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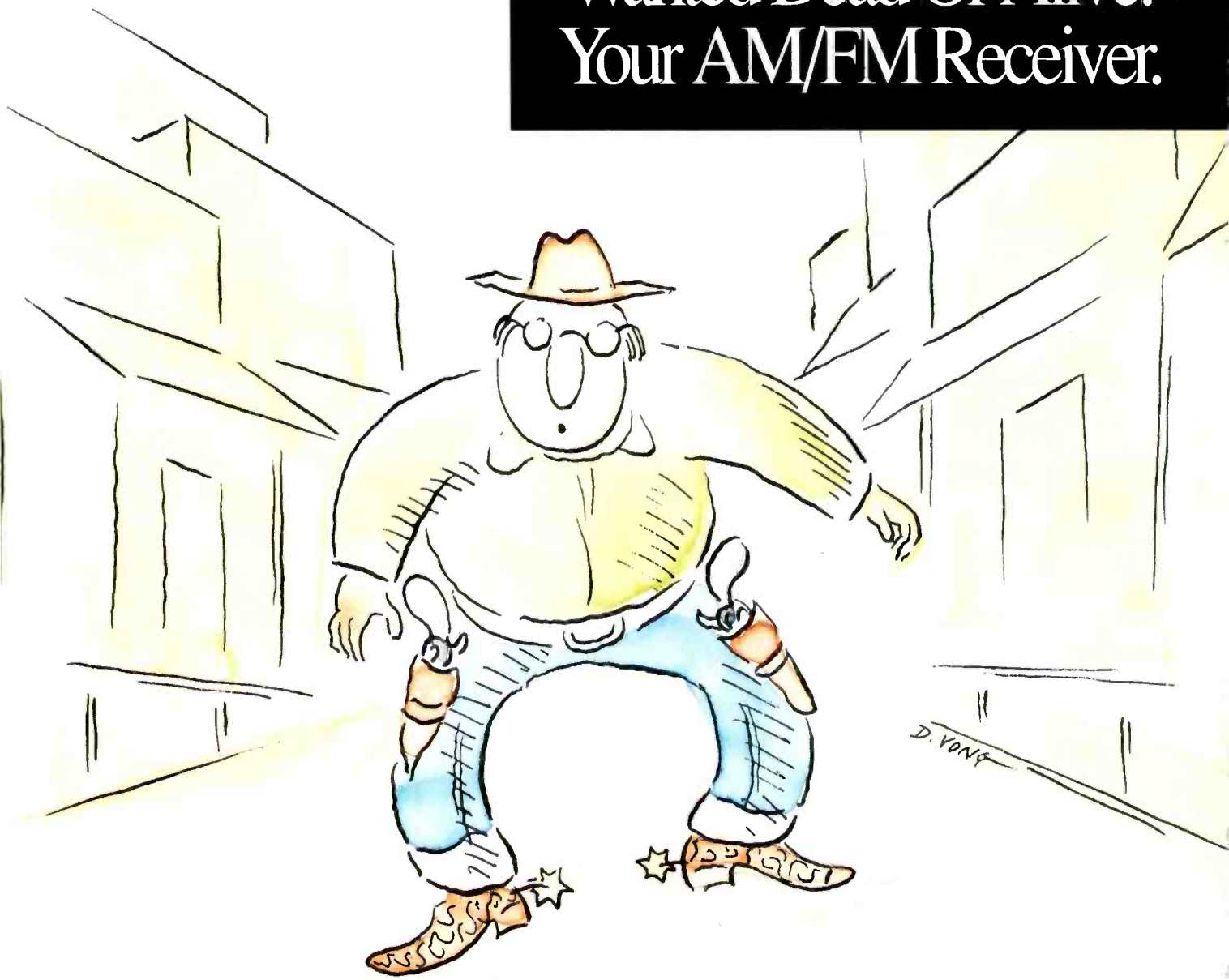

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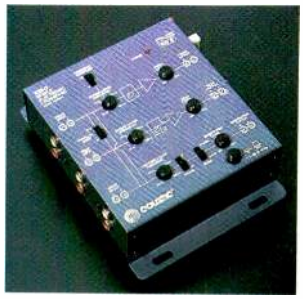

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"The XM-3 is an installer's dream come true... but the real beauty lies in the crossover's ability to be configured for practically any amplifier/speaker system you can think of... it's a very useful product and a tremendous value."

Michael Smolen
User's Evaluation,
CAR STEREO REVIEW
Summer 1988

AMP-460 Power Logic Component Amplifier

The first of Coustic's ***Power Logic*** Component automotive power amplifier line, the AMP-460 was honored as *"one of the most innovative consumer products of 1990"* at the **Innovations '90 Design & Engineering Exhibition**.

"It offers an excellent design, quality construction, reliable operation, and great sonics while avoiding the distraction of useless bells and whistles... in short, this is a very cost-effective but still hi-fi amplifier."

Ken C.Pohlmann
Test Reports,
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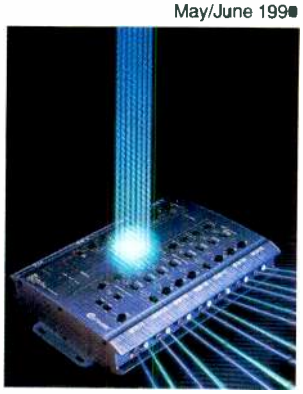
May/June 1990



XM-7 Multi-Function Mobile Electronic Crossover (Patent Pending)

The *"reference standard"* for electronic crossover design technology, the XM-7 was recognized as another *"one of the most innovative consumer products of 1990"* at the **Innovations '90** event.

RTA-33 30-Band One-Third Octave Real Time Analyzer. (Patent Pending)

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Ken C.Pohlmann
User's Evaluation,
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Jan/Feb 1992

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MPA

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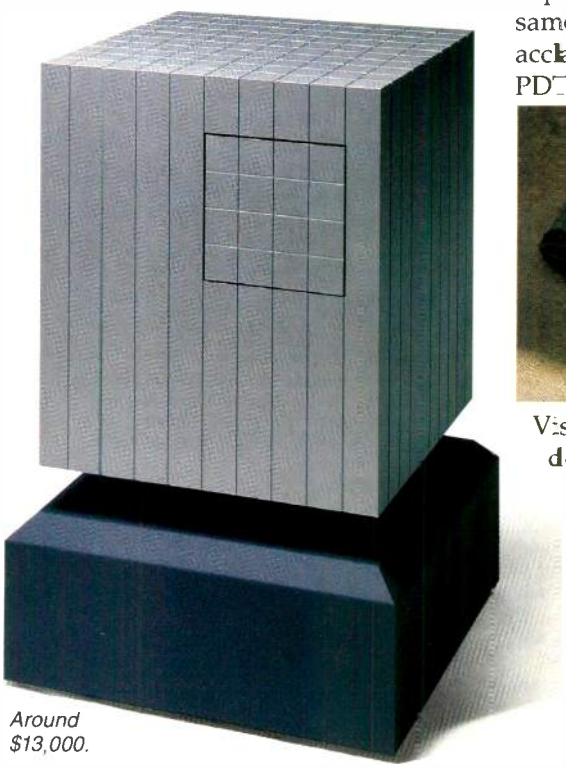

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Digital sampling of actual soundstages to recreate the same acoustic environments you once had to go out to enjoy.

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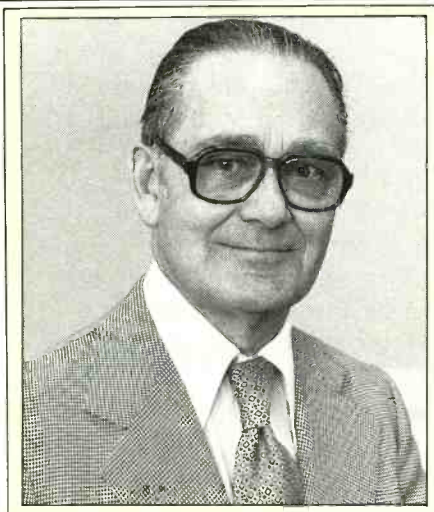

Coda: B. V. Pisha

It is with profound sadness that I report the death of dear friend, colleague, and Associate Editor of *Audio*, B. V. Pisha, on November 6, 1991. He died of a heart attack following a prolonged affliction with Parkinson's disease.

Born in New York in 1916, Barney Pisha spent part of his youth in Czechoslovakia before taking up permanent residence in the United States in 1926. He received an amateur radio license in 1927 as a result of his early interest in audio. Although he pursued studies in music and electrical engineering (audio), lack of employment opportunities diverted his interests to medicine. He became a physician in 1942 and served with the Army Medical Corps in North Africa during World War II.

While a practicing physician, Barney kept alive his love for music and audio by establishing a small, part-time testing laboratory for evaluating audio products in 1953. He retired from his medical practice in 1973 and became a consultant to a major drug company because of his expertise in clinical pharmacology. During this time, Barney was instrumental in the development of a number of significant new drug modifications, currently in wide use. It was also in 1973 that he expanded his testing laboratory and became *Audio*'s resident expert on phono cartridges, tonearms, and turntables.

Well-schooled in the disciplines of laboratory procedures, Barney's reviews of phono cartridges and associated equipment were widely viewed as authoritative because of his utilization of the most advanced ideas and instrumentation in measurement technology. He was a close friend of most of the scientists and design engineers in the phono industry and was greatly respected for his ability to discuss knowledgeably the most arcane aspects of phonograph record reproduction.

Barney was near-fanatic in his quest for accuracy and objectivity in his reviews, but he always emphasized that technology must be a servant to the music. He had a lifelong love affair with opera and held season tickets to the Metropolitan and New York City Operas for many years. His expertise resulted in a collaboration with Tom Stockham (of Soundstream digital recorder fame) to restore Enrico Caruso recordings for RCA Victor, with digital processing of these early acoustic recordings.

In 1986, Barney was made a Fellow of the Audio Engineering Society for "significant contributions to the testing and evaluation of audio products." He had a very wide circle of friends in the audio industry who admired him as much for his probing questions as for his ready wit. Barney's unflagging courage in the face of a debilitating and disabling illness truly inspired all of us who loved and admired him.

Bert Whyte

No More Dissin' DAT

Dear Editor:

I have to respond to Danny Blatt's letter in your October 1991 issue. He is right that DAT is here, and that everyone is raving about it, but he seems to focus on the down side of the format rather than looking at it as a whole.

As one who has DAT in both my home and car, I fully believe the format has much to offer both the audiophile and casual listener. I am fully aware that, since there is tape-to-head contact, there will be some wear on both heads and tapes. Comparing DAT to videocassettes is legitimate; the operating principle is about the same. I fully accept the fact that these tapes, unlike my Compact Discs and LaserDiscs, won't last forever.

On the up side of the format, however, I like the fact that I can program up to four hours of music on a single cassette (the LP speed on the DAT still sounds better than standard cassettes) and enjoy it in my car or at home. The smaller cassettes are easier to handle and store, and when you get right down to it, tape cost per hour isn't that much different than a standard 100-minute Type IV cassette.

Another format making itself known these days as well is Philips' DCC. While the idea of a cassette which is compatible in most respects to the standard Compact Cassette already in use is a good one, I can't agree on its execution. Making DCC decks able to play standard cassettes makes sense, but I have never seen anything about whether these decks will record analog on standard tapes. Also, I'm a firm disbeliever in using digital compression, such as the type proposed for DCC. I could be wrong, but I can't help feeling that you never get out of it quite what went in.

As for how long a DAT tape will last, Mr. Blatt, I can only say that it will likely last for a lot more plays than you'll ever give it. DAT is here to stay, whether you like it or not.

Jay Rudko
Hollywood, Fla.

Editor's Note: There are presently no plans for DCC decks to have analog recording capability.—*J.W.*

In the Change of Face

Dear Editor:

When are audio manufacturers going to return to producing components with silver faceplates? Enough of this black [expletive deleted]. I've seen that Yamaha and, recently, JVC have started producing silver components. It's so much easier to see the controls—and you can't see the dust, unlike black components. True, the new components sound better, but the outside looks really bad and cheap, especially with all the plastic that's been used recently.

R. Puczke
Tucson, Ariz.

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EDWARD TATNALL CANBY

BETTER HISTORY THROUGH BINAURAL

Illustration: Mary Schuck

I have deliberately spaced out discussion of binaural recording and playback over a good many months here. That's because I'm aware that this is a somewhat special audio area—a fascinating hobby, a source for much profound pleasure, but one not likely to become a major commercial operation. Binaural will never be big-time. If it tries, it will simply be swallowed into stereo. So if you are looking to make millions (or lose them), turn elsewhere. Enough competition is already on hand for that, what with new digital recording systems, a digital radio system, and enough audio/video to sink the proverbial battleship. But, sound hobbyists and recording enthusiasts, indoors and out, read on!

By binaural, of course, I mean true binaural, taken down via pairs of ears/mikes somewhat less than a foot apart, with or without an intervening head, dummy or alive. And always, *always*, played back for listening via headphones. Not loudspeakers. True, some recognizable binaural effects can be achieved through loudspeakers with special selective circuits to enhance channel separation. I've heard them. A modified stereo, I'd call it. And not necessarily—so far—for the better. We keep expanding stereo in dozens of forms and approaches, and here is one more. If, in the end, present-day stereo can be improved by these binaural additives, then this is all to the good. But as to reproducing *binaural* sound through speakers, I ordinarily find the effects (again, so far) just plain feeble and at times disturbingly unreal compared with the "original"—that is, the same through 'phones.

My own binaural experiments over many years—I began to "discover" this sound back in the "binaural" era, around 1953—have been sparse but, minus lab and minus kibitzing assistants, on the whole rather thorough. I followed where the medium led me, observing, then checking, in order to define the limits and parameters of this kind of sound reproduction. And there was—happy thought!—nobody to gainsay me. As I've said many times, scientific observation can be done both by highly trained professionals in teams and by the lone wolf who simply uses his best wits and observations. Expensive labs can fall en masse into corporate and/or advertising wishful-think. It's only too easy. Individuals can stumble on the truth, even by sheer accident. The effect of binaural recording is entirely subjective. It's inside the head. It's in the senses.

Thus, I've progressed by fits and starts, mainly as new and easier equipment came to hand. Imagine if there had been a stereo Walkman back in 1953! Instead, I had the extremely heavy "binaural Maggie," the staggered-head, two-channel Magnecorder PT-6. Maybe Bert Whyte had the other. (I suspect there were very few of them manufactured before the "stacked" heads, both tracks recorded in the same plane, took over everything, and thus led to today's multiple stacked heads and the ingenious whirling dervishes inside our VCRs and DATs.) I hauled Maggie up and down stairs, across acres of college campus at Washington University, down the length of endless city blocks—NO PARKING—and then went to get amps, two tall mike stands, mikes, and so on for another load. And this mostly without help. There was a blessed hiatus from *that*, and then came the first home tape machines. After this, the same with two channels—stereo, as it was by then called.

In 1959, I spent a month in the deep South with the first of these machines, the name of which I forget, and an accompanying pair of small crystal microphones, plus stands. Once again: Stairs, steps, greensward by the mile, city streets, but so much less weight! The machine's "fi" at 7½ ips dropped to zero at around 6 or 7 kHz, and at 3¾ ips it was abysmal. Moreover, the distortion was merely nominal, i.e., horrendous, easily outdone by the crystal mikes, which produced an edge you would not believe. (Some advantage to that: Distortion in the middle highs can make speech more easily intelligible with a cutoff such as we had in those days, and I took down a lot of speech.) Nevertheless, the young music students (it was a music school) were fascinated both by my stereo and by the headphone sounds I let them hear. (Permoflux still, the same 'phones I began with.) In all truth, I tiptoed around like a cat, tried to set up unobtrusively, and was as invisible as possible. But even so I aroused the annoyance of the school's leaders for distracting those students towards the nonessential—audio. This was a MUSIC school with a vengeance.

In the end, I left that place early, and I take it for granted that there was abso-

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Anything that sounds okay to the living ears will sound the same (or better) when recorded and played back binaurally.

lutely NO further mention of frivolous audio matters. Those kids, from age 12 to 16, were out to learn to play classical instruments, and so they did. Just recently I had a letter from a middle-aged professional oboist in Spokane, Washington. He remembered the summer of 1959 with pleasure—he was one of the kids who helped me carry my stuff around. Very subversive, this audio biz, at least in those days.

But I came home with a batch of highly informative tapes, however distorted. My stereo-intended recordings, made with loudspeakers in mind, were just so much more early stereo and not very good at that. I recorded the formal concerts that ended each week of practice. But to my delight, the deliberately binaural tapes of the endless *rehearsals* of the music (complete with starts and stops, groans, giggles, patient coaxing by the teacher/conductor), and especially the successes (after many tries, with much laughter and buzz of conversation), were startlingly impressive. Out of one of them I edited what to me was a wonderful radio program, the struggle to play a piece of the Beethoven "Eroica" Symphony, beginning with squawks and groans and no sense at all, ending at last with a recognizable rendition of the music. We broadcast it from WNYC New York in 1960, via separate AM and FM channels, and it was promoted as intended for 'phones. *Two* receivers, one AM and one FM, each hooked to an ear via its 'phone. (FM stereo was still some years away.) I wonder how many listeners heard it binaurally?

That program clinched an aspect of binaural recording that was becoming more and more obvious to me: This medium is nothing special for a formal concert, for any *formal* recording such as 50 million stereo published releases. But, on the other hand, it is absolutely marvelous for any sort of informal "surround sound" event, from a music rehearsal to a cocktail party. The more "interruptions" and unintended distractions—like people off in the distance, giggles startlingly a few feet to your right, a sneeze to your left, a dog barking in the distance—the better! My music rehearsals in binaural were, as a friend used to say, a gas. (In case you don't remember that slang, it means terrific.)

I had a similar experience at about the same time at Music Mountain in Connecticut, where the Berkshire String Quartet gave weekly summer concerts in a marvelous long wooden hall, arched beams overhead, said to have been made out of two Sears, Roebuck and Co. portable houses. (This has to be apocryphal; if the insides were removed, the houses would have collapsed in a heap.) I knew the members of this superb quartet and got permission to record a concert or two in that new medium, stereo. I did, with pleasure, but no special results. Others could do that far better than I

could and with fancier equipment. But then, inspired by experience, I asked if I could attend a day's rehearsal and experiment with something else, binaural recording. This time the musicians were wonderful. They ignored me even when I practically tripped over them, trying to see how close and how far I could advantageously place my mikes! The momentous answer was, *anywhere*. For binaural, that is. At any distance at all, from the back of the hall many yards away to a foot or so from the musicians' instruments. It did not matter. Wherever I went, the playback sound was exactly what I heard on the spot. It was a good hall. The acoustics, though too live without audience, still made it possible to listen "live" almost anywhere in the big space. That hall is still functioning and it is still one of the best, with an audience in attendance to damp down the shiny sound.

So I learned a new principle. Anything that sounds okay or interesting to the living ears will sound the same (or better, with a bit of volume enhancement) when recorded and played back binaurally. *Anything*. Can you say that of stereo recording for loudspeakers? One of my bright thoughts—still viable today—was binaural for students who wanted to record lectures. You know the problem. Can't get close enough. The professor walks around and back and forth, ignoring any nearby mikes, as professors always do. At a distance he records unintelligibly. He mumbles, he shouts, he makes asides. No use.

Not so in binaural sound! If you can hear what he is saying from your seat with your own two ears, binaural recording there will bring him to you just as clearly, or a bit more so if you turn him up a bit. You can sit *at the back of the hall* and attend the lecture all over again with the very same sound. Try it. Try it on today's tiny recorder! Never was binaural so easy to achieve. Listen on 'phones, of course.

The epitome of my recordings of "incidental" sounds in binaural came a bit later, with better equipment. I set up two mikes, 6 or 7 inches apart, on a chair and recorded an entire cocktail party for some dozens of people, preparatory to Thanksgiving turkey. At slow speed, with by then better quality, this tape ran unbroken for at least an hour of an increasing buzz of talk, everybody talking at once.

As a loudspeaker recording, it is unintelligible. Three minutes and you give up. Through 'phones, suddenly you are surrounded by live people, startlingly real. And you can *understand*! You find yourself in the midst of small conversations, on one side or the other; you can listen to each, as you wish. Exactly as in the living situation. It was an astonishing experience, and the only flaw in the whole recording was when a couple of kids tipped the mikes onto their noses. I didn't discover this for minutes—I was part of the conversations. Unfortunately, at least half of those familiar voices are now gone. Dead 30 years, maybe more. But the tape still is there. Can you begin to understand the power of this very uncommercial form of audio recording? Oral history of a sort nobody has yet tried. Except maybe me.

Listening in the 90's

Today people have become more and more space conscious. Many apartment dwellers don't want to give up valuable floor space for large speaker systems. Others who are planning a surround sound or home theatre system simply don't have the room for more speakers in their listening rooms or hesitate to commit the floor or wall space to a good sounding pair of speakers.

Until now, serious music lovers have had little, if anything, to choose from that would produce a large, bigger-than-life sound in a small, compact size. Systems that fit one's space requirements have been woefully disappointing in sound quality.

The RM 3000's satellites measure 7"H x 4 1/4"W "x 5 3/8"D and are available in black matrix, gloss black piano or paintable white. The subwoofer is 12 1/2"H x 20"W x 12 1/2"D and is available with black wood grain sides and a black, mar-resistant top.

The RM 3000 Three Piece System

Polk's engineers had determined long ago that there were indeed certain technical advantages in small speaker systems. Both high and mid frequencies could be faithfully reproduced with superior transient response and dispersion characteristics, and the convenient, more flexible placement of small enclosures within the listening area could create an ideal sound stage. Unfortunately, reproducing the life-like, full body of the lower frequencies could not be achieved in a truly compact enclosure.

Polk's RM 3000 replaces the traditional pair of speakers with three elements, two compact midrange/tweeter satellites and one low frequency subwoofer system. This configuration makes it easy to properly and inconspicuously place the system within your listening room while offering superior sonic performance.

The small satellites can be located on shelves, mounted on a wall or placed on their own floor stands. They are very attractive and yet small enough to be hidden from view if desired.

The RM 3000 subwoofer is also small enough to sit behind your furniture and can be used on its side to fit into tight spaces. And since it is beautifully finished, it can be used as a piece of furniture.

The Legendary Sound of Polk

In the tradition of Polk Audio, Matthew Polk and his team of engineers were determined to make the RM 3000 sound better than any other speaker of its type.

Initial reactions have been filled with superlatives including Julian Hirsch of *Stereo Review* magazine who says, "...they sound excellent...spectral balance was excellent—smooth and seamless."

Sound as big as life from speakers

Behind these accolades is an impressive technical story.

The Technical Side

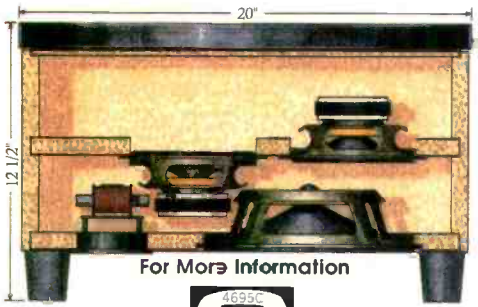
The big sound of the RM 3000 is due, in part, to the unique arrangement of the tweeter and midrange elements. This "time aligned system" delivers the high and mid frequencies at precisely the same instant. The result is a clear, lifelike and expansive presentation.

The cabinet materials selected for the satellites are over four times as dense as typical enclosures. The black matrix finish is a non-resonant polymer aggregate (FOUNTAINHEAD®). The gloss black piano and paintable white finishes are rigid ABS

small enough to live with.

surrounding a mineral filled polypropylene inner cabinet. Polk engineers have all but eliminated any "singing" or resonating of the satellite enclosure. You hear the effortless, free sound of a much larger system.

Most subwoofer systems look alike on the outside, but the Polk is worlds apart on the inside. Utilizing twin 6 1/2" drivers coupled to a 10 inch sub-bass radiator, the bass is tight and well defined. There is no tuned port to create "whistling" or "boominess" of the bass frequencies.



For deep, well defined bass, Polk uses twin drivers coupled to a sub-bass radiator. Normally, one subwoofer system is used for both channels. For those desiring even greater low frequency performance, a second subwoofer can be added, one fed by the left channel, the other by the right channel.

You Have To Hear It To Believe It

You really won't believe how good the RM 3000 sounds until you hear it. We invite you to your nearest authorized Polk dealer for a demonstration. You'll hear sound as big as life...from a speaker you can live with.

You'll hear the next generation of loudspeakers.

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BERT WHYTE

A SPROCKETFUL OF DIGITALS

Illustration: Mark Matcho

Our current economic woes notwithstanding, the market for surround-sound home theater systems continues to flourish. Now, even the most hidebound audiophiles must concede that the marriage of audio and video has been well and truly consummated. In the not too distant future, the union will see yet more interaction—with digital technology playing a major role.

Whatever the degree of technical sophistication of tomorrow's home theater systems, they still must depend on the movie business for program material. After all, movie videocassettes and videodiscs are really a byproduct of feature films, and thus technological advances in the audio and visual qualities of these films will directly benefit the owners of home theater systems.

Contrary to what most home theater enthusiasts believe, the digital soundtracks of these movies' videodiscs are not derived from original digital masters. The majority of Dolby Stereo movie soundtracks are recorded with Nagra quarter-inch analog magnetic tape recorders that provide special features like pilot tones and SMPTE time code. In the same way that many CDs are made from analog tape masters, the digital soundtracks of videodiscs are commonly derived from analog Nagra soundtracks.

There has been some use of professional R-DAT recorders to provide digital movie soundtracks. But in the very conservative (and expensive) world of film recording, the prime consideration is reliability of equipment. The Nagra is a proven device, while the jury is still out on R-DAT recording for soundtracks. Meanwhile, drawing attention is the increasing use of Dolby Spectral Recording (SR) soundtracks. Dolby SR is an analog process, but with a dynamic range of over 100 dB it actually exceeds the 96 dB of 16-bit digital recording. Given the wide frequency response and dynamic range of 35-mm Dolby SR films, theaters that have been acoustically modified and equipped with high-quality amplifiers and loudspeakers can deliver sound of stunning impact and clarity.

Nonetheless, the movie industry is well aware of the power of "digital" as a buzzword and a marketing advantage. Many consumers, for example, will not buy CDs if they do not have a SPARS code of DDD. So for some time, a number of companies have been trying to develop a film format with a digital optical soundtrack. This is a formidable task—and a particular aspect of it is of paramount importance.

As a foreword to this, let me sound a personal note. In 1932, when I was 12 years old, my Aunt Josephine married a brilliant Danish engineer, Gustav Plahn, whose field was optical systems and photography. Uncle Gus was a fascinating man of ideas and a great teacher. At that time, "talking pictures" were in their infancy, and color movies were rare indeed. One day, Uncle Gus took me to his studio/laboratory and showed me a large movie camera of very unusual design. He then handed me a length of 70-mm sprocketed black-and-white movie film. When I held it up to a light, I could see what appeared to be three identical images across the width of the film. The camera had been equipped with beam splitters behind the lens to produce three images. A red filter was placed behind one beam, a green filter behind the second, and a blue filter behind the third. A disc about a foot in diameter, which had various geometric cutouts, was mounted behind the filters and was rotated at high speed by an electric motor. Thus, the three filtered images were exposed on the film. Being standard black-and-white film stock, it was developed in ordinary black-and-white film chemicals. In essence, there were red, blue, and green negatives on the film for every frame.

Gus had filmed my red-haired aunt wearing a turquoise dress as she was walking around a blooming flower garden. Then he ran the black-and-white film through a projector that reversed the order of elements in the camera—color wheel, RGB filters, beam splitters, and on through the lens to the screen. The result was astonishing: There was my pretty aunt in "living"—but very natural and realistic—color! By contrast, the color film processes of the time produced rather garish, oversaturated hues.

A year later, Pathé, the French company whose newsreels were quite popular, offered to buy Uncle Gus' color system for a million dollars—a *great* amount of money in those days. He foolishly refused the offer because he wanted royalties as well. Pathé soon realized it was lucky in this negotiation, because Uncle Gus' system had a fatal flaw which has been the bane of other motion picture devices through the years. The flaw was that the system was not even remotely compatible with the projection technology of the time. Uncle Gus' technique was conceived in the depths of the Depression, and movie theater owners simply could not afford to install a costly new Plahn projector. To make matters worse, the pro-

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Dolby Spectral Recording gives analog tape better dynamic range than R-DAT or CD, for stunning sonic impact and clarity.

jector could not be used to show standard 35-mm movies.

About that time, early Technicolor films began to appear. Technicolor, employing a multi-layer film, was a process that required laborious dyeing of each layer with its separate color. Yes, it was cumbersome. Yes, the color was very chromatic and overbright. However, the system was acceptable—and most of all, it could be shown through the standard projectors in any theater.

Today, with the movie industry apparently ready for films with digital soundtracks, a number of companies have set out to develop such a recording system. A French company developed what is known as LC Concept, in which a time code is recorded on the film to synchronize with an optical disc that plays back the digital soundtrack. While the quality may be quite high—and while the integrity of the analog soundtrack on the film is maintained—this system does raise the question of compatibility, in that two different elements are required, and it is easy to imagine the film and the optical disc being separated or one of them lost, with obvious consequences.

Another contender is a digital soundtrack system jointly developed by Kodak and Optical Radiation Corp. This is called Cinema Digital Sound, or CDS. Compact Discs have their digital signals in their information pits; the CDS system uses tiny spots that are light and dark in a matrix pattern on the film, positioned in the same area that is normally used for the analog stereo soundtrack. This last point is very significant, because once again, there is a compatibility problem. If a CDS soundtrack is damaged or otherwise becomes unusable when running through the projector, there is no analog counterpart available to maintain sound continuity in the movie. The CDS system includes much clever technology, but I understand ORC has laid off personnel and is attempting to sell its interest in the system, citing the recession and the slow acceptance of CDS. Kodak, however, remains committed.

This basically leaves the playing field to Dolby Labs, which, from its earliest dealings with motion picture sound, has had an ironclad policy of maintaining compatibility with cinema systems in current use. After trying a number of ideas, Dolby engineers came up with the clever idea of employing the unused space between the sprocket holes of 35-mm film to encode a digital optical soundtrack. This SR-D system is wholly compatible. If the digital soundtrack between the sprocket holes should become unusable, the SR Stereo Variable Area (SVA) soundtrack is automatically switched in, thereby maintaining sonic continuity.

Dolby SR-D follows the SMPTE recommendations for digital film sound. Six channels are used: Left, right, center, sub-bass, and left rear and right rear surround. Most important, unlike Dolby's optical analog stereo, which uses a matrix for its four channels, the digital six-channel system is totally discrete—and thus separation and localization can be much more precise. The six channels operate in a 48-kHz sampling rate to code 16-bit words. In order to help get six discrete channels in the spaces between the sprockets, Dolby has used its AC-2 adaptive transform coding algorithm to compress the 48-kHz, 16-bit data to one-sixth the original rate. On the film, the optical digital data—the ones and zeros—are represented by dark and light spots. This data is read by a CCD scanner, which is easily mounted on standard movie projectors. The error-correction and digital data are very robust. In a conversation I had with Ray Dolby, he told me his engineers "looped" film with the digital soundtrack and played it over 1,000 times—and it was apparent the visual quality of the film would be impaired before the digital data would corrupt!

Ray also commented that in production form, beginning in mid-1992, the coding will be increased to 18 bits to accommodate the 100-plus dB of the system's dynamic range. The SR-D equipment should be widely available by the fall of this year.

There is much more to SR-D, of course, but for now its significance for the surround-sound home theater owner lies in the prospect of better sound quality in today's videodiscs and in future videotapes. In Japan, S-VHS VCRs with 16-bit PCM audio are available, and 8-mm models are coming. However, availability in the U.S. may await English-language software.

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JOHN EARGLE

ROOM ACCOMMODATIONS

As a general rule, conventions of the Audio Engineering Society inundate us with the newest in signal processing, digital workstations, loudspeakers, and multi-channel recording equipment. But it is not often that we *hear* something new. At the October 1991 convention at the New York Hilton, we were presented with two sonic treats that deserve special attention.

The first of these, auralization, is an outgrowth of several computer programs that allow a sound system designer to model loudspeaker performance in a given environment. These programs normally provide a set of architectural plan views showing loudspeaker coverage in the area occupied by the listeners. Many of these programs have as part of their analysis an image modeling subprogram that allows the designer to examine the pattern of all early reflections arriving at a selected listening position for a given speaker location. The view of this on the computer monitor is simply a group of vertical lines, arrayed horizontally, representing the individual arrival times of the reflections received by the listener. The height of the lines represents the strength of these reflections. However, much more data has been generated in the image modelling process, and the program also stores the "3-D" direction from which each reflection arrives at the listener.

In signal analysis, this information regarding reflected acoustical energy is related to the impulse reponse of the room over the path between the sound source and the listener. Then, through a mathematical technique known as convolution, it is possible to combine an anechoic signal with the pattern of reflections and generate a new signal representing what the room may actually sound like with a listener and loudspeaker at the assumed positions.

