jack. It might be even better to dab a little contact cleaner on each connector and immediately plug that connector into its mating jack. Do this a few times with each cable.

To check for defective cables, wiggle each cable a bit while the system's working and see if the sound cuts in and out. If it does, you may well have a bad cable. Cables are most likely to develop intermittent connections near their plug ends. If you find an intermittent section, cut it out and solder on a new plug (or reattach the old plug to the new end, if that's feasible).

Intermittent operation can also be the result of loose contact between a plug's center pin and a socket. If that's the case, try other cables to see if your cable's plug has too thin a center pin. (This is more likely to occur with cheap plugs.) If all plugs are loose in the socket, you may be able to tighten the socket's center contacts by squeezing them with needle-nose pliers, from inside the preamp. (Be sure the preamp is off.) The skirts of RCA plugs can also become loose, but that's more likely to introduce hum, not cut the signal out.

Does Speaker Cable Age?

Q *A repairman recently replaced the pin plugs on my 10-year-old speaker cable with banana plugs. He told me that I should also replace the cable itself because it could have deteriorated over the years. Is this reasonable?*—Name withheld

A I don't see any need to replace your cables. Cables do oxidize, but that's only a problem at their ends, where they are most exposed to air and where the oxidation can affect your connections. And the cable was presumably stripped clean at the ends when the plugs were replaced.

Loudspeaker Overload

Q *I have separate left and right front speakers but use my TV's speaker for the center channel. When I play movie soundtracks that have explosions, crashes, or other* *loud sounds, I hear a popping and cracking sound from the front. What causes this? And do I need a subwoofer to handle the low frequencies?*—Neal McIntosh, Front Royal, Va.

A From what you say, it sounds like you are overdriving your front loudspeakers. The popping and cracking you hear is the speakers' voice coils striking their pole pieces when the signal demands that they move further than they were designed to. If you continue to overdrive your speakers, their voice coils will eventually be damaged. This will cause audible distortion (especially at low signal levels) or, in extreme cases, total silence because of broken coil windings.

For the time being, you can prevent the problem by listening at lower levels. And if you're using a Dolby Pro Logic decoder, make sure you are running it in "Normal" mode, to keep as much bass as possible out of the TV's speakers. But, as you guessed, a subwoofer should cure the problem because it will enable you to feed less bass to your present speakers.

You'll also need a crossover that not only feeds bass to the subwoofer but also filters bass out of the signal that's being fed to your main speakers. Many subwoofers, especially powered subwoofers, have such crossovers built in.

If you are unhappy in other ways with your front loudspeakers' performance, this could be the time to audition other systems to find some you like better. Using speakers that have better bass response may or may not reduce your need for a subwoofer; however, if you still use your TV's speakers for the center channel, you're definitely better off with a sub.

Indeed, it is possible that the small TV speakers are the only ones being overdriven, in which case switching to a dedicated center speaker might on its own solve the problem while providing much improved overall sound quality in the bargain.

Two Center-Channel Speakers

Q *I'm setting up a surround system, and my equipment provides for one or two center-channel speakers. Even with two speakers, the center channel will still be mono, so what advantage could there be in using two?*—Name withheld

A In general, best sound quality will be obtained with a single center speaker directly above or below the TV screen. However, two speakers reproducing the same signal will sound like a single speaker placed midway between them—right in the middle of your TV screen, where dialog should seem to come from. With average-sized TVs, mounting a single center speaker just above or below the screen will make the dialog seem to come from the right place. But this illusion is harder to achieve with large projection TVs; that's where two center speakers might pay off.

In most installations there's not much room above or below the TV. So if you want to use a large speaker for your center channel (to match your main speakers, for instance), you might find it easier to install one on each side of the TV.

Those people whose equipment does not provide for two center speakers can connect a pair in parallel to their center-speaker terminals. Hooking up two speakers in parallel will halve the load impedance (i.e., paralleling two 8-ohm speakers makes a 4-ohm load), so they must be sure that the resulting impedance is no lower than their receiver or amplifier allows.

Using Two Preamps

Q *I want to adapt my stereo system for home theater. None of the surround processor/preamps I've seen has phono inputs, but the excellent preamplifier I already own does have them. Would it make sense to keep my current preamp for its phono section, using a Y-connector to connect both my present preamp and a new one to my main power amplifier? Feeding the old preamp into the new one would use up a high-level input, and the processor/preamp I want hasn't any to spare. I also think I'd get cleaner sound by feeding phono signals through one preamp instead of two. Could I also use Y-connectors to feed my CD player into both preamps? This would allow me to play CDs through my old preamp's DSP section as well as through the new surround preamp.*—John E. Gallagher, Goshen, Ind.

A It is certainly reasonable to use your present preamplifier for its phono section and to use its DSP section with your CD player.

You could use a Y-connector to feed your CD player into two preamplifiers, as long as you switch *both* preamps to whichever input the Y-connector is feeding. Otherwise, the preamp that you're not using will put a short across the CD player's output. That will kill the sound and might damage the player's output circuits.

Feeding your old preamp into your new one might not be as bad as you think it is. If you take the signal from your old preamp's tape outputs, you'll bypass that preamp's volume and tone controls (and most of its circuitry), so there should be little or no loss of sound quality. You could use your old preamp's line inputs as well, which would more than make up for the input you're using on the new processor/preamp. Unfortunately, this approach would probably also bypass the old preamp's DSP section, which you say you want to continue using. So you'll need to take the signal from your old preamp's main output rather than from its tape loop. You'll then be able to use its volume and tone controls and its DSP section. If you still want to avoid running the old preamp through the new one, you will need a way to feed one preamp or the other to your amp. But you must *not* connect the two preamplifiers to the power amplifier via a Y-connector. If you use a Y-connector, whichever preamp you are using will see the other preamp's output section as a load; this could reduce output and might cause distortion. You'd be better off making or buying a switch box to connect the amp to either preamp alone.

Controlling Remote Speakers

Q *My house is prewired for audio, with stereo speakers in six zones. I want to use these speakers and will probably want music in several zones at once. What would be the best way to power this system at a reasonable cost? Should I buy a good stereo amp and a good external speaker selector? Or, since I've heard that the protection circuits on speaker selectors degrade sound quality, should I buy something like Niles Audio's Model SI-1200, a moderately priced 12-channel amp? If I do use a speaker selector, should the volume controls have protection circuits?*—Kirk Creswick, Phoenix, Ariz.

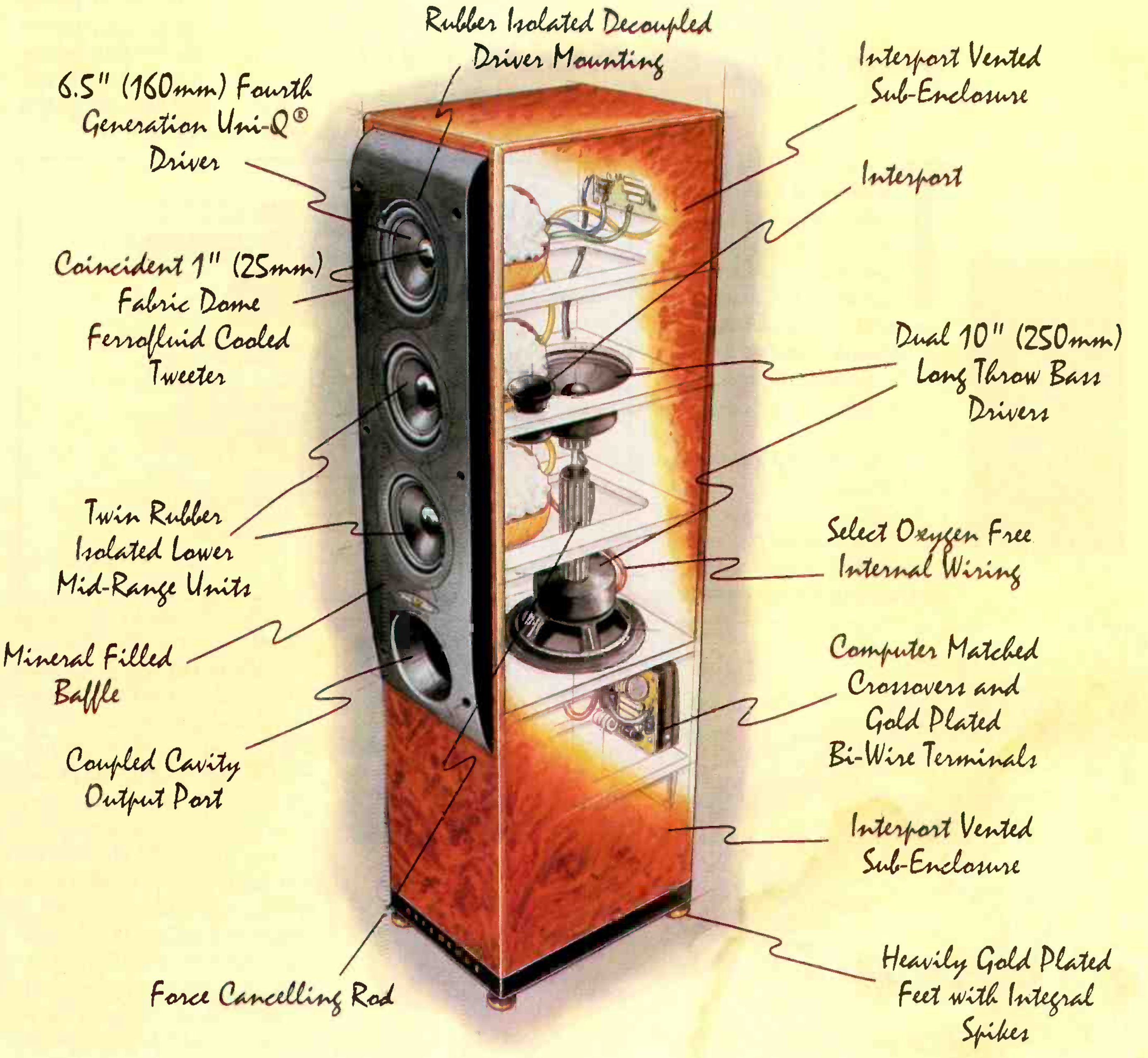
A Using an external speaker selector and wall-mounted volume controls would be the most affordable way to go. With separate volume controls in each zone, the listener can set his own sound level. (I prefer stereo controls; having separate controls for each speaker is an unpleasant complication.) At one time, I would have said not to do this, because volume controls were then resistive L-pads, which wasted amplifier power by turning it into heat. Good modern volume controls are autotransformers, which waste little power.

Although the protection circuits in good speaker switchers do use resistors and thus waste power, they should not, as you fear, noticeably degrade the sound. On the other hand, you need not switch the protection circuit in unless you're playing music in several zones. If you do so mainly for background music, then power limitations would probably not bother you. Since the protection circuit in the switcher will prevent damage to your amplifier, you don't need additional protection in your volume controls.

The Niles Audio 12-channel amplifier has preset level controls for each channel, but those controls cannot be set remotely. The listeners in any zone would have to be happy with the level they got, unless you used volume controls in each room. A

KEF Reference Series Model Four

The *Inside* Story



Look inside the new KEF Reference Series Model Four and you'll understand why it has been hailed as one of the finest loudspeakers in the world. You'll find brilliantly innovative design and advanced features found on no other speaker. No wonder it has met with such critical acclaim.

"...In the end, I was delighted with the performance of the KEF Reference Four..."

"...you won't be disappointed with the result..."

Tom Norton, Stereophile

"...This speaker has a degree of slam and overall dynamic range associated with the best at two or three times the price..."

Martin Colloms, Hi-Fi News

"...The Model Four's response within 30 degrees of the axis is extremely uniform in both the horizontal and vertical planes; KEF's Uni-Q® speaker systems are easily the best I've measured in this respect..."

"...be prepared to enjoy yourself a lot..."

D. B. Keele, Audio magazine

KEF®

The experience of sound

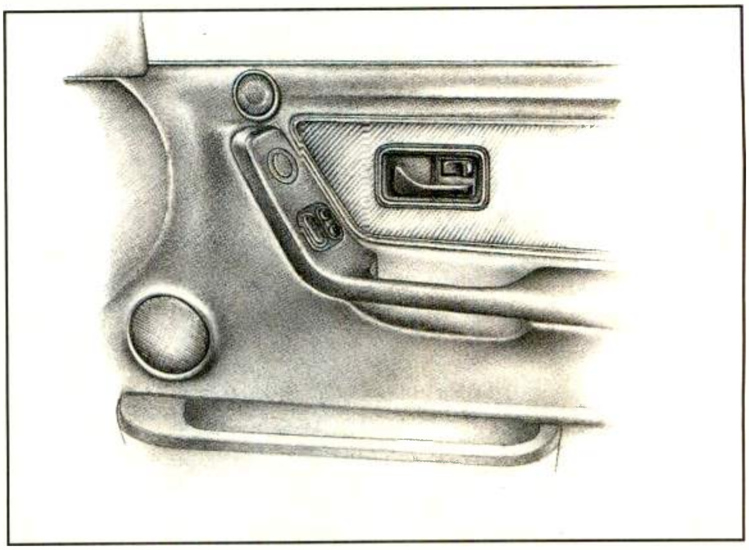
SPECTRUM

IVAN BERGER

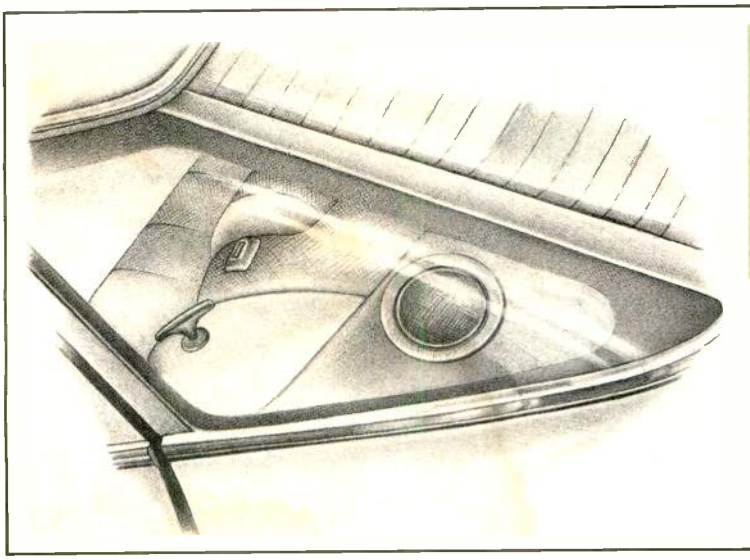
A STAR IN SCORPIO

To test good audio gear, you need a good sound system. I test car stereo gear, so I had a great excuse to put a stereo system into my Merkur Scorpio when I bought it in 1989. I worked closely with installer Tony Igel of Stratford Mobile Sound in New York City (212/749-5290). It was an educational experience for both of us.

We put a new midrange behind the door's grille, shown right, and added a tweeter up above.



What I wanted was a system that produced good sound without vast arrays of speakers or megawatt amps and without requiring that Tony rip my car to shreds to install it. I wanted clarity and articulation, good imaging, some sense of space, and reasonable bass response. I wanted just enough undistorted power to cut through road noise but not enough to share my sound with the whole neighborhood. I wanted, in other words, a system for grownups.



Replacing the original rear-deck speakers proved a mixed blessing.

What I got was pretty much what I had asked and worked for. Even now, after just about every component in my system has gone out of production, I'm still happy with the sound. There's a lesson in that: Good equipment can go out of production without becoming out of date.

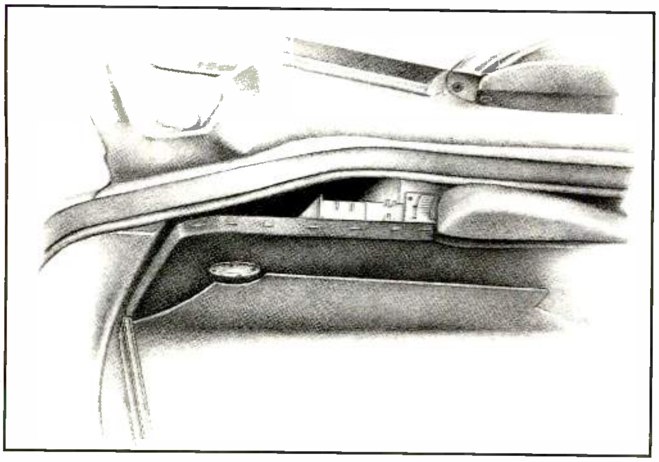
The first step in designing my system was to figure out where my speakers should go and which speakers Tony and I should put there. The Scorpio came with 3-inch tweeters atop the dash, 6½-inch midranges in the doors, and 6½-inch coaxials in the rear. Before making any changes, I asked Ford to lend a Scorpio to David Clark so he could measure its acoustics and original sound system. Ford requested that we not publish those curves, which is a pity: The stock front speakers were remarkably flat out to about 11.5 kHz; the rear ones were equally flat to about 2 kHz before rolling off.

I flirted with the idea of replacing the original dashboard and door drivers with KEF separates; I even called a KEF engineer in England who'd done just that in a Scorpio. But Clark told me, "Stay away from dashtop tweeters. You can't get any crossfiring, and the imaging suffers, pulling toward the nearer side of the car." I also disliked having the tweeters so far from the midranges. So I replaced the in-door midrange drivers and put broad-dispersion dome tweeters above the replacements. The drivers I picked were Audiophile 2.5s—the cleanest, flattest drivers I could then find, based on my listening at trade shows and Clark's measurements.

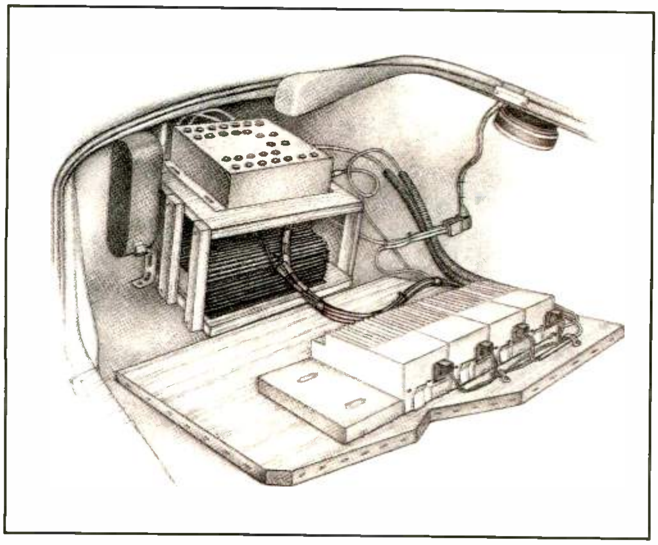
Illustrations: ©Lorraine Dey, 1996

HOW'S THAT AGAIN?

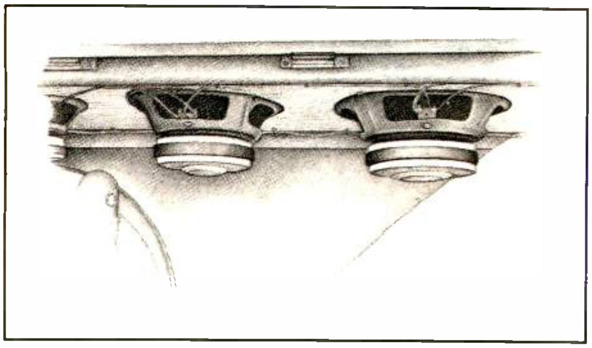
Rockford Fosgate and Kenwood compete in the car stereo arena. So I was surprised to see both names on one booth at the recent Mobile Electronics Show. Then came the double-take: The names were "Rockwood" and "Kenford."



A gap between the amp board and the trunk rim provides a little ventilation.



Tilting the amp board down reveals the main amp (foreground), subwoofer amp, and, just above, the equalizer.



Subwoofers (below) are under parcel shelf.

Tony installed the tweeters just below each front door's window. He angled them so that each front seat was well off the nearer tweeter's axis and on the axis of the tweeter on the far side. The high mounting ensured that the legs of anybody in either front seat would not block the opposite channel's treble; the angling was to make both channels' treble equally loud for listeners on each side of the car—a classic time-intensity trade-off. (We tend to focus on the louder of two sounds or the one that reaches us first; in a car, the nearer tweeter's sound usually is louder *and* reaches us first, which makes the other tweeter fade into the background. The nearer speaker's sound will always reach us first—yet if we're sitting off its axis and on the axis of the farther speaker, it will no longer be the louder one.) After we picked the drivers, I was concerned that the dome tweeters' dispersion would be too broad and that their off-axis sound would not be soft enough to make this work. I had reason to worry: While this setup did not shove soloists off to one side, the best it could do with the rear speakers faded out was to place center sounds just ahead of each listener. To make soloists seem to be on the car's center line (which I prefer), I must fade in the rear speakers slightly.

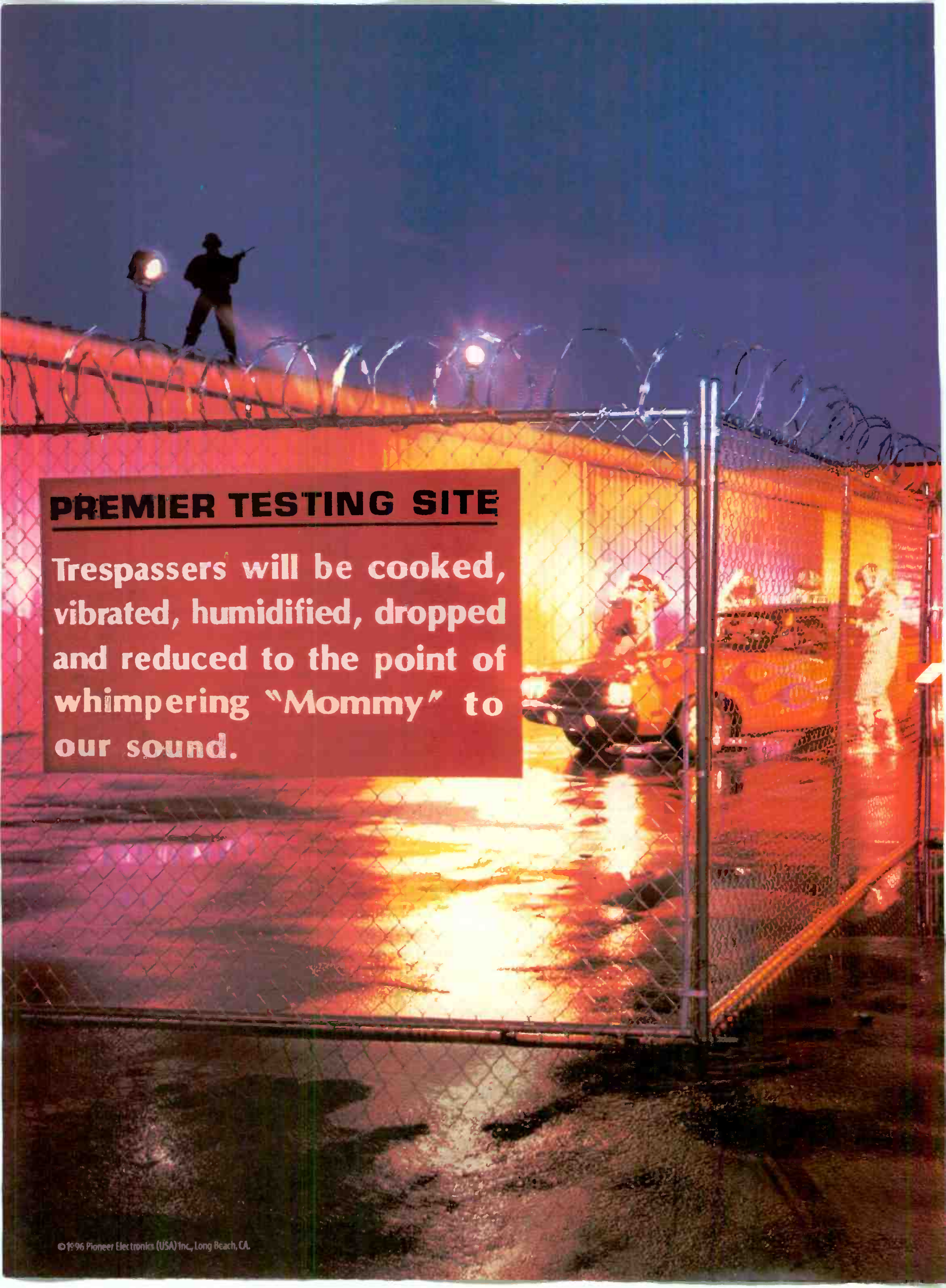
Those rear speakers are now Infinity 9 Kappas, with EMIT tweeters, which replaced the Scorpio's rear coaxials. By themselves, the Kappas sounded fine; but they didn't blend with the front speakers as well as the original coaxes did. Dana Hathaway, then of a/d/s/ (and now of Advanced Composite Audio) explained it to me: Good tweeters give you good imaging, but a good image in the rear conflicts with the imaging in the front. So I used an AudioControl equalizer to roll the rear channels off gently above 2 kHz. With the Infinity tweeters throttled back to match the factory speakers' response, the problem went away.

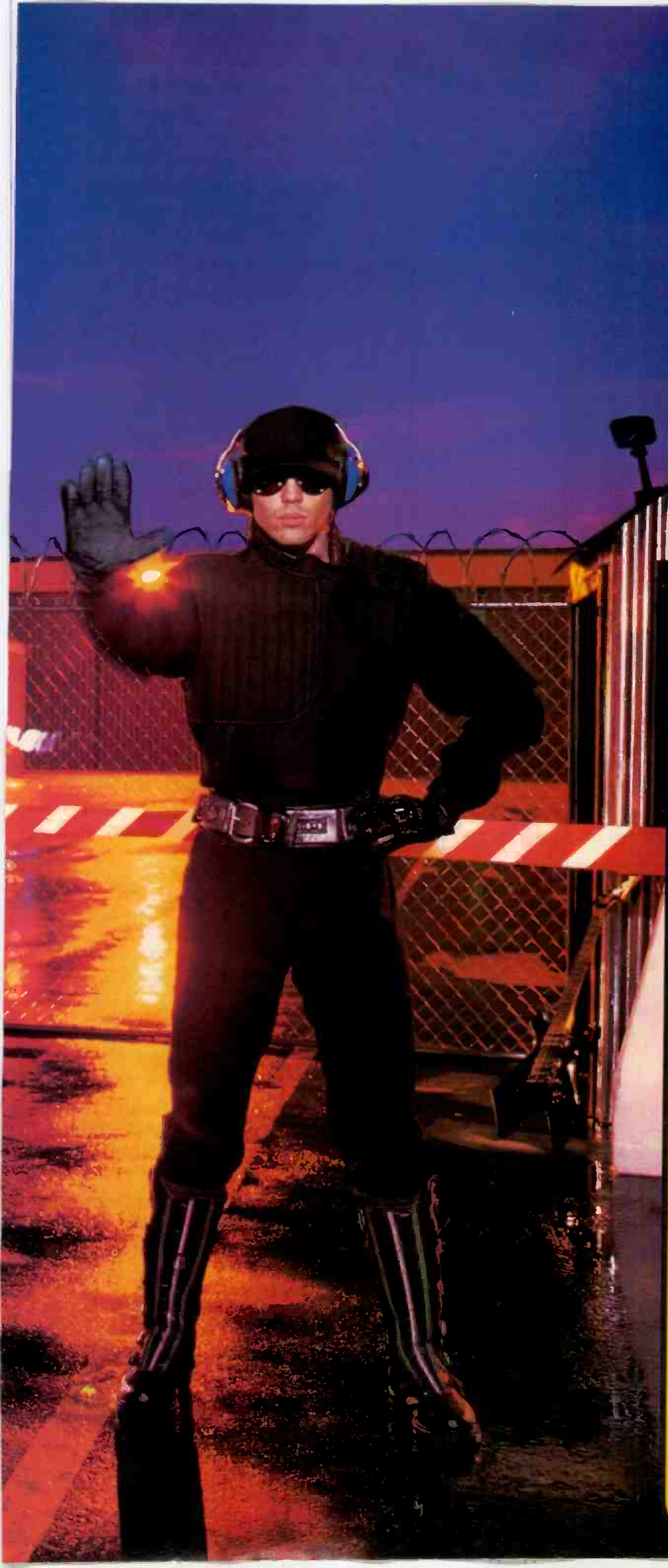
Installing a subwoofer presented a dilemma. One reason I bought the Scorpio was that I could stash cargo in its hatchback; a woofer box would reduce the cargo space. The obvious alternative was to sink woofers into the parcel shelf behind the rear seat. However, the Scorpio has a big gap between that seat and the shelf, so the woofers' rear waves would leak out and partially cancel their front waves, diminishing the bass. The best compromise I could find was to use Linear Power's 1752S subwoofer system, four 8-inch drivers (just the right size for that shelf) with a 175-watt servo amp that would at least try to compensate for the bass losses. I got pretty good bass, but (as Clark's measurements showed) that's partly because of the car's acoustical response, which rises steeply below about 75 Hz.

