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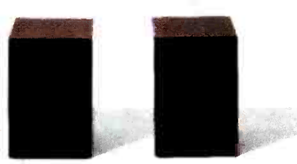

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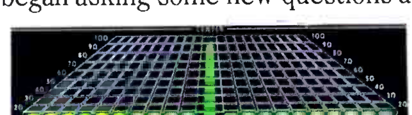

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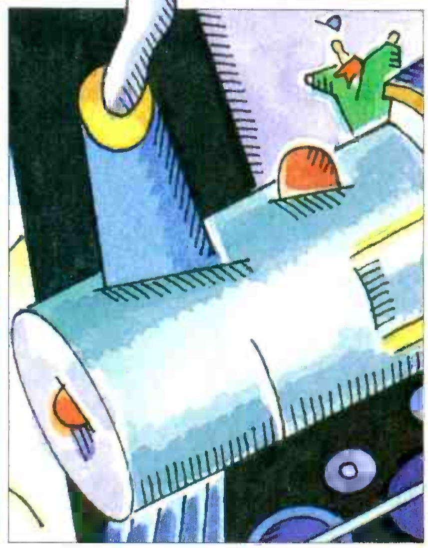
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Audio Publishing, Editorial, and Advertising Offices,
1633 Broadway, New York, N.Y. 10019

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TAPE GUIDE

HERMAN BURSTEIN

Slow-Speed Decks

Q. Please tell me what manufacturer makes a tape recorder that can play tapes at the 1⅞-ips speed.—K. Bailey, Woodbury, N.Y.

A. Cassette decks all operate at 1⅞ ips; that is the standard speed for cassette. A few decks also operate at 15/16 or 3¾ ips. Open-reel decks offer speeds between 15/16 and 30 ips; the standard speed is 7½ ips. Most of them offer two or more speeds. A frequent combination is 7½ and 15 ips; another is 3¾, 7½, and 15 ips. Revox and Uher make open-reel decks operating at 1⅞ ips.

More Notes on Hi-Fi VCRs

I have been recording audio on a Hi-Fi VCR for five years, and now own two of them. I always record FM programs at the slowest tape speed and record live performances at the fastest one. I have had very few problems with dropouts as long as good-quality tapes are used. The only real problems are cataloging a six-hour tape and trying to write all the identifying information on the small labels.

I have noticed that when "watching" one of my audio-only tapes on a video monitor, the dropouts are much more numerous visually than if a TV picture has been recorded on the same tape. Perhaps the video information somehow masks these dropouts, or some sort of video noise reduction is used; I don't know. I do know that very, very few of the visible dropouts are audible, at least on my VCRs.

Even if the video signal doesn't help with respect to dropouts, I can think of a reason for including it. A picture can be used to help in cataloging various sections of the audio program. If you have cable TV, there is usually at least one channel that displays the time and date. Noting the time of the various sections allows you to cue the tape visually when using a monitor.—William I. Whitten, Birmingham, Ala.

Pestiferous Squeal

Q. Many years ago I purchased 50 cassette tapes of Mozart works. At the time of purchase, the recordings were wonderful. I took great care in storing these tapes. Recently I played some of them, and to my surprise they began to squeak. With this many tapes on hand, is there a remedy to remove the noise? If I make a new recording, will the noise be transferred to the new tapes? What can be done?—Name withheld

A. Your problem is not an uncommon one, inasmuch as the grade of tape employed by producers of commercially prerecorded tapes has often not been of the best quality.

If you dub your tapes onto new cassettes, the squeal may or may not be transferred; most often, I believe, it will be. If the squeal comes out of your speakers as well as from the deck, it will definitely be transferred.

If the squeal gets transferred, put the tape through fast rewind, wind one or more times, and try again. If you are still unsuccessful in making a squeal-free dubbing—as is likely to happen—the following procedure *might* work: Store the original tape, along with a well-moistened piece of blotting paper or sponge, in a tight container for several days. Immediately upon taking the tape out of the container, try dubbing it again. *Perhaps* you will get one squeal-free dubbing. Also, a tape that squeals on one deck doesn't necessarily do so on another, so try other decks if you can. (*Editor's Note:* See "Archival Revival" in the November 1990 issue for more information.—*I.B.*)

Cassette Storage

Q. I store my numerous cassette recordings in inexpensive, three-drawer cassette cabinets made of cheap wood, covered with vinyl, and held together with a glue which (if my guess is correct) contains formaldehyde. The drawers are plastic. Due to the volume of my collection, I store the filled cabinets in the cardboard cartons in which they came. Is there anything about these storage conditions that could harm my recordings?—Robert E. Olsen, Madison, Wisc.

A. I see nothing about the conditions of tape storage you have described which would in any way endanger the tapes. The greatest dangers come from strong magnetic fields and temperature extremes.

If you have a problem or question on tape recording, write to Mr. Herman Burstein at AUDIO, 1633 Broadway, New York, N.Y. 10019. All letters are answered. Please enclose a stamped, self-addressed envelope.

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JOSEPH GIOVANELLI

Another View of Sampling

Q. I have been trying to learn more about sampling. The examples I've seen are taken from a single waveform. But isn't music a combination of many waveforms? How is a sample taken that represents all of the waveforms present at specific times? I may be missing the boat, so I hope you can clarify the "A to D" process.—Robert L. Keller, Gainesville, Fla.

A. Music can be represented by a single waveform, but a complex one, which can be analyzed into component sine waves of many frequencies and amplitudes. For example, a whole orchestral timbre might include a large bass wave on which are superimposed high-frequency jigs and jags representing the tones and overtones of the strings and winds.

But even complex waveforms can be represented by a sequence of points, if they're closely spaced enough. At the CD sampling rate of 44,100 Hz, a 20-Hz bass fundamental would be sampled 2,205 times, and a 20-kHz overtone would be sampled just a bit more than twice—but that's sufficient for the re-creation of the 20-kHz tone's positive and negative half-cycles. This is why a digital system's sampling rate determines the system's upper frequency limit.

Four-Second Sampling

Q. I know that CDs are produced by sampling the signal 44,100 times per second. But what is 4-second sampling?—Eric Wong, New York, N.Y.

A. Much of the rock/pop music we hear nowadays is played on synthesizers. Some of these instruments come remarkably close to sounding like other instruments, when this is the intent of the performer. Various methods are used to bring about this result, but perhaps the best approach is to "sample" the sound of the instrument to be imitated. A rather short digital recording is made of the instrument—not on tape but in computer memory. Because such recordings require a considerable amount of random access memory (RAM), it is customary to record as short a sample of the instrument as practical. Rather than recording a chord or part of a song, all that is recorded is one note. In the case of a violin or a drum tap, a very short recording can suffice, perhaps no longer than a half a second. The piano, because of the long time needed for bass tones to die away, requires a much longer recorded sample to provide a true representation of the character of the note. It is not just a matter of the time needed for the tone to decay and its rate of decay; it is also a matter of the note's harmonic structure changing as it dies away. Therefore, to make a good piano recording of a low bass string, the recording time should be even longer than 4 S.

Because of the characteristics of the piano, each note has a different decay time and harmonic structure. The harmonic content and percussive attack vary in accordance with how hard the keys are struck. For this reason, makers who desire to produce the best synthesizers will sample each note of the piano (or other instrument) and do so at various degrees of loudness. These wave shapes are analyzed and built into the sounds used in the synthesizer. As each sound is called for by the performer, a different set of wave tables is installed in memory, leading to the production of the correct wave shapes associated with that particular sound.

This subject is very involved, but I have tried to give you the flavor of the process.

Using Switched Outlets

Q. About 30 years ago, when I started buying audio equipment, I was told in no uncertain terms never to connect a mechanical device such as a tape recorder or turntable to a switched outlet [that loses its a.c. power when the device containing the outlet is switched off]. Not using the device's own switch to turn it off could lead to flat spots on the idlers, stretched belts, etc. I've followed this advice ever since, but frankly, it's a pain! Does this old rule still hold with today's mechanical equipment?

Also, is it a mistake to use switched outlets to power components that have memory, such as programmable tuners? I know many such components have memory backup power, but some backup systems have only enough power for two weeks or so. If I were to go away for three weeks, should I set a timer to turn the stuff on for 10 minutes a day, just to keep the memories alive?—Ira Solomon, Lynnfield, Mass.

A. You will be glad to learn that *most* equipment today can work just fine when connected to switched outlets. You are correct that much of the older mechanical equipment contained parts which could be ruined if they were left engaged. If you turn these components off by their own switches, automatically disengaging these parts, it won't matter if the equipment is plugged into a switched outlet. However, such outlets could tempt you to just turn the system off while the turntable or tape decks are still playing.

This is still true of many low-priced tape decks, whose transports are operated by keys or levers that require a strong push. But even moderately priced decks now often have electronic control systems that engage and disengage their idlers and capstans when you press a light-touch switch; such decks disengage these parts when the power goes off. Turntables with direct or belt drive, and CD players, can also be switched off at the outlet without problems.

Devices which hold programmed information in memory are something else again. Many VCRs, for instance, need power at all times to keep their memories refreshed and their clocks accurate. Memories in other components may be nonvolatile types that keep their contents indefinitely without power backup, or the memories may be ordinary RAM, with backup batteries that can operate for long periods without a.c. power but which eventually will go dead or need to be refreshed. (Lithium batteries give exceptionally long backup protection.) Consult your equipment manuals to determine backup requirements.

If you have equipment which, for whatever reason, needs its memory to be refreshed within some time period—such as two weeks—you will either have to connect it to unswitched outlets or, as you suggest, supply all such equipment with power via a timer.

If you have a problem or question about audio, write to Mr. Joseph Giovanelli at AUDIO Magazine, 1633 Broadway, New York, N.Y. 10019. All letters are answered. Please enclose a stamped, self-addressed envelope.

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COMPACT DISSENSION

Illustrations: Teresa Anderko

R-DAT's Prospects

It's by no means certain that R-DAT will be the next universal home recording medium, the digital successor to the Compact Cassette. Legal threats from the record industry have delayed its start, giving potential competitors a little breathing space. Not that there's any other digital medium around this year, but some buyers may hold off to see what happens to Philips' DCC digital system or recordable CD—either or both of which might just possibly show up by next year.

One thing that will help R-DAT is that it's a digital recording medium that even semi-pro garage studios can afford. And with SMPTE time code now available for DAT, it becomes possible to synchronize DAT with video and film, opening up new professional markets for the medium.

Pro success should add to DAT's cachet as a home recording medium. So should DAT's head start: The first home DAT recorders that appeared on the U.S. and European markets were generations newer than the first ones to appear in Japan in the 1980s, and they showed considerable refinement. The first recorders for other media may be rather less refined. However, they'll be able to catch up quickly, using DAT as a model.

There's Music and Then There's . . .

Record merchants the world over label each rack of merchandise according to its contents. But the British weekly *New Scientist* was puzzled by the nomenclature in one English store. Although they had no problem with the sections labelled "Rock and Pop," "Jazz," and "Classical," they didn't know what to make of a fourth section, labelled simply "Music."

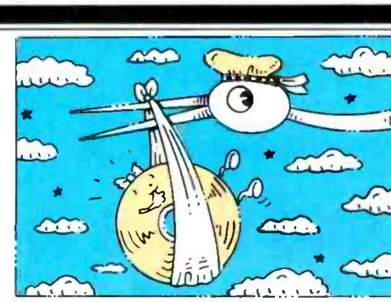
Write Now, Erase Later

No matter how the contest between DAT and the forthcoming Philips DCC digital tape system comes out, there's almost certain to be a new digital audio recording medium on the consumer market in a year or two. It's recordable digital disc, already under development by Radio Shack and being shown in prototype by companies like Denon, JVC, Kenwood, Philips, Pioneer, Sony, TDK, That's, and Thomson. The question, until recently, was whether the discs would be playable on the 50 million CD transports in use or whether they'd require new playback equipment—and if it would be possible to erase and rerecord the discs.

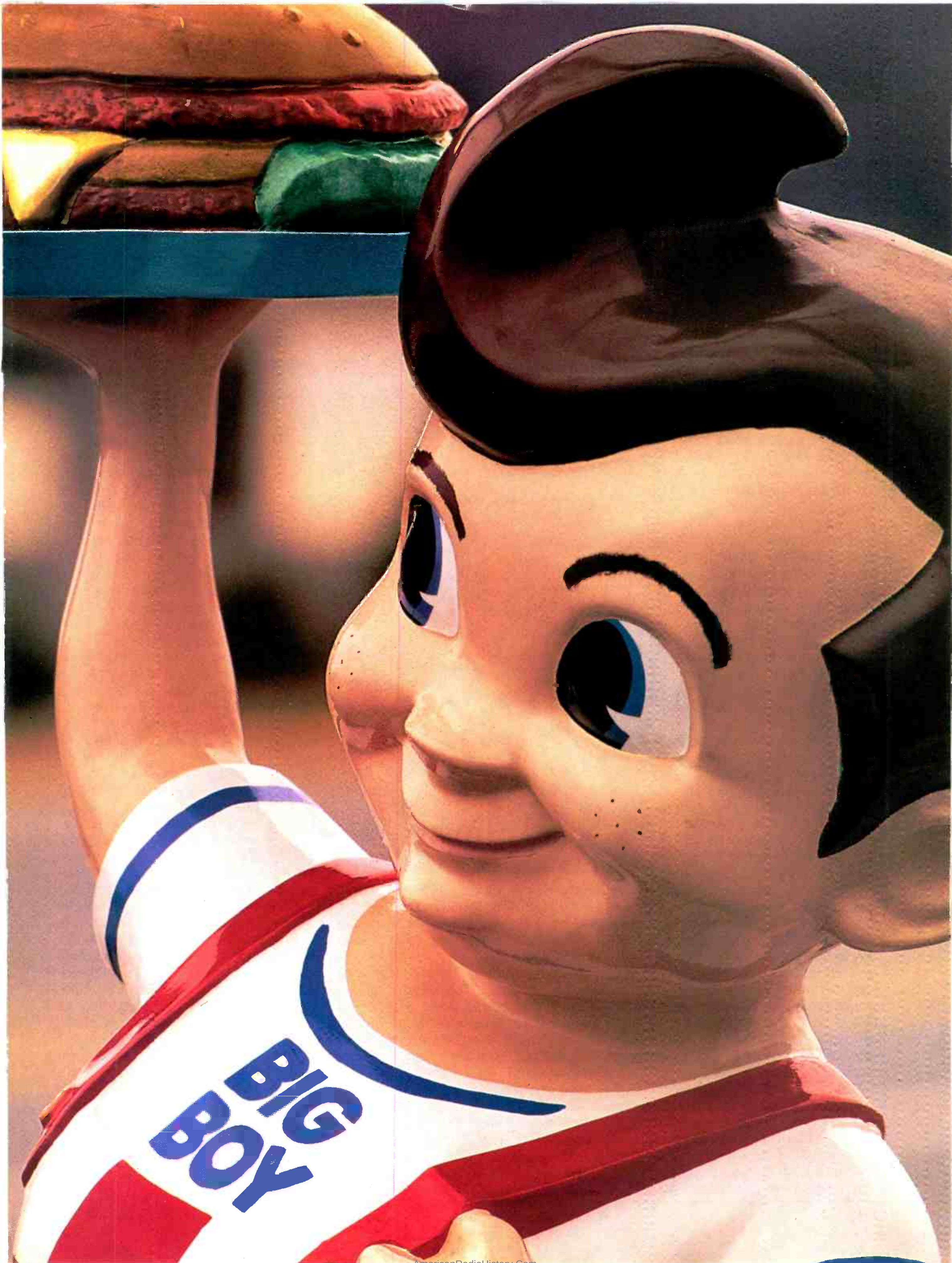
The answer seems to be record-once now, erasable later. Thomson (which owns the GE and RCA home electronics brands in the U.S.) has pushed back its timetable for introducing rerecordable magneto-optical discs (*Audio*, March 1990). MODs, incidentally, can accommodate still and full-motion video as well as audio, but they are not compatible with existing CD players. Most of the Japanese companies espouse write-once systems, which cannot be rerecorded but do produce compatible CDs. JVC has announced a late-1991 introduction for its recorder, which it says will be for computer use. Other, Japanese manufacturers are hinting at 1992 as a more likely target. Philips and Sony have shown both system types. The big stumbling block, at least for audio and audio/video recorders, remains the copyright and royalty question. That could perhaps be solved by building some version of Philips' Serial Copy Management System into the recorders.

Radio Shack is still working on its Thor system, which is promised to be both rerecordable *and* CD-compatible. "You may see a product come out of this development effort before Thor, which would not be called Thor. The research we've done on Thor is likely to spin off a whole family of products, possibly including a write-once system. But Thor has moved out of the research phase and into the product development phase," says Ed Juge, Radio Shack's Director of Market Planning. *Robert Angus*

Mystery Minidisc



Rumors that Sony plans a recordable disc system using 3½-inch magneto-optical discs have now been publicly confirmed—not by Sony but by Bertelsmann Music Group (BMG). Speaking at an International Tape Association seminar, BMG Senior Vice President Joel Schoenfeld said his company is considering both Sony's Minidisc and Philips' Digital Compact Cassette (DCC) as successors to the prerecorded analog cassette. The Minidisc is a magneto-optical system that can be erased and rerecorded. It's also said to use a new form of technology that packs six times as much data onto the disc as would fit a CD of the same size; that would give it a capacity of 75 to 80 minutes, more than a conventional CD holds. However, Minidiscs will probably not be playable on CD equipment.


BIG
BOY

EDWARD TATNALL CANBY

GET ME OUTTA HEAR

Isn't it about time for the Audio Implant? What with pacemakers and fuel injection "brains" and kids' toys that almost think, I've been toying in my devilish mind with a brilliant thought—a module *implanted inside the body* which would provide wall-to-wall music, for those who *must* have it, with absolutely no external impact, visible or audible. What an idea! Out of sight, out of mind, as they used to say. Not to mention out of *hearing*. What a boon to the rest of us.

Well, it was a good idea, but *Time* has scooped me. I mean *Time*, the magazine. A while back, in the January 7th issue, a *Time* writer, Lance Morrow, produced a *Time* column, "Essay," called "In One Ear, in the Other." Just recently, while I was incarcerated in my local automobile repairman's waiting room, I fell upon this "Essay" by accident. Might that catchy title indicate audio? Indeed it did, in a certain dire way.

When I was let out of the shop, I quietly filched that copy for further study. Yes, I am scooped. My own fault. Lance Morrow proposes an aural implant, precisely like mine. Morrow, like myself, detests what I tend to call wall-to-wall music. It is a drug, an abomination, a deadly perversion of otherwise healthy ear sensitivity. He thinks, just as I might, that an aural implant would at least sweep things under the rug, inside where it won't bother anybody. You carry your own music with you, day and night, every day, all the time, and so our hotels, banks, supermarkets, our walking Walkmans from Sony, would be freed from their never-stop task of lining the world with the sounds of meaningless music, or even music *with* meaning—just so there's never a moment of SILENCE.

Morrow is really more preoccupied with the iniquities of wall-to-wall music than with the Audio Implant. But like me, he thinks it is a cute idea and good for a laugh in a dismal situation. I'm always looking for laughs; humor is the way to get over pessimistic thoughts.

So I had fondly ruminated on the Audio Implant as a way to lighten up another sermon on audio evil. But as we all know, humor takes work. I worked and I worked, hoping maybe that in the end my Audio Implant might aspire to the highest honor this magazine bestows, a place in its famous Lirpa line of products, launched each April. But too many Aprils came and went, and Lance Morrow scooped me in January. So I have to give him credit for hitting the nail right on the nose, so to speak. And in detail, too.

Photograph: David Hamsley

"It could be done," writes Morrow of an aural implant. "The technology exists . . . perhaps a pulse monitor so that the music would follow the body's beat." Phew, just what I was going to suggest, but there are a few complications involved.

Yes, the body pulse, the heartbeat, is just fine in theory as a control, even if it may come in turn from an implanted pacemaker. The body's heartbeat, speaking philosophically, has always been an arbiter of music and mood, right along with that other sort of body pulse, the dance. Mood music—do you think we invented *that*? It harks back, for one thing, to the old baroque classics, to Bach, and to early opera. The Germans called it *Affekt*, I forget the Italian opera equivalent, but the thing absolutely ruled vocal music for centuries.

In opera, it was the familiar aria or "air" (breathing across the vocal cords?), in which a set piece is performed expressing the situation at the moment—the mood—while the entire opera stops dead and simply waits. Using this idea, the Germans did precisely the same for church music, as in Bach's St. Matthew Passion. Stop and go music. Each stop a different mood.

That's why so many opera near-corpses are able to sing vigorously from a prone position on the stage floor before expiring with a groan! Some floor-bound arias go on for minutes at top volume. Even death stops cold to wait for an *Affekt* to spin itself out, minus action. Jesus himself on the cross does an *Affekt* at length ("It is finished") before he gives up the soul, in Bach's and others' music. A very serious business, you see, long before our own mood music.

As to technical complications with the pulse control, it's a different story. Morrow evidently is not quite a classics man. He proposes a programming for his implant that would begin with an overall self-theme, suitably heroic, a la *Star Wars*. Then additional items for moods, according to pulse—romance, sorrow, shopping. These are each obviously standard mood music. Automatic transmission, of course, as pulsed by the heart. How about music for "Winning an Important Contract"? Morrow suggests *Chariots of Fire*. Some might prefer the Hallelujah Chorus. But my concern here is the auto-shift, from one mood to another. How about going-upstairs music, or hill climbing? Jogging music? And does each selection begin at the beginning and play through to its rightful ending? I doubt it!

Don't Buy A Fad, Buy A System

Look through this issue of AUDIO and you'll probably notice that many audio/video equipment suppliers have found a new buzzphrase: "home theater." Mitsubishi has been watching the recent proliferation of the term's use with great interest. Mitsubishi pioneered it over five years ago when the company launched its Home Theater Systems product line.

From the beginning, Mitsubishi's stake in home theater has gone far beyond using the term in its advertising.

The truth is, the Mitsubishi Home Theater Systems line—Dolby Pro Logic and Dolby Surround A/V receivers, compact disc players and changers, HX PRO dual cassette deck, laser disc combi players, Super-VHS Hi-Fi VCRs with pro editing features, big screen televisions, front and rear channel loudspeakers, subwoofer, learning remote controls, accessories and matched cabinetry—directly reflects more than a corporate ethic of quality manufacturing to meet exacting performance standards.

To hear Mitsubishi Home Theater Systems product manager Bill Loewenthal tell it: "Ours is a philosophy driven by intelligent product design, inside and out. It's one thing to incorporate the latest technological breakthroughs into your products, yet it's another to make those leading-edge features accessible and easy to use for anyone in the family."

When you buy a Mitsubishi Home Theater System, you buy a well-thought-out system. From the earliest stages of product development, Mitsubishi audio and video engineers work side by side so that the entire family of A/V components, in turn, work together smoothly. In its Home Theater Systems lineup for 1991, Mitsubishi has taken an already comprehensive approach to product integration several steps further by instituting a common operating language across all components. Consumers don't have to relearn basic operations as they add a new Mitsubishi component to their system.

Central to this common operating language are new owner's manuals, developed by Mitsubishi with the aid of specialists in communications research and design. Years of exhaustive study went into the rewriting of the manuals, with the result being revamped product literature unlike any in the industry. Mitsubishi

M-R8010 Home Theater Receiver: Auto-calibration of Dolby Pro Logic-specified delay and channel volume settings, with on-screen confirmation

has recently developed a next-generation learning remote control—the M-X254i—with a lighted faceplate for convenience in darkened rooms and large buttons that work common features on various components. For example, the "Play" button works "Play" on a VCR, CD player or cassette deck.

Even the newest technological feats are easy to perform. For example, properly setting volume levels for the five speakers and adjusting the Dolby-mandated digital delay on an audio/video receiver is a daunting challenge for most consumers; not with the Mitsubishi M-R8010 Receiver. With on-screen displays as a simple guide, the user simply settles down in the home theater's perfect "sweet spot" for stereo imaging, and uses the remote to enter the distance between the viewing area and the rear speakers by remote control. The receiver automatically calibrates the digital delay as mandated by Dolby Laboratories, and adjusts the volume levels for all five speakers by sending an audible pink noise from channel to channel, all with on-screen verification.

"Our goal is logical integration of a wide variety of equipment," adds Loewenthal, who urges customers interested in building a true home theater to visit a Mitsubishi dealer showroom for a test drive. "You'll see how easy it is to operate cutting-edge equipment—from recording between components to programming the VCR—all with one simple-to-use remote control."

Mitsubishi's design philosophy simplifies the operation of "crossover" audio/video functions, such as those on its M-T5010 cassette deck, the world's first audio recorder with a video output jack for on-screen display of commands. No more wondering whether the cassette deck is fast forwarding or rewinding: The mode is displayed on-screen with each remote command. The dual auto reverse deck offers twin amorphous tape heads, Dolby HX PRO/B/C and a variety of additional features.

The cosmetics of Mitsubishi products integrate as seamlessly as their technology. All components, equipment cabinets and direct view monitor/receivers (excluding consoles) are offered in a clean, sleek, matte gray finish. A standard height of 41 inches has been established for finished systems.

Mitsubishi is recognized for the world's first consumer 120-inch rear projection big screen, the invention of the 35-inch direct view picture tube, and additional audio success stories. While industry leading technologies such as these are incorporated into each component, Mitsubishi Home Theater Systems are very easy to use with an integrated common operating system that speeds users into enjoying every feature. ●

Wall-to-wall music is like a drug. It's an abomination, a deadly perversion of what would otherwise be healthy ear sensitivity.

Morrow, I think, goes right along with one of the saddest aspects of wall-to-wall music—the turn-it-on, turn-it-off principle, as in telephone "hold" music or elevator music. Your pulse monitor in the aural implant would simply switch, I'm betting, from one file (memory) to another, with every change of pulse. And what if you did build in a return-to-start, for each channel? Would it also hold on until the music finished what it had to say, if anything? It gets more and more complicated.

Worst of all, I figure that in my Implant and Morrow's, the control would have an awful time following any normal pulse, which is irregular and often speeds and slows. Nature's virtue! Not music's. The thing would tend to "hunt," to jump from one channel to another, frantically, from upstairs-going music to shopping music or romance, an uncontrollable (musically speaking) oscillation. This would be background-music hysteria! What is required in our wall-to-wall sonics is *regularity*, smooth nothingnesses with never a jolt, lulling pacifiers for the addicted nonlistener. Anything that suddenly attracts attention is OUT. Just listen to hotel music, washroom music, and so on, or maybe even, as Morrow notes, Japan's music-to-cross-the-street-with. So you see, his implant isn't so simple. Maybe it's just as well I held off my own for a few years or so. Lirpa would have turned me down.

Once the aural implant is discussed (and rejected), Morrow's *Time* "Essay" piece goes on to make some memorable and important points. Unfortunately, Morrow uses the term "canned music" to describe what I'm calling wall-to-wall music. Jimmie Petrillo's famous words against the recording art are not particularly relished in audio circles today. We do not produce canned music anymore. But we do denigrate our hi-fi by recording wall-to-wall, in digital or what have you. Morrow is okay—just substitute one term for another. He still has a lot to say.

For instance, when he compares canned music to Legionnaire's disease that seeps through every corner of a hotel and spreads to every corner of the earth, he gets my bravo—for this is exactly the way I feel, and why it is good to think of an improbable remedy such as an Audio Implant. As Morrow says, "Canned music settles over the mind like a terrible exhalation of 'air fresheners.' Noise becomes sinister when it ceases to be episode and becomes environment."

Better read that one twice. By episodic, Morrow means irregular, changing, always *noticeable*, the sounds that nature's ears were designed to detect—as warning, as information.

For you must understand that, in contrast, the advanced arts of our civilization have built themselves directly *on* nature's sensory abilities, not to dampen and lull but to stimulate them. As Morrow says, sound, noise entering the ears, "ought to be random, as life is random. If noise is programmed, deliberate, even institutionalized, it had better have a good reason. It had better be Bach."

You see how some of us think alike on these matters. Edgard Varèse, violent musical radical of the '20s and '30s, called music simply *organized sound*. If you pour Bach out of an audio faucet (we often do), you are destroying that organization—and you are equally destroying the ear's special mechanisms. Drug-like. It is, alas, just another part of our culture.

Frankly, I understand that the aural implant—the Audio Implant—would be no more than a panacea, a very superficial remedy for a major sonic evil. Reminds me of New York City's latest way to solve the incredible problem of the homeless, the people who sleep in subway stations, over street ventilators, on park benches. The park near me has a new set of benches, and the problem is solved—if you can say as much. The sleepers have departed. These benches have heavy steel "armrests" every couple of feet, solidly anchored to heavyweight wood. If you sleep, it must be sitting up.

As a technological challenge, the Implant is a cagey and interesting idea to, er, noodle with and to write about. There are so many aspects for amusing engineering argument. Equally for musical argument. I do not expect that we could contradict the basic idea of wall-to-wall music, for instance, by organizing the Implant memory for musical relevance, both start and finish preserved intact, or by diversification into categories, classical instrumental, wall-to-wall opera, disco forever, round-the-clock bank music. No point! What I think, myself, is that any implant we design should follow the established background principle set up by the audio cassette (and now the programmed CD player), just one whole piece after another, like those our equipment customers set up for themselves to play at parties or maybe just to sleep by, and none of this pulse stuff. Much too irregular. Radio has long been into this sort of thing, as reproduced in a zillion public areas. I do not know where bank music comes from, but I bet it's a programmed player, under a desk. Same for the supermarket. Let's upset no music apple carts, please! Just transfer all *this* nothing-stuff directly to your Audio Implant's capacious memory. That'll do it. Never tamper with a drug.

It remains merely to wonder about a last technological bit. How do we hook up the Audio Implant to the inner hearing sense? Surely not via 'phones! There must be a more direct route. I suspect Dr. Lirpa might have some ideas here, not to mention other more serious researchers into the mechanisms and psychology of hearing. Contact certain nerve synapses? Hook onto the fibrilla and the tibia or maybe the mastoid? When somebody bops us on the head, we see stars. Might we get to hear sounds similarly, though minus the bop?

Please, then, go to the nearest dentist's office and scrounge a copy of *Time* from January 7th so you may have all of Lance Morrow. Worth your thoughts. **A**

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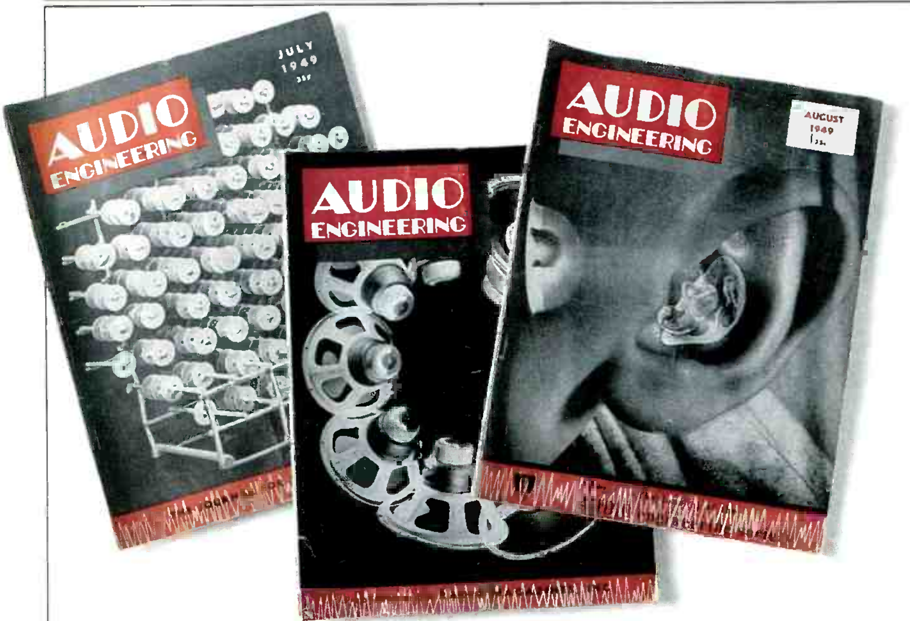
A FAIR OF THE HEART



Recently I received a unique and fascinating missive from the Audio Engineering Society. It was entitled "A Memoir of Yesterday" and was a copy of the program for The Audio Fair and First Annual Convention of the Audio Engineering Society, on October 27, 28, and 29, 1949, at the Hotel New Yorker in New York City. What a flood of memories this document unleashed!

Audio magazine (called *Audio Engineering* then) was in its second year of publication, and 1949 really marked the beginning of the hi-fi industry. With the May 1991 issue, *Audio* entered its 44th year of publication and the Audio Engineering Society will hold its 91st convention this October in New York City.

As digital audio technology will be the predominant subject at the 91st AES convention, so was magnetic recording at that first AES convention. There were papers on "Operating Problems and Experiences" by an NBC engineer, "General Problems," "Standards—Present Status," "Improving Uniformity," "Distortion Measurements," "Speed Regulation by Control Frequency" by P. Brubaker of Rangertone (an early rival of Ampex, with a recorder similar to the German Magnetophon), and "Duplication by Contact Printing" by Herr and Johnston of 3M Co. (Some 17 years later, 3M flew me and some other audio writers in their company jet to St. Paul, Minn. to demonstrate a new version of a contact-printing tape duplication device. An incredibly complex machine, it never reached commercial production.) Of course, there were papers on other audio topics too. Among them was a paper, "A New Development in Directional Microphones," by famed engineer Harry F. Olson of RCA, whom I had the pleasure of knowing. Another paper was "A New Coupling Circuit for Audio Amplifiers," by F. H. McIntosh. Yes, it was indeed *the* Frank McIntosh, in essence describing his famous bifilar-wound transformers that were a major feature of the first McIntosh amplifiers. There were also papers on audio measurements such as "The General Problem" by W. L. Black of Bell Telephone Laboratories, the famous engineer who developed feedback and feedforward circuitry. On the subject of intermodulation, there were contributions from a veritable Who's Who in audio—H. E. Roys of RCA, John K. Hilliard of Altec Lansing, and Norman Pickering of Pickering phono cartridge renown.

The exhibitors in the 1949 Audio Fair included many names and companies that became household words in the hi-fi industry. The Audio Fair was held at the New Yorker for quite a few years, and I attended all of them. Those were the golden years of hi-fi, when an audiophile could visit the Fisher exhibit and actually talk with Avery Fisher or hear Bozak loudspeakers demonstrated by Rudy Bozak. This held true for many other legendary names in hi-fi.

The companies that had exhibits at the 1949 Audio Fair are listed in the program the AES sent to me. It makes fascinating reading, and it is interesting to follow the fortunes of some of these companies through the years. Audak Co., an early manufacturer of magnetic phono cartridges, has been gone for many years. Altec Lansing Corp. was prominent in theater sound installations and broadcast monitoring equipment, and their 15-inch 604B coaxial speaker was a favorite of many audiophiles. (Currently, there are two Altec Lansing companies, one in Oklahoma City, Okla., which still makes equipment for professional sound installations, the other a hi-fi speaker maker in Milford, Penn., with models up to $12,000 per pair.)

Another exhibitor, Audio Devices (I'm not sure if they are still in business), made Audiotape, a rival to 3M's Scotch. Hewlett-Packard and Tektronix were also represented. 'Nuff said! Brush Development Co. made an early consumer-type tape recorder called the "Soundmirror" and it has passed into history. Brociner Laboratories was run by affable Victor Brociner who made some quite good integrated amps at low prices. That company is long gone. Frank Capps Co. made some of the best cutting styli for phono lacquers, but considering the moribund state of vinyl records, they may be out of business.

Cook Laboratories was the pride of legendary Emory Cook. He made all sorts of audio devices, but is best remembered for his famous specialty recordings. At one time Emory exhibited with his friend Rudy Bozak. Rudy made a pair of monstrous versions of his "Concert Grand" speakers, which weighed a quarter of a ton each!

Gloria Estefan–Into The Light. *Coming Out Of The Dark;* plus many more. (Epic) **415•943**

Madonna–The Immaculate Collection. (Greatest Hits). (Warner Bros./Sire) **414•557**

Paul McCartney–Tripping The Live Fantastic–Highlights. *Birthday;* etc. (Capitol) **417•477**

The Simpsons Sing The Blues. *Do The Bartman;* more. (Geffen) **413•971**

Vanilla Ice–To The Extreme. *Ice Ice Baby; Play That Funky Music;* etc. (SBK) **413•203**

AC/DC–The Razor's Edge. *Thunderstruck; Moneytalks;* more. (Atco) **410•662**

The B-52's—Party Mix/ Mesopotamia (Reprise) 416·313

Frank Zappa— Apostrophe/Overnite Sensation (Rykodisc) 412·395

Jimi Hendrix—Radio One (Rykodisc) 412·379

David Bowie— Changesbowie (Greatest Hits) (Rykodisc) 412·247

Hollies—Epic Anthology (Epic) 409·730

The Monkees—Greatest Hits (Arista) 408·203

Heart—Dreamboat Annie (Capitol) 405·936

Crosby, Stills, Nash And Young—Deja Vu (Atlantic) 404·202

The Band—To Kingdom Come... The Definitive Collection (Capitol) 388·181/398·180

Crosby, Stills, Nash and Young—So Far (Atlantic) 378·745

Grateful Dead—Skeletons From The Closet (Warner Bros.) 378·406

The Who—Who's Better, Who's Best (MCA) 376·657

The Doors (Elektra) 369·991

The Beach Boys—Pet Sounds (Capitol) 367·193

Van Morrison—Saint Dominic's Preview (Warner Bros.) 364·927

Best Of The Doors (Elektra) 357·616/397·612

Jimi Hendrix—Are You Experienced? (Reprise) 353·102

Rolling Stones—Sticky Fingers (Rolling Stones Rec.) 350·645

Bad Company—10 From 6 (Atlantic) 341·313

A Decade Of Steely Dan (MCA) 341·073

Elton John—Greatest Hits (MCA) 319·541

Stevie Wonder—Orig. Musiquarium I (Greatest Hits) (Tamla) 314·997/394·999

C & C Music Factory— Gonna Make You Sweat (Columbia) 416·933

Deee-Lite—World Clique (Elektra) 412·742

Creedence Clearwater Revival—20 Greatest Hits (Fantasy) 308·049

Paul Simon—The Rhythm Of The Saints (Warners Bros.) 412·809

Led Zeppelin IV (Atlantic) 291·435

Eagles—Greatest Hits 1971-1975 (Asylum) 287·003

Billy Joel—The Stranger (Columbia) 277·491

Jim Croce—Photographs & Memories: His Greatest Hits (Saja) 246·868

Original Soundtrack— Dances With Wolves (Epic/Associated) 417·436

The Rembrandts (Atco) 417·378

The Copland Collection Orchestral And Ballet Works, 1936-1948 (Sony Classical) 417·345

Jellybean—Spillin' The Beans (Atlantic) 416·875

Roger McGuinn—Back From Rio (Arista) 416·149

Various Artists—The "Amadeus" Mozart (CBS) 416·123

Molly Hatchet—Greatest Hits (Epic) 416·099

Twin Peaks—Original Sound Track (Warner Bros.) 413·641

The Pogues—Hell's Ditch (Island) 415·661

Candyman—Ain't No Shame In My Game (Epic) 415·638

Ralph Tresvant (MCA) 415·547

Devo—Greatest Hits (Warner Bros.) 415·455

Celine Dion—Unison (Epic) 415·430

Original Soundtrack— The Civil War (Elektra/Nonesuch) 415·828

John Williams Conducts —The Star Wars Trilogy (Sony Classical) 414·730

Nigel Kennedy—Vivaldi: The Four Seasons, English Chamber Orch. (Angel) 414·672

Soho—Goddess (Atco) 414·664

Happy Mondays—Pills, Thrills & Bellyaches (Elektra) 414·326

Big Daddy Kane—Taste Of Chocolate (Cold Chillin') 414·284

Al B. Sure—Private Times ... And The Whole 9! (Warner Bros.) 414·144

Mendelssohn:—Sym. No. 3 (Scottish) & No. 4 (Italian) Roger Norrington (Angel) 414·110

Debbie Gibson— Anything Is Possible (Atlantic) 414·078

Chicago—Twenty 1 (Reprise) 414·599

Fine Young Cannibals— The Raw & The Remix (I.R.S./MCA) 413·948

Christopher Parkening/ David Brandon—Virtuoso Duets (Angel) 413·823

Carlo Maria Giulini— Mussorgsky: Pictures At An Exhibition; Stravinsky: The Firebird (Sony Classical) 413·625

Levert—Rope A Dope Style (Atlantic) 413·575

Freddie Jackson—Do Me Again (Capitol) 413·542

10,000 Maniacs—Hope Chest (Elektra) 413·500

Various Artists— Masterworks Dinner Classics Dinner For Two (CBS Masterworks) 413·096

Steve Winwood— Refugees Of The Heart (Virgin) 413·005

The Traveling Wilburys— Vol. 3 (Warner Bros./Wilbury) 413·872

Harry Connick, Jr.—We Are In Love (Columbia) 406·645

Edie Brickell & The New Bohemians—Ghost Of A Dog (Geffen) 412·999

The Cure—Mixed Up (Elektra) 413·492

The Replacements—All Shook Down (Sire/Reprise) 412·668

Elvis Costello—Girls Girls Girls (Columbia) 412·619/392·613

King's X—Faith Hope Love (Atlantic/Megaforce) 413·039

Harry Connick, Jr. When Harry Met Sally— Music From The Motion Picture (Columbia) 386·821

Neil Young And Crazy Horse—Ragged Glory (Reprise) 412·528

The Best Of The Stray Cats—Rock This Town (EMI) 412·239

Pet Shop Boys—Behavior (EMI) 412·221

Megadeth—Rust In Peace (Capitol) 412·148

Gerald Alston—Open Invitation (Motown) 412·023

Technotronic—Trip On This · The Remixes (SBK) 411·967

Garth Brooks—No Fences (Capitol) 411·587

Asia—Then & Now (Geffen) 411·231

Bob Dylan—Under The Red Sky (Columbia) 411·199

Pebbles—Always (MCA) 412·163

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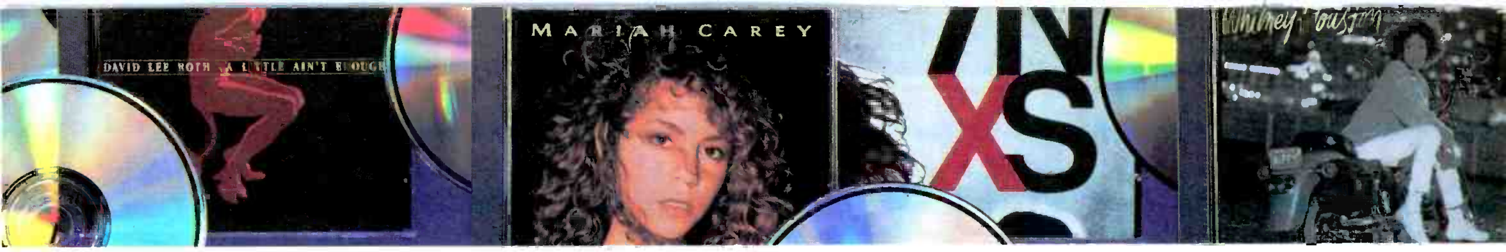

David Lee Roth–A Little Ain't Enough. Title cut plus more. (Warner Bros.) **416•610**

Mariah Carey. *Vision Of Love; Love Takes Time; Someday;* more. (Columbia) **407•510**

INXS–X. *Suicide Blonde; Disappear; Bitter Tears;* many more. (Atlantic) **412•106**

Whitney Houston–I'm Your Baby Tonight. Title cut plus more. (Arista) **411•710**

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Warrant—Cherry Pie (Columbia) 411·389

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Pixies—Bossanova (4AD Ltd./Elektra) 410·753

Bob Mould—Black Sheets Of Rain (Virgin) 410·464

Bobby McFerrin—Medicine Music (EMI) 412·064

Grateful Dead—Without A Net (Arista) 410·365/390·369

Living Colour—Time's Up (Epic) 410·357

Iggy Pop—Brick By Brick (Virgin) 409·854

Alias (EMI) 409·789

Concrete Blonde—Bloodletting (I.R.S.) 409·706

Guy—...The Future (MCA) 413·963

Bonnie Raitt Collection (Warner Bros.) 409·466

Brahms: The 3 Violin Sonatas—Itzhak Perlman and Daniel Barenboim (Sony Classical) 409·367

Toto—Past To Present 1977-1990 (Columbia) 411·371

Indigo Girls—Nomads Indians Saints (Epic) 411·355

Poison—Flesh & Blood (Capitol/Enigma) 408·963

Was (Not Was)—Are You OK? (Chrysalis) 408·864

Joe Cocker—Live! (Capitol) 408·799

Santana—Spirits Dancing In The Flesh (Columbia) 408·773

Daryl Hall & John Oates—Change Of Season (Arista) 408·245

En Vogue—Born To Sing (Atlantic) 408·112

Steve Vai—Passion And Warfare (Relativity) 408·104

The Allman Brothers Band—Seven Turns (Epic) 407·692

Jeff Healy Band—Hell To Pay (Arista) 407·569

Morrissey—Bona Drag (Reprise/Sire) 407·122

Bell Biv Devoe—Poison (MCA) 406·819

Bad Company—Holy Water (ATCO) 406·694

Greenpeace: Rainbow Warriors (Geffen) 406·603/396·606

Paula Abdul—Shut Up And Dance (The Dance Mixes) (Virgin) 406·264

Vladimir Horowitz—The Last Recording (Sony Classical) 405·985

Heart—Brigade (Capitol) 405·555

Depeche Mode—Violator (Sire/Reprise) 405·423

Robert Plant—Manic Nirvana (Es Paranza) 405·019

Sinead O'Connor—I Do Not Want What I Haven't Got (Chrysalis) 405·001

Alannah Myles (Atlantic) 404·475

The Vaughan Brothers—Family Style (Epic/Associated) 411·306

Susanna Hoffs—When You're A Boy (Columbia) 411·140

Midnight Oil—Blue Sky Mining (Columbia) 402·636

Duran Duran—Decade (Capitol) 401·869

Trixter (Mechanic) 410·266

Kenny G—Live (Arista) 401·505

Chicago—Greatest Hits 1982-1989 (Reprise) 401·166

ALL THIS JAZZ

Jon Faddis—Hornucopia (Epic) 416·206

The Chick Corea Akoustic Band—Alive (GRP) 416·081

Diane Schuur—Pure Schuur (GRP) 415·331

Mark Whitfield—The Marksman (Warner Bros.) 414·490

Joe Sample—Ashes To Ashes (Warner Bros.) 414·151

Gerald Albright—Dream Come True (Atlantic) 414·003

Kenny Garrett—African Exchange Student (Atlantic) 413·781

Take 6—So Much 2 Say (Reprise) 413·310

Rick Margitza—Hope (Blue Note) 412·585

George Benson—Big Boss Band Featuring The Count Basie Orchestra (Warner Bros.) 412·478

Lou Rawls—It's Supposed To Be Fun (Blue Note) 411·884

David Benoit—Inner Motion (GRP) 411·751

Branford Marsalis—Music From Mo' Better Blues (Columbia) 410·928

The Rippingtons—Welcome To The St. James' Club Featuring Russ Freeman (GRP) 410·498

Michael Franks—Blue Pacific (Reprise) 408·328

Larry Carlton—Collection (GRP) 407·825

Spyro Gyra—Fast Forward (GRP) 407·817

The Best Of Chet Baker (CAPJ) 407·486

Harry Connick, Jr.—Lofty's Roach Souffle (Columbia) 406·652

Wynton Marsalis—The Resolution Of Romance (Standard Time, Vol.3) (Columbia) 406·637

Chick Corea Elektric Band—Inside Out (GRP) 404·574

John Coltrane—Giant Steps (Atlantic) 371·591

Miles Davis—Kind of Blue (CL Jazz Masterpieces) 353·045

Eddie Money—Greatest Hits Sound Of Money (Columbia) 403·428

Basia—London Warsaw New York (Epic) 401·752

Rush—Presto (Atlantic) 401·695

Nelson—After The Rain (DGC) 411·009

Barbra Streisand—A Collection: Greatest Hits And More (Columbia) 401·141

Robert Palmer—Addictions, Volume One (Island) 400·937

Jane's Addiction—Ritual De Lo Habitual (Warner Bros.) 407·098

Wilson Phillips (SBK) 406·793

Paul Simon—Negotiations And Love Songs 1971-1986 (Warner Bros.) 400·721

Eric Clapton—Journeyman (Reprise) 400·457

Aerosmith—Pump (Geffen) 388·009

Tracy Chapman—Crossroads (Elektra) 387·951

Billy Joel—Storm Front (Columbia) 387·902

Rolling Stones—Steel Wheels (Rolling Stones Rec.) 387·738

Tina Turner—Foreign Affair (Capitol) 387·118

Billy Idol—Charmed Life (Chrysalis) 386·789

L.L. Cool J—Mama Said Knock You Out (Columbia) 411·165

Don Henley—The End Of The Innocence (Geffen) 383·802

Michael Bolton—Soul Provider (Columbia) 383·083

Tom Petty—Full Moon Fever (MCA) 382·184

Roxette—Look Sharp! (EMI) 381·939

The Cult—Sonic Temple (Sire/Reprise) 381·798

Bonnie Raitt—Nick Of Time (Capitol) 381·087

Beaches—Original Soundtrack (Atlantic) 379·669

Journey—Greatest Hits (Columbia) 375·279

Billy Joel—Greatest Hits Vols. 1 & 2 (Columbia) 336·396/396·390

Foreigner—Records (Atlantic) 318·055

Damn Yankees (Warner Bros.) 405·886

Pretty Woman—Original Soundtrack (EMI) 405·407

Tommy James & The Shondells—Anthology (Rhino) 405·746

Best Of Blondie (Chrysalis) 311·811

Bangles—Greatest Hits (Columbia) 405·977

Bette Midler—Some People's Lives (Atlantic) 411·934

Lenny Kravitz—Let Love Rule (Virgin) 401·893

Grateful Dead—Built To Last (Arista) 388·025

Elton John—Sleeping With The Past (MCA) 387·993

Bad English (Epic) 383·463

Pat Benatar—Best Shots (Chrysalis) 401·646

George Michael—Listen Without Prejudice, Vol. I (Columbia) 411·181

Fleetwood Mac—Greatest Hits (Warner Bros.) 375·782

M.C. Hammer—Please Hammer, Don't Hurt 'Em (Capitol) 403·477

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Audio Fairs in the late '40s and early '50s represented the golden years of hi-fi, when visitors could talk to Avery Fisher or Rudy Bozak.