Imagine that a house of worship wants to purchase a new speech reinforcement system. The sound committee will go to an acoustical consultant who will lay out a proposed system. Making use of auralization, the consultant will be able to "demonstrate" what the system will sound like at various assumed positions in the actual space. Several design options can be auditioned, and the differences between a central array and a distributed array of loudspeakers may easily be demonstrated. The auralization can take place over binaural headphones or, with more detailed convolution, over multiple loudspeaker channels in a dedicated auralization environment.

None of this is new in principle. But in the past, such demonstrations have required large mainframe computers and have been well outside the normal commercial scene. Soon, such capability will be more freely available, making use of personal computers outfitted with extended memory.

At the convention, an entire technical session was devoted to auralization, and several demonstrations were held. More impressive demonstrations were to be heard in the Bose and Renkus-Heinz suites. All of these systems are still in the early stages of development, and it will probably be another 18 to 24 months before most of the bugs are worked out. Looking a bit further into the future, it is almost certain that concert halls, yet unbuilt, will be able to be accurately auralized, given thoughtful and complete modelling.

In another area related to room acoustics, Lexicon was demonstrating a remarkable system for adding reverberation to acoustically dead spaces. Their process is called LARES, the Lexicon Acoustic Reverberance Enhancement System. A demonstration of LARES in a normal-size room made use of eight loudspeakers placed at the junctions of the ceiling and side walls. A stereo microphone was located on a stand in the middle of the room, and the microphone outputs were fed to eight reverberator/amplifier combinations, one for each loudspeaker. When the system was turned on, I immediately felt that I was in a large, natural reverberant space. Even the slightest sounds (whispering, for example) reverberated naturally. Reverberation time and level could be varied, and the simulated space could easily be altered. But under none of these conditions did the system show any signs of instability—or even hint at going into feedback or howling! How could such high system gain be achieved with absolute stability?

Years ago, some speech reinforcement system designers made use of frequency shifters to increase gain before feedback. It takes a finite amount of time for a system to go into feedback, and the frequency shifter foiled the process by constantly changing phase relationships through the system. The trouble was that the frequency shift was noticeable as such when it was used in sufficient amount to be an effective deterrent to feedback. The LARES solution is twofold: First, eight uncorrelated reverberators are used; second, each reverberation channel includes a random time-variant delay function. Both of these work to foil the feedback process. So effective is the feedback immunity with LARES that it was possible to position the microphone within about 20 inches of one of the loudspeakers with no degradation in system performance. Additionally, LARES can be set so that the reverberation time is appropriately long for music; when speech is detected, the reverberation parameters are adjusted for better speech intelligibility.

I know dozens of U.S. performance spaces that could benefit by using LARES for more acoustic liveness. Electronic architecture has been making steady strides for years. With LARES, it takes a giant leap!

Illustration: Michael Donato

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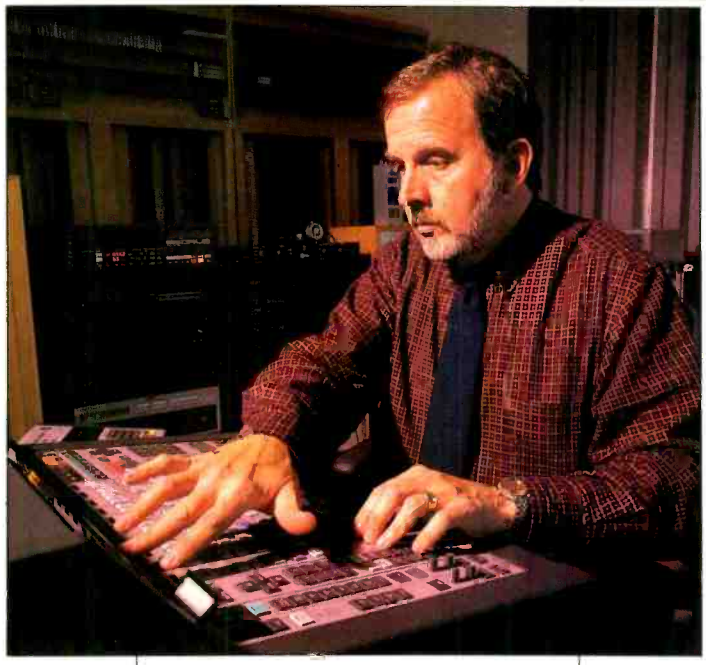
TOM JUNG

SPARRING WITH SPARS

By now, almost everyone has seen those three capital letters in the rectangle—the SPARS code that appears with virtually all Compact Discs. And almost everyone has some idea of what that "DDD" or "AAD" means, but in my experience, those ideas aren't always accurate, at least not completely.



Photographs: Dave King

Created by the Society of Professional Audio Recording Services soon after the CD was first introduced, the code's purpose is to indicate whether each step that goes into making a given CD—recording, mixing, and mastering—was done in the analog or digital realm. Since all CDs use a digital format, three Ds in the code seem to imply that the music stayed digital throughout the production process, and that a CD with a DDD code gives you the purest sound you can get.

By now, the SPARS code is seen by many CD buyers as a kind of Good Housekeeping Seal of sonic quality. Some CD booklets include brief explanations of the code, and audiophile magazines are increasingly noting the SPARS code in their CD reviews, an indication that the publications believe readers consider the code an important factor in evaluating a new record.

In concept, I've always supported the SPARS code. I think it's a good thing to tell consumers how the CD they are thinking of buying was made. In fact, the code is probably a necessity, given the high level of technical sophistication that many music lovers possess today. They do a considerable amount of "homework" to find just the right sound system for playing their CDs; it's safe to assume they also want to know as much as possible about the sonic capabilities of the discs themselves.

On the other hand, I've always felt that the code is incomplete and misleads the consumer who really wants to know if a given CD will produce the best possible sound quality. The SPARS code, as it is currently set up, does not go far enough to indicate the number of times that music is converted from an analog signal to a digital signal, and back again, during recording, mixing, and mastering. Each of these "D-to-A" and "A-to-D" conversions takes a little bit away from the purity of sound that you hear when you listen to the finished CD at home. If you want to know how close the music coming from a CD sounds to the music that was played live in the studio during the original recording session, you have to know how many A-to-D and D-to-A conversions that music *really* went through.

These conversions exist even for CDs that now carry a DDD SPARS code. The explanations I referred to will tell you that DDD means that a digital tape recorder was used during the recording, mixing and/or editing, and mastering steps. But this does *not* mean that the music being recorded stayed digital from start to finish. Here's why:

First of all, live acoustic music being played during a recording session is an analog signal. During the recording phase—the first D in the SPARS code—this analog signal first enters an analog recording/mixing console and then passes into a multi-track digital tape recorder. In going from the analog console to the digital recorder, the analog musical signal is converted to a digital signal. So right away you've started out with an A-to-D conversion.

In the second SPARS-code D, the mixing phase, the music that has been recorded is played back from the digital tape recorder and, usually, fed into an *analog* console for mixing. This step requires that a variety of outboard gear—interfaces, input amplifiers, output amplifiers, transformers, etc.—be connected to the recorder. The use of this additional equipment means that the digital signal stored by the original recorder has to be converted to analog so the outboard gear can process it, and then it must be converted back to digital so another recorder can store the final mix. So in the mixing process, there are two conversions—D to A and A back to D—that are not reflected in the DDD SPARS code.

During these two conversions, I believe some of the purity of the original digital signal is lost, never to be recovered. The analogy I'd use is two people trying to hold a fairly complicated discussion through an interpreter. Say one speaks English and the other Russian. Person "D" sends out a signal in English, which is then converted to Russian by the interpreter and passed on to person "A." Person A then accepts the signal, in Russian, and sends back a response, also in Russian, to the interpreter. The interpreter converts the Russian signal back to English and transmits it to person A. No matter how good the interpreter is, over time he will affect the meaning—even if only slightly—of the messages going back and forth between person D and person A. The conversation can never be as exact as when D and A speak the same language.

The three "hidden" signal conversions I've just described mean that, to

Tom Jung is president of dmp records in Stamford, Conn.

Just because a CD is given a SPARS code of DDD doesn't mean that it stayed digital from start to finish.

The dmp studios in Stamford, Conn.

be completely accurate about what really happened to the music during production, the vast majority of CDs coded as DDD should really be coded ADDAADD. The first A-to-D conversion, however, is unavoidable when you are recording a live session, because live acoustic music is *always* an analog signal. No technology currently available can change that. However, it *is* possible to eliminate the next two steps, the D-to-A and A-to-D conversions, and maintain a pure digital signal all the way to the finished CD.

One way I do that is to produce a recording "live to two-track." In this case, the live music the musicians are playing is mixed on an analog console, and the output of that console is then fed to a two-track digital recorder. The effect is the same as the DDD recording process I described above, an analog signal fed into a digital recorder. The difference, however, is that the track is *already mixed* when it is stored by the digital recorder. The next two conversions are eliminated, and the recording serves as the digital master that becomes the CD.

Another technique is to record the live session on a digital mixer/recorder that allows both recording and mixing without using any outboard gear. Everything is done inside the recorder console itself, and the music stays digital the whole way. This is one way I do it, and I use Yamaha's DMR8 mixer/recorder, which has a 20-bit dynamic range, compared to 16 bits for a CD. This means that we can record, mix, and master above the threshold of the final product—something we generally took for granted when we recorded LPs but have not so far been able to do with CD.

I'll be the first to admit that I'm obsessed with multiple A-to-D and D-to-A conversions. My experience over a 15-year career in digital recording has convinced me that these conversions are *the* weak link in the recording process. I was the first producer to use the very first digital recorder, from 3M, on a project with Flim & The BB's back in the 1970s. That experience convinced me that digital was where the industry was headed.

For me, the best digital recordings are made by converting the music to a digital signal as quickly as possible

SPARS Code To Be Retired

As we went to press, we received a news release from the Society of Professional Audio Recording Services. The following are excerpts from the release:

Lake Worth, FL—The Society of Professional Audio Recording Services (SPARS) has recommended that the SPARS Code be discontinued. The decision to retire the Code was made during a meeting of the Board of Directors during the AES '91 convention.

"The SPARS Code no longer fairly reflects the complexity of the technology we use today," explained Pete Caldwell, SPARS Chairman of the Board and president of Doppler Studios in Atlanta. "Our discussions began with an attempt to revise, expand, and update the Code. This quickly led us through a discussion of its present limitations, ambiguities, and misuses. . . . It became clear that any attempt to revise the code to embrace all of these subtleties and nuances would become so complex as to be meaningless. The SPARS Board therefore concluded that the Code served the consumer and the industry well in its day, but that in its present form, it cannot contain enough data to be a useful yardstick, and that any all-embracing revision would end up looking like rocket science—which, after all, is just about what we have."

Skywalker Sound's Tom Scott, who represented Board member Tom Kobayashi at the meeting, added: ". . . The code has been in danger of degenerating to simply a marketing device rather than being a useful piece of information to the consumer. I just feel that no code is better than an incomplete or misleading one."

"We know the discontinuation of the SPARS Code will be a slow transition," says Pete Caldwell. "We can't require the labels to discontinue using it any more than we could require them to use it in the first place. We can only ask that they weigh the usefulness of the Code, and consider our recommendation."

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My experience has convinced me that multiple A-to-D and D-to-A conversions are *the* weak link in the recording process.

and then staying strictly digital the rest of the way. Not long after that first BB's project, I founded dmp to record exclusively for CD, and to do it with the fewest A-to-D and D-to-A conversions that technology would allow.

Many of you probably know that dmp CDs carry a DD SPARS code. All of our CDs are done either live to two-track or, as is the case with such new releases as Chuck Loeb's *Balance*, on the Yamaha DMR8. The conversions that normally occur in the middle D of the SPARS code, the mixing process, are bypassed because we either mix before the music ever gets to the digital recorder or we use a digital recorder that can both record and mix internally. By using either method, we eliminate the outboard gear that standard multi-track digital recorders need during mixing, and that requires the music to be converted from digital to analog and back again.

I'm not advocating that the SPARS code should be changed, and to be honest, I don't think it will be changed in the near future. What I am saying is that the code should not be viewed as some sort of sacred cow of sonic purity. It does give you a basic idea as to whether the music was "more" or "less" digital during the process of being turned into a CD. But you need to know more about both the recording approach and the recording equipment used to really know if that CD will give you the best sound you can get.

There's no magic to DDD. In fact—and this may sound like heresy coming from me—I believe it's possible to use analog recording techniques and still produce a CD that offers sound quality equivalent to many CDs that now carry a DDD code. How? By recording analog through an analog console with, say, Dolby SR, which is essentially as quiet as digital, doing the mix on an analog console, and *then* recording the mix to digital. The code for that would be ADD, but it would sound as good as, or better than, most of today's DDD CDs because this technique eliminates multiple A-to-D and D-to-A conversions.

Finally, whenever the topic of CD sound comes up, I think there's one thing almost everyone—whether you're a recording industry professional or a member of the CD-buying public—forgets too easily: The music. We can all discuss SPARS codes and the technical aspects of recording until we're blue in the face. But the music itself is what makes a CD really sound good and determines whether a disc succeeds or fails. As a producer and engineer, my job is to use the best techniques I know to make sure the music I record sounds as clean and lifelike as possible. But if a tune is really great musically, I could record it on a telephone answering machine and it would probably still be a hit. On the other hand, if the music isn't there, all the Ds in the world won't help.

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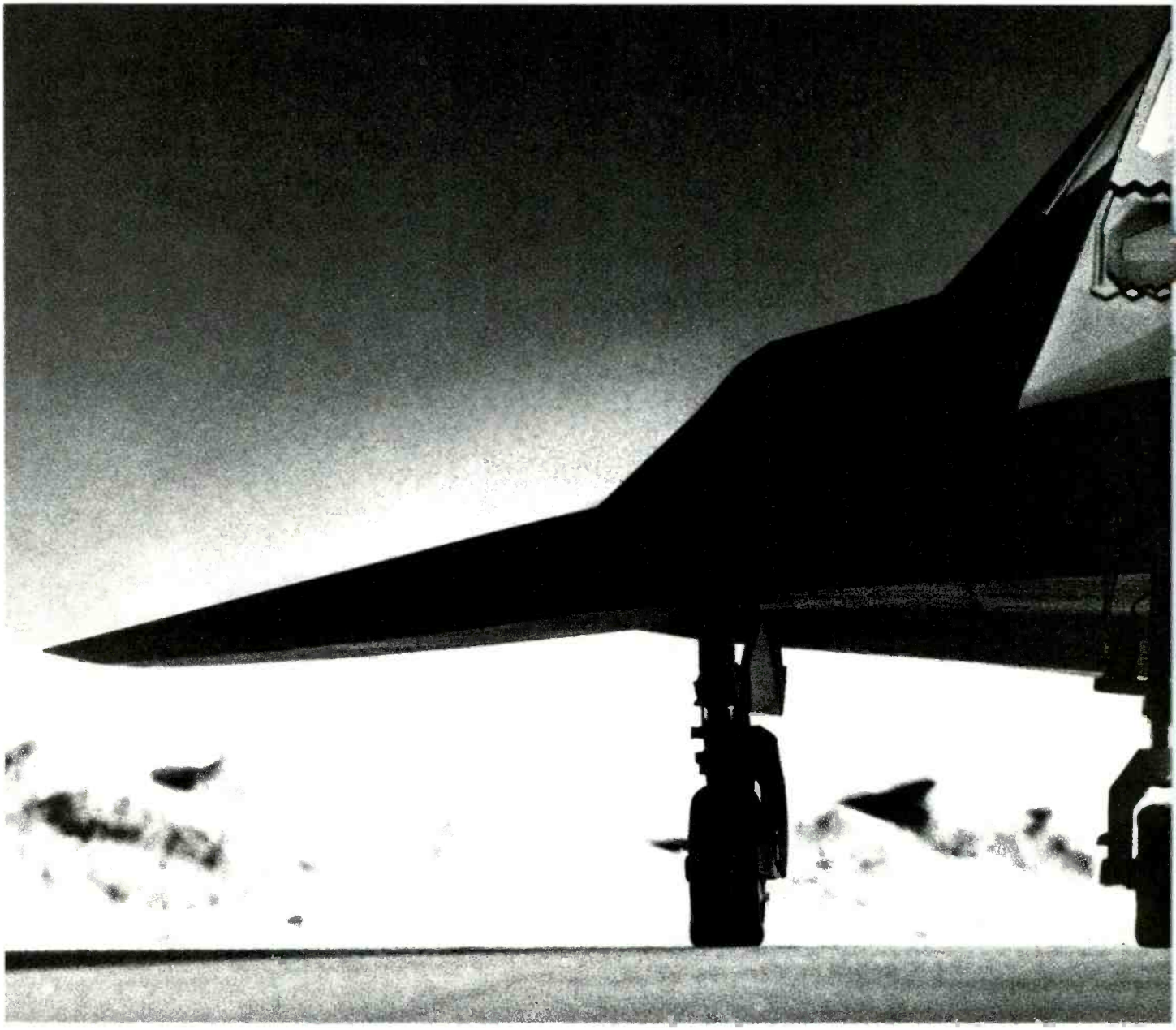


THE HIGHER THE PERFORMANCE,

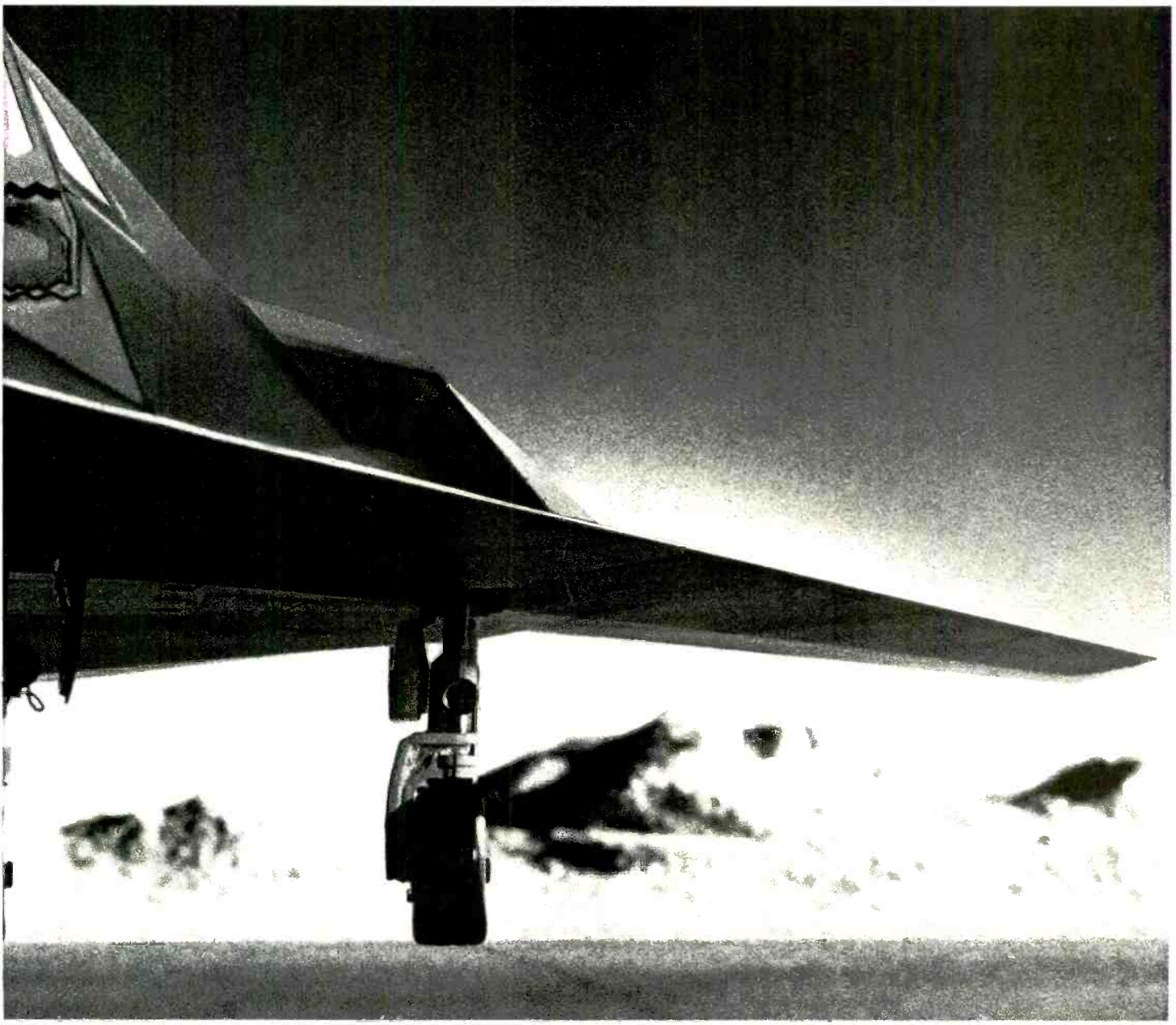
Compare Maxell's XLII-S to an ordinary cassette. An obvious difference is the size of the windows. Remember: there are no bay windows in rockets, but in houseboats there are.

That tiny little slit of a window allowed us room to build additional support into the cassette shell for greater rigidity and durability.

The shell itself is a compound of ceramic and polymer resins. With 1.4 times the specific gravity of standard cassette shell material, it's antiresonant, absorbs vibrations that can cause modulation noise.

Inside, the tape is formulated with Black Magnetite—a higher energy magnetic material harnessed by Maxell engineers.

It contributes to the sound *CD Review* magazine described like this: "Bass response that doesn't stop, staggering dynamics, real music." And in their review of Type II tapes, they



THE SMALLER THE WINDOWS.

rated XLII-S, "Head, shoulders and torso above the rest."

Of course, an XLII-S cassette is going to cost you more than one with big, low-performance windows and matching sound.

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CD Packagi

JOE WIESENFELDER

Roughly two years have passed since the Ban the Box Coalition formed to rid the music industry of the wasteful cardboard longbox in which Compact Discs are packaged. In 1991, ban-the-box legislation was introduced in California and New York, and a consensus has formed that the longbox's days are numbered; it's practically a dead issue.

Given that, a new controversy has arisen over what type of package will take the place of the longbox/jewel box combination. What has resulted is a prize fight of sorts. But it's unlike any you've seen. This match isn't limited to two boxers. In fact, anyone can get into the ring. And if that's not confusing enough, the rules keep changing—because there's more than one referee. As with all title fights, millions of dollars are at stake, which has the contenders questioning each other's qualifications, all the while claiming to be the true people's choice.

The people may have assumed that the standard clear-plastic jewel box would remain, sans longbox, as in the rest of the world. That's still a possibility, but there's a hitch. The longbox was introduced so that American retailers could split LP bins in order to display two rows of CDs affordably. If ban-the-box environmentalists were the first referee, then retailers, represented by the National Association of Recording Merchandisers (NARM), were the second. Their rule? Any new package must meet the approximate dimensions of the longbox (6 × 12 inches), to maintain theft prevention and merchandising and to avoid the cost of refixturing retail outlets. In keeping with the ban-the-box movement, NARM's guidelines also requested that manufacturers produce environmentally "friendly" alternatives.

Jewel box-only advocates objected to being thrown out of the ring and formed Jewelbox Advocates and Manufacturers (JAM), a coalition of Dow Plastics, other plastics interests, and consumers wanting to save the plastic case. Susanna Seirafi, marketing coordinator for Lift Discplay Systems and spokesperson for JAM, asks, "Why do we have to replace something that shouldn't have existed in the first place? Why are the retailers using a bin that was designed for an LP?"

JAM and the original Ban the Box Coalition proposed that some of the savings resulting from the elimination of the longbox go to retailers to help absorb refixturing costs, an idea not embraced by NARM or the record labels. Miriam Granberg, director of public affairs and government relations for NARM, says, "The actual bookkeeping, the accounting in determining who got what, would have been so ridiculous that, administratively, to do that would have cost 10 times more than they would have saved.

"You still would not be meeting the two major concerns of the retailer," Granberg adds, "neither of which is the cost of refixturing—eventually all retail stores redo their fixtures. Sure it would be expensive, but that's

ILLUSTRATION: LINDA BLECK

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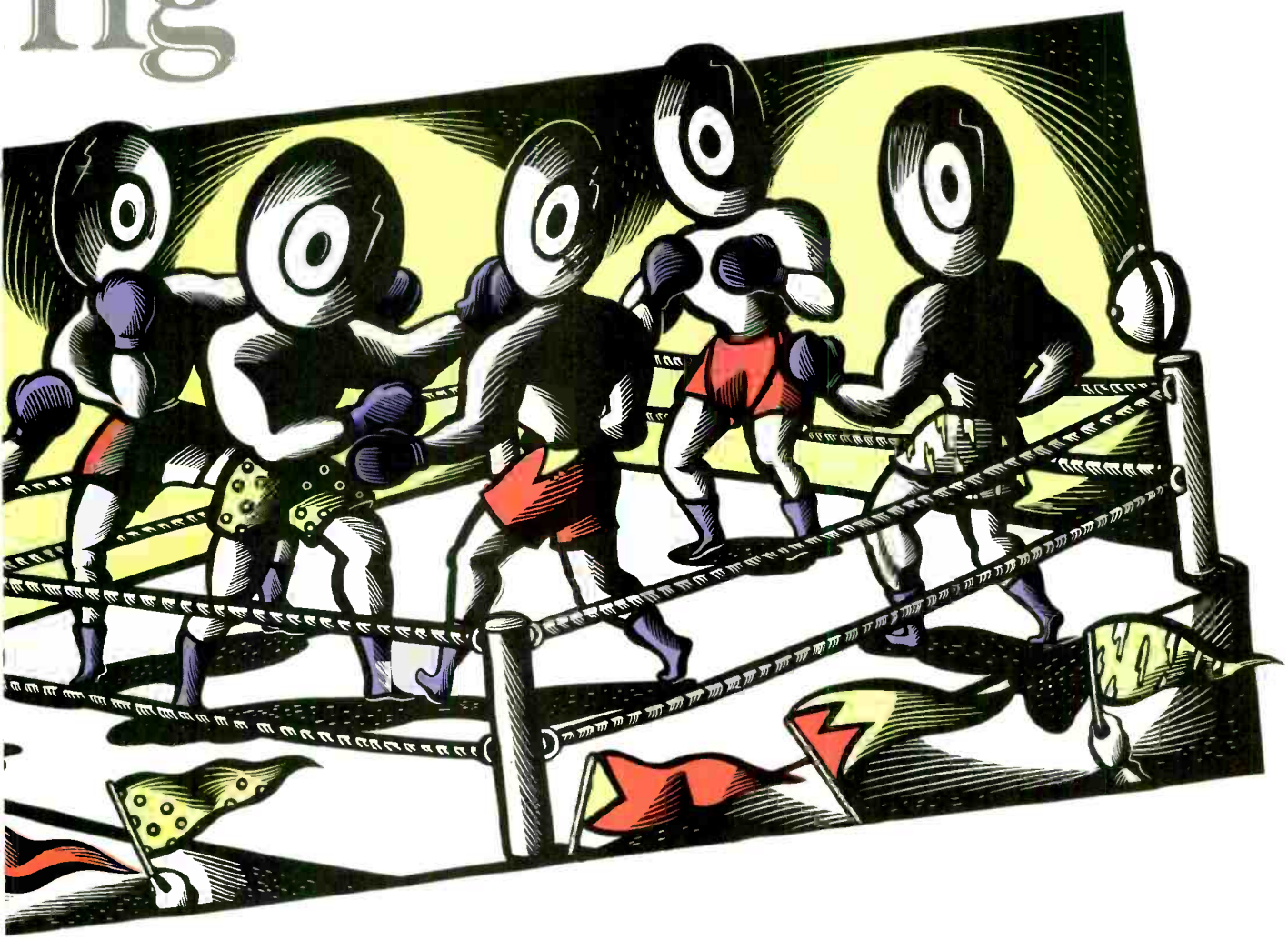
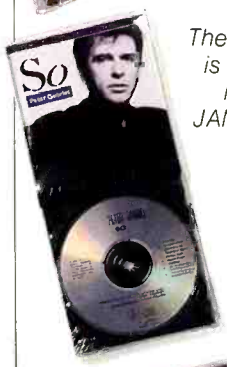


A Boxing Free-For-All



The jewel box is used both in the long JAM-Pak and in closed shrink-wrapped form.

not the point. The point is that they would lose the security, and they would lose the ability to merchandise the way they had."

The Contenders

Before the start of the bout, the jewel box was a favorite, partly because it's had a long career, its production means are already established, and it has the most (or at least the most vocal) supporters. Some music industry sources claim that early in 1991, the big six record distributors had acquiesced and were to decide a timetable for switching to the shrink-wrapped jewel-box format at a NARM convention last March. The introduction of Warner Music Group's Eco-Pak at this meeting is said to have stalled them. Slated for use with all WEA (Warner/Elektra/Atlantic) releases early in 1992, the Eco-Pak is a four-panel paperboard and plastic package (the manufacturer calls it eight-panel, counting surfaces rather than segments). Shrink-wrapped with only two of its three paperboard hinges folded, the longbox-sized package is made rigid by the plastic CD tray that spans the open hinge. After purchase, the consumer removes the wrap, slides the tray into its permanent position, and closes the package down to near jewel box dimensions with an audible click. When the WEA distribution group, which controls 40% of the domestic market, turned away from the jewel box, the other groups decided to reassess, allowing other contenders to enter the ring.

The Eco-Pak has not yet made its debut, but it is often confused with a contender from the same neighborhood, the DigiTrak, a similar four-panel paperboard package with less plastic and a wraparound rather than latched closure. DigiTrak was the first alternative on the scene, introduced to consumers on the grand scale with Sting's A&M release *The Soul Cages* in January '91, followed in June by Bonnie Raitt's *Luck of the Draw* on Capitol. Unlike the Eco-Pak, the DigiTrak has a fixed tray and uses plastic rails, or tracks, to stiffen the length of the shrink-wrapped package. After purchase, these would presumably be thrown away, an environmental no-no. (The DigiTrak, manufactured by Album Graphics Incorporated, or AGI, is a variation of the company's DigiPak, a two- or three-panel paperboard package introduced by Island Records in the mid-'80s with Robert Palmer's *Riptide*, among others, and now frequently used for CD maxi-singles.)

Brooklyn designer David Cowan introduced one of several all-plastic alternatives into the ring. "Weighing in" at the same dimensions as the jewel box, the Inch Pack utilizes a slide-out CD drawer rather than a hinged cover. This allows the boxes to be opened even when stacked. (The original name, Stack Pack, has been abandoned.) The boxes lock together like Lego blocks, which prevents them from falling over if stacked or grouped side by side on a shelf. For retail, the package is simply shrink-wrapped with the tray slid out, and only the wrap is thrown away.

Produced by Reynard C V C, the Laserfile is another plastic alternative that utilizes a drawer-type CD tray and is shrink-wrapped in the open position. The packages are also stackable, though they don't lock together, and are distinguished by the drawer tray, part of which hinges downward, facilitating CD removal and insertion into in-dash car CD players. Reynard C V C's executive director, Arthur Herr, says the package uses less plastic overall than the standard jewel box, and the CD tray is made from 100% recycled polypropylene. (Almost the full amount is from post-consumer waste, which would otherwise go to landfill; pre-consumer waste is factory trimmings, etc., now regularly recovered and reused.) Here too, only the wrap is discarded.

In this corner, wearing the green shorts, is the C-Case. "We're selling ourselves as a green alternative," says C-Case president Bill Dobias. "We don't think there are many others out there that have paid a lot of attention to it yet." The C-Case is a three-panel, all-paperboard package with a pocket apiece for the booklet and disc. Dobias says the case consists of 100% recycled paperboard, including 40% to 45% post-consumer material. According to C-Case literature, the all-paperboard construction makes the package easily recyclable, unlike paperboard/plastic combinations. C-Case takes it a few steps further, implementing a dioxin-free bleaching process and using only agri-oil inks and aqueous or soybean coatings, which are biodegradable and low in toxicity.

In addition to the shrink-wrap, C-Case uses a paperboard strip, or "belly band," to stiffen the open package for retail. Though it might be seen as disposable, C-Case has developed uses for the band, such as business-reply cards and spine labels for people who choose to transfer the CD to a jewel box. The wraps can also display the title for retail purposes, allowing designers to orient the cover art horizontally.

JAM has introduced the JAM-Pak, an open jewel box shrink-wrapped with a strong Mylar (versions using standard wrap broke too easily). Seirafi says the wrap comes from

100% recycled material and is recyclable. She stresses that the JAM-Pak is a transition package to eliminate the longbox immediately; JAM's goal is still a closed, shrink-wrapped jewel box. "The retailers have so much power, it's unbelievable," she says. "As long as it's 6 × 12—if it's made out of chocolate—they don't even care. Just as long as they don't have to refixture."

