

Audio

UPDATE
ON R-DAT

JANUARY 1989 • US \$2.75 • UK £2.00

PHILIPS CD880 CD PLAYER

CLOSE TO TOTAL REALISM



HEARING LOSS
EARNING A DEAF EAR

TESTED
SUMIKO'S YBA, AMP
OUTRAGEOUSLY GOOD

YAMAHA CX-10000
PREAMP
FEATURES PLUS PERFORMANCE





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Compact Disc
we weren't about
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The CDP-707ESD:
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The STR-GX10ES:
The quality of separate components
in a fully integrated design.

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achieved in a dual-deck design.

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For more information on where you can audition the full line of Sony ES components, call 201-930-7156.

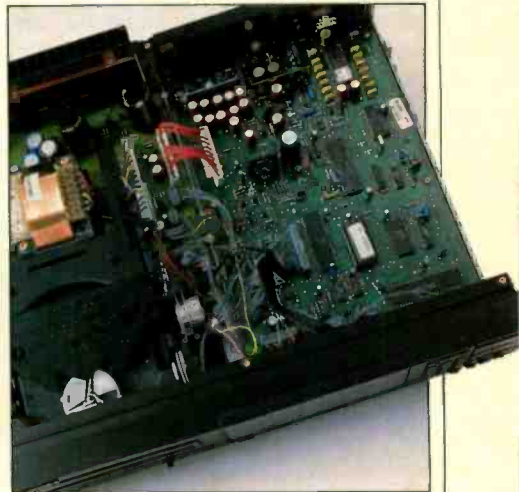


SONY

THE LEADER IN DIGITAL AUDIO™



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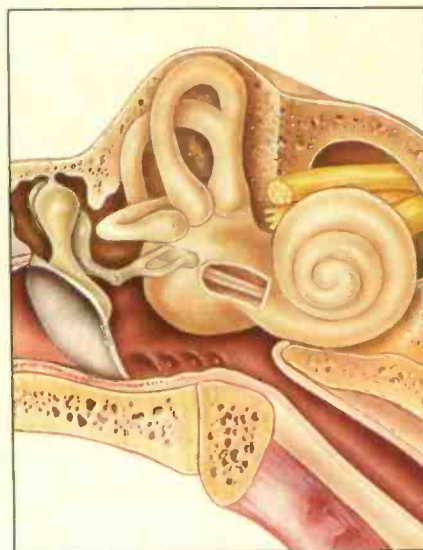
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THE SHAPE OF THINGS TO COME

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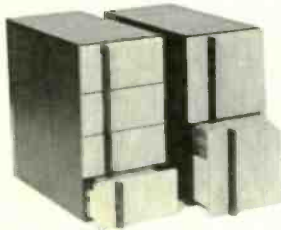
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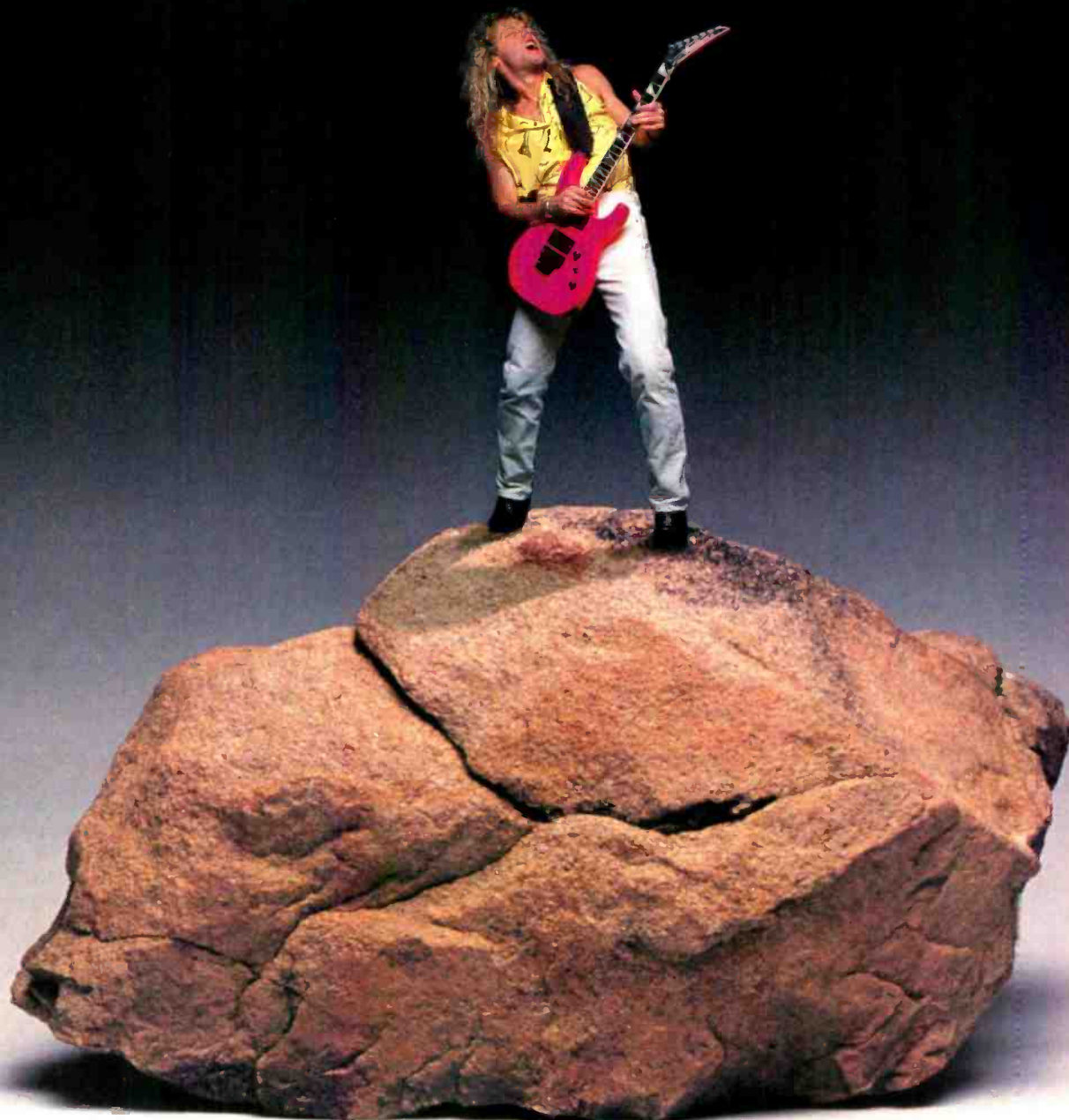
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Forcing the One-Point

Dear Editor:

I have read with interest Edward Tattall Canby's recent columns concerning stereo microphone techniques and Denon's so-called one-point approach using a pair of distant omnidirectional microphones spaced about a foot apart. I would like to make a few comments concerning the "Audio ETC" column in the August 1988 issue.

A common fallacy into which Mr. Canby falls is the assumption that inter-loudspeaker level differences translate into interaural level differences, and that inter-loudspeaker timing or phase differences manifest themselves as interaural time and phase differences. This is just *not* so, and, in fact, almost the reverse is true! The reason is basically because stereo reproduction is predicated upon the fact that each ear hears *both* loudspeakers, as opposed to binaural (i.e., headphone) reproduction, where each channel communicates with only one ear. It can be shown that, over the lower half of the audible spectrum, interchannel *level* differences produce interaural *time* differences which duplicate the dominant localization cues used in natural hearing, and so produce stable images between the loudspeakers. (Listening to two separated sources—loudspeakers—radiating highly correlated signals is quite unnatural, and it is not obvious, a priori, what signals should be fed to them to simulate the ear signals which occur naturally.) On the other hand, interchannel time differences produce quite unnatural interaural polarity differences and, consequently, vague and unstable imaging. The conclusion is inescapable: Coincident or quasi-coincident microphone techniques using *directional* microphones are essential if natural localization of the direct sound sources is to be achieved.