Emory used them to play his recording of the Queen Mary's whistle, and the ensuing blast made it sound like the ship was sailing through the halls of the hotel! Those were the fun days of hi-fi! Emory had another recording of the turbines in the engine room of a Navy cruiser, and this, through the Bozaks, was awesome. Music? You bet, with some great organ recordings that really plumbed the low-frequency depths—quite remarkable for their day. Emory is still with us, but his company is no more. Electro-Voice was heavily into consumer loudspeakers, both raw speakers and systems, notably their huge "Patrician" corner horn. They were also strong on high-quality microphones. They are still active today but not much of a factor in loudspeakers, prospering instead with their microphones and sound-reinforcement products.

Fairchild Recording Equipment Corp. allowed friend Sherman Fairchild to indulge his audio ideas. It made broadcast turntables and phono arms. Joe Grado made the first stereo phono cartridge there and the Fairchild tape recorders were made famous by Bob Fine in his early Olympian series recordings for Mercury Records. That company is no longer in business. The Allan B. DuMont Co. was well-known for its TV sets and was a principal manufacturer of early color TV sets, but, alas, the company is just a memory now. H. J. Leak Ltd. of London, England, was Harold Leak's company made famous by its "Point One" tube amplifier. It, too, is long out of existence.

Frank H. McIntosh was the founder of one of the hi-fi industry's oldest and most respected companies. Together with the indefatigable Gordon Gow, McIntosh established a reputation for excellence in amplifiers and diverse audio equipment. Sadly, both Frank McIntosh and Gordon Gow are dead, but the company prospers under its new owner, Clarion Corp. Magnecord, Inc. was one of the pioneer manufacturers of magnetic tape recorders. I have previously detailed my involvement with them as sales executive and musical director, as well as my work in binaural and stereo recording. Their sun set many years ago. Permoflux Corp. was the designer and manufacturer of headphones used by pilots during World War II. They were distinctive for their mustard yellow chamois ear cushions. Magnecord used Permoflux phones extensively for listening to binaural recordings. They hadn't much response above 8 kHz, but they were quite clean and smooth. To my knowledge they are out of business.

Pickering & Co. was founded by friend Norman Pickering but he left the business, and it became Stanton/Pickering. Norman lives not far from me, in Southampton, New York, where he makes violins and pursues other musical interests. Stanton/Pickering are dominant in the broadcast and DJ phono cartridge business, but, like all such companies, their consumer phono cartridge market is quite depressed. Rangertone Inc. was a pioneering manufacturer of tape recorders, based on "liberated" German Magnetophon designs. They never enjoyed the success of Ampex and went out of business long ago. Rek-O-Kut Company is a name well remembered by audiophiles. For a while in hi-fi's early days, they had a corner on the manual turntable business. If you were really into hi-fi, you owned one of their fancier tables featuring hysteresis-synchronous motors. The company is defunct. Stancil-Hoffman Corp. was another pioneer manufacturer of tape recorders, mostly for the industrial market, and a specialty was logging recorders. The company has been gone for years.

Stephens Manufacturing Co. made loudspeakers, raw drivers, and some systems quite similar to Altec Lansing's, but with quality and design touches that made them a favorite of many audiophiles (yours truly included). The company's founder, Bob Stephens was a figure in the heroic mold of a Sidney Greenstreet, great fun to be with and he had a great ear. University Loudspeakers Inc. was well-known for sound reinforcement equipment and then went into the consumer speaker business. They made a large variety of raw drivers and furnished plans for elaborate multi-way systems. They got ambitious and produced some electronics, notably a receiver, but it didn't fly and the company is kaput.

These were some of the companies that were the core of the early hi-fi business. As you can see, many have fallen by the wayside. There were a great many others, literally dozens of loudspeaker companies, which not unexpectedly had the highest attrition rate. In fact, it must be said that more of the early hi-fi manufacturers are defunct than still in business and prospering. Some things are sad—consumer open-reel tape recorders went from inception to demise in a little more than 35 years. Oh, there are still a few being made, but their sales are insignificant. It is interesting to note that the advances in recording technology caused their downfall. When the compact cassette first appeared, it was sneeringly dismissed as a toy by the proud owners of open-reel recorders. As time went by, and the top cassette recorders began to rival the open-reel in sound quality, the open-reel's death rattle could be heard.

It is nice to reflect that *Audio* was reporting on hi-fi matters at the dawn of the industry and 42 years after that 1949 Audio Fair, we are still at the old stand doing business!

JOHN EARGLE

VOLTS IN VEGAS

Illustration: Stefano Vitale

Despite the recession, the winter Consumer Electronics Show seemed an upbeat affair. While many of the mass distributors of mid-priced gear were wondering how to turn down their volume, so to speak, many of the value/image-oriented manufacturers appeared to be in good shape. In such times, many consumers place a priority on performance and perceived value, not necessarily on price. This in turn benefits reputable manufacturers. Everyone has felt the crunch of consumer reluctance. But the recession did not happen overnight; many manufacturers planned accordingly and are prepared.

Consumer Electronics Shows are buoyed whenever major software formats are announced. The last one was the CD in the early '80s; it is time for something new. The Philips Digital Compact Cassette (DCC) is just that. In digitizing the cassette, one of Philips' prime concerns was the fate of all the analog cassettes already in the marketplace. Common sense says that you don't abandon a medium while it is still growing, improving, and virtually without competition. It was in 1983 that the prerecorded cassette overtook the LP in unit sales in the United States, and that margin has grown to the point where the LP is all but nonexistent.

Philips estimates that 180 million cassette players are added yearly to the one billion plus population of players already in the field. They state further that 2.6 billion cassettes are purchased each year—40% prerecorded and 60% blank. This is the payback to the hardware and software industries for Philips' skillful management and maintenance of cassette standards over the past quarter century.

In promulgating a digital standard for the cassette, Philips determined that the new cassette would have virtually the same shape and mechanical parameters as the old one. This made it relatively easy to include an analog head so that all of the new digital recorder/players would be able to play back the older analog cassette format as well. What a marketing coup this truly is; it ensures, among other things, that the record companies will not have to start making digital cassettes tomorrow. They can take their time and phase in the new medium when they've tooled up for it and when there are enough new players in the field to justify it. It is thus possible that high-quality analog cassettes will continue to be manufactured for some years, while at the same time an orderly and careful phase-in of DCC can take place.

What does Philips' announcement mean to R-DAT? R-DAT has found its new existence as a professional two-channel recording medium, and I believe that its window for acceptance as a consumer medium for distribution of recorded programs was shut long ago. However, let's give technical credit where it is due: R-DAT is an archival medium and, as such, uses no data compression, while DCC depends heavily on a data compression scheme called Precision Adaptive Sub-band Coding (PASC). For the professional it is important not to use data compression unless absolutely necessary; for the consumer, the performance aspects of PASC are so well worked out that there are no audible artifacts.

The only possible casualty of DCC may be Dolby S-type noise reduction, which is just now making its appearance into a number of high-end cassette recorders. With DCC just around the corner, record companies may feel that no further changes need be made in the manufacture of analog cassettes, which universally use Dolby B-type noise reduction. Time will tell.

In the review of last summer's CES, I mentioned the plight of high-end audio manufacturers and their mass exodus to a Chicago north side museum to stage their own show. What a sad comparison this makes with the fair treatment of high-end audio in Las Vegas. Here, there is no attempt to keep all exhibitors in the Convention Center; there simply isn't enough room. So, CES books space in such hotels as the Sahara, Riviera, and Mirage for additional exhibit space primarily for audio and video specialists. There is ample space both large and small for all budgets, and just about everyone seemed happy. We hear that a midtown Chicago hotel has been discovered (or rediscovered?) to accommodate the high-end group in a manner similar to Las Vegas—or at least as it used to be in Chicago in the days of the Conrad Hilton and Pick-Congress.

It isn't often that a new electrostatic loudspeaker comes along, and the Dutch Audiostatic Reference Series made a notable impression at the Riviera. Fortunately, these loudspeakers were in a large room so that the inevitable placement difficulties with electrostatics could be dealt with adequately,

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from Switzerland, Hans Jürg Baum, **SOUND**, Aug. 1990

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from the U.S., Robert Harley, **Stereophile**, Nov. 1990

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from Italy, Andio Morotti, **SUOMO-M**, Oct. 1990

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from Japan, Kobayashi, **Record Geijuto**, April 1990

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#2 THE APPEARANCE

All Melior components are designed to look good in your home, and not to grab attention in a dealer's showroom. Our components are some of the smallest and least intrusive available. Unlike many other high-end components, Melior products are not designed to look high-tech in order to prove that they are state-of-the-art. We believe that understatement is the most powerful statement of quality in design.

Melior components feature elegantly rounded edges, mat black front panels, hand-crafted wooden side panels, and smoked acrylic tops. Special edition models are also available with high-gloss, lacquered mahogany or piano black wood panels on the sides and top. The appearance of all Melior components is a carefully orchestrated harmony of form and function. For example, the graceful trapezoidal shape of our speakers is also a functional necessity dictated by the acoustical need to avoid parallel sides.

#3 THE FUNCTIONALITY

While other high-end manufacturers achieve accurate sound reproduction at the expense of functionality, Museatex marches to the beat of a different drum. Melior components offer convenience features and flexibility that are unparalleled in high-end audio.

We believe that adjustments to volume and balance should be made from the listening position. That's why Melior components include full wireless remote control. Our remotes allow listeners to control all aspects of the sound system without ever leaving their favorite chair. Unlike other types of circuitry that make remote control possible, ours doesn't affect the quality of the sound. Our integrated Master Remote will even allow the user to control a complete Melior system from a single remote unit.

Melior components are also some of the most versatile and flexible on the market. For example, our Audio/Video Control Center can select from both audio and video sources. It provides for eight inputs and four tape loops in addition to an external processor loop. Our FM tuner allows the listener to select among 99 different preset stations simultaneously from both cable and antenna inputs.

Yet, despite all their power and versatility, Melior components are simple to use. Our programmable interface and LCD status screen allow the user to customize the equipment for his or her own listening habits. Volume and balance levels can be preset and recalled at the touch of a button, station call letters can be assigned for each FM station, and the names of each input can be specified so that the display screen will show CD or TAPE rather than INPUT 1 or INPUT 2.

The front of a Melior component is a simple interface that conceals the flexible array of jacks that are provided on the back.

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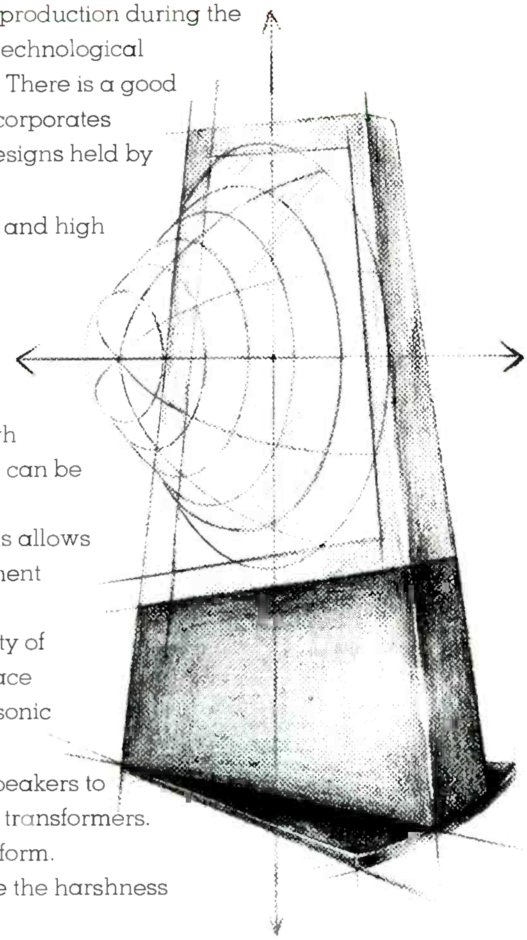
#4 THE TECHNOLOGY



Museatex has done more to advance the state-of-the-art in audio reproduction during the last decade than all other high-end manufacturers combined. Our technological innovations have both influenced and motivated an entire industry. There is a good chance that your present equipment, whatever brand it may be, incorporates technology that was inspired by Museatex. The list of proprietary designs held by Museatex is both long and varied. Here are some highlights:

The **floating charge power supply** minimizes signal contamination and high frequency noise while maintaining power reserves to handle peak currents.

Our **voltage controlled amplifiers (VCAs)** provide accurate signal transfer and permit remote control of volume and balance without the use of moving parts.

The **static fan heat sink** provides maximum heat dissipation for high current amplifiers without moving fans or large size. Our heat sinks can be up to five times smaller than equivalent conventional heat sinks.

The use of **infra-red surface mount technology** on our circuit boards allows the shortest possible signal path while providing the purest component connections and preventing defects due to sustained use.

Our pioneering use of **cryogenics** in audio improves the conductivity of individual electronic components and connectors by reducing surface tension at the molecular level. The treatment will also improve the sonic characteristics of records and CDs.

Our unique **point source speaker technology** enables the Melior speakers to reproduce the full frequency range without the use of crossovers or transformers. The result is a speaker that reproduces music in its absolute purest form.

Our latest innovation is **C-Lock**; a circuit that can virtually eliminate the harshness associated with digital sound that is caused by phase jitter.

#5 THE WARRANTY

While other high-end designers are seeking to become the latest pop hit among audiophiles, Melior components are designed to become the classics that you will listen to for many years to come. The solid construction and reliability of all Museatex products ensures that you will spend your money adding to your CD or record collection rather than on costly repairs to your sound system. In fact, Museatex has never charged for a repair since we started, and our Melior components include a **full five-year warranty for both parts and service.**

We also enhance the longevity of all Melior digital equipment with a special anti-obsolescence guarantee. For the period of the warranty, we guarantee that we will offer upgrades or modifications to all our digital equipment to ensure that they are kept current with any new technology that Museatex adopts in our production units. These updates will be offered at nominal cost to all our customers.

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Common sense says that you don't abandon a medium that is still growing, improving, and without competition.

while leaving sufficient room for listening. The basic radiating element is flat, about six feet tall, and about seven inches wide; as a result it fairly well approximates a vertical line source, with the accustomed excellent horizontal dispersion in the midrange. This, in fact, was the most notable aspect of the loudspeakers' performance. Bass was fairly well extended, with additional units functioning only at low frequencies. The overall physical impression was reminiscent of the Acoustats, rather than the Martin-Logans with their wide, curved panels, or the Quads with their sequential firing rings—a notable addition to a select group of loudspeakers.

Once more, John Dunlavy of Duntech proved that traditional cone and dome transducers can be combined into multi-way systems with superlative electroacoustical transfer characteristics to rival any of the electrostatics. His Black Knights, driven with FM Acoustics amplifiers, were on display at the Barbary Coast and again walked away with the Best-in-Class prize. His company has relocated from Australia to Utah, so we can expect Duntech products to be better distributed in the United States at lower prices.

Another Best-in-Class prize goes to Harman Video. In a joint demo with Fosgate, they showed a new projector that has a digitally controlled convergence system that simplifies alignment of the system. The result of this is an extremely clear picture with none of the mis-convergence at the edges that has too often characterized three-tube systems. When you can see all the raster lines in an NTSC transmission, as you could in this demo, you know that you are looking at monitor quality video! Incidentally, Fosgate has recently been acquired by Harman International Industries.

What has happened to DSP? Digital signal processing generally implies that such functions as gain control, equalization, and time delay (reverberation) are carried out in the digital domain rather than by traditional analog methods. Sony introduced a DSP preamplifier almost two years ago that combined equalization, spatial enhancement, and Dolby Surround in a single unit retailing for about $1,000. In Las Vegas, the most visible examples of DSP were in automotive systems for spatial enhancement and in the remarkable Meridian loudspeaker system, where all aspects of frequency division and time domain control were carried out digitally.

I believe that we are basically looking at aspects of cost effectiveness. For a given level of performance, it is still cheaper to carry out most signal processing in the analog domain; only time domain manipulations, such as delay and reverberation, are better done digitally. I would not expect to see the economic balance change in this area for at least two years. A

AUTO INQUIRIES

The Audio Engineering Society (AES) holds an International Conference once a year in North America to focus on a specific audio topic. This year, in early February, the place was Detroit, Mich. and the topic was sound for television. A mini conference on "The State of the Automotive Audio Art" was added and I chaired it.

I opened the conference with a short overview paper, noting that the great progress in automotive audio since about 1975 has been due to improved components and installations. Future progress, I believe, will come mainly from applying Digital Signal Processing (DSP) to overcome the acoustical problems of the car.

Robert Klacza of SGS Thomson, the French-Italian IC manufacturer, presented "Unique Power Supply for a Car Audio Power Amplifier." The design promises over 100 watts and is very lightweight and inexpensive. It runs directly off the 12-volt battery, using a clever, capacitor switching arrangement to obtain a high-voltage output.

I spoke next on "Measuring Drive-Unit Motor Linearity." The Thiele-Small parameters used to design systems are traditionally measured at the rest position of the cone. I found that as the cone moves over its permissible "linear" range, in normal use, significant changes in these parameters occur. This results in intermodulation distortion and changing frequency response at different volume levels. I showed methods of measuring parameters at all points of cone travel so they can be averaged to get a more realistic representation.

A step beyond averaging is to quantify the nonlinearities and include them in the design program. I also showed an example of this. I cautioned, however, that there are other forces that drive the cone off-center in a (for now) unpredictable manner.

The President of the AES, Dr. Marshall Buck, presented the next paper, "Modeling the Performance of Car Woofers." Models or simulations allow a designer to optimize performance without having to build real samples at each stage. Simulation results are, of course, checked by measurement, and any discrepancies between prediction and measurement can lead to improvements in the simulation.

Buck first modelled the magnetic field and voice-coil with a technique called finite element analysis (FEA), which divides a structure into geometric "elements" and models how each element interacts with its neighbors. Thus, a map of the magnetic field is developed from the shape and magnetic properties of the magnet, iron structure, and gap. It takes a fast computer several hours to generate such a map, but when it is finished, total magnetic flux operating on the voice-coil at any position is readily determined.

The flux variation with position is then programmed into the driver model. Buck chose to use an electronic circuit simulation program called "PSPICE" to build his model. Optimization of the model is achieved by changing the value of various circuit components which represent elements of the driver. Beginner versions of PSPICE are available for under $25.

Tom Nousaine spoke on "Assessment of Loudspeakers for Car Stereo" as it applies to his product reviews for *Car Stereo Review*. He noted that car audio enthusiasts frequently buy raw drivers or kits and do the installation themselves. This results in a lot of vari-

ation and a good review should cover all possible uses. Nousaine has equipped his Acura Integra with removable door baffle panels and a 150-liter woofer box in the rear of the hatchback so he can install any kind of speakers. Quick-disconnect adaptors allow the entire box to be removed for out-of-car tests.

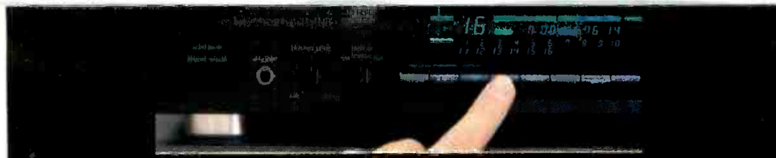
Lab tests include close-miked on- and off-axis frequency response and the Thiele-Small parameters. In-vehicle tests include maximum SPL and frequency response measured at the driver's location using the average of six microphone positions. Listening tests compare performance in four categories for four music types to a reference home system on a scale of one to ten. The same reference music program is used for every test to achieve consistency.

An interesting observation came from Nousaine's test of six pairs of different 8-inch woofers. The average response of all of the speakers mounted in his standard box rose by about 12 dB per octave below 80 Hz when the box was placed in the vehicle. This "transfer function" explains how many car systems achieve such powerful bass from small speakers.

Dr. Sangil Park, a research scientist for Motorola, presented the nuts and bolts of applying DSP to cancel acoustic echoes. The problem Park chose to attack was the echo from speaker to microphone which interferes with hands-free cellular phones. Since the acoustics of the car change as passengers or packages are added, the echo cancelling had to adapt to these changes.

The principle of echo cancellation can be applied to the troublesome early reflections in car music reproduction systems. These reflections are due to glass and other surfaces near the

Illustrations: Rick Tulka



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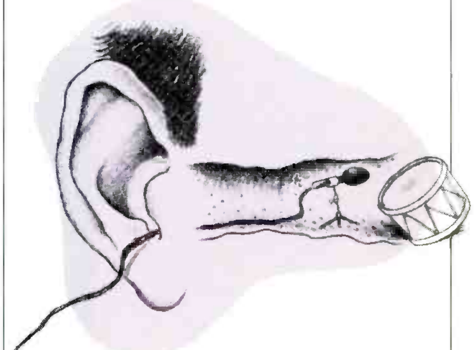
Papers showed that not only can DSP counteract unwanted echoes, but that optimized speaker placement can counteract them, too.

speakers and the listeners' ears. They produce comb-filter colorations and sometimes image shifts. Conventional equalizers can help. However, the root of the problem is not frequency response but time response. DSP echo-cancellation technology can, at least partially, equalize the time response.

There are limits to echo suppression because the echo-cancelling signals themselves produce echoes that need to be cancelled, and so on. Also, perfect "time equalization" can only work at one position in the interior, particularly at high frequencies. (Remember, we may have more than one listener, each with two ears, and heads tend to move around a little.) Still, even partial early-reflection removal in the lower midrange would be a tremendous improvement.

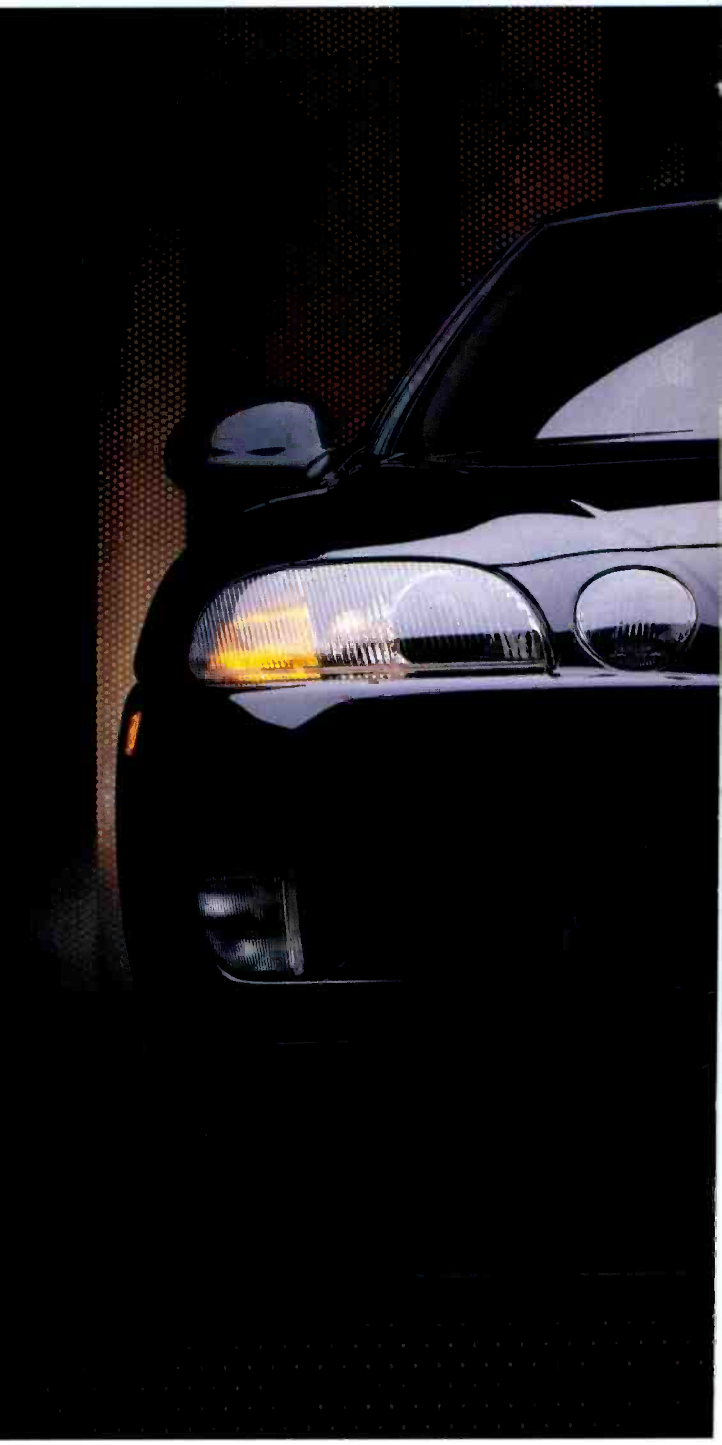
The last paper was given by Thomas Breithaupt, Blaupunkt's Senior Audio Systems Engineer. His topic was "Car Early Reflection Studies Using In-Ear Microphones." Breithaupt has observed, with some frustration, that listeners' opinions of an automotive sound system vary widely. He decided that it was time to measure the listeners rather than just the car.

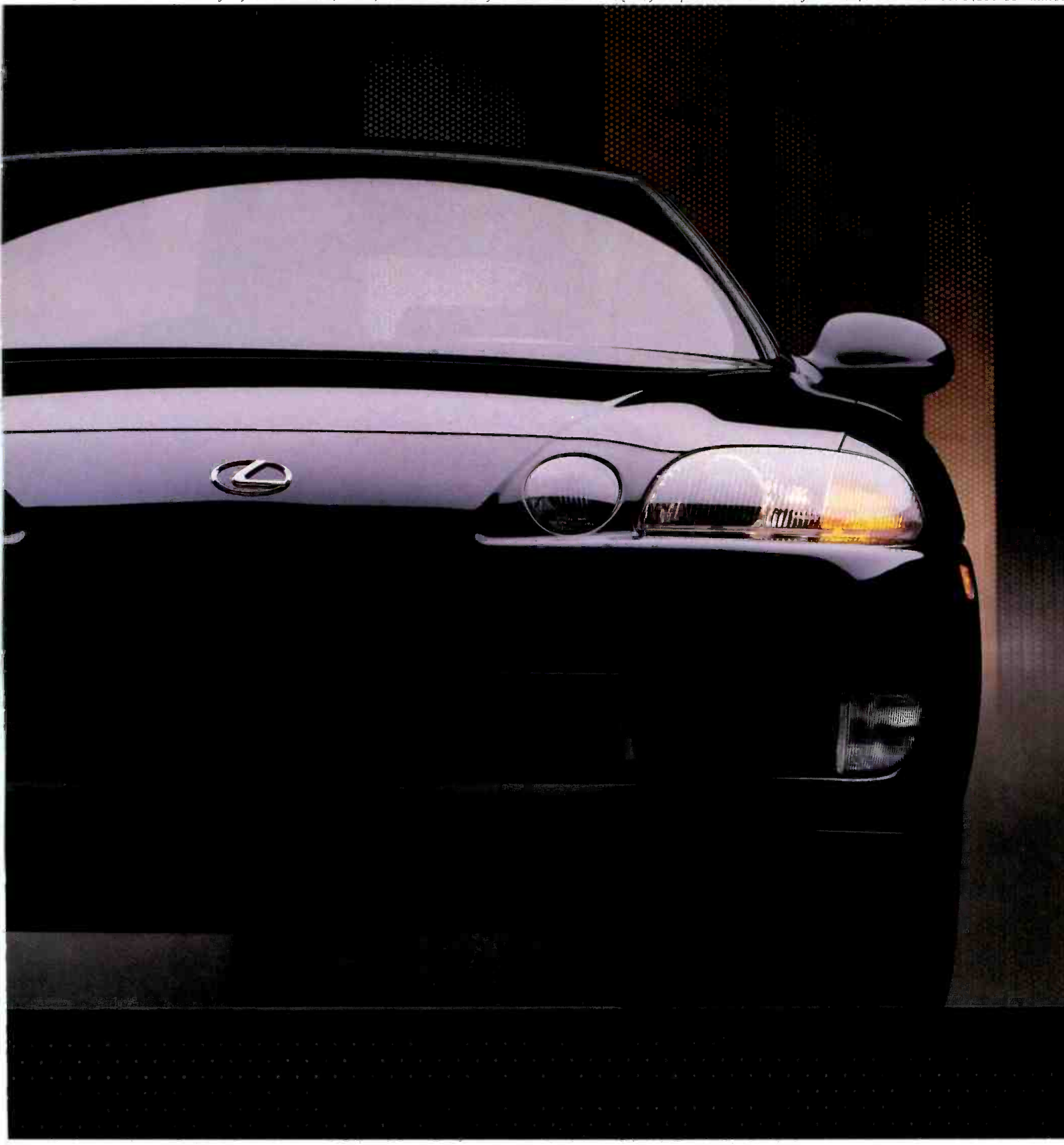


He used newly developed wide-range miniature microphones designed to be placed in the ear canal, almost touching the eardrum. Listeners with such microphones in their ears were then exposed to acoustic test signals from speakers and the frequency response and energy-time curve (ETC) were recorded. Breithaupt found significant frequency response differences between individuals for different sound-source positions in the horizontal plane.

In-ear measurements were made in an anechoic room and in a car. Breithaupt found that placing stereo speakers more to the sides than to the front allowed the head and body to block or shadow undesired early reflections. In the car, this gave a more consistent frequency response, person to person, as well. He concluded that car speakers are better mounted in the doors than on the front instrument panel.

This mini conference was a good sampling of the rapidly developing automotive audio state of the art, touching on the latest circuit developments, measurement techniques, computer simulations, DSP applications, and psychoacoustics. *David Clark*





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Part 1

SONIC RESTORATION *of* HISTORICAL RECORDINGS

An *historical recording*, broadly defined, is any recording, of even limited interest, which is not currently available in the marketplace in its original format. This includes just about all recordings on cylinders, 78s, wire, tape, LPs, and broadcast transcriptions as well as many movie and TV soundtracks and private recordings. We use *historical recording* in a more limited sense to mean any recording of important content or performance which in sound quality does not adequately represent the performance. *Dubbings* or *dubs* are sometimes called *transfers* and are mechanically or electrically made copies of an original recording. Duplication of cylinders was originally done by mechanical dubbing, and the copies made were inferior to the original (as is the case with most electric dubs of 78s). However, the transfers of early vocal records done by the HMV (His Master's Voice) engineers in the 1940s are an excellent exception and show what could be done with care and effort. A *repressing*, as the name implies, is a new record stamped from an original metal part. If the metal part has not deteriorated from age or wear, the repressing can be superior to the original issue since modern vinyl takes a better impression and is much quieter than shellac. *Reissue* is a confusing term that can mean either repressing or dub.

Michael R. Lane

There are also three interrelated concepts in the field that are often confused with each other and need clarification. *Sonic preservation* is done by sound archives, universities, and others to preserve the sound of an original source, which may be deteriorating. The main objective is to preserve the sound of original recorded media—cylinder, record, tape, etc. The main considerations are long storage time and no alteration of the original sound (or at least none that can't be undone). The common method is two-track analog tape recording using modern low-print-through tapes, such as AGFA 468, and documenting everything that is done, including stylus size, turntable speed, and inherent playback equalization, if any. Some noise reduction, such as from the Packburn 323A noise suppressor, may be used, but nothing must be allowed to alter the sound of the source in any way. For the purist, the less done the better. Additionally, the original source will be treated with the greatest care possible, e.g., records kept in acid-free sleeves and stored at 65° F and 40% humidity.

Sonic enhancement is the altering of a sound source to produce a desired result and may or may not accurately represent the sound of the original performance. Its criteria are subjective, usually commercial, and, more often than not, reflect the then-current popular ideas of what is good sound or will appeal to the buying public. *Sonic restoration* is similar to sonic enhancement in many of its techniques but more specific in its main objective, which is authenticity to the original performance. Authenticity is the central problem in sonic restoration, especially with acoustic material made before the development of the electrical recording process in 1925. While the sound of acoustic (sometimes called mechanical) recordings gives some idea of what the original performance was like, the many technical limitations leave an incomplete and even false image of the artist. The same is true of early electrical recordings but to a much lesser extent; indeed, a false image is intentionally given on many modern recordings for "effect." The objective of the sonic restorer of historical recordings is to discover, or at least infer with some degree of objectivity, what the sound of the original performance was really like and then to make all modifications with this in mind. While all three—sonic preservation, enhancement, and restoration—are interrelated and overlap to some extent, this discussion will be devoted primarily to sonic restoration.

The sonic restoration of historical recordings is both art and science. The science can be analyzed, made objective, and taught, while the art is difficult to analyze, largely subjective, and probably unteachable. Although most of our discussion applies to all forms of historical recordings, from cylinders to LPs, we will be most concerned with 78s since they are the most common.

BASIC REQUIREMENTS

The condition of the sound source is of the greatest importance in restoration work. While current LPs and CDs may be uniform, 78s were pressed or engraved on different materials, including cement, rubber, wax, shellac, acetate, and vinyl, and they were made in different sizes, from about 3 to 20 inches in diameter. They first appeared in 1894, and by the late 1950s they were gone from the marketplace, except for a few repressings still being made today. The most common 78s are made of shellac or shellac compounds, and they suffer from dirt, warps, digs, or gouges; from being pressed off-center, and from aging, moisture damage, and all degrees of wear as well as cracks and outright breakage. Cleaning is mandatory and an extensive subject in itself. We have developed our own cleaning system, but if nothing better is available, a mild detergent, water, and a soft sponge generally work. Water can damage the base material on Edison Diamond Discs, and acetate recordings need special care and handling. Whatever method is used, after cleaning a rec-

ord should be played once or twice using an extra-small stylus, as this will help remove embedded dirt and debris loosened from deep in the groove by the cleaning.

Many warps can be flattened between glass plates using carefully applied amounts of heat and pressure. With off-center records, the center hole can be enlarged and the record carefully "recentered" on the spinning turntable. Broken records, if the break is clean, can sometimes be glued or taped back together, with the tape on the reverse side. For bad gouges and digs, a temporary but useful technique is to fill in the damaged area using softened wax and to play the filled-in area of the record, before it becomes too firm, at a tracking force greater than normal. If the anti-skating force is perfectly balanced *and* the missing area is not too large, temporary groove walls will be formed that match up with the existing grooves. While not permanent, it is fast and usually enables the record to be played a few times for restoration. Extensive record repairs are only justified if the recording is very valuable or "one of a kind." With most common problem records undergoing restoration, the best solution is simply to find a better copy. Friendly collectors or sound archives may, if you promise to be very careful, loan you a good copy. Our own extensive collection of historical recordings has been of great assistance in this regard. Of course, with private recordings and rarities, the restorer has no choice but to work with whatever is available.

TURNTABLE SPEED AND PITCH

Many so-called 78s were not necessarily recorded at 78 rpm; they vary from the low 60s to over 100 rpm. When some restorations and reissues are made, the source recording isn't played at the speed used when the original was made, and the result is a shift in pitch which destroys the integrity of the performance. To accurately adjust speed and the resulting pitch, a quality variable-speed turntable, equipped with a multi-speed strobe or digital speed readout, is essential, but the real problem is, how do you know what the speed of the source was so that you can duplicate it to get the correct pitch? Some guidelines are helpful. The older records are generally recorded at lower speeds. Victor acoustics are most often around 76 rpm, and their electrics prior to 1930 are also often at 76 or 77 rpm. Many European electric discs are at 80 rpm, with Pathés about 90 rpm. Edison Diamond Discs are quite consistent at 80 rpm. The earliest records tend to be at low speeds, with G & Ts (Gramophone & Typewriter discs) in the low 70s or even 60s.

One technique useful with records made using cutter tables and amplifiers using alternating current is to sync on the a.c. hum. If the current was at 60 Hz (50 Hz in Europe), and a sharply spiked filter is used to exaggerate the power-line hum frequency, along with an accurate digital counter for setting that current frequency, then by adjusting the turntable speed higher and lower, you can tune for maximum hum and hence the correct pitch of the original. It may also be possible to use the second harmonic of the alternating current. This approach doesn't always work, and with acoustic recordings that employ cutter tables driven by falling weights, it is impossible. Comparing the sound of a 78 with a modern recording of the same music can be a good reference to correct the pitch to A = 440, *if* A = 440 was the pitch in use when the original was made. Care with LPs is necessary, too, as not all such discs that might be used for comparison are at exactly 33⅓ rpm. A pitch pipe, electronic synthesizer, or properly tuned piano, in conjunction with the musical score, may serve as useful references. Singers on early 78s are the biggest problem because of common key transpositions, and here biographical and discographical information may provide keys the artist usually sang in and their favored transpositions. Some old records have a playback speed printed right on the label, but this, as well as listings of correct speed by "experts," should always be accepted with caution.

The actual frequency of concert A, 440 Hz, has changed many times during the history of music, but at the time early historical recordings were made it was lower, about 435 Hz. Hence bringing everything to A = 440 or the sometimes higher pitches found today does not do justice to many older recording artists because even a small shift, insufficient to make a tone really sharp or flat, will alter the timbre or quality of instruments and singers. The restorer should try to set the playback speed of cylinders and 78s to the exact speed used when the original was made. This will produce the correct pitch employed by the artist at the time of the performance, with no subtle alterations of the sound from changing to A = 440. To correct pitch, the comparisons and hum technique indicated above are a starting point, but the musically trained and experienced ear, coupled with lots of experience with historical recordings, is still the best judge. The technique is to listen to the apparent "focus" of the sound, especially on vibrato. But despite all efforts, the correct pitch of some recordings will never be known with certainty.

CARTRIDGE AND STYLUS SIZE

A superb cartridge for 78s is the Shure V15 Type V used with their VN578E stylus assembly, but even better sound is obtained by using the VN578E assembly with Shure's Ultra 500 cartridge body. (See Table I for equipment information.) I feel this combination is outstanding. Moving-coil cartridges, as opposed to the moving-magnet types, can offer somewhat better sound and, in particular, better transient response. However, because a wide range of stylus sizes are necessary to play 78s properly, moving-coil cartridges are not suitable because frequent stylus interchange is difficult or impossible. The dynamic stabilizer brush integral to the Shure VN578E assemblies dramatically aids tracking of 78s with problem warps or broken-down groove walls. The elliptical stylus mounted on the VN578E assemblies (0.5 × 2.5 mils) is excellent for playing

Cutters of acoustic discs used no equalizers, but the cutting process did impose some mechanical equalization.

Frank Driggs Collection

78s of the 1940s and 1950s but not suitable for many earlier ones. Figure 1 gives our recommendations on stylus sizes; generally the earlier records take the larger sizes. Some believe that vertical-cut (hill and dale) records should only be played with conical styli. Old ideas die hard, but if common belief or theory says one thing and your ears say another, then throw out the theory and look for another that agrees with your ears! We know of no case where results are not improved by using elliptical styli. Furthermore, they should all be made in a truncated format (cut off on the bottom), as this minimizes noise pickup from the bottom of the groove. All styli should be diamond, but with the very large sizes necessary to play some vertical-cut records, cost may dictate the use of sapphire. The criterion on stylus selection for any given record is to choose the size that gives the cleanest, least distorted sound, not the least surface noise. Surface noise is much easier to deal with than distortion. Expert Stylus Co. can supply a wide variety of truncated elliptical styli mounted on Shure VN578E stylus assemblies, and their work is excellent.

TONEARM AND TRACKING

A high-quality tonearm long enough to play 16-inch transcriptions is a must. Equally important is correct geometry. Most tonearms come with specific mounting instructions detailing the turntable, tonearm, and cartridge geometry, but the proper approach is to have correct turntable, tonearm, and stylus geometry—which can be quite a different thing. The overhang, azimuth, and lateral and vertical tracking angles must all be easily adjustable. They should be normally optimized for 12-inch LPs, but with problem records the adjustments may have to be altered to even make tracking possible. (Vertical tracking angle is now very common at 20° for LPs, whereas for 78s it is theoretically 0°.) For Pathé records, with their very shallow grooves, and for "center start" records, the ability to adjust anti-skating force can be crucial. The optimization method for Pathés, and other apparently unplayable records, is to put the problem record on the turntable at its correct speed and then, with the stylus force reduced to almost nothing, gently lower the stylus to a position on the record about halfway through. The stylus will probably start skating across the record toward the inside or outside. Adjust the anti-skating force higher or lower until the stylus remains stationary without skating, then increase the tracking force to normal. This technique is not suitable for LPs and 78s that play normally, as it neglects the normal tracking pressure of the stylus, which is an important factor in normal anti-skating. However, we have found empirically that for problem trackers—the ones with shallow, deformed, slanted, or worn grooves—it is the way to go. To make the adjustment easily, the sliding-weight (not the weight-on-a-thread) type of anti-skating adjustment is best. On some occasions with difficult trackers like Pathés, where you might expect to need a very large stylus, going to the exact opposite, a very small stylus, 1½ or 2 mils, may solve tracking problems. With damaged records, you may need mechanical canting of the cartridge to make groove tracking even possible. This will require a tonearm design whose headshell can be physically twisted. Playing a difficult tracker at half speed and recording it at 7½ ips for later playback at 15 ips is another possibility. When all else fails, increase the tracking force but only as a last resort.

Unless 1-pound pickups have scraped off the highs, old records may have treble response out to 7 or 8 kHz.