The system's imaging is good enough to render a center speaker unnecessary (and we could never figure out where to put one anyway). But since I had originally intended to have a center speaker, I chose a Canton amp that had four plug-in channels (at 50 watts apiece) and room for a fifth. The Canton has built-in crossovers but no line-level subwoofer output to feed the Linear Power servo amp. The solution was an a/d/s/ 642csi crossover; it has a remote subwoofer-level control, which Tony installed in the console between the front seats.

This taught me another lesson: In a car, an accessible subwoofer control is a necessity. The bass level that suffices when the car is idling will be swamped by road noise when it's rolling; the level that sounds good on the road will boom you crazy when the car's at rest. And although I usually like my bass realistic, there are times (and recordings) that make me long for glorious excess.

The AudioControl equalizer I mentioned above was installed to correct frequency re-


PREMIER TESTING SITE
Trespassers will be cooked, vibrated, humidified, dropped and reduced to the point of whimpering "Mommy" to our sound.
©1996 Pioneer Electronics (USA) Inc., Long Beach, CA.



Premier is the car stereo that pain built. If the sound gets aggressive at times, it's because our merciless testing hammers something called *stereo angst* into the soul of each unit. Most of you have heard this condition referred to as *high-quality sound.* It answers to either one.

After the headunits are shaken like they're out of their minds, operated in 95 percent humidity, subjected to temperatures from −40 to 176 degrees and dropped from nail-biting heights, they're able to arm wrestle your car and win.

Our Premier® speakers wish they could be so lucky.

Their hell consists of acoustical analysis tests, strength tests, ultraviolet radiation tests, more extreme temperature tests and weatherability irradiation tests, which force them to belt out an obscene amount of volume for 150 head-kicking hours.

Whew! (Wipe sweat from forehead and flick.)

Special robotics and computer-aided design and manufacturing techniques were built by our own hands to ensure a nod from our furrow-browed engineers. Then to keep the obsessive-compulsive dedication to sound quality consistent, we chiseled Premier dealers from the same slab of concrete as the engineers.

Hopefully the headunits inherit some of our approach-me-and-get-racked attitude. But we felt the fools lurking. So Premier invented Detachable Face Security™ and then added a car alarm, built into the unit itself, that blasts its warning inside the car to terrorize the thieving rodents into scampering away without your beloved stereo.

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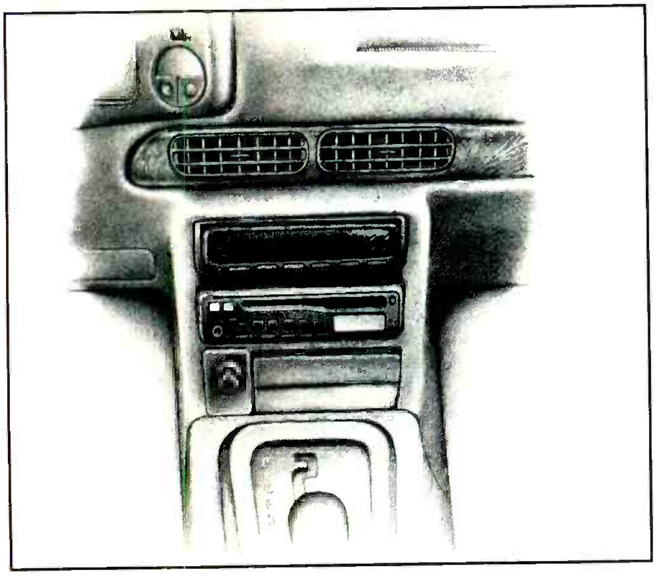
Assembled with high-quality components by bare hands, these amplifiers have a built-in crossover and come dressed in purple.

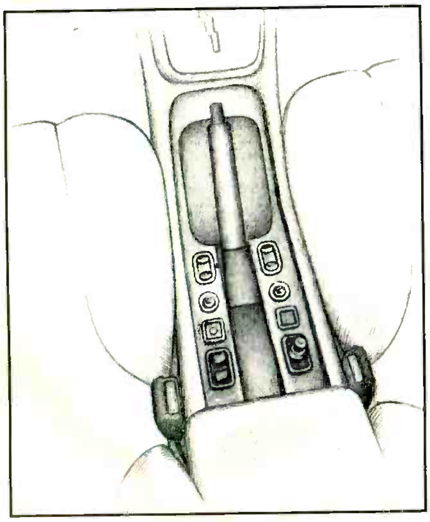
Depending on the speaker's frequency demands, Rigilite™ Composite Cones contain the perfect tailor-blended mix of maximum-performance materials in order to be both rigid and light.

PREMIER

The Scorpio's original console holds my reference head unit and whatever unit I'm testing.

We added two switches, shown below, for head-unit comparisons, and a woofer level knob.





sponse anomalies. Aside from rolling off the rear speakers' treble, however, I've never had to use it. Lesson: Leave space for an equalizer, but don't buy one until you're sure it's needed.

To hold the amps, crossover, and equalizer, Tony built a compartment into the left rear fender, where it would steal a minimum of trunk space. Unlike the Scorpio's sculpted trim panel, the compartment's door is flat. This made it a good surface for mounting the amp and left a small gap between the panel and the trunk rim, for ventilation. (The front of the compartment is open, also for ventilation.) With all the goodies hidden, I can open my trunk in public without advertising what I've got. (Someone did break into the car before the amp compartment was finished and stole the Linear Power servo amp. I then had a Clifford Avant Garde II alarm system installed and have had no more losses.)

The console just below the Scorpio's dashboard holds two DIN-sized chassis. I use the lower slot to hold my current reference head unit; whatever unit I'm testing goes above it. My first reference head unit in the Scorpio was the Soundstream TC308 I'd used in my Saab, a tuner/cassette player so good it took me a few years to switch to CD. Currently, I use a Denon DCT-950.

Another console runs between the front seats. Two neat little Carlingswitch Curvette rockers on top of this console let me switch between the two head units. The rockers actually control two relay-operated switchers, which are out of sight. (It struck me too late that a single rocker would have sufficed.) A Sony four-circuit switcher channels sound from either head unit to the amp compartment in the trunk, and a Zapco audio switcher toggles the retractable Hirschmann antenna between head units (the Zapco passes RF nearly as well as it passes audio!). The knob for the a/d/s/ crossover's subwoofer level control is just across the console from the rockers. In front of that knob, Tony installed a little toggle switch to control a processor I then decided I could do without. From that, I learned my final lesson: Don't use spindly little toggle switches in car stereo installations; sooner or later, they break.

By competition standards, what I have is modest: just four midrange drivers, four tweeters, four woofers, and only 375 watts of power. I'm using power, signal, and interconnect cables from Monster Cable and Phoenix Gold, and they're all tucked out of sight. Except for the add-on tweeters and the stacked head units, almost no one would notice this is not the car's original system. The only trick feature is the switching. And, as I said, virtually everything in my system is so old that it's no longer made. But it sure sounds good. A

TDK PUTS ITS MONEY WHERE YOUR EARS ARE

TDK's new SA-X Limited Type II cassettes are "the ultimate expression of analog recording technology." At least, that's TDK's opinion. But they'd like to know yours.

Since you can't form an opinion of a tape you haven't tried, TDK will send one free 100-minute SA-X Limited to the first 5,000 readers to write in for it. (Requests should be sent to TDK Offer, 24 East 21st St., Third Floor, Dept. A, New York, N.Y. 10010, and must be postmarked no later than August 31, 1996.)

There is a catch, albeit a tiny one: If you get the free tape, TDK wants you to fill out and return a short response card.

Presumably, the company expects your opinion to be favorable, since it claims SA-X can deliver flat response from 20 Hz to 20 kHz and a dynamic range (with Dolby S noise reduction) greater than 96 dB. (What you actually get depends on your deck, of course; mileage may vary.) The tape's coating is a selected version of TDK'S Super Avilyn, with its lower layer optimized for low frequencies and its upper layer optimized for highs. Its high-density shell and the dual-layer construction of its mechanism are said to combat resonance and vibration and reduce modulation noise and sonic "smearing."

MONDO AUDIO

KEN KESSLER

MAIL BONDING

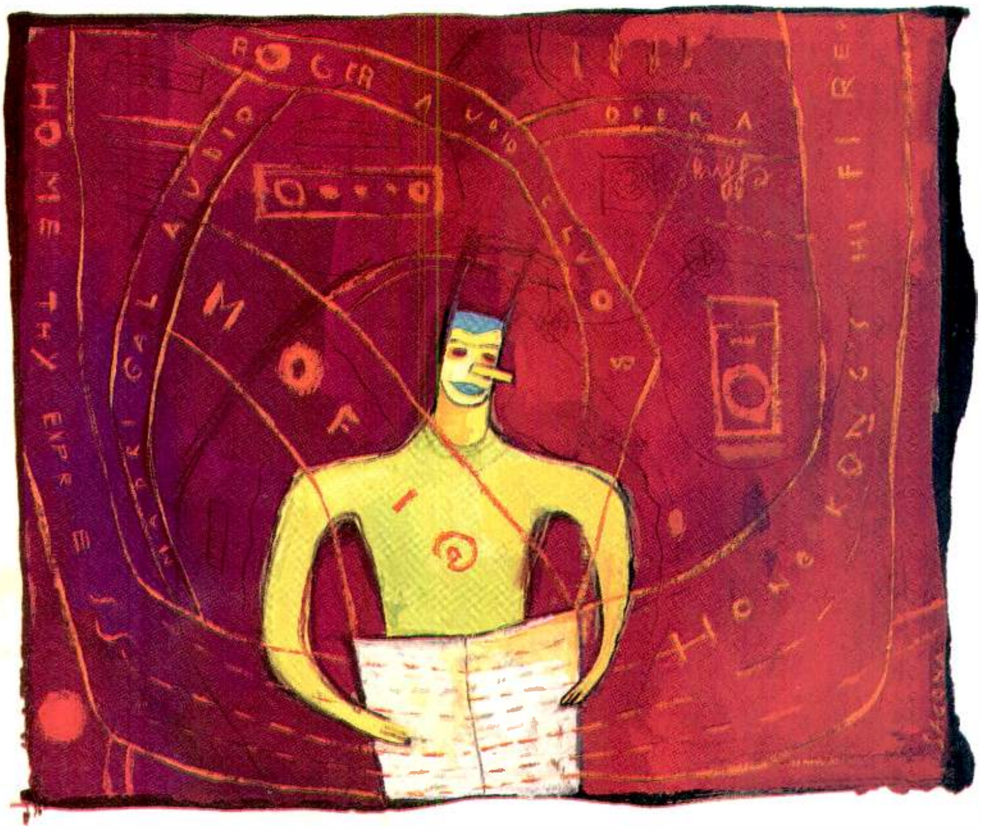


Illustration: Marina Sagona

Not content with magazines, audiophile clubs, and the Internet? Then how about the most deliciously self-promotional fanzines of them all? Many hi-fi crazies are completely unaware that a number of their fave brands publish newsletters, ranging from illustration-free, laser-printed two-pagers to slick, full-color booklets. I've been told of mail-outs as high as 3,000 and as low as 30. Maybe the lesson is a simple one: Always send in your warranty cards, because this seems to be the quickest method of getting onto the mailing lists.

Without question, one of the most polished mailings I've seen so far is Madrigal's 16-page, pocket-sized booklet, a semi-regular publication. The first arrived with full details of the Mark Levinson No. 33 mono power amp, a profile of Rob Kingsland (head of Madrigal's Management Information Services and a studio engineer whose track record is enviable), a page of speaker placement tips, some listening recommendations (Ella and Louis topped the list), and an interesting letter from Madrigal's chairman, Sandy Berlin, regarding his meeting with the legendary Josephine Baker.

MANY HI-FI CRAZIES ARE COMPLETELY UNAWARE THAT THEIR FAVORITE BRANDS PUBLISH NEWSLETTERS.

More of the same followed in the second issue, including a profile of video maven Joe Kane, some learned words about jitter, news of Harman International's acquisition of Madrigal, and the announcement that *Quarter Notes* was the name chosen for the publication in a reader competition. The winner received a Proceed AMP 2, incentive enough for joining in, although I must say I was sorely disappointed to find that my entry, *Berlin Diary*, was among the losers. Most definitely aimed at the public rather than the dealer network, *Quarter Notes* is my yardstick for company 'zines. (For information on where to drop a line to Madrigal and others mentioned here, see "Company Addresses.")

It's a pity that the equally professional *The Thiel Speaker* is dealer-oriented. Even so, roughly half of the latest issue—a six-page, fold-over glossy—contained enough non-trade items to make it interesting to both Thiel owners and owner-wannabees. Recipients learned that the CS7 and CS.5 speakers earned awards from Hong Kong's *Hi-Fi Review* and that optional new grille colors were available. Issue 39 contained details of the forthcoming CS6 (months before its Consumer Electronics Show launch), a sneak preview of a new in-wall speaker, and a wonderfully insane photo of the Thiel crew and CES officials in matching sunglasses. Alas, there is a lot of sensitive trade info, but I'm sure that if enough of you write in, Thiel might prepare a civilian edition.

In keeping with Ivor Tiefenbrun's not-inconsiderable ego, Linn Products' suitably named *The Record* is tabloid-sized. The latest full-color, four-page missive is a real keeper for Linn crazies and one of the most lavish of all the newsletters. Highly readable (because Linn-related matter is never less than contentious), one issue contained articles about Linn multiroom installations, news of the company's Web site (reported here in the July issue), details of the company's entry into home theater, a feature called "How To Select an A/V System," software news, praise for its U.S. distributor, and more.

Often, the motivation for launching a newsletter—not a minor undertaking if the standards equal those above—comes from outside pressure. Rogers' recent revival is a case in point. It's enthusiast-fueled rather than a mass-marketing cop-out. The company's loudspeakers have enjoyed a renaissance in numerous markets, partly because of the long-overdue arrival of a subwoofer for the LS3/5A and partly because the company has returned to amplifier manufacturing. According to Rogers' spokesperson, Anne Bailey:

> For some time now, we have been receiving "fan" mail from many long-standing Rogers owners who are keen to air and share their views with the company and staff who work here. We have also recognized that along with many general enquiries are regular demands for news about Rogers, as well as a definite desire amongst Rogers owners to somehow "be involved" with the internal affairs of the company. As a direct result of, and in response to, this demand, the Rogers Audio Club was born.

Although I've not yet seen it, Rogers produces a newsletter for some 3,000 enthusiasts worldwide. Its content includes competitions, news snippets, a letters section, and a feature called "Meet the Team." This is the most "interactive" of the magazines and the most club-like, in that Rogers is undertaking factory tours, issuing tickets for hi-fi shows, announcing offers on CDs, and more. Owning Rogers speakers doesn't seem to be a prerequisite for joining the club.

Another publication with a readership falling under the heading of "users' group" is the funky four-pager from Beam-Echo/Avantic. This reborn company makes tube amps. Run by a couple of crazies (who else would resuscitate a brand no normal person under 70 even remembers?), Beam-Echo is so British that it hurts. But *Echo Soundings* is a tonic for tube psychos. The first issue contains a history of the company and details of its rebirth, mouthwatering photos of vintage hardware, and news about user groups. But my favorite page has information about buying and selling old equipment; to prevent hassles, the *Echo Soundings* team contacts the buyer or vendor, thereby eliminating time-wasters. And while I'm too late to enquire about them, the first batch included a Thorens TD-124 turntable with SME 3009 tonearm for $180, a Garrard 301 turntable for $130, and a mint pair of original Quad ESLs for $550. [Cue deep sigh of longing.] Since this is a tiny operation, don't be offended if they ask for a few bucks per copy.

ALWAYS SEND IN YOUR WARRANTY CARDS, BECAUSE THIS IS THE QUICKEST WAY TO GET ON MAILING LISTS.

Like clockwork, Mobile Fidelity Sound Lab issues not one but two monthlies. MoFi has for years alerted trade, press, and public to new releases. Its flyers are now split into *Vinyl—New Releases* and plain old *New Releases*, which means CDs. Each four-page issue features full descriptions of the new titles plus cover art, reprints of reviews of earlier titles, and ordering information.

COMPANY ADDRESSES

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P.O. Box 2009, San Rafael, Cal. 94912

MADRIGAL AUDIO LABORATORIES
P.O. Box 781, Middletown, Conn. 06457; 203/346-0896

MOBILE FIDELITY SOUND LAB
105 Morris St., Sebastopol, Cal. 95472; E-mail, mofi@mofi.com; 800/423-5759

ROGERS INTERNATIONAL
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THIEL
1026 Nandino Blvd., Lexington, Ky. 40511; 606/254-9427

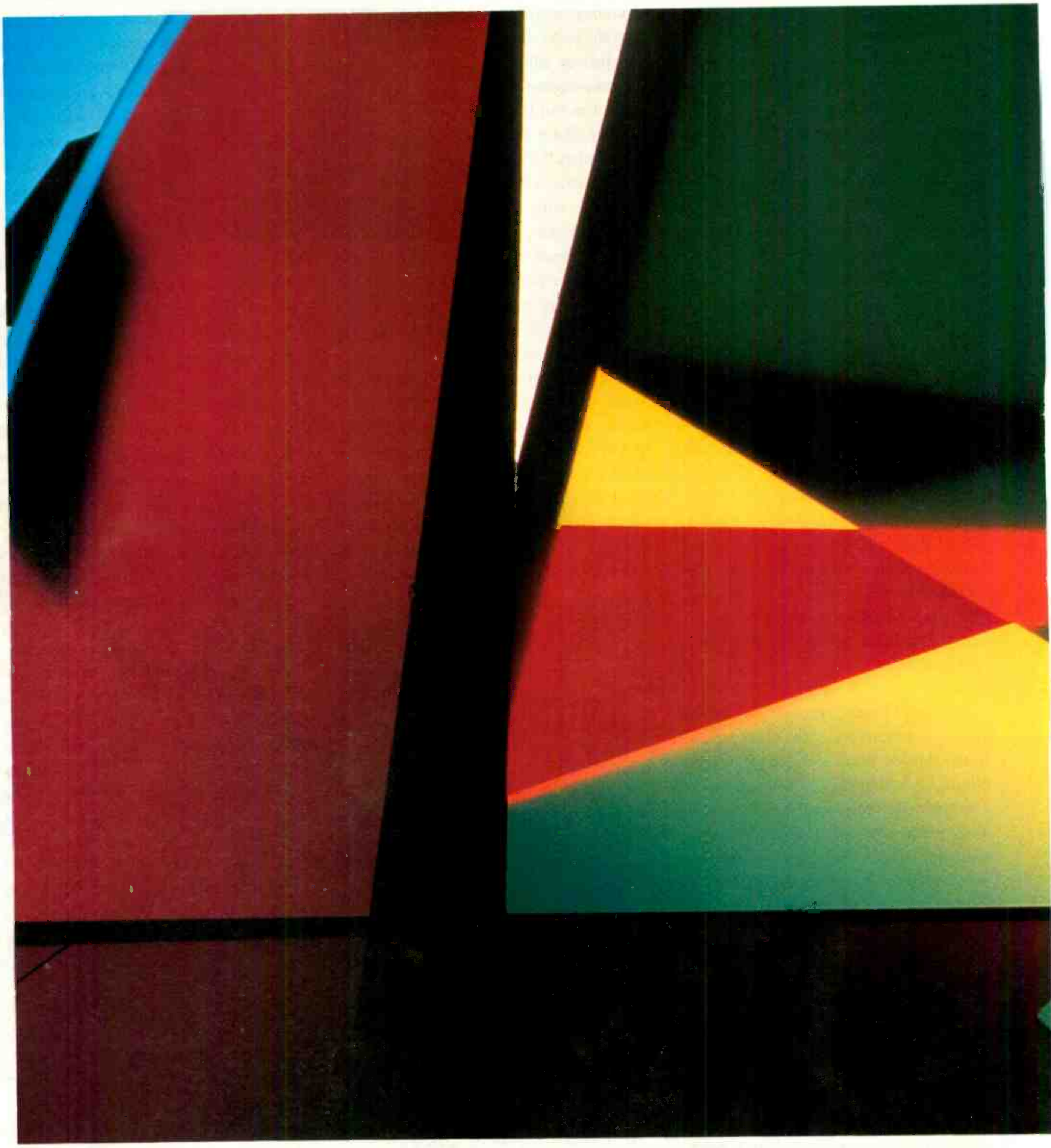
Interested in home theater developments? Wait'll you see *Home THX Express*. This four-pager arrived out of the blue (which means that Home THX Program Director Anthony Grimani hasn't crossed me off the THX mailing list), and it's essential reading if you like sound emanating from more than two speakers. The Winter 1995/1996 issue contained an interview with director Philip Noyce (the cover feature), articles about center-channel speakers and digital signal processing, and listings of new THX licensees. This one's a bit tradish, not that I found anything in it too confidential for public consumption, so maybe if you ask nicely. . .

No doubt there are dozens more, but these are the ones that arrived during the past few months without me so much as asking. Others of a more obscure, regional variety include *Opera Buffs* (published by the U.K. distributor of the Italian-made Opera speakers, it has a circulation of 30 copies), an incredibly professional mailing from another U.K. distributor called Audiofreaks, and the annual newsletter from yet another British importer, Absolute Sounds.

And do check out the major record labels; MCA, for example, produces a wonderful newsletter just for the restored Chess catalog. Sundazed and Rhino offer regular catalogs that read like insane rock magazines of the late '60s, and I can't remember the last time I bought a British CD single that didn't include a postcard so that you could get yourself on a mailing list for individual artist news. Rykodisc and Rounder are kind to their customers, too, and getting on their mailing lists is often the only way to learn about—let alone acquire—limited-edition sampler CDs. Hot tip for magpies: Send in any postcards that come with CDs or hardware, because you never know if the publicity materials you receive might suddenly turn into collectibles.

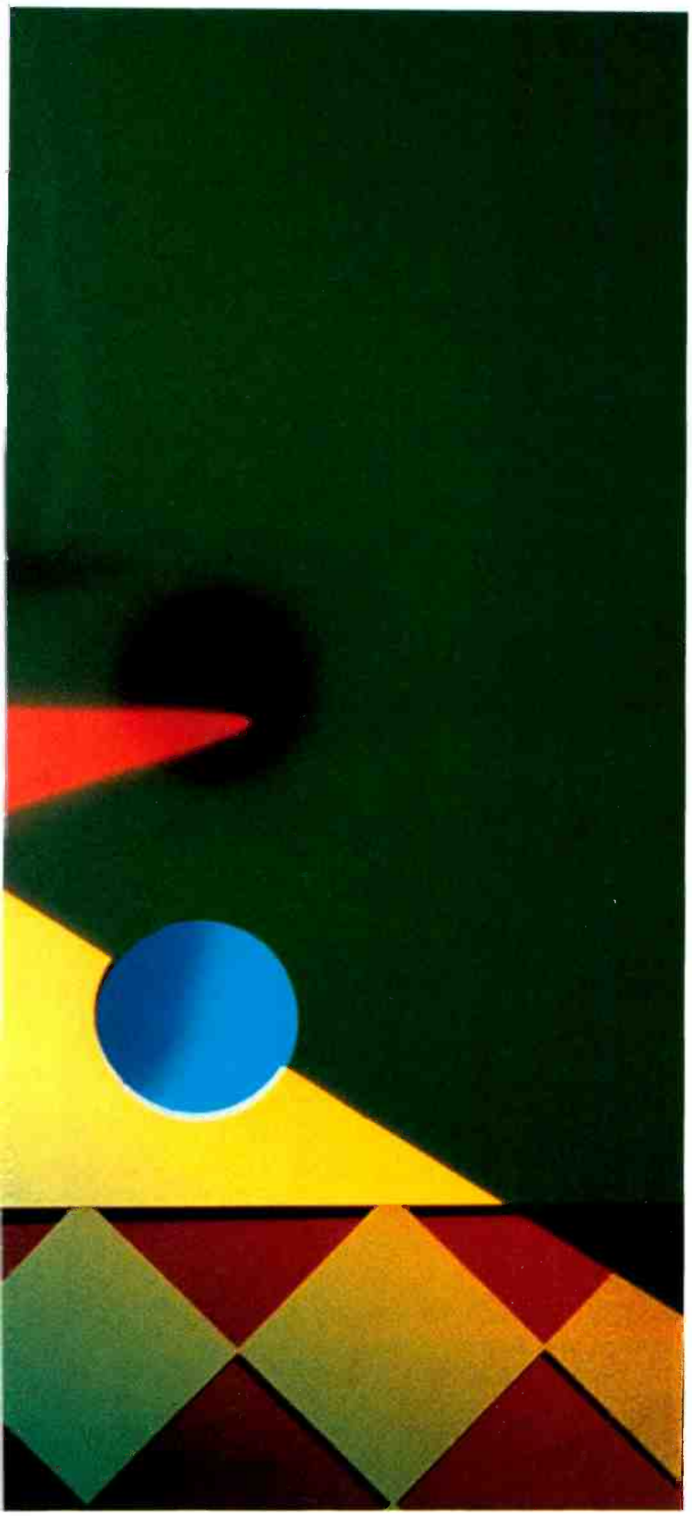
If all of this worries the paper-saving tree-huggers among you, look at it the way my father did, before he retired from the U.S. Postal Service: Junk mail keeps mailmen employed. A

TUNING UP FOR S



PHOTOGRAPH: © KENVIN LYMAN/PHOTONICA

URROUND SOUND



by Thomas R. Horrall

In the early 1970s at the acoustical consulting firm Bolt Beranek and Newman, my colleagues and I were interested in electroacoustically simulating the sound fields of typical auditoriums and concert halls. In the course of that work it became clear that reasonable simulations permitting some freedom of listening location required use of multichannel loudspeaker playback in an acoustically dead environment. Consequently, there were 12 primary loudspeaker channels in what we called our "acoustics simulator," as well as a common subwoofer channel (back then, we just

Multichannel systems require New approaches to room Acoustics and Speaker layout.

called it a woofer). Signals for the front two channels were conventional two-channel stereo from special tapes we made or from anechoic recordings. Signals from the remaining 10 loudspeakers were derived by processing the two main channels with suitable delays and artificial reverberation until their individual impulse responses matched those in real halls (or physical models of them).