So why does Mr. Canby so dislike the coincident microphone recordings he has heard? The reason relates to the nature of their *reverberant* sound pickup. He is quite correct in pointing out that coincident *cardioid* microphone recordings reproduce the indirect sound pickup and reverberation in phase in the two channels. This results in all the reverberation appearing to originate from between the two loud-

speakers, producing a rather "closed in" sound lacking in spaciousness. But this is most decidedly *not* a feature of all coincident recording techniques; it is, rather, a consequence of the cardioid patterns chosen. The use of polar patterns with out-of-phase rear lobes avoids this problem while retaining stable imaging on the direct sound. Thus, coincident hypercardioids angled at 105° to 109°, or figure-of-eight microphones angled at 90° (the Blumlein configuration), produce a much more pleasant, open, and spacious sound. Indeed, the Blumlein arrangement is equally sensitive to sound energy pickup from *all* angles in the horizontal plane (just as with omnidirectional microphones). It also produces anti-phase signals for all sounds arriving from the side quadrants (e.g., reverberation). In my personal experience, I far prefer a Blumlein or coincident hypercardioid recording to one made with coincident cardioids.

If the recording venue is suitable for distant omnidirectional microphones, then a Blumlein arrangement will work well and provide superb imaging—both laterally and in depth—together with convincing, open-sounding, reverberant reproduction of the acoustic. A goodly proportion of the ambient "warmth" so praised by Mr. Canby in spaced-omni recordings is nothing but "phasiness" on the *direct* sounds due to the inter-microphone spacing. This is the reason for the anomalous imaging produced by such recordings. Stereo is a flawed medium, but until the Ambisonic surround-sound extension of Blumlein's ideas reaches the marketplace, we should try to capture both imaging and ambience. This, spaced-omni recording does *not* do. It is a pity to throw out the baby in order to preserve the bath water!

Stanley P. Lipshitz
Audio Research Group
University of Waterloo
Waterloo, Ont.
Canada

Pleased with Polk

Dear Editor:

I would like to submit Polk Audio for your *Audio Accolades*. In this so-called service economy, where the service is usually lacking, Polk came through twice. My first difficulty was an intermit-



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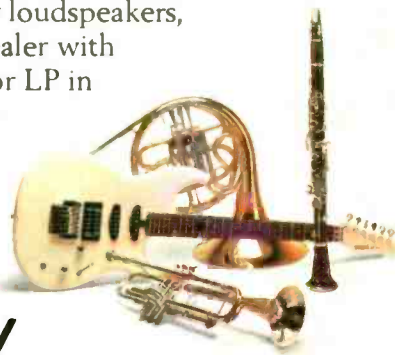
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Power Amplifiers



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A company providing good service should be thanked and patronized. Even if their prices are high, you may save money in the end.

tent problem with my car speakers. I couldn't find the receipt, so Polk willingly called the store to verify the purchase. I was also reluctant to send in my new speakers because of all the other things in the car that could be buzzing due to them. After so much satisfaction with my home models, I

also found it hard to believe that bad speakers could make it out of Polk's door. They encouraged me to send them in anyway, and I had new ones in less than two weeks.

Then one of my home units was stolen. As you know, Polk speakers are symmetrical sets, and my model was

discontinued. First they checked to make sure they didn't have the parts to build another unit. Then they provided me with documentation for the insurance company. Polk's personnel were courteous, prompt, and followed through on my requests.

These are things that it's nice to expect from any company but are difficult to get. I believe that any firm that provides good service should be acknowledged and patronized, even if the cost is slightly higher. In the long run, it may even save you money.

Name withheld

Profile Praise

Dear Editor:

I wish to compliment *Audio* on "An Informal History of Solid-State Amps" (June 1988). It is not often that readers get to see circuit topology discussed. Bravo!

Also, I was very happy to see the review of the Onkyo T-9090II tuner (July 1988). I was pleased that Leonard Feldman made an *adjacent-channel* selectivity measurement. I wish he could come up with some sort of cross-modulation immunity measurement—a step beyond spurious rejection. From my experience (two tuners), Onkyo has done some excellent work in designing r.f. front-ends having low distortion; they got rid of my cross-modulation problems.

Ronald J. Brey
Rockford, Ill.

Mats Made in Heaven

Dear Editor:

In response to Edward M. Long's fine review, "Mats & Clamps: By the Numbers" (April 1988), I wish to offer a few observations and recommendations.

Audio's continued coverage of record/playback hardware and accessories is most reassuring for those of us yet to be persuaded by the musical qualities of the Compact Disc format. The ascendancy of the CD has, however, released many thousands of LPs into the second-hand market—invigorating byproducts for the collector. Avid vinyl hounds can look forward to years of poring over record collections abandoned in favor of the shiny, anti-septic discs. Recently, I discovered a clean copy of Rachmaninoff's "Piano

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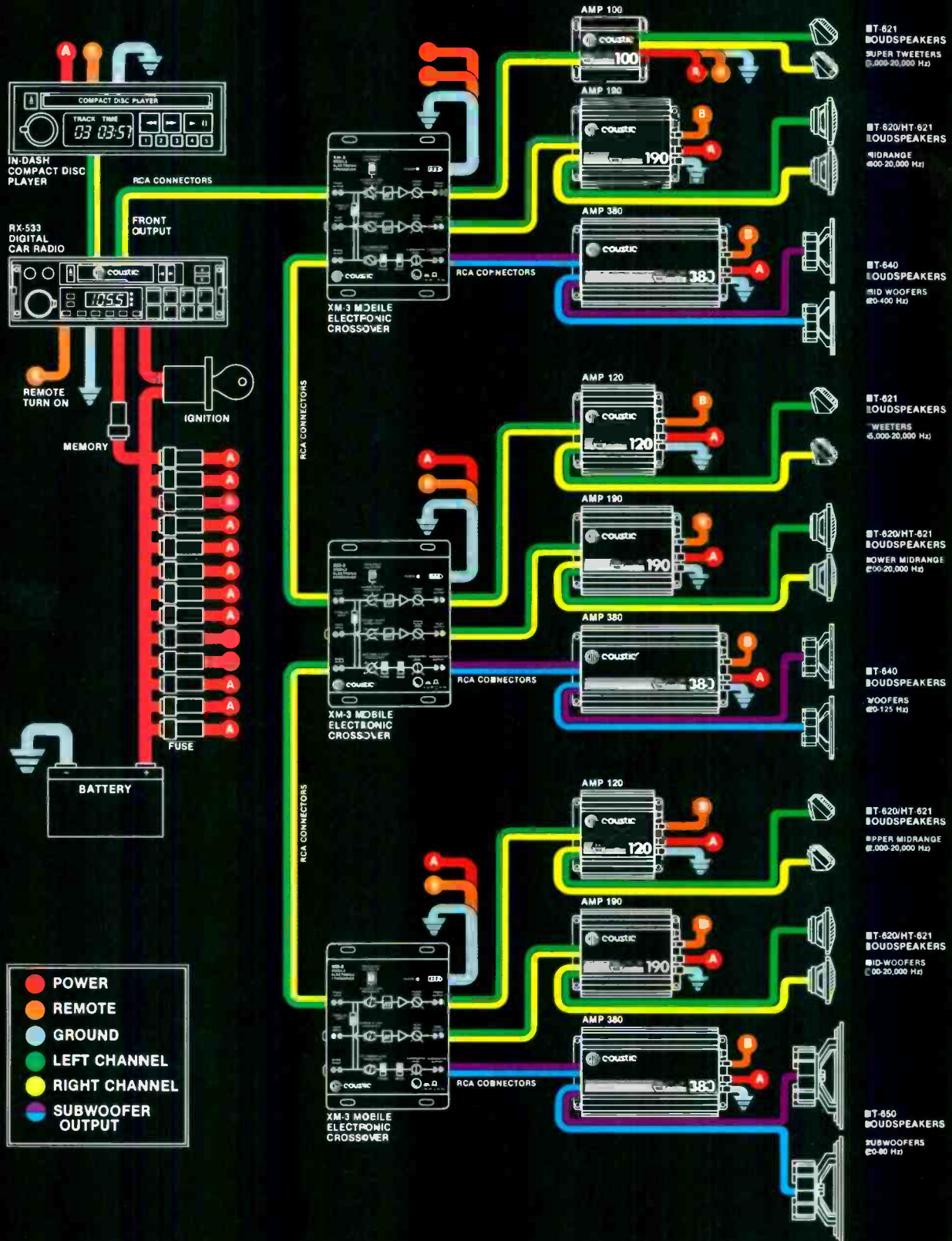