CARTRIDGE HOOKUPS

For best results in playing 78s, the cartridge should be connected in a normal stereo configuration and fed into a stereo preamp. Once the signal is amplified to line level, a "canting control" can be used (Fig. 2). To make this control, a ganged audio-taper pot is wired so that the center point of rotation gives equal amounts of left- and right-channel output. This is far better than the traditional left-plus-right wiring for mono sound, since with this method any mixture is possible. Usually, equal amounts of left and right signal are best, but sometimes noise and even distortion can be reduced by another mixture, possibly even all left or all right. For vertical-cut (hill and dale)

TABLE I—*Specific recommendations and sources of equipment. (Recommendations apply only to specific models or types.)*

Cartridge: Shure V15 Type V or Ultra 500; VN578E stylus assemblies
78-rpm Special Styli: Mounted on VN578E assemblies by Expert Stylus Co.
Recording Cleaning Kit: Lane Audio & Records
60/100-rpm Analog Speed Strobe: Lane Audio & Records
Digital Speed Readout: Jeffrey M. Duboff
Turntables: Technics SP-15, Esoteric Sound Vintage and other custom models, and custom-built and/or modified models from Jeffrey M. Duboff
Stylus/Tonearm/Turntable Geometry Kit: Lane Audio & Records
Magnetic Cartridge Processor: Kinergetics KMP-1 (no longer made; company indicates they have several hundred incomplete units and might finish one at a premium price)
Noise Suppressors: Packburn 323A; Dynafex DX-1 by Circuit Research Labs
Inherent Record Equalizer: Esoteric Sound Re-Equalizer
Multi-Graphic Equalizer: White Instruments 4650 (⅓ octave)
Parametric Equalizer: Orban 642B parametric equalizer/notch filter
Compression Limiting De-Esser: Orban 424A
High-Frequency Enhancer: BBE Sound 442 sonic maximizer
Analog Tape Recorders: Open reel, Otari MX series; cassette, Nakamichi MR-1 Model B
Analog Tape: Cassettes, TDK AR-X (Type I, C-60) and MA-X (Type IV, C-60); open reel, Agfa 469 (mastering), Agfa 468 (low print), Ampex 456 (mastering), and Ampex 478 (low print)
Contact Cleaner, Preservative: Cramolin R2 (2%) or R5 (5%) from Caig Laboratories
Technical References: *Handbook for Sound Engineers: The New Audio Cyclopedia* edited by Glen Ballou (Howard W. Sams & Co., 1987). *The Audio Cyclopedia*, First Edition, edited by H. M. Tremaine (Howard W. Sams & Co., 1959; out of print.) *Introduction to the Physics and Psychophysics of Music* by Juan G. Roederer (Springer-Verlag, 1979; this basic textbook establishes the close relationship of physics, psychophysics, and neuropsychology to music). *The Recording and Reproduction of Sound*, Second Edition, by Oliver Read (Howard W. Sams & Co.; out of print). *Audio Engineering Handbook* edited by K. Blair Bensen (McGraw-Hill, 1988).
New Repressings of Historical 78s on Vinyl: Vocal repressings from Historic Masters; instrumental, orchestral, and spoken repressings from Symposium Records

records, a simple polarity-reversal, two-pole, double-throw toggle switch can be used in the cartridge leads of one channel to obtain the required vertical signal (Fig. 3). With proper shielding against noise pickup into low-level phono cables, this works adequately, but as in the case of the canting control, polarity reversal is better done at line level using an inverting op-amp to avoid grounding and shielding problems. The combination of canting and polarity reversal gives the ability to fine-tune any record for best sound and least noise.

EQUALIZATION

Considerable confusion exists about equalization, especially in reference to historical recordings. In its broadest sense, the term means altering the amplitude of one part of the audio spectrum in relation to another part. A level control should evenly increase or decrease the entire audio spectrum, while an equalizer increases or decreases only a part, sometimes a very narrow part. EQ, or equalization, is less confusing when it is thought of as being of two types—adjustable or inherent (original).

The simplest form of adjustable equalization, found on inexpensive radios, is the tone control, which merely decreases high frequencies and thereby gives the illusion of more bass. True bass and treble controls raise or lower bass and treble frequencies from a reference, such as 1,000 Hz. Another common type of adjustable equalizer is the simple low-pass (for scratch) or high-pass (for rumble) filter. For restoration work, scratch and rumble filters need to be more elaborate than those usually encountered on consumer equipment. We recommend a Butterworth design with switch selection for repeatability of settings. Our own filter set employs 12-position rotary switches. The low-pass positions are "Off" and 15, 12, 10, 8, 7, 6, 5, 4.5, 4, 3.5, and 3 kHz at a slope of 18 dB per octave; the high-pass positions are "Off" and 20, 30, 40, 50, 63, 80, 100, 125, 155, 190, and 230 Hz at a slope of 12 dB per octave. Building such a set of filters is not too difficult, and details can be found in many books on active-filter circuit design. The potentiometer-controlled type of filters has the advantage of being continuously variable, but with 12-position switch-selected filters, almost any desired setting can be

Fig. 1—*Recommended stylus sizes for various types of old records. In general, the older records take the larger styli.*

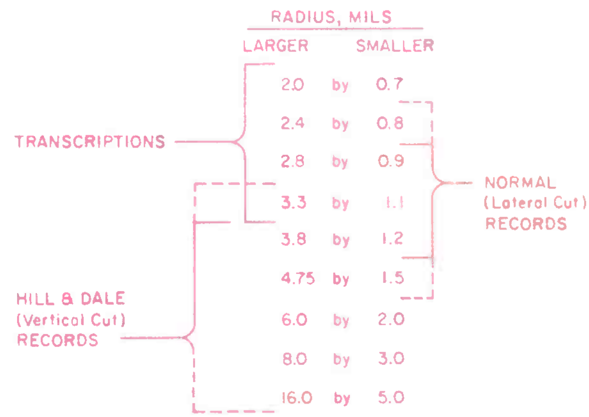

Fig. 2—*It is better to blend line-level signals with this form of variable "canting control" than to strap the cartridge's leads together for mono operation. The ganged pots shown should have audio tapers.*

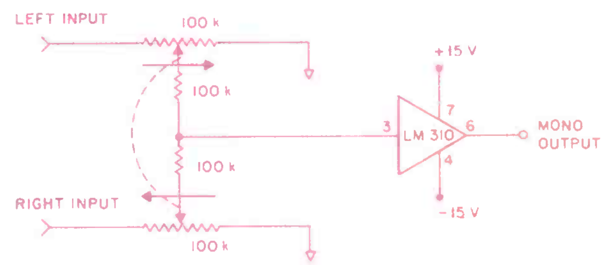

Fig. 3—*For hill-and-dale recordings, you should wire a double-pole, double-throw switch into the output of the cartridge to reverse one channel's polarity before mono summing. Wire the switch into the channel that is not grounded on the cartridge, and shield it within a small metal box, grounded to the turntable frame, and mounted close to the tonearm to keep leads as short as possible.*

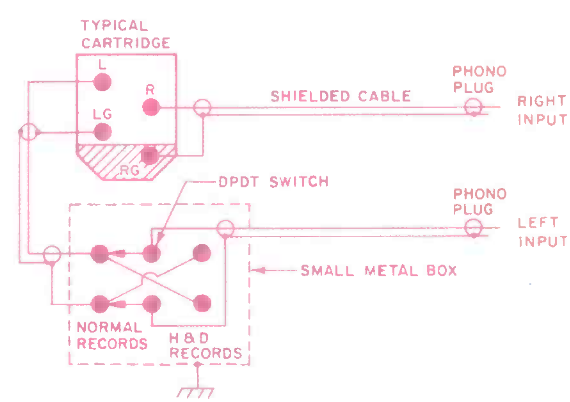

Fig. 4—*The Packburn 323A noise suppressor has three systems designed to reduce noise found on historical records.*

found, and you have the advantage of exact repeatability.

The multi-graphic equalizer, now quite popular, divides the frequency spectrum into discrete frequency bands, each individually adjustable in gain. The term "graphic" refers to the position of the slide potentiometers, as they show peaks or dips in the sound spectrum as if they were plotted on a graph. (The simplest multi-graphics are five-band equalizers, with each band being two octaves wide. The one- and third-octave units are common in professional recording consoles, and even sixth-octave equalizers are becoming more common.) In sound work, as the number of bands increases, the multi-graphic equalizer becomes more complex to use. The one-octave (10-band) multi-graphic is a good choice for home systems, but for restoration work the half- or third-octave unit is preferred.

Moving-magnet cartridges allow easy interchange of styli to match the various old groove shapes and sizes.

Most versatile of all equalizers, the parametric is somewhat similar to the multi-graphic equalizer, in that it divides the audio spectrum into frequency bands and that the level or amplitude of each band can be separately controlled. Unlike the multi-graphics, where each band is fixed in frequency, the parametric can shift this band (within limits) higher or lower in frequency. In addition, the shape (broadness or narrowness, also known as Q) of the affected band can be controlled from very broad (several octaves) to very narrow (notch). These three variable parameters (level, frequency, and Q) give the parametric equalizer tremendous capabilities in dealing with difficult problems such as the resonances in acoustically made recordings. However, the very versatility of the parametric makes it difficult to use properly, since there is an almost infinite number of sonic combinations. Eliminating one obvious problem can easily introduce another, more subtle one. The quasi-parametric, a type generally available on the consumer market, is not recommended because the three parameters are interacting, i.e., adjustment of any one affects the others. The true parametric, on the other hand, has noninteracting parameters and is easier to use, especially when trying to repeat a setting. We do not generally recommend the use of parametric equalizers by other than the most dedicated audiophile or sound-restoration buffs because of their complexity. Mere use of complex equipment does not guarantee good results. When used by inexperienced operators, the results are frequently exaggerated and unnatural. For those willing to spend the time and effort, the results with parametrics can be spectacular. We highly recommend the Orban Model 642B parametric equalizer/notch filter. Particularly impressive are its clarity of sound and the high- and low-pass filters for scratch and rumble elimination. For many years we have used and been happy with Orban's Model 622, but the new 642B is a marked improvement.

The adjustable notch filter is a very useful type of specialized equalizer. With its very narrow bandwidth and deep cut (40 or more dB), it can re-

ADDRESSES

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Austin, Tex. 78721

move 60- or 120-cycle a.c. hum as well as cutter whistle, a problem on many early electric recordings, and do this without apparent effect on the overall sound. Notch filters can be distinct units, such as the UREI Little Dipper Model 565 (unfortunately no longer being manufactured), or as combined units as in the Orban 642B. A word of caution—filters that are very narrow (Q of 5 and over) with deep notches (40 dB and over) should be used with discretion, as they have very severe phase shift, which is inherent in their basic nature. Unless great care is taken, this can be audible. It should be a basic premise of restoration work that if the listener is aware of electronic processing, the restorer has made a mistake. These various adjustable sound-shaping equalizers are indispensable in working with 78s and many early LPs and may also be useful in undoing some excessive enhancement in modern recordings, especially pop.

Three of the most common media of sound communication for the music lover are FM radio, tape recordings, and phonograph records. Each of these has a type of inherent or original equalization. Part of the confusion in talking about equalization comes from not clearly distinguishing between this inherent EQ and adjustable or user EQ. In the creation of the FM signal, tape recording, or phonograph record, a "fixed" equalization is introduced; the physical and electrical nature of tape, records, and broadcast signal require this for best results. The playback equipment must reverse this process by introducing a fixed and opposite playback equalization. When everything is done correctly, the result is a more faithful reproduction of the original sound, with less distortion, greater dynamic range, and lower noise than would be possible if this inherent equalization were not used.

The inherent equalization of electric analog records consists of a treble boost and a bass cut when the record is made, and a corresponding treble cut and bass boost in the playback equipment. Just as open-reel tapes use the NAB (50-μS) standard equalization, and cassettes use the 70- or 120-μS standard EQ, so do records now have their own standard recording EQ curve—RIAA. (A slight variation is the IEC curve used mostly in Europe and the Far East.)

The acoustic records made before the development of the electrical process in 1925 were recorded mechanically, and inherent in that process is a theoretical constant-velocity response of the cutter. Since there was insufficient musical energy to overcome the mass of the linkage between horn and cutter, the result was not a true constant velocity output in the lower frequencies. We call the result inherent mechanical equalization. In the acoustic process, low frequencies, what there were of them, had large cutter excursions that decreased as frequency increased. With the development of the electrical process, with its greater frequency range, problems appeared. The much lower frequencies could now be recorded but had too great a cutter excursion, and the greatly extended higher frequencies had such a small excursion that they were lost in the system noise. By changing from a constant velocity characteristic at some point in the frequency spectrum to a constant amplitude characteristic (which the electric process made possible), the problem could be solved, provided the playback machine did the same in reverse. The point in the frequency spectrum where the change takes place is the turnover frequency. Additionally, it became possible to boost the higher frequencies when recording, and that, in turn, required a corresponding high-frequency cut or roll-off in playback. The result of all this was that it became possible to get extended high-frequency response, which wasn't lost in the surface noise, and extended low-frequency response, which didn't break across into adjacent record groove walls. The combination of turnover and roll-off characteristics became known as the recording or inherent equalization curve, and it took almost half a century before everything finally settled down into the international standard of the RIAA curve.

A big problem for the collector or sonic restorer of 78s and early LPs is the very great variety of recording equalization curves used by different companies from 1925 through the early 1950s. Many different curves were required by the playback equipment to inversely match the original recording curves, which changed from company to company, year to year, and in some cases day to day! Some of the older vacuum tube preamplifiers had four or five positions of playback equalization, but this wasn't really enough. One, the justly famous McIntosh C-8 vacuum tube preamp, had 10 slide switches, with all their multiple combinations, for controlling treble roll-off equalization and bass turnover equalization. Hence, if you knew what the original recording equalization for a record was, then accurate playback equalization was possible. McIntosh also supplied an excellent chart that gave EQ settings for many different record companies. Some of the common terms for these differing playback equalization curves were NAB, Ortho, AES, ffrr, RIAA, Old 78, etc. In most modern audio systems for playing analog recordings, the playback equalization is now truly locked into the standard curve, and it is impossible with this equaliza-

Frank Driggs Collection

tion to play most 78s and many early LPs properly.

One approach to solving this problem is to use a multi-graphic equalizer to undo the gross distortions of the RIAA curve and simulate the various older equalization curves. It works after a fashion but takes considerable time and is definitely awkward. The Owl 1 monophonic preamp has a variety of EQ curves and is okay for a basic playback system, but we can't recommend it for serious work. The best approach is to use The Re-Equalizer by Esoteric Sound; it easily and accurately solves the equalization problem. Connected at the output of a preamp with RIAA equalization, it can undo the RIAA curve and offers six positions of turnover and six positions of roll-off. Its 36 possible EQ combinations can duplicate almost any of the old curves that will be encountered.

TABLE II—*Suggested inherent record EQ settings.*

	Speed, rpm	Turn-Over, Hz	Roll-Off at 10 kHz, dB
All Records Since 1955	33, 45, 78	500	13.7
Acoustics & Cylinders	78	250 (or as needed)	5

Records Made Between 1925 and 1955

Label	Speed, rpm	Turn-Over, Hz	Roll-Off at 10 kHz, dB
Transcriptions (many)	33, 78	500	16
Cameo Pathé *Oriole Romeo* *Banner Perfect*	78	Inconsistent (as needed)	
Allegro	33	750	16
American Record Society	33	500	12
Angel	33	500	12
Atlantic	33	500	16
Bach Guild *Banner*	33	750	16
Bartok *Boston*	33	630	16
Blue Bird	78	800	10
Blue Note	33	400	12
Brunswick (early)	78	1000	8.5
Brunswick (late)	78	300	16
Caedmon	33	630	11
Capitol	45	500	12
Capitol	33, 78	400	12
Canyon *Capitol-Cetra* *Colosseum*	33	400	12
Cetra-Soria *Columbia*	33	750	16
Columbia	45	500	16
Columbia (USA)	78	300	16
*Columbia (European)**	78	300	5
Concert Hall *Contemporary* *Coral*	33	400	12
Cook	33	500	12
Coral	78	750	16
Decca	33, 45, 78	750	16
Decca (Eng.) *ffrr*	78	250	5
Deutsche Grammophon	78	300	5
Dial	33	750	16
Disc *Diva (see Harmony)*	78	300	16
Electra	33	630	16
Electrola	78	800	10
EMS	33	400	12
Epic	33	750	16
Esoteric	33	500	12
Festival	33	750	16
Folkways	33	630	16
Good Time Jazz	33, 78	400	12
*Gramophone**	78	300	8.5
Handel Society *Haydn Society*	33	750	16
Harmony (acous. thru Aug. 1929)	78	300	16
Hit of the Week	78	500	5
HMV	33, 78	800	10
King	78	500	16
London	33	750	10
London ffrr	78	250	5
Lyrichord	33	630	16
Majestic	78	500	16
Mercury	33, 45, 78	400	12
MGM *Montilla*	33, 45, 78	500	12
Musicraft	78	750	14
New Records *Oceanic* *Oxford*	33	750	16
*Odeon** *OKEH** *Parlophone**	33, 78	300	8.5
Period	33	500	16
Philharmonia	33	400	12
Polydor	33, 78	300	8.5
Rachmaninoff Society	33	750	16
RCA Victor & Victor	33, 45, 78	800	10
Remington	33	500	16
Renaissance	33	750	12
Schirmer	78	1000	24
Stradivari	33	750	16
Supraphone	78	400	0
Technichord	78	800	12
Telefunken *Radiofunken*	33, 78	400	0
Ultraphone	33, 78	400	0
Urania (old)	33	750	16
Urania (new)	33	400	12
Vanguard *Vox* *Westminster*	33, 78	750	16
Velvet Tone (acous. thru Aug. 1929)	78	300	16
Vitaphone	33	950	18.5

NOTES

1. 78-rpm speed means 78.26 rpm when recorded at 60 Hz and 77.92 rpm when recorded at 50 Hz; earliest 78s may be 60 to 100+ rpm.
2. 33-rpm speed means 33⅓ rpm.
3. EQ for 78s on labels denoted by asterisks may be: Very early, with turnover of 250 Hz and 0-dB roll-off at 10 kHz; or very late, with turnover of 500 Hz and 14-dB roll-off at 10 kHz.

Acoustic records should be played back with a 250-Hz or higher turnover; otherwise, the bass, which was greatly attenuated by the mechanical equalization of the primitive recording process, will be almost nonexistent. At the lowest frequencies, where rumble may become severe, a high-pass filter should be employed as needed. Additionally, some slight roll-off of the high frequencies might be used, perhaps 5 dB at 10 kHz but rarely more. Some maintained that acoustic discs should be played back with no inherent equalization, since this duplicates the original condition of mechanical recording, a theoretical constant velocity response. If one likes the tinny sound of acoustic recordings acoustically reproduced for nostalgia, this may be okay, but this method ignores the mechanical equalization inherent in the process. Using a 250-Hz turnover with acoustic recordings does not exactly reverse the erratic inherent mechanical equalization, but it does help and offers a starting point for further work. In the field of sonic preservation, as opposed to sonic restoration, an argument can be made for using no inherent electrical equalization (no turnover) on acoustics, but we much prefer 250 Hz or higher with clear documentation as to what was done.

Electrical recordings have never been controversial as regards their need for using playback equalization, but there is still some disagreement as to what specific curves to use on which company's records made at what time. Based on the published curves, the McIntosh chart, information from record manufacturers, and many years of experience with old recordings, we have developed a list of recommended turnover and roll-off characteristics for playing most old recordings (see Table II). These are a good starting point, but only a starting point. In the earliest days of electric recording, engineers varied inherent equalization so frequently and erratically that the published curves couldn't be relied on as accurate for any specific record. Additionally, records issued at the same time and on the same label can be from different sources and hence have differing inherent EQ. Again, as in all matters related to the reproduction of old recordings, the trained, educated, and experienced ear is the best judge. In a way, inherent equalization for older recordings has itself become a type of adjustable equalization, since multiple choices have to be made to inversely duplicate the inherent equalization of the original.

NOISE REDUCTION

Noise-reduction systems are of two types—the double-ended or closed type (sometimes called encode/decode), where something is done during recording and undone during playback, and the much more difficult single-ended or open type, where only the playback can be affected. Most commercially available systems of the single-ended type, which are essential for 78s, are of little use in sonic restoration work. The most notable exception is the Packburn Model 323A noise suppressor (see Fig. 4). The Packburn has three noise-reduction systems designed to handle the different types of noise found on historical recordings. The first processor, called Switcher, selects the quieter of the two record groove walls when there is a significant difference in noise. It does this at a rate down to the resolving power of the stylus, but when operated below a user-selected threshold, the Switcher will produce an A + B output. The second processor, Blanker, eliminates most clicks and pops (impulse noise) by clipping off noise spikes down to 300 Hz. There is a noise problem common on 78s such as "Banner" Columbia acoustics and HMV electrics. On many, the clicks and pops are so frequent that they overlap each other, causing a particularly obnoxious frying type of noise often called "crackle." In effect, crackle greatly raises the hiss or noise floor. The Packburn Blanker is astonishing in eliminating this type of noise, and we know of nothing else that does the job so well. Finally, there is the Continuous Noise Suppressor, a gated high-frequency filter that can pass transients without the pumping so common and obnoxious on other systems. Of course, the Packburn, like any other signal processor, can be misadjusted to give poor results, but it is an extraordinarily valuable tool when used properly.

For straight hiss reduction, the Dynafex Audio Noise Reduction System is hard to beat and even a bit more effective than the Packburn's Continuous Noise Suppressor. It's a bit tricky to adjust, and, unlike the Packburn, it colors the bass sound slightly, but this can be reduced with parametrics. We have upgraded dual op-amps U-3, 4, 5, and 6 to Analog Devices AD-712s; this seems to just about eliminate the coloration. We have also used the AD-712 and AD-713, dual and quad op-amps, respectively, wherever we could in our audio system and are very pleased with the sonic results. The use of downward expansion to reduce noise is great in theory, but we would use only the mono Dynafex Model DX-1, as it has an extended range that enables great subtlety of operation, whereas the stereo Dynafex and other systems are more abrupt and the results can be audible.

John S. Allen has suggested the synchronous playback of multiple copies of records for improved signal-to-noise ratio. This would have to be done using SMPTE time codes and wouldn't be possible in the many cases where duplicate copies aren't available. Combining Allen's idea with the Packburn's Switcher is a possibility that needs investigation.

Digital reduction of noise via Sonic Solutions' NoNoise process has been much in the news lately. Their impulse-noise (click and pop) suppression may be marginally better than the Packburn's Blanker, but it is extremely expensive and unavailable for "real time" operation as it takes about eight minutes to process one minute of music. Sonic Solutions' Work Station includes very elaborate digital editing and processing capabilities, and represents potentially a great advance in restoration work, but its full potential still

Playback tracking can be fine-tuned by varying stylus shape, canting, and geometry together with the anti-skating.

seems a long way off. Reduction of hiss by the NoNoise process is very irregular, based on our analysis of CDs where the process was used, and often relatively dull and lifeless compared to the original 78s. However, this may be a matter of the choices made by processing operators or recording company clients rather than any defect in the technology itself. Listening critically to the before-and-after demo tape of the NoNoise process convinces us that the unprocessed version is more natural sounding. NoNoise, while reducing noise digitally, does seem to add to the final version the worst qualities of digital sound, qualities which recent digital work has been getting away from.

In England, the National Sound Archive, jointly with the Department of Engineering at Cambridge University, has developed Computer Enhanced Digital Audio Restoration (CEDAR). Both CEDAR and NoNoise seem effective on click and pop reduction but very questionable on hiss reduction. Without doubt, the future of noise reduction and restoration via digital techniques is wide open. The cost will come down, but the people doing the work will still need skill, patience, extensive experience with historical recordings, enough time to do the job right, and a sense of integrity to the authenticity of the original performance as well as a large dose of common sense! We have observed that since the demise of the 78, transfers and restorations done by collectors and restorers, perhaps with little in the way of elaborate equipment, can, on occasion, far surpass the products of the major recording companies. This shouldn't necessarily be so. It may be partly explained by the *remove noise quickly at any cost* approach of some and the *patient, tender loving care* of others. There is some excellent work being done today, but when you go to the music store and buy a restoration, be it analog or digital, on LP, CD, or cassette, "you pays your money and takes your chances."

If the listener is aware of electronic processing in a recording that has been restored, then a mistake has been made.

SONIC REBALANCING

Preliminary sound rebalancing to compensate for recording deficiencies can be done with a half- or third-octave multi-graphic equalizer. Weak areas in the treble and bass can be boosted, and broad areas of unpleasant resonance can be minimized. It is widely believed that the frequency response on acoustic recordings is about 150 Hz to 4 kHz, but a bit of experimenting with a third-octave multi-graphic will show that the frequency response on many is much wider. If the record is in good condition and has not had the higher frequencies literally scraped off by antique playback heads, which operated at weights up to and over 1 pound, then response up to 7 or 8 kHz may be found. While these frequencies are weak and need boosting, it can be done successfully since the shellac surface noise is worst about 3 kHz and tends to decrease at higher frequencies. Selective frequency boosting, combined with noise reduction and other techniques, can result in a lifelike vitality that can only be believed when heard. After all, these acoustic 78s, as well as most of the later electric 78s, were "direct-cut" discs, and despite their many obvious limitations, a sense of vital realism is possible when they are properly reproduced.

STUDIO BALANCE AND HEARING

The restorer's overall audio system should be of very high quality and must incorporate both room and speaker equalization for flat response. Without it, any rebalancing work done will have no meaningful reference, and judgments or comparisons made will incorporate the room and speaker imbalances. Flat response is the sine qua non of any sound work and, while not correcting subtle differences in audio playback systems, at least can give a fairly good reference standard. Additionally, the room and speaker equalization must be separate and distinct from all other equalization used in sonic restoration work.

Of great importance is the hearing of the sonic restorer, which must be good or correctable. Critical sound work is impossible if one has a cold or other problem that degrades the hearing. It is possible, in some cases, to compensate for hearing deficiencies by introducing a correction factor into the room and speaker equalization tailored for a specific individual, but if the hearing problem is tinnitus or distortion, a correction factor is not possible. Excessive sound levels should always be avoided. Indeed, the Number One injury in the United States today is traumatic hearing loss. Parametrics are especially dangerous, as incredible sound levels in very narrow frequency bands may not seem nearly as loud as they actually are. Many in the recording industry, particularly sound engineers and musicians, have damaged hearing from excessive sound levels. A good rule of thumb is that whenever you have to shout to be heard, leave immediately, for you are at risk of permanent hearing damage. Depending on the type of loss, hearing aids may be a big help, and reluctance by sound experts to be seen wearing them is regrettable if understandable. Unfortunately, by the time most people become aware of any hearing problem, the loss is permanent.

We'll discuss advanced considerations in the next part of this article. **A**

Frank Driggs Collection

The records shown are from the collection of Michael R. Lane and Donald H. Holmes, who run a restoration service, put out auction lists of historical records, and offer specialty equipment for historical record reproduction. Lane Audio & Records is located at 1782 Manor Dr., Vista, Cal. 92084; the phone number is (619) 945-7017.

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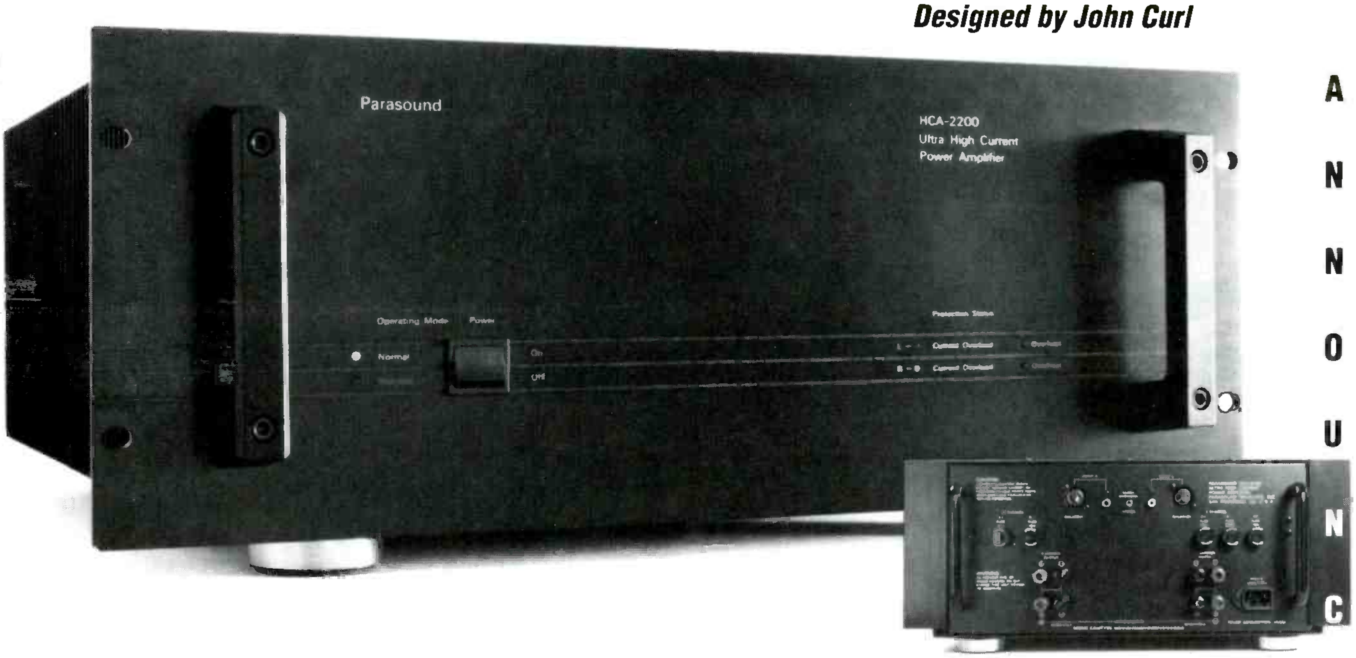

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What Ever Became of Frequency Response?

ROBERT LONG

Once the touchstone of audio, this important spec is on the endangered list.

It's my fault. And yours. We just haven't been paying attention. As the reams of manufacturers' specs pour in each year, we glance across them, questioning a number here and there, perhaps, and even ruminating on the other guy's sleaziness from time to time. But that's life, right? We all have our ideas about how audio products should be measured and specified, and we don't always agree—particularly when dollars are at stake, unfortunately.

It must have been at least a decade ago that the specs on a cassette deck I was testing caused me to blink in disbelief. The frequency response traces were exemplary—as flat as those shown in the sales brochure—through virtually the entire frequency range. I don't today remember all the specifics (let alone the model number), but it was well within ±1 dB from, I believe, below 100 Hz to at least 15 kHz and was down by 3 dB at around 35 Hz and 19 kHz.

In the manual, the frequency response was listed as ±3 dB from 20 Hz to 20 kHz. And if you were to shift the whole frequency response curve upward by 3 dB, so that its flat section ran at +3 dB instead of acting as the 0-dB reference, the −3 dB points would indeed fall at or even a hair beyond the specified frequencies. Didn't they realize, I wondered, that a spec of ±3 dB implied much worse performance than one of +0, −3 dB, given the slight difference in specified bandwidth that would result? Even keeping the same frequencies and calling it "+0, −6 dB" would—correctly—suggest the admirably flat response, which "±3 dB" does not.

It was easy to see how this state of affairs had arisen. The ability of some high-end decks (Nakamichi's name comes immediately to mind) to resolve very high frequencies, through a canny combination of narrow head gaps and compensating EQ, had set them well apart from the crowd. High-frequency response was where it was at—competition, that is—and the also-rans were scrambling to cover the coveted specification.

As I soon noticed, company after company was doing the same thing: Listing frequency response within ±3 dB, no matter how flat or otherwise the trace, in order to claim a still higher possible frequency as within the deck's grasp. Shades of the battle, a generation ago, over amplifier power specs with a "±3 dB" slop factor!

It certainly is no news to anyone in audio (or *Audio*) that differences of only a fraction of a dB can be perceived, at least in the "working" part of the frequency range, and that such differences create what we usually call "coloration." For this reason, the degree of flatness of the frequency response is of fundamental importance in audio products and has been recognized as such since audio (and *Audio*) began. Whether or not this flatness is maintained to extreme frequencies is of much less importance for two reasons: Some of the frequencies being bandied about in this context are demonstrably beyond the hearing acuity of most adults, and most music makes relatively little demand on these extremes.

In fact, as properly defined, frequency response has nothing *directly* to do with frequency; it is the range of level variation (that is, amplitude) in response that is to be expected of the

ILLUSTRATION: PAUL BINIASZ

product. The frequency range, or bandwidth, over which this variation is of interest should be implied or specified. For many products, a range of 20 Hz to 20 kHz is assumed; to be precise, however, the bandwidth should be spelled out.

So when we say that a device has a "frequency response of ±1 dB, 20 Hz to 20 kHz," the "±1 dB" *is* the frequency response, and "20 Hz to 20 kHz" is merely the bandwidth over which that frequency response applies. The current habit of saying "20 Hz to 20 kHz, ±1 dB" gets the cart before the horse, but at least it contains all the necessary information.

More and more, however, one sees statements like, "Frequency response is 20 Hz to 20 kHz." Recently I did some writing for an audio publication (not *Audio*) that included manufacturer-supplied product specs. In the "frequency response" listings of the portions I examined, bandwidth figures outnumbered true frequency response by at least two to one.

The harder it is to characterize the true frequency response, the more pressure there is to go for bandwidth instead, perhaps. Loudspeakers are particularly pesky, for example, because their response can vary so much in space. Change the measurement position even slightly, and the response curve can look very different. Furthermore, many speaker response traces leave one at a loss to determine what the reference 0-dB level should be. So it has become almost *de rigueur* to issue ratings like "60 Hz to 22 kHz" for speakers.

But the point is that this is not frequency response and should not be labelled as such. It is rated bandwidth. We might argue over whether bandwidth is as useful as *true* frequency response data (were it available), but I see no room for argument about which is which.

The accuracy that is presumed inherent in digital audio systems makes the distinction more important than ever. The bandwidth of all CD players is substantially the same in the sense that it is limited by low-pass filtering that puts the −3 dB point up around 20 kHz, give or take an inconsequential kilohertz. But the actual response, particularly in the treble, can vary from "perfect" by as much as 1 dB (and occasionally more), a difference that can alter how music sounds. A

BUILD A SIMPLE SURROUND DECODER

RICHARD J. KAUFMAN

Most movies today are made using Dolby Labs' surround sound process. Hollywood producers are bottom-line oriented and wouldn't shell out the extra money in production costs unless the process not only worked but actually sold more tickets as well. Evidently, the impact of more realistic sound does increase a movie's audience. If you have a Hi-Fi VCR, you can add much of the same impact to the movie videotapes you play at home.

Besides the usual right and left stereo channels, surround sound has extra channels used for special effects and added spatial ambience. There are actually three versions of this process, which can have as many as six discrete channels. The 70-mm prints of a film will have four or six channels and use magnetic soundtracks. The 35-mm prints have two optical soundtracks which contain a matrixed version of the surround sound channels. It is the 35-mm soundtrack which finds its way onto videotape, and into your home. If you already feed the output from your Hi-Fi VCR through your stereo components, it is a relatively simple matter to add surround sound to your system. Units to dematrix soundtracks can cost several hundred dollars, and they sometimes need an extra amplifier as well. A passive dematrixer, while not quite up to the standards of a digital surround sound processor, is still a good performer, with a much better cost/performance ratio.

The circuits to dematrix surround sound develop an R − L and an L − R difference signal. This signal has been treated with Dolby noise reduction, and a modified Dolby circuit cuts the highs in the proper proportion. A 15- to 30-mS time delay is applied to these signals, and the highs are rolled off above 7,000 Hz. The time delay ensures that patrons sitting near the theater's surround speakers won't hear them before the signal from the main speakers arrives. You may wish to include further bells and whistles: A subwoofer to reproduce the gut-wrenching impact of earthquakes, explosions, and car crashes, and a center channel to keep dialog centered on the screen.

The center channel is not essential for home use unless your speakers are excessively far apart. A subwoofer is a worthwhile addition to most systems and would be fully compatible with the circuit presented here. The difference signals can be generated using an op-amp difference amplifier, but there is a simpler way. The old DynaQuad matrix, popular in the early '70s during the height of quadraphonic sound, will produce the difference signals without using electronics and an extra amplifier. The circuit is diagrammed in Fig. 1.

The 15-mS time delay is not as important at home as in a theater, where you have less control over the seating accommodations. It takes sound roughly 1 mS to travel 1 foot. If the surround speakers are placed 15 feet further behind you than the main speakers are in front of you, this will achieve a 15-mS delay. It also requires a large room, perhaps 25 feet long. Fortunately, compromising the time delay is not so disastrous in the home environment as in a theater; shorter distances will still give good results. Another expedient is to put the surround

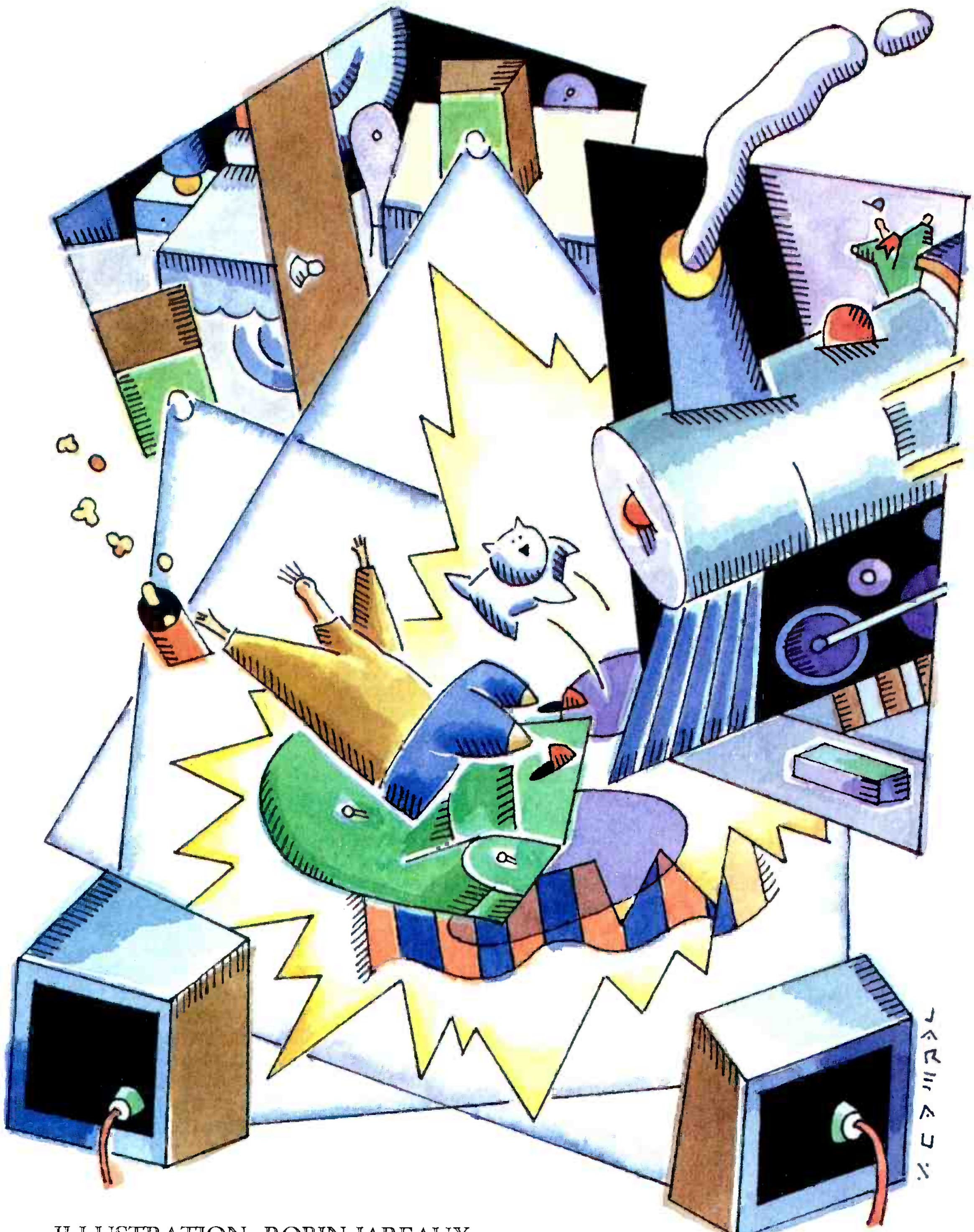

ILLUSTRATION: ROBIN JAREAUX

speakers down the hall or in an adjoining room. This has produced acceptable results in small apartments, adding a great deal of spaciousness to many a film's soundtrack.

Rolling off the high frequencies above 7,000 Hz in the surround speakers is the last remaining step. It could be done by putting an inductor in series with the surround speakers; I prefer to diminish the tweeters' response by mechanical means. Remove the grille covers from the speakers you intend to use for the rear channel, and put a piece of tightly woven fabric, as from a pillowcase, over the tweeters. Hold the fabric in place by any convenient means, such as tape, or place thumbtacks or staples through the fabric and into the baffle board. A layer of plastic kitchen wrap also blocks high frequencies while passing the midrange, and it may be used in conjunction with fabric so that fewer layers are required. The idea is to get most of

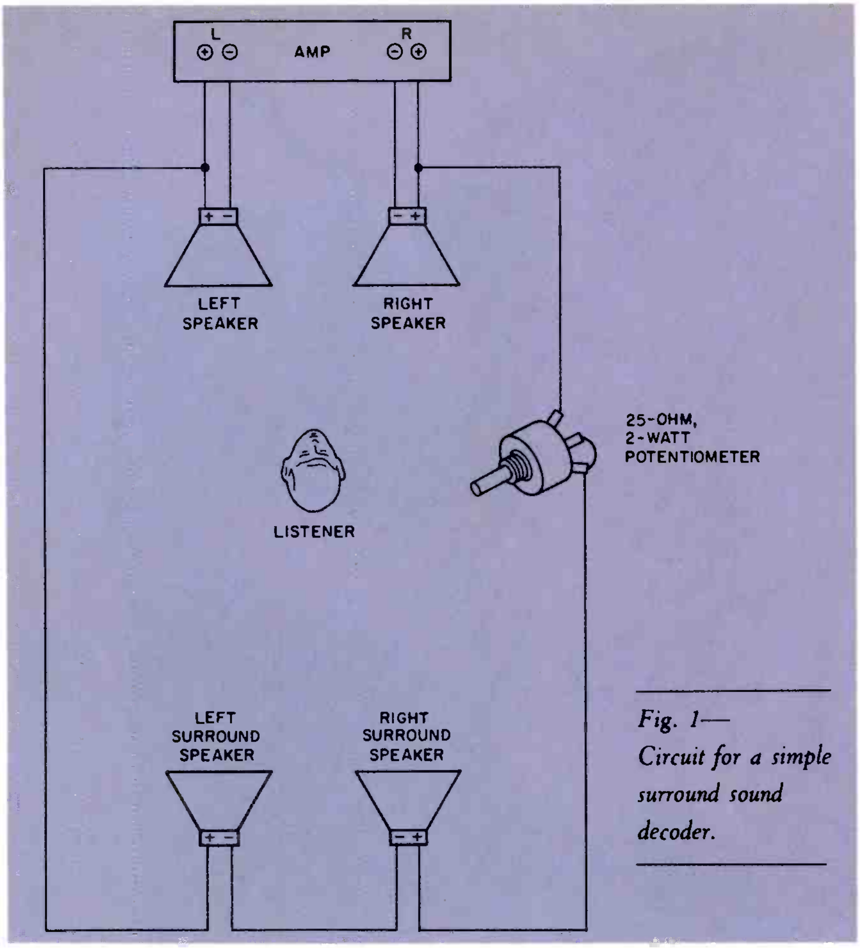

Fig. 1— Circuit for a simple surround sound decoder.

the midrange sound while muffling the highs. This method also makes up for the fact that the surround signal is Dolbyized, so no decoder is needed. You may wish to experiment with various amounts of covering over the tweeter; just how much is needed is a function of the particular driver you are treating and of the fabric covering you are using. I suggest starting with one layer of pillowcase and one layer of plastic wrap. If this gives satisfactory results, go no further.

> Once the decoder is set up and speakers are in place, you'll have to experiment to find the optimum setting for the potentiometer.

The choice of speakers for the surround channels is not terribly critical. They need not match your present speakers, which could be an expensive proposition. The surround speakers are not called on to produce much bass, and so they can be quite small. Several inexpensive models sold by Radio Shack will do quite nicely. Some have 4-inch woofer/midranges with 1-inch tweeters. Others, less expensive, have a single 3- or 4-inch driver. These seem to roll off above 7,000 Hz, so no treatment will be necessary. If such single-driver speakers produce surround effects that are too brilliant or zingy, due to too good a high-frequency response, try angling them away from the main listening area; the highs on such drivers will probably be very directional, and turning the speakers can bring out the off-axis response, which will have fewer highs.

The potentiometer used for this project should be rated for at least 2 watts. Any resistance value between 25 and 100 ohms is okay. Unfortunately, such pots are not all that easy to find these days, so some scrounging may be necessary. There are many potential sources, but Radio Shack carries a 25-ohm, 2-watt potentiometer (Catalog No. 271-265, for $2.99) suitable for this project.

It is not necessary to mount the pot in a case to test out the system, though soldering the leads to its terminals is strongly urged. If you like the results, the pot can be mounted in a case. Many pots of this wattage are made for screwdriver adjustment rather than using a knob mounted to a shaft. Since the pot will seldom be adjusted after the initial setup, this is no handicap. Terminal connectors are a nicety, and make the unit fully transportable. You can use the second set of speaker terminals on your amp or receiver for sending the signal to the surround speakers. This makes it possible to switch the unit in and out without having to wire in a switch.

A cautionary note: The extra load imposed by the additional speakers may be too much for some amplifiers. If the manufacturer does not recommend driving extra speakers in parallel, you may have problems with less powerful amps. In such a case, if the additional speakers are more efficient than the main speakers, the proper setting of the potentiometer will assure a high enough load so as not to bother the amp. Most low-power amps will deliver enough current that there will be no problem, but for your amp's protection, a 2-ampere speaker fuse at the amp's output, which is usually provided by the manufacturer, should be used. This will protect the output transistors from burning out if called upon to deliver more current than they can handle. If you have any doubts that this circuit is suitable for your amplifier, write to the manufacturer.

Once the decoder is set up and the speakers are in place, you will have to experiment to find the optimum setting of the potentiometer. Listen to an appropriate commercial videotape, a film whose soundtrack was recorded in Dolby Stereo. Turn down the level of the surround speakers until you are not normally aware of their presence but only hear something from behind you at an appropriate moment in the film. Ordinary stereo source material, such as a record or CD, can also be used to make the adjustment. Turn down the setting of the pot until the surround speakers just seem to disappear as a source of sound. You will find that though you don't hear them, the sound field seems to collapse toward the front of the room when they are suddenly disconnected.

Some experimentation will be needed to find the proper combination of speaker position and level-setting to get the best possible surround effects, but the result should contribute greatly to your video viewing and listening pleasure. *A*

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This article is adapted from Richard Kaufman's Enhanced Sound: 22 Electronics Projects for the Audiophile *(TAB Books, a div. of McGraw-Hill, Inc., paperback, $9.95).*

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EQUIPMENT PROFILE

YAMAHA DSP-A1000 DIGITAL SOUND-FIELD PROCESSING AMPLIFIER

Manufacturer's Specifications

Audio Section

Power Output per Channel, 20 Hz to 20 kHz: Main and center channels, 80 watts into 8 ohms or 100 watts into 6 ohms; front and rear effects channels, 25 watts into 8 ohms or 30 watts into 6 ohms.

Rated THD: Main and center channels, 0.015%; front and rear effects channels, 0.05%.

Dynamic Headroom: Main channels, 2.1 dB into 8 ohms or 2.0 dB into 6 ohms.

Damping Factor: Main channels, 120.

Frequency Response: Phono, RIAA ±0.5 dB; high level, 20 Hz to 20 kHz, ±1.0 dB.