The subwoofer was needed to assure that each of the 12 main channels, which were arranged to provide sound to the listening location from specific directions, could also provide flat low-frequency response. Without a subwoofer, the deep-bass response from each main loudspeaker was quite different and not very uniform, primar-

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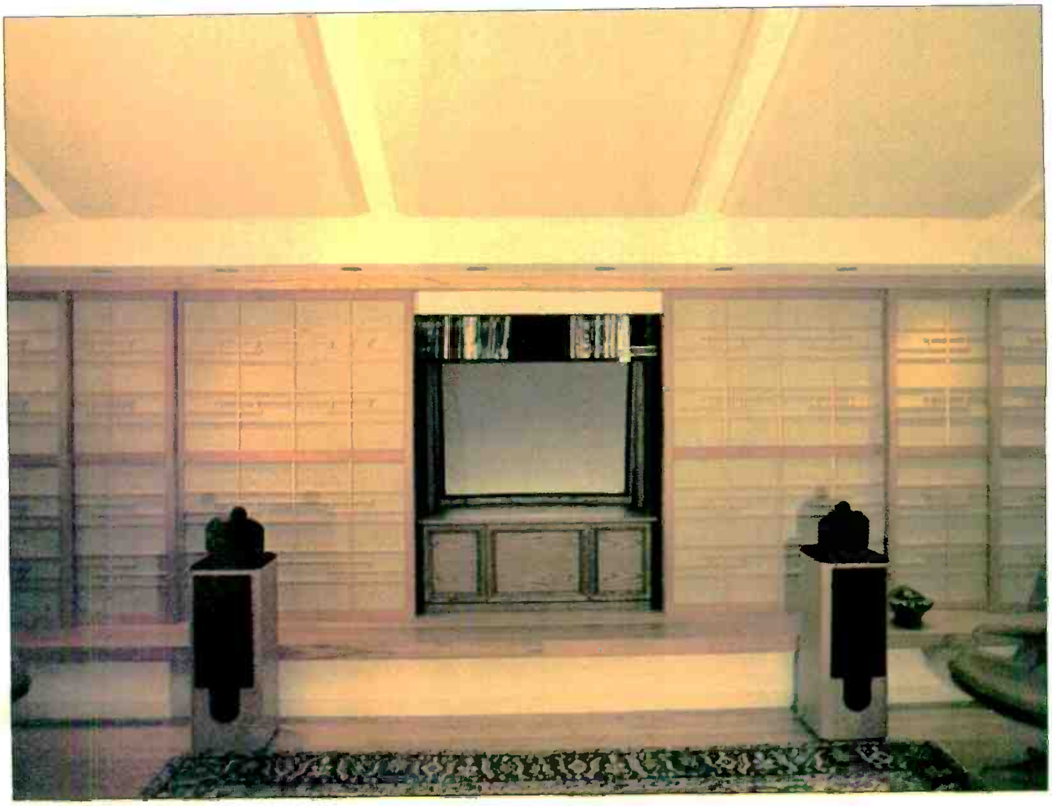
Without a subwoofer, the deep-bass re
main loudspeaker was quite different ar

ily because of different floor interference frequencies, which varied according to loudspeaker elevation. Also, the room was not completely anechoic at very low frequencies, and that further affected the response flatness. Ultimately, we found it necessary to provide two subwoofers, each operating over a different frequency range. No position for a single subwoofer could be found within the room that resulted in flat enough frequency response in the seating area, even over the relatively restricted bass operating range.

The simulations we achieved were relatively accurate, and it was certainly possible to distinguish major acoustical features of different halls modeled using the setup. Of course, we also experimented with playing conventional, commercially available two-channel stereo recordings through the simulator. Even that material sounded surprisingly believable, despite the double-signature problem: the superposition of the acoustical characteristics of the hall in which the recording was originally made and those of the hall being simulated by means of the signal processing. The common practice of recording with microphones placed much closer to the performers than typical audience members would sit in an actual performance probably helped with this problem by assuring that early hall reflections were not captured, or at least were minimized, on the recording.



A home theater with extensive acoustical treatment. Note particularly the use of large sound-absorbing panels on the ceiling.

On one occasion, a particularly vivid demonstration of a living room's effect on loudspeaker sound was afforded by the semi-anechoic simulator environment. Monophonic sound was, in turn, played back from two loudspeakers equalized to have nearly identical response. One loudspeaker was a large, highly directional, two-way professional type with horn-loaded drivers. The other was a popular three-way acoustic-suspension design that sprayed energy more or less equally in every direction. Two more different full-range loudspeakers can hardly be imagined, yet even the most highly trained and discriminating listeners had difficulty telling the two apart in the semi-anechoic simulator environment, where virtually all the sound arrived directly from the loudspeaker. Few experienced listeners would claim that these loudspeakers sounded even remotely similar when they were heard in a conventional living room.

Another interesting observation was how completely flat, two-dimensional, and lifeless even the best conventional two-channel stereo recordings sounded when played back through only the two main stereo loudspeakers in this anechoic environment, without

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any signal processing or supplementary loudspeakers operating. Again and again we switched supplementary loudspeakers off and always felt deprived by the lack of envelopment and immersion in the sound field, even when the two presentations were carefully level-matched. Anyone who has listened to music in an anechoic environment will readily appreciate what I mean. Yet, these same recordings were exciting and involving whenever the effects loudspeakers were switched on, in a way never achieved when they were played back on even the best stereo equipment in a more conventional semi-reverberant living room environment, where most listeners thought them to be superb. Clearly, the normal reflected sound in the living room environment contributes positively to the sound of two-channel stereo, even if it fails to provide the degree of spaciousness and realism apparent from the same recordings in a multichannel system. People experience sound from many directions in most indoor environments. They judge sound to be unnatural if it arrives from too narrowly defined a direction.

About the same time as our simulator experiments, commercial quadraphonic recordings became available. Although originally made from four-channel material, these recordings either suffered from unacceptable amounts of distortion and noise or, more typically, were actually only two channels matrixed to provide four on playback. While capable of entertaining effects, especially when decoded with steering-logic processors, the matrixed systems were unable to provide the instantaneous separation among channels required to keep musical instruments imaged believably in front and at the same time provide a musically satisfying and realistic surround of reverberant sound. No two-transmission-channel matrix system I've ever heard has remotely approached the spatial realism afforded by the simulator, and this judgment extends to present-day analog surround sound, which also uses a two-channel matrixed transmission format. In 1986, however, Yamaha introduced a digitally based simulator in a box—a device that mimicked the signal processing incorporated in the BB&N simulator, albeit in a somewhat limited way. This system, the Yamaha DSP-1, was soon followed by similar digital processors from a number of manufacturers. Most of these are available today, several in second- and third-generation incarnations, and some crude versions are even built into popularly priced A/V receivers and amplifiers.

Although limited to four or six channels (the two main stereo channels plus two or four supplementary effects channels), the best of these surround processors can provide a convincingly realistic simulation of real architectural spaces. To do so, however, they must be auditioned in a relatively dead acoustical environment or the double-signature problem presents itself, and in a particularly obvious way if the space being modeled is similar in scale to that of the listening room. If reflections from the listening room surfaces and the space to be simulated—say, a nightclub—occur with roughly similar delays and amplitudes, there is serious confusion, making the illusion at best unconvincing and, at worst, unpleasantly reverberant. Even if the simulated space is much larger (a concert hall, for example), the reflections from listening room walls mask important spatial cues, compromising the illusion. Another problem is that while they can do a good job of synthesizing a fairly large number of discrete reflections from different directions, most processors lack the computing power required to synthesize high-quality later reverberation. As a result, most rely on reverberation encoded within the original two-channel recording and optimized for two-channel playback, which is an unfortunate compromise.

Very recently, discrete multichannel digital recording and transmission systems, such as Dolby Digital (AC-3), have become available to the consumer, and these promise to deliver very high-quality music and video-soundtrack material to the home at reasonable cost. Instead of relying on expensive synthesis circuitry, such a system can record reverberation information directly in the software and retrieve it with a relatively simple and cost-effective discrete-channel surround decoder. The results can probably be superior acoustically to that provided by earlier consumer simulator-type processors. In addition, the new technology enables very precise location of sound sources and effects around the listener, which is of particular interest for video soundtracks.

So far, consumer releases of such discrete multichannel recordings have all been movie soundtracks on laserdisc, but the technology will be extended to other consumer formats—including DVD, DSS, and HDTV, all of which have committed to multichannel digital audio in some form. Although these are all combined audio/video formats, audio-only multichannel delivery will surely not be far behind. Initially, it may well use one or more of these audio/video formats. In any case, the optimum acoustical conditions in the listening room for both video-soundtrack and audio-only material are quite similar, and it is therefore useful to consider them together.

Speaker Placement and Listening Positions

The current standard complement for home theater loudspeakers is five primary speakers (plus, usually, a subwoofer). This appears unlikely to change in the foreseeable future, since all consumer video delivery formats comply with it, whether via two-channel matrix or 5.1-channel discrete means (the ".1" represents a dedicated, limited-bandwidth, low-frequency effects channel). A five-loudspeaker home theater system is thus unlikely to become obsolete, although those with particular interest in audio-only applications may want to supplement these five with two or more additional loudspeakers.

Of the five primary loudspeakers, the center-channel speaker delivers virtually all of the dialog in soundtrack presentations. Coloration of speech is particularly easy to identify, and using a single loudspeaker for dialog prevents the comb-filter frequency response typical of two-channel presentations of center-panned speech to listeners seated at different distances from left and right loudspeakers. A center loudspeaker also provides good directional realism: Regardless of the listener's position within the room, the visual and aural sources are coincident. It is interesting to note that the earliest public stereophonic presentations of music, in the 1930s, used a center channel as well as left and right loudspeakers. Perhaps stereo sound regressed initially in an effort to achieve commercial viability. Although three-channel professional tape recorders were available and used for recording much of the original material, it was difficult enough to put two channels of sound on a vinyl record, let alone three. In any case, after another 60 years or so it has finally become practical to deliver three and more discrete channels of sound into the home.

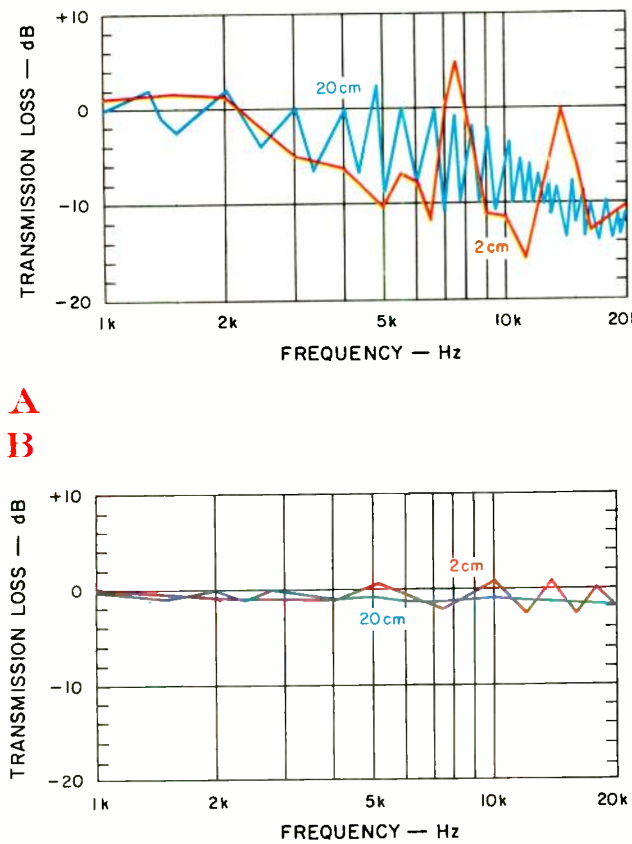

FIG. 1—*Sound transmission characteristics of a cinema projection screen (A) and of an acoustically transparent video projection screen (B). Note that in both cases response is smoother if the speaker is several inches behind the screen. (After Fukuhara et al., JAES.)*

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The highest-quality home theater will employ loudspeakers (or the center speaker, at least) *behind* the screen, although this is impractical unless the screen is separate from the projector. This is the same arrangement used in movie theaters, where the center speaker is concealed behind the perforated projection screen so that dialog emanates from the screen's center.

Unfortunately, the perforations in a standard movie-theater projection screen cause severe high-frequency attenuation as well as visual artifacts when used with a video source, including significant light loss and moiré patterns. However, there are now screens designed specifically for home theater applications that use small and random perforations and achieve satisfactory performance in all respects. Measurements of the acoustical insertion loss of such screens indicates that loudspeakers should be located several inches behind them in order to avoid significant ripples in high-frequency response (see Fig. 1). If the loudspeaker is recessed into a cavity behind the screen, acoustically absorbing treatment should be applied to minimize undesirable cavity resonances.

In a more conventional installation, built around a rear-projection or direct-view TV, the center loudspeaker should be immediately above or below the screen. Neither location is ideal from a localization standpoint, as both result in significant vertical offset, which can be heard by an attentive listener. Placing the center loudspeaker above the screen may be a little more favorable for localization, but placing it below the screen may yield smoother frequency response if a directional loudspeaker is used. The interference notch, or "floor dip," in the frequency response occurs at a higher frequency if the loudspeaker is closer to the floor, and the loudspeaker may have enough vertical directivity in the treble that the amplitude of the dip is minimized. In its THX criteria for front home theater loudspeakers, Lucasfilm requires a restricted vertical radiation pattern at high frequencies and states a preference for location even with or, if necessary, below the screen. For the floor dip to be minimized at lower frequencies, the loudspeaker should be placed on the floor or very slightly above. The loudspeaker listening axis should also be tipped up (or down if the speaker is above the screen) toward the listening area—a particularly important provision for loudspeakers exhibiting substantial vertical directivity.

Ideally, the front left and right loudspeakers should have the same directivity and frequency response as the center loudspeaker, to minimize timbral shifts as effects are panned across the front. They should be located at about the same elevation for the same reason, and because significant elevation changes during a pan are also detectable and undesirable even if the timbre does not change.

ons mask important spatial cues,
e illusion of being in another space.

However, if the loudspeakers are to be used for audio-only presentations, the floor location is not very desirable. Without the strong visual cues from an on-screen image, the listener will readily localize the sound below ear level, a somewhat unnatural aural perspective for most program material.

The lateral separation between loudspeakers depends on screen size and whether or not the loudspeakers will be used for both A/V and audio-only presentations. In a system with a large projection screen and intended strictly for home theater, the front left and right loudspeakers should be located just inside or just outside the edges of the screen to prevent discrepancies between aural and visual localization of certain sources. For smaller screens or where the same loudspeakers will also be used for high-quality audio-only reproduction, wider separation may be desirable. For best results with audio-only material, the loudspeakers should typically be in the range of 70° to 80° apart, as viewed from the listener's position. For A/V material, on the other hand, Lucasfilm recommends that the spacing between the left and right loudspeakers be no greater than 1½ times the screen width, even for small screens, which will almost invariably yield a narrower included angle. Some compromise may therefore be required. Alternatively, separate loudspeakers might be provided for audio alone and audio/video in the most elaborate installations.

In setting up a home theater system, it is best to keep the video screen well away from side walls so that the front left and right loudspeakers can be placed to avoid wall reflections. If the screen must go near a side wall, the wall should be effectively treated with sound-absorbing material of at least 1 inch in thickness, preferably 2 inches. The most effective place for such treatment is at the point along the wall where a direct reflection to the listener would otherwise occur.

For best acoustic imaging, it is desirable for the sound from the front left and right loudspeakers to reach the listener at the same time, within a small fraction of a millisecond, as that from the center loudspeaker. This implies that their distance to the listener should be the same (within an inch or less). Some surround processors provide adjustable delay circuitry to align these arrival times without requiring alteration of the loudspeakers' front-to-back placement. If such a feature is not available, the plane of the front left and right loudspeakers should be slightly in front of the center loudspeaker. This requirement is likely to be more critical for audio-only presentations.

For video soundtracks, the best location for surround-channel loudspeakers is directly to the sides of the listening area. These loudspeakers are often of dipolar design, which results in a null, or cancellation, of sound emitted directly toward the listening area. The intent is to diffuse the sound from the speakers by reflecting it from the front and rear walls of the room, creating a more non-localizable sound field. This arrangement may also provide effective surround for most music presentations, since reverberant sound in most performing spaces is highly diffused spatially. On the other hand, it may not permit as precise localization as desired for some special music mixes—for instance, where the intent is to place an instrument or soloist to the rear. The surround loudspeakers should also be elevated relative to the listeners' ears, near the ceiling unless it is very high.

Placement requirements for surround loudspeakers used with audio-only synthesis-type processors may be somewhat different. Elevations are normally as described above, but the horizontal angles to the listening position may vary. Six-channel ambience-synthesis processors normally place the four surround, or "effects," channels either in front of and in back of the listener, in a roughly rectangular array (this is what Yamaha recommends for its units), or to the sides and behind the listener (essentially, adding two rear speakers to the conventional home theater array). The exact angles are unimportant. Surround loudspeakers should be located so they do not reflect strongly from side walls to the listening position. If walls are too close to the loudspeakers, they may require acoustical treatment for best results.

Guidelines for subwoofer placement are difficult to provide. Although a corner location will normally result in the greatest acoustical average power into the room, the primary goal should be to place subwoofers where they will provide the flattest and most extended low-frequency response at the normal listening positions. This may be difficult to determine in advance. The shape of the room and its consequent modal distribution have a profound effect on the bass response, as do the loudspeaker location, listener position, and the location and extent of low-frequency sound absorption in the room.

One commonly cited rule of thumb is to place loudspeakers away from the corners of a room so as to avoid exciting room modes, but a corner location may very well provide the flattest response from a subwoofer if the listening position is favorable relative to the room's modal pattern. Perhaps the most useful advice I can give about subwoofer location is that you should be flexible about it and be prepared to experiment after the room setup is completed. Ironically, subwoofers are often made very large to increase their average output capabilities and then limited because of

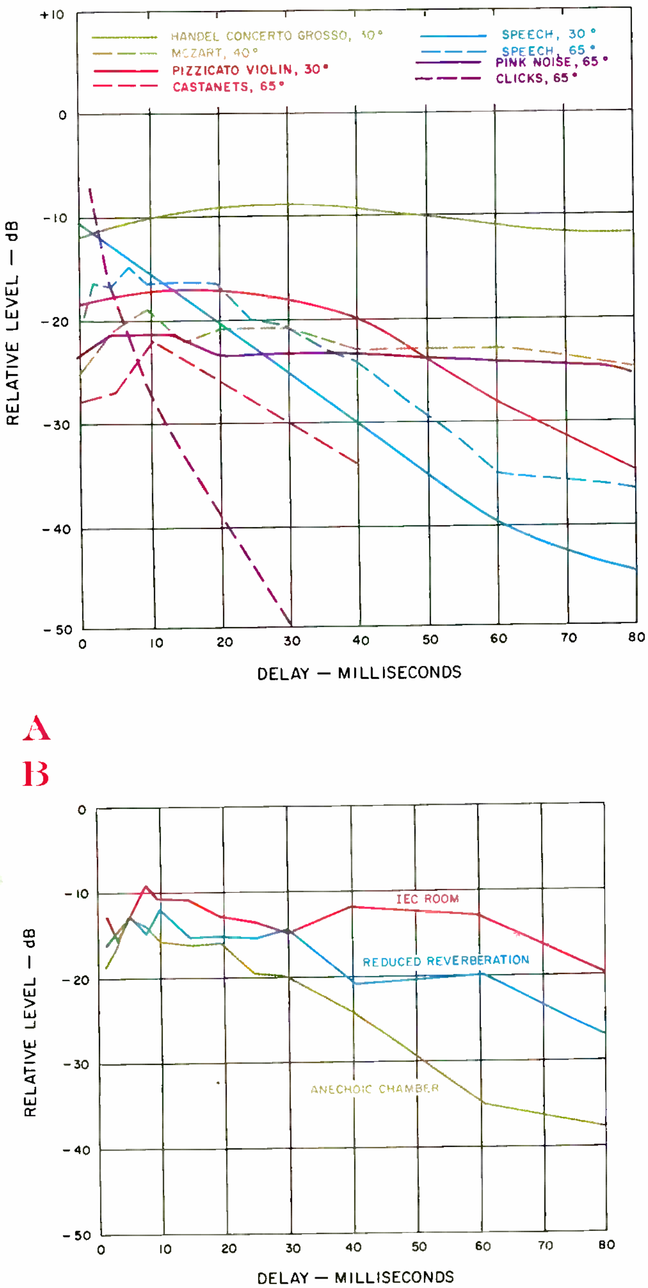

FIG. 2—*Audibility threshold versus delay of reflected sound relative to the level of the direct sound. Curves in (A) are for various sounds from different angles in an anechoic environment. Curves in (B) are for speech in rooms with different reverberation characteristics. (After Olive and Toole, JAES.)*

their size to just a few practical room locations, none of which provides very even response. Keep in mind that a favorably located medium-output woofer will often outperform a much higher-output woofer unfavorably located, at least in a small room such as most home theaters or listening rooms. If the room is rectangular and constructed with uniformly distributed low-frequency absorption, it is reasonably easy to predict the response at very low frequencies from the room's dimensions. If the room is irregular in some way, as is more typical, it is still possible to calculate response with room boundary element techniques, but few designers have access to such tools. Two (or more) subwoofers optimally located may give superior results to a single woofer.

On a related note, it may be best to provide for stereo drive to the subwoofers if more than one is used. That is, the best results may be obtained if the subwoofers are driven with incoherent signals, although standard motion picture practice is to drive them monophonically. This is a subtle point, and some will no doubt take issue with it. It may be most relevant to music recorded in large rooms, and there is indeed a substantial amount of such information on many Compact Discs, if not on many film soundtracks.

The listener is an important component in the system. Proper listening location within the room is arguably as important as proper loudspeaker location. Just as poor loudspeaker location results in poor imaging and low-frequency performance, so does poor listener location. In fact, consideration of reciprocity would lead us to this conclusion. The listener should not be immediately adjacent to any wall, including the wall behind him, if possible. Whenever practical, there should be at least several feet of space behind him, and the listening area should be well away from side walls. Although the perceived low-frequency response depends on the combination of loudspeaker and listener locations, it is probably easiest to optimize response by adjusting the location of the subwoofers for flattest response. There are other more important constraints on the listener's position, such as good stereo imaging and viewing relationship to the screen.

Room Acoustics

Although a full program of room treatment will enhance the overall acoustical experience, I realize that many will find that impractical and will feel that a less thoroughgoing implementation is good enough. Ideally, the listening room would not contribute any reflected sound to recorded material; the recorded environment would entirely establish the acoustical ambience of the presentation. However, with only five channels, it is helpful to have the room somewhat reflective to compensate for the limited spatial distribution of sound directly from loudspeakers. Nevertheless, perhaps the most important overall acoustical recommendation is that the room should be considerably more absorptive than most domestic living spaces.

Reverberation time (RT) in a small, acoustically dead room is not too meaningful but does provide some useful information. The Society of Motion Picture and Television Engineers (SMPTE) recommends an RT of about 200 milliseconds for a small theater of about 3,000 cubic feet, which is about the size of a medium to large

For soundtracks, the best location for surround speakers is to the sides of the listening area.

home theater. (This RT happens to correspond to an *average* absorption coefficient of about 0.5 for all boundary surfaces in a room that size and of typical proportions.) Even shorter reverberation times are recommended for smaller rooms.

It is also important to consider which surfaces will yield the greatest benefit from treatment and how the treatment should be applied. Figure 2A shows thresholds of detectability of reflections in an anechoic environment for various sources, relative to the level of the direct sound. Although the detectability of reflections clearly varies greatly depending on the type of signal—impulsive sounds, continuous music, and so forth—speech is among the types of signals with the lowest thresholds. Speech reflections with delays typical of those produced in living rooms are readily detected even if the level of the reflection is on the order of 20 dB or more below that of the direct sound. Reflection attenuation great enough to eliminate this effect implies an absorption coefficient of about 0.99.

Although that may seem extreme, similar speech reflections in a standard IEC listening room with fairly high reverberation are detectable at about −12 dB (Fig. 2B), implying that an absorption coefficient of about 0.94 would be needed to attenuate a reflection to inaudibility if the spreading losses for the direct and reflected paths are similar. Yamaha suggests "the deader, the better" in *Sound Field Creation*, a booklet on one of its multichannel processors, and Lucasfilm also recommends a relatively dead home theater environment for best sound.

Side-wall reflections of the output from front loudspeakers can be attenuated by using directional loudspeakers, keeping the speakers well away from walls, or applying sound-absorptive material to the walls. (Best results will be obtained by employing all three approaches.) The best way to apply absorption is to treat the lower side walls up to the height of the front loudspeakers. A 1-inch thickness of fiberglass panels wrapped in a suitable open-weave fabric will be sufficient in most cases. Aim for a total reflected path loss of at least 20 dB relative to the mid- and high-frequency direct-path loss from the front loudspeakers. Thin plywood covered with lightweight finishing treatments can provide good low-frequency absorption on all walls. Stud spacing behind the plywood should be randomized to avoid too much absorption over a single frequency range.

Front and rear walls may be similarly treated, except that surfaces above an elevation beginning just below the line of sight from the listener to the reflection of the surround loudspeakers should be acoustically diffuse to assure desirable reflections. Some acousticians suggest using diffusors on part of the rear wall.

Ideally, the ceiling should be entirely treated except for 2 or 3 feet around the perimeter, where some reflection is useful in diffusing sound from the surround loudspeakers. The ceiling surface area is typically large enough that it will be difficult to adequately reduce room reverberation without treating it. Making the ceiling treatment several inches thick will extend the frequency range over which it is effective. A suspended acoustical-tile ceiling that has a high NRC rating (greater than 0.85) is particularly economical and effective in providing low-frequency absorption.

On the floor, thick carpeting can provide useful attenuation of the highest frequencies and is good practice. However, its effective frequency range will be sufficiently restricted that other surfaces must provide the majority of absorption. Use of loudspeakers with restricted vertical dispersion will minimize the energy reaching the floor, making its treatment less important.

We are entering an era in which more than two main loudspeakers will be the norm in high-quality audio systems, which means that our thinking about rooms and speaker layouts will have to change accordingly. Although few people will be able to follow all the practices suggested here, I think that any of them will provide some sonic benefit in a multichannel system. And the more you can do, the better. A

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EQUIPMENT **PROFILE**

EDWARD J. FOSTER

MARANTZ SR-96 A/V RECEIVER

I find it interesting to observe how products evolve. A little over a year ago (March 1995), when I reviewed the Marantz SR-92 Mk II A/V receiver, I had reservations about it. For one thing, you had to manually adjust input level and balance for each program source when using Dolby Pro Logic decoding. The SR-92 had relatively few video inputs. And it allocated somewhat more power to the front left/right speakers than to the center (and considerably more power to the front than to the back). However, the SR-92 was far from alone in these respects at the time, so my review was quite positive.

Marantz's new SR-96 A/V receiver addresses the concerns I raised about the SR-92 Mk II—and goes a good deal further. Although power in the front left/right channels remains 110 watts per side into 8-ohm loads, the center channel has been boosted from 75 watts to 110 watts and the surround channels from 35 watts per side to 90 watts each. The number of video inputs has been increased from four to five ("TV/DBS," "LD," and two VCRs on the back plus an "AUX" input on the front), and input level and balance are now automatically corrected by a DSP-based Dolby Pro Logic decoder. The SR-96 also has a second digital signal processor for Home THX post-processing, THX-certified power amplifiers, and a six-channel audio input for an outboard Dolby Digital (AC-3) or other discrete-channel surround decoder. I'd certainly say that the SR-96 can justify the 30% price premium it commands over the SR-92 Mk II.

I'm also happy to say that nothing of great importance has been left out of the SR-96. True, it has neither a phono input nor selectable IF bandwidth in its FM tuner section, as the SR-92 Mk II had. On the other hand, few LP lovers cotton to A/V receivers, which makes the lack of a phono preamp of negligible concern, and the SR-96's tuner proved as remarkable on the bench and in use as did the SR-92 Mk II's. The new receiver's facilities for multiroom operation are, if anything, a bit more extensive than the earlier model's, in that you can use more than one Marantz IR-92 sensor kit or use third-party remote-control interfaces (such as the Xantech 794-50).

All video inputs and outputs, including those for recording on two VCRs, are carried on S-video and composite-video links. With the exception of the pair used for remote-control daisy-chaining to other Marantz components, all RCA phono jacks are gold-plated. And there are plenty

Rated Power, 8-Ohm Loads: Main channels, 110 watts/channel at 0.05% THD, 20 Hz to 20 kHz, two channels driven; center channel, 110 watts, 40 Hz to 20 kHz; surround channels, 90 watts/channel, 40 Hz to 20 kHz.

Dimensions: 17¼ in. W x 6¼ in. H x 18 in. D (43.9 cm x 15.8 cm x 45.8 cm).