Sony Music developed a package (not shown) following commissioned tests in which consumers preferred an open jewel box-type package (Sony used the Inch Pack) over the standard jewel box (both alone and with the longbox). The open package is stiffened by its tray, which must be removed and reoriented by the consumer after purchase. A 5 × 11-inch "collectible poster" serves as a cover for retail purposes—arguably a disposable element. "We're pretty much committed to go with a plastic case," says Sony Music Distribution president Paul Smith. "We believe the consumer is very much in favor of that."

The Odds

Comparisons are difficult. Manufacturers won't specify costs, but most claim their packages cost less to make than the current longbox/jewel box combo. Music buyers have only had their hands on the DigiTrak and shrink-wrapped jewel box. (Last year Geffen Records released Peter Gabriel's *Shaking the Tree* only in shrink-wrapped jewel box—causing some retailers to keep it behind the counter, out of sight; others refused to carry the disc initially.) For the first time, comparisons can be made when sales figures come in for U2's *Achtung, Baby*, which Island Records released last November in both DigiTrak and shrink-wrapped jewel box (though retailer preference will be gauged more easily than consumer).

In a *CD Review* reader poll last April, 87% of the 4,500-plus respondents preferred the jewel box to paperboard, but AGI sources say the test was unscientific and invalid because it showed a generic brown paperboard package, eliminating the graphics that are the material's major appeal.

Capitol Records reports receiving a few hundred consumer letters about the Raitt DigiTrak, from nearly one million units sold, most expressing dissatisfaction with the package and many supporting the jewel box. Lou Mann, Capitol's senior vice president of sales, says, "I don't know if that's a good ratio, a bad ratio. I have nothing to gauge this by."

A&M reports roughly 100 letters of the same type about the Sting package, from sales exceeding 4½ million worldwide (the DigiTrak was only used domestically, however). Letters aside, ask around and you'll find the DigiTrak was not well received. Consumers complained that the package didn't close squarely and that the paperboard surfaces and hinges would wear and tear.

Jim Oppenheimer, AGI's vice president of sales and marketing, says the company is working on a three-panel version of the DigiTrak in response to criticism of the original, four-panel version. The latter will still be available for labels wanting more graphics real estate but will be reconfigured, Oppenheimer says, so it will be easier to fold.

Following criticism for committing to the Eco-Pak without conducting consumer testing, Warner Music Group commissioned Chilton Research to do so. However, they tested the renamed Eco-Pak Jewel Box versus the longbox/jewel box—not versus the shrink-wrapped jewel box or alternative packages. The results were predictable: Participants preferred the Eco-Pak four to one. Opponents criticized Warner for muddying the waters with the name change, called the study moot, and publicly questioned Warner's motives, noting that the Eco-Pak is designed and manufactured by the Ivy Hill Corporation, a wholly owned subsidiary of Time Warner, parent company of WEA.

By then, the paperboard package interests had formed their own booster group, the Entertainment Packaging Council, comprised of the companies that designed the Eco-Pak and DigiTrak as well as other paperboard and package manufacturers licensed to manufacture them. Like JAM, EPC has a lot of money riding on its contenders, and the members of either entourage stand to win a large purse from the success of their respective packages. Longtime jewel box advocate Robert Simonds, chief financial officer of Rykodisc and founder of the Ban the Box Coalition, says, "The people with the most to lose with getting rid of the longbox are the packaging companies. All these packaging companies don't make any money on jewel boxes. They don't sell plastic. They sell cardboard. So they all have a specific interest in seeing a cardboard package become the new standard. And it gets even worse because you have a company like Ivy Hill, which is owned by Warner Communications. So in effect you have Warner Bros. Records, the biggest record company in the world, with an expressed financial interest in seeing this package that they are backing, the Eco-Pak, become the new standard."

A review of EPC and JAM claims and counterclaims shows valid points on both

The DigiTrak's plastic strips, called "tracks," are thrown out after purchase.

Even environmentalists are at odds about some aspects of the CD packaging battle, but all agree on the need for smaller packaging.

Inch Pack

Laserfile

sides, amid a good deal of misinformation. EPC ran drop tests on the jewel box and reported that they break if dropped from a height of 3 feet onto almost any surface, even carpet. Consumers agree that jewel boxes do break, especially the hinges, particularly if the case is open when dropped. JAM's Seirafi says, "That is one valid point that the hinges break, but another valid point is that you can replace it. You can't replace an Eco-Pak if you spill on it, if it rips."

Ivy Hill's executive vice president, Arthur Kern, says the Eco-Pak is plenty durable. "It's totally surrounded on all sides by plastic rails that protect the board from dog-earing, so the complaint by the JAM people that paperboard is not as durable, I think, is a fallacious argument."

Another shortcoming of the jewel box is limited graphics capability. In an article on CD packaging in the May/June issue of *Print* magazine, a number of music-business designers lamented the design limitations of the present jewel box. Paperboard proponents say their material is more versatile, allowing embossing, die cutting, and more printable surfaces. Kern says, "We've developed a package that gives to the consumer the same kind of graphics attraction at retail and also gives the consumer much more graphics attraction in a package that he takes home and keeps."

On the other hand, it appears that extra panels make the paperboard packages more cumbersome to open and close, often causing confusion—a major consumer complaint about the DigiTrak. At a Congressional hearing on product packaging last year, Representative Al Swift of Washington, chairman of the House Subcommittee on Transportation & Hazardous Materials, called Warner's Eco-Pak a Rube Goldberg contraption. "You have the instructions here so somebody can figure out how to do this. . . . I don't care whether you do the jewel box and shrink-wrap it—which seems to me the preeminently sensible thing to do—or do something else. As a public policy maker, I guess I don't care; I tell you, as a consumer, I hate that box."

It's Not Easy To Be Green

Because little will be thrown away by consumers, all the alternative packages are considerably more environmentally sound than the disposable longbox, but debate rages over the recyclability of manufacturer returns. (The amount of unsold merchandise varies per label and release but equals roughly 10%. Industry-wide, most returns were heretofore sent to landfills or shipped overseas for recycling.) Ivy Hill's intentions were clear in naming its package the Eco-Pak, but when Kern approached the Earth Communications Office (ECO) last June for an endorsement, the Hollywood environmental communications organization refused, citing problems with the recycling of paper bonded to plastic and the absence of any guarantee to use recycled stock. Floyd Glinert, executive vice president of marketing for Shorewood Packaging Corporation and EPC's chairman, says, "That's an artist's preference. If the artist says, 'I want mine to be on recycled board,' so be it."

At the time, ECO instead endorsed the shrink-wrapped jewel box, pending a review of other alternatives. Bruce Hartzell, ECO's project director, says the group is not completely satisfied with the jewel box because they believe it should have more recycled content. "We're going for the best package," he says. "The one that has the most recycled content, can be recycled itself, and uses the least amount of material."

Since ECO's initial rejection of the Eco-Pak, Ivy Hill's Kern has announced that the company is working on a machine that would separate the plastic and paperboard parts of the Eco-Pak, rendering both recyclable. Gary Petersen, ECO's recycling advisor, says, "I'm from Missouri. Show me." Petersen, vice president of Waste Management of California/Recycle America and a 22-year veteran of recycling, adds, "Everything's recyclable. It's just a matter of cost." Environmentalists are also skeptical, saying that the separation procedure, if possible, would likely be prohibitively costly.

Producers of plastic packages are in a similar situation. To make clear plastic from 100% recycled material would require a supply of clear polystyrene plastic in the recycling stream, which does not presently exist. JAM has been trumpeting that the National Polystyrene Recycling Company (NPRC) is challenging record companies to set up such a stream. Resa Dimino, outreach coordinator for Environmental Action's Solid Waste Alternatives Project, is doubtful. "The NPRC was created by the eight largest manufacturers of polystyrene," she says. "It's only succeeding as far as it has because of heavy industry subsidy." ECO's Hartzell says, "There's a lot of questioning in the environmental movement about how effective the NPRC is and exactly what's happening with all the 'styrene."

Environmentalists agree that it would be unwise to choose package type largely on the basis of recycling processes and streams that do not yet exist, leaving packagers crying "Catch-22."

Petersen still favors a plastic alternative because, he says, "You have to look at the long-term durability of product design. When you look at the Eco-Pak, it's a fiber material and it folds. That fiber material will eventually tear or wear out. If you're looking for longevity in product usage, you're looking at plastic as lasting three, four, five times as long because there's no parts to wear out. . . . Besides, you're still wasting more material. Why do that? If in Japan and Canada and Europe they can use just the jewel box, what the hell's the matter with us?"

ECO's executive director, Bonnie Reiss, says the group has now viewed the Laserfile, JAM-Pak, and DigiTrak and may have found a new favorite in the Inch Pack. But rather than endorse a particular package, Reiss says ECO is working with the National Resources Defense Council (NRDC) and Californians Against Waste to establish guidelines "that will become the industry standard." The guidelines should be complete by the time you read this.

"We hadn't seen an alternative package that wasn't extremely wasteful in using resources," Reiss says. "That's why we always said we were going jewel box-only. But we can find common ground; no one wants to waste money and resources throwing out the existing racks in all the retail outlets across the United States if another alternative can be found that really uses less material in the packaging."

Even nonpartisan environmentalists are at odds about many of the concerns of the CD packaging battle, but all seem to agree on the importance of source reduction, reducing package size. Jonathan Kimmelman, a research associate with NRDC, says the group is currently crusading to decrease the ratio of package to product size. Kimmelman has not seen the Eco-Pak or DigiTrak but says the smaller C-Case, though true to its environmental claims, "is still fairly big packaging." Environmental Action's Dimino says the C-Case's percentages of recycled content are "pretty good," but "there was a lot of material—if it could be done with less, that would be better."

Bulk and longevity questions aside, environmentalists also pit plastic and paper against one another in considering the front-end environmental impacts of production. Recycler Petersen says, "The plastics recycling process produces far less environmental impact than the processing of aluminum, glass, or paper. It's a much more desirable package to be recycled."

Dimino disagrees. "The production of polystyrene is a very hazardous process," she states. "On EPA's ranking of the 20 chemical processes that create the most hazardous waste, three of the top six processes are related to the manufacture of polystyrene.

"Everyone knows that the production of paper is problematic," she adds. "The difference as I see it is there is hope for cleaning up the paper production and paper recycling process. You cannot make polystyrene without using these hazardous chemicals; the problems are inherent."

The Winner, by Decision...

As it stands, the Warner Music Group is still committed to its Eco-Pak, while Sony will continue testing before committing to any package, even their own. Three independent labels have adopted the C-Case. American Helix, the first CD replicator to endorse an alternative package, has already shipped more than 10,000 units in the C-Case. "It's the only environmentally correct package of its kind," says Marc Feingold, American Helix's director of sales and marketing. "We feel strongly that the C-Case is the way to go." David Cowan says the six major record distributors are looking at the Inch Pack, and Arthur Herr says all but WEA are looking at the Laserfile. Susanna Seirafi says a major label will be implementing the JAM-Pak early this year. Capitol and A&M are now considering other packages for future use, but neither one is ruling out the DigiTrak.

Robert Simonds says Rykodisc has made no decision, though it would be easiest to go with a standard jewel box-type package. "From our standpoint, and from most independent labels' standpoint, anything outside of a jewel box is going to be a nightmare for us to deal with," he says. "None of the alternative packages are cost effective in small runs. . . . If the U.S. adopts anything other than a jewel box standard, then we will in effect be creating an entirely new format from a record company standpoint. Any company that does business in any other country can't expect to sell CDs outside of the U.S. unless they create a completely different package, the jewel box."

To have one standard package now seems a pipe dream. Unless a knockout alternative emerges, it's clear the winner—or winners—will be chosen by decision. At *Audio*, we have so far received only one letter on this whole topic. Your efforts in this matter would best be directed toward the referees—in this case, the record companies. Let's hope that once the industry's rules are met, we have a champ for which the fans are still willing to pay the ticket price.

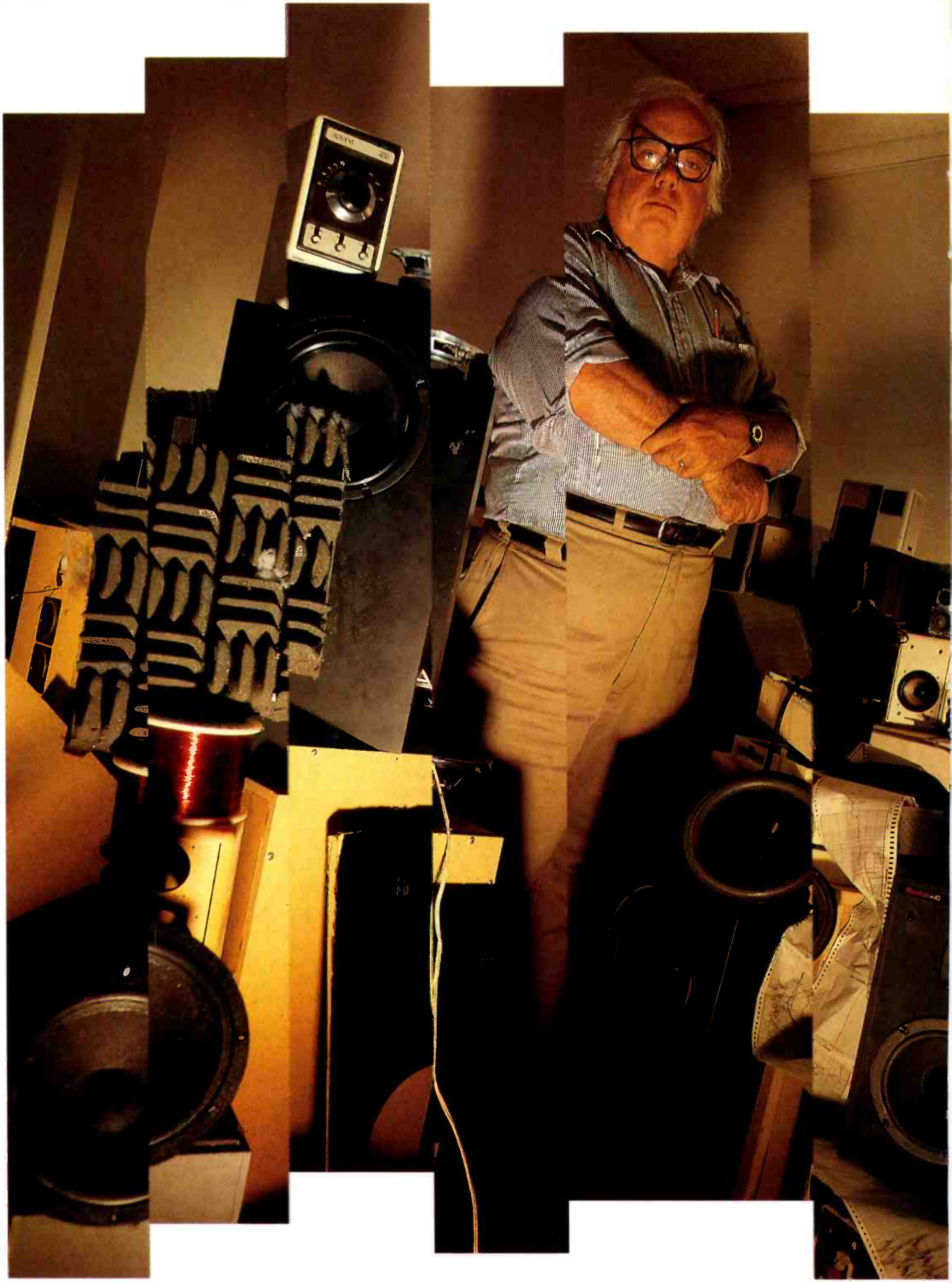
The C-Case's "belly band" stiffens the package in its retail configuration and is printed as a business-reply card.

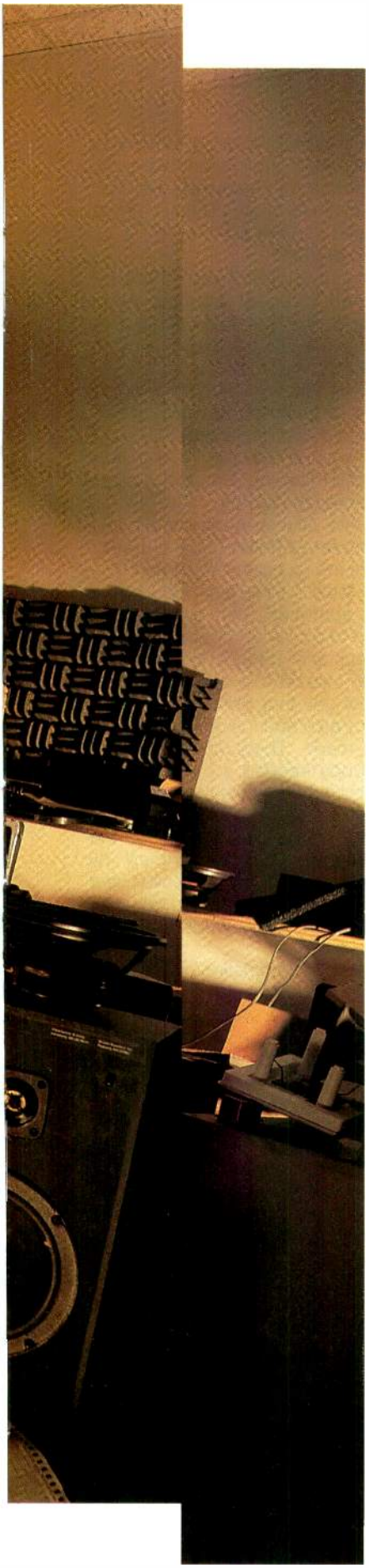
C-Case

For more information, contact the following organizations:

JAM
Jewelbox Advocates and Manufacturers
P.O. Box 1278
Old Chelsea Station
New York, N.Y. 10011
(800) 882-4JAM

EPC
Entertainment Packaging Council
30 Rockefeller Plaza
24th Floor
New York, N.Y. 10021
(212) 353-3030





Henry Kloss

DISTILLING THE ELEMENTS

DAVID LANDER

Henry Kloss is a builder, and he looks the part. The white hair surrounding his naked crown is long, pulled back, and twisted into a knot at his nape. He commonly wears khaki trousers and oxford-cloth shirts, sleeves rolled up to his elbows, button-down collars unbuttoned. For a long time, this utilitarian image extended to his cars. Kloss has owned two Checkers, one for 13 years, the other for 14. When the company, best known as a supplier of taxis, went out of business, he let himself be talked into buying a Mercedes diesel station wagon. This is now about 10 years old, and Kloss hopes it will serve him for at least another decade.

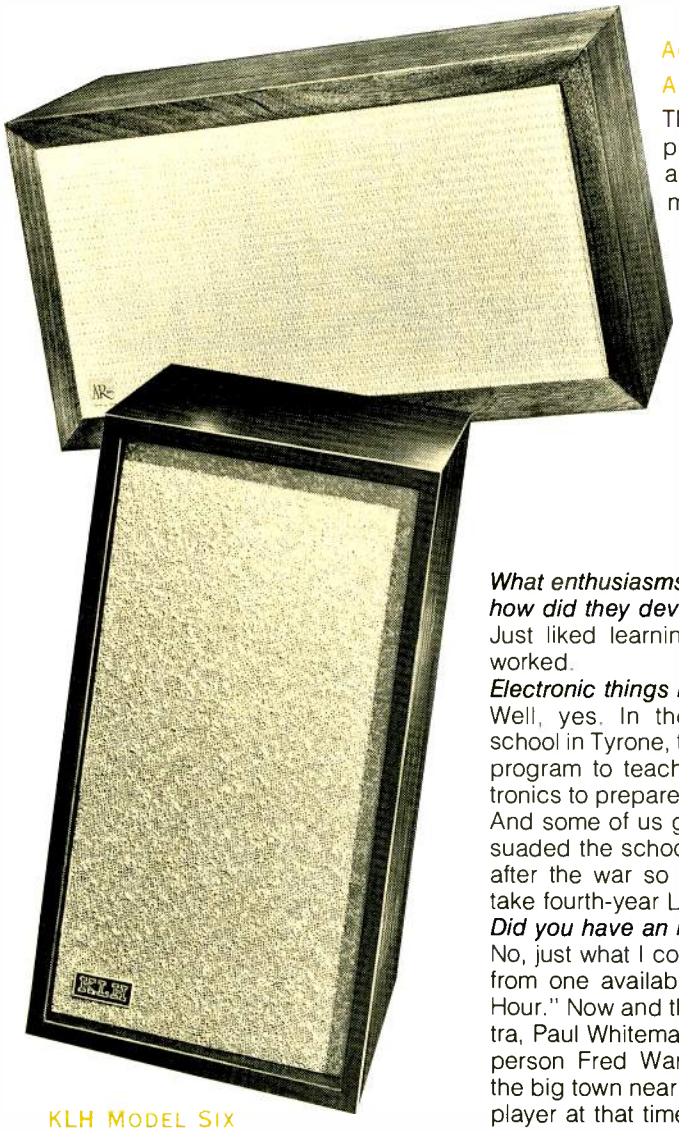
The fact that Kloss is so colorful a character has often led writers to put as much emphasis on his personal traits (his manner of referring to himself in the third person, for example) as on his many significant accomplishments. Of course, these attainments—first in high fidelity and later in projection television—have been the reason I and so many other journalists have called and visited him so often, first at Acoustic Research, KLH, and Advent, later at Kloss Video and Cambridge SoundWorks. In the nearly four decades since AR's startup, Kloss has repeatedly demonstrated a rare talent for spotting important new concepts and incorporating them into readily affordable consumer products. More than mere line extensions, his new models have stemmed from a deeply rooted desire to move audio technology forward and provide buyers with previously unavailable benefits.

Henry Esplin Kloss (pronounced with a long "o") was born on February 21, 1929 in Tyrone, Pennsylvania, a small town in upper Appalachia founded by his great grandfather. When Henry was eight weeks old, his family left for Sebastopol, California, chicken-farming country north of San Francisco, where he spent his first six years on a farm. His father, Daniel, a civil engineer by training, held a variety of construction jobs, including one on the Hoover Dam project as a foreman in earth moving and heavy construction. In the early 1930s, while working on a Pacific Gas & Electric project, Daniel Kloss was hit by a boulder that broke his back. His recovery took years, and because there was no workman's compensation at the time, the Depression years were particularly difficult for the Kloss family.

Just before Henry entered first grade, he returned to Tyrone with his mother, Gloria, and his two sisters. At first, they lived in town, later a couple of miles outside it in a log cabin. Henry went to a one-room schoolhouse there and spent much of his free time working around his home, building and plumbing a bathroom for the cabin and adding on a room for himself.

In fact, Henry Kloss has been building one thing or another ever since—most notably for *Audio*'s readers, the hi-fi products discussed in the following conversation. *D.L.*

PHOTOGRAPH: ROBERT LEWIS

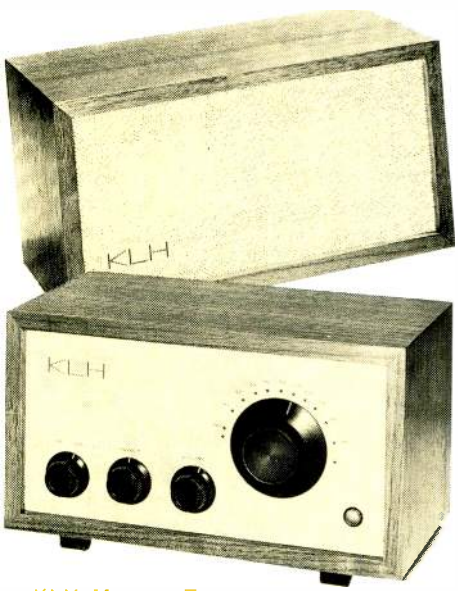


ACOUSTIC RESEARCH AR-1

The first acoustic-suspension loudspeaker, a full-range, bookshelf model.

KLH MODEL SIX

A "seminal" loudspeaker: "Here one had control of every element."



KLH MODEL EIGHT

The first FM radio with a high-selectivity tuner.

What enthusiasms led you to MIT, and how did they develop?

Just liked learning about how things worked.

Electronic things in particular?

Well, yes. In the last year of high school in Tyrone, there was a particular program to teach people about electronics to prepare them for the service. And some of us got together and persuaded the school to keep it one year after the war so we wouldn't have to take fourth-year Latin.

Did you have an interest in music?

No, just what I could hear on the radio from one available station. "Firestone Hour." Now and then a visiting orchestra, Paul Whiteman or neighbor townsperson Fred Waring, would come to the big town nearby, Altoona. A record player at that time was a rarefied kind of thing. I remember visiting somebody in Philadelphia who had probably a Capehart and the Tchaikovsky First Piano Concerto all on 78. I had a chance to sit down and listen to it the whole way through. That experience was a real treasure.

Why MIT?

It was one of the two names I knew in engineering, MIT and Rensselaer Polytechnic Institute. I got accepted to both, got a small scholarship at MIT, so that was decided. It was easier in those days than it would be today. Then I spent a year living with relatives in California trying to get enough money to get through the first year, working in the building trades—remodelling, plumbing, wiring, all that sort of stuff. The first person I found needed that work done, and I pretended I could do all that. "Yeah, I can plaster." Which is only one of many operations I've waded into to learn quickly how to do this or that. You do what you have to at the moment.

When did you finally get to college?

'48? Yes, it was Class of '52. I never got through with that class, but it was 1948. I attended full-time for two years, then part-time for two years. Maybe I completed three years. Then dropped out, yanked into the service.

You were drafted?

Impressed. [Laughter.] Well, that's the proper term. It turned out okay. And I didn't like school that much either. Lab work with a pre-known result has never interested me much.

Even before you went into the service, you were in business building speakers. How did that come about?

While I was a student, I regularly worked, first around Harvard Square for a contractor, cutting nice big old houses into little apartments for students. In one of these houses, I said, "Look, let me fix up the basement myself and have it rent-free." So I had a rent-free apartment, nice place. I was not going to go out and buy furniture—I went out and bought woodworking tools that I could make furniture with. And then got this contract to make furniture parts and never did get my furniture made. Then what happened is somebody needed a particular box made, and that's what started the modern chapter.

The box being an enclosure for the Baruch-Lang speaker, designed by Jordan Baruch, an MIT professor, and Henry Lang, one of his graduate students. Do you know what led to its development?

WGBH was broadcasting the Boston Symphony Orchestra live on FM, a relatively new medium. The idea of broadcasting live was an exciting kind of thing. And there were some decent FM radios, particularly from Zenith, with absolutely miserable speakers—which offended an idealistic professor at MIT, Lawrence Arguimbau, who wrote a very literate text on vacuum tubes. Arguimbau went to the acoustics lab at MIT and said, "Look, why can't you guys make a good speaker available to more people to listen to this wonderful music that's being broadcast? What these radios need is a good speaker."

Was the Baruch-Lang indeed a good speaker?

It wasn't that dramatic a kind of thing, but the loudspeaker had enough incidental merit and was the best loudspeaker a lot of people had then. So I made cabinets for that. And then later on, I would buy drivers, too, and put them in the cabinets. I actually sold those direct in the beginning, and later then sold through dealers. Sold as

many one way as the other, $20 direct and $30 through dealers. That was under the name Kloss Industries.

You had employees even then?

Yeah, graduate students in English at Harvard, and several people at MIT, who would come in at night.

You managed to keep this operation running during your time in the service. Where were you stationed?

Fort Monmouth, New Jersey, which was the Signal Corps Center. I instructed in basic electronics, sometimes 40 hours a week. I also absented myself every weekend. I'd dash out of there on Friday, grab a train at Red Bank, take the Hoboken Ferry to New York, and catch the train to Boston. I had transferred from my basement to a 2,000-foot loft in Harvard Square and was making and selling loudspeakers with part-time help, MIT students at that time.

You also took an evening course in high fidelity at New York University during that period—taught by Edgar Villchur, who became your partner at Acoustic Research. What did Ed do for a living then?

He was a very good technical writer and had repaired radios at an earlier time. He'd written a couple of good handbooks on sound reproduction and, as such, was a student of the business.

Enough so to develop a radically new speaker based on the principle of acoustic suspension. When did you learn about it?

We went out one evening, and he told me in a few simple sentences what it was. I said I would very much like to implement that in a commercial form. "No, this is for the big boys," he said. And he was right, and he tried Bozak, Altec Lansing, University. I knew what the answer would be—I knew what happened when inventors went to companies. There's a very strong syndrome of not wanting to acknowledge something from the outside in a large company—which he met.

I'd given Ed my name and address just in case it didn't work. And we met later and said, "Okay, let's give it a try." I had two friends—one army buddy, Malcolm Low, who was in the same teaching unit at Fort Monmouth, and Tony Hofmann, who was a solid-state physicist, a neighbor in Cambridge—who had $2,500 to put in. These two friends with $2,500 each, me with the beginning of a manufacturing establishment, and Ed with his idea, became Acoustic Research, which actually got formed, I think, when I was still in the army. I got out three months early by going back to school. I went to Boston University for two days.

Two days? [Laughter.]

I wanted to get back to work, which I did. Ed did later contribute some money himself, but the company was formed so he was half the ownership and control and we three were the other half.

When did the differences begin between you, Malcolm, and Tony on the one hand and Ed on the other?

Actually, there were philosophical differences from the beginning. I wanted to build a speaker from scratch. Ed wanted to buy speakers from a company called Best and cut off their suspensions and replace this and do that. I had to really go back to first principles and build a whole new speaker, which, okay, I did. Sketch out little drawings for a sand casting and get that made, get the machine shop to turn out some pole-pieces. That first magnet was magnetized on a great big two-story-high generator. Tony, in solid-state physics, acquainted with the magnet lab at MIT, carried the magnet over there. I did design studies by playing with areas, weights, and motors. Had a variable magnet, first used an electromagnet. The suspension was pool-table felt, and the piston was blocks of Styrofoam. At very low frequencies, anything works like a piston. So it was trying to optimize low-frequency response and efficiency and minimize box size, of course. That's when Tony, who has a very good analytical mind, systematized the whole thing about closed-box, low-frequency design. Volume of box, low-frequency response, and efficiency are necessarily tied together. You can increase one and decrease the other. So I wasn't missing anything. [*Author's Note:* Kloss delineated this in "Loudspeaker Design: Hofmann's Iron Law," published in the March 1971 issue of *Audio*.]

How many models did you work on in your three years at AR?

The AR-1, a self-contained, full-range, so-called bookshelf speaker. The AR-1W, which was the AR-1 minus the high-frequency driver, intended specifically to go with this very fine four-panel high-frequency speaker, the Janszen electrostatic—unquestionably the best high-frequency speaker built then. I did the engineering on the AR-2, and that coincided with the time of Malcolm, Tony, and me leaving. The AR-2 was first delivered on the day I left.

I understand the AR-1 employed an 8-inch tweeter with the lows rolled off.

One had used in the AR-1 this quite expensive Western Electric design then made by Altec, the 755, which was an 8-inch, full-range speaker. It had a better high frequency than the Bozak tweeter, regarded as the best hi-fi tweeter, which Ed had in mind using. I showed him there was a better high end on this 8-inch speaker. The high-frequency speaker had its own box [within the AR-1's enclosure], which was open to the front and stuffed with wool. Strange way to get a tweeter—just happened to be the best highs you could get.

I DIDN'T LIKE SCHOOL THAT MUCH. LAB WORK WITH A PRE-KNOWN RESULT HAS NEVER INTERESTED ME MUCH.

What improvements did the AR-2 represent over the 1?

Economy. It was a $96 rather than a $185 speaker. Still using the acoustic suspension but with a smaller woofer smaller box. And for the high frequencies, a pair of low-cost 4-inch drivers. Mechanically damped. I stuffed fiberglass in them. And then electrically equalized in the crossover. You could get a lot of output from some small, cheap speakers at high frequencies. You had far too much output at 3,000 cycles—horrible screechy little things. By electrical compensation, you could get the high end of a very low-cost, full-range dynamic speaker. You could get just the right amount of high frequencies for the rather low-efficiency low end. So the idea of using electrical tailoring of the frequency response, which is a key ingredient in any speaker I've done since, was first discovered there. I really used that to great advantage in the Model Six, which was a very important loudspeaker a bit later on from KLH.

You've said that electrical tailoring can make a cheap speaker sound like a much better one.

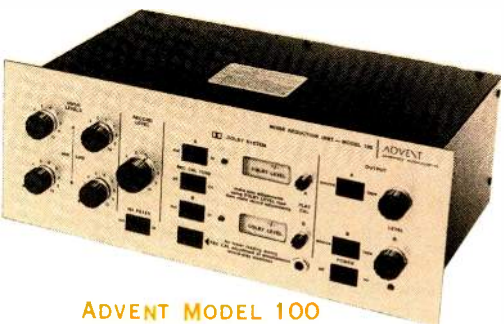
While at KLH, I ran an experiment with salespeople, who were musically knowledgeable people at that time.

KLH MODEL ELEVEN FM

An early portable system, with Garrard changer and Pickering cartridge.

KLH MODEL FORTY

The first consumer tape deck with Dolby noise reduction. The front panel and mechanism were designed by Kloss at Advent and then sold to KLH, which made the electronics.



ADVENT MODEL 100

The first consumer Dolby processor.