S/N: Phono, 86 dB; high level, 96 dB.

Residual Noise, A-Weighted: 150 µV.

Input Sensitivity: Phono, 2.5 mV; high level, 150 mV; center and main in, 1.0 V.

Maximum Phono Input at 1 kHz: 140 mV.

Maximum Output, Preamp Out: 3.0 V.

Headphone Output Level: 0.25 V at 1 kHz, for 8-ohm load.

Tone Control Range: Bass, ±10 dB at 50 Hz; treble, ±10 dB at 20 kHz; bass extension, +7 dB at 70 Hz.

Muting: −20 dB.

Video Section

Composite Video Signal Level: 1.0 V peak to peak, 75 ohms.

S-Video Signal Level: Luminance, 1.0 V peak to peak; chroma, 0.286 V peak to peak.

Maximum Composite Video Input Level: 1.5 V peak to peak.

S/N: 50 dB.

Frequency Response: 5 Hz to 10 MHz, +0, −3.0 dB.

General Specifications

Power Requirements: 120 V, 60 Hz, 400 watts.

Dimensions: 17⅛ in. W × 6¹¹⁄₁₆ in. H × 18⁷⁄₁₆ in. D (43.5 cm × 17 cm × 46.85 cm).

Weight: 44 lbs. (20 kg).

Price: $1,499.

Company Address: 6722 Orangethorpe Ave., Buena Park, Cal. 90620.

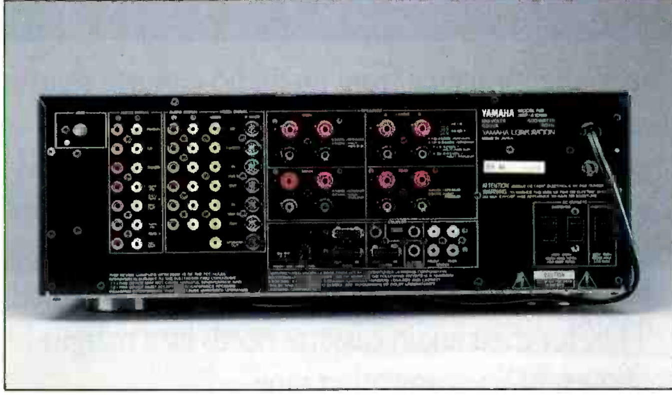
For literature, circle No. 90

Back in 1986, Yamaha introduced what was probably the very first home digital sound-field processor, the DSP-1. Yamaha's engineers had measured the acoustical characteristics of a wide variety of concert halls and other establishments where music was performed. Then, using digital signal processing and large-scale integrated circuits, they stored these characteristics in their first sound-field processor so that the environments could be duplicated in a home listening room. Yamaha's newest processor, the DSP-A1000, combines the company's latest digital processor circuitry with a seven-channel integrated audio/video amplifier. As I quickly learned, it also employs the most sophisticated digital sound-field processing and home theater surround-sound circuitry Yamaha has ever offered. The DSP-A1000 features 12 different sound-field programs and 23 variations, including separate modes for general and adventure movies. Utilizing a combination of digital processing and digital Dolby Pro-Logic to create a "70mm Movie Theater" setting, this all-in-one unit provides separate sets of information for foreground voices, special effects, and music and surround channels. In the seven-channel mode, dialog and front action are fixed at the video screen, while the effects are enhanced in the four available surround channels. A conventional Pro-Logic five-channel configuration is possible, as are four-channel arrangements (substituting a "phantom" channel for the preferred center-channel speaker) and even minimal three-channel installations.

The fixed sound fields are not limited to use with video sources. For music-only enjoyment, three different concert hall settings are provided (with two variations apiece)—as well as a church environment, two types of rock concert environments, and modes for disco, jazz, and stadium. Audio/video DSP programs include "Concert Video," "TV Theater," "Movie Theater," and, of course, the normal and enhanced modes of Dolby Pro-Logic.

The two main amplifiers and the single center-channel amp are designed to deliver 80 watts per channel into 8-ohm loads; the four effects channels provide 25 watts each into 8 ohms. (Part of the DSP-A1000's substantial weight of 44 pounds is attributable to the massive transformer employed in its power supply and to the anti-vibration, anti-resonance chassis.) In addition to supplying high power levels, this unit incorporates 10 audio and five video inputs with S-video as well as composite video jacks. Front-panel auxiliary terminals (including another S-video terminal) are provided so that you can connect the outputs of a camcorder without having to access the rear panel of this amplifier. A motor-driven input selector can be operated at the front panel or via the learning-capable remote control supplied with the DSP-A1000. A separate record-out selector lets you send any signal to "VCR 1" or "Tape 1" while another program is being heard or viewed.

A blank overlay lets users label the remote's programmable keys with whatever legends they want.

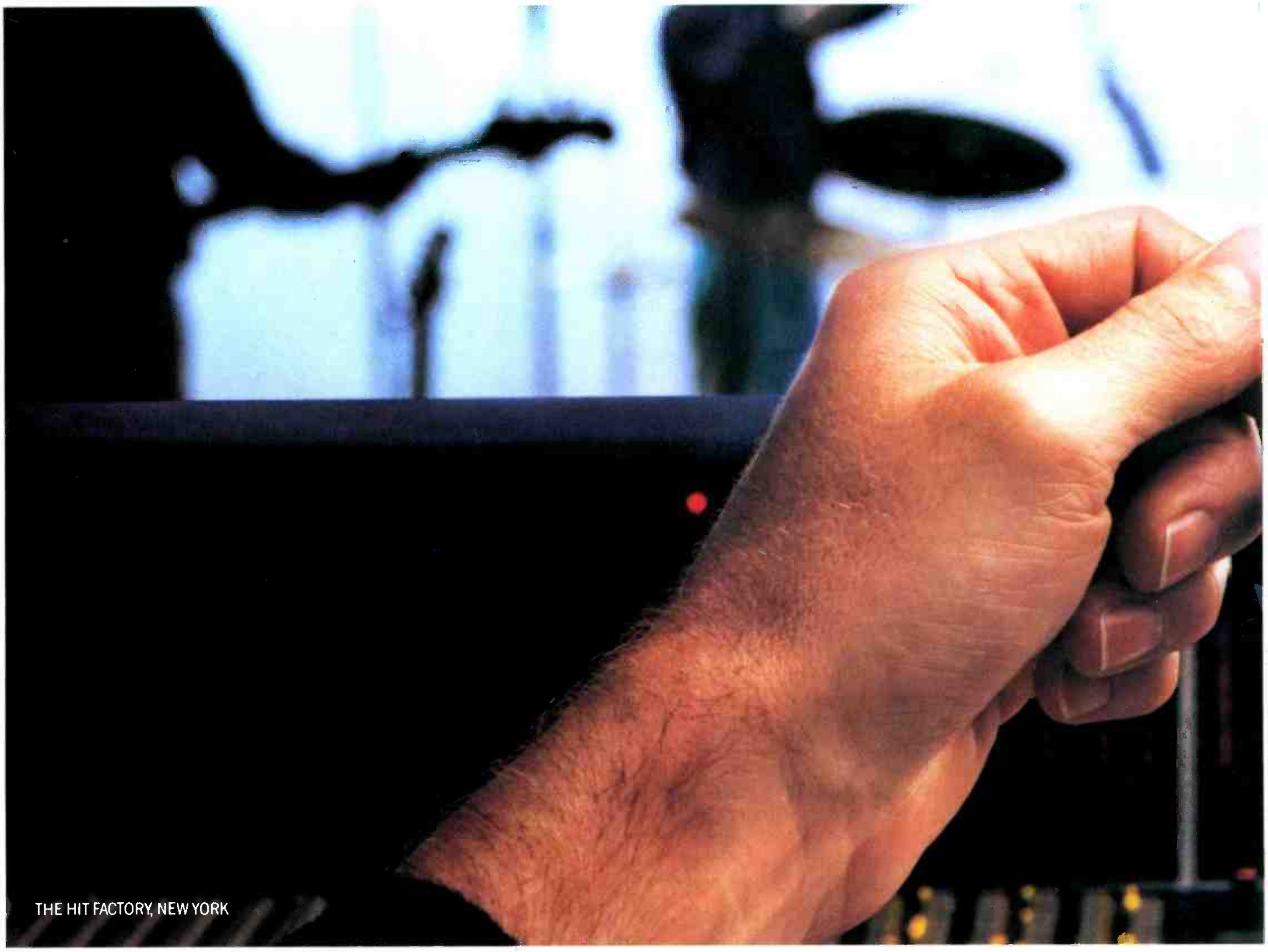


The DSP-A1000 includes a digital test-tone generator for DSP and Dolby Pro-Logic, five-band center-channel equalization, three center-channel modes (normal, wide, and phantom), and normal and three-channel Pro-Logic modes. Information that appears on the multi-function display on the front panel can also be superimposed on the screen of your TV monitor, if it's connected to the Yamaha's rear-panel "Monitor" output jack. Additional features of this amplifier include bass and treble tone controls, a preamp-out/main-in jack set, a subwoofer output terminal with a low-pass filter, dynamic "Bass Extension" (which I'll discuss later), audio muting for the main and effects channels, and a front-panel headphone jack.

Control Layout

The upper half of the all-black front panel houses the main power switch, a "Tape 2 Monitor" switch, the rotary source selector, and the master volume control (which is calibrated in dB from full volume, "0," past -80 to "$-\infty$"). The centrally positioned LCD display area shows selected program names and parameters, information about other various settings and adjustments, and activation of the Pro-Logic and sound-field processor circuits.

What The B



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ing endorsement of TDK? Perhaps they know that new TDK SA-X with its dual coating of Super Avilyn particles has an MOL which has been improved to 5.0 dB @ 315 Hz. Perhaps they know it has an ultra-low bias noise figure of -61.0 dB. Perhaps they know this translates into a dynamic range of 66.0 dB (the widest of any high-bias tape), making SA-X the perfect tape to capture the extra-wide dynamic range of digital recording sources. Or perhaps, after years of experience, their highly trained ears tell them all they need to know. So if you're looking for the best quality recording tape you can buy, why use what amateurs use, when you can use what the pros use.

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The DSP-A1000 has more sophisticated sound-field processing than Yamaha's original DSP unit, plus seven amplifier channels.

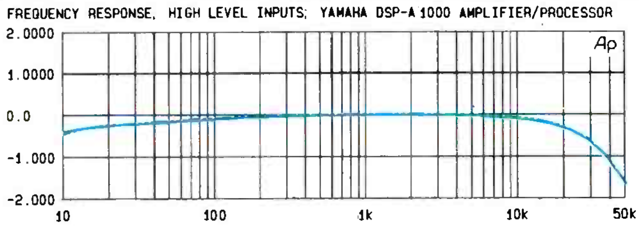

Fig. 1—Frequency response of main channels, for line input signal.

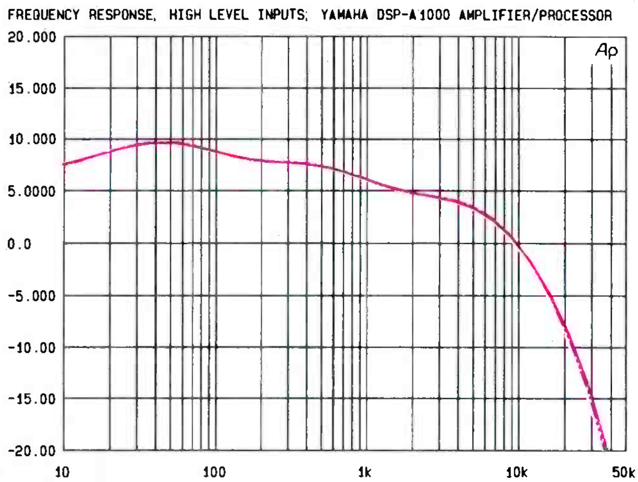

Fig. 2—Frequency response of effects channels in "Concert Hall 2" mode, for line input signal. Curves have been smoothed to eliminate time-delay effects; see text.

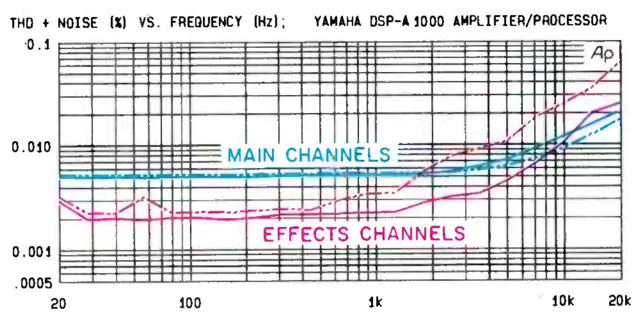

Fig. 3—THD + N vs. frequency for main and effects outputs at rated output into 8-ohm loads, for left channels (solid curves) and right channels (dashed curves).

Lowering a swing-down hinged panel reveals additional controls. These include an "Input Trim" control that adjusts input levels of each program source and also adjusts items selected by an adjacent "Set Menu" switch. That switch in turn brings up five different items for adjustment: "Pro Logic Mode," "Center Mode," center graphic equalizer, "Sub Woofer Level," and "Color" of the TV picture background (when no video signal is being applied to the connected TV monitor). A "Program" switch sequentially selects the sound-field processing programs, while an "Effect" switch turns effects speaker channels on or off. Other controls normally hidden by the swing-down panel are the stereo headphone jack; a "Bass Extension" switch; bass, treble, and balance controls; a "Rec Out" selector, and a set of audio and video auxiliary input jacks, including an S-video connector.

In addition to duplicating almost all of the control functions found on the front panel, the supplied infrared remote offers buttons that adjust rear- and center-channel levels relative to main-channel levels, change on-screen display parameters, and operate such other compatible Yamaha components as a CD or LaserDisc player, a tuner, and a tape deck. The remote can, in fact, be "taught" to control components from other manufacturers as well. Each key can learn two different functions, selected by flipping a switch from memory "1" to "2." Memory "1" is preprogrammed with functions that are called out on the panel, though it can be reprogrammed by the user. Memory "2" is empty, ready for user programming, and a blank template is supplied for personalized labelling.

When I turned the unit around to make my connections, it was easy to understand why the DSP-A1000 had to be more than 6½ inches high: The rear panel is crammed full of jacks and speaker terminals. There are seven pairs of RCA jacks for audio-only program sources, the 24 RCA or S-video jacks needed for routing two VCRs and inputting a LaserDisc and a DBS TV feed, and a monitor output in both RCA and S-video. The panel has some *eight* sets of speaker output terminals (two main, four effects, and two center), a subwoofer output jack (for use with powered subwoofers or with a separate amplifier), and four "Effect" output jacks (for those who prefer to use separate amplifiers for surround channels instead of the built-in amplifiers). There are also jacks for interconnection of the preamp and power amp sections, in/out jacks for the center channel, and a "Mono" output jack (which Yamaha explains is for fill between widely spaced speakers in large rooms). A small "Main Level" rotary control adjusts the line output level at the "Main Out" jacks. A "Front Mix" switch allows effects signals to be blended into the main outputs for systems that do not use front effects speakers. A center-speaker impedance-matching switch, three a.c. convenience outlets (two switched, one unswitched), and a ground terminal complete the rear-panel layout.

Measurements

My first objective in measuring this complex product in the lab was to determine the basic performance of its amplifier channels. Figure 1 shows the frequency response of the main-channel amplifiers. Attenuation was about 0.3

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Sound fields ranged from a concert hall just right for Mozart to film theater environments with the sweep to match adventure movies.

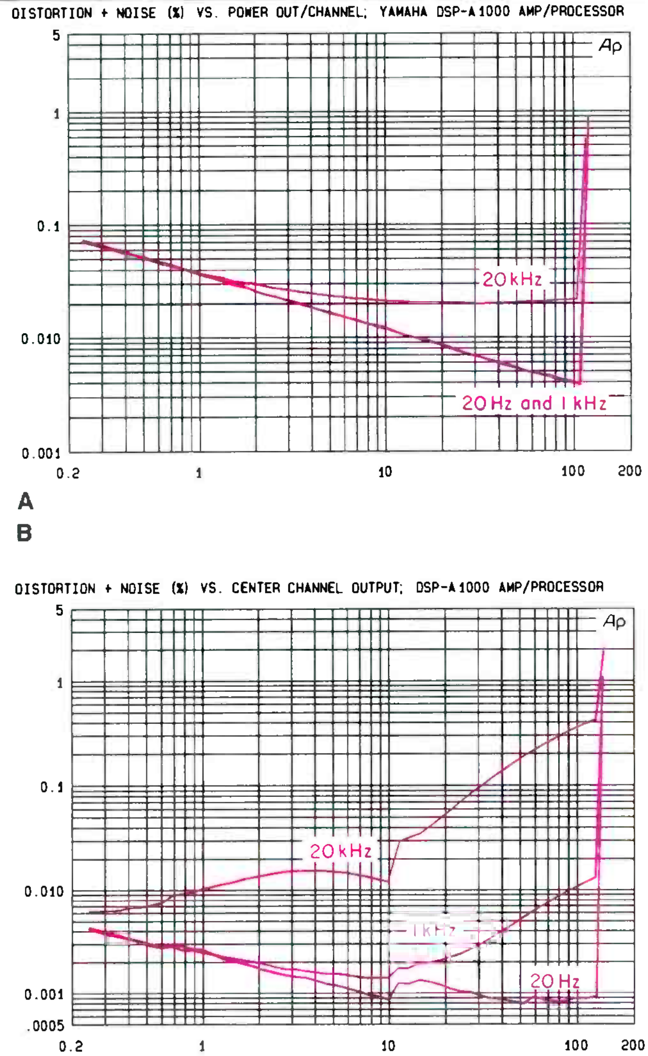

Fig. 4—THD + N vs. power output per channel into 8-ohm loads for main channels (A) and center channel (B).

dB at 20 Hz and 0.4 dB at 20 kHz. Those favoring wideband response for amplifiers will be delighted to note that even at 50 kHz, response was down less than 2.0 dB.

It is virtually impossible to measure the frequency response of surround or sound-field effects channels by the usual sweep methods. That's because the time delays built into such processors cause the resulting response curve to look like a closely spaced series of peaks and nulls as the measurement device tries to read the level of a frequency that has yet to arrive or one that has already passed. Thanks to a smoothing function of my Audio Precision test system, however, it is possible to average out the peaks and valleys. A typical response curve, shown in Fig. 2, was subjected to several passes of this smoothing process. It is presented only as a single example of the type of response that is generally available at the effects-channel outputs, where high frequencies are deliberately rolled off (much as they are in sounds reflected from walls and other surfaces of a concert hall). I could have plotted more of these effects response curves by using several, if not all, of the sound fields offered by the DSP-A1000, and each would have been slightly different. I chose not to do this simply because judging sound-field simulations is accomplished far better through extensive listening tests. I will discuss those tests a bit later.

Figure 3 shows THD + N versus frequency for the main and surround channels. Plotting this for the main channels was easy. At a regulated output level of 80 watts per channel, with both main channels driven, THD + N for all but the highest frequencies is well below the 0.015% specified by Yamaha—and is as low as 0.005% or thereabouts at low and middle frequencies. Measuring the power output capability of the effects speakers (front or rear) was not that easy. As a first attempt, I simply selected one of the DSP modes ("Concert Hall 2") and attempted to plot power output versus distortion for various test frequencies. Much to my surprise, apparent THD + N was well above the published specification. After conferring with some of the folks at Yamaha, I realized that what I was seeing were the time-delayed reverberant signals adding to the THD + N figures. I learned that the only way to isolate the effects amplifier channels from the DSP programs (in other words, to measure these channels simply as straightforward power amplifiers) was to insert RCA plugs into the effects output jacks. This effectively cut the connection between the DSP section and the power amplifier channels used for the front and rear effects speakers. Then I had to inject my generator signals directly to the amplifier inputs located on one of the p.c. boards. This, of course, meant taking the cover off the unit, which may have added a bit of noise or hum to the readings for the effects channels shown in Fig. 3. Even so, these readings were now well below specification for the rated output of 25 watts per channel. In fact, only near 20 kHz does THD + N creep above the 0.05% mark; over most of the spectrum, the readings range between 0.002% and 0.02%. Tests were made with two channels driven simultaneously, and results were about the same for front and rear effects amplifier channels.

Figure 4A is a plot of THD + N versus power output for the main channels. At 100 watts per channel, THD + N for 1-kHz and 20-Hz signals was even lower, around 0.0042%, proving that part of the earlier reading of 0.005% at 80 watts was due to noise rather than harmonic distortion. Figure 4A also reveals that maximum power output before clipping was actually more than 100 watts, even for the 20-kHz test frequency.

Center-channel distortion at rated power output of 80 watts, with a single 8-ohm load connected, was even lower than the THD of the main channels at most frequencies (Fig. 4B). It was less than 0.001% at 20 Hz and about 0.008% at 1 kHz, but it increased to about 0.28% at 20 kHz.


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Particularly spectacular for movie playback is the "70mm Adventure" submode, which combines DSP with Dolby Pro-Logic.

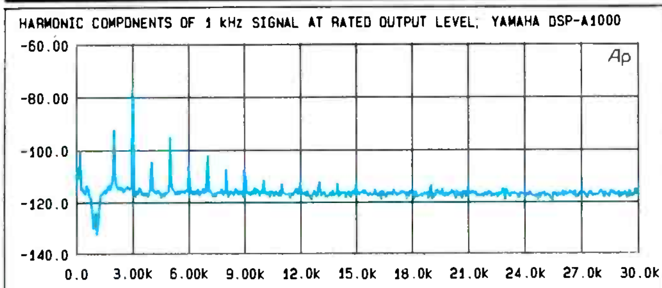


Fig. 5—Spectrum analysis of harmonics of 1-kHz main-channel signal at 80 watts per channel into 8 ohms. Curve shown is averaged result of 16 acquisitions, to reduce displayed noise and improve display of coherent signals.

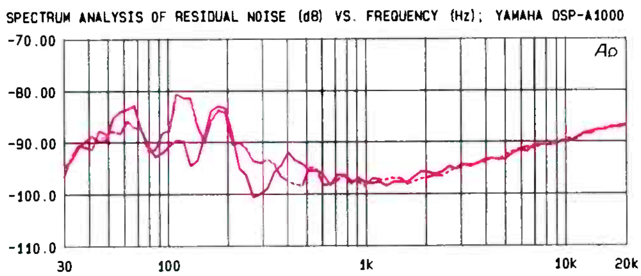


Fig. 6—Spectrum analysis of main-channel residual noise for 1-watt output with 500-mV line-level input.

To further differentiate residual noise from actual harmonic distortion, I ran a spectrum analysis of the distortion products for 80 watts per channel at the main amplifier outputs (Fig. 5). The major (and only significant) harmonic distortion component visible is the third harmonic of the 1-kHz fundamental, and that harmonic is down about 79 dB relative to the 0-dB fundamental, equivalent to a THD value of 0.0112%.

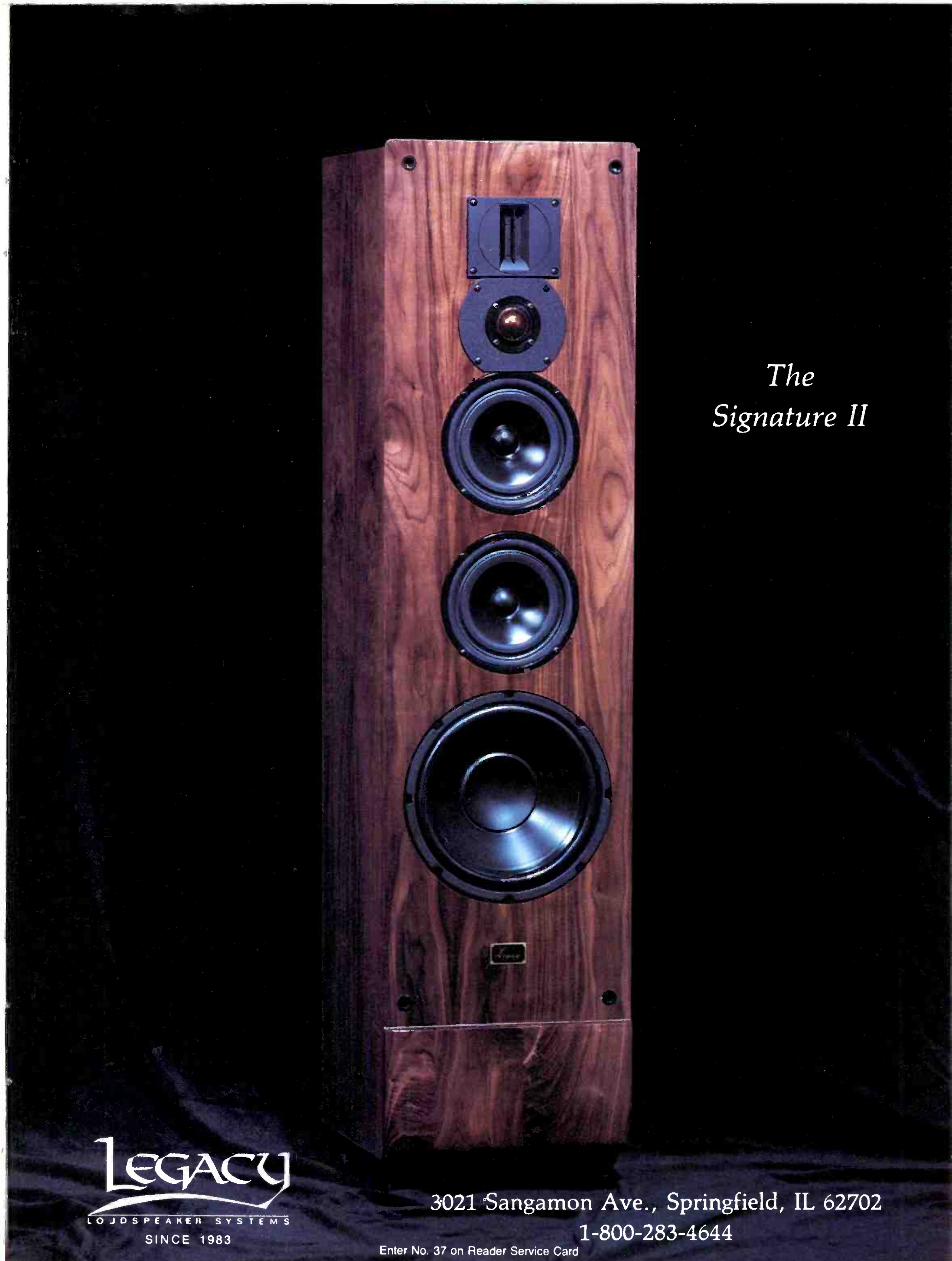
Dynamic headroom for the main channels of this amplifier was 2.0 dB, which means that for short-term musical crescendos, the main channels of the DSP-A1000 could deliver nearly 130 watts per channel before clipping. Damping factor for the main amplifier channels measured 125. Input sensitivity for the high-level inputs was 16 mV for 1 watt output; phono input sensitivity for 1 watt output was 0.27 mV. Maximum phono input level at 1 kHz before clipping measured 145 mV. High-level input signal-to-noise ratio, using a 500-mV input and adjusting the master volume control to produce 1 watt into 8-ohm loads, was an excellent 80.4 dB. For the phono inputs, using a standard 5-mV input at 1 kHz and adjusting gain once more for 1 watt of output, S/N measured 77.7 dB for the left channel and 75.2 dB for the right channel.

A third-octave spectrum analysis of residual noise of the main-channel outputs versus frequency, with the same reference levels used in the S/N measurement but without A-weighting, is shown in Fig. 6. Note that major contributions, as low as they are, are attributable to the power-supply fundamental frequency and its harmonics. Figure 7 shows the range of the bass and treble tone controls of this integrated amplifier. Also plotted is the response of the "Bass Extension" circuit, which peaks at 70 Hz and then attenuates bass rapidly to avoid amplifier overload. This sort of response will undoubtedly be favored by those who like a solid beat with their rock and pop music as well as by those who want the kind of tummy-rattling bass associated with action movies that have Dolby Surround soundtracks. Figure 8 shows the deviation from standard RIAA playback equalization for signals fed to the phono inputs of the DSP-A1000. Deviation was slightly less than ±0.5 dB for the entire audio spectrum from 20 Hz to 20 kHz.

Listening and Viewing Tests

There are so many ways to set up this sound-field processing A/V amplifier that I was delighted when three of Yamaha's staff volunteered to come to my lab and listening room to make certain I properly explored all aspects of this versatile component. I resisted at first, thinking that they might attempt to do a bit of "brainwashing" to make certain that I said nice things about the product. My fears were ungrounded. Armed with extra speakers, a laser videodisc player, and plenty of cables, the Yamaha crew took over my own home theater installation without in the least upsetting my own entertainment system, other than to use my reference front speakers as the main speakers of the system. To these, they added a center-channel speaker, perched atop my 32-inch reference TV monitor/receiver; a pair of front effects speakers (mounted high, and actually behind what I normally call the "front" speakers, but which they call the "main" speakers to avoid confusion); a pair of rear effects speakers, and a subwoofer. In sum, the installation now included a total of *eight* speakers, seven of which were being driven by the DSP-A1000! (The subwoofer was an active system.) In addition, they hooked up a Yamaha optical disc player so that we would not have to disconnect my own videodisc player from the rest of my system.

What followed can only be described as the most authentic concert hall and movie theater experiences that I have ever enjoyed in my somewhat cramped home theater listening room. Before I tell you about the impact of some of the motion picture excerpts I watched, let me describe what happened when I played a CD of Mozart's 40th Symphony (Telarc CD-80139) by the Prague Chamber Orchestra under the direction of Sir Charles Mackerras. (I felt that this was an appropriate starting point during this 200th-anniversary year of that sublime composer's death.) I began playback using the DSP-A1000's "Concert Hall 1" mode, a European hall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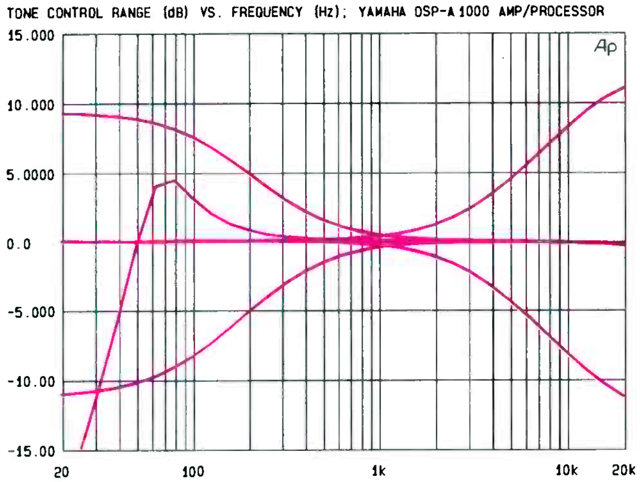


Fig. 7—Bass and treble control range, plus action of "Bass Extension" circuit.

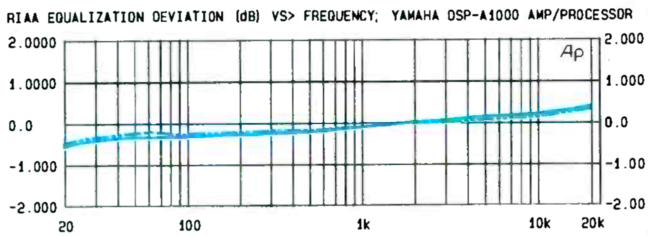


Fig. 8—Deviation from standard RIAA phono equalization.

that was not further identified. The room size seemed to expand to that of a moderately small hall, one that I deemed particularly appropriate for this Mozartean orchestra. When Gary Altunian, National Product Training Manager for Yamaha's audio component line, attempted to impress me with "Concert Hall 2" and "3," I felt that they sounded much too big for this Mozart recording, and he obligingly returned me to the smaller concert hall. I wanted to hear the entire symphony, but in the interests of time, I settled for just the First and Second Movements. I sensed that the Yamaha crew really wanted to get on with some demonstrations of blockbuster films.

The first clips we watched were from *Indiana Jones and the Last Crusade*. The scene in which Sean Connery and Harrison Ford fly (and crash in) a small biplane was first played using Dolby Pro-Logic. It was impressive enough as the heroes' plane was chased by the bad guys in another plane, with sounds streaming overhead and across my expanded home theater environment. Then I used the remote to switch to what Yamaha calls "Dolby Pro-Logic with enhancement," a mode that uses DSP to synthesize phantom images of the multiple effects channels in large movie theaters. Instantly, I was transported to a larger theater, one that made better use of the Dolby Stereo process. The scene now took on new, greater dimensions, with the sounds of the moving aircraft seeming to make smoother transitions from side to side or from front to rear. Finally, I used the remote to select the "Movie Theater" surround mode. There was suddenly an astounding increase in spatial depth. Sounds were coming not only from the actors (via the center channel) and from the space between the screen and my viewing position but also from "behind" the video screen. The contribution of those extra front effects speakers was particularly spectacular during the playback of the same scene in the "70mm Adventure" submode (which combines Dolby Pro-Logic with DSP circuitry); it simply has to be heard to be believed. With dialog at the screen position, sound effects in the near background, and music in the far background, this combination Dolby Pro-Logic/DSP mode truly enveloped me in total surround sound in a way that I had not heard before except in one of the few large motion picture houses remaining in the New York metropolitan area. Certainly, the sonic experience was far superior to the level of sound quality I typically encounter when attending movie theaters that have been subdivided into multiple screening rooms!

The "Movie Theater" mode has a second submode, "70mm General," that is perhaps more appropriate for less dramatic, less adventure-laden films. It was extremely effective with romantic comedies, drama, and what I can best describe as "lower budget" films, but for the greatest impact, give me that "70mm Adventure" mode every time!

I'm indebted to Yamaha's Larry Poor, Marketing Manager for Audio Products; Frank Ricatto, Eastern Regional Manager for Audio Components, and Gary Altunian. The reviewer's task with a product as all-encompassing and elaborate as the DSP-A1000 is not an easy one. I suspect that had it not been for their help, I might have overlooked some of the wonderful surround and sound-field capabilities of this processor/amplifier. As they were packing up the extra speakers and other components they had brought (leaving me the amplifier for further testing on the bench), I could not help but recall the first digital sound-field processor Yamaha introduced five years ago. That unit required the addition of several power amplifiers as well as the required number of speakers. Anyone brave enough to undertake assembly of a home theater or surround sound environment in those days ended up with a rack full of electronics—and a tall rack at that—before even considering the necessary extra speakers. That all of the electronics needed for the variations of Dolby Pro-Logic as well as the 12 programs (for 23 modes) of digital sound-field processing are incorporated in a single "do everything" component can only be regarded as a minor electronics miracle. That such a component carries a price tag actually lower than that of some processor-only components is an even more miraculous achievement.

Leonard Feldman

Signature Reference Series: The Very Best of the Best

The legendary sound of Polk loudspeakers has for years been exemplified by its flagship Signature Reference Series (SRS), the speakers that carry Matthew Polk's signature.

Polk now introduces its SRS 1.2TL, 2.3TL, and 3.1TL, each featuring the latest breakthroughs in loudspeaker technology. Following is a technical brief of why the SRS speakers sound so remarkably like a live performance. After reading this information, it is hoped that you listen carefully to the SRS loudspeakers at your Polk Audio dealer. While you will probably hear things you have never heard from a stereo system, you can be assured that everything you hear is true.

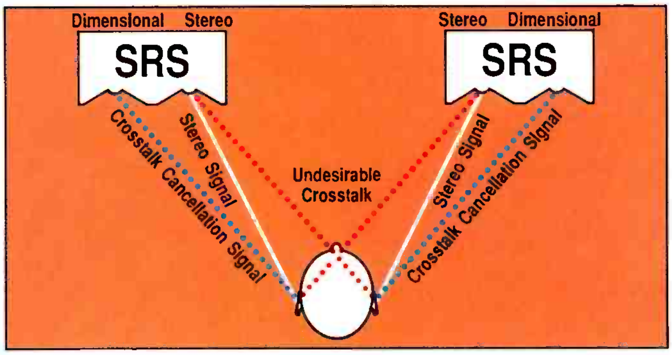
It All Begins With the Sonic Excitement of Polk's Stereo Dimensional Array (SDA)

Years ago Polk Audio recognized the importance of more absolute separation of information reaching each ear. Of course, the fundamental concept of stereo reproduction is that there are two separate channels of information, each intended for one ear only (i.e. "true stereo").

To more accurately reproduce sound as it was originally created, it is vital that the integrity of this separation of information be maintained.

With conventional speaker systems, each ear hears both speakers, and the separation is minimized. The resulting soundstage is reduced to the small space between the speakers. A large symphony orchestra is reduced to only a few feet wide and a few inches deep.

Polk's "True Stereo" SDA technology delivers left signal information to your left ear and right signal information to your right ear. Each ear only hears its proper signal, thereby maintaining full stereo separation. The resulting soundstage is dramatic.



Each Polk SDA incorporates a special extra set of drivers which radiate a difference signal that cancels the undesirable signal going from the wrong speaker to the wrong ear (interaural crosstalk distortion). The result is True Stereo reproduction.

...everything you hear is true.

Experts have called the Polk SRS Series featuring the revolutionary Stereo Dimensional Array (SDA) technology"mindboggling... astounding...flabbergasting...a new dimension in sound." Others have discovered new life in their favorite musical selections.

It is "True Stereo" by Polk.

Yes, Everything You Hear is True

Listen to what the critics say: "Mindboggling.. astounding...flabbergasting." Listen to what other Polk owners say: "I've never heard anything like it...it's whole new world."

But no number of written accolades will prepare you for the experience of listening to the SRS loudspeakers at your Polk Audio dealer.

We invite you to your local Polk Audio dealer for a demonstration of this technology. Because everything you hear is true.

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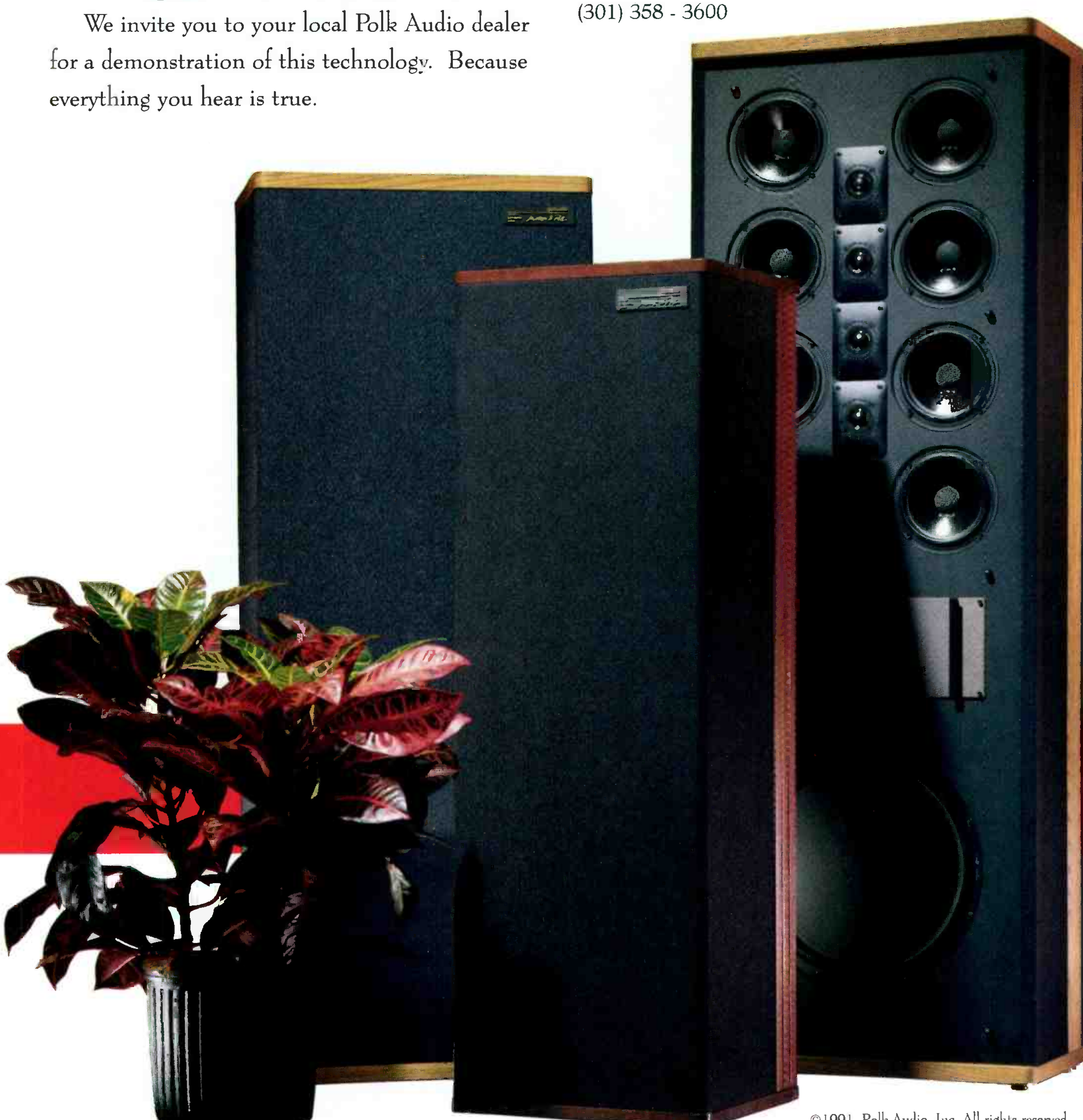

Where to buy Polk Speakers?
For your nearest dealer, see page 124

Enter No. 34 on Reader Service Card

2

KEF 105/3 SPEAKER

Manufacturer's Specifications

System Type: Four-way system with vented, coupled-cavity enclosure and optional KUBE external active equalizer.

Drivers: Two 8-in. (200-mm) cone woofers, two 6½-in. (165-mm) polypropylene cone low/midrange drivers, and 6½-in. (165-mm) coincident-source drive unit with 1-in. (25.4-mm) polyamide soft-dome tweeter.

Frequency Response: 49 Hz to 20 kHz, ±2.5 dB, at 2 meters on reference axis.

Directional Characteristics: Flat within 2 dB from 50 Hz to 17 kHz up to 30° off axis.

Sensitivity: 93 dB SPL at 1 meter, for pink-noise input of 2.83 V rms, band-limited from 50 Hz to 20 kHz.

Maximum Output: 115 dB SPL on program peaks under typical listening conditions.

Crossover Frequencies: 150 Hz, 350 Hz, and 2.3 kHz.

Impedance: 4 ohms, resistive, from 20 Hz to 20 kHz.

Recommended Amplifier Power: 50 to 300 watts per channel.

Dimensions: 43½ in. H × 11 in. W × 16 in. D (110.4 cm × 28 cm × 40.5 cm).

Weight: 92.5 lbs. (42 kg).

Price: $3,900 per pair, in black ash, rosewood, or walnut veneer; KUBE 200 equalizer, $400.

Company Address: KEF Electronics of America, 14120-K Sullyfield Circle, Chantilly, Va. 22021.

For literature, circle No. 91

KEF, a British company, has been in the forefront of applying the most modern loudspeaker technology. In the Reference Series Model 105/3, KEF has taken advantage of the latest in very powerful neodymium-iron-boron magnets to shrink a 1-inch dome tweeter and actually place it in the neck of a midrange cone loudspeaker. The 105/3 is the first of KEF's Reference Series high-end line to use the new "coincident source," coaxial-style, mid-high frequency driver, which they have dubbed the "Uni-Q." Previously, only a lower cost line of KEF loudspeakers utilized this technology.

The 105/3 is a floor-standing, four-way system that uses the Uni-Q 6½-inch coaxial driver to reproduce all the frequencies above 350 Hz. The lower frequencies, up to 150 Hz, are generated by two 8-inch cone woofers in KEF's "coupled cavity" bass-loading system. This is a form of single-tuned, bandpass vented-box enclosure design that KEF has used in several previous systems, including the Model 107 (reviewed in the February 1988 issue). Each woofer operates in its own sealed enclosure and is coupled to a third port-tuned, central enclosure which radiates bass energy into the room through its port. The two woofers are joined through the centers of their magnet structures by a heavy metal rod, which effectively cancels the opposing reactive motions of their frames. This helps minimize sonic coloration caused by unwanted box vibration triggered by driver reactive forces.

The remaining frequency range, between the bass section and the Uni-Q coaxial driver, is reproduced by two additional 6½-inch cone drivers symmetrically placed above and below the Uni-Q driver. This configuration provides a symmetrical, forward-facing, vertical coverage pattern that has no lobing error (i.e., its vertical directional pattern stays solidly aimed in the forward direction at all frequencies through crossover). KEF has chosen a relatively low crossover frequency of 350 Hz between the lower mids and Uni-Q coaxial driver, which effectively minimizes any additional lobing and beaming due to the relatively wide spacing of the midrange drivers. The two lower midrange drivers have the effective area of a much larger driver but the width of a small driver. This allows a narrow front panel that improves lateral imaging and reduces baffle-reflection and diffraction problems.

KEF makes extensive use of conjugate load matching to smooth the system's impedance, thus making it a much better load for amplifiers and their associated connecting cables. A system with a purely resistive impedance, independent of frequency, is a very easy load to drive. It is also very tolerant of high values of cable resistance that typically cause frequency response variations in speaker systems whose impedance varies with frequency. For a system with purely resistive impedance, the cable resistance causes only a reduction in power available to the loudspeaker, not any frequency response variations.

The Uni-Q driver is superficially much like a typical coaxial loudspeaker, but the tweeter is actually mounted at the apex of the midrange driver's cone, inside the midrange voice-coil instead of in front of the larger driver's cone. The latter technique offsets the acoustic centers of the individual drive units. The Uni-Q was designed to align the acoustic centers of the drive units (the points where the waves

appear to originate) so that their individual directional patterns will match very closely through the crossover region. This would effectively provide a two-way driver that would behave as a single coherent source of sound, providing uniform coverage over a wide but controlled region.

This concept was originally implemented in the distant past with horn-loaded high-frequency drivers, where the high-frequency sound actually passed through the center of the low-frequency cone driver and was radiated by a horn mounted in the center of the bass device. The old Altec Lansing 604 coaxial was just such a system, and utilized a 15-inch woofer and multicellular horn tweeter. These coaxes are still living in the professional market, where systems such as the UREI 813 control room monitor (with updated horn) are still used quite extensively. The U.K.'s Tannoy has several good horn-loaded coaxial systems in its current line of speakers.