Weight: 31.7 lbs. (14.4 kg).

Price: $1,499.99.

Company Address: 440 Medinah Rd., Roselle, Ill. 60172; 800/654-6633.

For literature, circle No. 90

Photos: Michael Groen

of these jacks, since the input for each of the five internal power amps is externally linked to its corresponding preamp output; this lets you reconfigure preamp and amp connections at will and add multichannel home theater equalizers or other signal processors.

One pair of color-coded multiway binding posts, spaced to accept double-banana plugs, is provided for each power amp's output. Although not the heavy-duty types used on many high-end power amps, they're about as good as you can expect to find on an A/V receiver and far more secure than the spring-loaded connectors on many receivers.

The rear panel also carries two convenience outlets, one switched and one unswitched, each rated at 120 watts. Spring clips are used to connect the supplied AM

MARANTZ'S SR-96 SHOWS HOW EVEN GOOD PRODUCTS CAN EVOLVE INTO BETTER ONES.

loop antenna. The FM antenna input is a 75-ohm "F" connector. A balun (balanced/unbalanced) transformer is included for use with a 300-ohm antenna.

In addition to the internal AM/FM-stereo tuner (which has 30 station presets, each of which can be "labeled" with a station name on the receiver's display), the SR-96 accepts three external audio sources: a CD player and two tape decks. (In a valiant effort to breathe life into a dead format, one of these is labeled "DCC," but any recorder or other source can be used here.) Two "Copy" buttons determine which program is recorded on the two audio decks and, separately, on VCR 1. The "Tape Copy" button cycles between "Source," "Tuner," "CD," and "DCC." The "VCR 1 Copy" button selects among "Source," "TV," "LD," "VCR 2," and "AUX." This arrangement enables you to dub from VCR 2 to VCR 1 while you're watching a different source or to copy the program you're watching onto both VCRs simultaneously. (VCR 2 automatically receives whatever signal you're watching.)

The supplied RC-96SR remote control operates virtually all of the SR-96's functions, with the notable exceptions of the two "Copy" buttons and the bass, treble, and balance controls. The 67-button remote is preprogrammed with the RC-5 command set used by Marantz D-BUS components and can "learn" the control codes of other manufacturers' products. When the remote is set to transmit the commands it has learned, it transmits RC-5 commands for any button that has not been reprogrammed. As usual for A/V receivers, it's easiest to control the SR-96 from the remote. It's the only way to work a few features (including "Mute," which is total) and to perform setup.

As with most A/V receivers, command menus are nested. The SR-96's panel display gives you an idea of where you are within these menus, but the on-screen displays (which are generated only as composite-video signals) are much more detailed and easier to follow.

From the remote or the front panel, you can independently select audio and video sources for listening, viewing, and recording. A "Multi Room" button lets you choose programs to route to other rooms and adjust volume levels there.

Surround options include "THX Cinema," "Pro Logic," "Movie," "3CH Logic," "Hall," and "Matrix" processing as well as "Stereo" or "Mono" operation. Surround-channel delay is adjustable: In Pro Logic and THX modes, it ranges from 15 to 30 milliseconds in 5-millisecond steps; in "Movie," "Hall," and "Matrix" the range is 10 to 90 milliseconds. "Test Tone" (only on the remote) routes test signals to your speakers so that you can adjust their levels to achieve proper balance.

The "Set Up" menus are nested two deep. The first level sets the center-channel mode ("Large" speaker, "Small" speaker, or "None") and informs the system whether or not a subwoofer is being used. Together, these choices determine which range of frequencies (if any) is stripped from the center and main channels and routed to the subwoofer (or from center to main if a subwoofer is not used). On the second level,

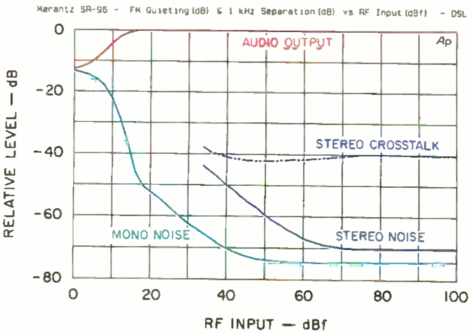


Fig. 1—Quieting characteristics and separation, FM tuner section.

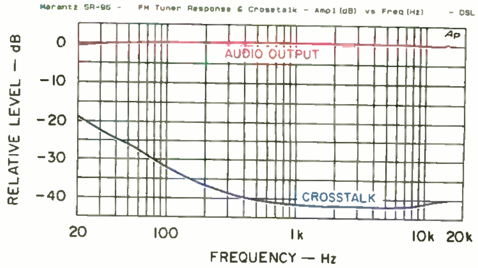


Fig. 2—Frequency response and crosstalk, FM tuner.

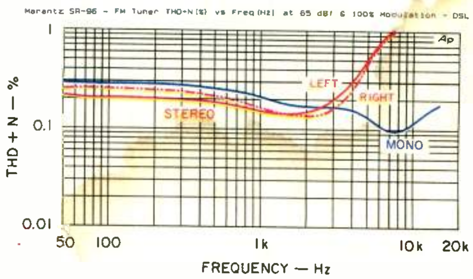


Fig. 3—THD + N vs. frequency, FM tuner.

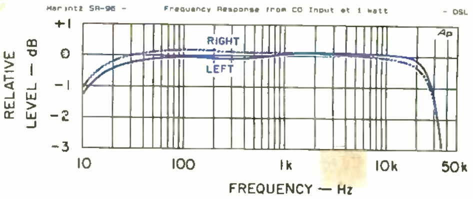


Fig. 4—Frequency response at 1 watt out, amp section.

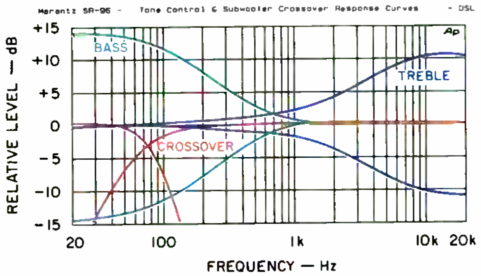


Fig. 5—Tone-control range and response of subwoofer crossover, amp section.

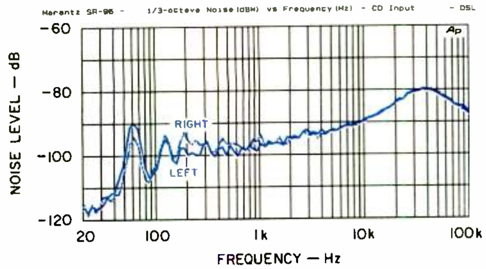


Fig. 6—Noise spectrum, amp section.

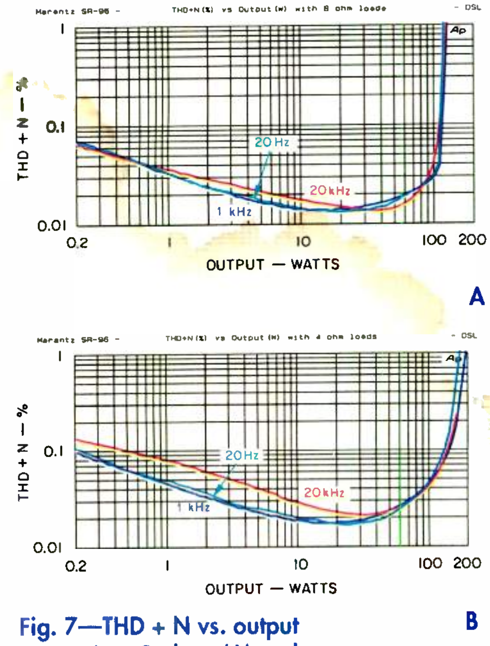


Fig. 7—THD + N vs. output power into 8 ohms (A) and 4 ohms (B).

you determine whether the "Multi RM" output level is to be variable or fixed and then set that level. With the second-level menu, you can also lock in all setup choices.

Another menu option activates and adjusts a sleep timer. It can turn the receiver off in 10 to 60 minutes (adjustable in 10-minute increments) or after 90 minutes.

The on-screen display can be activated at any time by tapping the remote's "OSD" pad. Whenever a button is pressed while the on-screen function is active, information associated with that control is displayed on your TV screen for a few seconds.

Measurements

All that distinguishes an A/V receiver from an A/V amplifier is the presence of a tuner section. And although the tuners in receivers seem mostly to be getting worse from year to year, the Marantz SR-96's FM section was definitely up to snuff—spectacular, in fact, compared to those in average receivers. Its quieting curves (Fig. 1) are steep, its frequency response (Fig. 2) reasonably flat, its channel balance virtually perfect, and its channel separation (also Fig. 2) unusually good.

As you can see in Fig. 1, the SR-96's FM tuner attains 50-dB quieting with an input of about 18 dBf on a mono broadcast and about 40 dBf on a stereo broadcast. Unfortunately, you must choose whether to receive in stereo or mono. If you set the tuner for stereo, it mutes stereo broadcasts below 34 dBf instead of switching to mono; with stereo switched off, the SR-96 receives every station in mono. However, you can switch between mono and stereo from the remote.

With a 65-dBf FM signal, the tuner section's signal-to-noise ratio (S/N) approaches 75 dB in mono and 70 dB in stereo; at higher input levels, stereo S/N improves a bit further. Selectivity (especially adjacent-channel selectivity) was far better than average, yet capture ratio was unusually low—i.e., also good. (You don't usually get good selectivity without sacrificing capture ratio, and vice versa.) Moreover, AM rejection was above average. These test results suggest that the SR-96's tuner will perform far better than average in the presence of multipath, that it has sufficient selectivity to be used in urban areas, and that it has sufficient sensitivity (and low capture ratio) to perform well in rural areas. The tuner section's image rejection did not set any record, but image-reception problems rarely occur except near airports. You can see from Fig. 3 that the tuner's total harmonic distortion plus noise (THD + N) is fairly low in FM, especially at high frequencies in mono. The tuner also did a far better job than average of suppressing stereo pilot and subcarrier signals.

Although the SR-96 doesn't have a tone-control defeat switch, its amp section's frequency response in stereo, with the tone controls at their detents, is reasonably smooth through the audio band. The results in "Measured Data" were taken on the right front channel, which was the poorer of the main channels by a slight margin. The curves are presented in Fig. 4; as you can see, channel balance is very good. Figure 5 shows the tone-control range and the subwoofer-crossover characteristics. The bass control affords a wider spread than the treble (more than I'd care to use, in any event); both controls are quite well balanced between maximum boost and maximum cut. The SR-96 receiver's subwoofer crossover points and slopes are pretty close to those called for in Home THX specifications.

Figure 6, a third-octave analysis of the SR-96's noise spectrum, reveals power-line-related components at 60, 120, and 180 Hz; above 200 Hz the noise is relatively "white." The A-weighted noise was within the normal range for an A/V receiver. Sensitivity was a bit below average, but the input-overload point was quite high and the input impedance more than adequate. Channel separation was quite good at low frequencies and decreased at about 5 dB per octave as frequency increased. Worst-case, it was still better than 45 dB from 100 Hz to 10 kHz. Levels and impedance at the recording output were fine.

Although Marantz's preliminary specification sheet suggested a power rating of 165 watts/channel into 4 ohms, the owner's manual for the SR-96 didn't list a 4-ohm spec. After plotting THD + N versus output at 20 Hz, 1 kHz, and 20 kHz with 8-ohm loads (Fig. 7A) and 4-ohm loads (Fig. 7B), I "assigned" the SR-96 a 4-ohm rating of 150 watts/channel, which was 1 dB below clipping with a 1-kHz test tone.

As you can see from Fig. 7, this receiver's THD + N decreases with increasing output level in classic fashion out to about 10 or 20 watts, above which it slowly rises to the clipping point. The curve shapes suggest that noise dominates distortion below 10 to 20 watts; distortion increases gradually above 20 watts. This gradual rise in distortion is reminiscent of tube amp behavior.

In Fig. 8, I plotted the amp section's worst-case THD + N versus frequency at 10 watts and at "rated" power (110 watts/channel with 8-ohm loads and my assigned rating of 150 watts/channel with 4-ohm loads). The results aren't remarkable, but they're decent enough. (Marantz doesn't list FTC power ratings in the manual, so

THE OUTPUT IMPEDANCE IS LOW AND FLAT, A THX REQUIREMENT FEW RECEIVERS CAN FULFILL.

it's difficult to relate my test results to the manufacturer's.) With 8-ohm loads, the SR-96 had 1 dB of dynamic headroom. As I mentioned, Marantz didn't provide a spec for 4-ohm loads, so I couldn't compute dynamic headroom for that impedance. However, the SR-96's amplifiers delivered 220 watts per channel on tone bursts with 4-ohm loads. The damping factor was high; furthermore, output impedance remained low across the audio band—unusual for a receiver, although it's one of Lucasfilm's requirements for Home THX certification.

Figure 9 shows the receiver's THD + N versus output at 1 kHz in Dolby Pro Logic mode with 8-ohm loads. (Although I measured each main and surround channel, I've included only the poorer of each pair.) The main and surround channels cleared their ratings by approximately 0.5 dB; the center channel cleared its spec by 1.2 dB, reflecting the reduced drain on the power supply when only the center is driven. The shapes of the main- and center-channel curves are quite similar to the curve shapes taken in stereo mode (Fig. 7); interestingly, the shape of the surround-channel curve is more like that of typical transistor amplifiers, with THD + N decreasing continuously right up to clipping.

This can also be seen in Fig. 10, which plots THD + N versus frequency at rated power in Pro Logic Mode. Note that in the midband, THD + N in the surround channel is less than that in the front channels, a most unusual result.

On the whole, my distortion measurements on the SR-96's digital Dolby Pro Logic decoder suggest excellent performance. However, these results are not directly comparable to my past tests of digital decoders because I've changed my procedure. I now use a narrower bandwidth in my distortion analyzer, to suppress the ultrasonic crossmodulation products often produced by digital decoders, which don't occur with analog processing. They should be inaudible, however, so I hope the change will reflect performance more realistically and put all processors on a more equal footing from here on.

Frequency response of the receiver's various channels is shown with the processor set for "Pro Logic" (Fig. 11A) and for "THX Cinema" (Fig. 11B). The latter reveals the effect of Home THX's front-channel re-equalization and surround-channel timbre-matching. Overall, the curves are quite good. Front-channel response in Pro Logic mode is flat within +0.1, –1.5 dB from 20 Hz to 20 kHz, the center channel rolls off below 100 Hz in "Normal" mode (as it should), and the surrounds roll off rapidly above 7.8 kHz (as they should). I did not include curves for center-channel response in "Wide" mode, because they were virtually the same as those for the main channels.

In Pro Logic mode, the amp section's A-weighted noise was very good, –78 dBW or below in all channels. Steady-state channel separation was excellent, ranging from a low of 53 dB (surround to right front) to a high of 77 dB (center to surround).

Use and Listening Tests

I did most of my listening in my home theater, although I did use the Marantz SR-96 briefly in my reference system as a standard audio receiver. As stated earlier, its tuner section's performance was well above average, almost on a par, in fact, with some separates. I did miss having a tone-defeat switch; I seldom use tone controls, and I think the Marantz's sound might have been a tad cleaner and smoother had I been able to bypass them. Nonetheless, it's probably unfair of me to compare an A/V receiver with an ensemble of carefully chosen separate components,

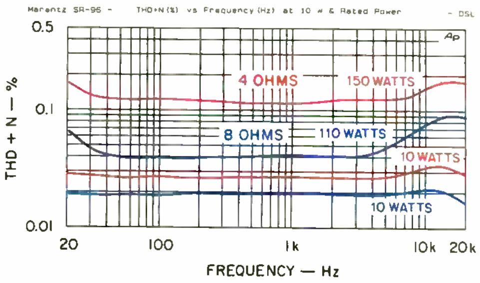


Fig. 8—THD + N vs. frequency into 8 ohms and 4 ohms, amp section.

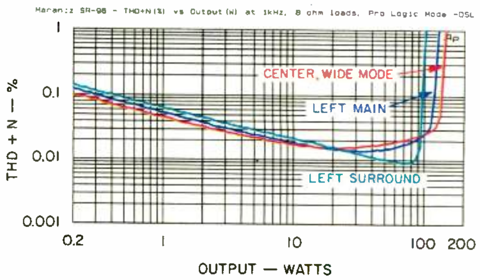


Fig. 9—THD + N vs. amplifier output into 8 ohms, Dolby Pro Logic mode.

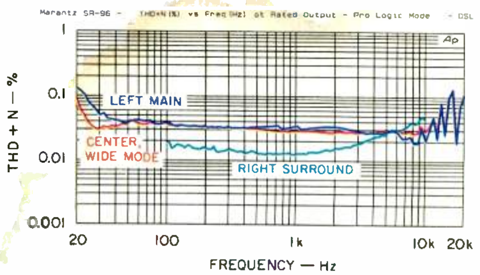
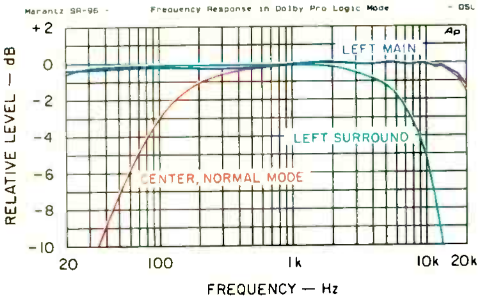


Fig. 10—THD + N vs. frequency at rated output, Dolby Pro Logic mode.



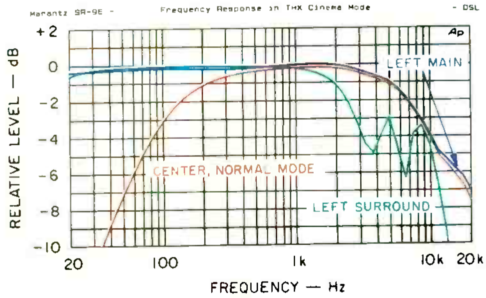


Fig. 11—Frequency response in Dolby Pro Logic mode (A) and Home THX mode (B).

each of which costs as much as or more than the SR-96 does.

In my home theater, the Marantz SR-96 strutted its stuff quite well. The Dolby Pro Logic processor was exemplary, and, with a little more than 500 total watts available from the Marantz's five channels, I had no problem running my system at Home THX standard operating levels. In the "THX Cinema" mode, the re-equalization and timbre-matching were apparent and welcome, but the surround channels did not seem as well decorrelated as I would have expected. They seemed more "Pro Logic-like" than "THX-like" and called attention to themselves more than is usual with Home THX post-processing.

What constitutes good ergonomics is a personal opinion. I found the Marantz SR-96 simple to use. I never got lost in its menu structure, and I could always figure out what to do without referring to the manual. Although the remote is not illuminated and most of its keys are the same size and laid out similarly, all controls are clearly labeled. For me, legible labels are very important; I've never been able to successfully operate a remote by touch unless it had very few keys.

By the time you read this, Marantz should be shipping its DP-870 Dolby Digital decoder ($699.99). This decoder will enable the SR-96 to accept the RF outputs from Dolby Digital AC-3 laserdisc players as well as digital bitstream AC-3 from satellite decoder boxes or DVD players. Because the DP-870 was not available in time for this review, I can't comment on its performance or operation; you'll have to check it out for yourself. I encourage you to do so, although the Marantz SR-96 deserves serious consideration in its own right. Fleshed out with the DP-870, it might be your ticket to home cinema nirvana. A

MEASURED DATA

FM TUNER SECTION

Sensitivity: IHF usable sensitivity, 15.2 dBf in mono; 50-dB quieting sensitivity, 17.8 dBf in mono and 39.8 dBf in stereo.

S/N Ratio, 65-dBf Signal Input: Mono, 74.6 dB; stereo, 69.3 dB.

Frequency Response, Stereo: 20 Hz to 15 kHz, +0.22, –0.75 dB.

Channel Balance: ±0.03 dB.

Channel Separation, 100 Hz to 10 kHz: Greater than 30.3 dB.

THD + N at 65 dBf, 100% Modulation: Mono, 0.27% at 100 Hz, 0.20% at 1 kHz, and 0.10% at 6 kHz; stereo, 0.20% at 100 Hz, 0.15% at 1 kHz, and 0.73% at 6 kHz.

Capture Ratio at 45 dBf: 0.6 dB.

Selectivity: Adjacent-channel, 8.0 dB; alternate-channel, 63.5 dB.

Image Rejection: 52.7 dB.

AM Rejection: 62.4 dB.

Stereo Pilot Rejection: 63 dB.

Stereo Subcarrier Rejection: 80 dB.

AMP SECTION,
MAIN CHANNELS, STEREO MODE

Output Power at Clipping (1% THD at kHz): 8-ohm loads, 125 watts/channel (21.0 dBW); 4-ohm loads, 190 watts/channel (22.8 dBW).

Dynamic Output Power: 8-ohm loads, 138 watts/channel (21.4 dBW); 4-ohm loads, 220 watts/channel (23.4 dBW).

Dynamic Headroom re 8-Ohm Rating: 1 dB.

THD + N, 20 Hz to 20 kHz: 8-ohm loads, less than 0.092% at rated output and less than 0.021% at 10 watts/channel out; 4-ohm loads, less than 0.177% at 150 watts/channel out and less than 0.035% at 10 watts/channel out.

Damping Factor re 8-Ohm Loads: 205 at 50 Hz.

Output Impedance: 39 milliohms at 1 kHz, 45 milliohms at 5 kHz, 54 milliohms at 10 kHz, and 57 milliohms at 20 kHz.

Frequency Response: 20 Hz to 20 kHz, +0.08, –0.48 dB; –3 dB below 10 Hz and at 34.6 kHz.

Tone-Control Range: Bass, +11.4, –11.6 dB at 100 Hz; treble, +10.2, –10.5 dB at 10 kHz.

Subwoofer Crossover: High-pass, –3 dB at 79 Hz and –6 dB at 55 Hz, 12 dB/octave; low-pass, –3 dB at 73 Hz and –6 dB at 89 Hz, 24 dB/octave.

Sensitivity: 26 mV for 0 dBW out and 275 mV for full rated output.

A-Weighted Noise: –81.6 dBW.

Input Impedance: 46 kilohms.

Input Overload (1% THD at 1 kHz): 8.3 V.

Channel Separation, 100 Hz to 10 kHz: Greater than 45 dB.

Channel Balance: ±0.03 dB.

Recording Output Level: 480 mV for 500-mV signal at CD input; 765 mV for 1-kHz, 100%-modulated FM signal at tuner.

Recording Output Impedance: 1.5 kilohms.

AMP SECTION,
DOLBY PRO LOGIC MODE

Output Power at Clipping, 8-Ohm Loads: Main, 125 watts/channel (21.0 dBW); center, 145 watts (21.6 dBW); surround, 100 watts/channel (20.0 dBW).

THD + N at Rated Output, 8-Ohm Loads: Main, less than 0.135%, 20 Hz to 20 kHz; center, less than 0.120%, 20 Hz to 20 kHz; surround, less than 0.05%, 100 Hz to 10 kHz.

Frequency Response: Main, 20 Hz to 20 kHz, +0.1, –1.5 dB and –3 dB below 10 Hz and at 20.87 kHz; center ("Wide" mode), 20 Hz to 20 kHz, +0.1, –1.6 dB and –3 dB below 10 Hz and at 20.81 kHz; center ("Normal" mode), 100 Hz to 20.81 kHz, +0.1, –3.0 dB; surround, below 10 Hz to 7.82 kHz, +0.0, –3.0 dB.

A-Weighted Noise: Main, –78.0 dBW; center ("Wide" mode), –78.5 dBW; surround, –78.4 dBW.

Channel Separation at 1 kHz: 53 dB or greater.

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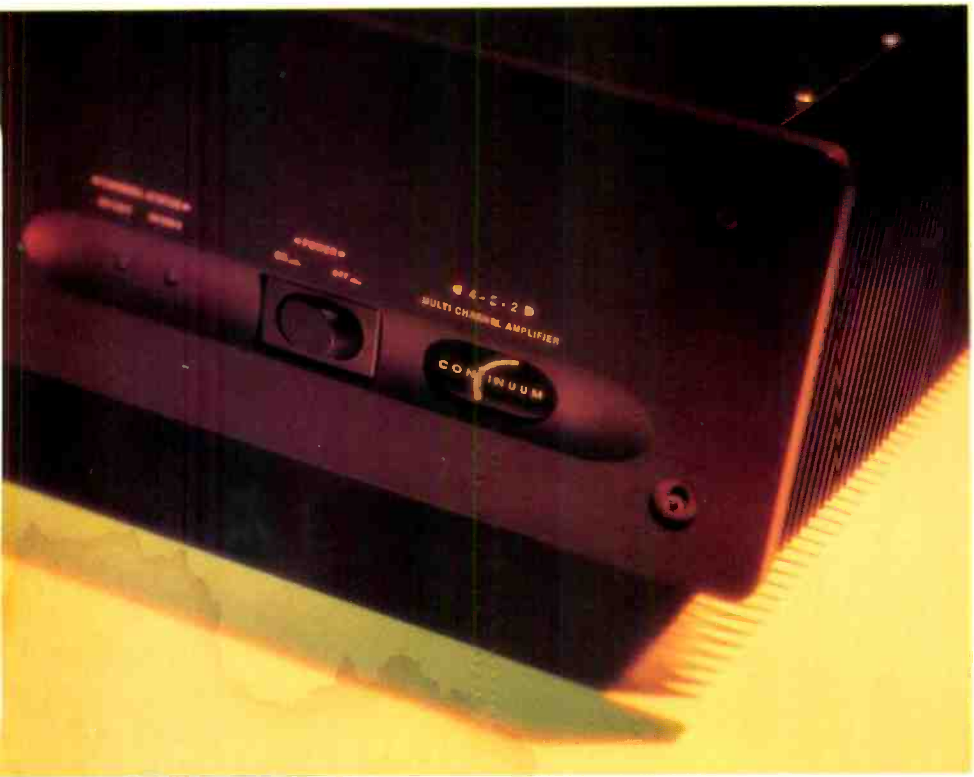
EQUIPMENT **PROFILE**

EDWARD J. FOSTER

CONTINUUM 4•3•2 FOUR-CHANNEL AMP



Continuum and Coda Technologies are sister companies that share a common design philosophy and, to a major extent, circuit topologies. If you want milled-aluminum chassis, gold-plated circuit boards, and 10-year warranties, you buy Coda Technologies—and you pay for it. If you want similar sound in a more affordable (but still hand-crafted) chassis and will settle for a five-year warranty, Continuum is the way to go. In fact, the Continuum 4•3•2 amplifier seems similar to the Coda V10 but costs about a grand less.

As its model number suggests, the 4•3•2 is a four-channel amp whose pairs of channels can be bridged to provide three channels (one pair bridged, two separate) or two channels (both pairs bridged). This increasingly common arrangement lets you use the 4•3•2 as a four-channel amp for biamping a pair of speakers, as a stereo amp for conventionally connected speakers, or, in any of its configurations, for home theater. The amp's 8-ohm rated power depends on its configuration, of course: 100 watts per channel in four-channel mode, 100 watts x 2 plus 400 watts x 1 in three-channel mode, and 400 watts x 2 in bridged stereo.

If you add up the numbers, you'll see that the total power available varies with the setup, but the Continuum 4•3•2's toroidal power transformer keeps up with the demand. The channel pairs on the left and right sides of the chassis each have their own secondary windings, rectifiers, and filter capacitors. The left and right channel pairs can be bridged independently, since each twosome shares a separate supply.

Each pair of channels has 48,000 microfarads of filter capacitance (two 12,000-microfarad, 80-volt electrolytics per rail), and each rail is fused separately. The filter capacitors are said to have very low effective series resistance (ESR) and internal inductance. As a result, these devices' performance as capacitors does not deteriorate at high frequencies and they can handle higher than typical levels of high-frequency ripple current without overheating.

The only elements common to all four channels are the transformer's core and primary winding, the power switch, and the line cord. In the two-channel mode, the 4•3•2 could be called a dual mono amp except that it has a shared power transformer. There are price and performance advantages to sharing, because one transformer is less expensive than two or four of comparable total output capability. And since it is unlikely that all channels will be asked to deliver maximum power at the same time (except on the test bench!), any channel can borrow the power its siblings aren't using.