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The Speaker Specialists

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Where to buy Polk Speakers? For your nearest dealer, see page 30.

A new mat and clamp combo, plus a few adjustments, and I no longer had the nagging desire to upgrade to a dearer turntable.

Concerto No. 3" with Byron Janis—a Mercury Living Presence issue of some rarity—in a New York City shop not known for carrying classical titles. This deep-maroon, margin-control copy cost \$2.00!

Returning to clamps and mats: Two years or so ago, I purchased a Thor-

ens Model TD 321 turntable and had a Premier MMT tonearm mounted on it. This duo, combined with the venerable Grace F-9E Super cartridge, contributed a very politely neutral—almost proper—yet tuneful presentation. The elusive magic, however, was missing for me. With classical material espe-

cially, there was a sameness to all recordings. It was, in some cases, unacceptably difficult (for me, anyway) to differentiate between various orchestras playing an identical piece. After much experimentation, including the use of a dedicated wall stand (which helped considerably), I hit upon a mat and clamp combination not covered in Mr. Long's article. Thorens provides a thick rubber mat with their better players which, I'm convinced, masks the capabilities of a player much more closely approaching the fidelity of the Oracle/VPI/Linn/SOTA league than has been previously written about in hi-fi journals. To top it all off, the Thorens TD 321 costs less than half as much as those other turntables.

I placed Sumiko's acrylic mat and clamp combination atop a generic felt mat, the felt/acrylic sandwich approximating in thickness the discarded rubber mat. Only a small adjustment in tonearm height was required. Gloriously (I assume all other setup problems had been addressed properly), the right stuff emerged, particularly in the areas of dynamics, pace, and bass articulation. At last, I was free to concentrate on the changing textures on each record or the complexion of the music, and not the system's response: I also approximated Premier's internal damping in their more costly FT-3 arm by wrapping a few turns of fiber tape on the MMT. This can result in better focus and sound-stage stability, but this option is, I believe, cartridge-dependent. Thus, empirical trials are called for. Try a turn just back of the headshell and another just before the junction at the pillar. In my listening, this modification has helped delineate inner-groove choral material and similar tracking complexities. This added weight will also change the resonance frequency and the Q of the arm and cartridge, which in this case added to the tracking ability.

Perhaps the most welcome result of these exercises has been that I no longer have the nagging desire to upgrade to one of the dearer turntables mentioned above. I write in the hope that other Thorens owners will discover the hidden delights inherent in this mass-marketed design.

John Hallenborg
New York, N.Y.

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Tape-to-Deck Matching

Q. I recently purchased an Onkyo cassette deck with Accubias. The manufacturer recommends Maxell tape, but I previously was using TDK. Will Accubias correct for the differences between the two tape brands?—Ray Maken, Rochester, N.Y.

A. It is likely, but not certain, that your deck will perform best with the tape recommended by the manufacturer. If you use other tapes, Accubias should enable you to get good performance with them.

Lest there be any misunderstanding, let me add that Accubias can do nothing for you in playback. Bias is employed only in recording (to achieve low distortion and high recording level on the tape).

When playing your old tapes, which were recorded on another deck, there is the possibility of deficient treble response owing to a difference in azimuth between the head employed in recording and the head employed in playback. Your audio system's treble control—or better yet, a built-in or stand-alone equalizer—may be able to compensate fairly satisfactorily.

Gilding the Lily

Q. I have just purchased a Hi-Fi VCR without any built-in noise-reduction system. Would adding an external noise-reduction unit make any difference?—Stuart Cohen, Austin, Tex.

A. I doubt that a noise-reduction unit would produce significant audible benefit. All such units have some side effects, albeit usually unnoticeable. Risking these possible side effects in view of the minimal benefits does not appear worthwhile.

Those VCRs which contain noise reduction apply it to the linear (edge) audio track, which normally has an S/N ratio of something like 45 dB. With Dolby B NR, S/N rises beyond 50 dB. In contrast, the FM recording system of a Hi-Fi VCR achieves an S/N ratio of 80 dB or better.

Magnetic Field Effect

Q. Because of limited space, I am forced to use my speakers as "shelves" to hold my audio components. As a result, my cassette deck is directly on top of one of the speakers. Does the speaker's magnetic field af-

fect the quality of my cassettes in recording or playback? (The woofer is mounted very near the top of the speaker enclosure, and it has a very strong magnet which can distort a TV picture when the TV is positioned where I now have the cassette deck.) Can I shield the deck by placing it on a sheet of metal, or must I move it further away from the speaker, even though this is impractical for me?—Robert F. Zurn, White Bear Lake, Minn.

A. A pretty strong magnetic field is needed to cause significant erasure of a cassette tape, especially with Type II (ferricobalt or chromium dioxide) and even more so with Type IV (metal) tape. Ordinarily, the cassette has to be brought within 3 inches of the magnetic source in order for the recording to be affected.

I suggest that you experiment by recording a cassette and bringing it as close as possible to the speaker after you have completed a few minutes of recording. Then play the tape, preferably comparing it with the source—such as an album. Careful listening should allow you to ascertain whether there is any impairment.

If you believe that the speaker is affecting the tape, try using Styrofoam or some other material to raise the deck a few inches above the speaker. If you are stacking components, you might put another component between the speaker and the deck. This solution, however, raises the possibility that the deck's playback head will pick up hum from the transformer of the component on which it rests (a problem that occurs with some components and not others).

I doubt that ordinary metal will shield the cassette deck. Mumetal, if you can get hold of some, *might*, but this material is expensive. (*Editor's Note:* The last source we knew of was Magnetic Metals, 21st and Hayes Streets, Camden, N.J. 08105.—E.P.)

Signal Processing for the Recordist

Q. I tape on an open-reel deck and sometimes use an equalizer and a Dolby noise-reduction unit. Should I be doing so? On which sources should I use them and on which not?—George Maraudas, Upper Marlboro, Md.

A. If your open-reel deck is sufficiently quiet without Dolby NR, taking

into account the levels at which you customarily listen, you probably should not use any NR. If you feel that you need a significant improvement in S/N ratio, use of an NR device—Dolby or dbx—is indicated. In the case of Dolby NR, Dolby C is preferable to Dolby B, in order to achieve a greater reduction in tape system noise and to better avoid tape saturation in the treble range.

If you decide that your tape system isn't sufficiently noise-free, use NR with all sources. Of course, an encode-decode system (such as Dolby or dbx) will do nothing about noise already present in a signal source. A dynamic noise-reduction unit can help, more or less, in the case of noisy signal sources.