KEF's Uni-Q assembly extends the concept to a completely direct-radiator design utilizing a well-behaved dome tweeter with a very small, high-energy magnet, mounted in the center of a 6½-inch midrange driver. The cone of the midrange driver actually acts as a waveguide for the high frequencies, and thus potentially matches the high- and low-frequency coverage patterns of the individual drivers. The 105/3 is designed to have wide but controlled coverage that improves its imaging capabilities by minimizing wall, floor, and ceiling reflections.

This model also follows KEF's established system of computer-matching all speaker and crossover components to minimize unit-to-unit variations. KEF tests all incoming components and numbers them according to their measured values; KEF schematics then either specify particular part

KEF's Uni-Q driver has its tweeter at the apex of the midrange driver's cone, aligning the acoustical centers of both drivers.

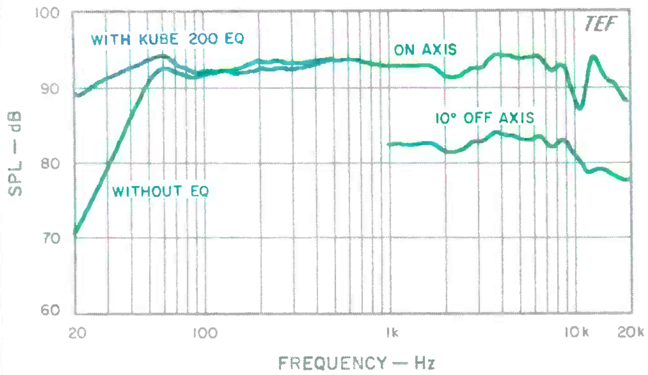

Fig. 1—Equivalent 1-meter frequency response.

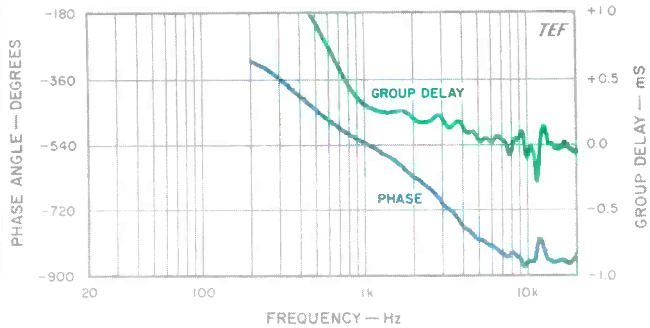

Fig. 2—Phase angle and group delay.

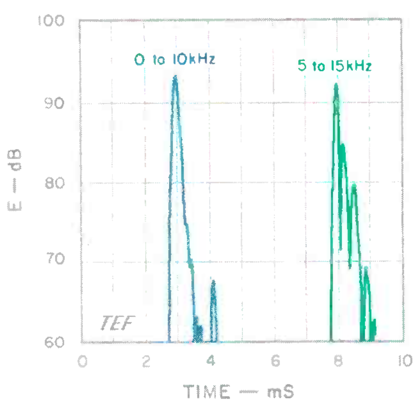

Fig. 3—On-axis energy/time curves over standard range (left) and centered over tweeter range (right). Tweeter ETC has been shifted right by 5 mS, for clarity; see text.

values or show tables for the component combinations to meet the company's very tight specifications.

The 105/3 can be used with the KUBE 200 external active equalizer, which extends the response of the system down to 20 Hz and also compensates for response variations caused by speaker placement and listening room acoustics. The equalizer has two "Contour" controls, "HF" and "LF," which provide limited-range adjustment of high- and low-frequency level. The equalizer also contains a front-panel EQ bypass switch and complete tape monitor switching capabilities. In addition, the rear panel contains equalized and nonequalized outputs (one set with level control) that allow versatile interconnection and level adjustment in a biamplified system and also provide convenient capabilities for multi-room or audio/video systems.

Twin sets of gold-plated terminals on each speaker's rear panel, spaced ¾ inch (19 mm) apart, allow bi-wiring or biamping. Removable, gold-plated connecting straps are installed at the factory for normal single-cable drive. The terminal can handle large cables up to about ¼ inch (6.3 mm) in diameter. Unlike some high-end systems I have reviewed, the KEF has easily accessible terminals so that I could get my fingers on their knurled knobs to tighten them securely.

Separate p.c. boards hold the high- and low-frequency sections of the crossover, but both are mounted in the woofer enclosure. The crossover is composed of 51 separate components, divided up into 15 resistors, 13 inductors, and 23 capacitors. All component quality is first-rate.

The enclosure is very substantial and well strengthened by the construction of the internal woofer-mounting compartments and additional bracing. The two midrange drivers and the Uni-Q high-frequency drive unit are mounted on an independent, specially profiled module, precision-machined from solid medium-density fiberboard, 3 inches thick. This mid/high-frequency module holds a vertically symmetrical array of three sealed sub-enclosures, made of die-cast aluminum, behind the drivers. The module, with drivers attached, is mounted to the front of the enclosure by four respectable, 5/16-inch socket-head bolts, 3 inches long. The module actually protrudes about 3 inches beyond the front of the woofer enclosure, making the system look front-heavy with its grille off. The smoothly contoured port outlet for the central resonant-air chamber is mounted just below the module.

The woofer enclosure is finished on all five sides in rosewood, walnut, or black ash veneer. The sculptured grille assembly covers the top seven-eighths of the front of the enclosure and is secured to the cabinet with four powerful disk magnets. (And they are powerful! You had better keep your fingertips from between the grille and cabinet when replacing the grille assembly, or you'll get pinched when the grille snaps into place!) The grille itself is contoured to fit snugly over the mid/high module and provides no added sharp edges to diffract the high-frequency sound.

Measurements

The performance of the 105/3s was evaluated by measuring several properties including: On- and off-axis frequency responses, energy-versus-time behavior, impedance versus

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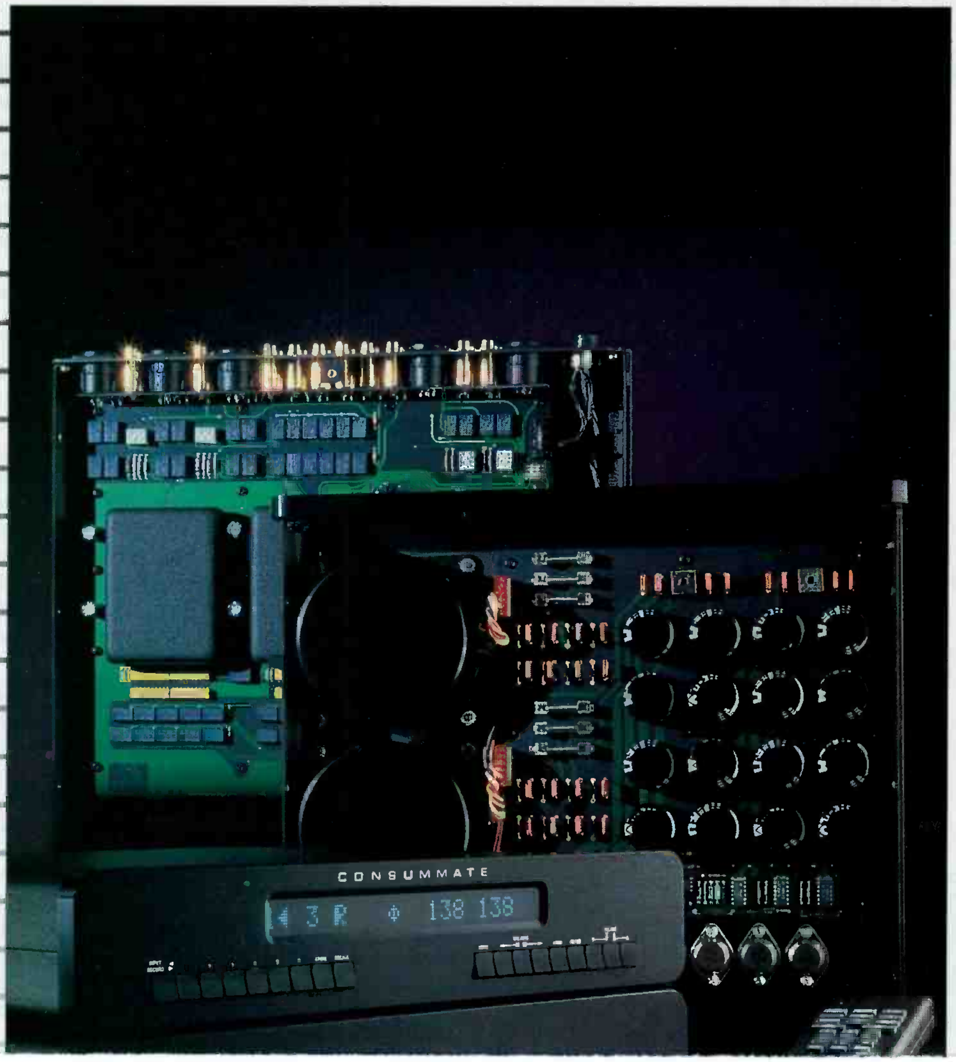

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With its KUBE equalizer, the 105/3 was flat within ±2 dB from 24 Hz to 10 kHz and smooth above that in most listening positions.

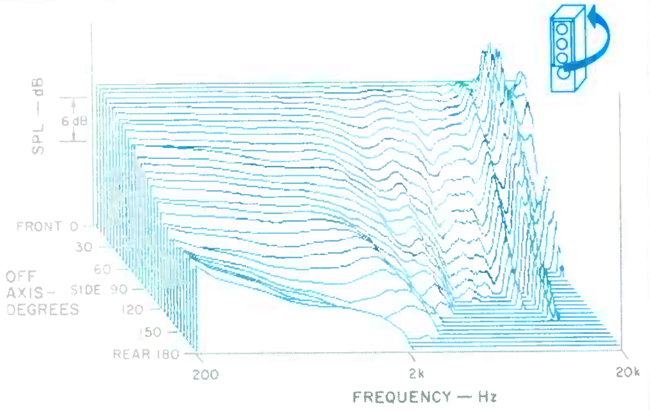

Fig. 4—Horizontal off-axis response, normalized to the on-axis response; see text.

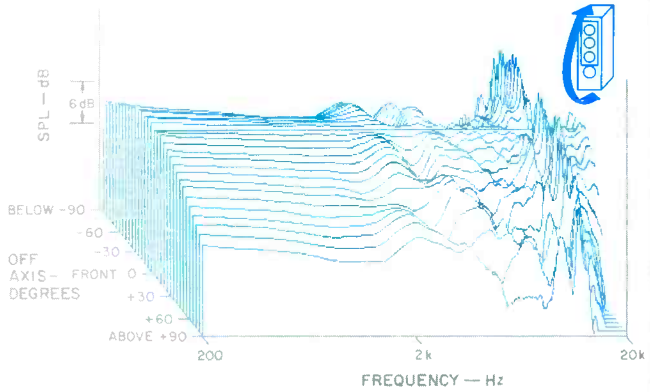

Fig. 5—Vertical off-axis response, normalized to the on-axis response; see text.

frequency, harmonic and IM distortion, and maximum peak input and output capabilities. A few frequency response measurements were also run on the KUBE 200 active equalizer. The systems were evaluated using ground plane, near-field, and elevated free-field methods. Evaluation equipment consisted of a Techron TEF System 12 Plus Time Delay Spectrometry (TDS) analyzer, a B & K 4007 condenser microphone, Crown power amplifiers, and Leader signal generators, attenuators, voltmeter, and oscilloscope.

The 1-meter on-axis frequency response curve, with and without the KUBE 200, is shown in Fig. 1, smoothed with a tenth-octave filter. The effects of the grille are not shown because it caused less than ±1 dB change in the curve. The curve was taken at 2 meters, 36 inches up, normal to the enclosure. This position is on a line toward the ear position of a listener seated 3 meters away and is about 2° above the axis of the tweeter. All the following measurements were also taken with the grille off.

Without equalization, the curve fits within a ±3.5 dB window from 44 Hz to 20 kHz, limited only by a moderately high-Q dip and peak between 10 and 15 kHz. With the KUBE 200's 18-dB lift at 20 Hz, the low-frequency response is extended down to 20 Hz. With equalization, the curve fits within a much tighter ±2 dB envelope from 24 Hz to 10 kHz. Subsequent measurements revealed that the response roughness above 10 kHz was confined to a cone roughly 7° around the axis. The curve at 10° off the horizontal axis exhibits much smoother high-frequency behavior.

The 1-meter, 2.83-V rms sensitivity was determined by averaging the axial response from 250 Hz to 4 kHz. This yielded an unusually high sensitivity of 93.5 dB SPL! The right/left matching of the systems was quite good, with no more than ±1 dB variation above 100 Hz.

Figure 2 displays the axial phase and group-delay measurements of the system, corrected for the tweeter's time arrival. The phase response (lower curve) exhibits a total phase rotation of about 325° between 1 and 20 kHz. A separate measurement of offset revealed that the Uni-Q's midrange trails its tweeter by about 0.21 mS (210 µS), which corresponds to a distance of 2.8 inches (72 mm). At the crossover of 2.3 kHz, this offset represents approximately one-half wavelength, or about 180°. Note that the top of the phase graph is not at 0° but at −180°; this is due to the additional phase lag that results from the low-frequency drivers' being mounted inside the box, and hence farther away, as compared to their being mounted on the enclosure's front surface.

The energy/time curve (ETC) is shown in the left-hand curve of Fig. 3, for a test signal swept over the range of 200 Hz to 10 kHz. This ETC represents mostly the tweeter's response and emphasizes energy from 2 to 9 kHz. The response is quite tight and is followed only by one arrival more than 24 dB down.

A second ETC sweep was run from 5 to 15 kHz, covering only the tweeter's range, to investigate the high-frequency problems seen earlier. The right-hand curve of Fig. 3 shows two closely spaced secondary arrivals delayed by 204 and 561 µS at levels of −7.6 and −12.6 dB corresponding to distances of 2.75 and 7.58 inches, respectively. To generate a dip at 11 kHz would take an in-phase signal delayed by one-half period, about 45 µS, which corresponds to a distance of about 0.6 inch. Because the measured times were much greater than this calculated value, I am at a loss to explain the significance of the second ETC measurement. Apparently there is a high-frequency reflection of the tweeter's output, possibly off the Uni-Q's midrange cone, with a delay of about 45 µS that causes the 11-kHz dip.

A high-level, low-frequency sine-wave sweep did not reveal any enclosure side-wall vibrations; the walls were quite rigid and unmoving. There was, however, some vibration of the mid/high module against the front of the woofer enclo-


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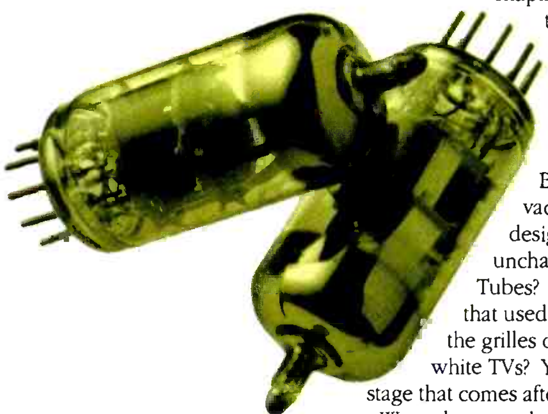
CAN TUBES WARM UP CD SOUND?

How a very old technology can make a brand new compact disc player sound extraordinarily good.

Our new SD/A-490t has a clock that "ticks" 33 million times a second, multi-stage noise shaping, pulse width modulators and enough other edge-of-the-art circuitry to finally qualify us for entry into the hallowed Compact Disc Techno-Jargon Hall of Fame.



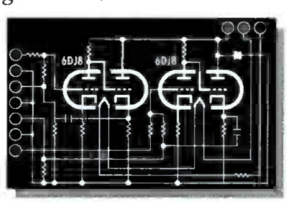
But it also includes two vacuum tubes whose classic design has remained unchanged for over 35 years.

Tubes? Those warm glass things that used to glow cheerily through the grilles of old radios and black & white TVs? Yes. In an important circuit stage that comes after all the digital wizardry.

We and many other critical listeners believe that this anacronistic addition to an already excellent CD player design significantly enhances its sound. Read on and decide for yourself.

THE AMPLIFIER THAT DOESN'T AMPLIFY.

Between a CD player's D/A converter and external outputs is circuitry called a buffer amplifier stage. When you hear the word amplifier, you think of something which makes a signal louder. But that's not a buffer amp's purpose. In fact, contrary to popular lore, a CD player's buffer amplifier doesn't boost the signal strength at all — the final output of a CD player's D/A converter already has sufficient voltage to directly drive a power amplifier!



Instead, the buffer amp is a *unity gain* device which *1) increases output current, and 2) in the process, acts as a sort of electronic shock absorber.

A signal emerging from a CD player's digital-to-analog conversion process has sufficient voltage but insufficient current for proper interaction with a preamplifier or power amp. By acting as a current amplifier, the buffer stage helps lower impedance to a level that's compatible with modern components — about 50 ohms in the case of the SD/A-490t.

At the same time, the buffer stage helps isolate the relatively fragile D/A chip set from the nasty outside world of demanding analog components.

TUBES VERSUS SOLID STATE.

All compact disc players have buffer amplifiers. But more than 98% of them use solid state devices for this stage: either integrated op-amp circuits or discrete transistors.

A handful of hard-to-find, esoteric designs in the $1200 to $2500 range employ one or more tubes instead. As does our readily-available $699 SD/A-490t. For fundamental physical reasons, tubes have different transfer function characteristics than transistors. When used in ultra-expensive, audiophile preamplifiers and power amplifiers, their sound is variously described as "mellower", "warmer", "more open and natural" or simply "less harsh than solid state".

At the heart of these perceived differences are three basic facts:

1. Tubes produce *even*-order distortion (i.e. 2nd, 4th, 6th harmonics, etc.) while transistors create *odd*-order distortion, particularly 3rd harmonics which are less psychoacoustically pleasant.

2. In a buffer stage, a tube acts as a pure Class A device, which is considered the optimal amplifier configuration. Op-amps function as Class A in and Class B out, with potential crossover distortion as voltage swings from positive to negative.

3. Tubes "round off" the waveform when they clip. When over-driven, solid state devices cut off sharply, causing audible distortion.

THE SD/A-490t'S OUTPUT SECTION

Our new CD player uses two 6DJ8 dual triodes (each literally two separate tubes in a single glass envelope) placed between the digital-to-analog converter and a motorized volume control.**

Operated at less than 30% of their maximum capacity, these tubes achieve a highly linear output voltage with very low static and transient distortion while providing very high dynamic headroom.

And because they're "loafing" at 1/3 their rated current capability, the SD/A-490t's tubes are designed to last the life of the CD player without replacement or need for adjustment.

A "LESS IS MORE" DIGITAL APPROACH FOR CLEANER ANALOG SOUND.

It would be pointlesss to have a tube output stage if the digital circuitry which precedes it

wasn't first rate. The SD/A-490t uses Single-Bit D/A circuitry to eliminate a form of exceedingly audible distortion inherent in most current CD player designs, and to provide better signal linearity than ever before.

If you've read current CD player brochures, you've probably stumbled across descriptions of de-glitcher circuits, laser trimming and even 22-bit converters. All these are merely fixes, applied to the same basic kind of D/A converter in an attempt to overcome built-in shortcomings.

In contrast, the SD/A-490t uses a completely new technology which avoids many of the problems that older approaches have struggled to surmount. We'd have to buy a whole section in this magazine to fully explain the differences (if you're interested, call 1-800-443-CAVR for an appropriately long and detailed brochure), but here's a short synopsis.

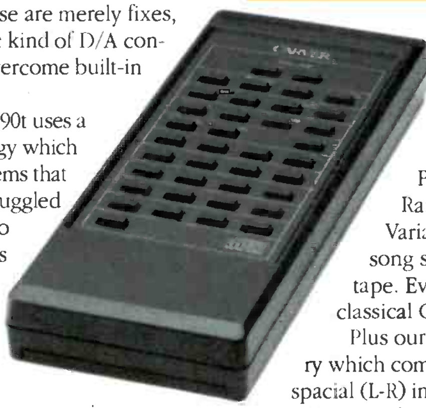
Traditional converters require 16 separate reference circuits, each of which must be accurate to one part in 65,536 — but, due to the realities of mass production, rarely are. If they're not "dead-on", an unpleasant form of noise called *zero-cross distortion* is produced. Because Carver's Single Bit D/A Converter transforms a 16-bit signal into a 1-bit pulse signal array, the "ladder" of 16 ultra-high-precision reference devices is not required: In effect, the SD/A-490t need only manipulate a stream of varying-width on/off pulses instead of having to accurately create 65,536 different amplitude levels at all times.

Zero-cross distortion is non-existent, and the SD/A-490t's Single Bit converter is able to decode linearity in excess of 115 dB below peak level with exceptionally low noise. You'll particularly notice the difference in the heightened purity and clarity of music during very quiet passages. Every nuance, intonation and harmonic of the original recording is there. Yet

The Carver SD/A-490t.
*At $699, its suggested retail is $500 less than the nearest competitor with tube output****

"digital" harshness is noticeably absent even before it enters the SD/A-490t's mink-lined tube stage.

AN ARRAY OF FEATURES AS RICH AS ITS SOUND.



We've designed the SD/A-490t to be both useful and easy-to-use. 21-key front panel or remote programming. Fixed and variable output. Programming grid display. Random "shuffle" play. Variable length fade. Automatic song selection to fit any length of tape. Even index programming for classical CD's.

Plus our proprietary Soft EQ circuitry which compensates for variables in spacial (L-R) information and midrange equalization found in many CD's mastered from analog tapes.

BRING YOUR TWO BEST CRITICS TO A CARVER DEALER.

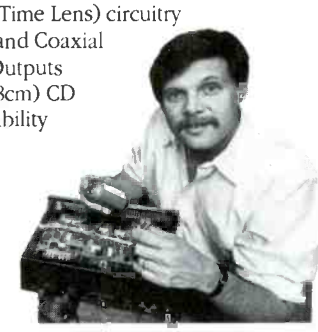
It's tempting to further regale you with how well we think the SD/A-490t's tubes and Single Bit circuitry improve the sound of a compact disc. But your own ears should be the final arbiter of quality.

Thus you are invited to bring a few familiar compact discs down to your local Carver dealer and compare for yourself, hopefully creating your own superlatives in the process.

Suffice it to say that almost all critical listeners not only are able to hear a difference, but prefer the sound of the remarkably affordable SD/A-490t's dual triode transfer function.

THE SD/A-490t

- Dual 6DJ8 Vacuum Tube Output Stage
- Over-sized Disc Stabilizer Transport
- 24-Track Programming with 21-key front panel & remote input
- Music Calendar Display
- Indexing
- Random Play
- Motorized Volume Control
- Time Edit/Fade Taping Feature with user-variable time parameters
- 2 to 10 Second Variable Length Fade
- Exclusive Carver Soft EQ (Digital Time Lens) circuitry
- Optical and Coaxial
- Digital Outputs
- 3-Inch (8cm) CD Compatibility



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****Source: 1990 Audio Magazine Annual Equipment Directory.*

Horizontal and vertical off-axis response curves are surprisingly alike, with no peaks or dips in the crossover region.

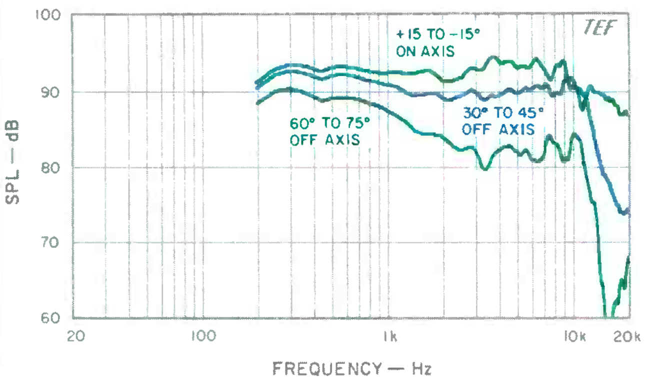

Fig. 6—Mean horizontal responses derived from data of Fig. 4.

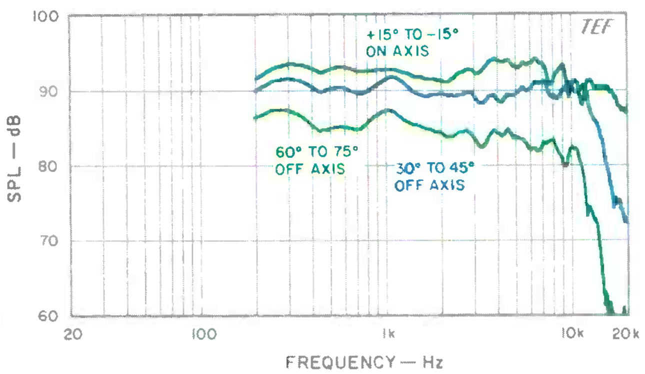

Fig. 7—Mean vertical responses derived from data of Fig. 5.

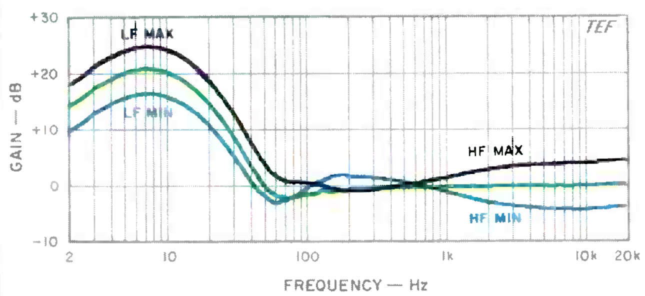

Fig. 8—Frequency response of KUBE 200 equalizer at different control settings.

sure, which seemed to be eliminated by tightening the bolts holding the module to the panel. No wind noises were evident from the port at high levels when driven at and near the box tuning frequency (55 to 65 Hz). The lower woofer, which could be viewed through the port with the system's grille off, had roughly constant excursion up to 50 Hz, decreasing by about 50% at 60 Hz, and reaching a minimum at about 65 Hz (the box tuning, apparently). The bottom woofer exhibited no dynamic offset that I could determine.

The normalized horizontal "3-D" off-axis curves of the 105/3 are shown in Fig. 4. The curves are very well behaved except for off-axis high-frequency roughness above 10 kHz. Because the on-axis high-frequency response is rough but the off-axis response is not, the normalization process actually transfers the on-axis roughness to all the off-axis curves. This implies that the on-axis high-frequency response should not be equalized flat, which would effectively make the response flat on axis at the expense of the response at all the off-axis directions.

The vertical off-axis curves, shown in Fig. 5, are actually quite similar to the horizontal curves but with some low-frequency fluctuations. Note the absence of sharp dips in the crossover region that typically occur with other systems due to spatially separated mid- and high-frequency drivers. The same apparent off-axis high-frequency roughness is evident in these curves due to the normalization process, as noted before.

Figures 6 and 7 were derived from the previous "3-D" data by calculating response mean averages of several adjacent curves in specific on- and off-axis angular regions. Figure 6 shows the horizontal curves of the 105/3. The curve within ±15° of the axis horizontally is quite smooth and extended except for a roll-off above 9 kHz and a slight dip at 11 kHz. The effects of the localized on-axis roughness, noted previously between 10 and 15 kHz, are minimized as a result of the spatial averaging. The 30° to 45° response is also quite smooth and extended but exhibits a rapid high-frequency roll-off above 12 kHz. The 60° to 75° off-axis averaged response exhibits a lowered plateau above 2 kHz, with minimal response anomalies, also coupled with a rapid high-frequency roll-off above 12 kHz. The uniformity of these curves indicates that the lateral imaging of the 105/3s should be quite good.

The mean vertical responses in Fig. 7 may make you do a double take after viewing the horizontal curves. The vertical and horizontal off-axis mean curves are virtually the same except for increased directivity below 1.5 kHz due to the system's greater size in the vertical dimension. There is absolutely no sign of the peaks or dips in the crossover region typically found in systems with spatially separated mid- and high-frequency radiators. The coaxial-style coincident mid/high-frequency driver really does work! The extreme uniformity of both the horizontal and vertical off-axis curves and the relatively high directivity of the 105/3's radiation pattern indicate that the imaging and soundstaging of the system should be excellent and minimally affected by listening room acoustical conditions.

Figure 8 shows the frequency response curves of the KUBE 200 active equalizer from 2 Hz to 20 kHz. Curves

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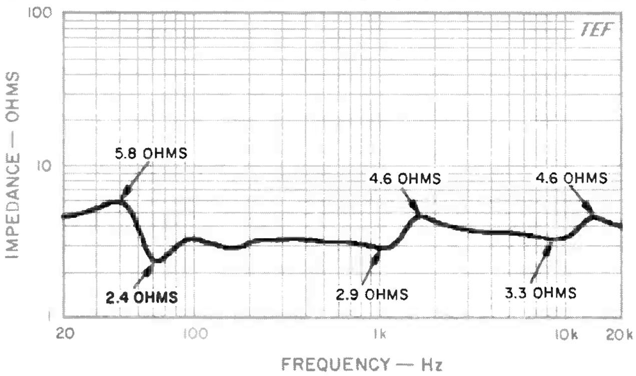


Fig. 9—Magnitude of impedance vs. frequency.

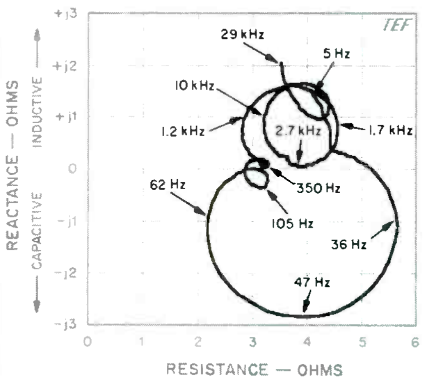


Fig. 10—Complex impedance, showing reactance and resistance vs. frequency.

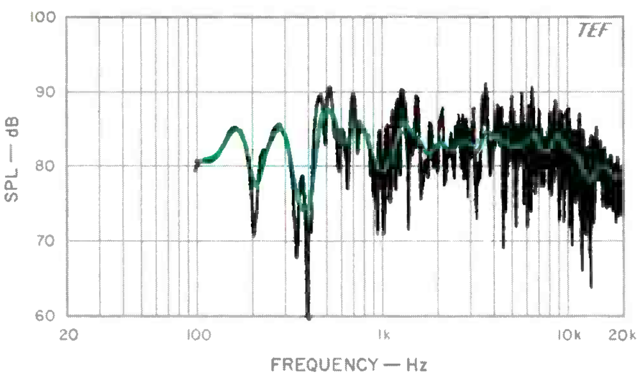


Fig. 11—Three-meter room response, showing both raw and smoothed data.

were run with the "LF" and "HF" controls in their minimum, detent (mid), and maximum positions. The measurements confirm that both controls provide an adjustment range of approximately −6 to +4 dB. The "LF" control mainly affects the range below 150 Hz, while the "HF" control adjusts the range above 500 Hz. The output of the equalizer clipped at about ±17 V d.c. with no load.

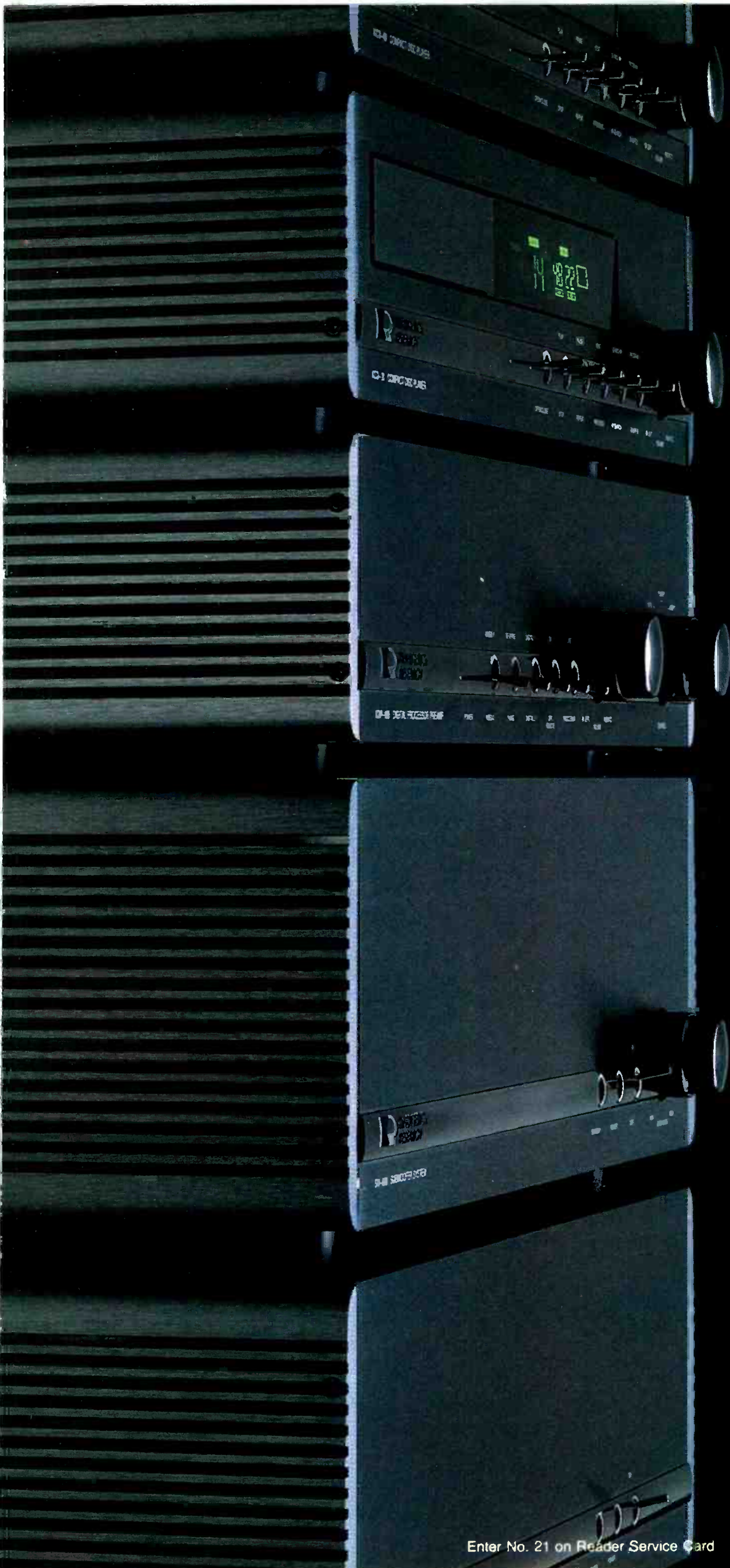
Note that with the "LF" control in its maximum position, there is a very high boost, of 20 to 24 dB, in the infrasonic range from 2 to 15 Hz! This could potentially cause amplifier/speaker overload problems, and decreased headroom, if any significant infrasonic program energy exists. Because one potential source of infrasonic energy is from turntable rumble (with the possibility of associated tonearm resonances), be aware of possible problems if you play LPs with the KUBE equalizer at this setting! Compact Discs, however, do not generate subsonic signals except for those deliberately recorded. Fortunately, below approximately 3 Hz, the response is rolled off at a 6-dB/octave rate. Measurements indicated that with the "LF" control at maximum boost, input voltage at subsonic frequencies from 5 to 15 Hz must be limited to a maximum of about 0.75 V rms, to prevent output clipping.

Figure 9 shows the 105/3's impedance from 20 Hz to 20 kHz. The average impedance is closer to 3 ohms rather than to the rated 4 ohms. A maximum of only 5.8 ohms and a significantly low minimum of 2.4 ohms were reached in the power-heavy bass range, at 40 and 65 Hz, respectively. Even though KEF went to great lengths to even out the system's impedance variations, its low minimum impedance of 2.4 ohms, coupled with its remaining variation of 2.4×, make the 105/3s still quite sensitive to cable resistance. To keep cable-drop effects from causing peaks and dips in response greater than 0.1 dB, cable series resistance must be limited to a (low) maximum of 0.050 ohm (50 milliohms)! Although the 105/3's load impedance is not much higher than the very low measured impedance of the Thiel CS5, reviewed in the February 1991 issue, the KEF's power demand is much lower due to its much greater sensitivity.

As with the Thiel CS5s, the low impedance of the 105/3s makes them a demanding load on the power amplifier. Only amplifiers that can supply large currents into low impedances should be used with this speaker and should be hooked up only with short lengths of low-resistance cable.

Figure 10 shows the complex impedance, over the range from 5 Hz to 29 kHz. Note that the horizontal and vertical scales only cover a range of 6 ohms. If the impedance were compensated exactly so that the system, had an impedance of 4 ohms at all frequencies, this plot would be a dot on the horizontal axis at a resistance of 4 ohms, with a reactive part of zero. The phase angle of the impedance (not shown) reached a maximum of +24° at 1.4 kHz and a minimum of −42° at 51 Hz.

The 3-meter room curve of the system, with both raw and sixth-octave smoothed responses, is shown in Fig. 11. The 105/3 was in the right stereo position, aimed at the listening location, and the test microphone was placed at ear height (36 inches), at the listener position. The KUBE 200 equalizer was not used for this test. The system was swept from 100 Hz to 20 kHz with a 2.83-V rms sine-wave signal, corre-



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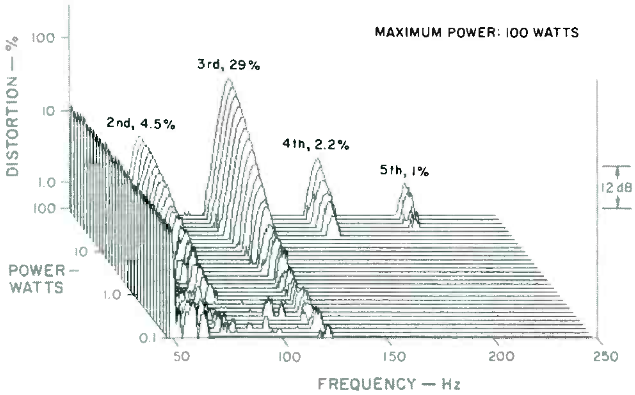

Fig. 12—Harmonic distortion products for the musical tone E_1 (41.2 Hz).

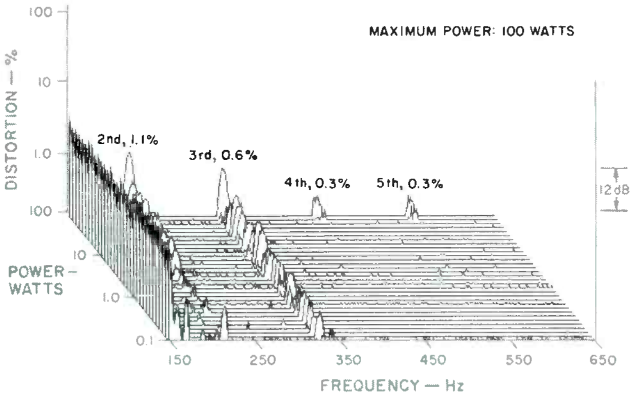

Fig. 13—Harmonic distortion products for the musical tone A_2 (110 Hz).

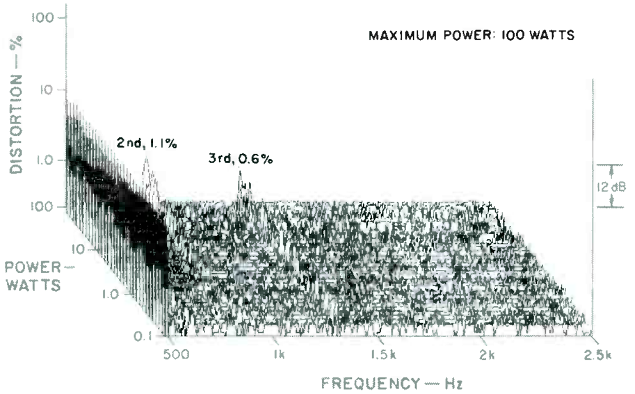

Fig. 14—Harmonic distortion products for the musical tone A_4 (440 Hz).

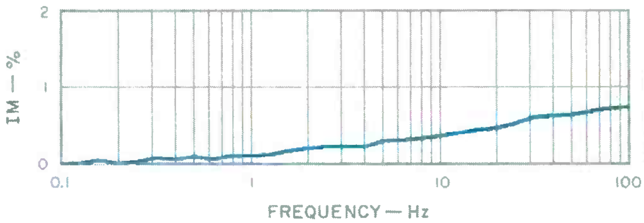

Fig. 15—IM distortion on 440 Hz (A_4) produced by 41.2 Hz (E_1) when mixed in one-to-one proportion.

sponding to 2 watts into the rated 4-ohm load. Note that the system is generating a loud 83 to 84 dB average SPL, as compared to the 75 to 80 dB range of most other systems. The parameters of the TDS sweep were chosen so that the direct sound and first 13 mS of the room's reverberation were included. The curve is very well behaved and extended, except for some roughness between 200 Hz and 1 kHz. Above 2 kHz, the curve is quite smooth but exhibits some high-frequency roll-off above 10 kHz.

Figures 12, 13, and 14 show harmonic distortion spectra versus power level for the musical notes of E_1 (41.2 Hz), A_2 (110 Hz), and A_4 (440 Hz). These measurements indicate the harmonic distortion generated with the application of power levels from 0.1 to 100 watts (−10 to 20 dBW, a 30-dB dynamic range) in 1-dB steps. The power levels were computed using the rated system impedance of 4 ohms, for which 20 V rms would nominally equal 100 watts.

Figure 12 shows that for E_1 (41.2 Hz), the second and third harmonics predominate at lower power levels, while at higher power levels, the fourth and fifth harmonics make themselves evident. The third harmonic reaches a substantial 29% at full power, which indicates a symmetrical two-

I was initially impressed by the KEFs' neutrality, precise imaging, and extremely even coverage, and I am still impressed.

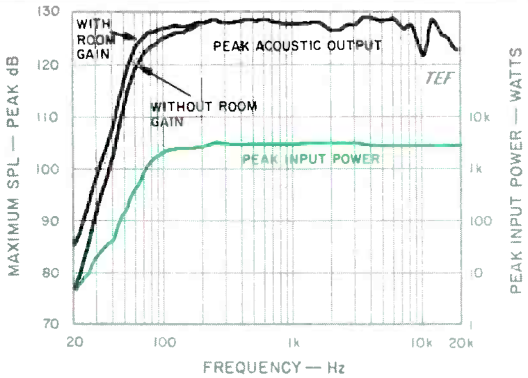

Fig. 16—Maximum peak sound output, measured at 1 meter on axis, and corresponding maximum peak input power levels.

sided nonlinearity, most likely the low-frequency drivers reaching their excursion limits at high amplitudes. The second, fourth, and fifth harmonics reach only 4.5%, 2.2%, and 1% at full power. Although the distortion is quite high, note that the system is generating a loud 103 dB SPL at 1 meter with full power at 41.2 Hz. Note also the very low level of higher order harmonics at full power, a direct result of the low-frequency enclosure's bandpass vented-box design, which acoustically filters out the higher order harmonics.

The A_2 (110-Hz) harmonic data is shown in Fig. 13. The graph shows that only the second and third harmonics were significant over the tested power range, with the second harmonic predominating at higher power levels. The second harmonic reached a level of only 1.1% at full power, while the higher order harmonics reached only 0.6% or less at full power. Realize that at 110 Hz the system is generating a very loud 110 dB SPL at 100 watts! I first tried the system at full power with a 110-Hz sine wave in my listening room, which caused massive sympathetic vibration of all loose objects in the room; a couple of knickknacks actually came off the walls!

The A_4 (440-Hz) harmonic measurements are shown in Fig. 14. The only measurable distortion at full power was a low amount of second harmonic, which peaked at about 1.1% and only 0.6% of third harmonic. All other distortion products were below the noise floor of the display!

The IM on a 440-Hz (A_4) tone, created by mixing with a 41.2-Hz (E_1) tone of equal input power, is shown in Fig. 15. The IM distortion gradually rises with power, reaching only 0.8% at full power. This is a very low value, one of the lowest I've measured. The first-order ($f_2 \pm f_1$) and second-order ($f_2 \pm 2f_1$) side frequencies were the only significant ones in this power range. The design of the 105/3, which places two crossover points below 440 Hz, minimizes IM distortion because the two test tones are channelled to two different drivers.

The maximum peak input power-handling capacity of the 105/3 is shown in the lower curve of Fig. 16. Below 20 Hz (not shown), the peak input power was limited to about 8 watts to avoid severe distortion. Above 20 Hz, the input power rises rapidly with frequency up to about 125 Hz, where the test power amplifier started to clip at about 2.5 kW nominal (100 V peak into the rated 4-ohm load, although the measured impedance was actually closer to 3 ohms). At this and all higher frequencies, the power amplifier's clip limit was reached before the speaker reached its limit!

The upper curve in Fig. 16 shows the maximum peak sound pressure levels the system can generate at a distance of 1 meter on axis for the input levels shown in the lower curve. 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. The peak acoustic output rises very rapidly with frequency up to 125 Hz, where the power amplifier limits the output. With room gain, a single 105/3 can generate peaks in excess of 110 dB SPL above 45 Hz and greater than 120 dB above 55 Hz. With or without room gain, the low-frequency output of a single system rolls off very rapidly with frequency; even with room gain, it drops to only about 86 dB SPL at 20 Hz. A pair of these systems playing mono bass will be able to generate levels some 3 to 6 dB higher. Above 100 Hz, the systems can generate whopping peak levels in excess of 126 dB! The high power-handling capacity of the systems, coupled with their high sensitivity, allows them to be played very loud indeed.

Use and Listening Tests

I listened to the KEF 105/3s in my listening room, which is furnished in normal living-room style with a carpeted floor and is approximately 15½ × 27 × 8 feet. Driving equipment included Rotel RCD-855 and Onkyo Grand Integra DX-G10 CD players, a Krell KSP-7B preamp, a Krell KSA-200B solid-state power amplifier, and Straight Wire Maestro interconnects and speaker cables. I did about half of the listening before the measurements were made.

All of the listening was done with the 105/3s placed in my customary evaluation position, about 6 feet away from the short rear wall, and separated by 8 feet. The speakers were about 4 feet from the side walls. The first round of listening was done with the systems toed in and aimed directly at my head. Later listening was done with them cross-fired at a 10° angle. The measurements indicated that this cross-firing would significantly smooth out the system's top-octave response. I listened sitting on the sofa about 10 feet away, which placed my ears about 36 inches above the floor.

The systems were hooked up in a normal single-cable configuration, not bi-wired. At nearly 100 pounds apiece, the systems are quite heavy, but one person can move them by tipping them slightly and walking them on two of the enclosure's feet. If the grille is off, a strong person can lift the systems by placing one arm under the exposed mid/high module and the other in the rear.