The Continuum 4•3•2's construction is simple, neat, and effective. The power-supply rectifiers, filters, and fuses are on a glass-filled board that extends across the rear of the chassis. The audio circuitry is on two boards (one for the left pair of channels, one for the right pair) that plug into 12-pin strip sockets on the power-supply board. Input and output signals pass through these connectors and through

Rated Power, 20 Hz to 20 kHz, into 8 Ohms: Four-channel mode, 100 watts/channel; bridged stereo mode, 400 watts/channel.

Rated THD: Less than 0.1% from 10 Hz to 20 kHz at 100 watts/channel, all channels driven into 2, 4, or 8 ohms.

Dimensions: 17 in. W x 6 in. H x 14 in. D (43.2 cm x 15.2 cm x 35.6 cm).

Weight: 45 lbs. (20.4 kg.).

Price: $1,895.

Company Address: 9941 Horn Rd., Unit A, Sacramento, Cal. 95827; 916/363-4653.

For literature, circle No. 91

Photos: Michael Groen

traces on the power-supply board. For those who get excited by such things, the few inches of wire linking this board to the input connectors are Music Metre cable, which has a "solid high purity silver conductor and a clear Teflon dielectric."

The Continuum's output devices (four power transistors per channel) and drivers are soldered to the amplifier circuit boards and are mounted on extruded-aluminum heat sinks that form the sides of the chassis. The front of the chassis is a milled plate of aluminum, somewhat more than ⅜ inch thick. The only sheet-metal parts are the bottom, top, and back, and even these are pretty thick.

The input and output connectors are gold-plated. The high-quality RCA input jacks are insulated from the chassis, and a bridging switch is below each pair of input jacks. Because the output connectors, four multiway binding posts per side, are arranged in square arrays, you can use double-banana plugs whether the channels are operated separately or bridged. The binding posts are of reasonably good quality, but their center holes are too small for really heavy-gauge cable. A removable three-wire line cord is at the center bottom. The front panel carries a rocker power switch and two "Channel Status" LEDs, one for each bridgeable channel pair.

I'VE NEVER BEFORE TESTED AN AMP THAT HAD SUCH UNIFORM OUTPUT IMPEDANCE ACROSS THE SPECTRUM.

The 4•3•2's circuit topology is rather interesting. According to the owner's manual, the circuit's differential configuration provides superior noise rejection and inherent DC stability. Differential circuits are common, but the manual says, "The unit also uses output followers operating without feedback." Now, that is unusual.

Running the output stages without global feedback virtually ensures that this amplifier will be stable with any speaker and cable. Thus, there's no need for an output inductor or other stabilization network. Provided that an amp has fast output devices—those in the 4•3•2 are 10-MHz transistors with an output current capability of 30 amperes and a combined power rating of 800 watts—it can achieve wide bandwidth while maintaining uniform distortion and constant output impedance over the audio band. The uniform characteristics come about because there's no need to roll off the loop gain within the audio band to stabilize the system. The net result is an amplifier that has a very high slew rate and isn't prone to transient intermodulation distortion (TIM). Indeed, Continuum claims that the 4•3•2's voltage-amplifier section has a slew rate of 50 volts per microsecond.

If operating output stages without global feedback is so marvelous, why doesn't everyone do it? Well, without overall feedback, some specifications take it on the nose: The very numbers that are more consistent are also likely to be less impressive. In amplifiers that don't rely on global feedback, distortion and output impedance are likely to be higher. It's often a good trade-off to make, however, especially if the amp can deliver the level of performance that the Continuum 4•3•2 does without leaning on the global-feedback crutch.

Measurements

Figure 1 shows the Continuum 4•3•2's frequency response at 1 watt with 8-ohm loading. The response truly is ruler-flat (within +0, –0.05 dB across the audio band!), and the –3 dB points were beyond my Audio Precision test system's measurement limits of 10 Hz and 200 kHz. Furthermore, the response of all four channels was identical (with no meaningful difference when the channels were bridged), and their gains all matched within ±0.025 dB! Very impressive.

But I was surprised to find substantial differences in residual noise among channels. Channel 1 was the worst (and therefore its

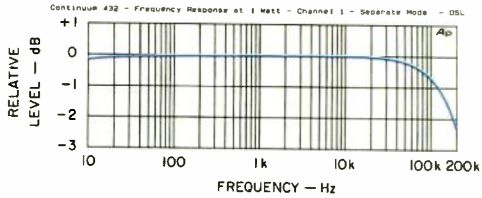


Fig. 1—Frequency response; see text.

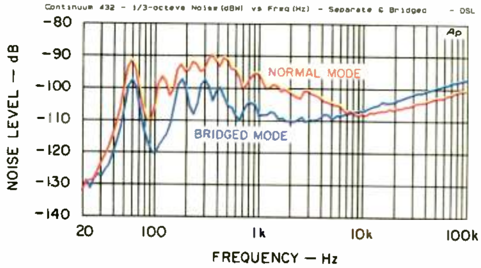


Fig. 2—Noise spectra.

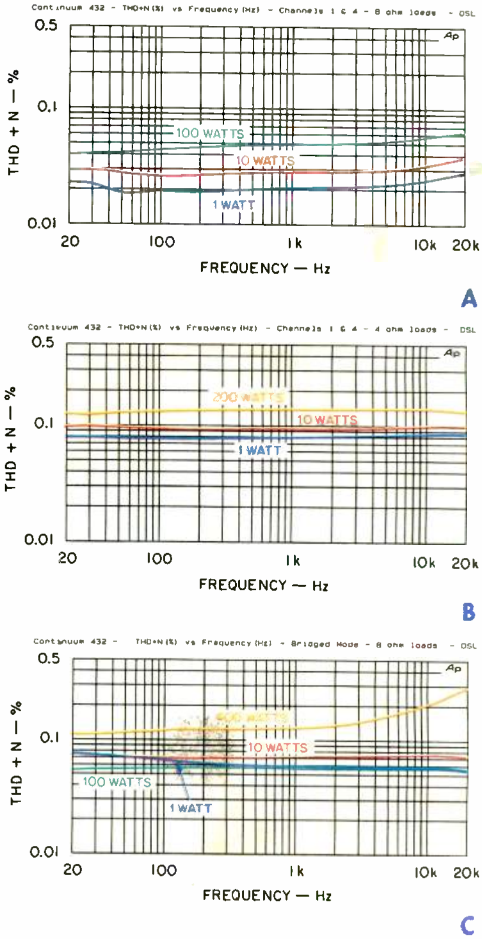
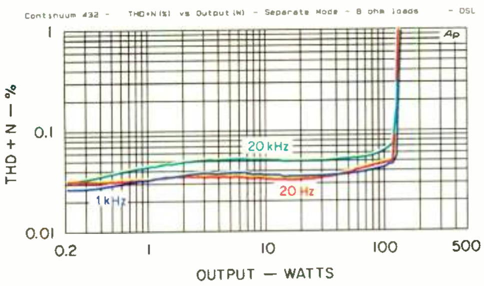


Fig. 3—THD + N vs. frequency for four-channel operation into 8 ohms (A), four-channel operation into 4 ohms (B), and two-channel bridged operation into 8 ohms (C).



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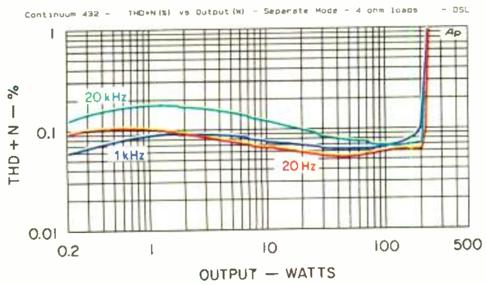

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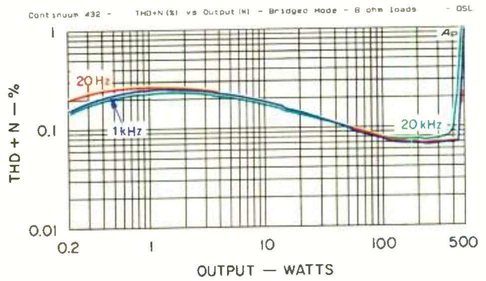


C

Fig. 4—THD + N vs. output power for four-channel operation into 8 ohms (A), four-channel operation into 4 ohms (B), and two-channel bridged operation into 8 ohms (C).

performance is detailed in "Measured Data"). And although it's not really bad in this regard, channels 2 and 4 were several decibels better. Channel 3's A-weighted noise was a minuscule –100.2 dBW, almost 8 dB better than channel 1's.

Sensitivity and noise usually increase when channels are bridged, but this proved not to be the case with the Continuum 4•3•2. Sensitivity remained almost the same (which is helpful for home theater, where sound pressure levels must be calibrated), and the noise floor actually dropped. Figure 2 is a comparison of the amp's noise spectra in normal and bridged modes. Interestingly, in bridged mode the 4•3•2 seems to cancel out even-order, power-line-related components (which are usually caused by power-supply ripple). What's left are a bit of 60-Hz fundamental and its odd harmonics (which are usually induced magnetically by the transformer).

Figures 3A, 3B, and 3C are plots of the 4•3•2's total harmonic distortion plus noise (THD + N) versus frequency at several output levels, with all channels driven. In Fig. 3A, I used 8-ohm loads and measured at 1 watt, 10 watts, and rated output. Figure 3B is similar, but I used 4-ohm loads and, because Continuum provides no 4-ohm rating, measured at 200 watts instead of 100 watts per channel. For Fig. 3C, I bridged channel 1 with channel 2 and channel 3 with channel 4, drove 8-ohm loads, and took measurements for maximum power at the rated 400 watts per channel. Both of the amp's power-supply sections were exercised for these tests, but I've presented only the worst-case channel or channel pair.

Several things are of interest in Fig. 3. Most amplifiers' 1-watt curves are dominated by noise and lie above the curves taken at higher output levels, so I usually don't present them. That's not the case here. For the most part, the 1- and 10-watt curves are very similar, which suggests that they represent distortion rather than noise. Although I included a 200-watt/channel curve in Fig. 3B, I omitted the 100-watt/channel curve for clarity because it was so close to (perhaps even a bit below) the 1- and 10-watt curves; the similarity between these curves suggests that the 4•3•2's distortion really doesn't change much up through this operating level. Note that only the curves taken at rated power lie substantially above the others and that, with one exception (bridged operation at 400 watts/channel), all the curves are quite flat. This suggests that the Continuum 4•3•2's local feedback (as opposed to the global type, which it eschews) remains fairly uniform across the audio band.

The next family of curves (Fig. 4) shows THD + N versus output power. These curves, too, are somewhat atypical. Usually, THD + N decreases as output level increases, hits a minimum just before clipping, and then rises sharply. Such behavior suggests that, up to the clipping point, what's measured is more noise than distortion. (A constant noise level becomes a progressively

MEASURED DATA

Output Power at Clipping (1% THD at 1 kHz), All Channels Driven: Into 8 ohms, 135 watts (21.3 dBW) per channel; into 4 ohms, 220 watts (23.4 dBW) per channel; bridged into 8 ohms, 500 watts (27.0 dBW) per channel.

Dynamic Output Power: Into 8 ohms, 160 watts (22.0 dBW) per channel; into 4 ohms, 285 watts (24.6 dBW) per channel; bridged into 8 ohms, 525 watts (27.2 dBW) per channel.

Dynamic Headroom re Rated Power into 8 Ohms: 2 dB; 1.2 dB in bridged mode.

THD + N, 20 Hz to 20 kHz: Into 8 ohms, less than 0.065% at rated output; into 4 ohms, less than 0.147% at 200 watts out; bridged into 8 ohms, less than 0.294% at rated output.

THD + N, 20 Hz to 20 kHz, at 10 Watts Out: Into 8 ohms, less than 0.04%; into 4 ohms, less than 0.11%; bridged into 8 ohms, less than 0.082%.

Damping Factor: 42 at 50 Hz for 8-ohm loading.

Output Impedance: 190 milliohms from 1 to 20 kHz.

Frequency Response: 20 Hz to 20 kHz, +0, –0.05 dB, with 3-dB down points below 10 Hz and above 200 kHz.

Sensitivity for 0 dBW into 8 Ohms: Four-channel mode, 131 mV; bridged mode, 136 mV.

A-Weighted Noise: Four-channel mode, –92.3 dBW; bridged mode, –94.4 dBW.

Input Impedance: 48.6 kilohms.

Channel Separation: Greater than 54.1 dB from 100 Hz to 10 kHz.

Channel Balance: ±0.025 dB.

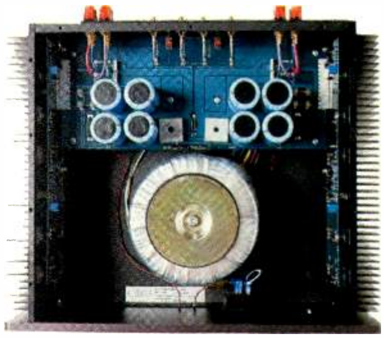
smaller percentage of the signal as output level rises.) The Continuum 4•3•2's THD + N, on the other hand, stays very constant over much of the power range when its four channels are operated into 8-ohm loads (Fig. 4A) and stays relatively constant with 4-ohm loading (Fig. 4B) or when bridged (Fig. 4C). Ultimately, of course, the 4•3•2 does clip, and the curves rise sharply—but not until its output is well above its rated power. The amp is rated at 100 watts x 4 into 8 ohms and delivers 135 watts/channel continuously, a 1.3-dB margin. When bridged, it's rated at 400 watts x 2 into 8 ohms and delivers 500 watts/channel continuously, a 1-dB margin. In the IHF dynamic-headroom test, it puts out somewhat more power: 160 watts (22 dBW) per channel with four channels driven into 8 ohms and 525 watts (27.2 dBW) per channel into 8 ohms when bridged. (Although there's no 4-ohm/four-channel rating in the owner's manual, Continuum does mention 100 watts/channel at 4 ohms in its literature. Needless to say, the 4•3•2 more than clears that hurdle!)

As I mentioned, amplifiers designed without global feedback are likely to generate more distortion than those that use a conventional design; the measurements above demonstrate this. Amplifiers without overall feedback are also likely to have higher output impedance; the Continuum 4•3•2 bears that out, too, with an output impedance of 190 milliohms (equivalent to a 60-foot run of 12-gauge speaker wire or just under 24 feet of 16-gauge cable). But note that this amplifier's output impedance was the same across the entire frequency spectrum; I've never before tested an amp that had such uniform source impedance!

Dividing 8 ohms by the 4•3•2's 190-milliohm output impedance yields a damping factor of 42. That's far lower than typical these days. Once upon a time, however, a damping factor of 42 was considered high. And as far as damping a speaker cone is concerned, it's not just the amplifier's output impedance that counts but the total circuit impedance: the output impedance of the amp, the resistance of the speaker cable, the resistance of the voice coil, and the resistance of any crossover components in series with the woofer. The last two items usually dominate the circuit and control the amount of damping current that can flow. That's why I don't attach much importance to extremely low impedance (a very high damping factor) in the bass. I consider uniformity of output impedance, which can affect tonal balance, far more important.

Use and Listening Tests

If power amplifiers can be said to have a specific sound—and I believe some do—there must be a technical reason for their differences. The Continuum 4•3•2 has a different design from run-of-the-mill amps;



THE 4•3•2 REVEALED REMARKABLE DETAIL YET SOUNDED WARM, ROUND, AND MUSICAL.

it measures differently, too. So I was not surprised to find that my listening tests revealed a difference in its sound character as well.

If I were to describe the sound of the Continuum 4•3•2, I'd use such adjectives as "round," "warm," and "musical." Although I found that it revealed remarkable detail, the Continuum's sound can hardly be described as analytic. In fact, if you lean toward sharply etched transients and electric brilliance, I doubt you'll like this amp's sound. It's laid back. At times, I had some concern about its rather fulsome and occasionally heavy bass. I first noticed this when listening to Antonin Kubalek's *My Gift to You, A Treasury of Favorite Piano Encores* (Dorian DOR-90218), made in the Troy Savings Bank Music Hall. The piano did sound like an American Steinway D, but a rather fat one.

As a check, I played a recording of another Steinway that I had made in New York a week earlier, using selected omni mikes and a professional Sony DAT recorder with Super Bit Mapping. I had not been too pleased with the recording when I first heard it, because the bass seemed swallowed up compared to what I heard during the recording session. With the Continuum 4•3•2, however, the bass blossomed out. It became fuller (without getting too heavy), and the piano's tenor and alto took on the bell-like quality that I look for in Steinway sound. The details were produced spectacularly—not just of the piano but of the audience, the performer, and the hall. These are sounds that you don't find on commercial CDs, and they can be the most revealing of all.

As a further check on bass overhang, I turned to the bass drum and tympani of Aaron Copland's "Fanfare for the Common Man," performed by Louis Lane and the Atlanta Symphony Orchestra (Telarc CD-80078). The low end was solid as a rock, with decidedly powerful drum thwacks that certainly did not suffer from overhang. The brass had great definition, too, and the woodwinds in the *Appalachian Spring* Suite (on the same disc) were outstanding.

The harp in *Appalachian Spring* was clean and precise through the 4•3•2, but other amplifiers in my listening room seemed to etch it more sharply. Was this a virtue or a fault? To find out, I played Ronn McFarlane's lute on *Music of John Dowland* (Dorian DOR-90148) and Christophe Rousset's harpsichord on Rameau's first book of Pièces de Clavecin (L'Oiseau-Lyre 425 866). With the Continuum amp, both had an uncommonly round, warm, and musical sound that appealed to me. But if you're after electric treble, look elsewhere. I found Itzhak Perlman's violin on Bach's Sonatas and Partitas (EMI Classics ZDCB 49483) and Elly Ameling's voice on Schubert's songs (Philips 410 037) absolutely wonderful with the 4•3•2 as well.

Was I deluding myself? Perhaps, but I don't think so. Were the differences I heard due to the Continuum's higher levels of distortion? Perhaps, but I don't think so. Over the years, I've found that the power amps I've liked have usually had particularly uniform output impedance. What I'm responding to in these amps, I believe, is the more accurate tonal balance that uniform output impedance can provide. The Continuum 4•3•2 provides that. I like it. A

EQUIPMENT **PROFILE**

EDWARD J. FOSTER

PHILIPS KEY MODULES IS 5021 DIGITAL SIGNAL PROCESSOR

Philips calls the IS 5021 a sound enhancer; I call it a digital toolbox. It's an analog-to-digital converter, a digital-to-analog converter, a sampling-rate converter, a noise shaper, a digital compressor/expander, a digital fader, a digital noise filter, and a jitter reducer. It can also widen or narrow the stereo soundstage, create stereo-like effects from a mono program, suppress the ticks and pops of a vinyl record, and serve as a precise digital tone control.

For all that, the IS 5021 is rather compact. One small box contains its analog and digital electronics; an even smaller power supply provides +6.2, +17, and –17 volts DC through an umbilical cord that plugs into the back of the main box. Also on the back of the main chassis are stereo analog inputs and outputs (one pair of each), two coaxial digital inputs, and two coaxial digital outputs. (Optical digital connections are not provided.) All analog and digital signal connections are via gold-plated RCA jacks.

The IS 5021's digital inputs accept consumer-standard S/P DIF (Sony/Philips Digital Interface Format) signals at any sampling rate between 15 and 50 kHz; a rear-panel pushbutton selects digital output at either 44.1 or 48 kHz. When operating with digital signals, the 5021 reclocks and "de-jitters" the data. Sampling-rate conversion is performed by a Philips TDA 1373 chip, which supports 20-bit data. The chip's output rate is established by a crystal oscillator, whose stability determines the output jitter.

If desired, the IS 5021 can perform what Philips calls Quantization Noise Imaging (QNI), a form of in-band noise shaping intended to move quantization noise outside the audible range. Philips says that QNI improves the sound quality of 16-bit audio signals (such as those from CD), especially low-level signals, but that it yields no benefits with 20-bit recordings. Analog signals are likewise said to gain nothing from QNI, perhaps because they're converted to digital

DESPITE ITS EXTENSIVE ARRAY OF FUNCTIONS, THE PHILIPS 5021 IS SIMPLE TO USE.

signals by a 20-bit Analog Devices MOD 79 A/D chip before being fed to the TDA 1373 processor chip. Subcodes embedded in digital input signals pass through the 5021 without being processed in any way. Signal processing is performed by a Philips PCF 5020D DSP chip, after which the digital signal is converted back to analog by a Philips TDA 1547 Bitstream IC.

Although the IS 5021 has many functions, it's simple to use. In addition to left and right rotary volume controls, the front panel carries four black pushbuttons, two gray pushbuttons, and two red pushbuttons. Three of the black controls ("Fade," "QNI," and "Effect") toggle DSP functions

Photos: Michael Groen

Dimensions: Main chassis, 8¼ in. W x 4½ in. H x 6½ in. D (21 cm x 11.5 cm x 16.7 cm); power supply, 6¼ in. W x 2¾ in. H x 3¾ in. D (16 cm x 7 cm x 9.5 cm).
Weight: Main unit, 4 lbs. (1.8 kg); power supply, 2.9 lbs. (1.3 kg).
Price: $1,500.
Company Address: c/o Mackenzie Laboratories, 1163 Nicole Court, Glendora, Cal. 91740; 800/423-4147.
For literature, circle No. 92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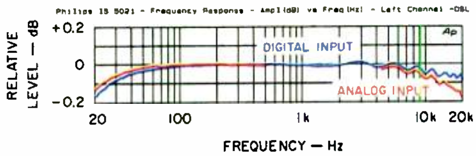

Fig. 1—Frequency response.

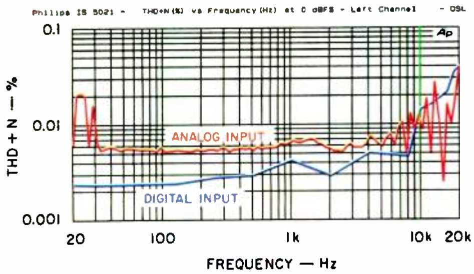

Fig. 2—THD + N vs. frequency.

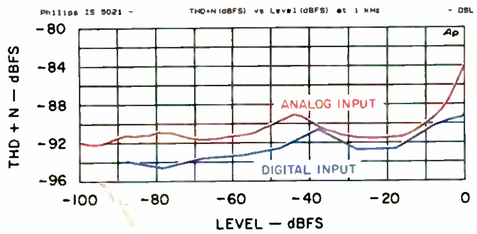

Fig. 3—THD + N vs. level.

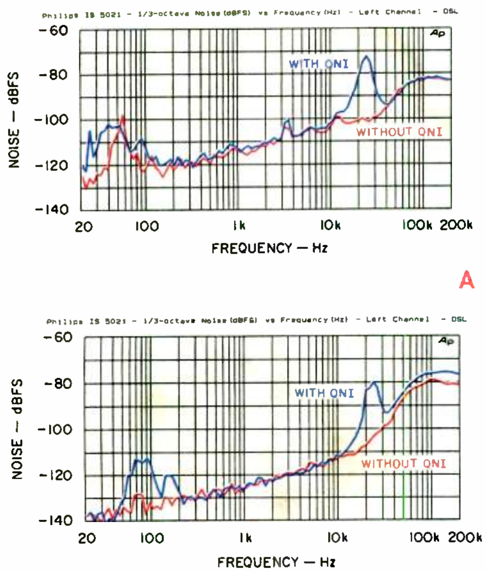

Fig. 4—Noise spectra for analog input (A) and digital input (B).

on and off; the fourth cycles through the three inputs ("Digital 1," "Digital 2," and "Analog"). The gray "Select" controls activate and deactivate other DSP functions ("Scratch," "Noise Filter," "Stereo Enhancement," "Compress/Expand," "Bass," "Treble," and "Spatial"). With the red "Adjust" controls, you can regulate the degree of each effect.

Amber LEDs in the upper portion of the IS 5021's front panel show which input and functions are active. Any function's parameters can be adjusted during the first 6 seconds after it's selected; its LED blinks to show this. After 6 seconds with no adjustment, the LED glows steadily. A green "Lock" LED turns on when the 5021 has locked onto a digital input signal; a red LED indicates "Overload" of the A/D converter.

The "Effect On/Off" button lets you check the sound with and without processing. When an indicator LED is flashing, "Effect On/Off" toggles only the function that's being adjusted; otherwise, it toggles all selected functions at once.

When any function is in adjustment mode, its setting is shown on the LED level display. The rest of the time, this display, which dominates the front panel, shows signal level, using two strips of 26 LEDs: Green LEDs are used for levels from –60 to –4 dB, amber LEDs from –3 to –1 dB, and red LEDs for 0 and +1 dB. Although you're unlikely to confuse volume and setup indications, an amber "Volume Display" LED illuminates when the two LED strips revert to the task of level monitoring.

The IS 5021's functions can be adjusted over quite a wide range. Bass and treble can each be adjusted by ±10 dB, and the noise filter can be set to any of 12 cutoff frequencies. You can choose from 20 "Fade" rates and 10 "Stereo Enhancement" levels. "Spatial" can widen or narrow the sound image by three steps either way. Compression and expansion are each adjustable in 10 steps, and the scratch suppressor's sensitivity is adjustable in 25 steps.

Most functions can be used simultaneously, but there are restrictions. For example, you can use "Scratch," "Noise Filter," and "Stereo Enhancement" in combination with each other but not with "Compress/Expand." The LED arrangement and panel markings help you remember what can and can't be used together.

Measurements

In testing the Philips IS 5021, I fed it analog and digital test signals but measured only its analog output. When the 5021 is fed a digital signal, its "Volume" knobs control the analog output level and the 52-LED level indicator monitors that level. The indication therefore varies with the volume setting, and the "0 dB" LED does not necessarily indicate 0 dBFS. With a 1-kHz input at 0 dBFS, I adjusted the "Volume" knobs to obtain a 2-volt output, which I defined as my reference; the "0 dB" LED lit up at this level. I used this setting for all tests that I made from the 5021's digital input. (With "Volume" set 1 dB higher, the 5021's output amplifier clipped.)

According to a block diagram in the owner's manual, analog input signals pass through the volume-control stage prior to A/D conversion. This is the logical arrangement, enabling you to adjust the level so that the A/D converter is exercised as fully as possible without overloading on peaks and to use the level indicators as a guide. Yet my tests suggest that it is possible for the 5021 to clip severely without giving you any visual warning. The problem is not A/D converter overload. At an input level of 1.8 volts rms (slightly less than the 2-volt full-scale output of most consumer digital products), distortion reached 1% and turning the volume down did nothing to reduce it. This suggests that a stage prior to the "Volume" control can be driven into clipping without turning the "Overload" LED on or having the level display go into the red. I consider this a serious design flaw, although the 5021 is hardly the first digital product I've tested that acted this way.

You can avoid this problem, however. If you set the "Volume" knobs to "6" (just above their midpoints), the level display will indicate "0 dB" with a 1.6-volt input, the output will be 2 volts, and midband distortion will be well under 0.01%. If you use "Volume" settings of "6" or higher, the display will warn you of dangerous operating levels; with settings below "6," all bets are off.

For all tests I made through the IS 5021's analog inputs, I turned the "Volume" controls to "6" and set the 5021's converters for 48-kHz sampling. For tests through the digital input, the sampling rate was 44.1 kHz. (For measurements made with either input, the left channel's performance is shown here; for most measurements, the right channel's performance was the same or differed insignificantly.)

Figure 1 shows the IS 5021's frequency response with analog and digital signals.

QNI'S REAL ADVANTAGE IS A DECREASE IN THE D/A CONVERTER'S LINEARITY ERROR.

Note the greatly magnified vertical scale (±0.2 dB per division) and the negligible difference between the two curves. Clearly, the frequency response of the 5021's A/D converter is nearly perfect; in this respect, the 5021 processes analog signals just as well as it does digital signals.