Did an A/B, with a lot of different records, between two speakers, and got people universally to choose A over B. B was the Model Six, A was a cheap Radio Shack speaker with a graphic equalizer that I could make sound more like the Model Six than the Model Six, literally, just by depressing that center octave.

Why did you, Low, and Hofmann leave Acoustic Research?

Each [faction] was convinced the other was psychologically unstable. It was that simple. Ed lived in Woodstock [New York] and did a great job of publicity. In three years, we were selling at a rate of $750,000 per year, quite profitable. Things were obviously happening fast. You had to fire this supervisor, you had to rent this building. Ed did not like to see those decisions being made by somebody else. I thought these decisions had to be made by somebody on the premises. From the beginning, it was agreed that, whichever faction left, they had a right unto the patent, a license to make the speaker. Each of us was sure the other half would never be any competition. So things went back and forth for some time. It was uncertain who was going to leave until the very end. And I had more to lose by staying in a company which couldn't take any positive action. You needed a majority of the board of directors. The board of directors was split, even, and a company like that could never take a positive action. Ed got $55,000 together and bought the three of us out. Well, $56,000; our attorney, at the last minute, just couldn't resist putting an extra thousand in there.

What goals did you have for KLH when it was started in 1957?

Didn't have anything specific in mind except make better speakers. In particular, the high end of the low-frequency speaker, always a difficult part to engineer. When that piston, no matter what it's made of, stops working like a piston—around 1,000 or 2,000 cycles—one tends to get a highly irregular response. The AR-1 was such a dramatic advance, details like that didn't matter much—what that blob of paper I bought from a cone manufacturer behaved like. So the first thing KLH did was use the consulting services of a paper chemist and set up a paper-making laboratory, get the beater and vacuum equipment to make paper cones.

How do you make paper? What material do you begin with?

You use all different kinds of fibers—wool, cotton, leather. Almost any fibrous thing can get beaten up in the presence of water.

Did you ever use leather as a basis for cones?

Not in the cones finally, but in experimental ones. We got the cycle down to where I could make a cone and test it in a speaker in two hours. So one just turned out a tremendous quantity of different kinds of things. I remember one time I was using that pure cotton stock, the way they used to make paper out of vegetable fiber rather than wood. And before that, I had been using wool in a mixture, just as Bozak had done. Came out as this nice white paper sheet with these little, fine red and blue threads embedded in it. I was about ready to make money the old-fashioned way. [Laughs.] This is the sticky part for a counterfeiter, to get this nice white sheet of paper with the little threads embedded in it. Here it came out accidentally while making loudspeaker cones. I was tempted. Maybe I should have succumbed.

In any case, you did produce a woofer with a better top end.

We made a low-frequency cone that was well behaved at high frequencies. Then made a dumb mistake, marketing products intimately tied to the product of another manufacturer. Here we had the world's best woofer that combined acoustic suspension and a cone built to behave properly at the higher frequencies. And the world's best tweeter then was the Janszen electrostatic. So the first products of KLH—Models One, Two, and Three—were woofer-only models made to go with the product of another company, Janszen.

How did the three woofer-only units differ from one another?

The first thing one did was a big two-woofer thing with a shelf at the appropriate height. Quickly thereafter, we did a single bookshelf box you could put the tweeter on top of, and then a single speaker on legs, dumb-looking thing, that you could put the tweeter on top of. Malcolm Low liked birch and ordered a whole bunch of birch Model Two cabinets that just sat there for a long time.

The Model Four was KLH's first full-range speaker.

CBS Records adopted it as their monitor speaker. The high-frequency driver was not one that we made. It was made by GE, of all places—just happened to be the best tweeter I could find at that time. So there's the first full-range KLH speaker, more expensive than the AR-1 and widely competitive with it. I think it was $224.

That speaker coincided with the first

stereo components. Did people buy the Fours in pairs?

The speakers were still always priced and described singly, but people frequently bought two of them. Back in the mono days when you were buying a system, the rule of thumb for spending used to be half the money for the speaker and the other half for the rest. We speaker makers should have kept that rule going. But that was how important the speaker was regarded in some quarters.

I understand KLH designated two different speakers as Model Five, one that came before the Six and one some time afterward.

The first one, the chronological Model Five, was an array of dynamic high-frequency speakers, a functional replacement for the Janszen. It wasn't a major product, except that what you could do with an array of high-frequency speakers, it did well. At a later time, I addressed the widely expressed desire for a three-way system. Another feature [of the second Model Five that] I thought was important, having worked with crossovers, was a highly flexible crossover network with, I think, two switches and three positions each on the back of the cabinet. These were not simple resistors or pots. They were a reconfiguration of the frequency contouring of the whole middle range of the speaker, which is what's important.

You've called the KLH Model Six "seminal." What made it such an important speaker?

It was the high-frequency speaker that was made in a way that it had substantial excursion. It could respond very effectively down to 1,500 cycles or below, and it was good at high frequencies because it was a one-piece cone; it wasn't a cone speaker with a dust cap on it. And the voice-coil was held with epoxy right on the apex. So one had very close coupling between the voice-coil and the speaker, enough area so the speaker could operate down low, and use of only a small portion of the radiating surface for high frequencies. And one had the freedom to tailor the speaker, play with the paper and the magnet and everything to make, for the very first time, our own real wide-range, high-frequency loudspeaker that could put out a lot of power down low.

Then it's the time spent with a live music source and the speaker itself. I borrowed a rather elaborate nickelodeon from Bearskin Neck Country Store here in Rockport [Massachusetts] and set that up with a microphone with a tape recorder and the speaker nearby—you could switch between the two. We did that one time at the New York Audio Fair; I thought it would be an impressive demonstration, and nobody even noticed. But it was a handy tool to have.

Before, I was making a low-frequency speaker only, or a high-frequency array that sounded like the Janszen, but here one had control of every element. And realizing that most speakers had too much output in the 800 to 1,600-cycle octave was an important discovery, just learning what it should sound like. By that time, one had a fair amount of experience. We started to get a lot of field experience about what something should sound like. Did a lot of listening—one would just sit there flipping records. There were about 13 bands you'd just cycle thrcugh all the time. Sum up field experience, do a lot of listening, and do the objective measurements—you know, you don't want any sharp discontinuity in the frequency response. There's no measurement that tells you how much energy should be in this octave compared with that octave. That's what takes field experience and final judgment.

So after you've got one set of requirements down, there's a second set of essentials you have to deal with.

You've got to have bandwidth. Okay, you get that. You've got to have no sharp discontinuities between adjacent frequencies. And ycu have to have low distortion. After you get those objective things that nobody can argue about, then what completely dominates the sound of a speaker is this octave-to-octave or half-octave-to-half-octave amount of energy that you put into it. And the Model Six had that more right than anything before. What it really had was this proper sound with respect to not having too much output in the particular octaves in the midrange or the middle highs. So that was the Model Six. It had the most right sound of any speaker made up to then.

The Model Six was very successful commercially.

Right from the beginning. The price was right, and the performance was spectacular, and it immediately started selling in what to us was very large quantities. Even many years later, you wanted any new speaker to sound like the Model Six. And some other people in the speaker business also recognized that.

Your KLH Model Eight was the first high-fidelity radio. How did that come about?

We were becoming a visible company, successfully selling speakers. Comes in through the door, as there has through the years, an inventor, a would-be consultant. This chap had a tuner which was better than the then very highly regarded McIntosh tuner. One engaged him. He went through his study. It was then noticed he did just one thing to make his product a better tuner than existed—put adequate selectivity up front. If you did that and made a very simple tuner, you could have high quality without being high priced. Even the component tuners of the time largely had front-ends from Germany, and they had no selectivity because they were designed in a country which had only three FM stations. The same thing, unfortunately, happened with McIntosh. Lawrence Arguimbau, who also did important FM work at MIT, was actually involved in the design of that tuner, but he was out in the country in Binghamton [New York, where McIntosh has its headquarters] and didn't realize the importance of the high selectivity you need in a real urban environment.

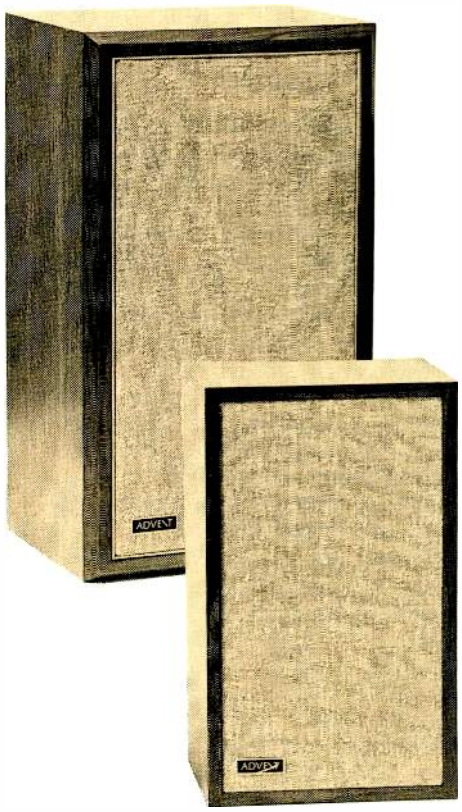
Wasn't the Model Eight's speaker designed for another purpose?

Yes. We'd become known enough to be able to make special speakers, and we got a request from acoustic consultants Bolt, Beranek, and Newman to help them equip the Senate chambers with individual speakers for each Senator. BBN had a very tight restriction on available volume, and they needed a very high-quality reproducer. I developed a speaker using essentially that cone of the Model Six tweeter with a very free suspension on it. So I had a very good high-frequency speaker that I allowed to move far enough so it could be a reasonable low-frequency speaker. I don't know what ever happened to the Senate project; the

THE KLH MODEL SIX'S PERFORMANCE WAS SPECTACULAR. EVEN MANY YEARS LATER, YOU WANTED ANY NEW SPEAKER TO SOUND LIKE IT.

ADVENT MODELS 200 AND 201

The 200, with a Nakamichi transport, was the first cassette deck with Dolby noise reduction. A Wollensak transport was substituted in the 201.



ADVENT LOUDSPEAKER AND SMALLER ADVENT

The Advent had a better low end than the KLH Model Six. And its brother, says Kloss, was not a "lesser" Advent.

speaker never was used for that application. But put two of these in a little box, and you have a great music reproducer, for the first time a sub-shoebox-sized speaker for serious music listening.

So one knew how to make a tuner, one had this great little speaker. It defined a radio. That was the product that first got us into the system business, the Model Eight. It was built with solid walnut cabinets, vacuum tubes—that was the end of the vacuum tube business. We made the transformers, had somebody else make the cases, handwired all the circuitry, made the chassis. And it was because one had learned to make a better tuner and a better speaker for other reasons.

How much did the Eight sell for?

$160. A lot of money for a radio. A lot of radio for the money. Many of them are still in use, I find. One of the problems with FM at the beginning was drift. Each Model Eight had an individual recording made for about two hours to measure frequency drift—an individual chart recording on every one that was produced. We did stuff like that. Those were exciting times because, with each of these new product developments, one was doing things that were very much different from what people had done before.

And the Model Nine?

Then Arthur Janszen joined KLH as a fourth member, with his Janszen Laboratories and his product, and proceeded to develop the low-frequency panels that resulted in a full-range electrostatic speaker. That was the Model Nine. It's the one speaker I didn't have anything to do with. A great speaker.

Then you developed the portable Model Eleven compact stereo record-playing system. Could you tell me about its genesis?

Joseph Horn, a big, old-line department store in Pittsburgh, inquired about a proprietary version of the Model Eight. Literally while talking to them on the phone, it dawned on me. That wasn't the product. What you really ought to have is a record-playing stereo music system. You had a good, reliable source of stereo in records at that time. Stereo broadcasting and the decoders were highly imperfect devices at that time, real problems. You had a really good library of records. Garrard was by then making a good changer. There was a good, low-cost cartridge, the Pickering, which had previously been very stiff. I had learned about this material that you could form, on low-cost molds, into a suitcase structure and matching speaker enclosures. And we'd already gotten into making a transistor amplifier by that time. It was these things falling together that became the Model Eleven.

Frequency contouring of the speaker was also important, wasn't it?

Oh, yes. In any product I've ever done since the AR-2.

The Model Eleven FM added a tuner section.

The Eleven FM, interestingly, was going to be FM/AM, and the front panel was designed for two circular dials. It was noticed that AM really isn't that important. In the meantime, the panel had this extra hole. So we kindly gave people a place to store the 45-rpm spindle and finessed it very neatly. [Laughter.] A later product, Model 24, was built with an AM tuner.

It's been said that the Eleven was the first successful industry product to employ transistors.

Slightly earlier, by a month or two, Magnavox did a similar kind of thing in a somewhat bigger wooden box. Not a product that one remembers, but it did have transistors and was a phonograph that could be packaged together and carried around. So technically we really weren't the first. We did affect the industry, though. Harman Kardon made one not because Magnavox did, but because we did. There were several follow-ons.

You introduced the Model Eleven in 1960. Four years later, I understand, it was selling at the rate of 10,000 units a year, an enormous quantity for a hi-fi product. Part of the reason had to be that it lowered the price of good sound by at least 50%. How did you manage to get the price down to $200?

Cleverness in the tooling, vertical integration of the manufacturing. And selling it for less than it should have been sold for. Like all the other products made by KLH.

Some people feel you weren't making the margins you should have at KLH. Were you?

No. First of all, the margins were low to start with. And the products stayed in the line for many, many years at a fixed price. The $200 price of the Model Eleven stayed $200. The same with the Model Six. For 10 years, it wasn't changed. The starting prices of the products were lower than they should have been, and they never went up.

Why didn't you raise prices?

Idealism, quest for volume. A combination of those two things.

Singer bought KLH in 1964. Why did you sell?

KLH was now a sizable company. Malcolm Low had always been interested in doing new kinds of things. High fidelity was new, he was in there, did an important part of that. Tony Hofmann had always been in solid-state physics through that time—40 hours a week in solid-state physics, 40 hours a week taking care of financial matters at KLH. He's got to make a choice. And he doesn't want to leave solid-state physics. I mean, the three of us had just worked together perfectly, all the flexibility of one person, the wisdom of the three of us. We couldn't have been a more ideal and tranquil combination, but they didn't want to devote their full lives to it. It was my life, making product. A friend of Malcolm Low's in the financial world introduced us to Singer. They had all these stores, could sell a lot of sewing machines, and thought they could sell another consumer product. The sale, incidentally, affected nothing in product development for the next three years. Manufacturing was still my responsibility. There were no manufacturing or product development people infused.

One product you developed during the Singer years was the KLH Model Twenty, also a complete compact system. What was the rationale behind that product?

It was, for the first time, a chance to address the broader question of what the customers wanted in an integrated package. The idea saved people from the rather difficult task of learning about components. We thought it would be much more efficient to present people with a single-choice purchase most could live happily with for tens of years. That was the Model Twenty, very popular because it was both more economic and a safer kind of decision. It never became a department store item; it was a little bit removed from that. But it was very easy for people to decide to buy and use.

That system's tuner later got spun off as the Model Eighteen. I understand you skipped model numbers when conferring a designation on the Twenty because you thought it was such an important product.

The Model Twenty was largely responsible for doubling again the sales of the company. Then that tuner was noted to be better than other component tuners, and it became a separate product. Unfortunately, the Model Eighteen was presented in a physical form that did not look like a serious component: It had a nice wooden box but a melamine front panel and, of course, this strange concentric planetary dial and tuning knob, which is so accurate and I think so easy to use but didn't play by the rules. Not your slide-rule dial.

You used the same configuration years later on the Advent Model 400 two-piece radio.

I always used that. Any tuner I've made has taken that form. And receivers. The KLH Model Twenty-Seven had two of those, AM and FM side by side. Looked strange.

What led to your leaving KLH?

I didn't see important new things to do in audio It was perfectly obvious how you make good stuff, anybody could make that speaker, anybody could make a tuner like that, nothing proprietary. And I thought audio was going to be a much bigger business, large enough to revert to the majors—the Zeniths, RCAs, Stromberg-Carlsons—who had the efficiency of manufacture and distribution. I was very right in one thing: It did become a much larger business. And I was wrong in another: It did not revert to the majors.

I WAS RIGHT IN ONE THING: AUDIO BECAME A MUCH LARGER BUSINESS. AND WRONG IN ANOTHER: IT DID NOT REVERT TO THE MAJOR COMPANIES.

I introduced the idea of television to Singer, and they understandably weren't interested. So I made my plans to leave and work in television, in presenting it in a living format. Advent was started to make projection television.

Didn't you hear about Dolby noise reduction at that time?

It was in the last weeks of my tenure at KLH that I heard about a form of noise reduction not detectable to a sensitive ear. Seymour Solomon of Vanguard Records claimed it did nothing to disturb the music. That was good enough for me—that guy really knew what things sounded like. I called Ray Dolby in London—he preferred to operate in London—and said I wanted to talk to him about it. He didn't encourage me in any way, but allowed the visit.

Ray remembers that you called him on a Friday and arrived in London the following day.

There was no need for any particular time to elapse. I wasn't deeply busy at anything. And getting reservations at that time happened to be pretty easy. Sargent Shriver, in an article in *The New Yorker* magazine, described how he would stretch out and sleep on those flights. He discovered that, if you get the cooperation of the person in back of you and get under two seats, you can stretch out and sleep on the widebody planes. Caused great consternation when I was thought to be missing. [Chuckles.]

You slept on the floor?

Slept on the floor, under the seats. It's noisy down there, but it's comfortable.

So you went over to see Ray.

And told him Dolby noise reduction ought to be used in consumer products. He said, "In the fullness of time it will be, after being used more extensively in professional equipment." You know Ray—quite conservative, careful kind of chap. And I said, "At least in audio now, it doesn't happen that way. If there's a commercial advantage to some particular technique, somebody's going to take it and run with it. I would suggest that it be you and me, Ray."

He was coming to visit this country, so we'd meet again, which we did a few weeks later. By that time, I had gone to a consulting engineer with a description of Ray's elaborate, four-band, £2,000 machine and identified the band that's important and used FETs instead of diodes for compression. I'm not really a design engineer, but I knew a little bit about what circuit operation could be executed at a reasonable enough cost to make a consumer version of the system. So by the time Ray arrived, I had a slow-speed tape machine, a Roberts 1⅞-ips machine, with that circuitry and showed what could be done with the tape speed being used for the Philips Compact Cassette.

Even after you left KLH, you wanted to see a consumer tape deck with Dolby produced, so you actually helped develop it. What, specifically, did you work on?

The mechanism of the deck, the drive. And sold it to KLH, where they would develop the electronics. Designing the front panel and making the whole mechanism was a first project of Ad-

vent as something supporting the plan of making projection television. It happened to be a drain on the activities at Advent, but that was my mistake.

That was the KLH Forty.

Yes. Open-reel, two 8-inch reels with Dolby. Very easy to load, a lot of very nice features. Then we got Advent into the first stand-alone Dolby processor. The Model A301 was the professional model, and then one had a very cleverly packaged, simple, but again strange-looking 100, which was a low-cost way for anybody to wrap Dolby around the recording or playback end of their existing deck. People don't do things that way. The idea of adaptors never works, no matter how well they work mechanically.

Then you produced your own Dolby deck, the Advent Model 200, which was the first to combine Dolby with the cassette.

That was using a Nakamichi-built deck and the Dolby circuitry. We had to do extensive work on modifying those units to overcome the insufficiencies of the early Nakamichi decks, a very expensive, unhappy experience. We had to pay an awful lot in air freight to get them in a timely way, and then electrically had to adjust and change components inside.

You very quickly came out with a successor, the Model 201. Didn't that use a transport from Wollensak?

Oh, yes. The 200 was mechanically insufficient, like a lot of Japanese products made then. It was really annoyingly underdesigned. In fact, the mechanism we thought we were getting had been changed to save 34 parts. Nakamichi had the reputation of building a reasonable machine, but the designer got in there and simplified it. The world at large hadn't learned how to make cassette machines then. So we noticed this good, rugged audio/visual mechanism made by the Wollensak division of 3M for language labs. And they agreed to supply us.

Another factor in the equation was chrome tape, so Advent introduced a line of blank chromium-dioxide cassettes.

Integral to my belief that the cassette would surpass the vinyl record were these two things: Dolby noise reduction and chromium-dioxide tape. I had read about chrome tape years before in *The Wall Street Journal* and noted this fact. Then we began looking at the cassette, and I remembered this and called DuPont to find out about chromium dioxide and learned that, yes, they had made some, had been trying to sell it to duplicators, had sold none of it in four years. We said we would like to market the tape. We spent quite some time talking to Memorex and were to jointly market the first chrome tape. Then Memorex decided not to pursue it. Fine. We said to DuPont, "Let us do this ourselves." Then we got a tape packager that was making cassettes for different OEM [original equipment manufacturer] uses. DuPont would supply them the tape, and they would package the cassettes. DuPont was very helpful in this.

You also marketed a line of prerecorded chrome cassettes.

We wanted to carry this process further, so we built tape duplicators that ran at only four times the 1⅞-ips playing speed, as opposed to the normal 32 times, and got access to musical material. We sold blank tape and prerecorded tape successfully. It could never be a major contributor to total volume, but it made people know about Advent.

You've said that your importance to hi-fi has been as a synthesizer rather than an inventor.

You learn about these elements and you put them together.

Advent had a playback-only deck in its line for a while.

Yes, we did. We thought the cassette—widely replacing the vinyl record, especially for library use—was a more durable playback medium. We hoped the deck might get wider use as an institutional if not home unit.

Did it?

No. Recording capability was so widely expected that a playback-only unit shouldn't have been produced.

You started Advent in 1967 to build projection TV, yet two years later you put the company into the loudspeaker business.

Work in projection television is far more expensive than work in audio. Money runs out after a while. And the world wasn't flooded with good speakers. Again, the audio business did not revert to the majors; it still belonged to the small specialty companies. KLH management was not the same as the old management, and there was nobody else filling that particular high-value niche. Fine. We'll go back and make loudspeakers, and we did—and sold more among our particular audience for at least a couple of years in a row than we'd ever done. That was the Advent Loudspeaker.

With that speaker, you once again proved your ability to lower the price of good-sounding audio equipment. The original Advent Loudspeaker had a better low end than the KLH Model Six and underpriced it by more than 15%. How did you accomplish that?

The Model Six's price had stayed the same, but it was introduced at a time when there weren't that many made. We could immediately assume a higher quantity when we priced the Advent. Fortunately the bigger quantity happened. It would have been a wrong price if it had been a minor product.

Then one did an interesting variant of it and made something that sounded exactly the same, 3 dB less efficient. As the laws of physics tell you, in one-half the volume, you can do this. You save a lot of money on the cabinet. But performance can be exactly the same, and it was. That was the Smaller Advent. It was thought by many people to be a lesser Advent, which it never was. It should have been far more successful because it cost a whole lot less. It's a product of some importance. I still listen to it.

You've played a seminal role in at least four of hi-fi's major advances—the acoustic suspension speaker, transistorized equipment, Dolby B noise reduction, and the cassette. What are your feelings about this?

Some of the particular things I have done so obviously could have and should have been done before. Chromium-dioxide tape is one example. It was sitting there, publicized. There were people in the tape business. Why nobody would pick that up when they were making tape every day is something I don't understand.

I BELIEVED THE CASSETTE WOULD SURPASS THE VINYL RECORD WITH THE USE OF DOLBY NOISE REDUCTION AND CHROME TAPE.

Author's Note: For his time and recollections, special thanks go to Andy Petite, who worked at both KLH and Advent under Henry Kloss for many years and then went on to co-found Boston Acoustics.

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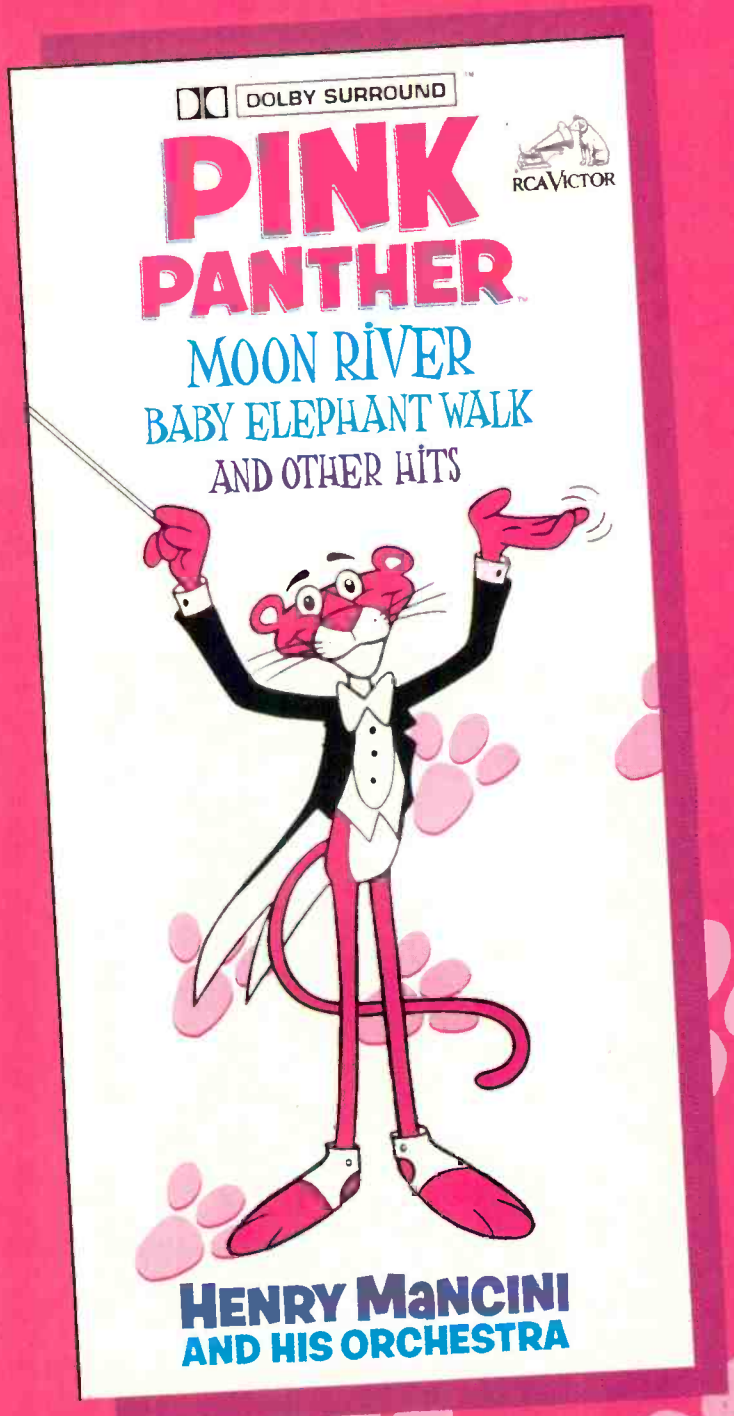

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McINTOSH MC2600 AMPLIFIER

Manufacturer's Specifications

Power Output: Stereo, 600 watts minimum continuous power per channel, both channels operating into 8-, 4-, or 2-ohm loads; mono, 1,200 watts minimum continuous power into 16-, 8-, 4-, 2-, or 1-ohm loads.

IHF Dynamic Headroom: 1.7 dB.

Power Bandwidth: 20 Hz to 20 kHz.

THD: 0.005% maximum, both channels operating at any frequency from 20 Hz to 20 kHz and at any power level from 250 mW to 600 watts per channel in stereo or from 250 mW to 1,200 watts in mono.

IM: 0.005%, both channels operating for any combination of frequencies from 20 Hz to 20 kHz if instantaneous peak power is 1,200 watts per channel or less in stereo or 2,400 watts or less in mono.

Frequency Response: 20 Hz to 20 kHz, +0, −0.25 dB; 10 Hz to 100 kHz, +0, −3 dB.

Hum and Noise: 105 dBA below rated output.

Damping Factor: Greater than 40.

Input Impedance: Unbalanced, 20 kilohms; balanced, 40 kilohms.

Input Sensitivity: 1.4 or 2.5 V, selectable.

Power Guard: THD kept below 2% and clipping prevented with up to 14 dB of overdrive at 1 kHz.

Power Requirements: 120 V, 50/60 Hz, 2 to 24.5 amperes (12 amperes, UL/CSA).

Dimensions: Front panel, 19 in. W × 10½ in. H (48.3 cm × 26.7 cm); chassis, 17 in. W × 10 in. H × 18 in. D (43.2 cm × 25.4 cm × 45.7 cm).

Weight: 130 lbs. (59 kg).

Price: $5,350.

Company Address: 2 Chambers St., Binghamton, N.Y. 13903.

For literature, circle No. 90

Photograph: David Hamsley

The MC2600 is the first piece of McIntosh equipment that I have ever formally reviewed, and what a piece it is! All 130 pounds of it! I have listened to and tested various McIntosh amplifiers over the years, and I have been generally impressed with the build quality and the measurements of most of the gear that I have tried out.

The amplifier under review, McIntosh's current best effort, is rated at 600 watts per channel into 2-, 4-, or 8-ohm loads in stereo or 1,200 watts mono into 1-, 2-, 4-, 8-, or 16-ohm loads. The MC2600 replaces the MC2500, which was a similar-sized, top-of-the-line unit rated at 500 watts per channel. The MC2600 has 50% more output transistors than the MC2500, more than twice as much energy storage in its filter capacitors, somewhat higher overall efficiency, both unbalanced and balanced inputs, much lower measured distortion, and more than twice the peak current into mismatched loads (i.e., loads that drop to values much lower than the matching impedance of the output autoformer tap used). The MC2600 is said to drive loads down to 20% of the rated tap impedance before current limiting sets in. Most impressive! This amp should drive the most difficult and demanding load with ease.

A good part of the MC2600's weight is in the output autoformers that allow matching to the various loads. An autoformer is a special transformer that uses a single tapped winding, instead of separate primary and secondary windings, to get the various impedance ratios desired. It is easier to make a good autoformer than a normal transformer, especially at the impendance levels used here.

Peak output currents of some 100 amperes per channel are mentioned in the McIntosh technical description but are not listed in the formal specifications. Very low distortion, less than 0.005%, is claimed over a frequency band of 20 Hz to 20 kHz at rated power or below. Interesting features include front-panel level meters with continuous or peak-hold reading modes and McIntosh's Power Guard circuitry that prevents the amplifier from being overdriven beyond about 1% clipping distortion.

Below the output level meters are a number of rotary controls: "Left Gain," a two-position "Meter" function switch, a two-position speaker on/off switch with LED indicators, and the right gain control (which also functions as the mono gain control when the amp is in mono mode). To the right of the controls are a headphone jack and a rocker-type "Power" switch, which is also the line circuit breaker. A pair of beefy rack handles completes the front panel.

On the rear panel, near the top, are two variable-speed exhaust fans. Between them is a chart detailing the proper input and output connections and the loadings to use for the amplifier's stereo, bridged mono, and parallel mono modes. In a row below the fans are the power-cord connector, four-terminal barrier strips for each channel's load connection, three pairs of input connectors (phono for unbalanced inputs, ¼-inch phone jacks and XLR for balanced inputs) and two slide switches for "Input Sensitivity" and operational "Mode." Both sliders have recessed toggles that are switched with a small screwdriver blade. The sensitivity switch has two positions, 1.4 and 2.5 V for full output, while the "Mode" switch has three positions: "Stereo," "Mono (Bridge)," and "Mono (Parallel)."

The gold-plated output terminals are very unusual and appropriate to this amplifier's high current-output capability. The normal connecting screws, used with small-gauge wires or spade lugs, terminate in cylinders ¼ inch in diameter. Removing these screws allows the removal of the cylinders, leaving holes that can accommodate up to ¼-inch wires. These wires can then be clamped securely with the very large set screws provided as replacements for the normal screws. My only complaint with this otherwise outstanding output connection scheme is that the barriers between the screw terminals aren't spaced widely enough to accept large connecting spades like the ones on the Cardas Hexlink speaker cables I use.

Inside the amplifier, the power transformer and both output autoformers are lined up across the amp, toward the front. Occupying most of the internal area toward the rear is a line of eight heat-sinks, each with five TO-3 metal-can power transistors along with associated interconnecting p.c. boards.

The output terminals' unusual design allows the use of cables up to ¼ inch thick, appropriate for this high-current amp.