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High peak output capability and power handling enable the KEFs to deliver greater impact and realism from music with high peak levels.

The KUBE 200 equalizer was used in the tape loop of the Krell preamplifier. A lot of my listening was done with the equalizer switched out. When it was switched in, I left the "HF" control in the flat position, though I did experiment with the "LF" adjustment. Switched in, the equalizer added a needed low-frequency heft or weight to most program material. However, if the program had any significant high-level material below 50 Hz, and was played loud, the equalizer's boost would often make the low frequencies sound mushy and distorted because of speaker overload.

When I first sat down to listen to the 105/3s, I placed a favorite orchestral CD in the player, turned the volume up to my usual level, hit the play button, and was promptly blown away by the volume. The KEFs are fully 6 to 10 dB more sensitive than the typical systems I listen to; the volume levels generated by typical speakers with your usual 200-watt amplifier can be generated by these KEFs with an amplifier of only 20 to 50 watts.

I was initially very impressed by the neutral character, precise imaging, and extremely even coverage of the KEF 105/3s. These impressions have not diminished after longer listening. The high peak output capability of the systems much improves their impact and realism in reproducing transient sounds that require high peak sound levels, such as drum rim shots, explosive sound effects (à la *Ein Straussfest*, Telarc CD-80098), and other program material with high peak levels. When played at realistic levels, the high sensitivity and power handling of the 105/3s directly translate into the ability to reproduce peak levels that closely match those of live sound, thus improving realism. Some digitally recorded jazz has crest factors approaching 30 dB, which makes it very hard to reproduce at realistic average levels without peak clipping. (Track 5 of the Flim and the BB's album *TriCycle*, DMP CD-443, has a measured crest factor of 29.9 dB!) If two speaker systems are compared with the same power amplifier and at the same realistic average sound level, the system with the higher sensitivity will reproduce higher peak levels. This is directly due to increased power amplifier headroom when driving the more sensitive system (assuming that the amplifier, when driving the low-sensitivity system, is being driven hard enough to cause significant clipping).

I was very impressed with the 105/3s' handling of the sharp, intense transient sounds and very distinct lateral imaging of the computer-synthesized plucked string sounds on track 14, "Silicon Valley Breakdown," on *The Digital Domain* CD (Elektra 9 60303-2). It is a great demo disc for imaging, dynamic range, and sound effects. The Huey helicopter sequence on track 16 could be played at very realistic levels. Due to high-level low frequencies on this track, it sounded much more realistic with the EQ switched out; when the equalizer was switched in, headroom suffered greatly. When played at highest level before audible distortion, the 105/3s produced sound levels of 92 dBA (105 dBC) with the EQ in and 99 dBA (109 dBC) when it was switched out. As long as we are talking sound effects, the 105/3s did an incredibly hair-raising rendition of the USAF F-16 fighter jet flyovers on track 3 of the *Sonic Booms* CD (Bainbridge BCD6276): 110 dBA, or 112 dBC, without the EQ. Great fun! Now on to more serious listening . . .

On the *Winds of War and Peace* CD of Lowell Graham conducting the National Symphonic Winds (Wilson Audiophile WCD-8823), the systems rendered the massed horns very cleanly and sounded excellent on the bass underpinning and snare drums on track 6. On Pat Coil's *Steps* (Sheffield Lab CD-31), the vocals, string bass, and particularly the strings on track 7 were reproduced effortlessly without any harsh or strident effects. Quite thrilling were the dynamics of John Arpin's playing of Louis Gottschalk's pre-ragtime piano compositions on *Cakewalk* (ProArte Digital CDD 515).

The 105/3s passed the pink-noise stand-up/sit-down/walk-around test with excellent results, the best I've heard to date. With pink noise, I could reliably hear the on-axis/slightly-off-axis high-frequency roughness indicated in the measurements. On program material it was much more difficult to reliably hear the differences. The 10° toe-in configuration noted earlier improved the top-octave high-frequency smoothness at my normal listening position and also somewhat improved image stability for listening positions not on the center line. Not many systems can profit from toe-in, because their off-axis response is insufficiently even and they lack enough directivity to make it worthwhile.

On direct comparison at matched, moderately loud levels, I found that the frequency balances of the KEFs and my reference B & W 801 Matrix Series 2 systems (*Audio*, November 1990) were very similar. Generally, I had no preference for one system over the other. The B & Ws were very slightly brighter on material with significant high-frequency content. However, after getting over the initial thrill of the KEFs' high sensitivity and high peak output capacity, I have reservations about their low-frequency performance and low-frequency maximum output capabilities.

Although the KEF systems are very efficient and can handle large amounts of power at frequencies at and above the upper bass range, their efficiency and power-handling capacity (and hence maximum output capability) below 40 Hz cannot keep up with their high-frequency performance. The maximum peak acoustic output of the 105/3s in the bottom octave from 20 to 40 Hz is some 5 to 15 dB less than my reference 801s. (Note, however, that above 60 Hz, the maximum output of the 105/3s *exceeds* that of the 801s by about the same margin.) On the 20-, 25-, and 31.5-Hz third-octave, band-limited pink-noise cuts on the *Pro Audio* CD (Brüel & Kjaer CD-4090), the maximum clean output of the B & Ws would "walk all over" the output from the 105/3s. At 20 and 25 Hz, the 105/3s could not be turned up loud enough for the fundamental to be heard without excessive distortion. On sine wave, the comparison was only slightly better. These tests were done without the equalizer switched in. The 105/3s would profit very much from the use of a high-output subwoofer.

I am quite pleased with the performance of the 105/3s, particularly with their high sensitivity, generally smooth response, very high midband maximum peak output capabilities, and amazingly uniform horizontal and vertical coverage. Improvements can be made, however, in smoothing the system's on-axis high-frequency response and increasing its very low-frequency maximum output capabilities.

D. B. Keele, Jr.

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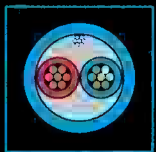

Lapis Hyperlitz*

****All diagrams are 1½ times actual size.***

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3

SONY TA-E1000ESD DIGITAL PROCESSING PREAMP

Manufacturer's Specifications

Preamplifier Section

Frequency Response (With All Digital Effects Off): High-level inputs to volume-controlled outputs (front, rear, and center), 10 Hz to 20 kHz, ±0.1 dB; phono input to fixed-level outputs (video sound and tape rec.), 20 Hz to 20 kHz, ±0.2 dB.

Input Sensitivity: Phono, 2 mV; high-level analog, 150 mV; digital (coaxial), 0.5 V peak to peak, ±20%.

S/N at Front and Rear Outputs: Phono, 84 dB; high-level analog, 95 dB; digital (coaxial), 110 dB to front outputs, 99 dB to rear.

Residual Noise: Less than 10 µV, A-weighted.

THD at 1 kHz (At Front Outputs): Analog, less than 0.004%; digital, less than 0.003%.

Subwoofer Output: Rolled off at 18 dB/octave below 80 Hz.

Video Section

Input Sensitivity and Output Levels: Composite video, 1 V peak to peak; S-video luminance, 1 V peak to peak; S-video chroma, 0.286 V peak to peak.

Digital Signal Processing Section

Parametric Equalizer: Three bands, each with adjustable center frequency (18 Hz to 20 kHz), level (±12 dB in 0.1-dB steps), and slope (Q of 0.7, 1.4, 3.7, or 20).

Compander: Adjustable; nine steps of compression or expansion.

Surround Sound Adjustments: Room size, 0.5 to 2.0; wall reflectivity, 0.5 to 2.0; seat position, front to rear and left to right in 101 steps; early reflection time, 1 to 255 mS; early reflection level, 0 to 100%; reverberation time, 0.3 to 5.0 S; reverberation density, low to high in three steps; spread, 0.5 to 2.0; effects level, 0 to 100%; Dolby Surround delay times, 15.0 to 30.0 mS.

Digital Converter Section

D/A Converter Types: Front, dual 18-bit linear, eight-times oversampling; rear, single 16-bit linear, four-times oversampling.

D/A Sampling Frequencies: 32, 44.1, and 48 kHz.

A/D Sampling Frequency: 48 kHz.

General Specifications

Power Requirements: 120 V a.c., 60 Hz, 35 watts.

Dimensions: 18½ in. W × 6 in. H × 14¼ in. D (47.0 cm × 15 cm × 36 cm).

Weight: 17 lbs., 11 oz. (8.0 kg).

Price: $1,000.

Company Address: Sony Dr., Park Ridge, N.J. 07656.

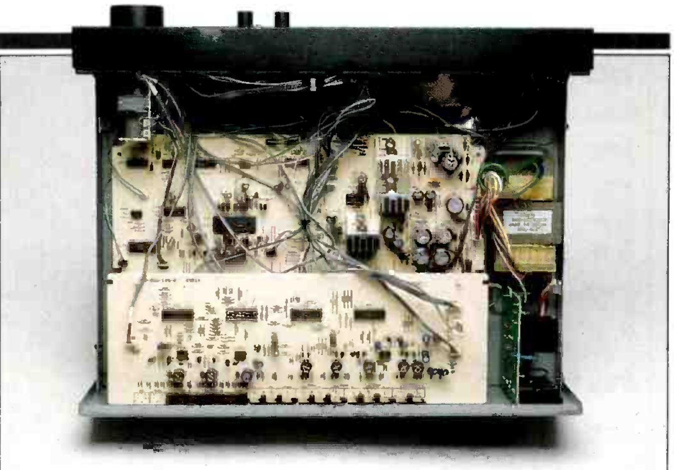
For literature, circle No. 92

The Sony TA-E1000ESD control amplifier may well represent the beginning of the next step in the audio world's transition from analog to digital signal processing. Essentially, this unit is a preamplifier with a built-in digital signal processor. And that makes it much more than a preamplifier. In functioning as a digital surround sound system, this unit electronically reproduces the early reflected sound as well as reverberations by using its digital signal processor. You can literally tailor the sound to match that of virtually any listening space, from large, cathedral-like acoustics down to small jazz-club environments. A built-in Dolby Pro-Logic surround decoder also makes use of the digital signal processing ICs to create the specific delay, response, and matrix decoding parameters established by Dolby Labs for Dolby Surround decoding.

One of the features that impressed me most about this unit was its digital parametric equalizer. Three individual EQ bands are available. Each can be adjusted to have its center frequency at any point in the audio spectrum. Each band has a maximum boost and cut range of 12 dB (and the three bands can be ganged for up to ±36 dB of variation). Perhaps best of all, the slope or "Q" of each band can be adjusted from 0.7 (very broad) to 20 (very sharp or narrow). I found the highest Q setting particularly useful in eliminating resonances caused by structures or furnishings in some listening rooms. The combination of three bands offering such a wide range of adjustment proved more effective than even the most elaborate graphic equalizer. More important, by executing this equalization entirely in the digital domain, even adding the most extreme amount of boost in one or more bands did not increase measured or audible distortion, nor did it introduce extreme phase shifts such as might occur if an analog equalizer were to be used for the same purpose.

The third function of this controller that is handled entirely in the digital domain is compression and expansion. By using the compressor feature in environments where background noise is high, you will hear sounds that might otherwise be masked by noise. There are no less than nine different compression settings available. Conversely, using any of the nine expansion settings can restore proper dynamic range to program sources that have been compressed, such as FM radio programs. Expansion also helps to eliminate undesirable noise between musical selections by pushing that residual noise downward below your threshold of audibility.

The parametric equalizer, surround sound capability, and dynamics controller have been used by Sony to create and store 10 recommended sound-field programs, identified by such descriptive terms as "Hall 1," "Hall 2," "Opera," "Church," "Jazz Club," "Stadium," "Live Concert," "Theater," "Disco," and "Dolby Surround." Each of these environments has been programmed with specific settings of some or most of the adjustable parameters (including the size and wall reflectivity of the simulated room, your own seating position, center and rear channel levels, parametric equalization settings, effects level, early reflection time and level, reverberation time and density, surround-field spread, compression or expansion, and Dolby Surround delay times). Tables in the instruction manual show Sony's settings and which settings can be altered by the user for each of the 10 preset environments. Users can create 10 additional sound fields and store them in system memory for instant recall. For Dolby Surround mode, only the Dolby-specified delay time (20 mS) is preset, but the user can vary it from 15 to 30 mS. Center- and rear-channel levels can also be adjusted in this mode.



Since the TA-E1000ESD is intended to serve as a preamplifier/control unit for just about any audio/video component system, it also incorporates a conventional analog phono preamplifier section. I was somewhat surprised and disappointed to find that the phono inputs accommodate only moving-magnet cartridges. If you own a moving-coil pickup, you will need to use a pre-preamplifier or a step-up transformer with your phono system. Aside from that fairly obvious omission, the TA-E1000ESD should be able to accommodate even the most elaborate of audio/video systems.

Control Layout

At first glance, the control panel of the TA-E1000ESD seems somewhat intimidating. After I had lived with the unit for a day or two, however, I realized that the layout was actually quite simple and logical and that a great deal of thought had gone into solving the problem of how to control such a vast number of adjustments without dozens, if not hundreds, of knobs and buttons. Sony's solution was to have two little rotary knobs control adjustments of just about every kind, depending on which parameters have been brought up on the visual display by means of other pushbuttons. For example, if you are in the "Parametric EQ" adjustment mode, one of these little rotary knobs adjusts the amount of boost or cut of the particular EQ band while the other alters the band's center frequency.

Primary controls on the front panel include "Power," display "Dimmer," a row of input selector buttons, small buttons for selecting "Parametric EQ" or "Dynamics" (compression/expansion) or "Surround," buttons for selecting the factory preset or user-set sound fields, a volume control, and a "Muting" button. To the right of the display window are the two small multi-function rotary knobs, and nearby are four small pushbuttons: Two for selecting main and sub-parameters that need adjusting, an "EQ Band" selector (for choosing which of the three EQ bands you want to adjust), The parametric equalizer proved more effective than any graphic equalizer, without analog's noise, distortion, or phase shift.

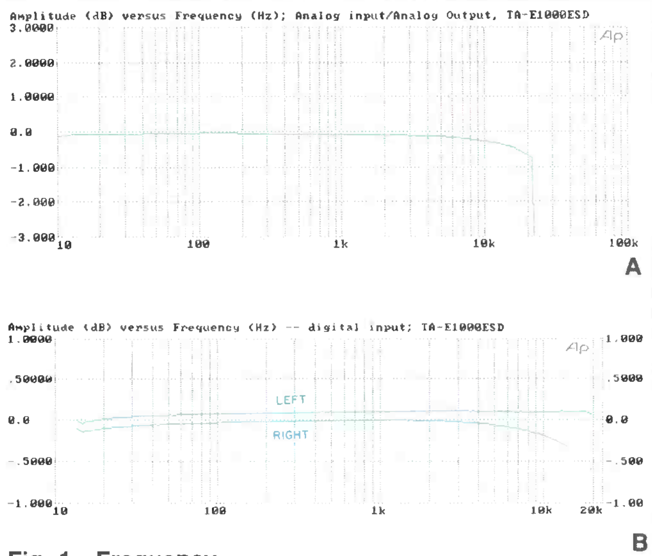


Fig. 1—Frequency response at analog outputs, for right-channel line-level analog input (A) and for left- and right-channel digital input (B).

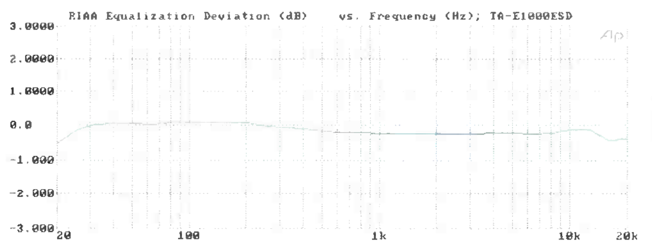


Fig. 2—Deviation from RIAA equalization.

and an "EQ Slope" button that sequentially alters the Q of the equalization band being adjusted. A headphone jack is situated at the left, beneath the power on/off switch.

A hinged panel along the lower edge of the front panel swings down to disclose a row of secondary controls. Included are a "Display" mode button with three settings (display all information, display the input function only, or turn off the display completely), digital input level buttons, an analog input level knob, controls for adjusting Dolby Surround "Input Level" and "Balance" and selecting Pro-Logic mode, a "Test Tone" button that helps in adjusting balance among the speakers (front, rear, and center), buttons associated with memorizing your own sound-field programs, a "Character" button with which you can label inputs with your own names, an "Effect Rec" button (for adding digital effects to the analog record output signals), a "Set" button that selects one program source for recording while you listen to or watch another program, a "Check" button for confirming that selection, a "Balance" knob, and a set of audio and video input jacks for the "S-Video" input, including an "S-Video" input connector. Included with the TA-E1000ESD is a programmable remote control that, in addition to duplicating the functions of most of the front-panel controls of the unit, can "learn" the commands of other remotely controlled components.

The rear panel of the TA-E1000ESD is equipped with enough input and output jacks to accommodate analog audio components such as a turntable system, a tuner, a CD player, and two tape decks. There are also enough inputs to accept the digital outputs of a CD player or DAT deck, either via optical digital inputs or via a single coaxial digital input.

As for video inputs, there are four S-video inputs as well as an S-video output, plus regular audio/video inputs to accommodate three VCRs (plus a fourth, if it is a player only), a videodisc player, and a TV tuner. You will recall that there is a set of front-panel audio and video inputs as well, and these would more than likely be used for convenient, temporary connection of a camcorder when transcribing or editing videotapes. Two TV monitors can also be connected to the unit. For audio, there are outputs for connection to two stereo amplifiers for front left and front right speakers, a set of outputs to feed the rear-channel stereo amplifier, an output for a mono amplifier to drive a center speaker, and another for driving the amplifier that might feed a subwoofer if one is used. Four convenience a.c. receptacles (two switched, two unswitched) are also located on the TA-E1000ESD's rear panel, as is a terminal for connecting a turntable grounding wire.

Measurements

While conventional test measurements could hardly begin to define the performance capabilities and flexibility of a unit such as this Sony Digital Processing Control Amplifier, I wanted to measure certain basic digital and analog performance characteristics to compare this unit to more conventional preamplifiers.

First, I measured frequency response for high-level analog signals and for digital signals from the coaxial input. Figure 1A shows the response via the right-channel analog

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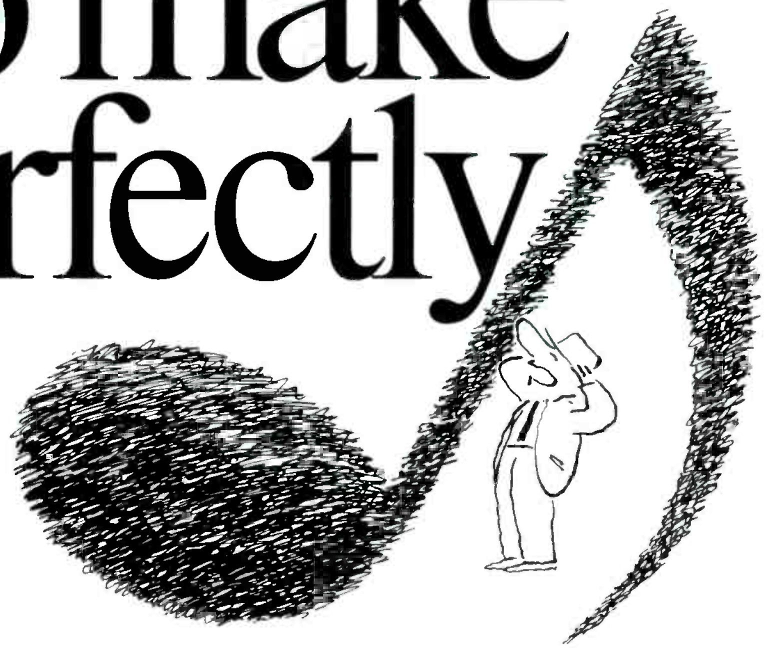

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—Lewis Lipnick, *Stereophile,* Vol. 11 No. 4, April 1988.

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

Line Protection: It Pays For Itself

The ACE-515 also protects your valuable equipment from harmful high-voltage spikes and surges. And, its sequential turn-on/turn-off control circuit guards your speakers from disturbing, damaging thumps.

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—Ken Pohlman, *AUDIO,* November 1987.

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Using the digital input, dynamic range was 91.5 dB by the EIAJ method and was slightly better than 105 dB by the EIA method.

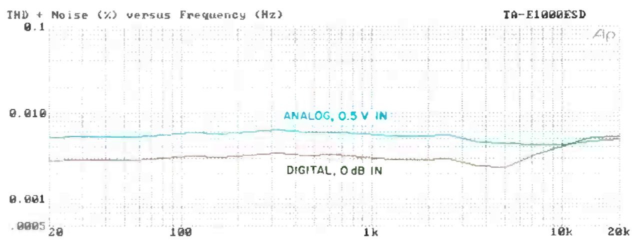


Fig. 3—THD + N vs. frequency for analog and digital input signals.

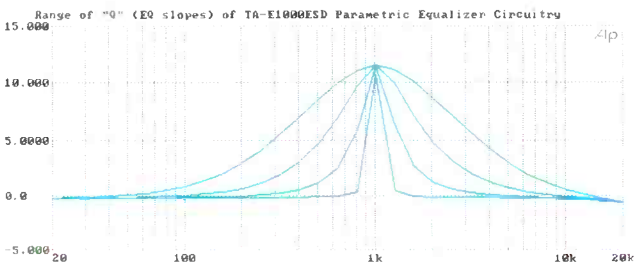


Fig. 4—Range of slopes that can be assigned to any of the three parametric equalizer bands, at maximum boost setting. Slopes for maximum cut setting were identical.

inputs. At 20 kHz, response is down by 0.6 dB. Note the steep attenuation that occurs beyond 21 kHz or thereabouts. That, of course, is characteristic of any bandwidth-limited digital signal-processing system. I was a bit concerned over the slight roll-off at 20 kHz and expected that I would not get the same result when I measured response using the coaxial digital input. Test results can be seen in Fig. 1B. This time I decided to measure the response of both channels. Somewhat surprisingly, the left-channel output is absolutely flat from below 20 Hz to 20 kHz. The roll-off is only apparent in the right channel (lower trace) and is the same as previously measured. I can only conclude that the roll-off occurs in the right-channel analog amplification stage following the D/A conversion process.

Next I measured the deviation from precise RIAA equalization that occurred when I fed low-level signals into the phono inputs. The results, shown in Fig. 2, are for the right channel only since I did not want to show the combined error of the high-level analog output stage and any error introduced by the phono stage. The RIAA playback error is less than +0.2 dB in the bass region and less than −0.3 dB at the extreme treble end of the frequency spectrum.

Finally, I measured frequency response at the subwoofer output jack. The actual cutoff point for this low-pass filter was very close to, but slightly above, the 80 Hz specified by Sony.

I plotted THD + N versus frequency for both 0.5 V signals applied to a high-level input ("CD," in this case) and for 0-dB signals applied to the coaxial digital input (Fig. 3). For the analog input, THD + N at 1 kHz measured 0.0052%, and varied only slightly from this value over the entire audio spectrum. For a digital input, THD + N was slightly lower, measuring 0.003%, just as specified by Sony.

It was difficult to correlate my signal-to-noise measurements for this unit with Sony's, since Sony apparently used a reference input level of 150 mV for high-level measurements and 2.0 mV for the phono inputs, and an output reference level set at maximum, or 1.5 V. I, on the other hand, followed the procedures mandated by the EIA/IHF Amplifier Measurement Standard, which requires an input level of 0.5 V for high-level inputs and adjustment of the master volume control to unity gain when making S/N measurements. For the phono input, an input of 5 mV is used and the master volume control is adjusted to produce 0.5 V output. Under these circumstances, I measured high-level S/N at 89.7 dB, while phono S/N measured 78 dB. Both readings compare very favorably with those obtained using some of the very best available analog preamplifiers.

Input sensitivity, for 0.5 V output with the volume control set at maximum, measured 1 mV for a 1-kHz analog input signal, and phono overload was a somewhat disappointing 90 mV. High-level input sensitivity measured 72.4 mV for 0.5 V output, with the TA-E1000ESD's master volume control set at maximum.

I measured EIAJ dynamic range for this preamplifier, using the digital coaxial input and the appropriate −60 dB track on my CBS CD-1 test disc. The dynamic range measured in this manner was 91.5 dB. Using the EIA proposed method of dynamic range measurement, the result was slightly above 105 dB.

D E E P
BASS
SUBWOOFERS

The digital surround system can make even a recording made in a totally dead room sound as if it had been taped in an ideal hall.

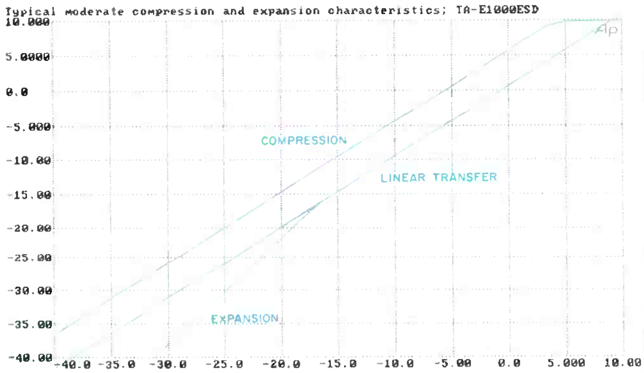


Fig. 5—Typical compression and expansion characteristics of Sony TA-E1000ESD, superimposed on linear transfer curve. Input levels are shown on horizontal axis, output levels on vertical axis; see text.

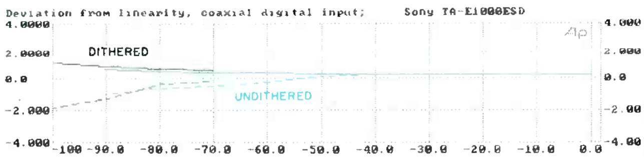


Fig. 6—D/A converter deviation from linearity, for dithered and undithered signals.

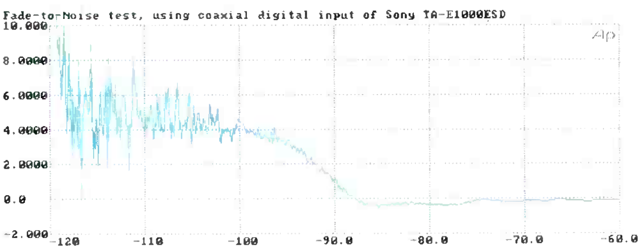


Fig. 7—Fade-to-noise test of D/A converter section.

Figure 4 shows the range of slopes that can be achieved with each of the three parametric equalizer bands. I set the center frequency arbitrarily to 1 kHz and cranked up the adjustment knob for maximum boost (12 dB) at that frequency. Then I made successive response sweeps, each time altering the Q setting. Note the perfect symmetry of the filters when equalization is performed in the digital domain. I have never seen an analog equalizer, graphic or parametric, that could produce such a perfectly symmetrical group of EQ curves. And I could have adjusted the amount of boost (or cut) in 0.1-dB increments.

Next, I tried to graphically demonstrate the action of the "Dynamics" section (compression and expansion) of the signal processor. First, I plotted a curve of output level versus input level from −40 dB to +10 dB, with neither compression nor expansion applied. This test is represented in Fig. 5 by the diagonal center line, where output level is always precisely equal to input level. (The volume control was adjusted for unity gain.) Next, a moderate compression setting (the fifth of the nine possible settings) was dialed up. This produced a new curve of output versus input. With this setting, gain is raised for low-level signals (in effect, pulling up softer sounds that might be masked by ambient noise); for signals above approximately +3 dB, the sudden change in the curve's tilt indicates extremely loud signals are being kept from getting louder—a form of compression that might more properly be described as limiting.

Finally, I set a moderate expansion level and plotted output versus input again. The lowest curve in Fig. 5 shows how soft sounds are made even softer. For example, an input level of −25 dB results in an output of nearly −30 dB. This sort of signal processing would be used to improve the dynamic range of program material that had been compressed, or to push residual noise in some program material down below the threshold of audibility.

Since this unit is intended to be used as an outboard D/A converter with such digital program sources as CD players and DAT recorders, I wanted to check out its low-level linearity, much as I test for linearity when evaluating CD players. Figure 6 shows deviation from perfect linearity for undithered signals in the range from 0 dB (maximum level) to −90 dB and for dithered signals in the range from −70 dB to −100 dB. The left channel's linearity was nearly perfect down to −100 dB for both tests, while the right channel exhibited a deviation from perfect linearity of about −2.0 dB at −100 dB levels.

Using the fade-to-noise test on my CD-1 test disc and with the digital output of my reference CD player connected to the coaxial digital input on the TA-E1000ESD, I obtained the plot in Fig. 7 for the less perfect of the two channels. Note that departure from perfect linearity here (where the curve leaves the 0-dB horizontal axis) occurs between −90 and −100 dB but then remains fairly constant down to −120 dB.

Use and Listening Tests

I first became acquainted with the TA-E1000ESD when *Audio* sent me out to give a series of lectures on digital audio. To demonstrate the capabilities of digital sound processing, I used a TA-E1000ESD and five CDs from my

Sony's TA-E1000ESD goes beyond anything yet devised for consumer audio; it is the start of something totally new.

growing collection, each designed to illustrate a different digital signal processing feature. In several of these appearances, local audio dealers provided speakers and amplifiers for surround demonstrations. So I had quite extensive experience in setting up the TA-E1000ESD in a variety of rooms and systems.

My first demonstration involved the parametric equalizer, and for this I used an album entitled *Broadway Brass* featuring the Empire Brass Quintet (Sine Qua Non 79002-2). Since the quintet's instruments consist of a tuba, a trombone, a French horn, and two trumpets, I thought it would be interesting to highlight each of these instruments during a Sousa march. By revving up the "boost" and sweeping through the frequency spectrum to continuously vary the center frequency of that boost, I was able to bring each of these instruments up to "solo" position quite smoothly and remarkably. I had in the past tried this same demonstration with both graphic and parametric analog equalizers but had always felt that with such extreme boost settings there was an audible increase in distortion. Not so with the parametric EQ section of the TA-E1000ESD. Though each instrument "moved forward" as I swept the equalizer across the spectrum, sounds remained clean and crisp throughout the course of the experiment.

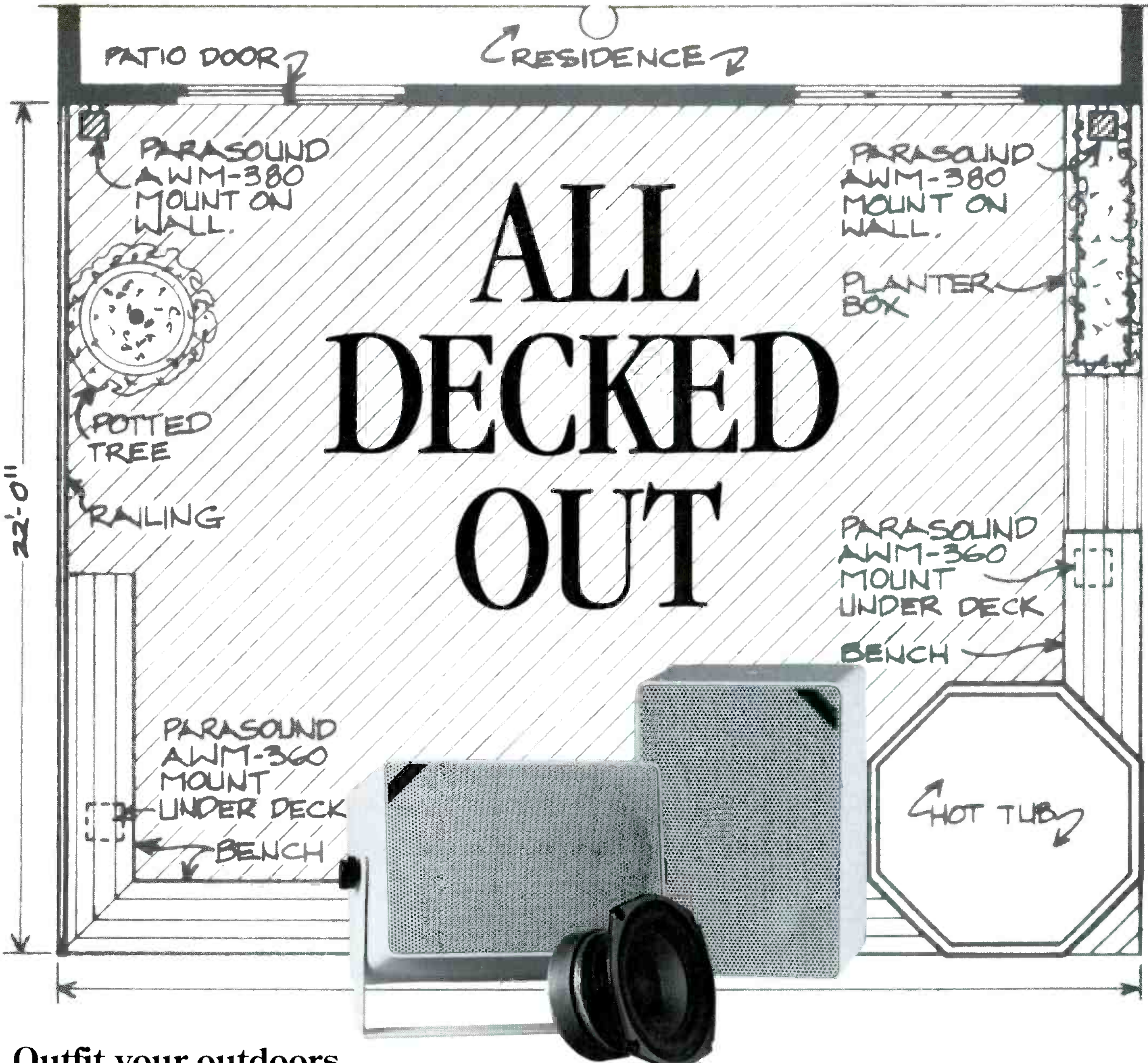
I used a lovely organ recording from Towerhill Records (CD-900101, entitled *The French Romantics*, John Rose, organ) originally taped at the Cathedral of St. Joseph in Hartford, Conn. to demonstrate the advantages of the compression portion of the digitally processed dynamics circuitry. Here was a very light, fragile-sounding selection whose soft tones and subdued bass were easily buried in any kind of ambient noise environment. By adjusting for maximum compression, those soft, almost inaudible tones suddenly came to life, and sounds from the extreme bass pipes, almost inaudible because of human hearing characteristics when listening to low-level sounds, suddenly were clearly audible with all of their sonority.

My next experiment involved "moving" my listeners (acoustically, not physically) about the halls in which the demonstrations took place. For this trick I used the original soundtrack recording of the film *The Rose* starring Bette Midler. By adjusting the front/back and left/right parameters on the TA-E1000ESD while we listened, I was able to transport those listeners seated near the center of the room to any other room location in which I wanted to place them. This effect is quite amazing and works much better in a room of normal home size than it did in the more spacious rooms in which I gave my talks. Even so, those seated centrally reported that they did feel that their position relative to Midler in our digitally created sound field had indeed shifted to the locations that I predicted.

My final demonstration, which involved two discs, was designed to show how I could create a listening space of virtually any size and reverberation characteristic using the TA-E1000ESD's almost infinitely variable parameters. For the first part of this experiment I used an unusual Denon disc (PG-6006) consisting of works recorded by a symphony orchestra in a huge anechoic (reflection-free or "dead") room. After playing a brief selection of such strange-sounding, lifeless music, I added a previously arrived-at set of parameters to "move" the sound into a well-designed concert hall. The results were astounding, to say the least. Now, the music sounded as it would have sounded had it been performed in an acoustically ideal space. Had my audience not agreed with the amount of reverberation, wall material, effects level, and audience positioning that I had assigned to this playback, it would have been a simple enough matter to adjust the parameters to their preferred settings.

In my last playback experiment I used a Proprius CD entitled *Cantate Domino* (PRCD7762) recorded in Sweden. The instrument, again, was an organ, and the idea was to move it from the rather limited space in which it had been recorded into a cavernous cathedral. Admittedly, I exaggerated the size of the "new" hall a bit, giving it a reverberation time of some 3.6 S. Still, when that parameter was punched in for surround sound, the effect was very dramatic. At one point I simply put the CD player in the pause mode, and the reverberatory sound continued for several seconds, in accordance with the preset reverberation time; the reverberation issued from both front and rear speakers as it died away. Furthermore, that reverberant sound, created entirely by the digital circuitry, sounded fully as real as the primary sounds had sounded, with no audible distortion or other unwanted artifacts added.

I could have carried on endless other experiments, but by this time, my audiences (and I) were convinced that the Sony TA-E1000ESD is a component that goes beyond anything yet devised as a consumer audio product. We all agreed that it represents, as I stated at the outset, the beginning of a totally new direction in the world of audio. Perhaps even more amazing than its digital audio capabilities is its suggested retail price. When I first saw the unit put through its paces, I guessed that its retail price would be precisely twice as high as it is. Other knowledgeable audio enthusiasts have guessed similarly. Sony is to be commended not only for coming up with an outstanding and innovative digital audio product but also for being able to deliver it at a price well below that of far less impressive and less versatile preamplifier control units. *Leonard Feldman*



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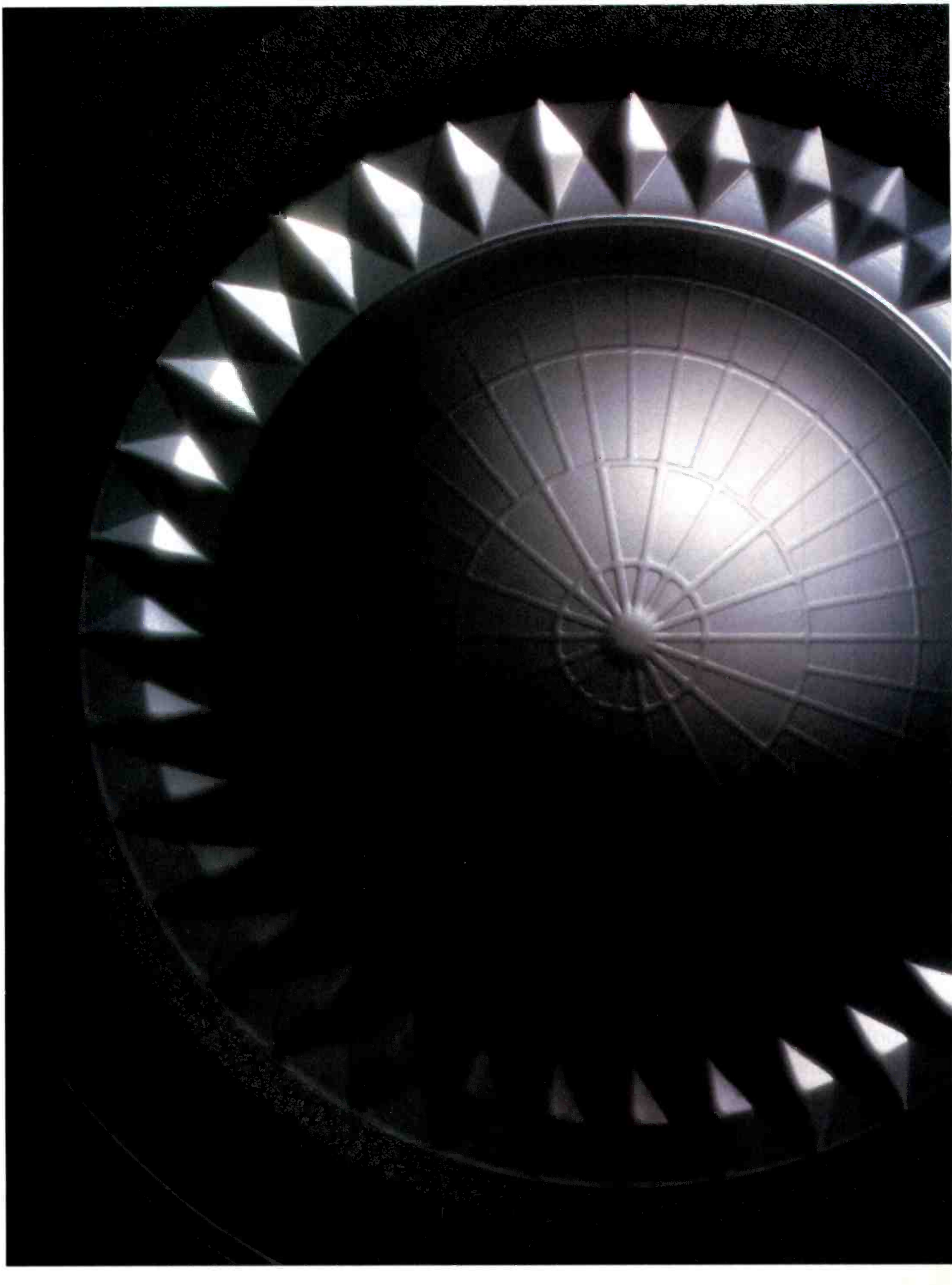

4

AIR TIGHT ATM-1 POWER AMP

Manufacturer's Specifications
Power Output: 36 watts per channel into 8 ohms.
Load Impedance: 4 or 8 ohms.
THD at 1 kHz: Less than 0.1% at 1 watt out; less than 1% at full rated power.
Frequency Response: 20 Hz to 20 kHz, ±1 dB or less at full rated power.
S/N Ratio: 100 dB, IHF A-weighted, with inputs shorted.
Input Sensitivity: 1 V.
Input Impedance: 100 kilohms.
Power Consumption: Approximately 250 watts.
Supply Voltage: U.S. version, 117 V; European version, 220 to 240 V.
Output Tubes: Two 6CA7/EL34 tubes per channel.
Dimensions: 14½ in. W × 11½ in. H × 9 1/16 in. D (368 mm × 293 mm × 231 mm).
Weight: 48½ lbs. (22 kg).
Price: $3,450.
Company Address: Edge Marketing, 611 B Santa Clara Ave., Venice, Cal. 90291.
For literature, circle No. 93

Would you believe this? A tube power amplifier imported from Japan! While not unprecedented, it is rare. I am surprised that more Japanese tube amplifiers are not imported, as many Japanese audiophiles are really into tube gear and quite a lot of it is available in Japan. I remember with fondness the mono tube amps that Luxman imported a number of years ago. I ran into the Air Tight products (including the larger ATM-2 stereo tube amplifier and the ATC-1 tube preamp) at the 1990 Winter Consumer Electronics Show and was intrigued. They had superb construction quality with very generously sized output transformers, and the sound in the demo room was rather good.

The company that makes the Air Tight products was formed by Mr. A. Miura, who worked with Lux for 30 years and served as president of Lux Audio of America between 1976 and 1979. In 1985, he resigned from Lux and, with two

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Price breakthrough... only $399!

We're now pleased to announce Ensemble II, a single-subwoofer version of the best-selling Ensemble system. Ensemble II sounds virtually identical to Ensemble (with its dual subwoofers placed next to each other). In fact, the satellites in Ensemble II are the same as we use in the original Ensemble. But the big news is Ensemble II's price: only $399. Ensemble II features quality components and cabinet construction normally found only in very expensive speakers. And sonically it outperforms systems selling for well over $750 a pair. But it's priced in the same range with miniature bookshelf speakers.

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Audio Hall of Fame member Henry Kloss created the dominant speakers of the '50s (AR), '60s (KLH) and '70s (Advent). Now he's created a new kind of audio company for the '90s...Cambridge SoundWorks.

The subwoofer can be placed just about anywhere in a room. It can go behind a chair, in back of drapes...or be used as a plant stand. The subwoofer uses a dual-chamber design. The first chamber consists of two long-throw 6.5" woofers, sealed in a true acoustic suspension cavity. These woofers project the bass notes into a second cavity, which acts as an acoustic filter. This design is far more accurate than a conventional ported woofer.

The satellites.

The satellites in the Ensemble II system are identical to those in the original Ensemble system† (which *Audio* magazine said **"may be the best value in the world"**). Unlike our competition, an Ensemble satellite is a true two-way system, using high-grade components normally found in more expensive systems. With Ensemble II's dual-chamber subwoofer, they create spectacular sound.

Conquer the fear of spending too little.

Don't be fooled by Ensemble II's price. Since we sell factory-direct to you, your money goes into making better speakers, not into paying for layers of distribution. Ensemble II is an all-out performance speaker that's equal to or surpasses competing systems selling for hundreds more. We guarantee it – or your money back.

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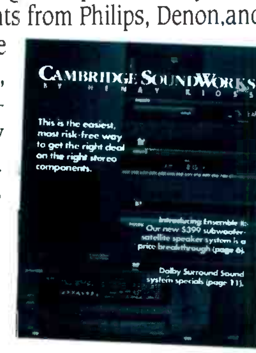

The frequency response is notable for wide bandwidth and the lack of any peaking at the higher frequencies.

other partners, formed A & M Ltd. to pursue his dream of making premium vacuum-tube audio electronics.

The ATM-1 is a stereo tube power amplifier built on one chassis, and it is rated at 36 watts per channel. Some of its features include the use of oxygen-free copper wire in its hand-wired construction, two rectifier tubes instead of solid-state diodes, generous-sized Tamura output transformers, a copper-plated chassis, select tubes from name-brand manufacturers, and two sets of switchable signal inputs.

Front-panel attributes, from left to right, include two signal input phono jacks, a rotary selector switch, two rotary input level controls, the gold-colored brand and model plate, and a pushbutton power switch with a pilot light above it. On the rear panel are the a.c. power cord, three speaker output binding posts per channel, two additional signal input phono jacks, and a ground post. An a.c. line fuse is inside the chassis. Being built in the old, traditional tube-amp way, the ATM-1 has all its tube sockets and transformers fastened to the top surface of the chassis. A series of large holes around the output- and rectifier-tube sockets insures a generous flow of cooling air for these tubes. The main filter capacitors appear to be mounted to the top of the chassis too, but are actually mounted with capacitor clamps underneath the top surface. Looking underneath the chassis reveals a beauty of construction rarely seen in a modern tube amplifier. The input and phase-inverter tube sockets are mounted on a copper plate held below the main chassis by ⅛-inch standoffs. A series of insulated terminals on standoffs, and the tube socket pins, serve as tie points for the circuit wiring. A number of ancillary components, such as bias-adjusting pots and the main high-voltage filter choke, are mounted underneath in the wiring area. About the only concession to modern practice here is the use of plastic tie wraps instead of the old lacing cord! Parts and construction quality appear to be first-rate in this unit.

The amplifier's construction couldn't be much simpler. A piece of steel is bent up to form the top, sides, front subpanel, and rear panel, with the bottom being open. A separate copper-plated bottom piece and a handsome front panel complete the picture. The bottom piece is slotted to allow air flow up through the interior space and out the holes around the output and rectifier tubes.