Preferably, EQ should be used mainly or entirely in playback. Using it in recording may risk distortion if you boost treble and/or bass substantially. However, some source material may demand EQ in recording, if you wish to obtain tapes that make for pleasurable listening when playback occurs on another audio system.

The equalizer is useful in compensating for deficiencies in either your audio system (for example, speakers which are bass-shy or shrill) or the program source. In the first case, you would leave the desired EQ on whenever reproducing tapes or other sources. In the second case, you would use EQ only as necessary. If system EQ is also needed, as in the first case, you would modify the system EQ as the program source required, and afterward return to the system EQ settings.

If you need the equalizer for recording as well as playback, it should be in the tape loop. Equalizers usually incorporate a switch so that, when thus situated, they can apply EQ either in recording or playing any source. If the equalizer is not intended for use in recording, a desirable location is between the preamp and the power amp (or in the case of receivers and integrated amps, between the preamp and power amp sections, if feasible).

If you have a problem or question on tape recording, write to Mr. Herman Burstein at AUDIO, 1515 Broadway, New York, N.Y. 10036. All letters are answered. Please enclose a stamped, self-addressed envelope.

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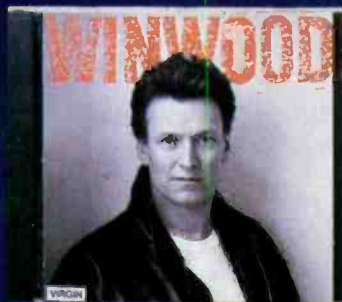
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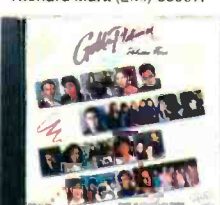
The Movies Go To The Opera—Various Artists. (Angel Studio) 372342



Robert Palmer—Heavy Nova (EMI) 370395

Elton John—Reg Strikes Back (MCA) 370536

INXS—Kick (Atlantic) 361519



Gold & Platinum Vol. IV—Various Artists
(Real Gone Music) 369413

Bob James—Ivory Coast
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UB40 (A&M) 372730

Brandon Marsalis—Random Abstract
(Columbia) 371849

Grover Washington, Jr.—Then and Now
(Columbia) 371476

Yehudi Menuhin—Handel: Orchestral Suites Royal Philharmonic Orch.
(MCA Classics/RPO) 371005

Spyro Gyra—Rites of Summer (MCA) 370767

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(Warner Bros.) 370643

Pat Benatar—Wide Awake In Dreamland
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Bob Dylan—Blonde On Blonde (Columbia) 369942

Jerry Lee Lewis—18 Original Sun Greatest Hits
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America—Greatest Hits
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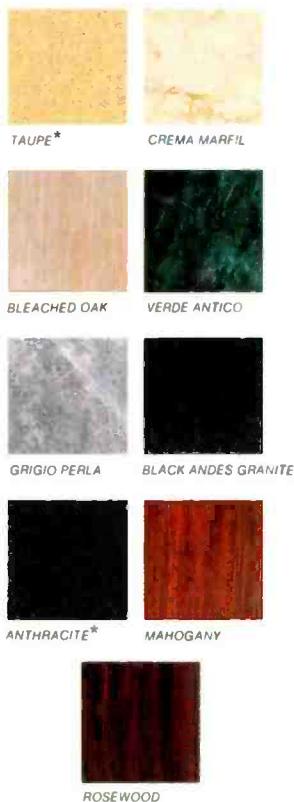
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One reason I prefer using a PCM processor is that the system can compensate for dropouts; a Hi-Fi VCR alone cannot.

Audio on Video Recorders

Reader Brent Jessee of Hoffman Estates, Illinois has a number of illuminating remarks on the subject of high-fidelity recording on a VCR:

I have been recording with a Hi-Fi VCR and a PCM processor for three years. The one serious drawback to

recording on a Hi-Fi VCR that you and Joseph Giovanelli failed to mention in the September 1988 issue is tape dropouts. Even the best grades of videotape have them. Deep dropouts can produce an audible tick or pop. Frequent use of a tape can increase the number of dropouts. While there

seems to be no method of dropout compensation with a Hi-Fi VCR, there is one in PCM. In the 14-bit EIAJ Standard, an error of up to 32 lines can be concealed—that is, TV horizontal lines, as this is a video-encoded PCM. Thirty-two lines is a big dropout!

Recording in a slow-speed mode with a Hi-Fi VCR aggravates the problem. Dropouts then pass the heads more slowly and wreak more havoc.

Recording with a PCM converter gives excellent error correction, the ability to make digital dubs directly, and, at least in Sony units, the ability to decode and encode at the same time. This last feature enables me to "bounce" tracks by decoding the digital signal, adding signal processing in the analog loop, and returning to another tape in the digital domain.

Use of a Hi-Fi VCR and PCM gives me four high-quality tracks: Two in analog form on Hi-Fi and two in digital form (via the PCM) on video. For two-track work, I can use the Hi-Fi analog tracks as a backup. This can be an asset, when recording live, if either the video or Hi-Fi heads clog. Then I have a much better chance of obtaining at least one good set of stereo tracks.

For Hi-Fi VCR and/or PCM recording, I suggest using only the fastest speed on the VCR and employing the very best grade of tape. When recording live, be aware that the very low noise floor of the Hi-Fi and PCM recordings can be marred by hiss from consumer-grade microphones and mixers. Stick with professional mikes, and buy the best you can afford.

In conclusion, both Hi-Fi VCR and PCM recording produce very good results. I prefer PCM, but because PCM processors are becoming harder to find, I hope DAT will soon become widely available.

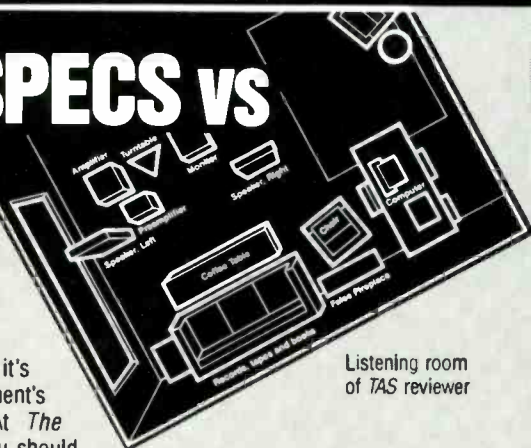
Automatic Bias Problem

Q. My cassette deck has a feature which, with the aid of internal test tones and a microprocessor, enables me to obtain optimum bias for whatever tape I use. This feature requires that I manually turn a knob until a red light appears, indicating that bias is correct. However, the knob setting is seldom the same, even though I use the same brand and kind of tape. Sometimes, the setting even varies on the same

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HIGH END INSIDER BULLETIN # 2

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Some audiophiles believe it's enough to know a component's technical specifications. At *The Absolute Sound*, we think you should know a little more—how it sounds. It's not that charts showing harmonic distortion or frequency response aren't revealing. But *specs don't say nearly enough about a component's individual sonic signature*. In the pages of *TAS*, you'll find reviewers who rely first on the most sensitive and time proven test-instrument—the human ear. They tell you what you'll *hear*, using an audio vocabulary we've developed for fifteen years. And since critical listening is a subjective art, we make sure you know their personal listening biases and the reference equipment they use. We even show you sketches of their rooms. So you see, High End audiophiles *do* believe in specs. But when you're after musical truth, the charts just look a little different.

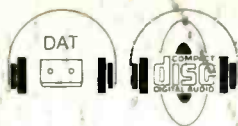
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Bias calibration in your tape deck can be affected by poor cassette shells, changing line voltage, or recorder malfunctions.

cassette. Is there a problem with my tapes or cassette deck?—Len Lochmiller, North Hollywood, Cal.