Figure 2 shows total harmonic distortion plus noise (THD + N) versus frequency at 0 dBFS. The reason the analog curve appears more irregular above 6 kHz than the digital curve is that the digital measurements are taken at relatively few, widely spaced frequencies, whereas the analog data is taken at 100 points across the frequency range. Thus, the analog curve is more likely than the digital curve to reveal problems caused by intermodulation between the signal and the sampling rate. Although I've tested a few digital products with somewhat lower THD + N at high frequencies than the 5021, I find little to complain about in either curve.

When I tested the IS 5021's THD + N versus level for a 1-kHz signal, there was a small difference between left- and right-channel performance; the curves in Fig. 3 are for the worse (left) channel. Below the –10 dBFS level, the curves are nearly flat except for relatively minor rises in THD + N at about –40 and –45 dBFS. This time, the analog curve is slightly smoother, as a result of its larger number of data points. The analog curve lies above the digital because of residual noise in the analog input electronics and, possibly, in the A/D converter.

The measurements in Fig. 3 were taken without the IS 5021's Quantization Noise Imaging. I took similar curves with QNI, but they lay well above the ones shown. (They were at –78 to –79 dBFS, just off the top of the scale.) Figure 4, which presents noise spectrum analyses with and without QNI, indicates why. Using QNI with the analog input (Fig. 4A) causes a huge peak in the noise (28.5 dB!) near the Nyquist frequency (one-half the sampling rate); with the digital input (Fig. 4B), QNI also substantially increases the noise in the octave from 10 to 20 kHz. The whole idea of in-band noise shaping is to move noise from the midrange and lower treble, where the human ear is most sensitive, to the high treble, where hearing is less acute. This doesn't change the total noise energy; it just shifts more of it to a region where it will be harder to hear, sort of like squeezing the air in a balloon from one end to the other. The problem with Philips's QNI noise shaping is that it doesn't seem to reduce midrange noise. Within the limits of experimental error, there's no difference in Fig. 4 between the noise with and without QNI from 200 Hz to 7 kHz—just the huge peaks in the high-frequency area (where they are, admittedly, pretty inaudible).

This anomaly affects every item in "Measured Data" that includes the effects of noise. With a digital input, the IS 5021's A-weighted noise was 11.3 dB higher with QNI than without, quantization noise and unweighted dynamic range were 13.7 dB worse, and there was 6.4 dB less A-weighted dynamic range. (Although Philips does not claim a benefit from using QNI with analog input signals, I ran the tests anyway; the results were similar.)

So why use QNI? Well, it does reduce the D/A converter's linearity error, as you can see from Figs. 5 and 6. Figure 5 reveals that linearity error is substantially smaller with QNI than without it, and the results in "Measured Data" confirm this. Figure 6 il-

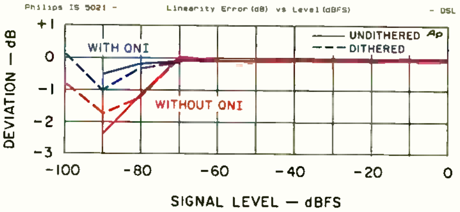

Fig. 5—Deviation from linearity.

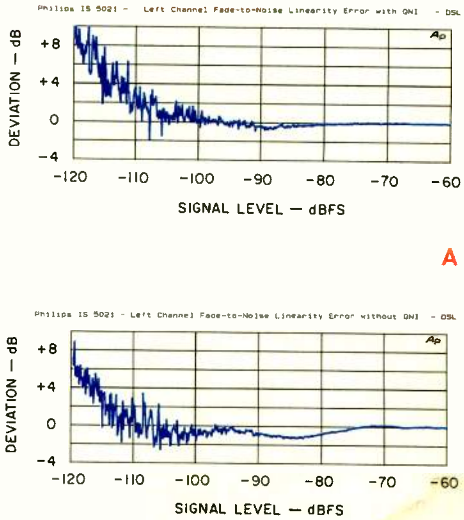

Fig. 6—Fade-to-noise test with QNI (A) and without it (B).

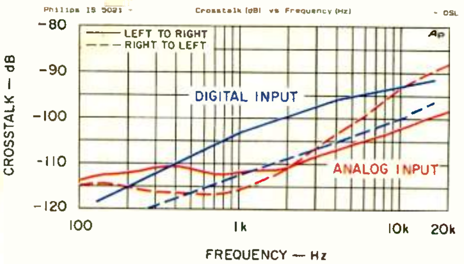

Fig. 7—Crosstalk vs. frequency.

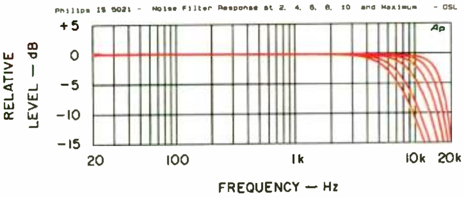

Fig. 8—Noise filter's frequency response.

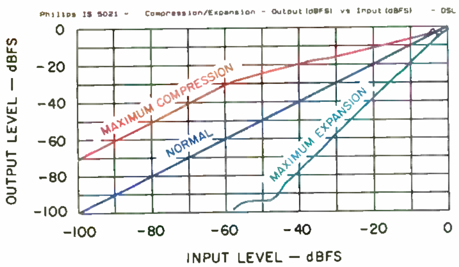

Fig. 9—Compressor and expander characteristics.

ustrates fade-to-noise linearity error. Again, the linearity error from −75 to −100 dBFS is smaller with QNI (Fig. 6A) than without it (Fig. 6B). (In all fairness, I've tested other D/A converters whose linearity at least equaled that of the 5021 with QNI, but they did not have the noise-related problems QNI seems to induce.)

Figure 7 shows crosstalk versus frequency. The results are excellent for both inputs.

The treble control's curves (not shown) were pretty standard, though the bass control's curves shelved below about 80 Hz. The controls allowed 10 dB of boost and cut at 20 Hz and 20 kHz, in 1-dB steps.

Figure 8 shows how the cutoff frequency of the IS 5021's noise filter changes with different control settings. (Curves were taken at every setting; for clarity, however, only every other curve is presented.) These measurements were made with an analog source and 48-kHz sampling; the cutoff frequencies would scale down proportionately if 44.1-kHz sampling were used.

Figure 9 shows the steady-state transfer characteristics of the IS 5021's compressor and expander when set for maximum effect, as well as a transfer curve with no compression or expansion. With maximum compression, the top 60 dB of the input dynamic range (horizontal axis) is compressed to a 30-dB output range (vertical axis). At input levels below −60 dBFS, the compressor returns to unity transfer—i.e., the output tracks the input, decibel for decibel. With maximum expansion, the topmost 44 dB of the input dynamic range is expanded to 88 dB. Below that point, the expander attempts to return to unity transfer; my measurement was probably affected by residual noise.

Use and Listening Tests

The Philips IS 5021's analog outputs have plenty of drive voltage and a low source impedance, and its analog input impedance is adequately high. Interfacing it to your system can still be a problem, however, because the input will clip with analog input levels above 1.8 volts. You could fashion an attenuator so this will not happen, but with a $1,500 processor, you shouldn't need to. Nor should you need to restrict the volume control to half its range.

Although there's no problem with digital levels, there is a potential snag with the IS 5021's digital connectors. Recently, I have noticed that some Japanese manufacturers of CD players are omitting coaxial digital connections and providing only Toslink optical jacks. I can't say I approve (wired connections usually have wider bandwidth than the Toslink connections found in many consumer digital audio components), but if that's the way the elephants are moving, the rest of the animals in the jungle would be wise to adapt. The 5021's inability to accept an optical signal and deliver an optical output makes it less universally useful than it could be.

I WAS SURPRISED TO FIND I LIKED THE WAY THE 5021'S "STEREO ENHANCEMENT" TREATED MONO RECORDS.

Fortunately, this was not a problem in my setup, because my CD player, a Sony CDP-XA7ES, has coaxial as well as optical digital connections. I drove the IS 5021's "Digital 1" input from the XA7ES and then connected the 5021's analog outputs to one input of my preamp and the CD player's analog outputs to another. After I matched levels, I could compare the sound quality straight from the player and through the processor by toggling the preamp's input selector. The switch on the Bryston BP-20 preamp is silent, and a friend operated it for me, so the test was reasonably blind. Later, we swapped tasks so I could get a second opinion.

Turning QNI on and off causes a momentary break in the sound. As a result, we could not make such near-blind comparisons of the IS 5021's sound with and without this noise shaper. We therefore used the CD player's D/A converter as a reference and used the preamp's silent switch to compare it to the 5021's D/A converter with and without QNI.

On the whole, both of us preferred listening to the IS 5021 with QNI. This was especially true on piano recordings that have a fair degree of ambient "tail," such as Antonin Kubalek's *Czech Miniature Masterpieces* (Dorian DOR-90121). To a lesser extent, the same was true of Evgeny Kissin's recording of Schubert's "Wanderer Fantasy" (Deutsche Grammophon 435028), although there's less ambience in this recording than Dorian captured when recording Kubalek in the Troy Savings Bank Music Hall.

Neither of us heard much difference from QNI on the EMI release of Lalo's "Symphonie Espagnole" (EMI Classics CDS 55292), with violinist Sarah Chang and Charles Dutoit leading the Royal Concertgebouw Orchestra. One disc whose sound I preferred without QNI was Canteloube's *Songs of the Auvergne*, featuring soprano Dawn Upshaw with the Lyon Opera Orchestra led by Kent Nagano (Erato 96559). I thought the voice was cleaner and less "hairy" without QNI, but my friend did not react similarly.

From these experiments, I conclude (at least tentatively) that, with the music I used and with the possible exception of the soprano voice, I find low-level nonlinearity more objectionable than a dollop of noise in the near-ultrasonic region. But how did the IS 5021 compare with the sound of my CD player alone? Except on the "Symphonie Espagnole," which did not seem to reveal differences, both of us consistently preferred the Sony player's converter to the 5021's, with or without QNI. The CDP-XA7ES is a tough player to beat, so I reran the tests, using an older Sansui CD-X711 player (which was one of the first to use a MASH 1-bit converter). With QNI, the 5021 gave the X711 a good run for its money on the piano recordings; with QNI off, I'd give the edge to the Sansui.

The 5021's compressor should come in handy when you're making tapes for your car; if the compression ratio is not pushed to extremes, the sound is quite listenable even without complementary expansion (which the IS 5021 will also be happy to perform).

The action of the Philips IS 5021's bass and treble controls was precise and repeatable, and I found the alterations in tonal character they induced more to my liking than is typically the case. I was even impressed with the "Spatial" feature, which seemed to add some spread to narrow stereo recordings without making a mockery of the soundstage.

The IS 5021's "Stereo Enhancement" function creates stereo effects from mono recordings. I tried it with the only mono CD in my collection that had not already been "stereo-ized," Chopin's Waltzes, played by pianist Dinu Lipatti (EMI Classics CDH 69802). I usually don't like what pseudo-stereo circuits do to solo instruments, but I was surprised to find I rather liked the results with the IS 5021. So I dug up some old LPs.

When I say "old," I *mean* old. Down in the bowels of my collection, I found one of the first LPs I ever bought, Rachmaninoff's Piano Concerto No. 2 in C Minor, Op. 18, with the Austrian Symphony Orchestra conducted by Kurt Woss and Felicitas Karrer (a boy, judging from the picture on the record jacket!) at the piano. (This was on the Remington label and was "Factory Guaranteed" for "Complete Audible Range Reproduction.") Although the IS 5021 couldn't make a silk purse out of this relic, it made a valiant effort. By the time I got through doctoring the sound, the 5021's panel was lit up like a Christmas tree. A little treble cut and a little bass boost helped fix the (presumably nonstandard) equalization used in making the disc. The "Scratch" filter was reasonably adept at removing the big ticks; however, if I turned it up enough to tackle the minor ones, it punched more holes in the signal than I found acceptable. I therefore tried some aggressive noise filtering, which helped remove the hiss as well as the minor scratches; not much, if any, of the music was lost by this. (I expect that the "Audible Range" was less "Complete" back then.) Finally, "Stereo Enhancement" did a very nice job of expanding this old chestnut into stereo.

As the above example might suggest, I expect that audiophiles will be interested in the Philips IS 5021 more for its special features than as an independent D/A converter. And I must say it's quite adroit at doing what it does. I was particularly impressed by its subtlety—a major virtue in this type of component. A

THE 5021 COULDN'T MAKE A SILK PURSE OUT OF MY OLDEST LP, BUT IT MADE A VALIANT EFFORT.

MEASURED DATA

Analog Line Input Characteristics: Impedance, 49 kilohms; sensitivity, 0.34 volt for 0-dBFS output; overload, 1.8 volts.

Analog Line Output Impedance: 450 ohms.

Frequency Response: Analog or digital input, 20 Hz to 20 kHz, +0.02, –0.16 dB.

THD + N at 0 dBFS, 20 Hz to 20 kHz: Analog input, less than 0.0398%; digital input, less than 0.0394%.

THD + N at 1 kHz: Analog input, less than –83.8 dBFS from 0 to –90 dBFS and less than –89 dBFS from –30 to –90 dBFS; digital input, less than –87.5 dBFS from 0 to –90 dBFS and less than –90.4 dBFS from –30 to –90 dBFS.

Maximum Linearity Error: Analog input, 0.8 dB to –90 dBFS and 1.11 dB to –100 dBFS; digital input without QNI, 2.58 dB to –90 dBFS (1.72 dB at –100 dBFS); digital input with QNI, 0.47 dB to –90 dBFS and 0.99 dB to –100 dBFS.

A-Weighted S/N re 0 dBFS for Infinity-Zero Signal: Analog input, 95 dB without QNI and 86 dB with QNI; digital input, 105.5 dB without QNI and 94.2 dB with QNI.

Quantization Noise: Analog input, –89.8 dBFS without QNI and –75.3 dBFS with QNI; digital input, –92.7 dBFS without QNI and –79 dBFS with QNI.

Dynamic Range: Analog input without QNI, 91.2 dB unweighted and 93.3 dB A-weighted; analog input with QNI, 75.7 dB unweighted and 86.4 dB A-weighted; digital input without QNI, 94.5 dB unweighted and 97.9 dB A-weighted; digital input with QNI, 80.8 dB unweighted and 91.5 dB A-weighted.

Channel Separation: Analog input, greater than 87.8 dB from 100 Hz to 20 kHz; digital input, greater than 91.6 dB from 125 Hz to 16 kHz.

EQUIPMENT PROFILE

BASCOM H. KING

SONIC FRONTIERS POWER-3 MONO AMP

I have followed the rise of Sonic Frontiers as a major player in high-end audio for a number of years. I was impressed enough by its amps at the 1994 Winter Consumer Electronics Show to ask for a chance to review one. Though I had hoped to get the mono Power-3, the company's top-of-the line amplifier, I expected to get the Power-2 stereo amp. So I was surprised and delighted when a pair of 220-watt Power-3s arrived on my doorstep. (The UPS guy who delivered these 100-pound amps was not delighted.)

Like most Sonic Frontiers components, the Power-3 is available with a black or gold front panel. The only features on that panel are pushbutton switches and indicator LEDs for "Standby" and "Power."

The power and output transformers and the filter capacitors are in a rectangular enclosure at the back of the Power-3, which also forms the amp's rear panel. A switch near the input jacks on this panel selects balanced input, unbalanced (single-ended) noninverting input, or unbalanced inverting input. Balanced signals can be fed in through an XLR connector or a pair of RCA jacks. One of these RCA jacks also serves as the noninverting unbalanced input; the other serves as the inverting unbalanced input. Another position on the input selector mutes the Power-3, shorts all of its inputs, and activates the bias-setting circuitry for the output tubes.

The Power-3's audio circuitry is in a stainless-steel chassis extending forward from the transformers' enclosure, and the tubes extend through the top of the chassis. Between the chassis and the transformer enclosure behind it is a small band, about 1¼ inches wide, that is slotted to help cool a number of heat sinks for power-supply components that are just below the band. A slotted metal cage fits over the tubes, giving the amplifier a simple box shape; the cage is attached to the chassis with captive screws. The amplifier's bottom plate is slotted to allow cool air to enter.

THE CIRCUIT COMBINES FAMILIAR ELEMENTS WITH NEW REFINEMENTS TO PRODUCE A UNIQUE DESIGN.

Inside the Power-3 are two p.c. boards. A large board beneath the chassis holds all the tube sockets and most of the audio circuitry. This board is liberally drilled to allow air drawn up through the bottom plate to pass through to the tubes. A smaller board under the transformer enclosure holds power-supply components. Unlike many tube amps that have p.c. boards beneath their chassis, the Power-3 has most of its components mounted to the undersides of the boards for easy access.

Rated Power Output: 220 watts into 8-, 4-, or 2-ohm load.
Dimensions: 18 in. W x 9 in. H x 22 in. D (46 cm x 23 cm x 56 cm).
Weight: 100 lbs. (45 kg) each.
Price: $8,995 per pair.
Company Address: 2790 Brighton Rd., Oakville, Ont., Canada L6H 5T4; 905/829-3838.
For literature, circle No. 93

Photos: Michael Groen

All in all, the Power-3 is beautifully made and attractive. The chassis metalwork is first-rate, with Pemm nuts and machine screws fastening the pieces together. On the p.c. boards, high-quality components abound (e.g., capacitors from MIT, Solen, and Wima and resistors from Caddock and IRC). The insulation on the internal wiring appeared to be of Teflon.

I have seen most of the Power-3's basic circuit elements (see "Circuit Highlights") in various other amplifiers over the years. But Sonic Frontiers' combination of these elements, using modern components together with refinements wrought through countless hours of listening evaluation and circuit tweaking, makes the Power-3 unique.

Measurements

The performance of the two Power-3s I received matched quite closely in most respects, so I'm presenting data for the one I've designated amp A, unless otherwise noted. As an example of how close the match was, voltage gain on the 8-ohm taps was 25.75 dB for amp A and 25.95 dB for amp B, whether I used their balanced or unbalanced inputs.

Frequency response, at the 8-ohm taps at a 2.83-volt output (1 watt into 8 ohm), is shown in Fig. 1. Across the audio band and beyond, the output varies very little with changes in load, an indication that the Power-3's output regulation is very good. Technically, where the curves first cross (at about 60 kHz), the output impedance becomes negative; when this happens, the output increases for decreasing loads. The situation reverses at about 120 kHz, where the output impedance becomes positive again. This is a result of the compensation scheme the amplifier uses to ensure high-frequency stability; the output transformer is probably the major element involved. With a dummy load that mimics the impedance curve of a typical impedance-compensated two-way speaker, the Power-3's frequency response is still good (Fig. 2). The response variations caused by this load's impedance changes are small. (The vertical scale in Fig. 2 is magnified so that you can see them clearly.)

The Power-3's overall negative feedback is taken from its transformer's 8-ohm taps; frequency response should therefore be flattest at these taps, since coupling between this and the other taps is imperfect. Comparing Fig. 1 to a graph of response at the 4-ohm taps (Fig. 3) bears this out. At the 4-ohm taps, there is more high-frequency rolloff and less uniform output within the audio band when the loading is changed. Even so, the response with 2-ohm loading does not fall to –3 dB until it reaches about 90 kHz, an impressively wide bandwidth. I'd expect the rolloff and less uniform output regulation to be more pronounced on the 2-ohm taps, but I did not measure response there.

Square-wave response is presented in Fig. 4 for 8-ohm loading on the 8-ohm taps. Rise and fall times for a 10-kHz signal into 8 ohms (top trace) are 1.3 microseconds. With the 8-ohm load paralleled by a 2-microfarad capacitance (middle trace), ringing is not damped as quickly as it is in most other power amps. The excellent low-frequency response of the Power-3 is revealed by the 40-Hz trace (bottom), which has almost no visible tilt.

The common-mode rejection ratios (CMRR) of the two amplifiers' balanced inputs differed somewhat. Amp A's CMRR was greater than 57 dB from 20 Hz to 20 kHz. Amp B's was greater than 73 dB from 20 Hz to 1 kHz, then started a gradual decrease that reduced it to 61 dB at 20 kHz.

THE POWER-3'S BANDWIDTH WAS QUITE IMPRESSIVE, AND LOW-FREQUENCY RESPONSE WAS EXCELLENT.

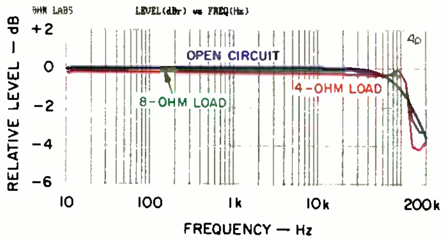

Fig. 1—Frequency response, 8-ohm taps.

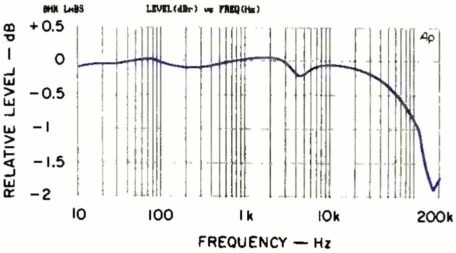

Fig. 2—Frequency response, 8-ohm taps, with dummy speaker load.

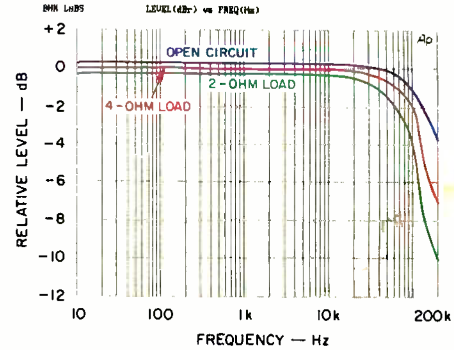

Fig. 3—Frequency response, 4-ohm taps.

The Power-3 generally has lower distortion in its balanced input mode because of better cancellation of even harmonics (Fig. 5). Plotting total harmonic distortion plus noise (THD + N), at 1 kHz and as a function of power for several loads (Fig. 6), reveals that performance is best when the load impedance ranges from the value that matches the selected output taps (e.g., 8 ohms on the 8-ohm taps) down to half that impedance (e.g., 4 ohms on the 8-ohm taps). For double the matched load (e.g., 16 ohms on the 8-ohm taps), the available power is reduced and there's some increase in distortion from about 2 watts up.

As with most amplifiers, the Power-3's THD + N increases at higher frequencies, although it does not really start rising until about 10 kHz. Figure 7 shows this for balanced input. (With an unbalanced input,

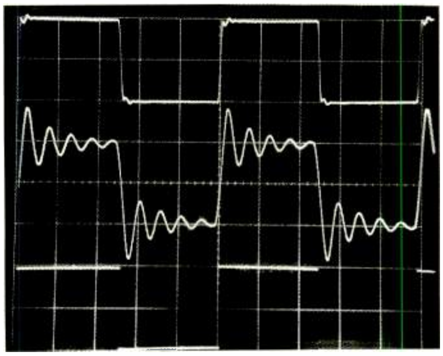

Fig. 4—Square-wave response, 10 kHz into 8 ohms (top), 10 kHz into 8 ohms in parallel with 2 µF (middle), and 40 Hz into 8 ohms (bottom).

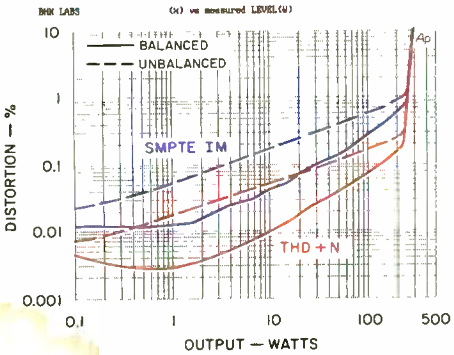

Fig. 5—Distortion vs. power, 8-ohm load on 8-ohm taps.

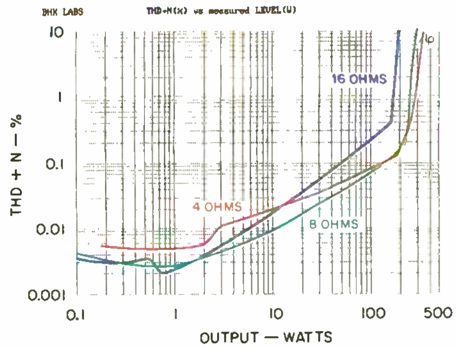

Fig. 6—THD + N vs. power, 8-ohm taps.

THD + N was higher overall but its rise above 10 kHz was less noticeable.) A distortion spectrum analysis for a 1-kHz signal at an output of 10 watts revealed that the amplitude of the harmonics decreased rapidly as their order increased. The fifth harmonic reached a level of only 0.00005%, and higher harmonics were not detectable! The Power-3's distortion performance is among the best I've seen in a tube power amplifier.

Output noise in the Power-3 was very low, especially in its balanced input mode. Measured via the unbalanced noninverting input, output noise for the less quiet of the two amps was 187 microvolts wideband, 155 microvolts from 22 Hz to 22 kHz, 36.7 microvolts from 400 Hz to 22 kHz, and 32.1 microvolts on an A-weighted basis. The IHF signal-to-noise ratio was 98.9 dB, an excellent figure.

The Power 3 had the highest damping factor I can recall measuring on a tube amp. On the 8-ohm taps, it was about 50 from 100 Hz to 2 kHz; it fell off gently on either side of this range, to about 32 at 10 Hz and 20 kHz. I did not measure damping factor on the 4-ohm taps directly, but the data I collected for Fig. 3 indicated a damping factor of about 30.

Dynamic power attainable—with the IHF tone-burst signal and an 8-ohm load on the 8-ohm taps—was 272 watts, and there was negligible output drop from power-supply sag over the course of the 20-millisecond burst. This 272-watt output corresponds to a dynamic headroom of 0.92 dB. Power at the visual onset of clipping was 250 watts, for a clipping headroom of 0.56 dB.

The Power-3's AC line draw was 1.4 amperes in standby and 4.1 amperes in idle. The AC line current stayed constant up to about 20 watts out. This is because the amplifier operates in what I call "rich" Class AB: It operates in Class A most of the time, with only loud passages crossing over into Class AB. At 8.2 amperes of line current for a pair of Power-3s, it definitely won't be cheap to run them all the time! However, the Power-3's front-panel "Standby" switch reduces power draw substantially. Sonic Frontiers recommends that the amps be in standby mode when not you're not listening to them. Since switching to standby and back does not affect the sound, I also recommend it.

Use and Listening Tests

Phono equipment in my system during the review period included an Oracle turntable fitted with a Well Tempered Arm and an Accuphase AC-2 moving-coil cartridge used with a Vendetta Research SCP-2C phono preamp. For CDs, a Sonic Frontiers SFT-1 or a Counterpoint DA-11A CD transport drove a Sonic Frontiers SFD-2 MkII D/A converter with a Genesis Digital Lens jitter-reduction device placed between the transport and the converter; digital cables were Illuminati DX50s. Other power amplifiers used for comparison were a Spectron 1KW, a Crown Macro Reference, and a pair of Quicksilver M135 tube amps. The loudspeakers were Genesis Technologies Vs and B&W 801 Matrix Series 3s; the B&Ws were augmented from 20 to 50 Hz by a subwoofer in each channel.

I did most of my listening with the Sonic Frontiers Power-3s through the Genesis Vs. With these speakers, the Power-3s produced the best overall sound of all the amplifiers I had on hand, delivering absolutely amazing reproduction! There was a sense of ease, musical rightness, and spatial presence that continued to astound me, whether I was listening to my current reference CDs and LPs or to older recordings I hadn't heard in a while.

I had listened to other state-of-the-art tube amps with the Genesis V speakers at the Genesis Technologies factory, and the sound I got in my listening room with the Power-3s compared favorably to what I had heard there. Yet I must note that the Genesis Vs have their own servo bass amp, which handles frequencies below about 85 Hz. Any power amp driving these speakers is therefore relieved of delivering the low bass.

As mentioned in "Circuit Highlights," the connections you use to select the Power-3's output taps are under the transformer. Thus, I had to turn each of these heavy amps over and change the connections whenever I switched between 4- and 8-ohm speakers. Since I started with the 4-ohm Genesis Vs, I listened to the 8-ohm B&Ws on the 4-ohm taps before I got around to resetting the amps to 8 ohms. With the B&Ws, changing to the 8-ohm taps improved the overall presentation and gave the bass more punch.