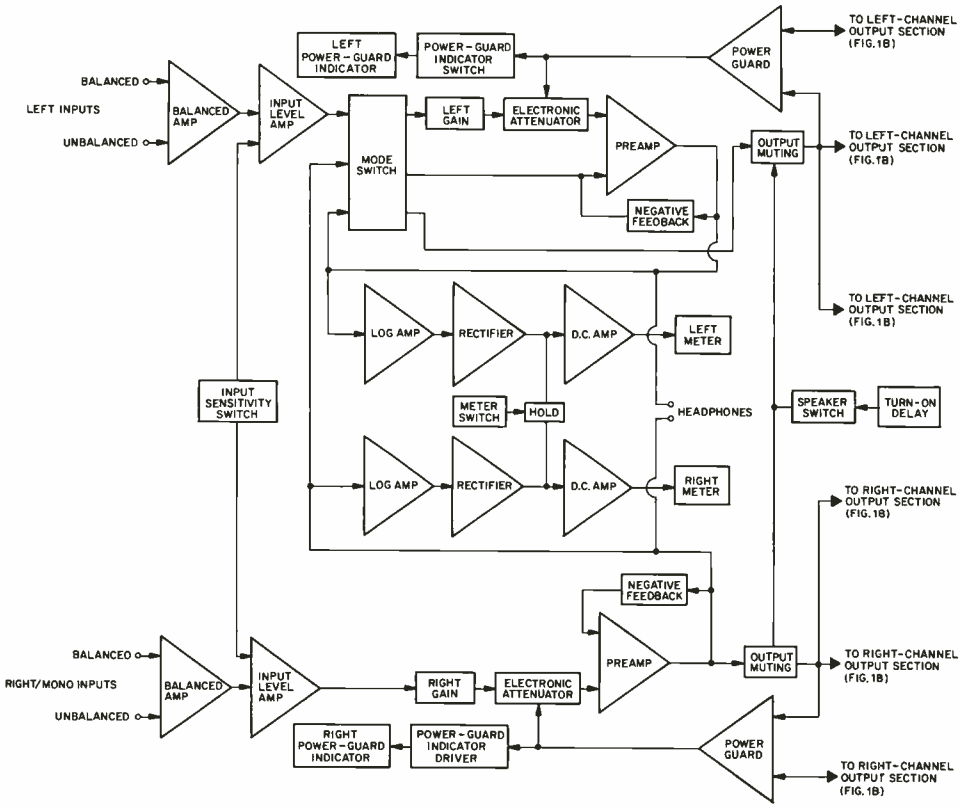

Fig. 1A—Block diagram of input stages.

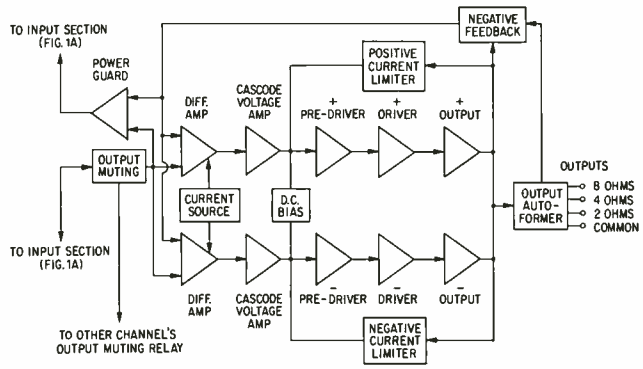

Fig. 1B—Block diagram of output stages.

An internal dividing piece of metal, about a third of the way up from the bottom, serves to mount the transformers. This plate is strengthened and supported by a perpendicular plate below it, attached to the amplifier's bottom plate, which also holds the four main power-supply filter capacitors (two per channel). Mounted to the terminals of the main filter capacitors are two p.c. boards that interconnect the filter capacitors and distribute power-supply voltages and audio output current from the heat-sink assemblies. Each heat-sink attaches to the appropriate board via a connector. This makes for easy servicing of the output stage, as you can remove the whole heat-sink without soldering. Support for the heat-sinks is supplied by the transformer mounting plates at the front of the amp and by another horizontal plate, the same height as the transformer mounting plate, at the rear of the unit.

Mounted in front of the filter capacitors are two p.c. boards that contain the front-end circuitry for each amplifier channel. The main power-supply rectifier bridges are mounted to the right side panel, near the bottom front.

At the top of the amp, toward the front, a p.c. board mounted to the middle autoformer carries the circuitry for the front-panel meters. At the bottom left rear, two more p.c. boards are mounted behind the input connectors and sensitivity and "Mode" switches. The input circuitry is contained on the board behind the switches; the board behind the phone and XLR jacks serves mainly to connect these two balanced inputs in parallel.

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Paralleling channels is decidedly a bad idea for most solid-state amps, but the MC2600 makes such connection workable.

The overall chassis enclosure is made up of separate pieces forming the sides, rear and front, and top and bottom. Overall, it is built like a tank and certainly can stand up to the rigors of professional use. One touch that I like is the presence of feet on the rear as well as the bottom, so the amp can be put on its back without having the rear panel's protrusions touch the floor. These feet are mounted on inch-wide aluminum bands that attach to the front panel and side plates and are removed if the amplifier is rack-mounted. For rack mounting, threaded holes in the sides of the amp can be used to attach it to slides. This will allow the MC2600 to be pulled out like a drawer while remaining supported. (Remember, this unit weighs 130 pounds!)

Circuit Description

Block diagrams of the MC2600 are shown in Figs. 1A and 1B. As can be seen, this is a sophisticated and rather complicated system. The actual signal circuitry starts with an input differential amplifier (which accommodates balanced or unbalanced inputs) feeding an adjustable-gain level amplifier. This two-stage circuit uses a dual NE5532-type op-amp IC. The gain of the second stage can be selected by switching the feedback resistor to set the MC2600's input sensitivity at 1.4 or 2.5 V for full output. Following the input level amplifier is the "Mode" switch. As noted, this switch selects stereo, bridged mono, or parallel mono operation.

Referring to Fig. 1A, it can be seen that, following the mode switch in the left channel and the input level amplifier in the right channel, are the gain controls, the Power Guard circuit's electronic attenuators, the preamp blocks, and the output muting relays that precede the actual (finally!) power amplifier circuitry.

In stereo operation, the "Mode" switch passes each channel's signal straight into the gain control and other following circuitry, and the amplifier functions as two independent channels.

In bridged mono mode, the "Mode" switch's input comes only from the right-channel preamp output; the left input-level amp's output is not used. This right-channel signal then passes into the inverting input of the left channel's preamp input, with the net result that the channels' outputs are of opposite polarity. This is, of course, what is required for normal bridged operation, and the load is connected between the hot terminals of the two channels' outputs.

In the parallel mono mode, the left channel's preamp is bypassed; the right channel's preamp output goes, via the output muting relay, directly into the left channel's power amplifier input. The result is that the two channels' outputs are identical, in-phase signals.

Note that, in both mono modes, the Power Guard function is controlled from the right channel's signal path. In parallel mono operation, the user must tie the two channel outputs together, hot to hot and ground to ground, at the output terminals. Load matching occurs when the load is half the nominal value of the output hot taps that are tied together. For instance, a 1-ohm load is driven to 1,200 watts by tying the 2-ohm taps together. As another way of looking at this, imagine not tying the outputs together and driving two separate 2-ohm loads. Here, 600 watts would be delivered to each load for a total of 1,200 watts. A basic network theorem states that if there is no potential difference between two points in a network, they can be tied together with no effect. The two channels' outputs are moving together in phase and presumably are at the same amplitude, so we can short them together. When this is done, we have a composite 1-ohm load being fed 1,200 watts. With solid-state amplifiers in general, paralleling channel outputs is decidedly not a good idea, as any difference between channel outputs, especially d.c., makes a large common-mode current to flow between the channels, usually causing destruction of the output stage. In the case of the MC2600, the d.c. resistance of the autoformer windings and careful matching of levels make the scheme workable.

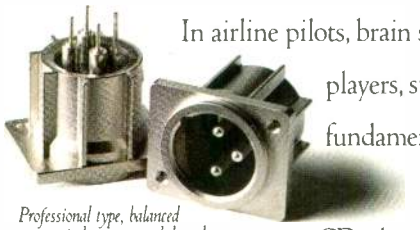
The main amplifier circuit, seen in Fig. 1B, is fully complementary-symmetry from input to output. In the following description, I will sometimes be talking about half of the circuit, with the understanding that there is a mirror-image part with opposite-type transistors. Incidentally, the circuitry uses all bipolar transistors—nary a FET to be found.

For the first stage, both the positive and negative paths use complementary differential amplifiers, each with its own two-transistor current source. Output of the first stage is direct-coupled to a cascode-operated second stage. Although the block diagram does not show this, both of the input differential amplifier's output phases are used by the cascode circuit to develop its output current. Local feedback is employed via 100-ohm emitter-degeneration resistors in the cascode transistors closest to the supply rail. The cascode stage develops all the voltage swing for the output signal and is what I usually term the "last voltage amplifier" in describing amplifier topologies. A bias-spreading regulator connects the output collectors of the two complementary halves of the cascode stage. These output collectors go on to feed the output stage.

The output stage itself is a triple Darlington, with a predriver, a driver, and the paralleled output devices all configured as emitter followers. Having nine paralleled output transistors for each half-cycle, or a total of 18 for each output stage, is what it takes to deliver the kind of output power the MC2600 offers. An overall negative feedback loop is taken from the output back to the inverting input of the input differential amplifier.

A protection circuit is employed in the form of a current limiter that clamps the drive to the output stage when current is deemed excessive. Although this circuit is called a current limiter in the schematic, it seems to have the topology of a volt-amp limiter, as the threshold of limiting depends on the output voltage as well as the output current.

The Power Guard circuit acts upon the difference between the input differential amplifier's two inputs, which consist of the input signal from the previous stages and the fed-back output signal. When the output starts to clip, this difference signal starts to reach material levels and is amplified, rectified, and applied to the Power Guard circuit's LED/photocell control element, reducing its resistance. Since the photocell is placed as a shunt element in a signal voltage-divider circuit, reducing its resistance decreases the overall circuit gain enough to keep the output from clipping beyond perhaps 1% to 2% THD as the input signal's amplitude



Professional type, balanced output jacks are grounded, and shield the signal against noise

In airline pilots, brain surgeons, and CD players, steadiness is a pretty fundamental requirement. In the case of our newest CD player, the Elite® PD-75, its rock-solid stability has rocked the world of music lovers and audio critics. As the reviews have rolled in and the awards have been bestowed, it is apparent that the standard for CD players has been advanced dramatically. Behind this success lies a principle that Elite has brilliantly exploited: The mechanical elements of a CD player are just as critical to its quality as its electronic components.

The first significant innovation to come out of this insight is at the heart of the PD-75. The stable platter.

Two basics of physics—mass and inertia—combine to make the stable platter an obviously superior platform to support a disc spinning at high velocity.

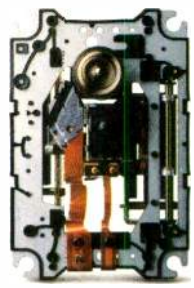
The Elite PD-75 Compact Disc Player. Its elegant urushi finish reflects technical elegance within

Next, the stable platter, by supporting the entire area of the CD disc, minimizes wobble and chatter.

A wobbling disc presents a difficult target for the laser, while a chattering disc creates resonance, distorting the signal, which distorts the sound.

Another problem for CDs is gravity. Spinning above the laser pickup and supported only in the center, the disc sags microscopically. Which to a laser beam is significant degradation.

[How A Concept Called The Stable Platter Turned The CD Upside Down.]



An advanced linear drive motor moves the laser pickup with smooth speed and precision.

But on the Elite CD platter, the disc is turned upside down—that is, label down, information side up. The disc lies firmly clamped to a solid surface.

Meanwhile, the laser pickup reads the disc's digital code from above, where it is immune to dust settling on the laser optics.

We invite you to bring your favorite CD to an Elite dealer and demonstrate the advantages for yourself. Give that disc an audience on the PD-75 for what one critic called "a dimension of sound that you have never heard before."

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And usher in a new era of stability.

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The Power Guard circuit, which McIntosh has used for years, has likely saved many a tweeter from being burnt out by hard clipping.

Table I—Gain and IHF sensitivity vs. setting of MC2600's sensitivity switch.

Setting	Gain, dB		IHF Sensitivity, mV	
	LEFT	RIGHT	LEFT	RIGHT
1.4 V	34.3	34.3	54.7	54.7
2.5 V	29.4	29.4	95.9	95.8

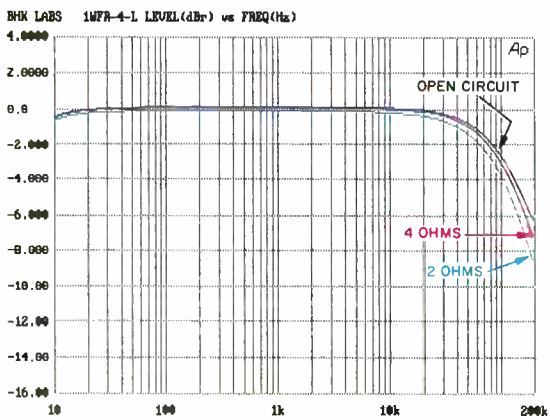


Fig. 2—Frequency response as a function of loading, at 4-ohm tap.

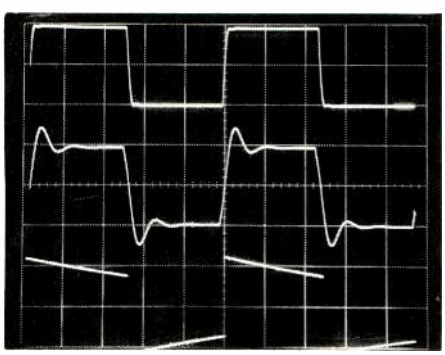


Fig. 3—Square-wave response, measured at 8-ohm tap, for 10 kHz with 8-ohm load (top), 10 kHz with 2-μF capacitance across 8 ohms (middle), and 40 Hz with 8-ohm load (bottom). Scales: Vertical, 5 V/div.; horizontal, 20 μS/div. for 10-kHz traces, 5 mS/div. for 40 Hz.

increases. This is a very good circuit idea that McIntosh has used for years. It very likely has saved many a tweeter from being burnt out from the excessive high-frequency content of hard clipping.

The main power supply uses two separate secondary windings feeding full-wave bridge rectifiers whose output is filtered by four 30,000-μF/100-V filter capacitors into positive and negative supply rails for the two channels. The output stages operate directly off these voltages, and RC decoupling networks filter the voltages fed to the first and second stages of the amplifier circuitry. A novel circuit controls the output from a separate 15-V a.c. secondary winding to supply regulated 12.6 V a.c. to the meter lamps. This keeps the lamps' intensity from fluctuating when the line voltage is drawn down at high amplifier output power levels—a nice touch. The 15 V a.c. also supplies power to the front-end op-amps and the meter's driver circuitry via half-wave rectifiers and capacitor input filters feeding three-terminal positive and negative IC regulators. Drive for the meter circuitry is derived from the output of the preamp blocks preceding the input to the main power amplifier circuitry. As can be seen in Fig. 1A, a signal processing chain of log amplifiers, rectifiers, and d.c. amplifiers takes care of this.

In the input a.c. line circuit, two thermal sensors with different trip temperatures control the fan motor circuit to produce three states: Fans off for most normal music use, a low fan speed for moderate cooling requirements, and full fan speed when the going gets tough. Additionally, two thermistors (devices with negative temperature coefficients) serve to reduce the in-rush current upon turn-on, thereby promoting long component life in the power supply.

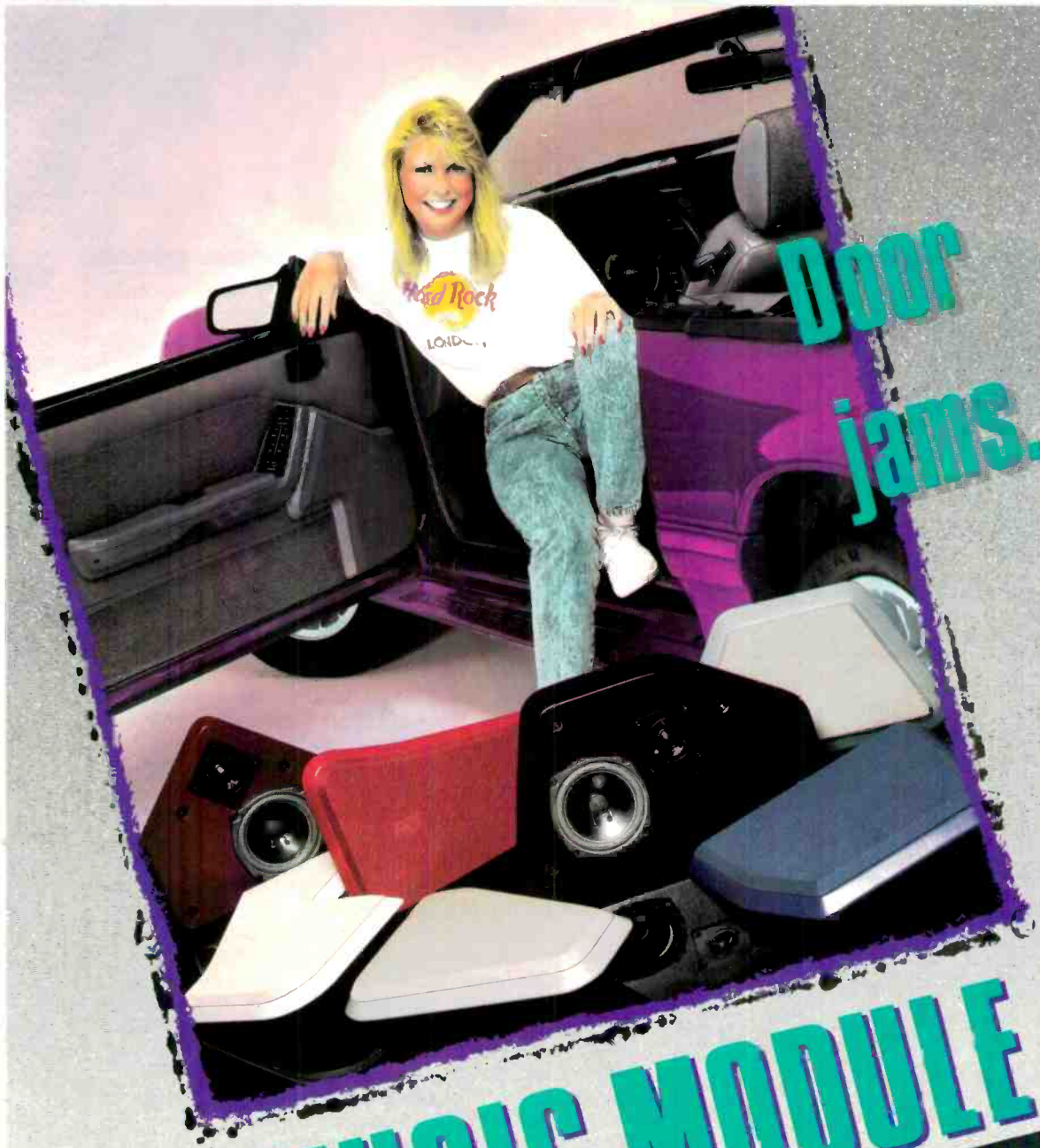
All in all, the McIntosh MC2600 circuitry is logical and well thought out, but I can't help wonder what would happen to the sound of the amp if some of the signal circuitry were eliminated—for example, if the input signal were to be directly injected into the power amplifier proper.

Measurements

Gain and sensitivity were measured first, for both positions of the rear-panel sensitivity switch and with 8-ohm loads on the 8-ohm output taps (Table I). Voltage gain is on the high side, compared to the usual 26 dB or so, especially with the 1.4-V sensitivity setting.

Frequency response on the 4-ohm taps is shown in Fig. 2. The three curves show the effect of loading. Output impedance is fairly low, as evidenced by the close similarity of the curves, and the high-frequency response, at least up to 200 kHz, is nicely behaved. Related to frequency response is rise- and fall-time for step functions or edge transitions in square waves. For the MC2600 at an output level of 10 V peak to peak, rise- and fall-times were, respectively, about 2.0, 2.1, and 2.5 μS for 8 ohms on the 8-ohm tap, 4 ohms on the 4-ohm tap, and 2 ohms on the 2-ohm tap.

The top trace of Fig. 3 shows the amp's response to a 10-kHz square wave with 8 ohms on the 8-ohm tap. This is the fastest of the three conditions previously described; the corner shape gets progressively more rounded as you go down the output taps. The middle trace of Fig. 3 shows the effect of a 2-μF capacitive load paralleled across the 8-ohm



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Onset of clipping occurred at 856 watts per channel in stereo and up to 2,025 watts in mono—no mean beast, this MC2600!

Table II—Output noise. The right-channel readings for wideband and 22 Hz to 22 kHz were dominated by 60-Hz hum; see text. The IHF S/N ratios were 79.6 dB for the left channel and 79.2 dB for the right channel with 1.4-V sensitivity and 83.3 dB left, 82.4 dB right, for 2.5-V sensitivity.

	Output Noise			
	1.4-V Setting		2.5-V Setting	
Bandwidth	LEFT	RIGHT	LEFT	RIGHT
Wideband	1.12 mV	1.19 mV	892 µV	1 mV
22 Hz to 22 kHz	422 µV	639 µV	275 µV	567 µV
400 Hz to 22 kHz	381 µV	385 µV	250 µV	251 µV
A-Weighted	300 µV	310 µV	193 µV	212 µV

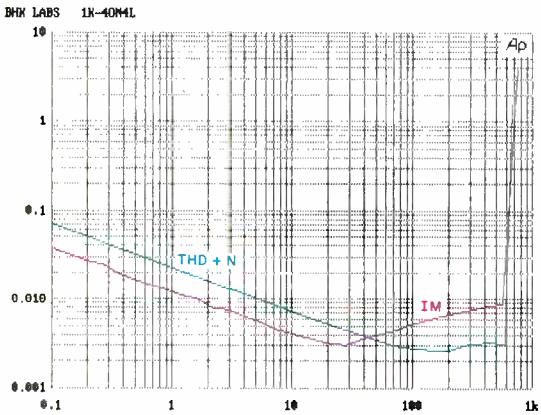

Fig. 4—THD + N for 1-kHz input, and SMPTE-IM distortion, vs. output power for 4-ohm load on 4-ohm tap.

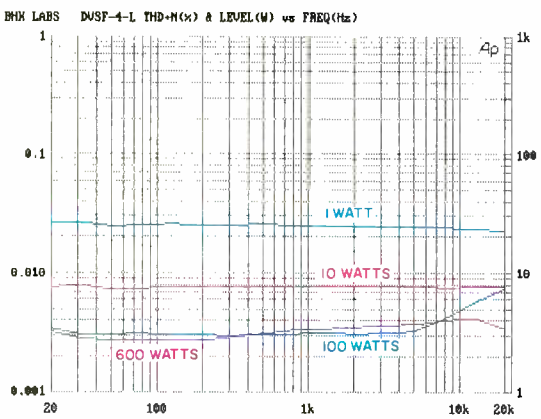

Fig. 5—THD + N vs. frequency and power for 4-ohm load on 4-ohm tap.

resistance. The ringing seen here is fairly typical of solid-state amplifiers. In the 40-Hz square wave in the bottom trace, there is somewhat more tilt than I like to see. This relates to the fact that response is nearly 1 dB down at 10 Hz, as was seen in Fig. 2.

Distortion properties were looked at next. Figure 4 is a plot of SMPTE-IM distortion and 1-kHz THD + N as functions of output power. Loading was 4 ohms on the 4-ohm tap. Results are shown for the left channel, which read slightly higher than the right. The THD + N curve is dominated by circuit noise below about 80 watts, as shown by the curve's rise of 20 dB per two decades of decreasing power. The IM emerges out of the noise at about 30 watts.

Figure 5 shows THD + N versus frequency at a number of power levels. Notable here is the relatively small rise in high-frequency distortion at any given power. The curves for 10- and 1-watt levels essentially show circuit noise again, but it is of interest that distortion at low levels doesn't poke up above the noise level at higher frequencies. McIntosh sure has got it down with regard to low distortion at high power! Thirty to 40 parts per million (0.003% to 0.004%) is very good measured performance.

Figure 6 is a spectrum analysis of the distortion products at the 10-watt level, again for the left channel. A time waveform of this signal, as I usually show, would just look like random noise. In the figure, a second-harmonic component of about 0.00018% is visible along with a third harmonic of about 0.0017%. In the right channel, both the second and third harmonics measured about 0.0003%.

Output noise as a function of the sensitivity setting at various bandwidths is covered in Table II. The measurements made wideband and from 22 Hz to 22 kHz are higher in the right channel due to the presence of a 60-Hz hum, probably induced from the power transformer. The hum appears in the form of a low-order square wave (that is, one with little upper harmonic content).

Crosstalk versus frequency in the right-to-left direction is shown in Fig. 7. The top curve is with the level control of the undriven, measured channel fully clockwise; the middle curve is with the level control down four panel markings from clockwise, and the bottom curve is with the level control all the way down, or counterclockwise. In the bottom curve, the effects of residual hum in the amplifier can be seen in the fundamental and the third, fifth, and seventh harmonics of 60 Hz. The left-to-right direction yielded lower crosstalk levels but higher levels of 60-Hz hum components.

Damping factor versus frequency on the 8-, 4-, and 2-ohm taps is plotted in Fig. 8. Damping factor is highest on the 4-ohm tap. It would be expected that the damping factor would be lowest at the 8-ohm tap, which is furthest from the 3-ohm point, where the amplifier's output connects to the autoformer. However, I cannot explain why the damping factor on the 2-ohm tap is not higher than it is.

Dynamic headroom was checked on the 8-ohm tap. Visual onset of peak clipping and the flashing of the Power Guard lights occurred at ± 117 V peak output, or an equivalent power output of 856 watts per channel! This corresponds to a dynamic headroom of 1.54 dB. With a 4-ohm load on the 8-ohm tap, I measured an equivalent power

Continued on page 61

There's something more powerful than what we see.

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SONY

The World Of The Compact Disc

Remember vinyl? If you were collecting music before 1982, you probably do. The 33⅓ rpm Long Playing record, introduced in 1948, long reigned supreme as the king of home audio. But by the late 1970's, the LP was showing signs of age. And in 1982—a decade ago—the music business and the audio industry entered an entirely new world. The world of music that is the Compact Disc.

The Compact Disc was based upon the brilliance of digital audio, a then-new method of recording music with unprecedented fidelity. In a single stroke, digital technology overturned many previously-accepted limitations in high-fidelity reproduction. But bringing a digital audio disc format to the music lovers of the world would require more than just technology. It required an internationally-accepted standard.

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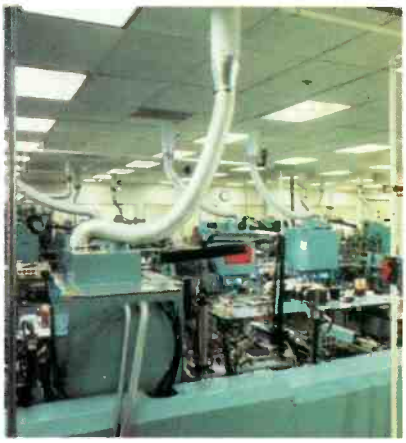
The essential step toward standardization took place in June, 1980. That's when Sony Corporation and N. V. Philips formally announced a new digital audio disc format.



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Bringing the Compact Disc out of the laboratory and into the living room required a monumental effort. It entailed new ways to record and master music. New technology to press discs. New machines to play them back. And Sony was there every step of the way. By October, 1982, digital audio discs were finally ready to come home. The world of music hasn't been the same since.

TEN YEARS AND MORE THAN A BILLION DISCS LATER, PEOPLE STILL ENJOY THE WORLD'S FIRST COMPACT DISC: BILLY JOEL'S *52ND STREET.*

THE WORLD'S FIRST COMPACT DISC PLAYER: THE CLASSIC SONY CDP-101. IT WAS INTRODUCED IN JAPAN IN OCTOBER 1982, AND THE U.S. MARKET FIVE MONTHS LATER.

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When Sony introduced the Compact Disc back in 1982, it was with tremendous feelings of pride, anticipation and excitement. Ten years later, it appears that the excitement was contagious. People everywhere have taken the Compact Disc into their homes, their cars—even outdoors. Americans alone have bought nearly 40 million CD players and over one billion Compact Discs.

But sales figures alone can't do justice to the full impact of CD. Its unprecedented fidelity has transformed the way we hear music. Which in turn has transformed the way musicians compose, record, and release their life's work. For music lovers, this just might be the biggest thrill of all.

THE FIRST MACHINE TO TAKE THE EXCITEMENT OF DIGITAL AUDIO ONTO THE ROAD: THE SONY CDX-R7, THE WORLD'S FIRST CAR CD PLAYER

WHAT COULD BE BETTER THAN A COMPACT DISC IN THE CAR? HOW ABOUT TEN DISCS! THE SONY CDX-A10 DISCJOCKEY® UNIT WAS THE WORLD'S FIRST CAR CD CHANGER.

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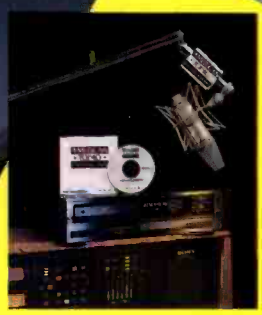

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WELL, NO, I WOULDN'T GO *THAT* FAR...."

THE COMPACT DISC ISN'T JUST FOR THE MUSIC OF TODAY, IT'S ALSO FOR REDISCOVERING THE MUSIC OF YESTERDAY THROUGH HISTORIC REISSUES AND BOXED SETS.

"[CD IS] THE GREATEST THING THAT'S EVER HAPPENED TO RECORDED MUSIC... IT REALLY IS A MARVEL. I WAS LISTENING TO MY OWN REMASTERED 1966 VERSION OF VERDI'S *FALSTAFF* THE OTHER DAY IN MY CAR'S CD SYSTEM, AND THE SOUND WAS SO EXTRAORDINARY THAT WHEN I ARRIVED HOME, I COULDN'T TURN OFF THE ENGINE, I JUST SAT THERE TILL THE END. AND THIS WAS AN ALMOST TWENTY-FIVE-YEAR-OLD RECORDING!"

—LEONARD BERNSTEIN*

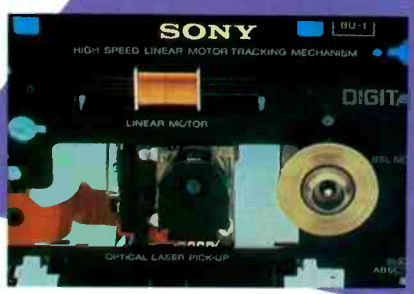
A World Of Innovation.

An undeniable part of CD's success is the fact that it has been a consistent, universally compatible format. Think of it: any standard Compact Disc will play on any standard CD player—anywhere in the world. But while the fundamental format has not changed, the technology around that format is constantly moving forward. In fact, few products have seen such intense technological refinement in so short a time as the CD player.

WITH SYSTEMS LIKE THE LASER LIBRARY, SONY IS IN THE FOREFRONT OF MAKING CD-ROM AVAILABLE AND AFFORDABLE.

Building A Better CD Player.

While some manufacturers claimed that the first generation CD players had already achieved "perfect sound," Sony believed otherwise. And Sony engineers immediately rose to the challenge of refining the CD player. The resulting stream of advances has had one dramatic effect: even staunch audiophiles—some of whom originally greeted the CD with hostility—have now embraced the CD format.



SONY'S CD PLAYER REFINEMENTS INCLUDED UNILINEAR™ CLOCK CIRCUITRY, PLUS THE FIRST 8X OVERSAMPLING FILTER AND 18-BIT CONVERTERS. WE ALSO CREATED DIGITAL SYNC™ CIRCUITRY, ONE-BIT PULSE CONVERTERS, AND THE LINEAR MOTOR LASER TRANSPORT SHOWN. THE TRANSPORT WAS THE FIRST TO CUT TRACK ACCESS TIME TO UNDER ONE SECOND.

Taking The CD In New Directions.

With its durability and sound quality, the Compact Disc has won the hearts of music lovers. With its capacity to store over 6 billion bits of digital data, the Compact Disc has stimulated interest in disciplines far afield from music. New extensions of the Compact Disc format are creating exciting new possibilities.

CD+G, CD-I And More.

In the world of computing, CD is just coming into its own as a medium for high-density data retrieval. Thousands of CD-ROM (Read-Only Memory) titles are giving the computer user on-line access to vast quantities of information.

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COMPARED TO USING CONVENTIONAL REFERENCE BOOKS, THE DATA DISCMAN SYSTEM IS FASTER, EASIER, AND MORE VERSATILE.

and easy access to encyclopedias, travel guides, baseball stats, medical reference and languages.

There's also Compact Disc + Graphics (CD + G), for music with the added attraction of still frame graphics and lyrics. And the new Compact Disc-Interactive (CD-I) format, which combines sound, pictures, text and action in a way that involves you as never before. And coming soon is the Photo CD, your own family photo album on Compact Disc!

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Don't believe a word of it. Even after ten years, the Compact Disc remains the unchallenged champion of digital sound quality—unsurpassed by any other prerecorded music format. And for durability, convenience and versatility, nothing else comes close. It's no wonder that Compact Disc continues to spark more innovation than anything else in the digital audio world.

And as the Leader in Digital Audio™, Sony is about to introduce a new generation of home, car, and portable Compact Disc players that achieve entirely new levels of performance and value. So, if you don't own CD's, there's never been a better time to join the revolution and discover the incredible sound of Compact Disc for yourself.

After all, it's what the whole world is turning to.