A. One explanation for why the bias setting changes is that varying voltage conditions in your location may cause the amount of bias at a given setting to change somewhat. Another explanation

is as follows: The decks that allow you to adjust bias to an optimum point operate on the principle of equating the response of a high-frequency tone, such as 10 kHz, with the response of a low-frequency tone, such as 300 or 400 Hz. Response of the high-frequency tone depends not only on bias but

also on azimuth; azimuth is correct when the head gap is exactly at right angles to the length of the tape. But there may be enough play in the cassette shell, or perhaps in the deck, to allow azimuth to change slightly, so that the best bias setting also changes. A third explanation is simply that something is wrong in your deck and requires servicing.

The real test is in what you hear. If, despite the varying optimum bias settings, the audible results are satisfactory, then this is what counts.

Double Noise Reduction

Q. My home tape deck has only Dolby B noise reduction. All my recorded tapes have been made on this machine with Dolby B NR. The audio system in my new car provides DNR (Dynamic Noise Reduction). Are Dolby B NR and DNR compatible?

Most new home decks have Dolby B and C as well as dbx NR. Which would be most compatible with the DNR in my car's audio system?—Harry Schwartz, Diamond Bar, Cal.

A. A fundamental rule in audio is that one should not tamper with the signal any more than is strictly necessary. While Dolby (either B or C) and dbx NR are not incompatible with DNR, it is inadvisable to use DNR unless you find that noise is excessive.

It is possible to use DNR together with Dolby B or C NR, because the DNR and Dolby systems work in totally different ways. With Dolby B NR, which only achieves signal-to-noise ratios in the range of 60 to 69 dB, it is possible that you would find system noise excessive when playing tapes at a loud level in a quiet home. Using DNR (if home decks had it) with Dolby B NR would reduce this noise. In the far less quiet environment of a moving car, I think it unlikely that using the two together would add to your enjoyment. However, there is no harm in trying.

With Dolby C NR, which achieves S/N ratios of 70 dB or more, it is quite unlikely that you would find tape noise excessive in a car, so use of DNR is all the more contraindicated. On the other hand, if you are playing a tape that contains a serious amount of noise—due to the program source or underrecording—DNR might then prove a valuable aid.

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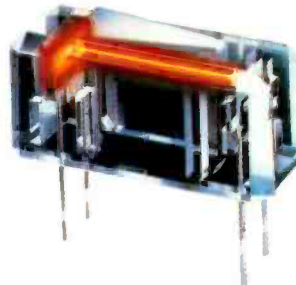
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Matching Power Amp Outputs to Loads

Q. You've written about this before, but I just can't seem to understand this business of not matching impedances between a loudspeaker and a power amplifier. Some amps can work with speakers having 2-ohm impedances.—Tony Mauldin, Lewisville, Tex.

A. Contrary to popular belief, the impedance of the loudspeaker never matches that of the power amp—certainly not in the case of solid-state amplifiers, at any rate.

A power amp does have an output impedance, usually of about 0.1 ohm. If we really wanted to obtain the highest possible power output from that amplifier, we would match impedance between it and the external load—in this case, the loudspeaker system. Remember: I am saying that this is so if, and only if, we are attempting to transfer the maximum power between the amplifier and its load.

The manufacturer knows that if a loudspeaker system with an impedance of 8 ohms is connected to the amp, the maximum power available to that loudspeaker will be, say, 100 watts. If the impedance of the loudspeaker system is 4 ohms, the maximum amount of power available will be somewhat greater. Several variables enter into the picture, but we'll say that the maximum power at 4 ohms is 150 to 200 watts.

The reason more power is available at 4 ohms than at 8 ohms is that the external load is a closer match to the output impedance of the amp. Okay so far? We have not disagreed with the idea of getting more and more power as the external load drops closer to our 0.1-ohm amplifier impedance.

Even though we have placed a load of 4 ohms on our hypothetical amplifier, the match is not perfect. We are still a long way from 0.1 ohm.

Power is calculated by multiplying the voltage by the current. Most amplifiers are designed to maintain the same voltage output capability within the normal range of speaker load impedances. But as we come closer to matching impedance between the amp and the load, the current taken from the output stage increases.

Output stages have some d.c. resistance, and current drawn through a

resistance is dissipated as heat. The more current drawn, the more heat, until the output transistors self-destruct. Somewhere between minimum recommended load and a true match of impedance between that load and the output stage, the stage will overheat and burn out.

The manufacturer knows from experience that his equipment can work safely into some given load, well above a true match between that load and the output stage. This is why this spec is included in the instruction manual. Some output stages can withstand more current than others, which is why some equipment is capable of working into 2 ohms or even lower impedances. However, for its own protection, no audio amplifier is built to work into a load whose impedance truly matches that of the amp's output stage.

Having a lower impedance than the speaker it drives also enables the amp to provide damping, and thus control the speaker's motion more precisely

Loudspeaker Destruction

Q. In my car I have two 10-inch subwoofers. These "subs" were made as complete enclosures. The bass, however, wasn't clean! I had what I thought was a brainstorm: Take the subwoofers out of the boxes they were in and have them installed on the rear deck. Well I wrecked the "subs" the second I hit them with "real" bass.

Why do some speakers require an acoustic-suspension box while others don't? Some even have boxes with ports in them.—Michael Van Kampen, Frankfort, Ill.

A. How a subwoofer is to be enclosed depends both on its free-air cone resonance and the stiffness of the cone's suspension. In the short space in this column, I can't give you complete guidelines on how to use this information properly. However, here are a couple of examples to help you understand what is happening:

If the cone has low mass, its free-air resonance is around 30 Hz, and it is free to travel a considerable distance, then it should be mounted in a relatively small space. In this case, the enclosure should be rather well sealed against air leaks. When the cone attempts to move, air pressure builds up behind the cone, restraining it. You

could think of the air as acting as a pneumatic spring. If the cone is not restrained in this way, it would travel beyond its design limits and its voice-coil would be destroyed when it struck the pole piece. This is what happened when you removed your drivers from their enclosures and placed them on the rear deck. The trunk was a large enclosure, and insufficient back pressure was available to restrain the cone's motion.

If the driver has a rather high resonant frequency (say, 60 Hz), a high physical mass, and is not free to travel a great distance, it will operate best when mounted in a large enclosure. Ports might even be helpful in such a situation. (These ports can be tuned to reduce the audible effect of the cone's resonant frequency.) On the other hand, by mounting this driver in a small enclosure, the back air pressure developed will raise the resonant frequency and reduce overall cone movement, resulting in poor sound.

Comparing Frequency Response

Q. Assuming all factors to be the same, what is the difference between subwoofer A, with a frequency response of 19 to 100 Hz (1.5 dB) and subwoofer B, with a frequency response of 19 to 100 Hz (4 dB)? Do these differences mean that if a subwoofer is played loud, it will not be able to reach down to 19 Hz? If subwoofer B is played lower than 4 dB, will it be capable of reproducing 19 Hz? Which subwoofer will be able to reach down to 19 Hz, whether I am playing my system soft or loud?—Senen A. Silvestre, Cypress, Cal.

A. The dB figures specified in connection with these subwoofers' frequency response have nothing to do with the loudness at which these units deliver their rated frequency range. Instead, they describe how far response varies from flat.