The bass power and tightness of these amps were most impressive! Although the differences between the various amplifiers in my system weren't as obvious to me on the B&W 801s as on the Genesis Vs, the Power-3s sounded exceedingly good on these speakers, too. The words that came to mind as I listened included ease, dynamic nuance, lack of irritation, and musical believability. The Power-3s are among the very best amplifiers I have had the pleasure of auditioning.

I did find a few faults with the Power-3s, however. For example, when they were in standby mode, turning them completely off produced a strange noise through the speakers. This took the form of a chirp on the Genesis Vs and a grunt on the B&W 801s, but the two Power-3s each produced the same noises. One amp also made an audible popping noise for a few minutes after I switched it from muting to an unbalanced input mode. The cages covering the front of the amps were rather resonant when struck; better mechanical damping would have prevented this. And then there's the matter of the 8.2 amperes of line current that it takes to run a pair of Power-3s—aah, but it's worth it to hear them. A

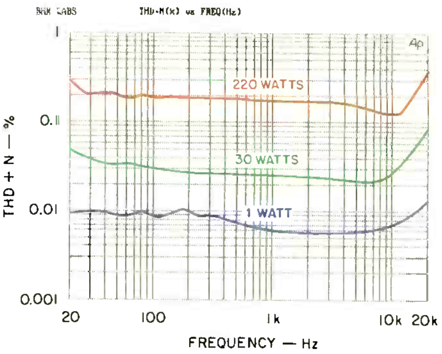

Fig. 7—THD + N vs. frequency, 8-ohm load on 8-ohm taps.

Circuit Highlights

The Power-3's circuitry is fully balanced, all the way from its input switching and muting section to its output transformer. Following its input connectors and input switch is a balanced input buffer stage. This is actually a pair of buffers, one for each signal phase. Each buffer is a cathode follower that uses the two halves of a 6922 dual-triode tube, with a constant-current tube source for each signal phase.

The outputs of the buffers are directly coupled to the voltage-amplifier stage, a cross-coupled phase inverter (i.e., a push-pull stage with each phase of its input signal coupled to the cathode of one tube and the control grid of the opposite tube). Cross-coupling makes each input phase contribute equally to both output phases. (As a phase inverter for single-ended inputs, this circuit in the Power-3 should maintain its push-pull balance well, even when tubes age or if they're replaced.) Each plate output of this stage is coupled to the next stage through a two-resistor voltage divider. Each divider's series resistor is bypassed by a capacitor; its shunt resistor is taken to the –120-volt supply, which provides bias reference to the following stage.

That stage is the differential driver, a push-pull stage that boosts the voltage from the previous stage and provides the signal-voltage swing that will eventuallly drive the output tubes' grids. The output of this stage is capacitor-coupled to the next of the Power-3's circuit blocks, the output cathode follower.

This block, a push-pull circuit, is directly coupled to the output tubes' control grids. Two 5687 dual triodes are used here, each triode element handling the drive and bias adjustment for two of the output tubes.

The output stage uses eight Russian-made Svetlana 6550C beam power tubes in a push-pull parallel configuration. The tubes are connected for Ultra-Linear operation, with their screen grids connected to taps on the output transformer's primary winding.

The secondary winding of the output transformer is center-tapped and has separate pairs of output taps for 2-, 4-, and 8-ohm speakers. A barrier strip under the output transformer connects the single set of output binding posts to whichever pair of taps you wish to use.

Overall balanced negative feedback is taken from the 8-ohm taps of the output transformer's secondary back to the cross-coupled phase inverter stage. Within this loop is a balanced feedback loop from the cathode follower stage to the cross-coupled phase inverter stage. This provides some positive feedback, to increase open-loop voltage gain. The inner feedback loop also has the effect of reducing overall distortion and output impedance. (Sonic Frontiers says it reduces the rise in distortion that occurs in many conventional designs above about 1 kHz.) Although positive feedback can be destabilizing, this loop's component values are carefully chosen to increase the Power-3's overall stability.

Regulated power supplies abound in the Power-3. Regulated supplies feed +100 and –120 volts to the input buffer stage. A +360-volt regulator supplies the plate circuit of the differential driver stage and is RC-decoupled for the plate supply to the cross-coupled phase inverter. Another regulator supplies +160 volts to the plates of the output cathode-follower stage. Each regulator circuit includes a bipolar constant-current source feeding zener regulator diodes; the outputs of these diodes drive N-channel MOS-FET source followers to supply the regulated output voltages. The high input impedance of the MOS-FETs' gates permit additional RC decoupling between these gates and the zener diodes without any loss of DC regulation; this should result in very low overall noise levels in the regulator outputs. Film bypass capacitors are used generously in all the regulator and power-supply circuits.

The output cathode-follower stage's negative supply is –310 volts; it is unregulated, to keep the output stage's plate current more constant as the AC line voltage varies. The output stage's B+ supply is an unregulated +540 volts. Of interest is the use of International Rectifier HEXFRED (ultrafast, soft-recovery) rectifier diodes in this supply. Several noted designers have concluded that this type of rectifier makes circuits sound more realistic than they would with conventional slower rectifiers. The input buffer tubes' heaters are supplied by unregulated DC. The other tubes' heaters are AC powered. *B.H.K.*

COREY GREENBERG

NHT SUPER ONE SPEAKER

How many times have you come across something really cool, but you wished it were just a little more [____]? I mean, the Mazda Miata is a cute li'l sportster, but wouldn't it be great if it were *fast*, too? Snap 'em Pops (a.k.a party snappers) can generate startled chuckles a'plenty and then some, but what if they packed the power of industrial-grade blasting caps? And then there's li'l Kate and what's-her-face, the Olsen twins of TV's "Full House" fame—sure they're adorable as the dickens (nay, *more* adorable), but if they could knock back a bottle of whiskey each and belt "No Bread, No Meat," they'd *rule*! You could make one of 'em President and the other Senate Majority Leader, and you wouldn't hear a peep out of me except "Hail to the Olsen twins, Kate and what's-her-face!"

You can add the little SuperZero loudspeaker from NHT (Now Hear This) to the list. In the five years since its birth, this amazingly cheap, amazingly good-sounding minispeaker has become a bona fide hi-fi classic. Inexpensive minispeakers existed before the SuperZeros, but precious few could be taken seriously as true high-end monitor speakers by hardcore audiophiles. Somehow, NHT was able to give the $240/pair SuperZeros the kind of detail, imaging, and spaciousness you usually have to pay a couple of grand for, and thousands of budget-minded audiophiles the world over have given them a happy home since.

But with all of their strengths, the tiny SuperZeros have a whopping big asterisk: They've got no bass. With its 4-inch woofer, the SuperZero sounds wonderfully smooth and clear in the midrange and highs, but it's utterly bass-free. Lots of minispeakers are designed with a hump in their upper bass response so that they'll sound fuller even though nothing's really happening below 80 Hz or so. But the SuperZero doesn't go in for that kind of carnival-grade flimflam; its woofer is very flat down to around 85 Hz, and then its response rolls off pretty quick below that.

Of course, none of this matters if you're using the little NHTs in a system that's got a subwoofer to handle the low end. But it makes recommending the SuperZeros on their own a lot more iffy for me when I know that the recommendee is a non-audiophile civilian who's just going to plop 'em on a bookshelf and expect to hear full-range sound. Because, solo, the SuperZeros sound very thin and kind of wispy-spacious, but squeaky.

Over the years, hardcore audio nuts have made an art out of blending the SuperZeros and NHT's own subwoofers by making their own crossovers and playing with trick wiring schemes. The results can be awesome when everything's right. But that leaves out the other 99% of the populace that just wants to buy a pair of speakers, hook 'em up to their hi-fi, and hear decently full-range sound.

You might think that all the SuperZero needs is a bigger woofer, maybe the 6½-inch job that so many other two-way bookshelf speakers have, but it's not that simple. One of the main reasons the SuperZero sounds so great is that its 4-inch paper-cone woofer is a very, *very* fine midrange transducer. All else being equal, it's lighter, faster, and more linear in the upper bass and midrange than a 6½-inch woofer. And because the 4-inch woofer is also less beamy at the top of its range, where it crosses over to the tweeter, the crossover can be more seamless and coherent than with a larger woofer, especially when it comes to off-axis response.

Company Address: 535 Getty Court, Benicia, Cal. 94510; 707/747-0151.
For literature, circle No. 94

Photo: Michael Groen

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In fact, NHT already makes two bookshelf speakers that mate the SuperZero's 1-inch tweeter with a 6½-inch woofer, the $480/pair plastic-woofered Model 1.3A and the $380/pair paper-woofered Model 1.1. Both go much lower and play much louder than the SuperZero.

Except I like the SuperZero better than *either* of them! It's true: I've done head-to-head comparisons with both of NHT's larger bookshelf speakers, and I always come back to the SuperZeros. See, I'm a midrange nut, so the most important characteristic for me is how natural speakers sound with a recording of the the human voice. And to my ears, NHT's 6½-inch two-ways have never sounded as good in the midrange as the SuperZeros.

Even NHT's Ken Kantor concedes that the SuperZeros "do" things in the midrange that his more expensive two-ways don't. That's what got him thinking about a new speaker, a sort of beefed-up SuperZero that would preserve all the little guy's good qualities while adding a real low end.

Well, it's finally here. It's the NHT SuperOne. Think of it as a SuperZero with another octave of real bass. Same tweeter, same crossover circuit, but a larger (6½-inch) paper-cone woofer and a larger (but still quite compact) cabinet. Like the SuperZero, the SuperOne is a two-way acoustic-suspension minispeaker that has full video shielding so you can plop it atop a direct-view TV without purpling the screen. Its designer says the SuperOne sounds identical to the SuperZero above 85 Hz while delivering clean bass down to 57 Hz. And for only 110 clams more per pair!

The biggest challenge in designing the new speaker, Kantor told me, was getting a 6½-inch woofer to "do" the same things in the midrange that the SuperZero's 4-inch paper-cone woofer does. But as luck would have it, he found the answer in a 6½-inch paper-cone woofer he'd already designed a few years ago for another small two-way speaker, the Acoustic Research 218V, which mated this woofer with an updated version of the classic ¾-inch AR dome tweeter.

When Kantor took the AR woofer and matched it up with the 1-inch NHT tweeter used in the SuperZero, he found a combination that preserved the SuperZero's best qualities but added another octave of bass. By keeping the crossover point at a low 2.2 kHz instead of the 3 kHz or so used in most small two-ways, the larger driver is rolled off before becoming too beamy at the top of its range. The SuperOne's crossover duplicates the SuperZero's. It has the same first-order (6-dB/octave) high-pass network for the tweeter, while the woofer is rolled off above its passband with a second-order (12-dB/octave) network.

I swear, I almost feel as if NHT came out with the SuperOne just to prove to me that the company can make a two-way speaker with a 6½-inch woofer that sounds better than the SuperZero! I feel like I sort of goaded NHT into doing it. Kind of like the mean mom in that '70s Lance Kerwin made-for-TV movie about a bed-wetting high school track star. The kid ran so fast because his mom always hung his sheets out of his bedroom window to dry, and every day after school he would race home so he could pull 'em inside before the school bus drove by. Okay, so maybe the mom crossed the line between tough love and child abuse. But the kid went on to win an Olympic gold medal! So it all worked out in the end.

THE SUPER ONES THREW UP A *HUGE* SOUNDSTAGE, WITH EXCELLENT IMAGE FOCUS BETWEEN AND FAR BEHIND THEM.

But I digress. I listened to the SuperOnes in two of my systems, the all-out he-man reference rig and my nappy-time bedroom system. The he-man rig comprises a Theta Digital Data III CD transport and DS Pro Generation V D/A converter, a Rega Planar 3 turntable with a Sumiko SHO cartridge and McCormack Audio Micro Phono Drive phono stage, a Citation 7.0 preamp, an Aragon 4004 Mk.II 200-watt power amp, Kimber PBJ interconnects and 4TC speaker cables, and Power Wedge AC line conditioners. The bedroom system: a Harman Kardon HD710 CD player, an NAD 314 integrated amp, Kimber PBJ interconnects, and Monster Cable XP speaker wire.

The first listening I did was actually in NHT's own listening room at its Benicia, California, factory. A level-matched demo was set up to compare the sound of a pair of SuperZeros with a pair of SuperOnes that were equalized to roll off the bass below 85 Hz. A switcher enabled me to listen for differences in the spekers above 85 Hz.

Like I said, I'd always heard a big difference between the SuperZeros and NHT's larger two-ways; the bigger speakers always sounded chestier and more nasal on vocals than the SuperZeros. But the SuperOnes didn't sound that way at all. I was expecting them to sound a lot like the SuperZeros, but I was surprised to hear them sound *just* like the smaller speakers above 85 Hz! Even on pink noise, the SuperOnes sounded just like the SuperZeros.

To be completely honest, the SuperOnes didn't sound just like the SuperZeros above 85 Hz: They sounded noticeably better. The SuperOnes had the same degree of midrange naturalness and detail but were much cleaner at all levels, especially loud levels. It's no surprise that a 6½-inch woofer is working a lot less hard than a 4-inch woofer at any given output level, and this is something you hear immediately with the SuperOne. It's the classic SuperZero sound, but without the slight cloudiness that sets in when the volume is cranked up.

Now, the SuperOne's no air-raid siren. The lowish crossover point and the shallow first-order high-pass section mean that the SuperOne rides its tweeter a little harder than most two-ways. As with the SuperZeros, you hear the upper midrange get a little wiry and strained when you drive the SuperOnes past their limits. But I'm talking *very* loud here. Unless you listen to The Orb at Stupid-Approved levels, you probably won't ever exceed these speakers' limits.

With the SuperOnes on a pair of sand-filled, 24-inch metal stands in my he-man system, it was hard to believe I was listening to a $350 pair of speakers. The SuperOnes threw up a *huge* soundstage, with excellent image focus between and far behind them. Although the SuperZeros can sound bright because of their deficient low end, the SuperOnes have a much more natural-sounding, full-range balance. And their 1-inch tweeter offers the same kind of transparent, detailed treble as speakers that sell for way more than $350. Just like the SuperZeros, the SuperOnes deliver a level of sound quality that kills most "high-end"

Continued on page 73

AURICLE

IVAN BERGER

SOUNDWAVE VR-3.5 SPEAKER

Year after year, I've listened to Vero Research's Soundwave speakers at trade shows. Year after year, I've been impressed by their smoothness, clarity, and imaging. So when I heard the new Soundwave VR-3.5 ($1,690 per pair) at the Winter Consumer Electronics Show last January, I couldn't resist getting a pair for review.

The VR-3.5s are both attractive and inconspicuous. Only 40¼ inches high and 10 inches wide, they're covered in matte black fabric with a black, high-gloss acrylic top (white fabric and white Corian top optional). Their upper portions taper gracefully from a rectangular footprint to a pentagonal top.

Much as the taper adds to the Soundwave's distinctive appearance, it has an acoustical purpose. The speaker's front panel carries two 8-inch drivers and a 1-inch dome tweeter; the taper begins at about the midpoint of the upper 8-inch driver, coming to a point a few inches above the baffle-mounted dome tweeter. This is a very attractive way of making the baffle's width diminish as frequencies rise. Behind the facets of the tapered section are hollow spaces, to reduce reflections; rounded enclosure edges minimize diffraction. A second 1-inch dome, on the top plate, contributes a touch of added spaciousness to the sound. All drivers, including the tweeters, are said to be long-throw designs.

Although Vero Research refers to both 8-inch drivers as bass/midrange units, the VR-3.5's spec sheet lists crossovers at 125 Hz as well as at 1.8 kHz, so this is apparently another of the increasingly popular 2½-way designs. Rated frequency response is 34 Hz to 20 kHz, ±3 dB. Nominal impedance is 5 ohms; sensitivity is 90 dB SPL for 1 watt at 1 meter, with a maximum SPL of 115 dB.

The vented enclosure has nonparallel sides and internal bracing. Spikes or soft rubber feet (both are provided) can be screwed into sockets in the bottom; spikes are mandatory on thick carpet, as these speakers are quite tippy.

On the rear panel are a tweeter-level switch ("+1.5 dB," "Flat," and "–1.5 dB") and two pairs of input posts to allow bi-wiring (removable linking bars let you use single cables). The big, beefy binding posts will accept double-banana plugs and heavy-gauge wires. Except where they were scalloped by the cable holes, the posts' shanks were too fat for my Kimber Kable PostMaster spade connectors. The posts' milled cylindrical heads are exceptionally easy to tighten by hand, and there's plenty of finger clearance between the upper and lower pairs of binding posts.

Easy as it was to hook up the Soundwaves, positioning them in my

Company Address: c/o Vero Research, 1150 University Ave., Rochester, N.Y. 14607; 716/271-7930.
For literature, circle No. 94

Photo: Michael Groen

room proved difficult. In the first position I tried, they sounded unpleasant. Bass was weak, and there was a steely edge on everything. I traced the harshness to a mirror above the fireplace on the wall behind the speakers. I'd forgotten it was there, because it causes other speakers no trouble: With front-firing speakers, the mirror reflects only sound that's already made a few bounces around the room. The back waves from dipoles, such as the Martin-Logan SL3s (which I reviewed for the January issue), miss the mirror if the speakers are toed in a bit, which is the best way to use dipoles, anyway. But the Soundwave's top-firing tweeter bounced its sound off the mirror, causing sonic glare. Moving the speakers out in the room tamed the glare but greatly reduced the bass (Vero Research recommends my original distance of 0.5 meter from the wall).

AMBIENCE BLOOMED, IMAGING SNAPPED INTO PLACE, AND THE SENSE OF SPACE BECAME PALPABLE.

So: time to try the other end of the room, where there is no mirror. *Much* better. The glare was gone, and the sound was excellently smooth but with less ambience than I'm used to. Turning the tweeter switches to "+1.5 dB" helped a little. I did hear a nice sense of ambience on Holst's "In the Bleak Midwinter," performed by the Christ Church Cathedral Choir on *Make We Joy: Christmas Music By Holst and Walton* (Nimbus NI 5098), but it was all behind the speakers, as if they guarded the entrance to a cavern. I moved my chair forward, to the classic equilateral triangle position. There was still something missing.

At this point, I tried putting the speakers on the room's long wall. That was the key. Suddenly, I began to hear the spaciousness and clarity I'd heard at Soundwave demos. Ambience bloomed nicely (though I'd still have welcomed a touch more). Imaging snapped into place. The Chesky recording of Stravinsky's *L'Histoire du Soldat* (CD122) sounded exceptionally good, and Jennifer Warnes's voice on "Famous Blue Raincoat," from the CD of the same name (Private Music 01005-82092), sounded lifelike and natural. Pink noise exhibited no noticeable tonality. It changed neither when I stood up or sat down nor when I moved across the room. On Manuel de Falla's *The Three-Cornered Hat* (Delos DCD 3060), the sense of space was palpable, and Della Jones's voice was clear and clean.

Clarity was, in fact, a hallmark of the VR-3.5's sound. A visitor remarked that she was hearing details on familiar cuts that she had never noticed before. Choral recordings, such as Robert Shaw leading the Atlanta Symphony and Chorus on the "Requiem Aeternam" from Berlioz's Requiem on *Grande Messe des Morts* (Telarc CD 80109), revealed their fullness and enveloping space; voices blended but were not homogenized. The Soundwaves accentuated the youth of the boy choir singing Gerd Watkinsson's "Jublen I Himmlar" from *Test Record 3: Dynamics* (Opus 3 CD 8300). An Orlando Quartet recording of Haydn's Opus 76 (Philips 410053) made me feel as if I were in the room with the musicians.

Clarity was enhanced by the VR-3.5's well-damped bass. (Vero Research claims a "transient-perfect" Q of 0.5, with less ringing than the Q of 0.707 yielded by the common Butterworth alignment.) Still, I could have used a touch less upper bass and more deep bottom. The VR-3.5s faded out on the last few notes of Ray Brown's descending bass run on "You Look Good to Me" from the Oscar Peterson Trio's *We Get Requests* (Verve 810047), but at least they bowed out gracefully, with no sense of distress. If I hadn't heard those 40-Hz notes through other speakers, I would not have guessed that anything was missing. I suspect a slight touch of EQ would have taken care of it (for starters, I'd try about 3 to 6 dB of boost at 30 Hz and maybe 1.5 dB of cut somewhere around 125 Hz). As with virtually all speakers in this price range, a subwoofer might not be amiss, but I think only organ freaks will feel really deprived without one.

Had I not already heard what the Soundwave VR-3.5s were capable of, I might have blamed them, not my room, for the harshness I heard at first—and might not have persevered until I heard them at their best again (yet another reason to audition speakers before buying them). And their best, it turns out, is very good indeed. A

NHT, *continued from page 70*

speakers selling for two, three, and even four times their price. In fact, the SuperOnes' midrange quality was easily on a par with that of the $1,600/pair B&W Matrix 805 6½-inch two-ways I had on hand for comparison. There just aren't many $350/pair speakers able to stake that kind of claim.

One that can is Paradigm's excellent Mini Mk.3, a 6½-inch, two-way vented design that I consider one of the best speakers I've heard in this price range. So I compared the Paradigms with the NHT SuperOnes. How'd they rate? I like both speakers, but I give the NHTs the edge. The Paradigms have an instantly likable, very clean and open sound, so they gave the SuperOnes a real run for their money. Being a ported design, the Paradigms go a bit lower in the bass and are about 2 to 3 dB more efficient than the NHTs, and they can play quite a bit louder without strain. But if I had to choose, I'd pick the SuperOne for its more accurate midrange, higher overall resolution, and treble purity. Both are excellent, no-brainer recommendations, but my tastes run more toward the SuperOne.

I've lived with SuperZeros in my various systems for about five years now, so I know what these speakers sound like in every possible permutation—with subwoofers and without, driven by budget gear and the most exotic, etc. So it was kind of startling to hear the SuperOnes do a Rich Little on them, only with a real low end that was much bigger and meatier than the size of these speakers begins to suggest. When I put the SuperOnes on stands and set them a few feet into the room, what I heard suggested SuperZeros plus a good subwoofer, except the midrange was even cleaner and there were none of the audible satellite/subwoofer integration problems I've run into in some rooms. Of course, the SuperOnes won't go as low as a good subwoofer, but they do fill in the bottom to such a large degree that I bet most people who buy them will live happily without a sub.

Finally, there's a budget NHT everyman speaker I can recommend to hardcore audiophile and civilian alike, knowing that both will get the best full-range sound that $350 can currently buy. If you're one of the thousands who love the NHT SuperZero but wish it had more bass, the new SuperOne has answered your prayers. A

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Sioux City, Iowa

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–Mike Abt
Abt Television and Appliance
Morton Grove, Illinois

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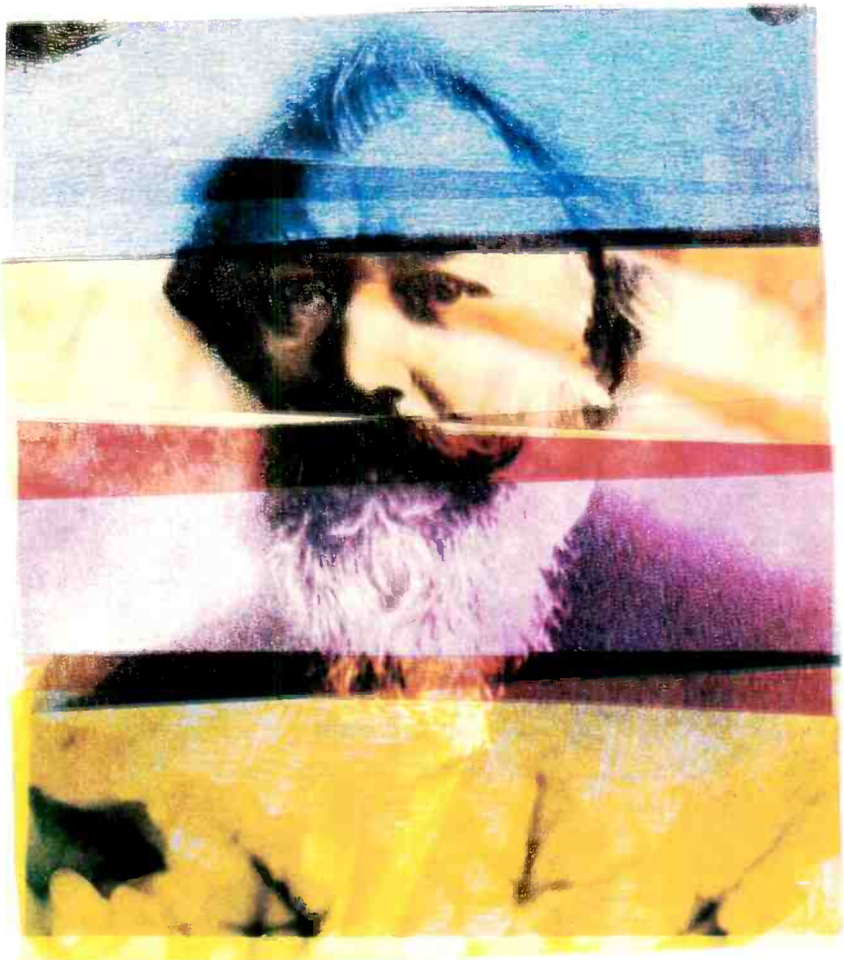

Photograph: ©David Hamsley

Brahms: Four Symphonies; Variations on a Theme by Haydn, Op. 56a; Tragic Overture, Op. 81; Academic Festival Overture, Op. 80

Bamberg Symphony Orchestra, Emmanuel Krivine

DENON CO-78956-58

Three CDs; DDD; 3:27:17

Sound: A, Performance: A+

Johannes Brahms was hesitant to compose for orchestra; he seemed to be intimidated by the symphonic monuments created by his predecessor, Beethoven. Nonetheless, over the last century his four symphonies have gained unrivaled popularity. In frequency of performance, all four are in the top 20 works of most major orchestras, and at least one of them can be found on everyone's top-five list.

Brahms's symphonic overtures have also become standard literature. His "Haydn" Variations, eight variations on Joseph Haydn's Partita in B-Flat Major, became his first orchestral triumph at its premiere in 1873.

In the summer of 1880, Brahms composed both the "Academic Festival" Overture (written for the University of Breslau, which had awarded him the degree of Doctor of Philosophy) and the "Tragic" Overture. The latter was given no specific dramatic outline; its title simply sets its emotional mood. Of these contrasting works, the composer explained to a friend, "One is crying, the other laughing."

Soon after Brahms finally premiered his First Symphony in 1876, it was nicknamed Beethoven's 10th by its admirers. So many musicians commented on how strangely similar its finale's theme was to the famous "Ode to Joy" in Beethoven's Symphony No. 9 that Brahms gruffly admitted, "Indeed, and even stranger that every jackass hears it right away!"

Brahms's popularity creates a formidable challenge for a conductor and orchestra who set out to record all of this composer's symphonic masterpieces. Yet Emmanuel Krivine and the Bamberg Symphony Orchestra bring new life to these familiar works. All three discs are performed with intensity and precision, and Krivine's interpretation is thoughtful and moving. Yet it is the performance of the orchestra members themselves that makes these recordings so memorable. The Bamberg Symphony Orchestra was founded in 1946 by some of Europe's finest musicians, made refugees by World War II. The orchestra continues to attract talented musicians, who are spotlighted in significant passages: the

Dvorák

Piano Trio No. 1 in B-Flat, Op. 21, and No. 4 in E Minor, Op. 90 ("Dumky")

Vienna Piano Trio

NIMBUS NI 5472, CD; DDD; 63:52

Sound: A–, Performance: A+

These are superb readings of Antonín Dvorák's first and last piano trios. No other recordings I know so deftly capture his mercurially changing moods. The musicians' unanimity of impulse and sensitivity of phrasing are extraordinary.