*LEONARD BERNSTEIN QUOTE FROM ROLLING STONE NO. 592, NOVEMBER 29, 1990, FROM AN INTERVIEW BY JONATHAN COTT. QUOTED WITH PERMISSION.

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SONY

SONY CORPORATION OF AMERICA
NATIONAL OPERATIONS HEADQUARTERS
SONY DRIVE, PARK RIDGE, NJ 07656

Frequency balance, space, and resolution were good, and operation was perfect—appropriate for McIntosh's flagship amplifier.

Continued from page 52

level during the 20-mS burst of some 1,378 watts. With a 2-ohm load on the 8-ohm tap and with one channel driven, I got ±90 V out at the visual onset of clipping, for a peak current of ±45 amperes and an equivalent power output of 2,025 watts. No mean beast, this MC2600!

When I tried to measure sustained continuous maximum power, the limitations of my a.c. mains power feed became apparent. I have a 30-amp Variac and about 25 to 30 feet of No. 10 wire in a dedicated circuit from my fuse box. I measured about 650 watts per channel into 4-ohm loads for a clipping headroom of about 0.35 dB. With the amplifier delivering this power, my line monitor showed that the only way I could maintain an input of 120 V a.c. to the amplifier was to use the Variac setting which produces a no-load output of about 130 V. McIntosh suggests rewiring the amp for 240 V when making high-power measurements, but unfortunately I don't have both a.c. phases coming into my electric meter box. Even though I could deliver a measured 120 V a.c. to the line plug of the amplifier under full-power conditions, the waveform of the line voltage would have considerable peak clipping when the rectifiers conduct, as occurs when current is delivered to the power supply. The net effect was that the actual d.c. power-supply voltage to the output stages was lower than it would have been with a lower impedance a.c. line. The impedance of my a.c. line, while low, is not low enough for accurately measuring the maximum steady-state power output capability of an amp the likes of the MC2600. No doubt, with a really low-impedance a.c. source, higher continuous power levels would be attainable. All of this is relevant to the use of this amp. As McIntosh recommends, a dedicated high-current a.c. line should be installed if you really want to get the most out of the MC2600.

A few miscellaneous comments: Idling a.c. line draw was about 1 ampere, and the main d.c. supply voltage was ±80 V. Meter accuracy for steady-state sine waves was quite good; the left channel was spot on, and the right channel read high by about two needle widths. With tone-burst signals, the meters read essentially the steady-state equivalent for bursts with a duration longer than 20 to 30 mS.

Use and Listening Tests

During the early part of the MC2600's stay, I used it as the bass amplifier in biamping Martin-Logan Monolith III speakers. In this service, bass was well damped and extended with, of course, enormous and effortless power delivery. When I started to listen to the amplifier wide-range, driving the Martin-Logans (with their own passive high-level crossover) and several other speaker systems, I got a pleasant surprise. I had subconsciously expected the MC2600 to sound powerful but perhaps somewhat irritating and undistinguished. Surprise! It sounded very good. Frequency balance was very good, space and resolution were good, and—a high listening priority for me—it was not edgy or irritating. I found myself using the amp quite a bit in listening to a lot of music, and it was quite musically satisfying. In use, there were no unwanted noises like turn-on or turn-off thumps, just perfect operation. This is a very competent amplifier whose performance is appropriate for its position as McIntosh's flagship. *Bascom H. King*

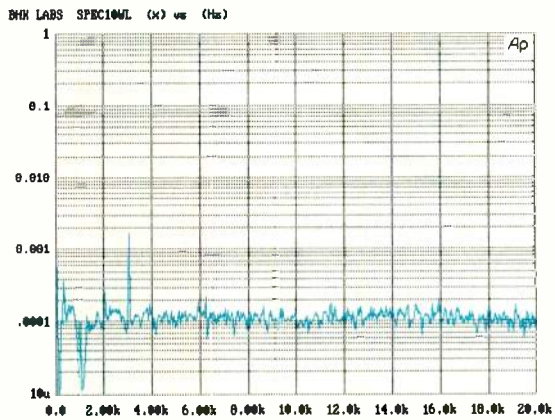

Fig. 6—Distortion spectrum for 1-kHz signal at 10 watts out into 4 ohms on 4-ohm tap.

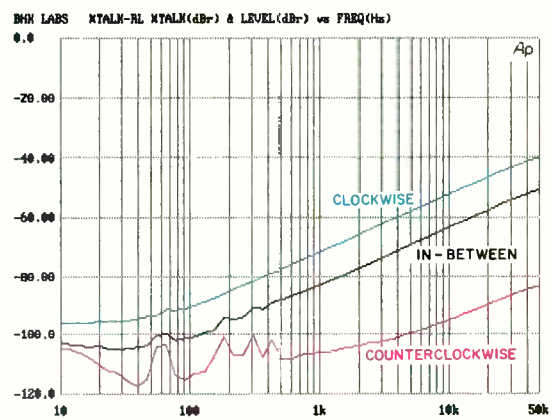

Fig. 7—Crosstalk vs. frequency, from right channel to left, for three positions of input level control. Middle curve is with control four markings down from full clockwise position.

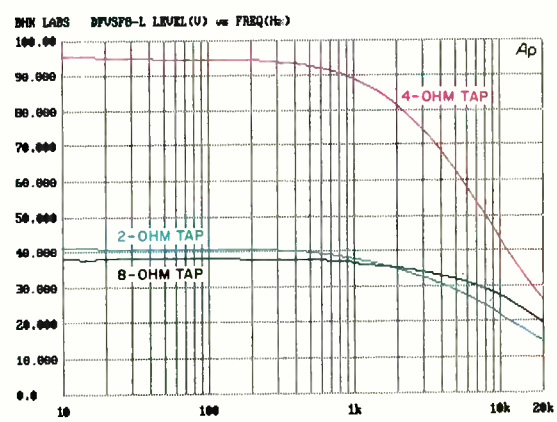

Fig. 8—Damping factor vs. frequency for all three output taps.

2

QUART 490MCS SPEAKER

Manufacturer's Specifications

System Type: Two-way, bass-reflex bookshelf system.

Drivers: 8-in. (20.3-cm) cone woofer and 1-in. (2.54-cm) titanium-dome tweeter.

Frequency Range: 37 Hz to 32 kHz.

Sensitivity: 89 dB at 1 meter with 2.83 V rms applied.

Crossover: 2.1 kHz; 12-dB/octave low-pass on woofer, 18-dB/octave high-pass on tweeter.

Impedance: 4 ohms nominal.

Continuous Input Power: 100 watts.

Dimensions: 17 5/16 in. H × 10 7/8 in. W × 11 1/4 in. D (44 cm × 27.6 cm × 28.5 cm).

Weight: 24.3 lbs. (11 kg) each.

Price: $849 per pair in oak, raw oak, walnut, matte black lacquer, or matte white lacquer; in pine or cherry, $976.35 per pair.

Company Address: MB Quart Electronics, 25 Walpole Park South, Walpole, Mass. 02081.
For literature, circle No. 91

MB Quart Electronics of Germany has been in the audio business for more than 20 years. Previously known as Peerless MB, the company manufactures microphones, headphones, OEM speaker components, and complete loudspeaker systems.

The Quart 490MCS system is one of nine speakers marketed by MB Quart in America. The line consists of four bookshelf-sized systems, of which the 490MCS is the largest, and five floor-standing systems. The seven small systems are all two-way, while the two largest are three-way designs.

The 490MCS incorporates an 8-inch long-throw woofer with a large magnet and high-temperature voice-coil along with a Ferrofluid-cooled, titanium metal-dome tweeter. The tweeter has an integral covering screen that incorporates a built-in reflector disc to smooth the response and widen the high-frequency coverage. Several design features minimize diffraction, including rounded cabinet corners and edges, flush-mounted drivers, and a flock-coated front baffle. The cabinet corner moldings and edge strips are in solid hardwood, while all sides of the cabinet, excluding the front baffle, are fully veneered and finished. The system is avail-

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From 65 Hz to 10 kHz, on-axis frequency response fits within a relatively tight envelope of +1, −3 dB.

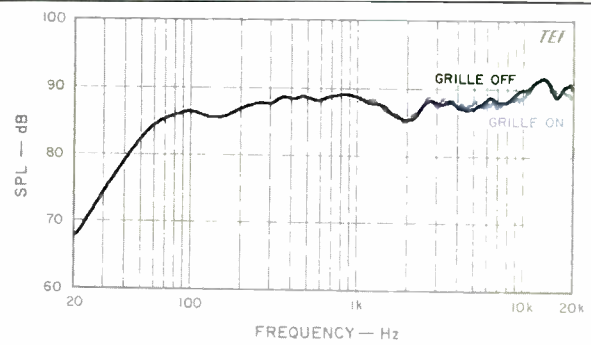

Fig. 1—One-meter, on-axis, anechoic frequency response, for an input of 2 watts into 4 ohms (2.83 V).

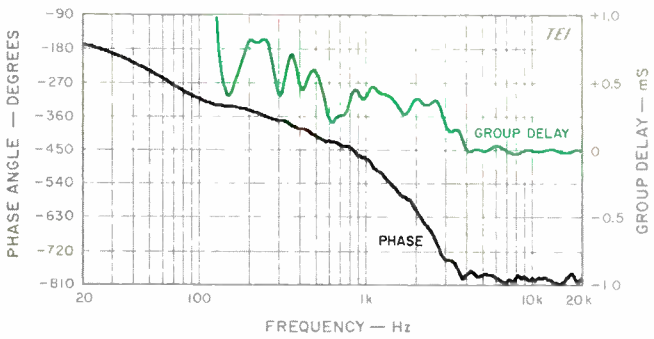

Fig. 2—On-axis phase response and group delay, corrected for tweeter arrival time.

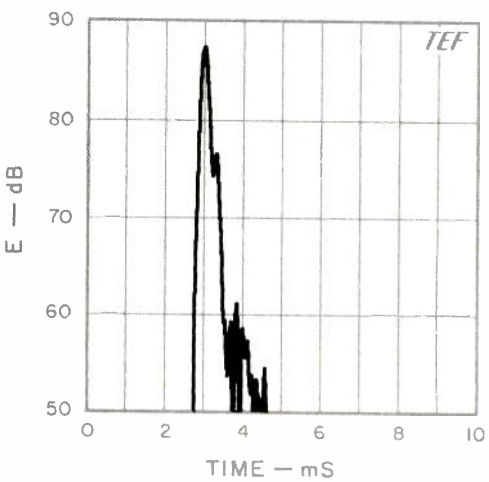

Fig. 3—One-meter, on-axis energy/time curve.

able in several high-quality, furniture-grade hardwood finishes plus matte lacquer.

The grille of the 490MCS, which Quart calls a Transcover, comprises a metal-grid frame covered with an acoustically transparent, highly porous woven material. The grille frame fits into vertical grooves along the sides of the front baffle and thus presents a minimum of front-panel protrusions for sound diffraction.

A common theme of the company's six largest systems is a low-frequency enclosure design that MB Quart calls the Motion Control System, or MCS. This consists of a cabinet-mounted, molded plastic assembly containing two vent tubes of different diameter that are partially filled with acoustic resistance material. A six-page MB Quart white paper states that MCS:

> . . . greatly improves on textbook acoustic-suspension and bass-reflex design by combining the advantages of both while minimizing the drawbacks. . . . The principle . . . is that the speaker is neither open as in a bass-reflex design nor closed as in an acoustic-suspension design. If an MCS speaker is examined via traditional loudspeaker measurement techniques it behaves exactly as a closed-box design should. If you look at its front panel, however, you will see what clearly seems to be a system of ports. . . . The larger tube, or main tuning port, is designed to make the speaker act like a bass-reflex design by producing faster cone movement in the woofer. The smaller tube provides ventilation to the larger one to eliminate distortion. . . . The damping of the large port is so high that no acoustic energy can be found at its opening. The tuned frequency of the small port is too low to produce any acoustic energy. They serve simply to correct the speaker's impedance characteristics. . . . Therefore, the effect of MCS is not directly measurable.

This is just a small quote from the white paper, and MB Quart goes on for three pages to describe the MCS concept in detail. Frankly, although some of the copy describing MCS in this white paper was weak technically, I was quite interested to see how the concept worked from a practical standpoint. Quart was kind enough to provide me with a copy of the German patent, which consists of 24 pages of text, including 22 claims, along with 42 figures! (The whole thing was in German, of course, so I couldn't read a word of it, but I did understand the equations!)

Measurements

The first pair of 490MCS systems I received, which were first auditioned at *Audio*'s New York offices, exhibited woofer voice-coil rubs at high excursions. The measurements and listening tests discussed here were done on a second pair, received directly from the American distributor. The replacement pair operated properly.

The system's 1-meter on-axis frequency response is shown in Fig. 1. Also shown is the effect of the grille. Though there is a modest high-frequency peak at 13 kHz, the response fits within a relatively tight envelope of +1, −3 dB from 65 Hz to 10 kHz. A moderate dip in the 2-kHz crossover region is evident. The low-frequency response rolls off at 12 dB/octave below 60 Hz and is down about 10 dB at 35 Hz. The grille mainly affects the response from 6 to 13 kHz,

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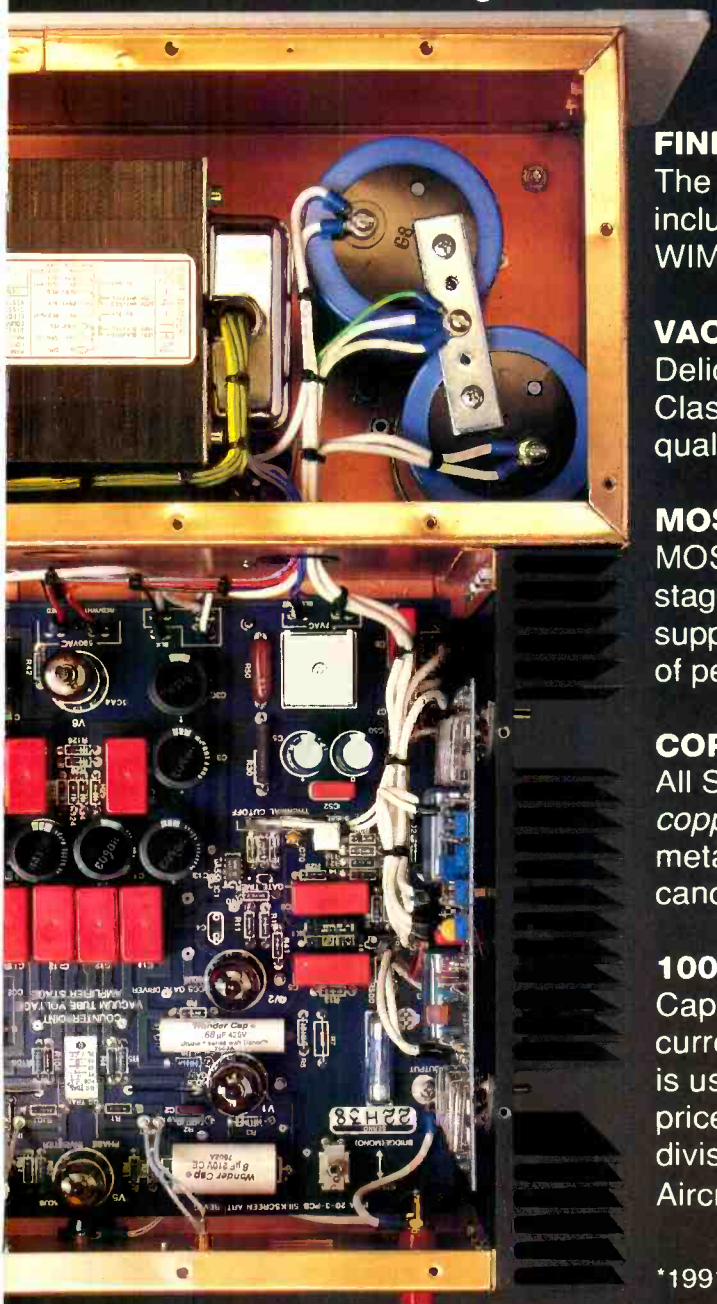

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The off-axis curves are generally well behaved and indicate that vertical and horizontal high-frequency coverage are excellent.

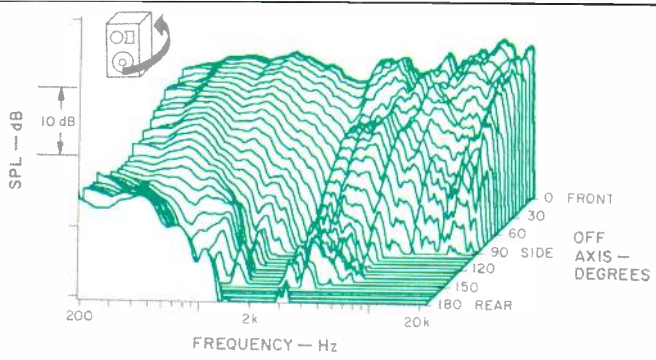

Fig. 4—Horizontal off-axis frequency responses, taken from the front, around the side farthest from the tweeter, and to the rear of the speaker.

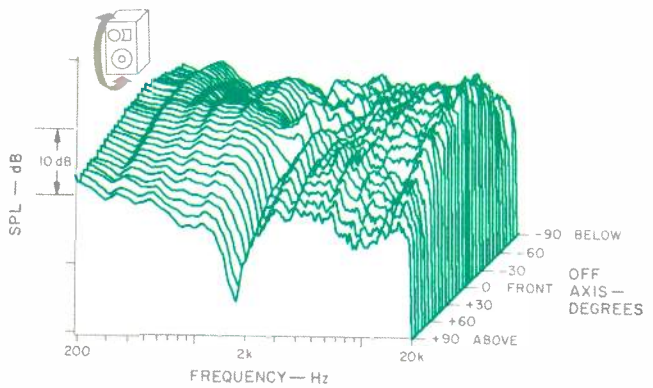

Fig. 5—Vertical off-axis responses, taken from below, up the front, and to the top of the speaker.

where the level is reduced by a modest 1 dB. The response above 20 kHz (not shown) exhibited a peak with a high Q (about 26) at 25.2 kHz, presumably due to the tweeter's metal-dome resonance, and then fell off rapidly at higher frequencies.

Figure 2 shows the system's phase and group-delay responses referenced to the tweeter's arrival time. Both curves are typical for a small two-way system. The group delay indicates that the upper range of the woofer lags the tweeter by about 0.3 to 0.4 mS, which corresponds to about 0.6 to 0.8 wavelength at the 2.1-kHz crossover. This delay is partly due to the offset between the drivers' physical positions and partly to electrical delays inherent in the crossover filter.

Figure 3 shows the energy/time response, swept from 200 Hz to 10 kHz. The main arrival, at 3 mS, is fairly compact but broadens at lower levels and is accompanied by a few minor later returns that are down some 25 dB. The delayed woofer contribution is just visible as a slight perturbation at about 75 dB SPL.

Figure 4 shows the "3-D" horizontal off-axis curves of the system. For a system with perfect off-axis response, all the off-axis curves would have the same shape as the on-axis curve (including any axial aberrations). The on-axis response curve is shown at the rear of the graph in bold. Because the Quart's tweeter is slightly offset from the center of the box, the horizontal off-axis response is slightly asymmetrical. The asymmetries were only evident, however, at extreme angles off axis, where there was more of a dip in the crossover region on one side as compared to the other. In the primary listening range of about ±30°, the system's off-axis response was very symmetrical. The figure shows the horizontal off-axis responses for one side only, in the direction which exhibited the deeper crossover dip (the MCS port side). The curves are generally well behaved and indicate excellent high-frequency horizontal coverage.

The vertical off-axis curves are shown in Fig. 5. In the center of the graph (front to rear), the on-axis response curve is shown in bold, and the above-axis responses are in the front of the display. Except for the 2-kHz crossover region, these curves are also very well behaved. The similarity of the response curves above 3 kHz again indicates the system's excellent high-frequency coverage. Not clearly shown in the graph is the Quart's asymmetrical up/down crossover response behavior, which indicates some lobing. Fortunately, the response through the crossover region was much smoother for angles at and above the tweeter axis than for angles below the tweeter axis.

Figures 6 and 7 show, respectively, the NRC-style mean horizontal and vertical on- and off-axis response curves. The mean axial (+15° to −15°) horizontal response curve in Fig. 6 is quite similar to the on-axis response, which indicates very good off-axis coverage in the primary listening angles if the speakers are toed in. The 30° to 45° response is surprisingly similar to the axial curve but with some added roughness. The lack of high-frequency roll-off above 10 kHz is notable. Notwithstanding the dip in the crossover region, and a downward trend above 5 kHz, the 60° to 75° off-axis response holds up well as compared to some other systems. Evident in both off-axis average curves is a high-frequency peak at 17 kHz, which indicates some localized broadening of the coverage in this range.

Figure 7, the mean vertical responses of the 490MCS, exhibits a depression and response roughness between 1.5 and 4 kHz, a result of the vertical lobing mentioned previously, which creates below-axis crossover dips in the response. The 30° to 45° response is very similar to the corresponding horizontal response except for a much sharper dip at crossover. The 60° to 75° response is also

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MB Quart said the 490MCS should measure just like a closed-box design, and it did—like a very good one!

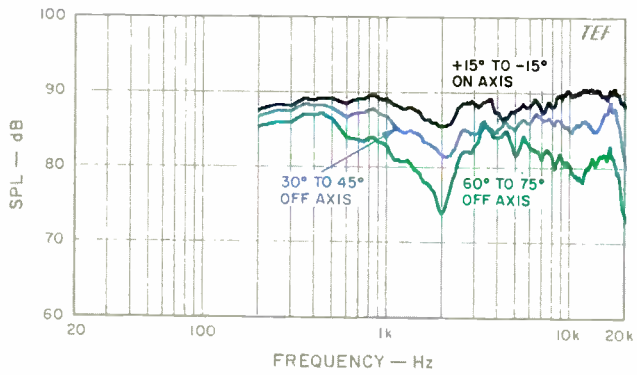

Fig. 6—Mean horizontal responses derived from data of Fig. 4.

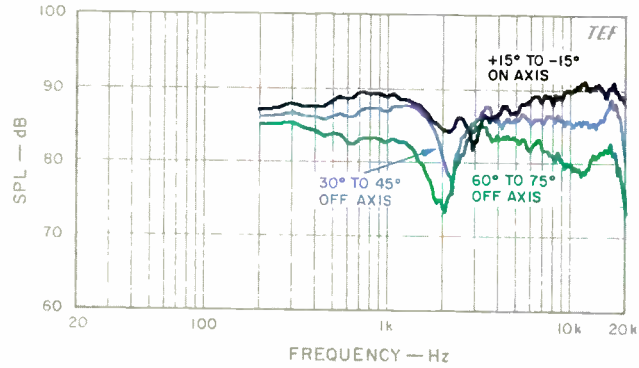

Fig. 7—Mean vertical responses derived from data of Fig. 5.

surprisingly similar to the corresponding horizontal response. Evident in these curves as well is the absence of any severe high-frequency roll-off and the same broadening of coverage at 17 kHz seen in Fig. 6.

An examination of the inside of the enclosure, with the woofer removed, revealed a well-constructed, tight-fitting cabinet made of ¾-inch-thick, medium-density fiberboard. No internal braces were evident in this inspection. All inside surfaces of the enclosure were covered with a 2-inch-thick white batting-like, sound-absorbing material. Two small rolls of the same absorbing material were also placed in the box.

With the woofer reinstalled, a high-level low-frequency sine-wave sweep revealed one significant wall resonance in the vicinity of 280 Hz. At this frequency, an internal buzzing was also evident. The woofer's excursion as a function of frequency essentially was that of a closed-box system with a corner frequency of about 50 Hz. No reduction of excursion was visible due to the MCS ports of the enclosure. Commendably, the woofer did not exhibit any dynamic offset.

The woofer's linear excursion capability was about 0.25 inch, peak to peak, with a limit excursion of about 0.5 inch, peak to peak (average values for an 8-inch woofer). The woofer overloaded gracefully at high levels. Its effective piston diameter was 6½ inches, measured from the middle of the surround on one side to the middle of the surround on the other; the outside frame diameter was 8¾ inches.

The crossover consists of two inductors, three capacitors, three resistors, and a series tweeter-protection device called a Poly/Safety Switch. The crossover is wired on a 3½ × 2½-inch p.c. board that is attached to the rear of the input-terminal mounting panel. Parts quality is high. A medium sized iron-core inductor is used in the woofer's path and an air-core inductor in the tweeter's portion of the crossover. The crossover consists of a second-order low-pass filter (one capacitor, one inductor, and two resistors) connected to the woofer and a third-order high-pass (two capacitors and one inductor) driving the midrange. All connections to the drivers are made with stranded 14- or 15-gauge hookup wire, which is soldered to the driver terminals rather than fastened by clips.

Now we come to the most interesting part of the review: How well does the Moving Control System work? I conducted every test I could dream up, including near-field low-frequency response, impedance, pulse, and listening assessments and came to the conclusion that the system, for all intents and purposes, is a closed-box design—a good one! Before you and the folks at MB Quart cry foul, let me describe the tests and the results.

Removing the molded-plastic MCS assembly revealed a two-port arrangement consisting of a large tube, with an inside diameter of about 1¾ inches, and a small tube with an inside diameter of about ⅜ inch. Both tubes are covered at their outer ends with an acoustical-resistance material that restricts the flow of air in and out of the tubes. I informally tested the flow resistance of each tube by blowing into its open inside end. The large tube presented a very high resistance, which approached a closed condition. The small tube was easier to blow through but still had significantly high resistance. I judged that the larger tube was effectively closed and thus would have no effect on the system's response.

With the port assembly installed, and using a low-frequency swept sine wave, I could only detect air flow in the MCS port assembly through the smaller tube, and then only at frequencies below about 30 Hz and levels above 5 to 10 V rms. To check the effect of the ports, I replaced the MCS assembly with a piece of ¼-inch-thick hardboard cut exactly to the assembly's outside shape. After checking to make sure this arrangement had caused no air leaks, I made a

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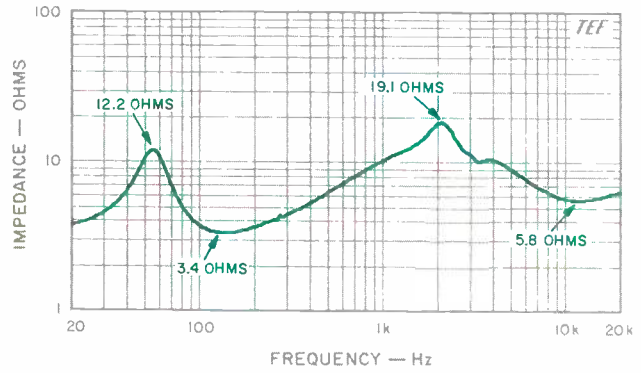


Fig. 8—Impedance.

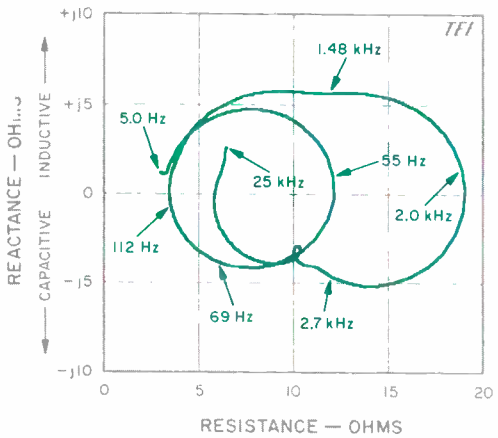


Fig. 9—Complex impedance, showing reactance and resistance vs. frequency.

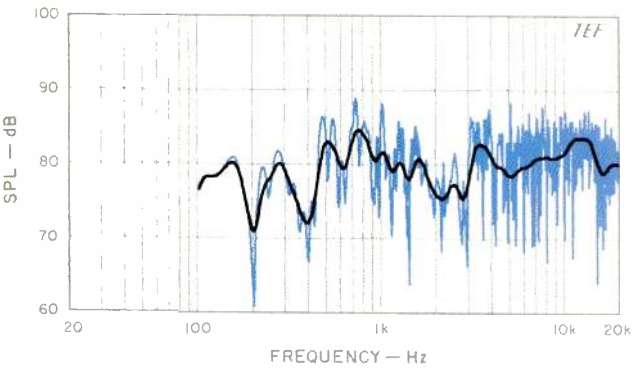


Fig. 10—Three-meter room response, showing both raw and smoothed data.

series of measurements comparing the speaker's performance both with and without MCS.

Traditional measurements revealed no differences in near-field woofer response except for very small effects (±0.3 dB) below 20 Hz, and there were no visible differences in cone excursion on high-level displacement using shaped, peak-power tone bursts. The impedance did decrease by 5% below 20 Hz with the covering plate in place, insignificant compared to the unit-to-unit impedance variations among the four systems. I could detect no audible differences on A/B comparison of a system with MCS and a system with my cover plate when the two were placed side by side and fed identical mono signals.

The 490MCS's impedance magnitude, plotted over the range from 20 Hz to 20 kHz, is shown in Fig. 8. No surprises here; the minimum impedance is only 3.4 ohms, a reasonable value for a 4-ohm rated system. The Quarts will still be quite sensitive to cable voltage drop because of the impedance's relatively high, 5.6-to-1 variation (from 19.1 to 3.4 ohms). Cable series resistance should be limited to a (low) maximum of about 50 milliohms to keep cable-drop effects from causing response peaks and dips greater than 0.1 dB.

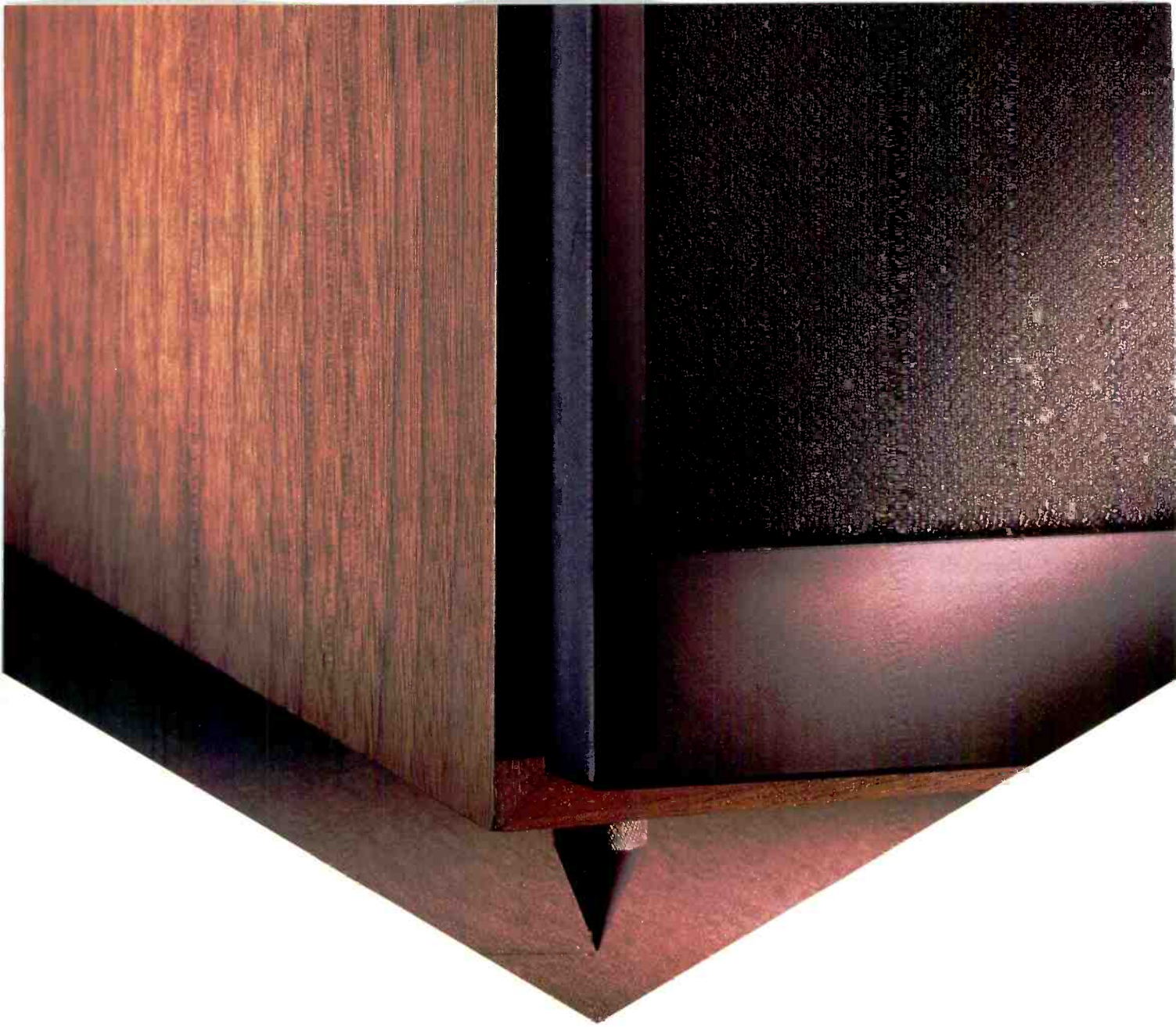
Figure 9 is a polar plot of the system's complex impedance. The smoothly changing spirals indicate no resonance problems. The phase angle of the impedance (not shown) reached a maximum of +40° (inductive) at the midrange frequency of 575 Hz and a minimum of −32° (capacitive) at the bass frequency of 72 Hz.