The specifications given in your letter omit the arithmetic signs which usually accompany these dB figures. For instance, if subwoofer A were rated "19 to 100 Hz, ±1.5 dB," its response

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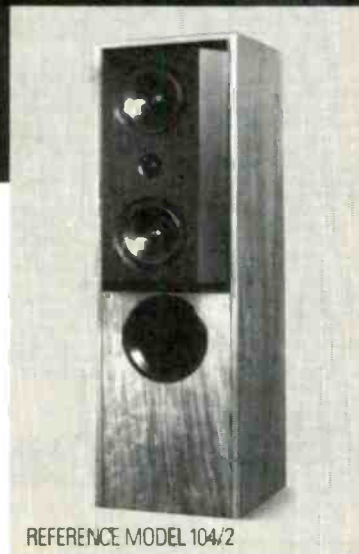
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would theoretically vary no more than 1.5 dB up or down over its entire rated frequency range. If it were rated "19 to 100 Hz, -1.5 dB," its response at its highest and lowest rated frequencies would be 1.5 dB below its response at some frequency in the middle of its range. One would have no way of

judging how much, if at all, its response might rise at other frequencies.

In any case, subwoofer A, with 15 dB of variation, would appear to be much flatter than subwoofer B, with 4 dB. However, A's manufacturer could have used " ± 1.5 dB," which implies a total variation of 3 dB, when his speak-

er actually measured "+0, -3 dB"—that is, flat over most of its range but 3 dB down at its end points. If subwoofer B's response was listed as "-4 dB," there would actually be little difference between them, as far as specs are concerned.

Remember that specs are not the whole story. Use them to narrow your choice, but make your decision based on what your ears tell you.

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DE Wilmington: Bryn Mawr Stereo
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GA Athens: Hi Fi Buys • Atlanta & Suburbs: Hi Fi Buys • Augusta: Stereo City • Brunswick: H&H Service Store • Columbus • Merit TV Meacon • Georgia Music • Savannah: Audio Warehouse • Valdosta: Stereo Connection
HI Honolulu: Honolulu Audio Video
IL Danverport: Gregg's Music • Des Moines: Audio Labs • Dodge City: Sound World • Dubuque: Reners Iowa City: Hawkeye Audio • Mason City: Sound World • Waterloo: Team ID Belser: Stereo Shoppe • Sandpoint: Electracraft
IN Twin Falls: Audio Warehouse
IL Alton: Reliable Stereo • Aurora: Stereo Systems • Carbondale: Southern Stereo • Champaign: Good Vibes • Chicago & Suburbs: United Audio • Decatur: J.R. Lloyd's • Dekalb: Audio Plus • Highland Park: Columbia • Joliet: Stereo Systems • Kankakee: Barrett's Entertainment • Lansing: Audio Clinic • Naperville: Stereo Systems • Normal: Sundown One • Peoria: Team Electronics • Rockford: Columbia • Springfield: Sundown One • Spring Valley: Audio Labs • Vernon Hills: Alan's • Waukegan: Alan's
IN Bloomington: Campus Audio • Bluffton: Eley TV & Appliance • Evansville: Riskey's • Ft. Wayne: Classic Stereo • Indianapolis: Ovaton • Lafayette: Good Vibes • Marion: Classic Stereo • Michigan City: Audio Connection • Muncie: Classic Stereo • South Bend: Classic Stereo • Terre Haute: Stereo Crafters

KS Junction City: Audio Junction • Overland Park: Audio Electronics • Wichita: Audio Visions • Topeka: Nelson's
KY Bowling Green: Audio Center • Lexington: Ovaton Audio • Louisville: Audio Video Buy Design • Owensboro, Paducah: Riskey's • Pikeville: Mayo Inc.
LA Lafayette: Sound Electronics • Metairie & New Orleans: Allerman Audio • Opelousas: Sound Electronics
MA Boston: Waltham Camera & Stereo • Fitchburg: Fitchburg Music • N. Dartmouth: Sound II • Pittsfield: H.B.S. Stereo • Worcester: O'Connors
ME Bangor: Sound Source • Camden: Harbor Audio • Portland: New England Music
MD Annapolis: Spaceways • Baltimore: Soundscape • College Park: Spaceways • Gaithersburg: Audio Buys
MI Ann Arbor: Absolute Sound, Hi Fi Buys • Birmingham: Almas Hi Fi • Dearborn: Almas Hi Fi • Farmington Hills: Almas Hi Fi • Flint: Stereo Center • Grand Rapids: Classic Stereo • Kalamazoo: Classic Stereo • Lansing/Midland: Hi Fi Buys • Petoski: Kurtz Music • Royal Oak: Absolute Sound, Court St. Listening Room • Trowersville: Kurtz Music
MN Duluth: Mel's TV & Audio • Mankato: Audio King • Minneapolis & Suburbs: Audio King • Rochester: Audio King • St. Paul: Audio King
MO Cape Girardeau: Stereo One • Columbia: Johnston Audio • Rolla: End of the Rainbow • St. Louis: Sound Central
MS Hattisburg: McLeland TV • Jackson: Hoopers • Pascagoula: Empress
MT Billings: Video Sat & Sound Bozeman: Thrifty Ear • Great Falls: Rocky Mountain Hi Fi • Missoula: Aspen Sound
NC Boone: Hollins • Chapel Hill: Stereo Sound • Charlotte: Audio Video Systems Converter • Tri-City • Greensboro: Stereo Sound • Hendersonville: Pro Sound • Kinston: Stereo Concepts • Moorehead City: Anderson Audio • New Bern: Anderson Audio • Raleigh: Audio Buys Stereo • Rocky Mount: Microwave Audio • Wilmington: Atlantic Audio • Wilson: Modern Stereo • Winston-Salem: Stereo Sound
ND Bismarck: Pacific Sound • Fargo: Today Electronics
NE Kearney: Midwest Audio • Lincoln: Stereo West • Omaha: Stereo West • York: Midwest Audio
NH Concord: Audio of New England • Laconia: Lakeside Stereo • New London: North Star • Salem: Quomox
NJ East Brunswick: Atlantic Stereo • Maple Shade: Bryn Mawr Stereo • Montclair: Perdue Radio • Raritan: AC Audio • Ridgewood: Sounding Board • Shrewsbury: Mornmouth Stereo • Toms River: Rands Camera • Wall Twp.: Mornmouth Stereo • West Caldwell: Perdue Radio
NM Alamogordo: D&K Electronics • Albuquerque: West Coast Sound • Carlsbad: Beason's • Clovis: Towne Crier • Santa Fe: West Coast Sound
NV Las Vegas: Upper Ear
NY Albany: Clark Music • Batavia: Unicom Audio • Buffalo: Speaker Shop • Corning: Chemung • Elmira: Chemung • Fredonia: Studio One • Glens Falls: Audio Genesis • Goshen: Longplayer's Stereo • Ithaca: Chemung • Jamestown: Studio One • Manhasset: Audio Breakthroughs • Massena: Hi Fi Shop • Newburgh: Audio Expressions • New Hartford: Adirondack Music • New York City: Audio Breakthroughs • Electronic Workshop • Rochester: JB Sound • Seaside: Listening Room • Syracuse: Clark Music • Vestal: Hart Electronics • Woodbury: Audio Breakthroughs

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PUERTO RICO Rio Piedras: Precision Audio
RI N. Providence: Eastern Audio
SC Anderson: Music Machine • Charleston: Audio Warehouse • Columbia: Music Machine • Greenville: Mitchell's Stereo, Music Machine • Greenwood: Stereo Shop • Spartanburg: Stereo Shop
SD Aberdeen: Engel Music • Rapid City: Team Electronics • Sioux Falls: Audio King
TN Chattanooga: R&R TV • Cookeville: Lindsey Ward • Jackson: New Wave Electronics • Kingsport: Audition • Knoxville: Lindsey Ward • McMinnville: Lindsey Ward • Memphis: New Wave Electronics • Nashville: Hi Fi Buys
TX Amarillo: Sound Systems Ltd. • Arlington: Sound Idea • Austin: Marcum Electronics • College Station: Audio Video • Corpus Christi: Tape Town • Dallas: Hillcrest Hi Fidelity • El Paso: Soundquest • Ft. Worth: Sound Idea • Houston: Sheffield Audio • Hurst: Sound Idea • Laredo: Melex International • Longview: Audio Techniques • Lubbock: Electronics Supercenter • San Antonio: Bill Case Sound • San Marcos: Discovery Audio Video • Sherman: Worldwide Stereo • Temple: Audio Tech • Texarkana: Sound Towne • Waco: Audio Tech
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WY Cheyenne: Electronics Unlimited

Guitars and Hi-Fi Equipment

Q. I plug my electric guitar into my sound system. To obtain sufficient volume, I have to turn up the volume control much farther than for most other program sources. The guitar itself has no active circuitry, but occasionally I use an effects pedal, such as a distortion pedal. My guitar sounds much better through my high-fidelity system than it does when I play it through my guitar amp. Am I damaging my "good" speakers when I use the distortion pedal or straining my amp in any way?—Lester Gong, Oakland, Cal.