Circuit Description

Circuitry of the ATM-1 is quite conventional and topologically similar to a Marantz 8B, a classic old amp long out of production. From the switch that selects the front or rear input jack, the signal passes into a 100-kilohm input level control. Variable output from this control passes through an input coupling capacitor and a series resistor to the input tube's control grid. A 12AX7 dual triode is used for the left and right input stages, which are configured as ordinary common-cathode amplifier stages. The plate outputs of this first tube are direct-coupled into the grid of one of two tubes acting as long-tailed-pair phase inverters. A separate 12AU7 dual triode is used for this phase-inverter function in each channel. This kind of a phase inverter is, in reality, a differential amplifier with one input dynamically grounded through a capacitor and the other input driven with the signal from the first stage. The plate outputs of the phase-inverter stage are capacitor-coupled to the output tubes' control grids. Operation of the output stage is ultralinear, with fixed bias. A potentiometer in each output-stage grid circuit balances the plate current between the two output tubes. A bias level potentiometer in the power supply sets the overall bias voltage for both channels. Overall negative feedback, taken from the 16-ohm tap, is applied to the cathode of the first stage; this results in an overall noninverting input/output phase relationship.

High voltage from the power transformer secondary winding is full-wave rectified with the two 5AR4/GZ34 rectifier tubes, whose elements are wired in parallel, effectively forming two higher current diodes. Filtering is of the capacitor input type, with an input capacitance of 47 μF. A series filter choke of some 1.25-H inductance feeds into a final filter capacitance of about 150 μF to form the B+ supply to the output stages. This supply is resistor-capacitor decoupled to the driver or phase-inverter stage, and that supply point is, in turn, further decoupled as the supply to the first stage. A tap on the high-voltage secondary is half-wave rectified with a solid-state rectifier and RC-filtered to form the output-stage bias supply. All tubes in this design are run on a.c. from suitable secondary windings on the power transformer, which is typical practice in tube power amplifiers.

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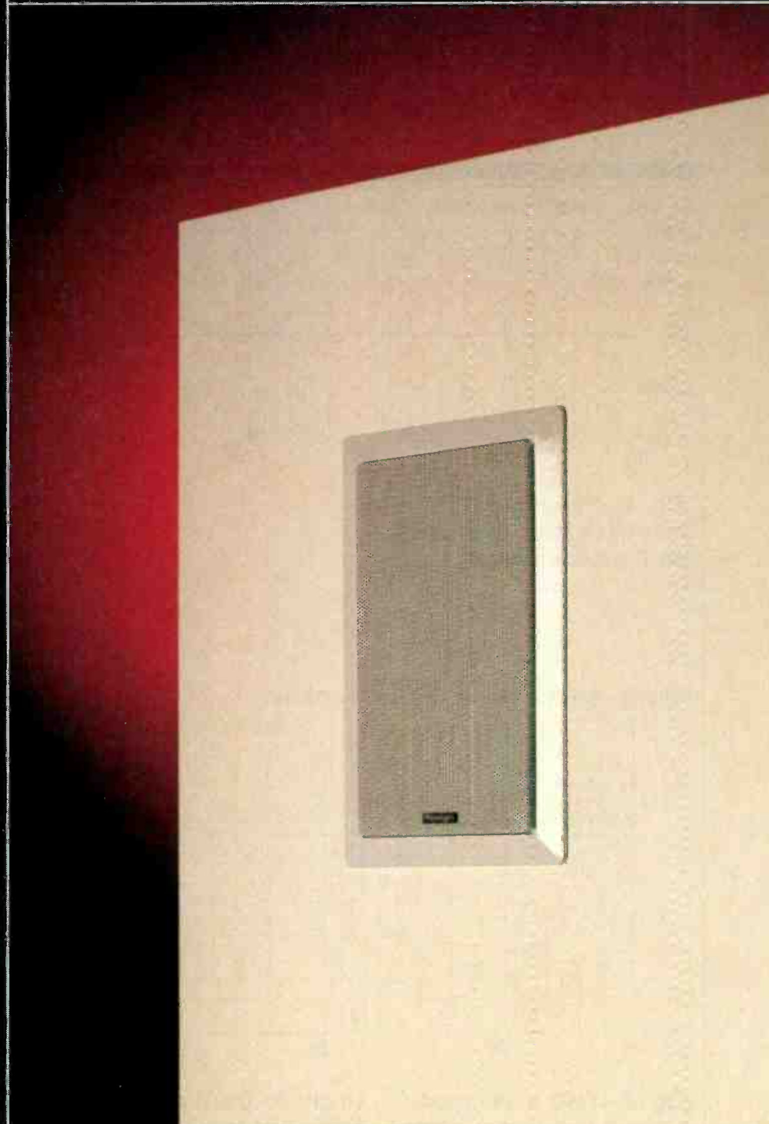

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Both clipping headroom and dynamic headroom are quite high, indicating that the ATM-1 will play louder than one might expect.

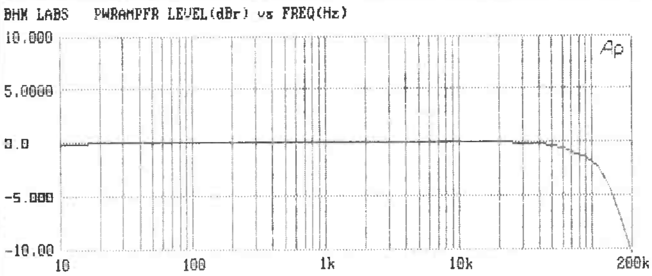


Fig. 1—Frequency response for 8-ohm loads on the 8-ohm taps.

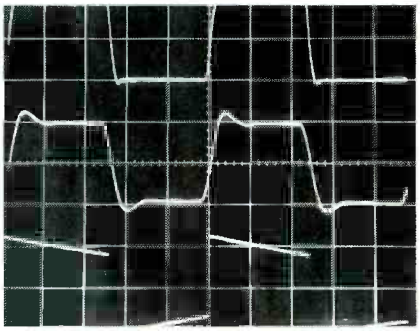


Fig. 2—Square-wave response at 8-ohm tap for 10 kHz into 8-ohm resistive load (top), 10 kHz into 8 ohms paralleled by 2 µF (middle), and 40 Hz into 8 ohms (bottom). Scales: Vertical, 5 V/div.; horizontal, 20 µS/div. for 10-kHz traces, 5 mS/div. for 40-Hz trace.

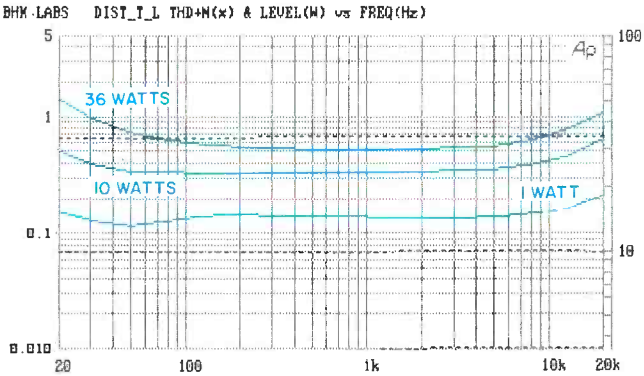


Fig. 3—THD + N (solid curves) and power output (dashed curves) vs. frequency, with 8-ohm loads on the 8-ohm taps. Read distortion from left-hand scale, power output from scales at right.

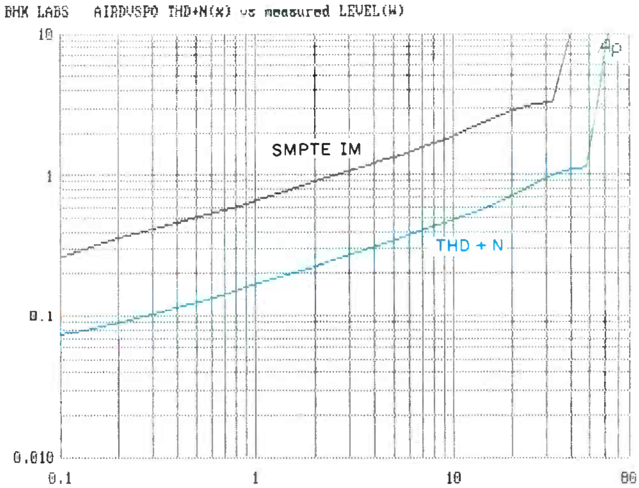


Fig. 4—SMPTE IM and 1-kHz THD + N vs. power output for 8-ohm load on 8-ohm tap.

Measurements

Voltage gain and IHF sensitivity were measured first. With 8-ohm loading on the 8-ohm taps, voltage gain for the two channels measured 30.1 and 30.3 dB for left and right channels, respectively. Corresponding IHF input sensitivities were 88.9 and 87.0 mV.

Frequency response at 1 watt output was very similar for both channels. Figure 1 shows the 1-watt frequency response for 8-ohm loading on the 8-ohm tap for one of the channels. Notable here is the wide bandwidth and the lack of any peaking in the response up to the upper frequency limit of my Audio Precision measurement set. Related to the frequency response is the response to square waves. My usual set of these is shown in Fig. 2. The top trace is for 10 kHz with 8-ohm resistive loading. Damping, or amount of overshoot, is quite good for a tube amplifier. The waveforms for open-circuit loading and for 4-ohm loading on the 8-ohm tap look substantially like the top trace in the figure. This uniformity of response shape with loading speaks well for the high-frequency stability margin of this design. The middle trace shows the effect of adding a 2-µF capacitor across the 8-ohm load resistor. The amount of ringing with this load is well controlled. Finally, in the bottom trace, response to a 40-Hz square wave is shown; there is somewhat more tilt than I've seen in some of the other tube amplifiers that I have reviewed. Judging from the high-frequency and square-wave response, it appears that the output transformers used in the ATM-1 power amp are of high quality.

Total harmonic distortion plus noise is shown in Fig. 3 for the left channel (which has slightly higher distortion than the right) as a function of frequency for three power levels. Distortion doesn't rise much with increasing frequency; I consider this a desirable amplifier characteristic. Both 1-

In listening tests, bass definition was excellent and space, dimension, and resolution were quite good.

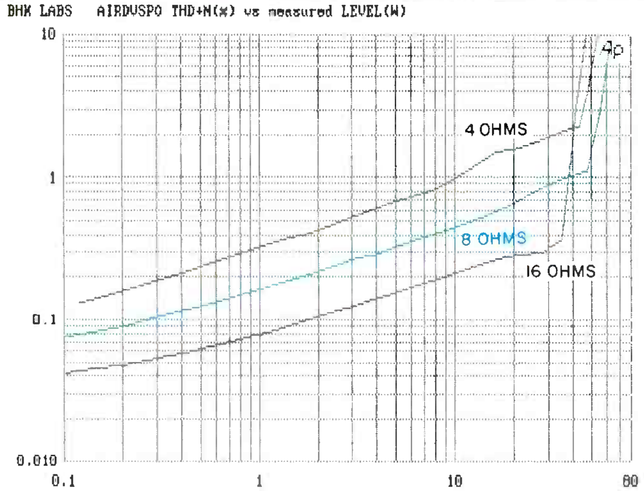


Fig. 5—THD + N vs. power for various loads on 8-ohm tap.

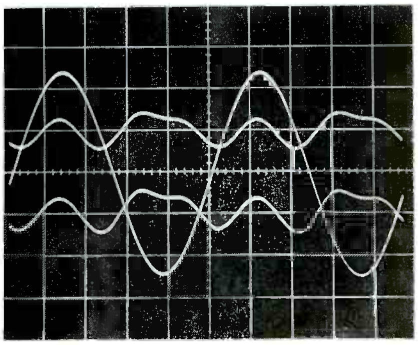


Fig. 6—Output and distortion residue for 1 kHz at 10 watts out into 8 ohms. Right channel (upper residue trace) had 0.38% THD, left channel (bottom residue trace) had 0.41%.

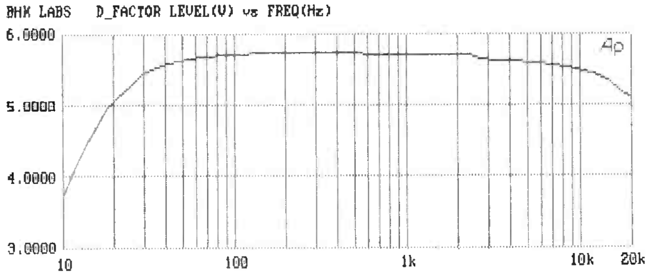


Fig. 7—Damping factor vs. frequency at 1 watt into 8 ohms.

Table I—Output noise, with inputs terminated by 1 kilohm. The IHF S/N ratios were 87.7 dB for the left channel and 86.7 dB for the right.

	Output Noise, µV	
Bandwidth	**Left**	**Right**
Wideband	779	717
22 Hz to 22 kHz	734	670
400 Hz to 22 kHz	134	129
A-Weighted	115	129

kHz THD + N and SMPTE-IM distortion as functions of output power appear in Fig. 4. The load is constant at 8 ohms on the 8-ohm tap for this figure and for Fig. 3. What is interesting about this data is that the ratio of IM to THD is just about the "classic" 4:1 ratio for simple distortion character over most of the power range shown in the figure. I measured 1-kHz THD + N versus power output for 4-ohm loading on the 4-ohm tap as well; the 4-ohm and 8-ohm curves virtually overlaid, so performance into their respective loads is substantially the same for both taps. I cannot say this for some other tube amplifiers I have measured in the past. Figure 5 shows THD + N for different loads on the 8-ohm tap. As might be expected, distortion is the highest for the lowest load impedance. Even with a 16-ohm load, the amp puts out a good 30 watts or more per channel. This is a very well-behaved amplifier in all the measurements so far and, from the foregoing, should be very tolerant of tough speaker loads.

Figure 6 shows harmonic distortion residue for a 1-kHz signal at 10 watts out, as an oscilloscope trace of amplitude versus time. To a trained eye, these pictures give a good indication of the dominant harmonic content. In this case, the waveforms look like a mixture of second, third, and fourth harmonics, and not much else. To check further, I ran a spectrum analysis on the Audio Precision (not shown), which revealed harmonics of higher order at lower amplitude. The presence of a whole series of higher order harmonics, even in small amounts, may be significant in terms of how sweet or irritating an amplifier may sound. In future reports, I'll be able to include spectrum analyses showing these harmonics in detail.

I came up with a way, using the Audio Precision measurement system, to assess output impedance as a function of frequency and get the machine to compute, scale, and plot the damping factor itself. Such a plot for the ATM-1 is shown in Fig. 7. Results are fairly typical for tube power amplifiers. Damping factor is quite uniform over most of the audio range and falls off at the frequency extremes. Output noise and IHF S/N are presented in Table I; the noise level is satisfactorily low.

Regarding clipping and dynamic headroom, the ATM-1 put out a steady-state 59 watts per channel at the visual onset of clipping, for a clipping headroom of 1.3 dB. With the IHF tone-burst signal, a power level of 58 watts per channel was observed. This translates to a dynamic headroom of 2.1 dB. The conservative power rating of this amp means that it will play louder than one might expect.

The ATM-1 is a beautifully made little stereo amplifier that delivers a high degree of resolution, space, and inner detail.

Some miscellaneous measurements: The a.c. line draw at idle was 1.62 amperes and was 3.1 amps at rated power. Plate supply voltage at idle was 480 V, dropping to 450 V at rated power. This is pretty good supply regulation.

Use and Listening Tests

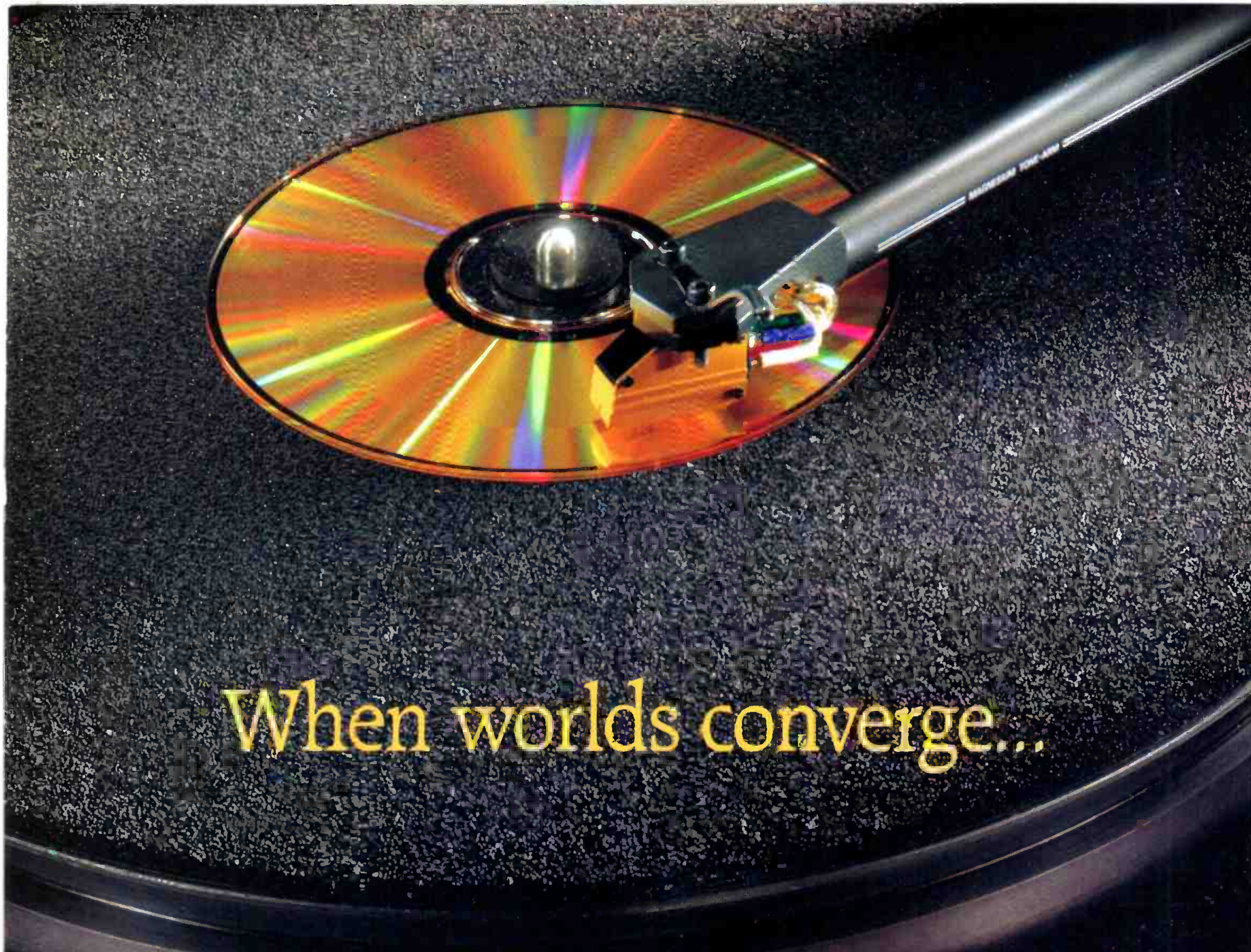
Signal sources used to evaluate the ATM-1 included an Oracle turntable fitted with a Well Tempered Arm and Spectral MCR-1 Select cartridge, a Magnavox CDB-560 CD player feeding into a Wadia 2000 decoding computer, a Nakamichi 250 cassette recorder, and a Technics 1500 open-reel recorder. A Vendetta Research SCP-2B pre-preamp was used for playing records. The outputs from the Vendetta and the other high-level sources were selected and volume controlled with my reference selector switch and switched attenuator unit. Other power amps on hand were a Berning EA-2101, my own EAR 519s, a set of Cary Audio monoblock CAD-50SLs, and a pair of Carver Silver Sevens. Speakers used were the Siefert Research Magnum III, Martin-Logan Monolith III, and Spica Angelus.

I was using the Siefert Research speakers when I first received the ATM-1. With these speakers, I found the sound of the ATM-1 to have amazing resolution and space but at the expense of some brightness and irritation on some program material. After doing some testing of the Cary Audio CAD-50SLs, I found myself continuing to use the Cary amps with the Martin-Logans for some weeks because I really like the sound from that combination. After measuring the ATM-1, I put it in this setup, driving the midrange panels of the Monoliths, and continued to use the Cary as a bass amp. With the ATM-1, the sound became a bit brighter, with increased resolution and detail. Again, as with the Sieferts earlier, the increased resolution was accompanied by some irritation on some material. Other material sounded very, very good.

I then took down the Monoliths and set up the Spica Angelus speakers to get a better idea of the sound of the ATM-1 used full range to drive these very good speakers. This pair of Angelus speakers is not fully broken in yet and has a tendency to be a bit bright with most amplifiers. The ATM-1 drove these speakers nicely. The low end was slightly lean compared to my reference EAR 519s, although bass definition was excellent. Space, dimension, and resolution were very good. As with the other speakers used, there was some edginess and irritation on some program material. This effect was more noticeable with CD sources than with records. One person that I loaned the ATM-1 to had nothing but good things to say about its sound.

I think the ATM-1 is a beautifully made little amp that delivers a high degree of resolution, space, and detail. Its sound should appeal to those with these sonic priorities.

Bascom H. King



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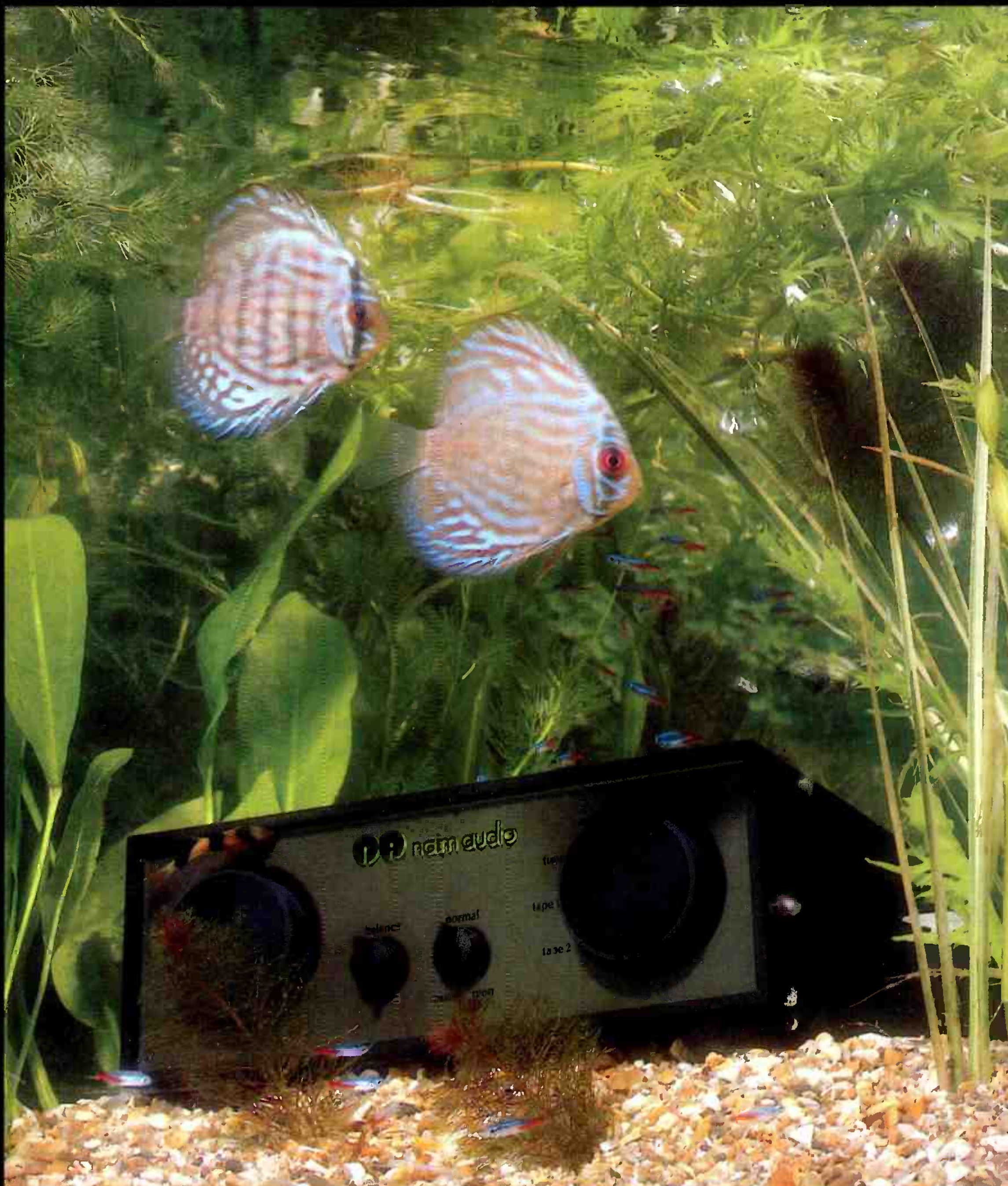
I remember seeing Cambridge SoundWorks' Model Eleven advertised in *Audio* and thinking, "What a keen idea! I would like one of those." As luck would have it, a conversation with the editor revealed that the magazine had a Model Eleven available for review, and I could use the equipment for that purpose.

The Eleven is a portable stereo sans signal source. Typical intended signal sources would be a portable CD player or personal portable cassette player. Other uses that come to mind would be impermanent connection in a video system, either for the main front system or for rear-channel surround sound, powering it from one's car and setting it up for outdoor events, or using it in an office or as a second system at home. A little imagination would no doubt yield many more applications for the Eleven.

The system consists of two satellite speakers and a three-channel amplifier enclosed in the BassCase, a carrying case which is also the woofer enclosure for the system! Inside the case are cutouts in the foam lining with spaces for the satellites, amplifier, connecting cables, and a signal source (not provided). The lining serves the dual purposes of providing protection for the packed system parts and damping for the woofer enclosure.

At the heart of the system is the three-channel amplifier unit. Each amplifier channel delivers about 12 to 15 watts; two drive the satellites, and the third drives the woofer. A low-level electronic crossover cuts the bass frequencies, below about 200 Hz, out of the drive to the satellite power amps. Additionally, this crossover sums the left and right inputs and low-passes the signal feeding the woofer amplifier. Crossover slopes are 12 dB/octave for both filters. The bass section, in addition to rolling off the high frequencies above 150 to 200 Hz, has a mild bass boost peaking up 4 to 5 dB at 50 Hz and then rolling off at 12 dB/octave below 50 Hz. This contouring of the bass helps to deliver a more convincing bass line. Although there is no low-frequency level control per se to adjust the relative bass level in respect to the satellites, the bass tone control does a nice job of this. A front-end signal selector and volume, balance, and tone controls precede the electronic crossover. The amplifier can be operated from 120 or 240 V a.c. at 50 or 60 Hz or from a 12-V battery source. A rechargeable battery pack is available as an accessory. Further, the 9-V output jack on the back of the amp will power a portable CD player or, possibly, a portable cassette player. In addition to the speaker connecting wires, several other cables are provided; these include a cigarette lighter adaptor cable for getting 12-V power from a car or boat, a signal cable with a mini stereo phone jack on one end and a pair of phono plugs on the other end, and a cable for supplying power to the signal source. Numerous accessories, including cable retaining clips, wire nuts, wall anchors, and rubber bumpers, are also provided. All in all, this is a well-thought-out product.

Rotary controls on the front panel of the amp include a three-position source switch and knobs for volume, balance, bass, and treble. Two slide switches provide the functions of power on/off and stereo/mono selection. A red LED indicates power is on. Facilities on the rear panel, in addition to the 12-V power input and 9-V power output



A RARE BREED

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I wondered why I needed all my fancy equipment when this little portable system sounded so good.

connectors previously mentioned, include three pairs of phono connectors for signal input, three speaker connections, a 120/240-V a.c. line switch, and the a.c. power cord. The satellites' connectors are polarized, two-pin sockets on the amp that mate with plugs on one end of the speaker wires. A pair of thumbscrew binding posts provide for connection of these wires to the back of the satellites. Another pair is used on the back of the amp for connection to the woofer wire. Two pin plugs interface the woofer wire at the woofer end. This arrangement of plugs and thumbscrews is presumably used to make correct hookup easy.

I first hooked the Model Eleven into my video system. This setup has the video monitor positioned in the middle of a 24-inch-deep shelf that is about 27 inches off the floor and goes across the whole side of the room. The normal speakers used here are a pair of powered three-way units that were prototypes of a speaker manufacturer's design; they are positioned about 2 feet on either side of the monitor. These resident speakers sound quite good in this use, and generally I am quite pleased with them. I had a mild problem in determining correct polarity for speaker hookup in the Model Eleven system; I had to figure out which wire of each pair was to go to common and which was to go to hot. Being of the school that holds, "hook it up and try it before reading the manual, and if you have to read the manual, scan it hurriedly for the particular answer," I mistakenly concluded that the manual left out this particular detail. I called the company's toll-free number and was told that the white tracer is to go to common. Later, after a more careful perusal of the manual, I found that there is indeed reference to this subject, and it instructs that the white tracer is to go to hot. Hmm, a conflict that has the ultimate consequence of the system being in or out of absolute phase, with debatable effect.

In my video setup, the Model Eleven sounded generally like the resident speakers in overall tonality. I just put the bass unit on the floor, to the left of the monitor position, with the satellites on top of the resident speakers, and this worked out well; there was a reasonable bass-to-midrange balance and bass extension. When I tried some laser videodiscs, I was surprised at how good they sounded. The Eleven system would not crank it out like the normal system, but it played surprisingly loud, and at these louder levels, I thought I detected some bass compression occurring. This is a phenomenon, distinct from audible bass distortion, whereby the bass levels just don't get any louder and seem not to go down as low in frequency. After doing some measurements on the system, I

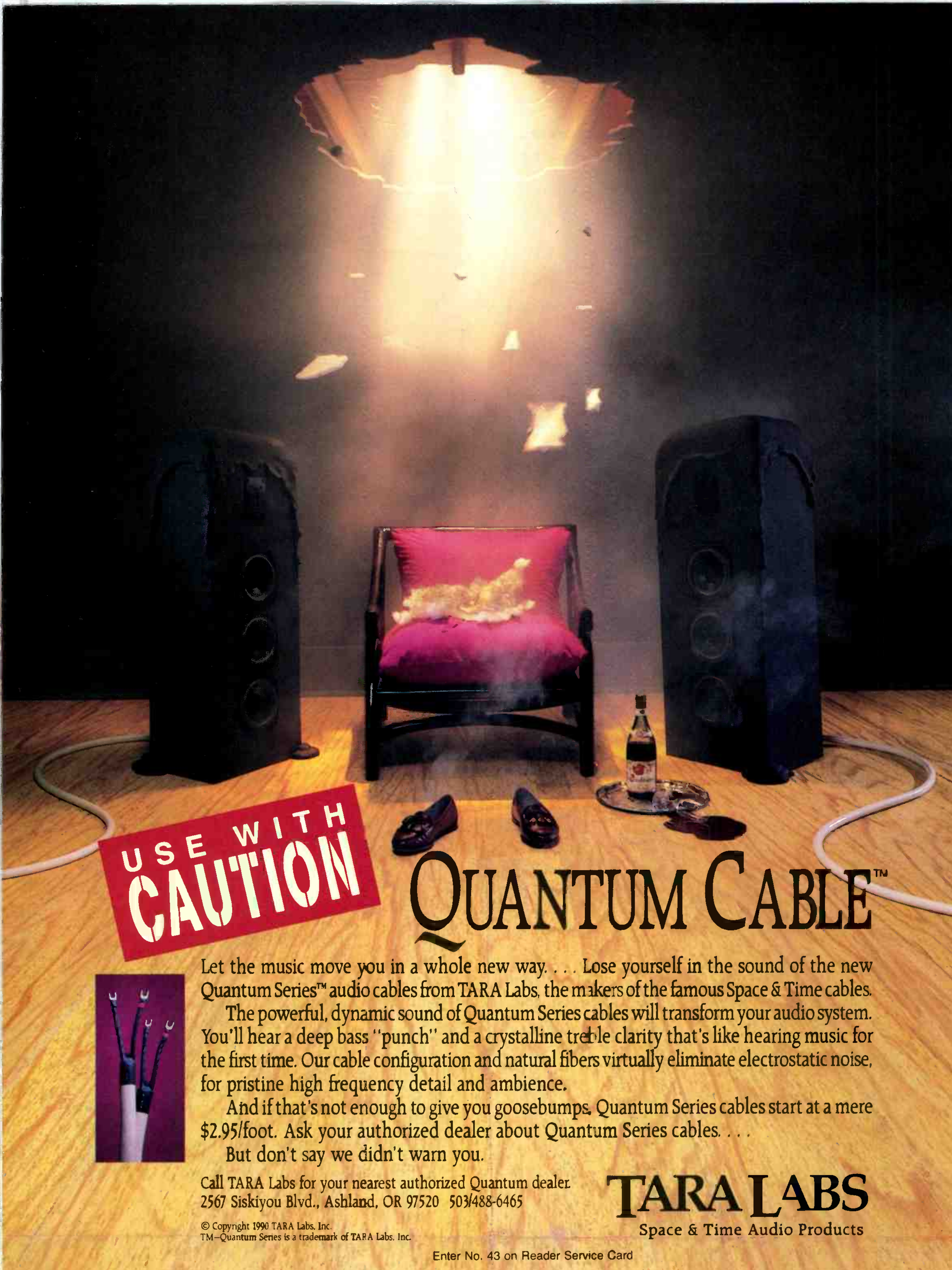
found that this turned out to be just simple bass-amp clipping.

I next took the system out to my lab and hooked it up in place of my resident system, which consists of a tuner or cassette recorder hooked into a Marantz 1120 preamp prototype feeding Dynaco's Stereo 35 tube amp driving a/d/s/ L300 speakers. I put the satellites on top of the a/d/s/ speakers and the woofer down on the floor, about midway between the satellites. Right away, the resolution and space were better than the resident system, and the bass sounded very good and was extended in response. However, there was more of a tendency to harshness in the upper midrange frequencies. I noticed this more than in the video system, possibly because I listen somewhat more closely to the speakers when I'm in the lab.

I then set up the Model Eleven where my normal sound system is, in my living room. Speakers being used at the time were Martin-Logan Monolith IIIs. I simply left these speakers where they were and put the Eleven satellites in a variety of positions set on ASC Tube Traps in front of and around the Monoliths, and finally on top of the Monoliths. I placed the woofer against the wall behind the right resident speaker and, after trying a few other positions, settled on this as working quite well. Using the Model Eleven this way, I realized how good the little system is. An interesting illusion was created with the satellites on top of the large Monoliths—the sound seemed to be coming from the big speakers! Playing a variety of sources on this setup and looking at all the expensive amplifiers on the floor behind the big speakers made me momentarily wonder why I need all the fancy stuff when this little portable system sounds so good. Imaging was absolutely outstanding with these small speakers. Although the tonal balance was generally good over much of the frequency range, and bass output level and quality were good, there was a noticeable thinness, or lack of energy, in the lower midrange area. This would not be as noticeable if the satellites were placed closer to the room walls. The quality of the sound was very good with the Eleven system, though it clearly was not as refined in delicacy and airiness as with the "real hi-fi" equipment I normally use.

Some operational nitpicks: The center detents on the balance and tone controls felt downright clunky. The detents were so strong that it seemed that the controls wanted to snap into the center position. There was a healthy thump in the speakers when the power was turned off, but the turn-on noise was more reasonable. With the volume control set at about half rotation, considerable hiss could be heard close to the satellites.

Nitpicks aside, and considering the Model Eleven's price of $749, I was impressed with its execution and performance and wished that I had thought of the idea myself. I heartily recommend this little jewel of a system, and with the 30-day free trial offer, how can you go wrong? *Bascom H. King*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The XR 240 is a carefully matched three-way system that has excellent dispersion. It has a high power handling twelve-inch woofer, a six-and-one-half-inch midrange and a one-inch tweeter. A complex and extensive crossover accurately blends the drivers together. The system is attractively styled to blend with any decor and takes up very little floor space.

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Every high-end audiophile who has had extensive experience with both Compact Discs and analog records has dreamed of finding some way of getting the best features of digital and analog from a single system. There has never been any real prospect analog could provide the flat frequency response, separation, and freedom from noise and distortion that digital provides, but the advances in CD players over the last two years have shown there is a growing prospect that the advantages of digital can be combined with the musically sweet upper octaves, correct musical harmonic structure, transient response, and natural soundstage, depth, and imaging found in the best analog systems.

While mainstream manufacturers have attempted to find affordable solutions to recognized problems in the first several generations of CD players, high-end manufacturers have sought to build the combination of CD deck and digital decoder that would provide the best features of analog and digital. Some high-end firms have made astounding progress towards this goal in the last year, but the Krell MD-1 CD deck and SBP-64X digital signal processor may well be the first high-end combination that can claim to have truly succeeded.

Like all Krell gear, the MD-1 and SBP-64X are superbly built and styled. Their appearance and construction are state of the art, as is their sound quality—although excellence is something that might be expected in a transport that costs $5,400 and a decoder that costs $8,950. These are luxury prices even for the high end.

The Krell MD-1 CD transport is built on the Philips CDM-3 transport, with a single-beam laser and glass lens; this mechanism is extremely reliable and is normally used for CD-ROM applications. It is a top-loading mechanism that uses a heavy die-cast chassis mounted on a subframe machined from solid blocks of aluminum. The MD-1 is by far the heaviest and most rigid CD deck mechanism I've encountered, and it is isolated from outside mechanical interference by four suspension towers that hold the substructure. These towers are adjustable to allow precise levelling and coupling to any surface. There is a large, separate power supply in addition.

The SBP-64X digital signal processor is the equivalent of a minicomputer. It uses proprietary, upgradable software to allow four Motorola DSP-56001 processors to perform the equivalent of 64-times oversampling. The SPB-64X is run at a clock speed of over 28 MHz, and uses two Burr-Brown PCM-64 18-bit D/A converters. Unlike most competing processors, the SBP-64X runs parallel data through the DSP-56001s

and into the D/A converters. This allows the unit to run at the extreme speeds needed for 64-times oversampling without multiplexing and then summing the data.

No steep slope or brick-wall filtering is used in the SBP-64X, and current-to-voltage conversion is performed in the analog domain, directly after the D/A converter. Krell believes that doing this in the converter or after using an op-amp—the way it's done in virtually all other digital signal processing systems—produces an unacceptable loss of sound quality.

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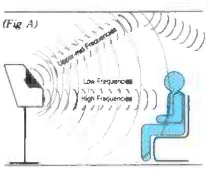
(Fig. A)



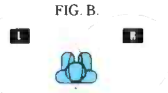
The technology responsible for Holographic Imaging could only have come from the people who invented acoustic suspension.

ASTOUNDING SOUND BECAUSE WE BROKE THE VERY RULES WE MADE.

For instance, the first four in the H/I Series have the woofer on top, angled precisely. This minimizes unwanted crossover components and diffraction effects, leaving nothing between you and the music.

The offset dome tweeter adds strong, precise imaging over a broader area than merely the traditional sweet spot. (Fig. B)

FIG. B.



In the two largest H/I Series, we put the midrange on the top on an angle. Then we mounted the woofers into an acoustic suspension cabinet that fires into a filtered chamber. The result… Filtered Suspension… tight bass response combined with dynamic, efficient performance. (Fig. C)

The narrow speaker encasement (Minimal Baffle Design) reduces reflected information and gives you an enormous sound from a surprisingly small amount of space.

FIG. C.

SOUND DESIGN DICTATED COSMETIC DESIGN.

The design philosophy here is "form follows function." As such, every physical characteristic is born from specific physics and psych-acoustic principles. The result is a seamless blend of engineering innovation and visual art.

From bookshelf to tower, each sleek, uncompromising model projects precise stereo performance. Other finish options are available on the largest model.

See and hear these new speakers only at selected AR dealers. They are offering an extraordinary demonstration featuring Nova artists such as Brandon Fields and Jude Swift on a special CD which you're free to keep afterward.

The other thing free is information. So if you have questions about the H/I Series or Holographic Imaging call 1-800-969-AR4U.

AR ACOUSTIC RESEARCH

WE CAN BREAK THE RULES BECAUSE WE MADE THE RULES.

Adjectives can only hint at the musical subtleties this equipment can reveal in true high-end systems.

The analog stages are the high-bias Class-A designs that have made Krell one of a handful of world-class high-end preamp and amp manufacturers. A separate power-supply unit holds three completely independent power supplies and 10 cascaded discrete regulators to provide the five different voltages needed by the SBP-64X. The unit has optical and coaxial digital inputs, and both balanced outputs with XLR jacks and unbalanced, phono-jack outputs.

What really counts about the MD-1 CD deck and SBP-64X, however, is their sound, and this sound is superb with all digital media I have tried: CD, DAT, and satellite. Even when the Krell deck and processor are compared to top competing decoders, DAT decks with advanced digital technology, and state-of-the-art bitstream CD decks, the Krells provide a degree of smooth musicality that has to be heard to be believed.

Adjectives can usually only hint at the musical subtleties that such units can reveal in a true high-end system. The sonic advantages of the MD-1 CD deck and SBP-64X processor are readily apparent, however. One quick way to demonstrate their superiority is to play older CDs, particularly ones that are slightly hard or edgy on most other players. The Krells cannot make the CD produce sound it doesn't already have, but they do generally make the sound of poor or mediocre CDs more listenable—at least when the problem is not in the CD's miking or production values.

Similarly, no player I have heard does quite so well with AAD recordings. Many great analog recordings have not fared well in their transformation to a digital format. In case after case, the Krell MD-1 CD deck and SBP-64X processor restore most of the ambience and depth of the original and take most of the graininess out of the upper octaves. The soundstage opens up and is less forward, and the power of the bass comes through.

The true merit of the Krell MD-1 and SBP-64X shines forth, however, when they are used to reproduce the latest and best all-digital (DDD) recordings. The upper midrange and treble have a natural smoothness that causes remarkably little listening fatigue. The Krells reproduce massed strings, piano dynamics, and complex choral and organ music with less congestion and hardness than any CD system I have heard. At the same time, the Krells provide a more natural timbre, a consistency in pitch, and a lack of noise that no consumer-level analog turntable or tape recorder can compete with.

The Krells also deliver a degree of low bass, mid-bass, and upper bass/lower midrange detail and power that no other CD units I know of can match, either in low bass test-tone comparisons or in music. This adds to the best

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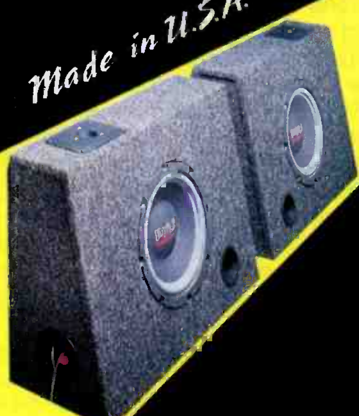

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The MD-1 and SBP-64X combine the best sonic features of analog and digital in a musically natural, rich way.

recordings a degree of natural emotion and warmth that you may have missed until you have heard the MD-1 and SBP-64X.

The soundstage is both superior to and strikingly different from that of most digital systems. Mediocre digital systems tend to collapse the soundstage, remove depth, and blur the imaging. Most superior digital systems—relatively speaking—expand the soundstage and restore depth but have a "forward" apparent listening position, and they add what often appears to be a slightly unnatural amount of upper octave detail and energy. In recent bitstream players, there has also been a tendency to focus the imaging in the center and provide soundstage detail from the upper six octaves while losing a bit of lower octave reverberation and energy.

The MD-1 and SBP-64X tend to have an apparent mid-hall listening position. They do not emphasize upper octave detail, and they do an excellent job of reproducing soundstage detail in all octaves. Anyone familiar with the Dorian recordings at Troy Savings Bank Music Hall will find the difference between the Krells and the competition to be particularly striking, as will fans of the organ, Romantic orchestral music, opera, chamber music using older instruments, and naturally recorded acoustic jazz.

Anyone familiar with the digital and analog versions of the Proprius recording *Jazz at the Pawnshop* should listen to the CD version on the Krell MD-1 and SBP-64X. Compare the Krells' reproduction of the bass line and feeling of space with those heard through competing high-end digital equipment, or with their sound on the LP version on a top-quality turntable. The sound of the Krells is not analog, but it comes remarkably close while still providing all the advantages of CD.

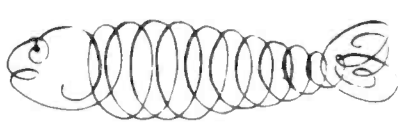
In short, when it comes to providing the best sound features of both digital and analog, the MD-1 and SBP-64X not only make the impossible seem possible, they make the end result seem rich and musically natural. However, it is only the subtleties in the way they reproduce music—not my words—that can ultimately persuade you of the merits of the Krell MD-1 and SBP-64X. *Anthony H. Cordesman*

BLAZING THEORBOS

"Il Tedesco della Tiorba"; Kapsberger: Pieces for Lute. Paul O'Dette, lute and chitarrone.
Harmonia Mundi HMU 907020, CD; AAD; 69:27.

Sound: A Performance: A

(This is one of those dumb reviews where the chief editor imposes his inane musical taste on frightened underlings and bored readers. I will quickly admit that I am no musicologist, but this record was fun for me. I should therefore write this review, because only I truly know what I like. Anyway, we couldn't think to whom in



our group of reviewers this disc might be nearly so enjoyable, so Mr. Hyde, all atremble, assigned it to me. I don't get paid for the review, but I do get to keep the disc, which is equivalent to getting paid to me, because I'd buy this one otherwise.)

Giovanni Girolamo Kapsberger's music is High Baroque, full of flourishes and filigrees, a form of music that has always seemed to me to be the equivalent of calculus with double integrals. It's like juggling more Indian clubs than the Laws of Physics allow. It's like naming all the states, with their capitals, in the order in which they were admitted to the Union—together with the names of their governors and populations of the largest cities.

"Il Tedesco . . .," of the title, roughly translates as The German Theorbist, the theorbo being a relative of the lute. Now, just which side the theorbo is related on might be the subject of some banter, as it has a rather absurdly long neck with two sets of tuning pegs. I leave it to a proper reviewer, Chris Greenleaf, whose proper review of an actual recording of an actual theorbo follows, to describe this improbable instrument and its place in the stringed instrument family.

Signore Greenleaf told me that there is another recording of Kapsberger's music on a European label in response to my complaint that there are no other recordings listed in Schwann *Opus*. He also told me that Kapsberger reputedly had very long fingers which were—most unusual—even at the ends. While Chris was, of course, not there to have examined Il Tedesco's fingers, even if it would have been allowed, we agreed that such a set of string-pluckers would have been a very great advantage in playing these instruments.