The 3-meter room curve, with both raw and sixth-octave smoothed responses, is shown in Fig. 10. The 490MCS was in the right-hand stereo position, mounted on a stand (which raised the tweeter to a height of 36 inches) and aimed at the listening location. The direct sound plus 13 mS of the room's reverberation were included. A main feature of the curve is a dip in the 2-kHz crossover region. This depression corresponds to the level decreases in the same frequency range that the rest of the response curves exhibit. Above 800 Hz, although somewhat rough, the smoothed curve fits within a resonable ±4 dB envelope. Below 800 Hz, the expected effects from room peaks and dips are evident.

Figures 11, 12, and 13, respectively, show spectra of single-frequency harmonic distortion versus power level for the musical notes of E_1 (41.2 Hz), A_2 (110 Hz), and A_4 (440 Hz). The power levels were computed using the rated system impedance of 4 ohms.

Figure 11 shows the E_1 (41.2-Hz) harmonic distortion data. At this frequency, the maximum power was limited to 50 watts (14.14 V rms), because my usual 100 watts generated excessive distortion and was clearly overloading the woofer. At full power, the second and third harmonics reached a significant 14.5% and 25.7%, respectively. The higher order harmonics were only significant above 2.5 watts. At 50 watts, the system generates a fairly loud 100 dB SPL at 1 meter at 41.2 Hz.

The A_2 (110-Hz) harmonic data is shown in Fig. 12. The second harmonic reached only 6.8% at full power, with the fourth rising rapidly above 40 watts to 2.3% at 100 watts. Interestingly, the third harmonic reached an intermediate high of 0.65% and actually fell at higher power levels. At 110 Hz, the system generates a loud 107 dB SPL at 1 meter for



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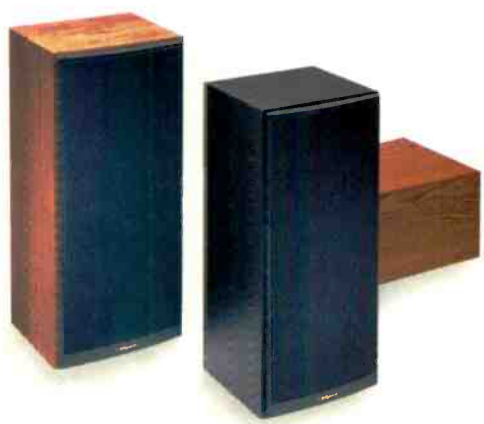

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On organ, the speakers' sound was so involving and well balanced that I just let the CD play and enjoyed the music.

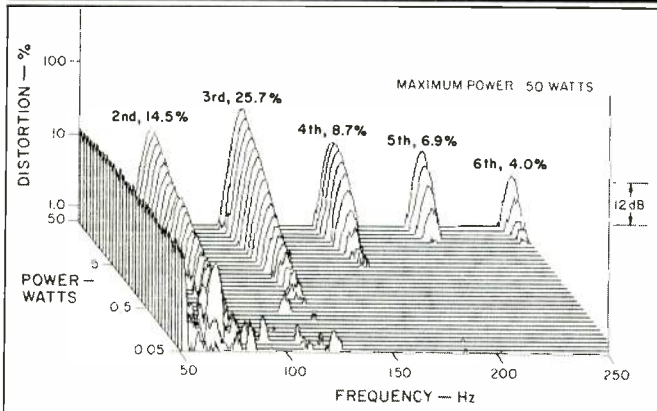

Fig. 11—Harmonic distortion products for the musical tone E_1 (41.2 Hz).

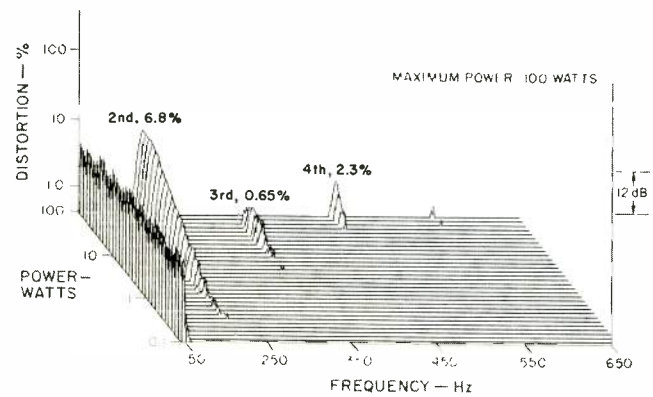

Fig. 12—Harmonic distortion products for the musical tone A_2 (110 Hz).

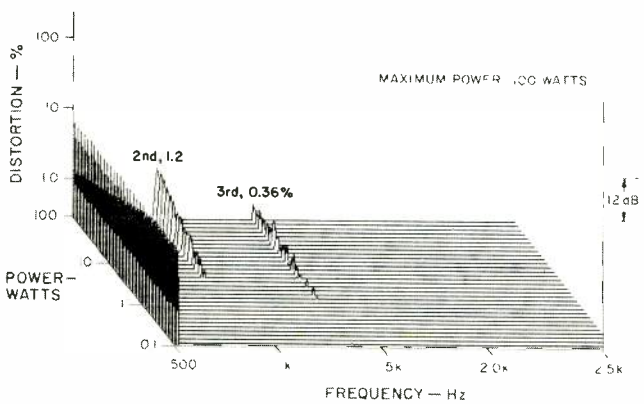

Fig. 13—Harmonic distortion products for the musical tone A_4 (440 Hz).

100 watts input. The A_4 (440-Hz) harmonic measurements, shown in Fig. 13, are quite low, with the second harmonic reaching only 1.2% at 100 watts.

The IM on a 440-Hz tone (A_4) created by a 41.2-Hz (E_1) tone of equal level is shown in Fig. 14. At 50 watts, the IM distortion reaches a moderate 14%, primarily consisting of only first- and second-order IM products.

Figure 15 shows the Quart's short-term peak-power input and output abilities. The peak input power was calculated by assuming a 4-ohm impedance; the maximum input power-handling capacity is shown in the lower curve.

The input power rises with frequency, reaching a level of about 400 watts at 100 Hz. Above this frequency, however, the maximum power actually decreases, due to severe distortion which changes the waveform to a triangular shape above 400 watts. As I had run into this effect before (see review of the B & W 801 Matrix Series 2 in the November 1990 issue), I suspected inductor overload in the woofer's leg of the crossover. A rerun of the test, with direct connection to the woofer, confirmed this hypothesis (see Fig. 15). The input power handling between 250 and 500 Hz increased by nearly 10 dB with the direct connection. At 315 Hz, the peak input power jumped from 245 watts up to 2.4 kW! The subjective audible effect of this increase was very dramatic. The maximum burst output in this range, with normal connection, sounded quite anemic. With direct connection, however, the output levels generated were quite impressive. In the tweeter range, above 3 kHz, the peak input power rose to nearly 7,000 watts (165 peak V) in the normal connection.

The upper curve in Fig. 15 shows the maximum peak sound pressure levels the system can generate for the input levels shown in the lower curve (normal connection only). Also shown on the upper curve is the "room gain" of a typical listening room at low frequencies. This adds about 3 dB to the response at 80 Hz and 9 dB at 20 Hz. A pair of the 490MCS speakers in a standard stereo setup, operating with common-channel bass, will be able to generate higher bass levels. The peak acoustic output rises very rapidly with frequency up to 100 Hz, where a maximum of about 110 dB is reached. After a moderate decrease, the output level continues to increase, attaining levels of about 125 dB SPL above 3 kHz. If not for crossover problems, the level in the range from 125 Hz to 2 kHz would be much higher.

Use and Listening Tests

Curiously, MB Quart provides no owner's manual or other information on the setup and use of the 490MCS. The only user information is a small guarantee booklet outlining the company's warranty (which is quite good, incidentally—a limited warranty for 5 years from date of purchase). The second set of systems I received allowed me the luxury of seeing both the oak and walnut cabinet finishes. Both sets were quite gorgeous, and the workmanship and cabinetry were top-notch.

Connection to the systems is through a pair of very accessible five-way binding posts on the bottom rear of the 490MCS, spaced about 1⅛ inches apart. Unfortunately, due to the posts' wide spacing, double banana plugs with standard ¾-inch spacing will not fit. Large, finger-twist

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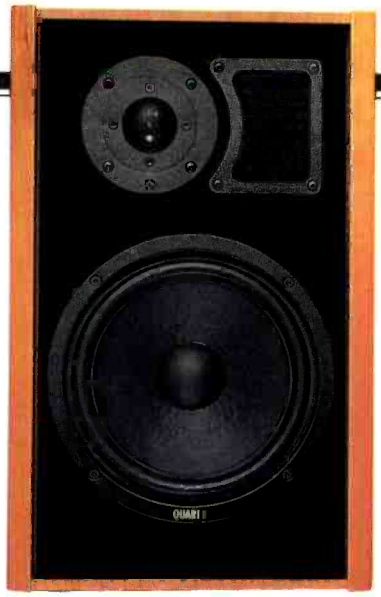
On live jazz tracks, the Quarts demonstrated very good presence as well as a sense of "being there."



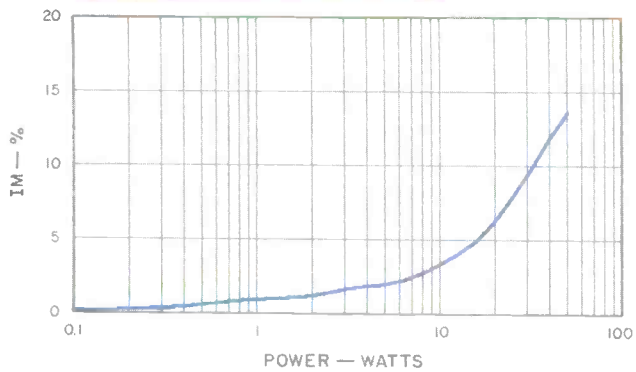


Fig. 14—IM distortion on 440 Hz (A_4) produced by 41.2 Hz (E_1) mixed in one-to-one proportion.

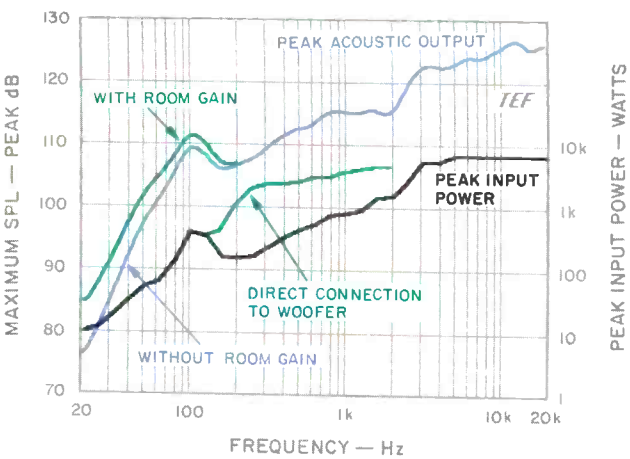


Fig. 15—Maximum input power and maximum peak sound output vs. frequency at 1 meter on axis; see text.

knobs and connection holes of 0.11 inch diameter easily allow connecting large wire, up to #10 AWG. No provision is made for bi-wiring or biamping.

Listening was done from my sofa, about 10 feet from the speakers, with the speakers 8 feet apart. To keep them well away from nearby reflecting surfaces, I set them up about 6 feet from the rear wall and 4 feet from the side walls. The systems were mounted on 22-inch-high stands, which placed the tweeter 36 inches above the floor, ear height. I drove the Quarts with my usual Rowland preamp and power amplifiers and connected them with Straight Wire cables. All listening was done with Compact Discs, mostly before the measurements were made.

First listening impressions of the 490MCS revealed a relatively uncolored presentation, with a moderate amount of high-frequency emphasis and an adequate but not overpowering low end. Imaging and soundstaging were first-rate, but a bit of upper midrange roughness was evident.

On track 1 of *Take Me to the Sun*, a jazz-fusion CD by Gil Evans (recorded live at the 1983 Montreux Jazz Festival, Last Chance Music LCM 002), the systems demonstrated very good presence and a sense of "being there." The bass line was rendered quite smoothly, and the Quarts did an excellent job of re-creating the high-level, sharp-transient sounds of the percussion instruments.

The voice of baritone Daniel Lichti on *Songs of Hugo Wolf* (Dorian DOR-90131) was re-created with much sonority and minimal strain. The low-level decaying piano and room reverberation sounds were dealt with very compellingly by the 490MCS.

The systems passed the pink-noise stand-up/sit-down test with only minimal tonal changes in the upper midrange. The noise test also clearly demonstrated that the systems were definitely brighter than my reference B & W 801 systems and had a somewhat rougher midrange. On third-octave band-limited noise, the Quarts became clearly audible at 32 Hz and came on strong at 40 Hz and higher; at 20 and 25 Hz, only low-order distortion products could be heard. Moving the systems toward the rear wall did improve performance at very low frequencies but at the expense of performance in the upper bass and midrange, which is highly room-dependent.

The emphasized high-frequency response of the 490MCS did create some vocal sibilance problems on some pop/rock material. And, yes, the systems can do justice to loud rock 'n' roll. To demonstrate this I played track 11, "Bad Girl," of ZZ Top's *Eliminator* (Warner 23774-2).

On Jean Guillou's *Vivaldi for Organ* (Dorian DOR-90118), the speakers exhibited a full, quite involving sound, with good balance, and did such a good job I let the CD play on for a while and just enjoyed the music.

The Quart 490MCS, although at the upper end of the price range for two-way, 8-inch systems, has demonstrated excellent performance value for the money and has stellar good looks with its fine hardwood cabinetry. Even though the MCS low-frequency technology did not quite live up to its billing, the system's bass response is still quite good for its class. If you're in the market for a bookshelf-sized or stand-mounted system, the 490MCS requires your thoughtful consideration. *D. B. Keele, Jr.*

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3

HARMAN KARDON HD7600II CD PLAYER

Manufacturer's Specifications
Frequency Response: 4 Hz to 20 kHz, +0, −0.5 dB.
THD: 0.003%.
S/N: 106 dB.
Dynamic Range: 98 dB.
Low-Level Linearity: ±0.2 dB at −90 dB.
Channel Separation: 93 dB.
Line Output Level: 2.0 V.
Digital Output: Coaxial, 0.5 V, peak to peak; optical, −18 dBm.
Number of Programmable Selections: 30.
Power Consumption: 20 watts.
Dimensions: 17 7/16 in. W × 4 1/16 in. H × 14 in. D (44.3 cm × 10.3 cm × 35.6 cm).
Weight: 18.9 lbs. (8.6 kg).
Price: $699.
Company Address: 8380 Balboa Blvd., Northridge, Cal. 91325.
For literature, circle No. 92

Harman Kardon was one of the first companies to use one-bit D/A converters, and I was very favorably impressed with the way they have implemented this technology. The HD7600II CD player uses bitstream one-bit technology (see sidebar), which involves pulse-width modulation (PWM) in its D/A signal processing. The bitstream converter in the HD7600II operates at 33.8688 MHz. The circuitry also includes a discrete analog output section with 34 separate transistors and 8,480 μF of power-supply filter capacitance. Four separate power supplies are employed for the digital, analog, transport, and display sections. About 3 pounds of steel plates are built in to inhibit vibration, and a three-beam laser pickup is used. Among this player's features are a 30-selection program memory, a "music calendar" display, audible two-speed cue and review, index search (via the supplied 27-key remote control), a display on/off switch, coaxial and optical digital outputs, A/B repeat, fixed and variable analog outputs with gold-plated jacks, a headphone output jack, and an output level control.

Control Layout

The "Power" switch is at the extreme left of the front panel, adjacent to the CD drawer; the "Open/Close" button is just to the drawer's right. A large display further to the right shows the current function, selected by means of pushbuttons at the extreme right: "Repeat," "A-B" repeat, "Program" mode, program "Clear," "Intro Scan" (to play the first 15 S of each track or of each programmed track), "Time" (to select either elapsed time of the current track, time remaining for the current track, or time remaining for the disc), and "Check," which performs several functions. With a disc loaded but not in play, repeatedly pressing "Check" displays the time of each track on the disc. In the program mode, pressing "Check" displays cumulative times of programmed tracks—with one push showing the time of the first track, two pushes showing the times of the first and second tracks, and so on. An eighth pushbutton, "Display," turns the entire display off or on. A motorized "Output Level" control and the headphone jack are at the lower right corner of the front panel, along with a switch that turns the digital output on or off.

A row of numbered buttons (including "+10" for accessing or programming track numbers higher than 10) is arranged horizontally beneath the display area. Beneath them are the usual transport pushbuttons, including those for track skipping and audible fast scanning.

Two functions not found on the front panel are available from the remote control. These are forward and reverse "Index" search, for CDs that have index points marked within tracks, and a "Space" button that inserts a 4-S pause between tracks. This is useful when recording onto cassette for playback in decks having a search feature.

The rear panel of the HD7600II is equipped with pairs of variable- and fixed-level output jacks. There are two digital output jacks as well, one coaxial and one optical.

Measurements

Figure 1 shows the frequency response of the HD7600II. At 20 kHz, response is down a minuscule 0.19 dB for the left channel and 0.13 dB for the right.

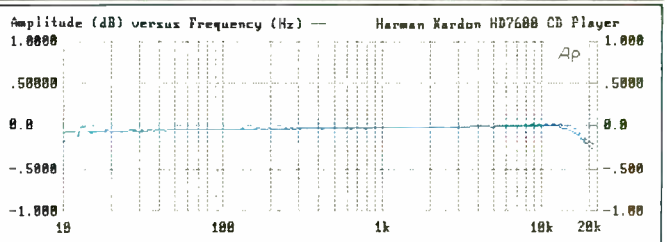

Fig. 1—Frequency response of left channel (solid curve) and right channel (dashed curve).

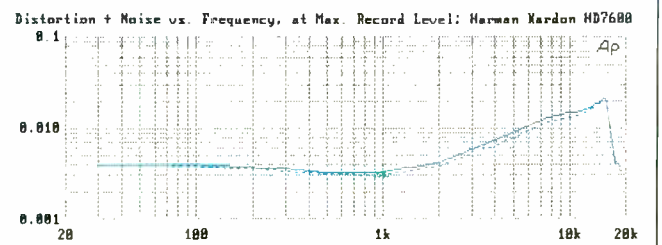

Fig. 2—THD + N vs. frequency at maximum recorded level (0 dB).

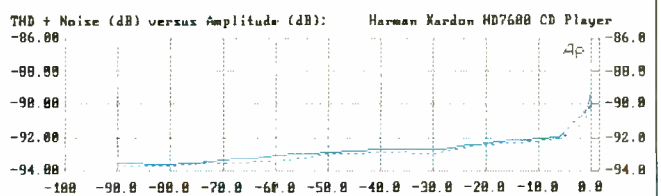

Fig. 3—THD + N vs. level for a 1-kHz tone.

Figure 2 shows how THD + N varies with frequency, for a signal recorded at maximum level (0 dB). At 1 kHz, for each channel THD + N is slightly higher than 0.003%. A slight rise occurs as higher frequencies are approached, with a maximum reading of 0.022% at around 15 kHz. Figure 3 shows how THD + N varies with recorded signal level. The results are in dB, referenced to maximum recorded level. Credit must be given to Harman Kardon's discrete output stages, which introduce only a very slight increase in THD + N as the highest output levels are reached. Many CD players exhibit a steep rise in THD + N as higher and higher output levels are approached. In the case of this CD player, THD + N ranges from −93.5 dB to −92 dB over most of the test signal's amplitude range, and it increases to

The HD7600II has superb linearity, extremely low distortion, flat response, and inaudible noise.

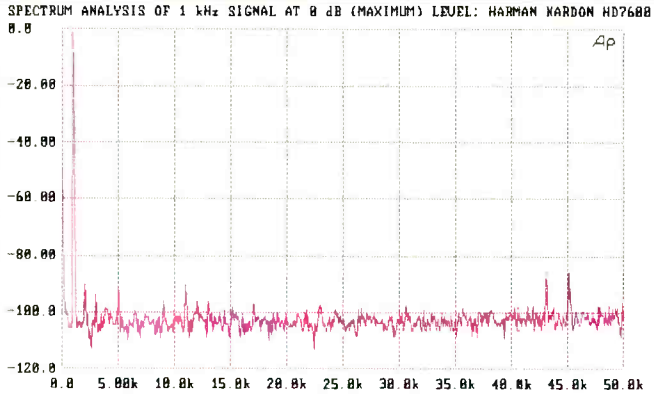

Fig. 4—Spectrum analysis of a 1-kHz signal at 0-dB recorded level.

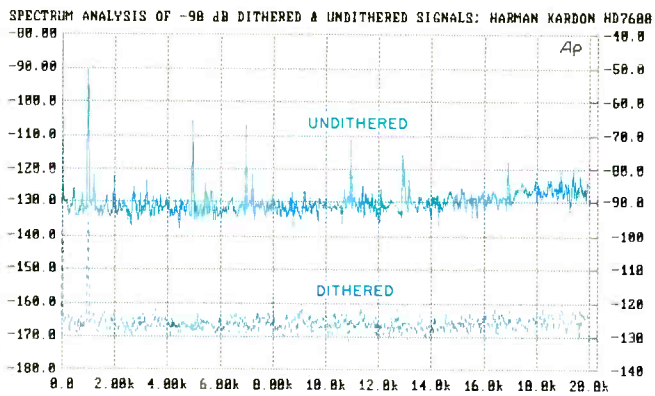

Fig. 5—Spectrum analyses of 1-kHz signals at −90 dB recorded level. Use left-hand scale for top curve, right-hand scale for bottom curve.

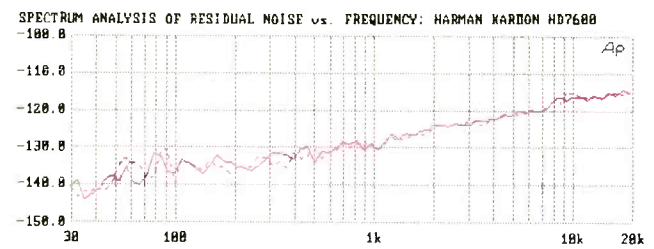

Fig. 6—Spectrum analysis of residual noise when playing "no-signal" test track.

only −89.3 dB on one channel and about −90 dB on the other at maximum level. These readings at 0 dB correspond to 0.00342% and 0.00316%, almost perfect correlation with the results at 1 kHz for the 0-dB signal seen in Fig. 2.

Figure 4 is a spectrum analysis of a 1-kHz signal at 0 dB. The signal itself is seen as the tall spike at the left, while harmonic components are visible at 2, 3, 5, 9, and 11 kHz. Most of these components are down by about 90 dB or more. Notice the two little "blips" that show up at around 43.1 and 45.1 kHz. They are obviously minute beats caused by the interaction of the 1-kHz signal with the CD's 44.1-kHz sampling rate. These beats are more than 85 dB below maximum recorded level, however, and even if their level were higher, their frequency would make them inaudible.

The ability of a properly dithered signal to exhibit lower distortion than an undithered signal of the same amplitude (−90 dB) is dramatically demonstrated by the spectrum analyses in Fig. 5. Note the high levels of fifth-, seventh-,

Multi-Bit and One-Bit D/A Conversion

A digital recording is made by sampling the input signal's voltage several thousand times per second, encoding each of these voltage readings, and then recording the coded data. For CD recording, samples are taken 44,100 times per second and are encoded as 16-bit binary numbers. The D/A converter's job is to turn those 16-bit numbers back into the discrete voltage values of the original signal. Basically, there are two ways to accomplish this.

In a typical multi-bit system, the voltages represented by the presence or absence of 1s in all 16 bit locations are applied simultaneously to a ladder-type converter that sums their outputs. For example, if the sample is:

0001001001011101

and if the least significant bit corresponds to a value of 1 μV, this sample would be equivalent, in microvolts, to:

0+0+0+4096+0+0+512+0+0+64+0+16+8+4+0+1

or 4,701 μV out of a possible maximum of 65,535 μV (the voltage that would be delivered if each bit in the 16-bit string were a 1).

An alternate way of accomplishing the same conversion would be to use a single-bit D/A converter capable of delivering only 1 μV at a time, but to serially (and very, very rapidly) feed that single microvolt along with all the information contained in all 16 bit locations of each sample. In essence (and greatly oversimplified), that is the theory behind the one-bit D/A conversion schemes. While individual approaches to one-bit D/A conversion differ, all of the designs must use very high sampling rates and internal clock speeds so that information normally applied to the 16 locations of a ladder-type D/A converter can be applied to the one-bit converter in the same short time (1/44,100 of a second). Benefits claimed for the one-bit conversion technique include superb low-level linearity (a goal not always obtained with more conventional D/A converters unless somewhat costly techniques are used) and freedom from phase irregularities. *L.F.*

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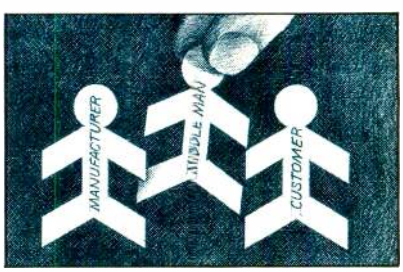

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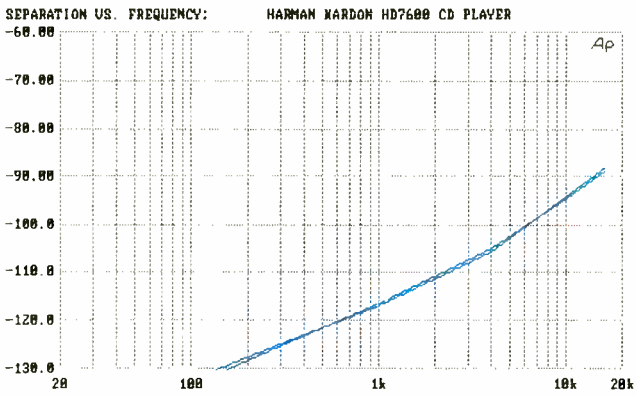

Fig. 7—Separation vs. frequency.

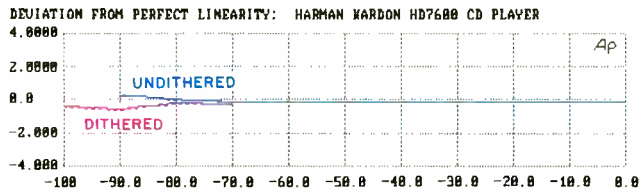

Fig. 8—Deviation from perfect linearity.

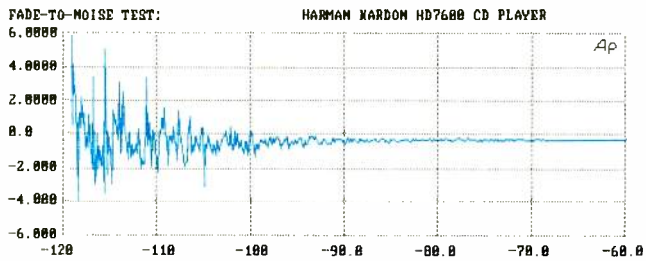

Fig. 9—Fade-to-noise test, using dithered signal.

and 11th-order distortion components for the undithered signal. By contrast, these components virtually disappear into the noise when a dithered signal is used. For the undithered signal, the fifth-order distortion component, 5 kHz, is down some 104.5 dB, whereas for the dithered signal, distortion plus noise at that same frequency is down a full 128 dB—an advantage of 23.5 dB!

A-weighted S/N, using the "silent" track of my CBS CD-1 test disc, measured exactly 109 dB for each channel, well above the 106 dB claimed by Harman Kardon. A spectrum analysis of the output from that same track is plotted in Fig. 6. This player's excellent isolation of power-supply components from the rest of the audio circuitry is amply demonstrated by the fact that there are only the barest "bumps" in the plot at 60 and 120 Hz. At the power-line frequency, these small peaks are some 132 to 134 dB below maximum recorded level.

Stereo separation, plotted in Fig. 7, is virtually identical for both channels, measuring 116.6 dB at 1 kHz. At 16 kHz, separation decreases to 87.8 dB.

Figure 8 shows deviation from perfect linearity with undithered signals ranging from 0 to −90 dB and dithered signals ranging from −70 to −100 dB. It is interesting to note that although the deviation is certainly minimal for undithered signals (less than 0.5 dB of error at −90 dB), the use of dithered signals at even lower levels results in a deviation of no more than −0.2 dB at −100 dB! Again, this illustrates how effective a bit of properly applied dither can be in reducing quantization distortion in low-level signals. (Engineers in major recording studios, take note!)

Figure 9 is my usual plot of a dithered fade-to-noise signal. Again, signal levels are almost perfectly accurate until they become buried in the residual noise, below about −105 dB. This plot enabled me to assess the EIA dynamic range of the player, approximately 108 dB. Measured by the EIAJ method, dynamic range was 94 dB.

A couple of additional spot checks I made while the player was on the lab bench included a check of SMPTE-IM distortion, which was 0.0066% for either channel, and frequency or clock accuracy, which was "off" by an insignificant −0.0021%. My check with a unit-pulse test signal (not shown) demonstrated that the HD7600II does not invert signal polarity.

Use and Listening Tests

The Harman Kardon HD7600II's linearity is superb. Its distortion is extremely low. Frequency response is as flat as anyone could hope for, and residual noise is inaudible. Furthermore, the sound quality couldn't be better, as I discovered when I played some of my most treasured CDs, including some that had sounded a bit harsh on earlier players. I used to blame this harshness entirely on the recording engineers. Now I know better; some of what I complained about was entirely the fault of the CD players I used. Well, that harshness is gone when those discs are played on the HD7600II.

Tracking ability, however, was less than exemplary, at least for my sample. I would hasten to add that this may or may not be true for other units, since good tracking depends on many factors, not the least of which is accurate alignment and adjustment of the laser pickup assembly. In any case, the player I tested mistracked when a defects disc presented it with "missing" data extending just 0.5 mm along a track. Almost every player I've tested over the last couple of years has been able to track through data gaps of at least 0.7 mm, and some have even tracked through 1.2 or 1.5 mm of missing digital data. Perhaps some jarring in shipment caused the problem with my sample. Even if that is not the case, however, I can recommend this CD player with its bitstream technology and its superb sound quality to anyone who is more than a casual listener to music but can't afford the kilobucks demanded by other high-end players that sound as good as this model from Harman Kardon.

Leonard Feldman

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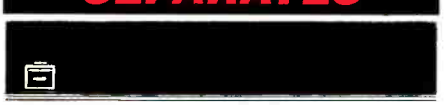

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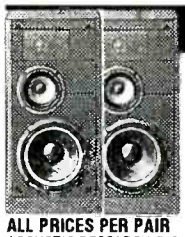

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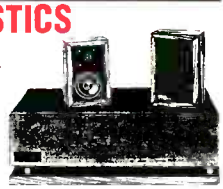

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BERLIOZ BLITZ

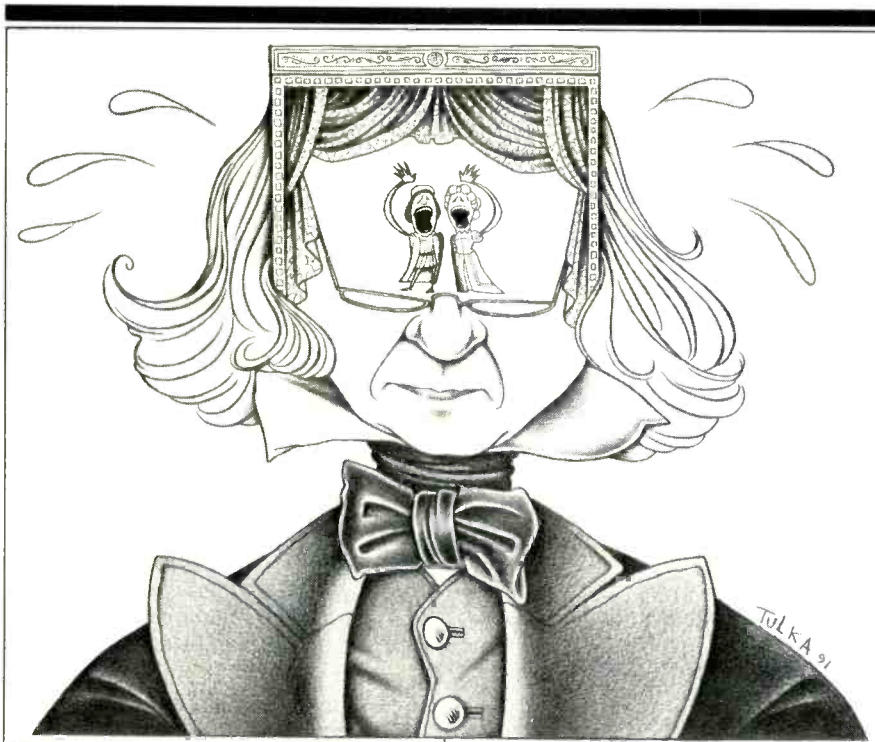

Illustration: Rick Tulka

Berlioz: La Damnation de Faust. Maria Ewing, soprano; Dénes Gulyás, tenor; Robert Lloyd, baritone; various choruses and Frankfurt Radio Symphony Orchestra, Eliahu Inbal.
Denon 81757 9200 2, two CDs; DDD; 2:06:51.