A. It is unusual to hear someone say that his guitar sounds better through a high-fidelity system than through an amplifier designed for that application. Guitar amps and their associated speakers are made to color the sound in ways which make an electric guitar sound like an electric guitar. A hi-fi system is designed, as far as possible, not to introduce coloration but to reproduce faithfully the sounds being fed into it.

The voltage produced by the pickups in your electric guitar is considerably lower than that which is produced by a tape recorder, CD player, or tuner. This lower voltage accounts for the fact that you must turn up the volume to produce acoustical power equal to that of your other program sources.

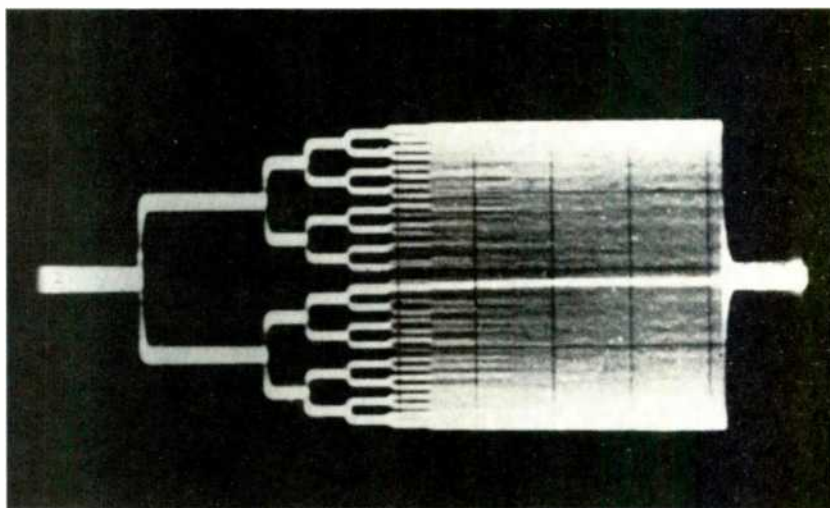
Whether your loudspeakers will be damaged depends on the amount of power the tweeters can handle; most speaker specs for power handling are for the system as a whole. The tweeter often cannot stand anything like the full power shown for the entire speaker system. Your effects pedal will cause your system to supply a larger than usual amount of power to the tweeter, a situation similar to adding a great deal of treble via your tone controls and an equalizer simultaneously. **A**

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WHY IT TAKES A 20-BIT CD PLAYER TO APPROACH TRUE 16-BIT LINEARITY.

If human ingenuity could build the perfect 16-bit digital-to-analog converter, there would be no need for Denon's new 20-bit approach to building CD Players. Unfortunately, 16-bit players have always been susceptible to distortion-inducing non-linearities and quantization errors. This means they can't maintain accurate spacing between all of the 65,536 amplitude levels available from the 16-bit samples of the Compact Disc.

Enter Denon's "Delta" system. It combines the world's first 20-bit 8x resampling digital filter with the first true 20-bit linear converters to process each 16-bit sample to four additional digits of accuracy. (That's something like using 3.141593 as the value of "pi" when everyone else uses 3.14.)



This oscilloscope trace confirms the even spacing of amplitude levels in Denon's 20-bit system.

This is no mere computational trick: Denon 20-bit CD Players literally extract more music from the Compact Disc. They exhibit better dynamic range, lower noise, and lower distortion during quiet passages. In the process, Denon 20-bit machines reveal more of the low-level detail that defines musical timbre. On well-recorded CDs, you'll hear more of what makes a french horn sound like a french horn.



DCD-3520 Compact Disc Player

There's more. Since the days of Denon's early digital recorders, we've understood that not all digital bits are created equal. The digital word's Most Significant Bit (MSB) contributes 32,768 times the amplitude of the Least Significant Bit (LSB).

That's why every Denon Compact Disc Player since 1983 has included the Super Linear Converter — a circuit we use to hand-adjust the MSB of every Player for superior accuracy. Recognizing the wisdom of Denon's approach, independent academic papers have now identified D/A conversion error in the MSB as the primary culprit behind audible distortion in Compact Disc Players.

With Super Linear Converters, the 20-bit "Delta" circuit, and Denon refinements in power supply, laser transport and chassis design, the new Denon DCD-3520 and DCD-1520 elevate digital playback to a new level of musicality. In the process, they achieve the closest approach yet to true 16-bit linearity.

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U2: Rattle & Hum • New live set includes the hit Desire. Still Haven't Found What I'm Looking For, more. Island 200596

Anita Baker: Rapture • Sweet Love, Caught Up In The Rapture, You Bring Me Joy, Been So Long, Mystery, more. Elektra 173404

Izhak Perlman: French Violin Showpieces • Carmen Fantasy, Tzigane, Poeme, Havanaise, more. DG DIGITAL 115457

Tracy Chapman • Extraordinary singer/songwriter with hit Fast Car, Talkin' Bout A Revolution, Baby Can I Hold You, Mountains O' Things, Why?, etc. Elektra 153582

Guns N' Roses: Appetite For Destruction Welcome To The Jungle, Sweet Child O' Mine, It's So Easy, more. Geffen 173048

Jerry Lee Lewis: Original Sun Greatest Hits • Whole Lotta Shakin' Goin On, Great Balls Of Fire, more. Rhino 154118

Kitaro: The Light Of The Spirit • Sundance, Mysterious Encounter, The Field, In The Beginning, etc. Geffen DIGITAL 164228

Richard Marx • Endless Summer Nights, Should've Known Better, Don't Mean Nothing, etc. EMI-Manhattan 134073

Jimmy Page: Outrider • Wasting My Time, The Only One, Prison Blues, more. Geffen 123721

Robert Plant: Now And Zen • Dance On My Own, Heaven Knows, Tall Cool One, Ship Of Fools, etc. Es Paranza 134392

Led Zeppelin: Houses Of The Holy Dyer Maker, Over The Hills And Far Away, etc. Atlantic 134321

George Harrison: Cloud Nine • Title song, I Got My Mind Set On You, When We Was Fab, more. Warner/Dark Horse 174328



Phil Collins: Buster 100517

James Taylor's Greatest Hits Warner Bros. 123790

Dire Straits: Brothers In Arms • Money For Nothing, Walk Of Life, So Far Away, more. Warner Bros. DIGITAL 114734

Pops In Space • John Williams & The Boston Pops. Music from Close Encounters, Star Wars, others. Philips DIGITAL 105392

Rod Stewart: Greatest Hits • Do Ya Think I'm Sexy?, Tonight's The Night, Maggie May, Hot Legs, etc. Warner Bros. 133779