Paul O'Dette, who plays a 10-course lute and a chitarrone, both of contemporary make, on this recording, also wrote the quite interesting liner notes. He is the head of the early music program at the Eastman School in Rochester and is in great demand as a concert performer. He writes a fascinating story of the German nobleman, Kapsberger, who was born in Venice about 1580 and, by the end of the second quarter of the 17th century, had become quite celebrated in Italy as a musician. Hence "Il Tedesco. . . ." Apparently, writes O'Dette, he had "a prodigious technique" on this newly invented instrument and so was employed for most of his career by the papal family. But despite his fame, Kapsberger had a falling out with a critic of the period, Doni, and, says O'Dette, the resulting "vitriolic attack apparently provided the basis of most commentary about Kapsberger and his music ever since, without, evidently, objective consideration of the music. The time would seem right to allow the music to speak for itself." Indeed!

So, what about the music? Well, for some—those without a taste for this type of music—it will be about as interesting as being forced to count each grain of sand as it falls through the middle of an hourglass. For me, the music is that intricate, agreed, but that particular quality is a large part of what makes it interesting. And, too, for me, the melodies are about as captivating as Pachelbel's Canon, Borodin's String Quartet No. 2 in D Major (the good one's by the Guarneri Quartet on an RCA LP, ARL1-4331), or any of Benedetto Marcello's wonderful sonatas (my CD is Jecklin-Disco JD 5001-2 via Koch Import Service). Yeah, great, whopping huge melodic hooks—easily big enough to catch Great White Sharks with.

Now, when it comes to the playing, those with statistically twisted minds will immediately point out that since this is the only example of Kapsberger's music, it is automatically both the worst of playing and the best of playing. I, however, prefer to invoke a minor god, Subjective Judgment, at this point. My sense of the music says that there is a rightness, a correctness, about the variations, all frilled and ornamented, as O'Dette apparently

Center Illustration: Yvonne Buchanan

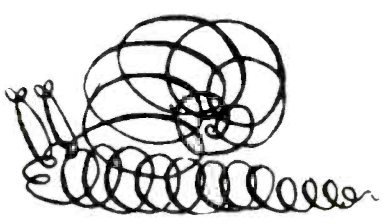
properly plays them from the sheets, that makes the whole as proper and good to do as eating thirds at a Thanksgiving dinner. My rhythmic ear tells me, in just a couple of places in these hyper-complex passages, that O'Dette isn't the total master of the music. At this point, I have to stop and say that probably no one would be, totally. And this is more the measure of the virtuosity of Kapsberger the artist than any deficiency in O'Dette.

Indeed, I owe Mr. O'Dette a large debt of gratitude for introducing me to The German Theorbist, for I have been playing the music, on my bus rides to and from work, at the rate of once a week or so for the past couple of months. (The actual ride, and therefore playing time, is about 40 minutes.) That is, I think, very often. Small things of note: The producer is Robina Young; the engineer is Peter McGrath of Sound Components in Coral Gables, Florida. The venue was the Bethel United Church of Christ, Manchester, Michigan; the date, November 1989. The charming spot illustration, used here, is by Kapsberger himself. *E.P.*

De Visée: Music for the Theorbo. Hopkinson Smith, theorbo.
Astrée E 7733, CD; AAD; 57:30.

When the Compact Disc first appeared, there were fears that only repeat recordings of the warhorse repertoire would be trotted out. Thankfully, this bad dream has *not* been realized! Small, explorative companies, such as Astrée, have continued to issue an ever-swelling stream of fascinating rarities for uncommon instruments, and by composers whose names have been household words only in the homes of certain scholars.

Robert de Visée was born in France around 1650 and presumably died about 1723. He first encountered Louis XIV when Mazarin was running the country, and he worked most of his life in the Sun King's service. Mazarin and Louis attracted Italian writers and performers to France, so it is no surprise that Italian instruments like the theorbo soon were in regular use at Versailles and at other courts. This was not an era of "free market" composition and publishing; only composers and performers who enjoyed a royal license or who were in the favor of the leading musical figures (like Lully) could hope for dissemination of their work. De Visée was a relatively minor figure but, by all accounts, a popular one. His livelihood and access to the sovereign were guaranteed as long as Louis lived.



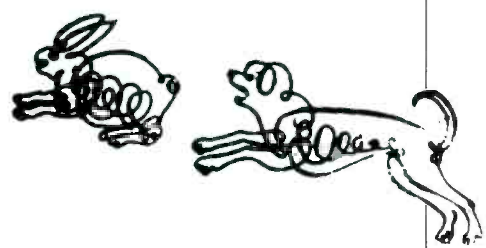
Solo literature for the lute and guitar abounds, but the theorbo's heavy use in Italy, France, and parts of German-speaking Europe was limited to a role as an accompanying or continuo instrument. A few solo compositions for it survive, with de Visée's being the best known.

Could it be the very awkward physical makeup of this plucked cousin of the lute that limited its popularity? With a lute-like body and an extremely long neck—up to 7 feet!—the chitarrone, to give it its Italian name, is strikingly beautiful, a commanding shape from the Italian Renaissance. In simple music, the eight unstopped (freely vibrating) gut strings—tensioned by the offset pegbox at the neck's outer end—are mere drones, strummed or plucked to provide an uncomplicated but firm bass. More complex works like de Visée's three suites and three short single movements involve tuning these gut courses so that they can participate in polyphony or harmony. The second, more conventional pegbox, located near the player, holds six strings meant to be stopped against the gut frets on the fingerboard, as in a lute or guitar.

The intimate, deep, and transparent sound of the theorbo in Hopkinson Smith's deft hands serves de Visée's suites beautifully, as does the excellent analog recording. The music is unmistakably French but is surprisingly reminiscent of Bach's lute and keyboard suites, especially in the ruminative slow movements. This is a musical *and* sonic discovery to be savored again and again. *Christopher Greenleaf*

Bartók: Early Orchestral Works. Rotterdam Philharmonic Orchestra, James Conlon.
Erato 2292-45458-2, CD; DDD; 51:40.

While Arnold Schoenberg was still struggling with what might be termed (ungraciously) the post-Mahler elephantiasis of the *Gurrelieder*, Béla Bartók already was finding his own voice—a voice that, in retrospect, was even more modern than Schoenberg's



was to become. In these little-played works, we see the process actually unfolding.

The earliest is the "Two Portraits" of 1907. The first of these, "An Ideal," also served as the opening movement of the violin concerto (now counted as No. 1) that he wrote secretly for violinist Stefi Geyer—a work that only came to light after her death. Bartók hoped that his love for her, unlike the manuscript, would be returned; it evidently was not, though she kept faith with their secret even after his death.

"An Ideal" is a rhapsodic piece, particularly in the solo violin part, here played by Pierre Amoyal. Its companion, "A Grotesque," is angular and rather brutal—a distant relation, perhaps, of Mussorgsky's "Night on Bald Mountain." Some of the scoring already points toward Bartók's mature style, but there are abundant hints of earlier influences.

As the title betrays, the two "Images" of 1910 bear a debt, specifically, to Claude Debussy—who, together with the Hungarian folk music that Bartók had recently discovered, was the major influence over him in this period. The "Images" are titled, respectively, "In Full Flower" and "Village Dance."

With the "Four Pieces" of 1912, Bartók was assuming his mature self. The suite contains suggestions even of the Concerto for Orchestra. The move-

Bartók's "Two Portraits" already point toward his mature style but retain abundant hints of earlier influences.

ments are titled Preludio, Scherzo, Intermezzo, and Funeral March. It is arguably the most finished—or at least the most advanced—of the works in the collection.

Although Bartók produced the String Quartet No. 1 in 1909 and the opera *Bluebeard's Castle* in 1911, nothing on this CD is a similarly major contribution to the literature. However, these "minor" works are far from uninteresting pieces, even above and beyond their historical importance as indicators of the unfolding of genius. And they are well played and well recorded here.

Robert Long

Britten: The Company of Heaven; Paul Bunyan Miscellany. London Philharmonic Choir, English Chamber Orchestra, Philip Brunelle.
Virgin Classics VC 7 91107-2, CD; DDD; 67:37.

This disc is a bit of a mixed bag, but it's a valuable addition to the discography and a must for all fans of Benjamin Britten. It contains first recordings of early work. "The Company of Heaven" is a "cantata" written in 1937 for the BBC, for performance at Michaelmas—the feast of St. Michael and all the angels. Begun before the Variations on a Theme of Frank Bridge were completed, it exceeds even their accessibility and charm. The *Paul Bunyan* excerpts were omitted from both the final revision of the opera and its debut recording, also on Virgin. The last three tracks contained on this disc therefore are an appendix to the complete *Bunyan*.

There are more compelling reasons for their omission than the otherwise excellent booklet to the present record implies. The overture, admittedly overlong for the short opera, is not exceptionally interesting. The "Lullaby of Dream Shadows" is even less so, at least out of context, as it is here. And "Inkslinger's Love Song" fails to make much of W. H. Auden's witty words. But lovers of the opera will want all three as relics of its first form, in 1941.

The soloists, chorus, and orchestra all do well, but the two speakers in the cantata, Sheila Allen and Peter Barkworth, are downright superb. Their texts, and those of the singers, come from many sources, from the Psalms to Gerard Manley Hopkins. Though the chorus has the most to do, the spoken narration is extremely important, because Britten's original commission was to supply incidental music. It is anything but incidental to the final production, but the narration remains the spine of the piece.

Virgin continues to provide recordings of exceptional clarity, and this one—made in London's Henry Wood Hall in 1989—finds a nice compromise between the studio sound for which the cantata was written and an acoustic redolent of the concert hall to which it aspires. Full English texts and historical notes are provided. *Robert Long*

András Schiff will show you that Schubert's music still lives, *is* understood, and hence projected; it is a kind of miracle.

Schubert: Impromptus D. 935, etc. András Schiff, piano. **London 425 638-2,** CD; DDD; 74:26.

The true musical ear is an extraordinary phenomenon and defies every sort of education. This kind of ear, like the artist's eye and hand, does not learn, it *understands*, somehow intuitively, and proceeds to teach itself, painstakingly and yet like lightning.

All too many pianists today, for instance, do not really hear the remarkable harmonies, the dramatic, startlingly profound and unsettling alterations to distant keys and back, that are the hallmark of late Schubert. It is becoming a lost art, gradually, as the early 19th century and its ways remove themselves further and further from us. I myself hear them. Why? Because I have an ear, but also because I learned them in an earlier time when these things were far more forward, even after a century, than they are now. So, is Schubert a lost art or on the way to it?

András Schiff will show you that this music still lives, *is* understood, and hence projected. (If the pianist doesn't understand, how can the listener get the message?) It is a kind of miracle; for this is a young pianist, with wavy auburn hair in current style, more or less of the neo-Romantic school, many of whose members make hash of Romantic music by putting the emphases all in the wrong places, hesitating when they should rush forward, missing the larger structures altogether. Not this man! True, his playing does dally a bit along the way, in the current style for youthful Romanticism, and he does not sternly emphasize the great arches of musical structure as the big pianists of the earlier 20th did. But he *understands*. He really does. It all just comes naturally, or so it seems.

The title, perforce, resorts to "etc." for an entire varied program of Schubert, large and small, short of the big sonatas and fantasies. This is very fine Schubert, as good as we are likely to hear. Even on a Bösendorfer! Not at all the proper piano for Schubert.

Edward Tatnall Canby

Haydn String Quartets, Vol. 3: Op. 20, No. 5; Op. 33, No. 4; Op. 71, No. 2. Lindsay String Quartet. **ASV DCA 674** (recorded live).

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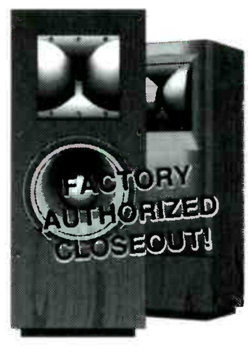

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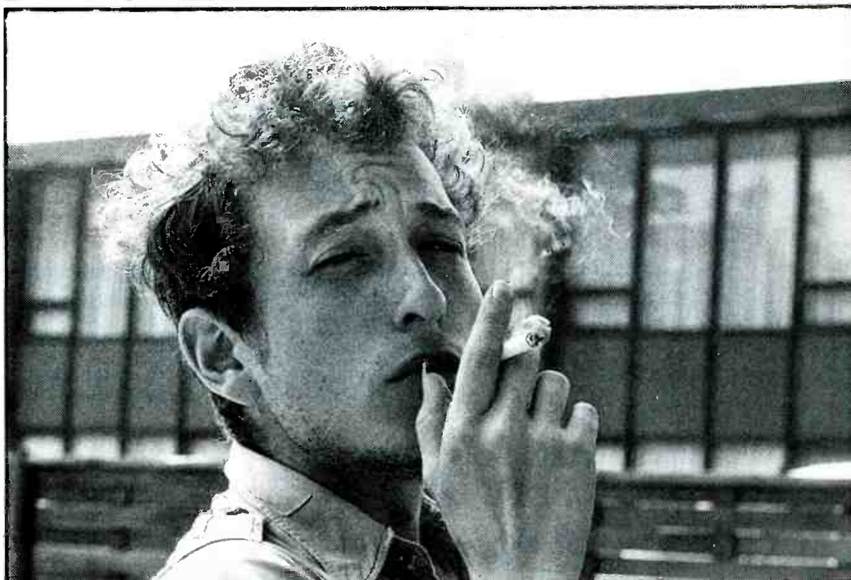


The Bootleg Series, Vols. 1-3 (Rare and Unreleased), 1961-1991: Bob Dylan
Columbia 47382, three CDs; AAD and ADD; 77:10, 76:48, and 77:00.

Sound: A Presentation: A+

Bob Dylan's songs can be credited with changing (or at least helping to change) the face of pop culture and its marketplace. The Peter, Paul & Mary smash-hit cover of his "Blowin' in the Wind" was groundbreaking in that its message contrasted sharply with the usual boy/girl pap of the time. Then, in the summer of 1965, Dylan's own six-minute recording of "Like a Rolling Stone" shattered the three-minute barrier for hit singles.

And then there was a double LP appearing in 1969 that should be recognized as the first widely disseminated bootleg (unauthorized) recording of a major pop artist. *Great White Wonder* was a treasure trove of songs and stories recorded in clubs and living rooms during the early '60s, along with pirated publisher demos recorded by Dylan with his band (later to become The Band). Columbia subsequently released much of this material during 1975 as *The Basement Tapes*, permanently erasing any doubts as to the impact or importance of material presented on Dylan bootleg albums.

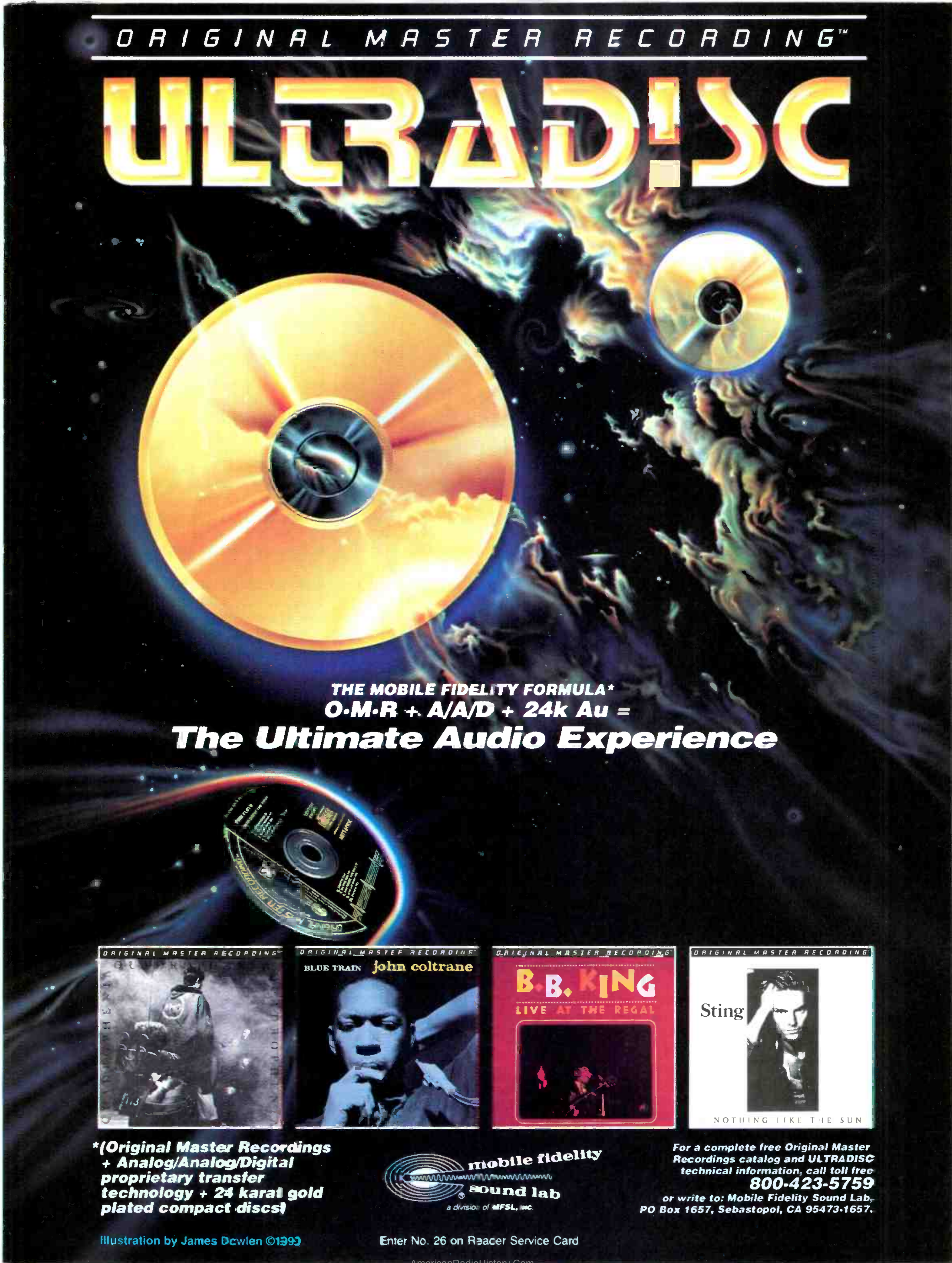
In 1985 came *Biograph*, and it opened the floodgates for the current box-set retrospective mania. Although it was no secret that the vaults contained hours of Dylan material, *Biograph* barely scratched the surface. It was sequenced like a crazy quilt, with no apparent logic or reason beyond some oblique thematic design.

Not so with *The Bootleg Series, Vols. 1-3*, which is presented in close-to-chronological order. The set is top-heavy with material from the early days, but deservedly so. All of the first CD and part of the second date from the short but incredibly fertile two-year period that produced Dylan's first three albums: *Bob Dylan*, *The Freewheelin' Bob Dylan*, and *The Times They Are a-Changin'*. Outtakes from all three are included. Among these are all the songs bumped from *Freewheelin'* between the time the rare test pressing leaked out and the official release date. Five songs recorded for *Times* but not used are here, as are three live recordings that were to have been on the scrapped *Bob Dylan in Concert* album, which got at least as far as cover slicks sent to stores to alert customers of the impending release.

Some of these early songs are as good as any on the albums. Among them are "Man on the Street" and "Only a Hobo" (both about the homeless), "Paths of Victory," "Walkin' Down the Line," and "Who Killed Davey Moore" (about a boxer who died in the ring during a title fight). The poem "Last Thoughts on Woody Guthrie," recorded at New York's Town Hall, is placed last on Vol. 1 and serves as an apt summary for that early segment.

The *Times* outtakes which open Vol. 2, "Seven Curses" and "Eternal Circle," signal a shift in Dylan's writing from issues and adapted folk songs to more personal concerns, even though "Seven Curses" is another reworked traditional, whose examination of corrupted justice links it to "Percy's Song" from *Biograph*. "Eternal Circle" is an anecdote about a lovely girl in the audience, apparently enraptured with the singer, who disappears with the end of the song. Other key selections on Vol. 2 are from the *Bringing It All Back Home* sessions, including outtakes of "Mama You've Been on My Mind" and "Farewell Angelina." (Many thought Dylan never recorded the latter, which was only rediscovered as this set was being compiled.) There's "She's Your Lover Now," a deliciously complex narrative of a triangle originally intended for *Blonde on Blonde* (the track falls apart going into the last verse, but the unsung lyrics are generously provided in the annotation), "Wallflower," and versions of "Tangled up in Blue" and "Idiot Wind" scrapped from *Blood on the Tracks* after Dylan suddenly decided (days before release date) that they lacked energy. These original takes, with some very different lyrics, are softer and more wistful than the electrically charged, rerecorded versions that made it onto the album. Another *Blood* outtake, "Call Letter Blues," is included here, and it is clear why this one was not issued. Although its bluesy feel wouldn't have fit, it is a

Photographs: ©David Gahr



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Joni Mitchell's lyrics have returned to a form of confessional narrative that has always been her strength.

very good song that I had never heard of before.

Volume 3 begins with yet another *Blood* song that Bob recut, the very sad and ironic "If You See Her, Say Hello." There are two *Desire* outtakes in "Golden Loom" and the baseball song "Catfish" (about the pitcher Catfish Hunter). Also here is a scorching live take of "Seven Days," a song that Rolling Stone Ron Wood once did on a solo album. There are outtakes from the sessions of *Slow Train Coming*, *Shot of Love*, and *Infidels*. Best of these are the lengthy "Angelina," "Foot of Pride," and especially "Blind Willie McTell," a dark-hued paean to the great blues singer. The set's finale, "Series of Dreams," was left off the Daniel Lanois-produced *Oh Mercy* album, much to Lanois' consternation. Full of storm and ache, it is a good closer for this collection, as it does seem to reflect Dylan over the long haul.

Sprinkled throughout are publisher demos, test runs, and works in progress. Most notable among these are curious piano demos of "When the Ship Comes In," "The Times They Are a-Changin'," and a stab at "Like a Rolling Stone" in ¾ time. There is a solo acoustic run-through of "Subterranean Homesick Blues," in which you can feel Dylan coming to grips with how all those convoluted words feel coming out of his throat, and a fascinating broken take of "I'll Keep It with Mine," in which you can hear the arrangement fall into place as Dylan's singing and piano playing gradually get more and more confident. The original demo of "I Shall Be Released" features the sad falsetto voice of the late Richard Manuel, who later sang it on The Band's *Music from Big Pink*. There is a charming alternate take of "If Not for You" (with the song's co-writer, George Harrison, singing and playing along), a gorgeous demo of *Shot of Love*'s "Every Grain of Sand" (with Jennifer Warnes singing harmony and dogs barking in the background), and lots more.

British Dylan scholar John Bauldie wrote the accompanying 68-page booklet's excellent opening essay and song-by-song notes. Taken together with the music, Bauldie's notes do a lot to help put the greater arc of Dylan's life work into perspective, with a focus that the original albums and nonchronological sequencing of *Biograph* did not have. I expect Bauldie will garner at least a Grammy nomination next year for his work here, it is that good. The photos, too, are wonderful, but I wish that Columbia had avoided double-page spreads across the square-back perfect binding, as a lot gets lost in the gutter.

Obviously, *The Bootleg Series* is not the place for a neophyte to get introduced to Bob Dylan. Appreciation of this collection is much enhanced by some familiarity with his work, and there is so much illumination to be found in these songs that I couldn't recommend it any more highly.

The sound quality throughout is astonishingly good, even on the dodgiest of demos, especially considering how miserable many of the bootlegs of this material have sounded over the years. Well-earned kudos to producer and compiler Jeff Rosen and engineers Mark Wilder, Tim Geelan, Jim Ball, and Josh Abbey.

There are still hours and hours of unreleased Dylan recordings in the can, and future *Bootleg Series* releases should be a whole lot of fun.

Michael Tearson

Night Ride Home: Joni Mitchell
Geffen GEFD-24302, CD; AAD; 51:44.

Sound: A–　　Performance: A–

Straight from the top, *Night Ride Home* sounds more like a Joni Mitchell album than anything she has done in a decade or more. There is a continuity of sound here, as the scattershot world beat of *Chalk Marks in a Rain Storm* has been left behind for now.

The musical vocabulary resembles Joni's *Hejira* album more than any other, with spare arrangements that, save for the piano-based finale "Two Grey Rooms," are built upon her acoustic guitar and the swooping sustained bass sounds of co-producer (and husband) Larry Klein. Vinnie Colaiuta and Alex Acuña supply drums and percussion, respectively. Very smooth production is a hallmark.

Though there aren't as many cameos as on Joni's recent albums, there are some notable ones in Wayne Shorter's late-night sax sound on two songs and guest vocal appearances by David Baerwald, Brenda Russell, and Karen Peris of The Innocence Mission. The opener, "Night Ride Home," features cricket sounds as a rhythmic base, which, according to your taste, may be annoying or clever.

The songs feel like a return to the confessional narrative form which has always been Joni's greatest strength as a lyricist. But there is a valid question as to whether these songs are fact, fiction, or some mixture of the two. Surely the reminiscences of "Come in from the Cold" and "Ray's Dad's Cadillac" have some basis in a Saskatchewan upbringing, but a song about an abused child, "Cherokee Louise," may or may not be based on fact. However, it doesn't really matter either way, as its story rings vivid and true. "The Only Joy in Town," about a "Botticelli black boy" encountered on an otherwise dreary holiday, is oddly reminiscent in subject matter of "Carey" from *Blue*, but this is a darker, more adult vision.

Night Ride Home is not a very joyous cycle of songs. There is a whole lot of ruefulness here, most particularly in "Two Grey Rooms." But this is the most artistically satisfying set of Joni Mitchell songs in far too long.

Joni's recordings from the '70s included the youthfulness of *Ladies of the Canyon* and *Blue*, giving way to the sparkle of *Court and Spark*, which in turn gave way to the jazzy musings of *The Hissing of Summer Lawns* and *Hejira*, the Third World rhythms of *Don Juan's Reckless Daughter*, and a whole lot of experimentation through

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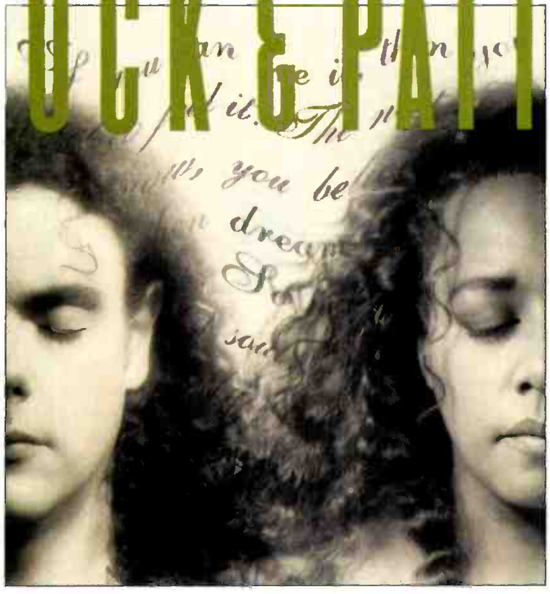

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In *Love Is a Strange Hotel*, Gregson & Collister cover a collection of songs from 10cc to Hank Williams, and do it with winsome charm.

the '80s. *Night Ride Home* seems like a reexamination of the elements which have served her art best, and which she has chosen to concentrate on as her foundation here. As restless a spirit as Joni has always been, I don't expect her to remain in this place long. Nevertheless, this album really is what its title might suggest—a kind of dark homecoming. *Michael Tearson*

Love Is a Strange Hotel: Gregson & Collister. **RNA R21S 70961.**

This is an album of covers, a dozen of them. Clive Gregson and Christine Collister, best known for their work with Richard Thompson, serve up 12 of their favorites from sources as diverse as 10cc, Aztec Camera, Hank Williams, Jackson Browne, Merle Haggard, Bruce Springsteen, Joni Mitchell, and Paul Carrack. Clive and Christine play the instruments, sing, and produce this intimate, mostly acoustic set, and they do it with winsome charm.
Michael Tearson

In and Out of Focus (I.R.S. X2-13059), **Moving Waves** (I.R.S. X2-13060), and **Focus III** (I.R.S. X2-13061).

One of the early Eurofusion outfits was the Dutch band Focus, whose long out-of-print catalog has been re-released on CD by I.R.S. The group featured vocalist/flautist Thijs Van Leer and guitarist Jan Akkerman. While 1972's *Moving Waves* yielded the hit "Hocus Pocus," 1973's *Focus III* comes closest to a modern fusion sound. Original producer Mike Vernon oversaw the remastering and has managed to preserve this band's dynamism with crystal clarity.
Michael Wright

Fotheringay. Hannibal HNCD 4426.

One album was completed by Fotheringay, the band formed by the late Sandy Denny after she left Fairport Convention. Hannibal's reissue sounds really lovely and warm on CD. The songs are excellent, most of them written by Denny and her husband, Trevor Lucas, and the band plays them splendidly. For the reissue, two previously unissued songs have been added: Dave Cousins' "Two Weeks Last Summer" and the traditional "Gypsy Davy." These extras make the release especially appealing. *Michael Tearson*

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HISTRI-SONICS

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Metamorphosis: World Saxophone Quartet and African Drums
Elektra/Nonesuch 79258-2, CD; ADD; 61:56.

Sound: A –	Performance: A –

The World Saxophone Quartet has become an institution in its 15 years together. The jazz equivalent of a string quartet, they play music of classic jazz composers, such as Ellington, along with their own wide-ranging compositions. *Metamorphosis* breaks the formula, adding African percussion and even some electric bass.

WSQ has worked with percussion since the early 1980s, when performing with Max Roach's percussion ensemble, M'Boom. But *Metamorphosis* culminates a relationship with three Senegalese drummers that began at New Music America 1989. That performance was notable for the energetic playing of the quartet, finally relieved from having to account for their own rhythm.

That same energy can be heard on *Metamorphosis*. Rather than tying WSQ down to its cadence, the percussion allows the members even freer rein. The wild interchanges and circling blowing patterns of the opening cut, "The Holy Men," presage much of *Metamorphosis*, but WSQ never leaves its roots far behind. Tenor David Murray's languid "Ballad for the Black Man" recalls the voicings of Ellington. Altoist Oliver Lake's "Africa" is a relentless Afro-Cuban trance piece that would've made Chano Pozo ecstatic. Hamiett Bluiett's baritone saxophone maintains the ostinato bass line, tying into the percussion section while Lake and altoist Arthur Blythe engage each other.

This is the first WSQ disc in which Blythe replaces founding member Julius Hemphill, and there's a net loss of zero in the exchange. Blythe is a more exuberant player, marked by his signature wail into the upper register on his solos. The album takes its name from his previously recorded composition, written before he was discovered by the big labels.

WSQ has always epitomized the interaction of jazz, from intricate arrangements one moment to free interplay the next, and it's in the latter that *Metamorphosis* comes up a notch short of brilliant. The percussionists rarely interact with the horn players and, in fact, after establishing the intermeshed rhythms, hardly interact with each other beyond the plan. Even when they have percussion breaks in Bluiett's "Feed the People," they stick tight to the established grooves. In addition, Melvin Gibbs' electric bass lines on three pieces sound like afterthoughts.

Yet the drive given WSQ is invigorating to hear and, obviously, to play over. David Murray in particular seems to be delirious as he reels through the rhythms. *Metamorphosis* is another of WSQ's joyous recordings, an indication that some institutions do grow and evolve.

John Diliberto

The Dreamtime: Foday Musa Suso
CMP CD 3001, CD; AAD; 68:26.

Sound: B –	Performance: B +

Sufi Music of Turkey: Kudsi Erguner and Suleyman Erguner
CMP CD 3005, CD; DDD; 66:40.

Sound: A	Performance: A

Shobha Gurtu
CMP CD 3004, CD; DDD; 58:32.

Sound: A	Performance: B +

Gamelan Batel Wayang Ramayana: Kusama Sari
CMP CD 3003, CD; DDD; 69:02.

Sound: A	Performance: A

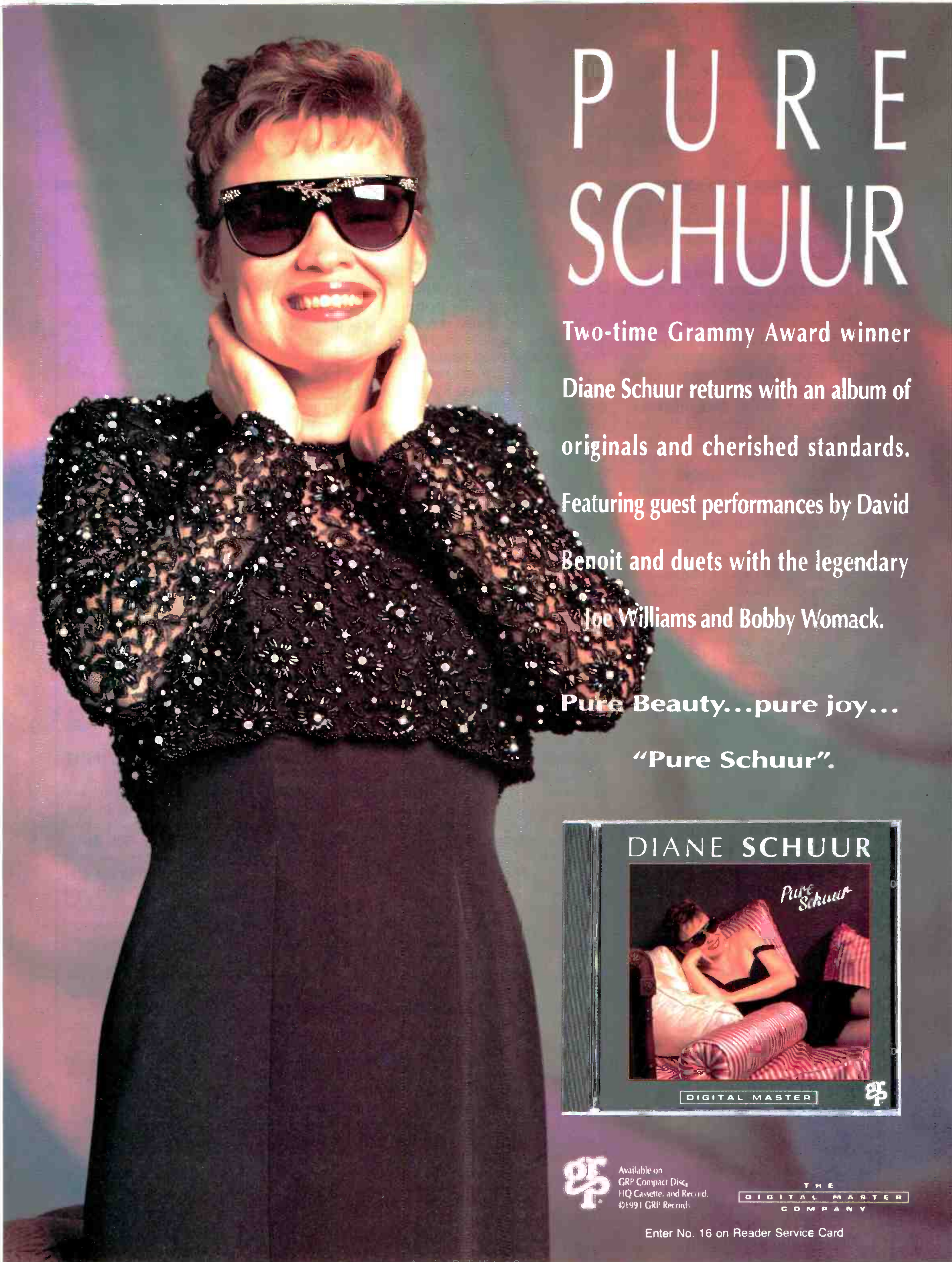
Record of Changes: SamulNori
CMP CD 3002, CD; AAD; 39:03.

Sound: A	Performance: A +

World Music is the buzzword, but for most people that means world beat: Dance music from Africa, Brazil, and the Caribbean. Yet to those who grew up on the Nonesuch *Explorer Series* of the 1960s and 1970s, world music is the ancient traditions of music refined over centuries, homing in on the beat of the spirit and the pulses of the mind rather than the groove of the dance floor and the thump of electronic drum machines.

CMP Records subscribes to the former idea of world music, as shown in a series of new CDs from Bali, Africa, India, Turkey, and Korea appropriately called the *World Music Series*. Taken in terms of world music, it's an all-star collection.

Probably the best-known artist here is Foday Musa Suso, who plays an African version of the harp called the kora. Suso has appeared on records by The Mandingo Griot Society, Philip Glass, and Herbie Hancock. The kora is often used to accompany stories, and it usually supplies an ostinato plucked by the thumb. Suso maintains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World music is the ancient traditions of music refined over centuries, homing in on the beat of the spirit and the pulse of the mind.

that style on *The Dreamtime*, a series of cyclical compositions. When Suso is at his best, his melodies weave freely in and out of the ostinato groove. It's surprising how similar some of his ostinatos sound to synthesized sequences heard in some electronic music.

Occasionally, Suso's pieces become overly repetitious, full of "trance" tracks but with little development. Nevertheless, producer Bill Laswell keeps it interesting by having him overdub several other native instruments on each track, often creating subtle shadings with the talking drum or the nyanyery, a one-stringed violin. On several pieces Suso sings in his native tongue, curving his grainy soprano around the ostinatos. Laswell uses the studio to create a pleasing surface sheen. However, often he leans too heavily on technology, resulting in a harsh and brittle quality, and some coarse edits create sharp ambient dropouts at the ends of compositions.

Kudsi Erguner works in a modal music style with a certain amount of trance effect. He plays a Middle Eastern flute called the ney, and also a frame-drum, on *Sufi Music of Turkey*. Erguner was heard on Peter Gabriel's soundtrack for *The Last Temptation of Christ*, which was released by Geffen Records as *Passion*, as well as on a follow-up recording called *Passion Sources* (Real World/Virgin). Together with his younger brother Suleyman (who is also a master of the ney), he spins seductive, sinuous melodies in long duets. The ney is more flexible than the Western flute, allowing subtle microtonal slides that coil like smoke. Recorded with each instrument panned hard left or right, the lines drift back and forth as one brother picks up the melody from the other.

Shobha Gurtu works the same sort of elegant flow of long, swirling lines, only with the voice. She's the mother of the highly regarded Indian percussionist Trilok Gurtu of Oregon (the group, not the state) and The John McLaughlin Trio. Indian singing is an acquired taste, as it doesn't share our standards of vocal beauty. Many of India's most renowned singers, such as Pandit Pranath, have raw, coarse voices for instruments. It's the feel, the technique, and the expression and invention of melodic lines that are important. Gurtu's singing isn't quite that harsh, but for Westerners whose only experience with Indian vocalists might be Najma, her natural grit can be unsettling.

On the percussion side, CMP has journeyed to Bali and Korea. Balinese gamelan music has gotten a lot of play over the years. In fact, its instruments have become stock sounds in many digital samplers and synthesizers. A gamelan isn't an instrument but rather an orchestra composed of different metallophones and gongs—and, in this case, a couple of drums and flutes. CMP's recording features the ensemble Kusuma Sari playing the *Gamelan Batel Wayang Ramayana*. The Ramayana is Bali's epic myth.

This is a remarkable, nearly encyclopedic work that personifies the dramatic expanse of gamelan music. Like most percussion music, it's cyclical, but the cycles change tempo, dynamics, and tunings at a rapid pace. They can accelerate to a clangorous charge of banging metal and decelerate to a quiet run accompanying a lone flute. The rhythms are startling in their intensity, sometimes swaying with the bass gongs in a ceremonial trance, then suddenly escalating to rapid-fire exchanges. This album was recorded on location in Sading, Bali, but you'd never know that it is a field recording except for a rooster crowing between movements.

Traditional percussion music of Korea is probably less well known, but SamulNori's recording might help to change that. This quartet of musicians playing various drums and gongs makes an orchestra of sound. SamulNori claims this music was recorded on a "tour of exorcism," and it sounds like it: The guttural growls of Lee Kwang Soo on "Kut" conjure up unwelcome spirits. Performing compositions based in shaman rituals, the musicians create dramatic, almost symphonic structures, playing off gongs and drums in rhythmic counterpoints. Damping and striking cymbals with an array of techniques form a range of envelope effects. In concert, SamulNori's players cavort and swirl with their instruments, but even on record, you can almost see their dance.

CMP has made a stunning effort to record this music faithfully while taking full advantage of the sonic capability of CDs and the sense of presence and space available from modern audio equipment. This isn't a Nonesuch/David Lewiston recording with an EV 635A microphone stuck out in a field somewhere. CMP producers Kurt Renker and Walter Quintas, as well as Bill Laswell (who produced both the SamulNori and Suso discs), are taking traditional music out of the archives and defining a living theatrical space for it. *John Diliberto*

Furthermore: Ralph Moore. **Landmark LCD-1526-2.**

Another solid, hard-hitting quartet-quintet record from this continually maturing saxophonist. The date balances the talents of youngsters such as trumpeter Roy Hargrove, pianist Benny Green, and bassist Peter Washington with drummers Kenny Washington and Victor Lewis. Original compositions by Moore, Green, and Hargrove complement "Monk's Dream" and "Girl Talk." *Jon W. Poses*

Rhythmstick: Various artists. **CTI 847 199-2.**

A very hip, though occasionally flawed, various-artist recording that features Tito Puente, Phil Woods, Randy Brecker, Bernard Purdie, Bob Berg, and many others. This disc marks producer Creed Taylor's return to the biz. Benny Golson leads, and Dizzy's not far behind on this acoustic-and-electric, Latin-filled be-bop and percussion potpourri. *Jon W. Poses*

Quintergy: Live at the Village Vanguard: J. J. Johnson. **Antilles 422-848214-2.**

A Live-at-the-Village Vanguard session that grows with each listening. Saxophonist Ralph Moore shares the date with the legendary trombonist, as does Victor Lewis. There is much J. J. Johnson material here including "Lament," "Coppin' the Bop," and "Doc Was Here." A nifty reading of "When the Saints . . ." opens, followed by Sonny Stitt's "Bud's Blues" and Wayne Shorter's "Nefertiti." *Jon W. Poses*

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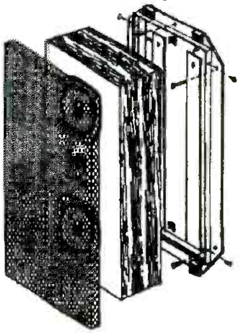

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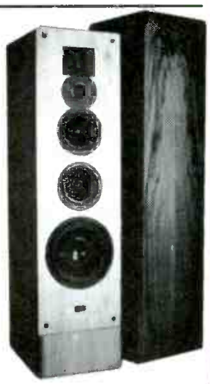

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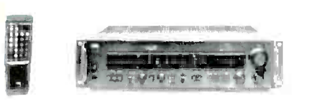

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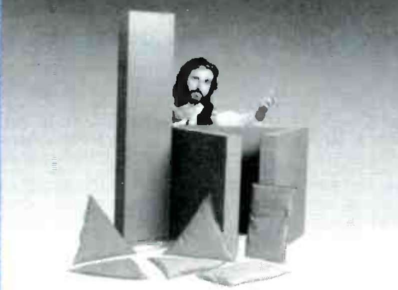

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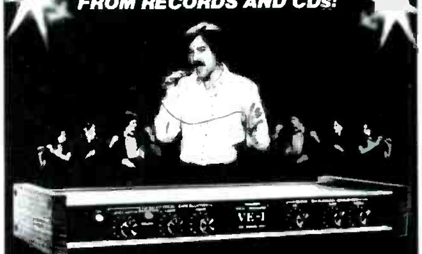

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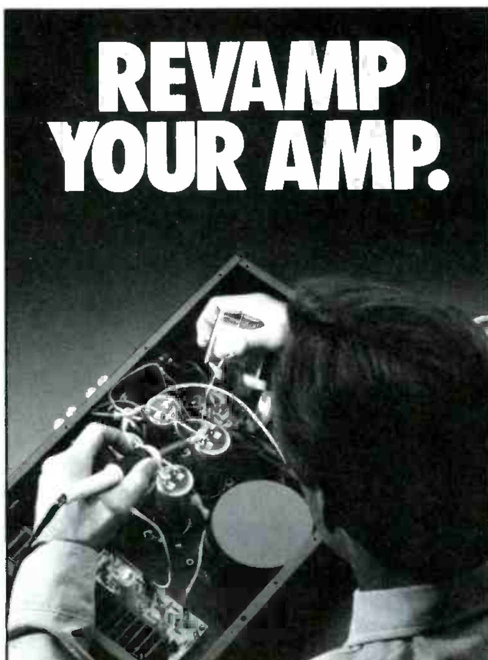

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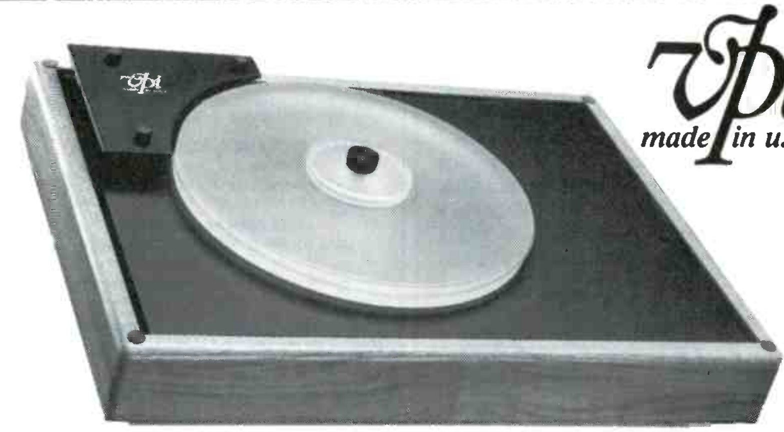

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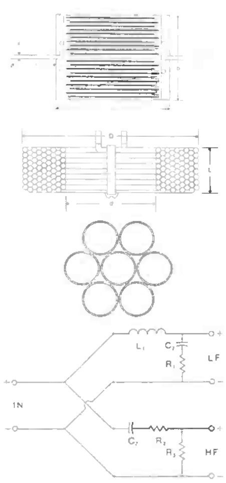

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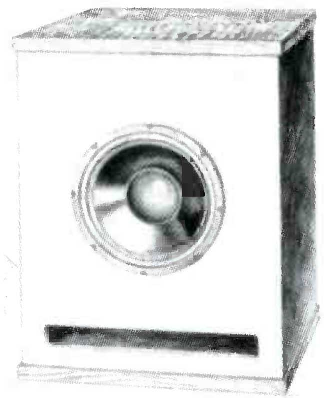

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