Berlioz: L'Enfance du Christ. Margarita Zimmermann, soprano; John Aler, tenor; Eike Wilm Schulte, baritone; Stanfford Dean, bass; various choruses and Frankfurt Radio Symphony Orchestra, Eliahu Inbal.
Denon 81757 6863 2, two CDs; DDD; 91:22.

Berlioz: L'Enfance du Christ. Anne-Sofie von Otter, mezzo-soprano; Anthony Rolfe-Johnson, tenor; Gilles Cachemaille, baritone; José Van Dam, bass; Monteverdi Choir and Lyon Opera Orchestra, John Eliot Gardiner.
Erato 2292-45275-2, two CDs; DDD; 95:22.

The term "theater of the mind," while coined for radio, applies as aptly to the oratorios—sacred and secular—that have been penned by composers from Handel to Honegger and beyond. Of these, none ever used the form (under whatever name) more brilliantly than did Hector Berlioz. Here we have two of his three major theater-of-the-mind works (the third being the "dramatic" symphony "Roméo et Juliette," of course), with the least known twice represented.

The *Damnation of Faust* has been produced as an opera, basically a thankless undertaking. How can any stage spectacle equal the awesome vision conjured up by Berlioz's "Ride to the Abyss," for instance? Throughout, the action is strictly within the mind of the auditor. Some sections are dramatically static; others show panoramas so vast no opera house could contain them. Recordings are arguably the ideal way to encounter such a score.

Eliahu Inbal's approach is big and splashy. It makes the most of the drama almost throughout. The biggest exception, unfortunately, is the crucial "Ride," which is not as carefully thought out as Ozawa's (Deutsche Grammophon 2709 048) or Munch's (RCA Victor LM6114) on LP and consequently lacks the exceptional impact that Inbal manages elsewhere. Still, the excellent choral work and fine orchestral sonics—all captured with a dynamic range unknown on LPs—keep the Inbal in contention.

The sound is big, with a nice but not very specific sense of space. It was recorded in Frankfurt's rebuilt opera house, but similar results might have been achieved in a first-rate studio with sufficient care. On climaxes, the sound does tend to become congested despite its outstanding transparency in the less densely scored passages.

The singers are well chosen for the piece. Dénes Gulyás, as Faust, has an all-stops-pulled style reminiscent of the late Raoul Jobin. Maria Ewing has just the right hint of vocal smokiness to catch Marguerite's wistful earthiness. Robert Lloyd comes on as a singing actor: The gravel that sometimes enters the voice merely suggests an appropriately dissipated Méphistophélès. All three overextend themselves occasionally on climaxes, though one notices it least in Lloyd's case.

L'Enfance du Christ is subtitled a "trilogie sacrée," which sometimes is translated as "sacred triptych." The suggested reference to the "Flight into Egypt" panels of the Flemish masters is appropriate, and—though it's hard to believe today—parts of the piece were passed off as rediscovered antiquities until Berlioz owned up to their authorship. The mistaken attribution proved that his music had solid links with the past despite its rejection as too radical by the French academic oligarchy. It reflects the simple, direct faith and naiveté of an earlier time, and it includes "old-fashioned" musical forms: The chorale, for instance, which serves as a lullaby for the infant Jesus.

This aspect of the work often leads to performances with a chamber "feel" that you might expect in, say, a Cherubini mass. Not so Inbal's conception, which reminds us at every turn that this is Berlioz, the orchestrator who led the way to Gustav Mahler and Richard Strauss. He has assembled large, capable forces similar to those for *Faust*, and Denon recorded them in the same venue with comparable sonic results.

The soloists are different: All competent, at minimum, though none is outstanding. "Serviceable" might be a good word for the recording as a whole. While it won't induce me to chuck the old Cluytens/de los Angeles/Gedda version on Seraphim LPs (SIB-6125), it's a good reading unless you insist on smaller forces and more intimate sound.

If you like the Denon *L'Enfance*, you may love the Erato. Though it's similar

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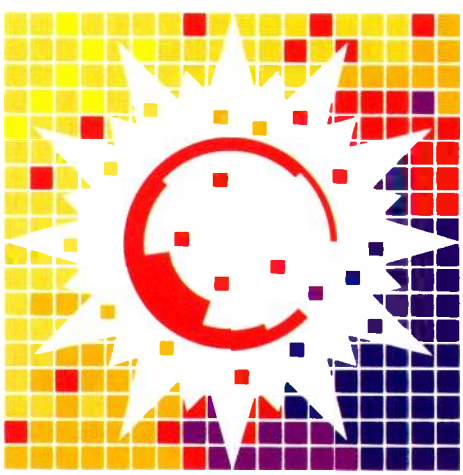

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Photograph: Martin Beckett

The Domus ensemble offers music of young Mendelssohn, but it is not childish; rather, it is as charming as anything he ever wrote.

in some ways, it outpoints the Frankfurt recording on almost every score. The sound is superb. Erato chose a Romanesque church near Lyon for its venue and miked its wonderful ambience to perfection: The dimensions of the church are always palpably present, but never do they blur or obscure the slightest musical detail. The engineering team deserves the Légion d'honneur.

Then there's Van Dam, whose Herod is the most fully realized I've heard. He is so convincingly unsettled by Polydorus' entrance after "Toujours ce rêve" that you may turn to look for an intruder yourself. Anthony Rolfe-Johnson is unfortunately miscast as the Narrator. The quality of his voice is much more attractive than John Aler's on Denon, and he certainly does some fine singing. But he is strictly a lyric tenor, and the Narrator requires a more stentorian thrust.

The star, and the startlement, of the recording is certainly John Eliot Gardiner. Here is a conductor whose name has become synonymous with the playing of "old" music on period instruments, essaying Berlioz—whose music has recently been discovered by the period-instrument set—and playing it like something between Brahms and Verdi! Brahms, because the roundness of sound Gardiner gets from the winds, together with the numbers and prominence of the strings, minimizes the winds' plangency and literally imparts a Brahmsian sound to the orchestral mix at times. Verdi, because it is so dramatic—even melodramatic, in the urgency of Mary and Joseph as they entreat shelter in Egypt. But it works. Like it or not on musicological grounds, I have never heard its equal, as theater of the mind, in any other recording of the piece. *Robert Long*

Mendelssohn: Piano Quartets 1, 2, and 3. Domus.
Virgin Classics VC 7 91183-2, CD; DDD; 79:16.

Domus is the name of a chamber music ensemble whose composition varies, I assume, with the repertory. Here it consists of Krysia Osotowicz, violin; Timothy Boulton, viola; Richard Lester, cello, and Susan Tomes, piano. All play with engaging energy and commitment on this recording, and I hope we hear a lot more from them.

It is the music itself that commands the attention, however: The first three opus numbers of the teenaged Mendelssohn. Perhaps the early opus numbers or knowledge of the composer's age have proved off-putting; I can think of no other concrete reasons for the quartets' neglect. There certainly is nothing "childish" about them. They are as brimming with the Mendelssohn charm as anything he ever wrote, though admittedly he would manage more depth later in his career.

Yet depth isn't everything. If it were, it would not have been worth our while rediscovering Mendelssohn's immediate predecessors—Johann Nepomuk Hummel, John Field, and Ignaz Moscheles, to name three. Too long has their music, and much of Mendelssohn's, languished in the shadow of titans. Mendelssohn's grace and limpid poetry grow directly out of their style and owe less to Schubert, Beethoven, and Haydn than what we have tried to find there, thanks to the Beethoven-ocentric "music appreciation" upbringing that has so deeply colored American sensibilities.

Consider: What comes after Schubert? Schumann and Brahms? How, then, does one explain Donizetti and Bellini—by citing Rossini? Their delicacy and sentiment were, like Mendelssohn's, a product of the early Romantic movement that Beethoven somehow skipped over while its seeds were germinating among his contemporaries. Some 50 years ago, "Romantic" and "sentiment" were terms of disparagement among American musical cognoscenti. We have gotten beyond that, I surely hope.

The recording? Perhaps a hair more luscious than is good for the music—I would have preferred a more intimate sound—but more than acceptable. Don't buy the record for that or for its value (80 minutes for the price of one CD ain't bad); buy it for the music, and be prepared to be charmed not just by Mendelssohn's precocity, but by his sheer musicality. *Robert Long*

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Lambert Orkis' genius is his fantastic ability to discern what old pianos could do for the composers of their own time.

Schubert: Impromptus, D899 and D935. Lambert Orkis, fortepiano. **Virgin Classics VC 7 91142-2,** CD; DDD; 63:05.

Piano lovers should come to quick attention when they see the odd name Lambert Orkis on a record label. This somewhat mousey pianist is one of the powerhouses of *recorded* piano music (though he plays live too). He puts out both contemporary piano and "historical" works, but his genius is a fantastic ability to discern what the old pianos could do for the composers of their own time—and to bring it to the microphone in dramatic musical fashion. Here he plays solo on an 1826 Graf fortepiano, of Schubert's own time and place, Vienna. This is no copy but an original, kept in stunningly perfect condition. And, moreover, it was built in a place only "a few doors" away from the living Schubert himself, who could have strolled down the block and put his chubby fingers on this very keyboard! The piano is one year older than the music.

The rather lengthy Impromptus are late Schubert, single movements in extended form, mega-songs if you will, full of splendid melodies but also a vast expanse of repetitive accompanying figurations, the bane of many a pianist trying to make musical sense out of them. All too often, pianists "hush them up," relegating the fingerwork to the background, pounding out the melodies to make them heard. Ten minutes of this disc should show any receptive pianist the futility of *that* procedure!

On this instrument, still full of the varied colors (the sharp clanks and buzzes and the metallic edges contrasted with pearly soft tones) that persisted in pianos through half the 19th century and more, it is simply impossible to subjugate the running accompaniments; neither is it necessary to "bring out" the melodies—they are entirely clear in spite of the figurations, which surround them with colorful arabesque-like settings. NOW we know what Schubert should sound like!

This remarkably perfect piano, more than 150 years old, is preserved in Holland in an ancient building evidently of stone, and this is a mild problem in the acoustical surround. The instrument itself is beautifully miked, but the diffuse acoustic is the sort that tends to blur the harmonies together. Not seriously, and in a few moments (as "live" on the spot, without a doubt) our ears put this small impediment aside. A closer miking would have exaggerated the prominent piano colors—the recording has them in ideal balance.

Edward Tatnall Canby

Fauré: Piano Quartets, Nos. 1 and 2. The Ames Piano Quartet. **Dorian 90144.**

The French say Gabriel Fauré (1845 to 1924), like some fine wines, doesn't travel well; the rest of the world has never accorded him the major position he enjoys in France. Especially his first quartet ranks with the greatest chamber works, and about 3½ minutes into its finale you realize once again that musical inspiration has supernatural origins. Solid, musicianly performances, and superb technology in an acoustic jewel of a hall, make this something special for audiophile music lovers. *Paul Moor*

Huapango: Various Mexican composers. Xalapa and Mineria Symphony Orchestras, Herrera de la Fuente. **O. M. Records 80135.**

This mixed Mexican bag ranges musically from near-pop stuff (Moncayo) to modern Mexican classic (Chávez), but it stands out because of the pieces by that still insufficiently known, underappreciated phenomenon Silvestre Revueltas (1899 to 1940), a sort of Mexican cognate of Charles Ives. The performances, recorded in concert, do the music justice; thanks also to bright recording, this CD reveals things in Galindo's delicious piece you never heard in Carlos Chávez's wonderful old first recording of it. *Paul Moor*

IN A DIFFERENT LIGHT

Nothing But a Burning Light: Bruce Cockburn
Columbia CK 47983, CD; AAD; 60:24.
Sound: A– Performance: A

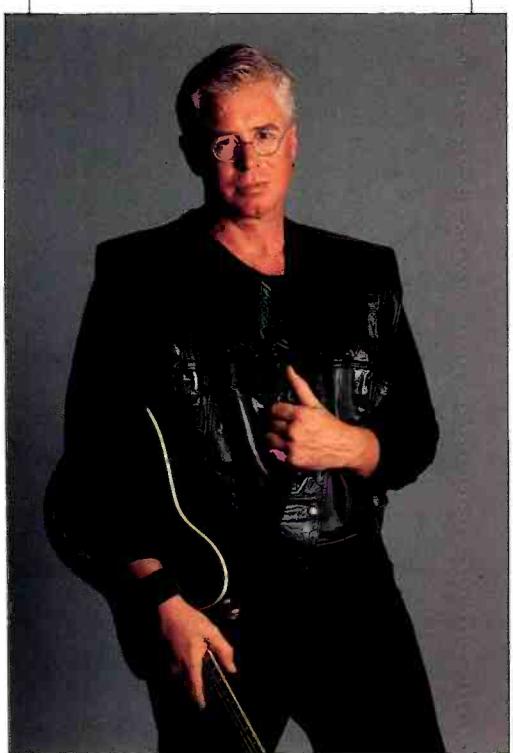
Bruce Cockburn, a Canadian, has long been an exceptional writer whose songs are not afraid to make a point in vivid, sometimes startling terms. "If I Had a Rocket Launcher" (recently covered by U2) comes to mind. He is also a superb guitarist and a very inventive melodist whose instrumental skill has produced some terrific vehicles for his messages. His flaw has been that he occasionally crosses the line to being preachy and strident.

With the involvement of producer T-Bone Burnett, *Nothing But a Burning Light* includes a totally different set of musicians than Cockburn has ever worked with. Among them are organist Booker T. Jones, drummer Jim Keltner, Nashville violin ace Mark O'Connor, and bassists Michael Been (of The Call), Larry Klein, and Edgar Meyer. The result is a record with a lighter, more lilting feel than Cockburn's previous efforts, owing especially to Burnett's penchant for spare arrangements. One touch that stands out is the washboard Keltner plays on Cockburn's cover of the 1930-vintage Blind Willie Johnson blues "Soul of a Man," which contains the album's title line.

This is one of the strongest collections of songs Cockburn has recorded—a mystery tour through a lot of places, some hopeful, some grim and bloody, some very private. As always, his religious faith is a beacon, but not always overtly. The opener, "A Dream Like Mine," sets forth his vision of what can and should be. It quickly segues to the darkest statements of the album—his portrait of the government-sponsored scorched-earth drive executed by "Kit Carson," a tale of failing factories and the jobless in their wake in "Mighty Trucks of Midnight," and "Soul of a Man." These are immediately counterbalanced by the upbeat "Great Big Love" and the gorgeous "One of the Best Ones." Taking another dark turn, "Indian Wars," a duet with Jackson Browne, is a bitter screed against the white man's harsh treatment of the Native Americans, but this bitterness is cushioned by a pair of fine instrumentals, "Actions Speak Louder" and "When It's Gone, It's Gone," then ultimately balanced by the album's closing hymn to nature, "Child of the Wind."

If you haven't encountered the provocative and melodic songs of Bruce Cockburn, *Nothing But a Burning Light* is an excellent place to begin. It's simply one of his best. With Burnett's light-handed turn at production, this album is more fun to listen to than what Cockburn has done in ages. It is a collaboration that bears further exploration.

Michael Tearson



Photograph: ©David Gahr

The Essential King Crimson—Frame by Frame
Virgin EG CAROL 1595-2, four CDs; AAD/ADD; 4:22:29. (Available from Caroline Records, 114 West 26th St., New York, N.Y. 10001.)
Sound: B+ Presentation: B+

This landmark British art-rock band is no stranger to compilations. *The Young Persons' Guide to King Crimson* (1976) and *The Compact King Crimson* (1987) each appeared as a double LP; the latter also was condensed onto a single CD. But the LPs are out of print, and the CD is terribly incomplete. So now we have *The Essential King Crimson—Frame by Frame*, a four-CD box set that, like previous compilations, is a personal selection by guitarist Robert Fripp.

The expanded space allows Fripp to include almost everything from *Guide* and *Compact* and to go much further, giving the best representation yet of the band's work. *Lizard* ("Bolero") and *Islands* ("Ladies of the Road" and "The Sailor's Tale") are both represented. Plus, two crucial albums—the 1969 debut, *In the Court of the Crimson King*, and the 1981 launch of the reformed band, *Discipline*—are here nearly intact. The set's biggest bonus is a disc filled with nine live tracks, all previously unreleased (except "Asbury Park" from *USA*) and including a free-form exploration of Donovan's "Get Thy Bearings" and a pounding interpretation of "Mars" from Gustav Holst's "The Planets" (both recorded in 1969), a refreshened "21st Century Schizoid Man" by the *Larks' Tongues in Aspic* lineup (1973), and piercing versions of "Indiscipline" (1982) and "Sartori in Tangiers" (1984).

As on *Guide*, Fripp has edited some of the studio material. A few remixes comfortably add new bass and vocals. More important, Fripp nips and tucks on four "abridged" tracks. The results are usually sensible, although I would have preferred keeping the midsection of "Fracture." Inexcusable, however, is Fripp's surgery on "Starless," the finale of *Red*, which stops dead after the ballad intro; gone are eight minutes of some of the most exhilarating, most *progressive* rock the '70s generated. This truncation is like halting "A Day in the Life" after the *first* orchestral crescendo.

The gorgeous 64-page booklet (accompanied by a separate family tree of the band's myriad progenitors/offspring) provides discographical credits, a list of the band's gigs, plenty of rare photographs, and an updated reprint of *Guide*'s massive chronology. In addition to remarks by Fripp, that chronology gathers ads, articles, reviews, and interviews—followed by a rebuttal

of sorts in "A Personal Note from Robert Fripp," which is sometimes literate and sometimes pedantic.

Aside from the remixes, all studio tracks are the remasters from Caroline Records' "Definitive Edition" CDs of 1989. For the most part, the sound is fine and certainly a great improvement in depth and detail over the original Crimson CDs released in 1987. If the live recordings from '69 strike your ears as rudimentary, think of them as relics of an age and be glad that they exist at all. And take heart that in these increasingly conformist times, *Frame by Frame* reminds us how wonderfully schizophrenic rock can be.

Ken Richardson

Trompe Le Monde: The Pixies **Elektra 9 61118-2,** CD; AAD; 39:04.

Sound: A Performance: A–

Paradoxes crisscross The Pixies' *Trompe Le Monde* like skid marks after a freeway accident, creating a stimulating multi-layered montage of punk, pop, and poetry.

At times this can mean moments of strange, almost delicate beauty, as on the tribute to the French aerodynamics innovator "Alec Eiffel," which wraps themes of misunderstood youth and visionary achievement in a wall of wailing guitar distortion filled with an angelic choir of close vocal harmonies. At other times, as on "Bird Dream of the Olympus Mons," it's raw primal energy juxtaposed with pleasant pop melodies, sounding much like The Velvet Underground (a band clearly emulated), with abstruse expressionist lyrics. Sometimes The Pixies just set their music machine on "stun" and thrash out tunes that mix industrial rock with a carnival organ (the title cut), surf rock with punk aggression ("Head On"), hardcore noise with the sparse strains of an Indian raga ("Space [I Believe In]"), love songs from Mars, odes to Native Americans who have a good tolerance of heights, and the magnificence of nature as glimpsed in colonies of brine. Brine?

In no sense is The Pixies' music easy listening. The oblique lyrics take brainwork (you can read them, fortunately), while the grating grunge of Joey Santiago's guitar and the pounding drive of the rhythm section maintain an insistent, nervous edge that can make an unexpected turn at any moment. But, unless you like music that's smart, unpredictable, and *not* clichéd, don't listen to The Pixies. *Michael Wright*

City of Hysteria: Pulnoc. **Arista 07822-18668-2.**

Czechoslovakian President Vaclav Havel's house was once burned down by police for allowing this band's predecessor, Plastic People of the Uni-

Pulnoc

Juilliard-bred Mark Wood designs his own electric violins, and his music owes more to Led Zeppelin than to Mozart.

verse, to record there. Pulnoc (pronounced "Pool-notes" and meaning midnight) blends moody semi-industrial keyboard grooves with '60s-inspired psychedelic fuzz-guitar solos. Most of Pulnoc's songs chug forward in long Euro-dance repetitions and are cast in dark, brooding minor keys. With titles like "Destroying Angel," "End of the World," and "I Sweep but Don't Clean," you can guess that this isn't a group of exchange students performing "Up with People." Still, there's a compelling cathartic effect that emerges from Pulnoc, and you can be sure *City of Hysteria* isn't the same ol', same ol' of most contemporary pop rock. *Michael Wright*

Shades of Two Worlds: The Allman Brothers Band. **Epic EK 47877.**

The big surprise here is how much this new album feels like the fabled first two Allman albums. Warren Haynes' guitar chemistry with Dickey Betts favorably compares with Duane Allman's work. Songs are solid throughout, and the 11-minute "Nobody Knows" is riveting. Super all-digital sound. *Michael Tearson*

Voodoo Violince: Mark Wood. **Guitar Recordings 88561-5040-2.** (10 Midland Ave., Port Chester, N.Y. 10573.)

Playing an assortment of self-designed electric violins, including a fretted double-neck six- and nine-string, a "Flying V," and a MIDI fiddle, the Juilliard-trained Mark Wood (with his power trio) saws through 10 instrumentals. As you may expect, they owe more to Led Zeppelin and melodic metal than to Mozart. If your ears hear more guitar than violin, it may have to do with the existence of frets on Wood's violins, along with his use of guitar amplifiers and effects boxes. Wood also has a knack for a catchy tune, which makes *Voodoo Violince* good listening as well as mighty curious. *Michael Wright*

Shake Me Up: Little Feat. **Morgan Creek 20005-2.**

After the jazzy but obtuse *Representing the Mambo*, Little Feat returns to what it does best with its Morgan Creek debut, the song-filled *Shake Me Up*. Simply put, if you liked Feat's 1988 comeback album, *Let It Roll*, then this is your cup of tea. *Michael Tearson*

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Gonzalo Rubalcaba

The Blessing: Gonzalo Rubalcaba
Blue Note CDP 7 97197 2, CD; AAD; 56:53.

Sound: A– Performance: A

Havana Cafe: Paquito D'Rivera
Chesky JD60, CD; DDD; 58:40.

Sound: A Performance: B+

It is nearly impossible to skirt the politics that are, for better or worse, intertwined with the careers of saxophonist Paquito D'Rivera and pianist Gonzalo Rubalcaba. Since his defection to the United States in 1980, D'Rivera has openly stated his distaste for Fidel Castro. Rubalcaba, who remains a Cuban citizen, hangs with a champion of left-wing causes, bassist Charlie Haden, and continues to do an "end around" in order to have his music heard in the States.

Rubalcaba's *The Blessing*, like his previous Blue Note release, sets him in a trio with his patron saint, Haden. However, drummer Jack DeJohnette holds the throne on this project instead of Paul Motian. What's most impressive about the 28-year-old pianist is his ability to mesh stunning fluidity, as on his own "Circuito," with extraordinary sensitivity, as on an atypical introspective reading of "Besame Mucho" and DeJohnette's "Silver Hollow."

Futhermore, Rubalcaba demonstrates that despite being denied access to the United States, he's taken the time to learn essential modern American jazz traditions. Consequently, with Haden and DeJohnette supporting, Rubalcaba works his way through the Ornette Coleman-composed title track and "Sinpunto y Contracopa," an original blues-and-funk episode. However, it is the superlative readings of Bill Evans' "Blue in Green" and John Coltrane's modal triumph, "Giant Steps," that represent some of the pianist's best moments to date as a soloist and as a bandleader. Hence the pianist distinguishes himself with startling clarity and a refreshingly appropriate air of confidence.

Ironically, it was D'Rivera who offered a teenaged Gonzalo Rubalcaba an opportunity in Paquito's well-respected ensemble, Irakere. This was more than a decade ago, before D'Rivera arrived in the States with much fanfare and splash. In the ensuing years, his CBS albums garnered attention, though gradually he seemed to fall out of company favor. Now he appears to have settled in nicely with the Chesky brothers.

For *Havana Cafe*, the multi-reedman surrounds himself with a varied musical coterie, each member offering lots of experience and most contributing original material. Working primarily in quintet-sized groups and alternating between guitarists, D'Rivera emphasizes percussion on this date. Veteran percussion master Sammy Figueroa and newcomer drummer Jorge Rossy complement each other, particularly on guitarist Ed Cherry's "Jean Pauline" and bassist David Pinck's "Look at You." Offering respite from the eight relatively more congestive selections are two all-too-brief cuts: "Improvisation," a clarinet-and-guitar duet written by the relatively unknown yet respected guitarist Fareed Haque, and "Contradanza," the leader's unaccompanied clarinet adventure.

If *Havana Cafe*, a largely artistically successful project, does have a problem, then it's with the overall flow and cohesion; D'Rivera & Co. may be trying to accomplish too much stylistically in one shot. Nevertheless, the album's best moments are undoubtedly deserving of attention. *Jon W. Poses*


Paquito D'Rivera

13 Strings: Howard Alden and George Van Eps
Concord Jazz CCD-4464, CD; AAD; 59:54.

Sound: A Performance: A

His fluid neoclassical chords, tightly controlled voicings, and mellow, swinging bass lines on a signature seven-string guitar are some of what has made George Van Eps a legendary jazz guitar figure since his emergence from the big bands of the '40s. Unfortunately, his contributions to the idiom have been difficult to enjoy because he's made so few recordings, and they're very hard to find. This situation has been rectified somewhat with the release of *13 Strings*, a duo recording with the talented young trad-jazz guitarist Howard Alden, which is Van Eps' first record in more than 20 years.

Van Eps and Alden, accompanied by bassist Dave Stone and drummer Jake Hanna, swap licks over a dozen standards and one Van Eps original. Alden's brightly colored lines weave in and around Van Eps' svelte chording on ballads like "My Ideal" and the Gershwins' "Love Walked

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Van Eps and Alden's new release, *13 Strings*, is indispensable listening for guitar fans.

In" as well as on harmonically mobile showstoppers like Johnny Mercer's racing "Too Marvelous for Words" and the highly embellished but bluesy Gershwin standard "Mine."

Van Eps' uniquely accomplished fingerstyle can be heard on two solos (without Alden or the rhythm section), a striding romp through "Ain't Misbehavin'" and a glowing reading of "Embraceable You." You'll swear you're hearing a bass accompaniment, but that's just Van Eps' facile thumb and the added range of that lower seventh string. Alden zips through a solo as well on "Queerology," an oblique tribute to Django Reinhardt that is full of modern, slightly dissonant intervals and slippery progressions composed, ironically, by Van Eps. In an effort to help the listener appreciate each player's unique voice, the guitars are kept fairly well separated, with Van Eps in the right channel and Alden in the left.

Clearly, Van Eps and Alden are artistically sympatico, and the elder master has maintained his touch during his years out of the limelight. The duo's *13 Strings* is indispensable listening for guitar fans and will repay all lovers of traditional jazz and skillful musicianship. *Michael Wright*

Raincheck: Nick Brignola. **Reservoir RSR CD 117.**

Nick Brignola is a feisty, energetic multi-reedman who displays his talents here on baritone, alto, and soprano saxes and also on clarinet. While he's proficient on each, the baritone anchors him and will excite listeners continually. Working in terrific ensemble, trumpeter Randy Brecker plays hard and willingly, along with Kenny Barron, Rufus Reid, and veteran drummer Dick Berk. *Jon W. Poses*

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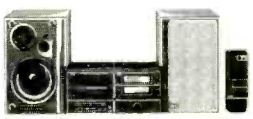

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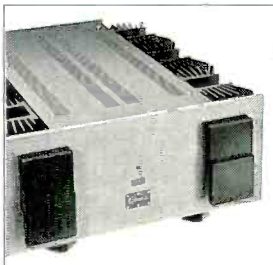

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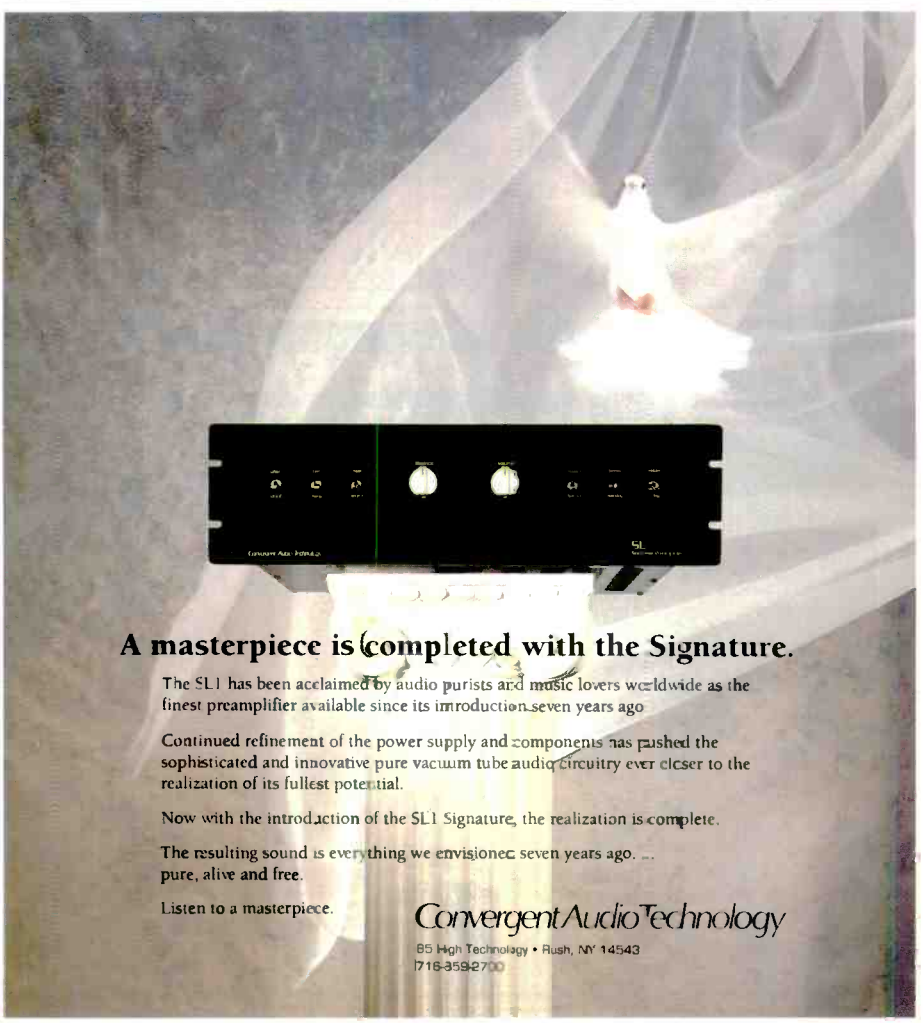

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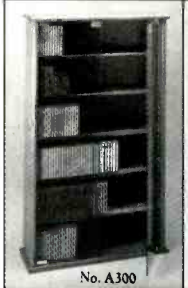
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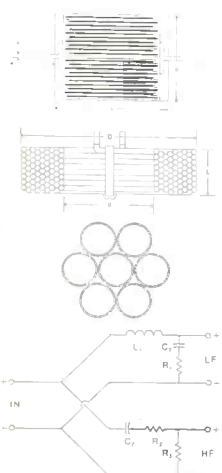

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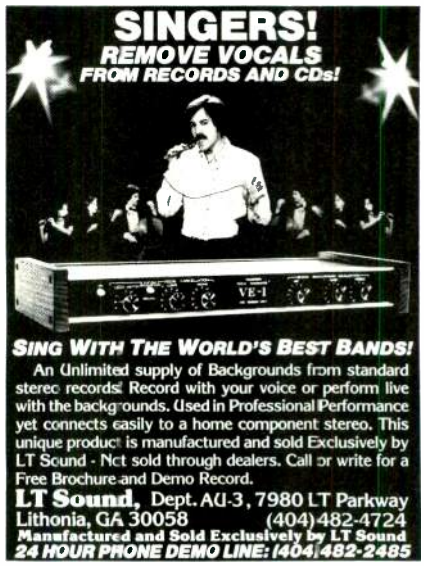

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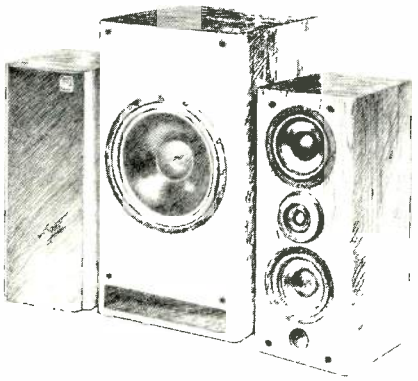

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