The First Trio is delightful and, in contrast to the complexities of the "Dumky" Trio, delightfully simple. They make a satisfying coupling. Although the sound was generally fine, on my system a few loud passages, particularly in the First Trio, suffered from some congestion and ambiguity in the imaging. This was enough to occasion the grade of A– but not enough that it detracted seriously from the music or the performances. *Robert Long*

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GOOSTLY PSALMES

Anglo-American Psalmody, 1550-1800

His Majestie's Clerkes, Paul Hillier
HARMONIA MUNDI FRANCE 907128, CD; 61:23
Sound: A+, Performance: A

There is some really remarkable music on this disc, which covers unaccompanied psalm-singing and related genres in basically chronological order. Its focus, however, is on the American psalmodists and fuguing-tune composers—most famously, William Billings and Justin Morgan.

Despite its elaborately Old World name, the Chicago-based chorus is just right for the music: professional in matters of pitch, timing, vocal coloration, and phrase-shaping, but never slick. His Majestie's Clerkes are "real people," to steal an old phrase from TV, and that's important in keeping the historical material from becoming mere vehicles. Much as I admire the King Singers (among others), their approach would have been as out of place here as tap shoes at a hoe-down.

The just-right chorus is matched by the just-right acoustic space afforded it by Harmonia Mundi. If the engineers were tempted to apply the stone-vault resonances of the chart-topping plainchant CDs, they have mercifully abstained in favor of what can be taken as a good-sized meeting house. Bravos, and a grade of A+, for their taste and precision!

Make no mistake, this is austere stuff. But austerity hasn't hurt chant recordings, and I find this repertory far more compelling. Full texts and provenance notes are supplied, together with French and German translations. (Incidentally, none of the four Billings pieces here duplicates anything on the group's equally excellent all-Billings disc, *A Land of Pure Delight*, on Harmonia Mundi France 907048.) *Robert Long*

gorgeous string sound in the finale of the First Symphony, the beautiful horns that open Symphony No. 2, the delicate lower woodwinds heard in the Third Symphony's Andante, and the powerful brass in the famous passacaglia of Symphony No. 4, to name but a few of them.

Recordings of Brahms symphonies are usually good for trying out new audio systems, and these are no exception. Their sound quality is excellent, exhibiting a very wide dynamic range and great clarity between the various instrumental forces. A remarkable example is the triangle's entrance in the Fourth Symphony's third movement: Its high pitch cuts through the entire orchestra with such distinction that you might run to answer the telephone by mistake. *Patrick Kavanaugh*

Voice of the Blood

Sequentia
DEUTSCHE HARMONIA MUNDI, 0547277346, CD; 76:55
Sound: A, Performance: A+

There are monks and there are chants. Then there is Abbess Hildegard von Bingen, the 12th-century Benedictine mystic who composed a body of chants, hymns, and sequences that have never been equaled. Writing for female, rather than male choirs, Hildegard composed celestial evocations to God that are both serene and sensual. While Gregorian chants often sound as if they have been cloistered in the dust of ancient monasteries, Hildegard's always sound as if they just wafted down from heaven. That's why she's found so much resonance with such contemporary pop/rock artists as Dead Can Dance, Shiela Chandra, Vox, Richard Souther, and others looking to tap an ancient spirit for a modern music.

Rarely, however, has Hildegard's music attained such a powerful expression as in the voices of Sequentia, a German-based group headed by American expatriate Barbara Thornton. This is Sequentia's second release in a series that will cover the entire Hildegard canon; so far, each album reaches new heights.

Hildegard's lyrics weren't just hymns to God. They were also love songs with barely concealed eroticism. Even in Latin, lines such as "A honeycomb dripping with honey was Virgin Ursula, who longed to embrace the lamb of God," from "Favus distillans" reveal a rapture that is as erotic as it is spiritual when sung by Sequentia.

Thornton is a traditionalist, but she leavens her vocal arrangements with instrumental pieces and a tamboura-like drone from a portative organ that gives a horizon against which to measure Sequentia's vocal flights. *John Diliberto*

Harvey: Concerto Antico; Gray: Guitar Concerto

John Williams, guitar; London Symphony Orchestra, Paul Daniel
SONY CLASSICAL SK 68337, CD; DDD; 60:58
Sound: A+, Performance: A

Yoshimatsu: Symphony No. 2; Guitar Concerto, "The Pegasus Effect," Threnody to Toki

Craig Ogden, guitar; BBC Philharmonic, Sachio Fujioka
CHANDOS CHAN 9438, CD; DDD; 69:18
Sound: A+, Performance: A

New guitar concertos seem to be popping up like spring flowers, and these three will surely please listeners who appreciate accessible 20th-century works for this most accessible of instruments. The first two concertos were written especially for John Williams. Richard Harvey wanted to tweak his friend Williams's abilities by writing a piece "impossible to play, yet interesting enough to be a challenge." It is a challenge, and Williams rose to the occasion.

Steve Gray, whose background is in jazz, based his concerto on popular song forms in a big-band framework. His concerto calls for a larger orchestra than Harvey's.

Both concertos are tonal and optimistic without being "light music." Williams' guitar is comfortably front and center, certainly more audible than it would be at any live concert, but well balanced with the orchestra.

Takashi Yoshimatsu's Guitar Concerto ("The Pegasus Effect"), performed here by Craig Ogden, was written for another great concert guitarist, Kazuhito Yamashita. The title refers to the mythical transformation of an ordinary horse into a winged one. The Concerto's theme of transformation is evident in its three movements: "Bird," "Flower," "Wind." This concerto is in a more minimalist style than the other two and offers less solo virtuosity. It blends the guitar with the flowing string section to lovely effect.

The most substantial of the three Yoshimatsu pieces is his Second Symphony. Its three movements consist of a "Dirge" in Asian style, a European-style "Requiem," and a Canticle in African styles. The European movement is evocative of Arthur Honegger's string symphony. Minimalism can be detected in the movement based on African materials, with subtly varied, subwoofer-tickling rhythms to forestall tedium. *John Sunier*

Musical Evenings with the Captain

Philharmonia Virtuosi
ESS.A.Y CD1047, CD; DDD; 75:46
Sound: A, Performance: A

I almost passed over this zesty CD because of its silly title. It refers to the musical episodes in the sea novels of Patrick O'Brian, whose essay in the booklet makes the case that these performances might have taken place, on a quiet evening at anchor, aboard a ship of, say, Nelson's fleet. Bilge! The stringed instruments might be found aboard perhaps, but what would an early, wooden-frame piano sound like after a month at sea? And are we really to expect this level of musicianship among even the best educated of naval officers?

And then there's the sound. The nicely reverberant space is not huge, but surely larger than any available space aboard a sailing ship. If, instead, you imagine a moderately large drawing room of the late 18th Century, you'll be close to the feeling this recording conveys. (It even includes a little simulated tuning—a touch I'd gladly do without and one that evidently caused a missed cue, because all the subsequent tracks are misnumbered on my review copy.) The actual recording venue, however, was the Orchestra Room on the Purchase campus of the State University of New York.

The fare includes a Locatelli sonata for violin and continuo (fortepiano and cello) and sonatas by Locatelli and Leclair for two violins and continuo. The rest are all for violin and cello without continuo: a three-movement duet by Haydn, a collection of eight pieces by Handel, and a Boccherini sonata. Some of this music would have sounded very dated by 1780 or so, but we know that Mozart could find Handel in the collection of a Viennese amateur, so why not? The program is varied; it's full of little surprises and delights and played stylishly and with gusto.

This is a kind of recording I scour record stores for: one with communicative music-making and a palpable sense of time and place. So why the fatuous title? Unfortunately, I don't constitute a market, and marketers must make potential buyers sit up and take notice somehow, I suppose. Ship ahoy! *Robert Long*

ROCK ~ POP RECORDINGS

Photo: Kevin Westenberg

Down on the Upside

Soundgarden

A&M 31454 0526, 65:55

Sound: B+, Performance: A–

Since the late '80s, Soundgarden has explored punk, metal, and pop textures, evolving from a bedraggled grunge band into a behemoth. But even on its previous album, *Superunknown*, Soundgarden retained its galvanizing ire and cynicism. On its new disc, *Down on the Upside*, the band expresses defiance even more vociferously by going beyond the fringes of alternative's mainstream. Instead of simplistically lashing out in a heavy-booted plod, Soundgarden indulges in rhythmic diversity and softer, more psychedelic atmospheres. Guitarist Kim Thayil plays with less distortion, so his subtle passages flow fluidly into the dense rhythms, and Chris Cornell's voice ranges from a Jim Morrison croon to a savage howl.

The band experiments with a number of styles, from plaintive to raging: "Pretty Noose" opens the album with a wigged-out guitar lick and features vocal harmonies reminiscent of Aerosmith, "Ty Cobb" is a storming hard-core track with a mandolin solo, and "Never Named" is a churning anthem with surging wah-wah guitars. Still, it would be wrong to say that this record is entirely original. Soundgarden has often been compared to Led Zeppelin, and *Down on the Upside* won't do much to change that. But whereas the band's past albums authentically replicated Zep's swaggering stomp, the new disc is more representative of the mystic ruminations of Zeppelin's *Physical Graffiti*. Because of this, Soundgarden seems wiser and more mature, less prone to temper tantrums, and more likely to find a path to spiritual enlightenment.

Down on the Upside is less hostile and more musically adventurous than the band's previous records, yet it still addresses alienation, hatred, confusion, and despair. Instead of cobbling together a dozen catchy tunes and having another mindless hit record, Soundgarden has successfully sought to challenge itself and its fans. Even if the song remains the same thematically, Soundgarden is well on its way to reaching new musical ground. *Jon Wiederhorn*

lush

Lovelife

4AD/REPRISE 9 46170, 42:00

Sound: B, Performance: B+

The music press has sometimes been eager to peg Lush as a "shoegazer" band or a girl band. But *Lovelife*, the London-based quartet's third full-length release, showcases the multifaceted creativity of Lush—and particularly dual songwriters Miki Berenyi and Emma Anderson—that was overlooked in the past.

Lovelife is also a distinct departure from Lush's trademark swirly, dreamlike pop sound. The production is based more on vocals, with lyrics that are sharp, discernible, and, more often than not, whip smart (particularly on "Ciao," a duet featuring the rabble-rousing Jarvis Cocker of Pulp, and on the infectious single "Ladykillers").

The well-honed songs of Berenyi and Anderson range from the rich and string-laden ("Last Night") to the quirky and angst-ridden ("Heavenly Nobodies"). Despite the departure into a more rock-sounding record, the Lush women have maintained their most distinct characteristic, gorgeous harmonies. Their vocals play off each other perfectly, clearly putting them in a league of their own. *Laura Schlosshardt*

jawbox

TAG RECORDINGS 92707, 47:50
Sound: A–, Performance: B+

For Your Own Special Sweetheart, Jawbox's '94 Atlantic debut, disproved the myth that a band's power and ideals will be crushed by signing with a major record company. But, more important, the Washington D.C.-based outfit proved that there is room within the parameters of "punk rock" for a band to be aggressively passionate *and* infinitely musical. The tracks on that album encompassed punk's power within a framework of well-thought-out songs and accomplished playing.

Two years later, the band returns with an eponymous album that takes them far beyond even the greatest promise held within *Sweetheart*. As focused as it is expansive, *Jawbox*'s emotive range boldly flexes within songs as varied as the mid-tempo "Livid," the frenetically changing torrent of "Won't Come Off," the keyboard-colored, full-on drive of "Mule/Stall," and the complex, infectious, Fugazi-done-better-than-Fugazi rallying cry of "Chinese Fork Tie." To be sure, it's a heady brew, but it's encouraging to find Jawbox completely unafraid to look forward while keeping their feet firmly planted in the punk-rock ground that spawned them. *Jason Ferguson*

The Road to Ensenada

Lyle Lovett
CURB/MCA MCAD 11409-A, 56:37
Sound: B, Performance: A

The Road to Ensenada restores the country element to Lovett's music. The Large Band, cellos, and big gospel choir are history; this time fiddles and pedal-steel guitars define his sound. But hold on: He's not about to steal any of George Jones's, Merle Haggard's, or Dolly Parton's fans. The long, tall Texan is still too wordy, too urbane for that. Lovett's gallery of quirky strangers and fleeting lovers still populates his songs with starkly drawn portraits that are fleshed out with Lyle's dark humor.

Enseneda leads off with a tale of a man and his headwear on "Don't Touch My Hat." Here, Lovett is tipping his Stetson to Carl Perkins' "Blue Suede Shoes" (you can do anything you want to, even take his girl, but keep your cotton-pickin' hands off his damn hat!). "That's Right (You're Not from Texas)" is his tribute to the king of Texas Swing, Bob Wills. It flies by, and ol' deadpan Lyle is having such a good time that he might even crack a smile on this one. The one blind alley on this road is "Long Tall Texan," a duet with Randy Newman. It doesn't go anywhere, as the two spend 3:28 ignoring each other. Too bad. Then it's time to move on, where Lovett finds redemption on the title track and his best bit of wisdom: "Listen to your heart that beats/And follow it with both your feet." Amen.

Lovett has made his fair share of great sounding recordings. Unfortunately, this isn't one of them. His older albums had a warm tonal balance; this one's a little chilly. Maybe they had the air conditioning in the studio set to 11. After all, *The Road to Ensenada* from Georgia can get pretty hot! *Steve Guttenberg*

All This Useless Beauty

Elvis Costello
WARNER BROS. 9 46198, 48:21
Sound: A–, Performance: B

If Pete Townshend hadn't included the words "hope I die before I get old" in a song, the young Elvis Costello probably would have. At first blush, the angry young man of New Wave may not have seemed like a candidate for graceful maturity. But underneath his rage was an adventurous yet classic sense of melody and an intelligent and witty knack for wordplay—all the ingredients for a lasting artist of true substance.

Costello has been turning out one fine disc after another in recent years, all without the fanfare of his early work. *All This Useless Beauty*, produced by legendary Geoff Emerick, is yet another one, a conceptual flipside to his *Kojak Variety* covers album (this time, Costello sings songs he wrote for other acts), and a continuation of his reunion with The Attractions begun on 1994's *Brutal Youth*. Although the team may never again come up with something as awesome as it did 10 years earlier on *Imperial Bedroom*, they recall that album's best qualities here, albeit with a subtler touch.

It's a tack that suits much of *Useless Beauty*'s material, songs Costello can lend his thin yet surprisingly supple voice to with a crooner's élan. Listen to the way he caresses the refrain in the title track and you'll hear the same slant on wonderfully sophisticated songs like "Little Atoms," "Why Can't a Man Stand Alone" and "I Want To Vanish." Thanks to Steve Nieve's splendidly sympathetic keyboards, the once-raucous Attractions offer a sweet and soft touch. There are also tastes of their trademark pop-rock aggression on "Shallow Grave" and the Byrds-ish "You Bowed Down" (written for Roger McGuinn), but the bulk of this album is the sound of Costello growing old artfully, as the best angry young men should. *Rob Patterson*

Irresistible Bliss

Soul Coughing
SLASH/WARNER BROS. 2 46175, 42:21
Sound: B+, Performance: B+

Take the Violent Femmes, add a dash of funk, generous portions of downtown poetry, then fold, spindle and mutilate, and you've got Soul Coughing.

As Gordon Gano is to the Violent Femmes, M. Doughty is to Soul Coughing. Guitarist/composer/vocalist/frontman and spinner of arcane imagery, Doughty is an urgent young poet with a wildly creative streak; a charismatic, intelligent frontman in the tradition of David Byrne and all his geeky progeny, only way more funky.

On *Irresistible Bliss*, Doughty sings/rants about innocent farm girls raised by aliens, coffee buzzes, and the plight of the average man ("Phantom kisses buzzing like the insects/Beads of sweat dripping down on the rent check," and "Talking like the saint on the site of the accident/Ringing like the change in the legless man's Dixie Cup"). And he raps with quicksilver-tongued agility alongside a Raymond Scott sample on "Disseminated." Now *that's* arcane.

Doughty's cause is well served by the groove-heavy, syncopated acoustic-bass lines of Sebastian Steinberg and the solid underpinnings of drummer Yuval Gabay, whose huge backbeats and fondness for loose-tight shuffle rhythms keeps this artsy-fartsy outfit well grounded in funk, as on "Super Bon Bon," "White Girl," and "4 Out of 5." And loopologist Mark De Gli Antoni adds neat little sampled ear cookies that shroud Doughty's verbal dream walk in mystery. Soul Coughing is truly original. *Bill Milkowski*

Just Fred

Fred Schneider
REPRISE 9 46215, 36:38
Sound: B–, Performance: B

Most indie-rock fans couldn't give two hoots (or Hooties) about the B-52s, so the thought of wacky vocalist Fred Schneider doing a solo album holds about as much interest to them as a game of Parcheesi. But ironically, its those very people who *Just Fred* is aimed at. Eschewing his usual brand of screwball quirk-pop, Schneider has recruited irascible punk producer Steve Albini (Nirvana, P J Harvey) and created a visceral disc that appropriates the roaring sounds of the alternative underground.

Unlike records by other dinosaur rockers trying to sound hip, *Just Fred* is more than an anachronistic bid for credibility. It's an aggressive, cathartic outlet for Schneider, who has 18 years of repressed angst under the B-52s' good-time veneer to contend with.

But what does someone like Schneider know about writing scorching guitar riffs and plundering rhythms? Not much, which is why he enlisted members of Jon Spencer Blues Explosion, Six Finger Satellite, Tar, and Shadowy Men on a Shadowy Planet to provide musical accompaniment for his nasal vocal rants.

The results are equivalent to watching Jerry Seinfeld convincingly play James Bond. It's unconventional, and a bit awkward, but it works surprisingly well. There's even a refreshing amount of musical variety. On "Sugar in My Hog," Schneider yowls over a rhythm that sounds like it was yanked from a '60s spy film or a sexploitation flick. A cover of Harry Nilsson's "Coconut" starts with a three-note arpeggio before bursting into a raging punk riff, and "Lick" features shimmering guitars and a rhythm that builds from an ominous drone to a torrential roar.

If you're a B-52s hater, there's no need to worry—this is *Just Fred*. *Jon Wiederhorn*

Walking Wounded

Everything But The Girl
ATLANTIC 82912, 57:26
Sound: A, Performance: A+

Everything But The Girl's Ben Watt and Tracy Thorn used to make sad, acoustic music best suited for contemplation, cappuccino, and coffee houses. Then, a bout with a near-fatal disease forced Watt to rethink his creative process. The result (from their last record, *Amplified Heart*) was "Missing," a forlorn tale suffused into the pounding energy of house music. A few million album sales later, EBTG now makes sad electronic music. But it's much more than that.

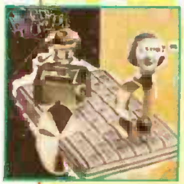
Relying on the numbing tones and fractured rhythms of house and drum & bass styles coupled with Thorn's beautiful and smoky voice, EBTG blends sophistication with loss and modern torch songs with weary melancholy. While most contemporary R&B and folk-pop use production techniques unlikely to surprise anyone,

RICHARD THOMPSON

you? me? us?
CAPITOL CDP 7243 833704
Two CDs, 1:14:09
Sound: B+, Performance: A–

Richard Thompson has made quite a career out of singing unhappy love songs; you'd think he would have run dry by now. *you? me? us?* decisively proves otherwise.

This double-CD set segregates the two sides of Thompson's personality. The "Nude" disc is the folky, all acoustic Thompson and the "Voltage Enhanced" disc is the electric. "Razor Dance" appears on both discs, and it's quintessential Thompson. Here, a fractured couple hurls barbs at each other, then retreats. In its electric version, the song is almost a celebration of release, while its acoustic twin is more contemplative and darker in tone. They're bookends of cutting agony.



On "Bank Vault in Heaven," Thompson rages against the rising tide of greed he sees enveloping the world and accentuates his rage with a charged guitar solo that raises the anger to a higher level. On "Cold Kisses," he finds himself behind "enemy lines," discovering pictures of his girlfriend's old boyfriends while rummaging through her things. This invasion further fuels his insecurities. (Poor Richard!)

Produced by Thompson's long-time associates Mitchell Froom and Tchad Blake, *you?* is a departure from the previous, somewhat cluttered-sounding affairs they've done with him. The "Nude" disc, in particular, displays Thompson's talents to their best advantage. His acoustic guitar work is peerless; to have an entire CD of minimally adorned Thomspon is a rare treat. With the two-for-the-price-of-one strategy on *you? me? us?*, Thompson and his label give his fans both quality and quantity. Then again, maybe they're just trying to cheer us up. *Steve Guttenberg*

EBTG have emerged from their own private cyberspace with a classic album grounded in still-breaking trends. Using splintered breakbeats, ambient strings, and whirring space noises, *Walking Wounded* brings the underground world of DJs and all-night raves into the daylight.

Walking Wounded's first single, "Wrong," merges the swaying beat of house with a Motownish bridge and chorus. "Single" is lean and moody with a skipping beat and mournful saxophone that could pass for 21st-century bossa nova. "The Heart Remains a Child" and "Mirrorball" are as lighthearted as EBTG gets, and the title track is pure, symphonic drum & bass. As strings glide overhead, hyper-fast drum beats rupture and quake, and bass notes ping-pong like richocheting meteors.

Stomach-rumbling low sounds, brilliant electronic effects, plus earthy acoustic instrumentation give *Walking Wounded* a dark, glorious sheen. From both a sonic and songwriting angle, it's a quiet revolution. *Ken Micallef*

Martin and Me
J. Mascis
REPRISE 9 46177, 40:59
Sound: C–, Performance: C

There's no question that Dinosaur Jr. frontman J. Mascis is a gifted guitarist and a talented songwriter, but he's also one of the laziest, most apathetic sloths on the planet. While his past three albums have glimmered with brilliance, an overabundance of sleepy, unfocused passages detracted from their overall impact.

When it comes to noodling, Mascis is more of an authority than Chef Boy-Ar-Dee. He once described his songs as "excuses to play guitar solos." And onstage he frequently lapses into long, sprawling jams that rival Carlos Santana in terms of useless verbosity. Which brings us to *Martin and Me*, a live, solo disc that documents Mascis's "unplugged" tour last year.

Aside from a couple of covers, including The Smiths' "The Boy with the Thorn in His Side" and Carly Simon's "Anticipation," the disc comprises previously released Dinosaur Jr. songs. But instead of using state-of-the-art equipment to translate some sort of pristine acoustic vision, Mascis has created the album with a minimum of effort and impact.

Much of it sounds like it was recorded on a four-track cassette deck; the guitar sound is muddy, and the vocals are occasionally distorted. Moreover, on songs like "Blowin It" and "Repulsion," Mascis's guitar is almost as off-key as his trademark whining vocals.

Still, there's a certain sensitivity that an acoustic performance provides, and *Martin and Me* is no exception. Without Dinosaur Jr.'s blazing feedback and booming rhythm section, Mascis's songs are stripped bare, revealing the inner pain and vulnerability of their creator. But there's a difference between sincere emotional expression and half-assed fumbling. Had Mascis included new material on the album, or recorded it with precision and care, *Martin and Me* might have been a refreshing side project record. But as it is, only diehard Dinosaur Jr. fans will find anything of interest in it. *Jon Wiederhorn*

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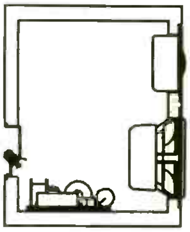

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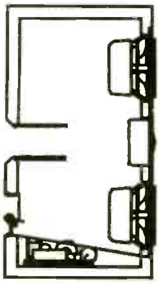

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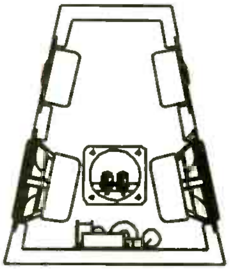

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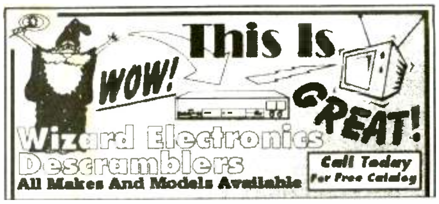

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AD INDEX

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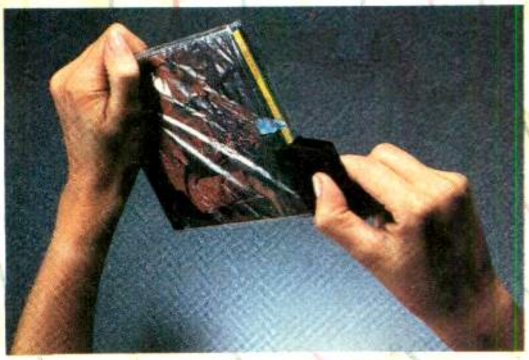
PlayBack

MacTec CD Opener

Struggling to get the shrink-wrap off your new CD? Silly question. I've used knives—and pondered hatchets. Then along comes this little $2.99 gadget, and the problem's solved. The EZ-CD's side runners straddle a CD jewel box while a safely recessed blade cuts the wrap. Once in a while, it takes two passes, but the job gets done. MacTec, which makes the EZ-CD, sells it in a keychain version or with self-adhesive, hook-and-loop fastener patches so that you can store it handily; I've also seen it without the patches for $2.50 or less. The one I bought at my local record store is white, which makes it easier to find than the black version; other colors are available. Whatever. Get one. **Ivan Berger**

For literature, circle No. 120

GRADE: A+



GALAXY AUDIO
CRICKET POLARITY/CONTINUITY TESTER

Galaxy's Cricket system ($399) makes it easy to check the absolute polarity and continuity of loudspeakers, audio components, and cables. It comprises two small battery-powered boxes, the Cricket-S sender and Cricket-R receiver, and a plastic carrying case. The Cricket-S generates positive-pulse test signals, at high or low levels, to drive cables or audio components; it also provides amplified signals for speaker testing or acoustical pulses from a built-in speaker. The Cricket-R indicates whether the pulse signal's polarity is normal or reversed after it has passed through the device under test (or whether the device failed to pass the signal at all). Cables or components can be tested for continuity and polarity by connecting them between the Cricket's send and receive units. To test a loudspeaker's polarity, connect the speaker to the Cricket-S (which has enough output to drive most loudspeakers) and place the Cricket-R (which has a built-in

GRADE: A

microphone) near each individual driver. Microphones are tested by placing them near the send unit's speaker and checking their output with the receive unit. A green LED on the receiver blinks when a pulse is received with positive polarity; a red LED blinks for negative polarity. If the acoustical polarity of the individual drivers of a system don't all have the same polarity (when measured in close), it doesn't necessarily mean that they have been wired incorrectly. The drivers of some multiway speakers are wired with opposite polarities to achieve a combined positive acoustical output at the normal listening position. (Before you change wiring, you should consult the speaker's manufacturer.) I found the Cricket to be a very useful, reliable, and simple device for electro-acoustical testing and trouble-shooting. **Edward M. Long**

For literature, circle No. 121

AKG Acoustics K 290 Surround Headphones

Home theater has created a demand for surround listening via headphones. Although at least one electronic surround box for use with stereo 'phones has been introduced, AKG has brought back an approach from the quad era: Its K 290s ($259) have two drivers for each ear, one forward and one to the rear, with center signals reproduced through both front drivers. To place sounds front and rear, the drivers are toed in to control the angle at which sounds strike your outer ear. It works—and when I turned the K 290s around to double-check the effect, the voices of the starship *Voyager*'s crew moved behind me while the ship's ambient hum and sound effects moved up to the front. The K 290s sounded better than my wireless stereophones but lacked the deep bass of my high-end 'phones.

GRADE: B+

The K 290's cord ends in multipin plugs that mate with two supplied adaptor cords. One adaptor ends in a standard ¼-inch stereo phone plug. The other terminates in wires for connection to four speaker-level outputs; its eight wires are color-coded (good luck if you're color blind!), but they're too tiny to hook up easily and too short for installations that use separate front and surround amplifiers. It might be easier to use AKG's $179 accessory switchbox (which I didn't get for review); it has multipin jacks for two K 290s on the front, speaker connections on the rear, and a speaker/headphone selector. **John Sunier**

For literature, circle No. 122

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