Andres Segovia Plays Bach • Includes the famous Chaconne. MCA 163600

Poison: Open Up And Say...Ahh • Nothin' But A Good Time, Good Love, Fallen Angel, Love On The Rocks, etc. Capitol/Enigma 173989

Bobby McFerrin: Simple Pleasures Don't Worry Be Happy, All I Want, Drive My Car, Little song, Good Lovin', more. EMI-Manhattan 164165

Cream: Disraeli Gears • Sunshine Of Your Love, more. Polydor 104898

Simon & Garfunkel: The Concert In Central Park • Mrs. Robinson, Bridge Over Troubled Water, etc. Warner Bros. 244006

Alabama: Live RCA 160027

Previn: Gershwin • Rhapsody In Blue, Concerto in F, more. Philips DIGITAL 115437

Eagles Greatest Hits, Vol. 1 Asylum 123481

Keith Richards: Talk Is Cheap • Big Enough, How I Wish, Take It So Hard, Struggle, I Could Have Stood You Up, more. Virgin 100518



Steve Winwood: Roll With It 154633

Liz Story: Speechless • Forgiveness, Speechless, Welcome Home, Back Porch, Vigil, Frog Park, more. RCA/Novus 100494

Decade/Best Of Steely Dan MCA 154135

Beethoven, Symphony No. 7; Coriolan & Prometheus Overtures • Royal Philharmonic/Previn. RCA DIGITAL 153621

Jethro Tull: Aqualung Chrysalis 124705

Whitney Houston: Whitney • I Wanna Dance With Somebody (Who Loves Me), Didn't We Almost Have It All, more. Arista 152854

Metallica: ...And Justice For All • One, Blackened, title song, To Live Is To Die, Shortest Straw, more. Elektra 200478

Talking Heads: Naked • (Nothing But) Flowers, Mr. Jones, Totally Nude, Blind, The Democratic Circus, The Facts Of Life, etc. Fly/Sire DIGITAL 153810

David Sanborn: Close-Up • Lush jazz sax effort! Slam, You Are Everything, J.T., Goodbye, Same Girl, etc. Warner Bros. 134408

Dwight Yoakam: Buenas Noches From A Lonely Room • Title Song, Streets Of Bakersfield (with Buck Owens), more. Reprise 100009

The Best Of The Band Capitol 134485

Classic Old & Gold, Vol. 1 • 20 hits! A Little Bit Of Soul, He's So Fine, A Teenager In Love, Sweet Talkin' Guy, etc. Laurie 134627

INXS: Kick • Need You Tonight, Devil Inside, New Sensation, title song, Never Tear Us Apart, The Loved One, Wild Life, etc. Atlantic DIGITAL 153606

The Glenn Miller Orchestra: In The Digital Mood • In The Mood, Chattanooga Choo Choo, more. GRP DIGITAL 143293

Tangerine Dream: Phaedra 100510

Steve Winwood: Chronicles • Higher Love, Valerie, While You See A Chance, My Love's Leavin', Talking Back To The Night, more. Island 134501

Pictures At An Exhibition, Night On The Bare Mountain, more • Montreal Symphony/Dutoit. London DIGITAL 125314

Whitesnake • Here I Go Again, Still Of The Night, Give Me All Your Love, Crying In The Rain, Bad Boys, more. Geffen 163629

ZZ Top: Afterburner Warner Bros. 164042

Carly Simon: Greatest Hits Live Anticipation, You're So Vain, Coming Around Again, Nobody Does It Better, etc. Arista 154537

Huey Lewis: Small World • Perfect World, Walking With The Kid, World To Me, Better Be True, Old Antones, etc. Chrysalis 134347



Horowitz Plays Mozart 115436

Najee: Day By Day • Personality, title song, That's The Way Of The World, Tonight I'm Yours, Gina, Najee's Nasty Groove, etc. EMI-Manhattan 100001

Genesis: Invisible Touch • Land Of Confusion, title song, etc. Atlantic 153740

More Dirty Dancing • Do You Love Me, Love Man, Big Girls Don't Cry, Wipe Out, Some Kind Of Wonderful, Cry To Me, more. RCA 130766

The Who's Greatest Hits MCA 164160

Tchaikovsky, 1812 Overture; Romeo & Juliet; Nutcracker Suite • Chicago Symphony/Solti. London DIGITAL 125179

James Galway: Greatest Hits RCA 173233

The Moody Blues: Sur La Mer • I Know You're Out There Somewhere, No More Lies, Here Comes The Weekend, Vintage Wine, etc. Polydor 124546

The Beach Boys: Endless Summer California Girls, Help Me Rhonda, Surfer Girl, more. Capitol 223559

Cinderella: Long Cold Winter • Gypsy Road, Don't Know What You Got (Till It's Gone), The Last Mile, etc. Mercury 114780



Bon Jovi: New Jersey 100516

Strauss, Also sprach Zarathustra Chicago Symphony Orchestra/Reiner. RCA 163627

Charlie Parker & Dizzy Gillespie: Bird & Diz • Leap Frog, My Melancholy Baby, Mohawk, etc. Verve 173413

Robert Palmer: Heavy Nova • Simply Irresistible, Disturbing Behavior, She Makes My Day, More Than Ever, Change His Ways, etc. EMI-Manhattan 100035

The Very Best Of The Everly Brothers Bye Bye Love, Crying In The Rain, Bird Dog, others. Warner Bros. 103826

Kenny G: Silhouette • We've Saved The Best For Last, title song, Tradewinds, Pastel, Against Doctor's Orders, Let Go, more. Arista 100603

D.J. Jazzy Jeff & The Fresh Prince: He's The D.J., I'm The Rapper • Parents Just Don't Understand, Nightmare On My Street, etc. Jive 264134

Raffi: Singable Songs For The Very Young Shoreline 144494

Elton John: Reg Strikes Back • A Word In Spanish, I Don't Wanna Go On With You Like That, Goodbye Marlon Brando, Town Of Plenty, etc. MCA DIGITAL 100602

Elton John: Greatest Hits, Vol. 1 MCA 163322

Vivaldi, The Four Seasons • English Concert/Pinnock. Archiv DIGITAL 115356

Joe Cocker: Classics Contains 13 Hits! A&M 104887

Bruce Hornsby And The Range: Scenes From The Southside • The Valley Road and Jacob's Ladder, plus others. RCA 180187

Crosby, Stills, Nash & Young: Greatest Hits (So Far) • Suite: Judy Blue Eyes, etc. Atlantic 130230

New Age Bach: The Goldberg Variations Joel Spigelman plays the Kurzweil 250 Digital Keyboard. East-West 100488

John Cougar Mellencamp: The Lonesome Jubilee • Paper In Fire, Check It Out, Cherry Bomb, Rooty Toot Toot, etc. Mercury 134420

Elvis: 18 Number One Hits RCA 172190

Roby Cray: Don't Be Afraid Of The Dark Title song, Don't You Even Care, more. Mercury/Hightone 100471

Jimi Hendrix: Kiss The Sky • Purple Haze, All Along The Watchtower, Voodoo Child, Are You Experienced, etc. Reprise 161349

Parton/Ronstadt/Harris: Trio • To Know Him Is To Love Him, etc. Warner Bros. 114804

Chicago 19 • I Don't Wanna Live Without Your Love, Heart In Pieces, etc. Reprise 154404

Peter Cetera: One More Story • One Good Woman, more. Warner Bros. 100463

Buckwheat Zydeco: Taking It Home Why Does Love Got To Be So Sad? (with Eric Clapton), Creole Country, more. Island 100597

The Sound Of Music: Orig. Soundtrack RCA 100046



Randy Travis: Old 8x10 100008

The Police: Every Breath You Take—The Singles • Don't Stand So Close To Me (B6), Roxanne, etc. A&M 173924

Sting: Nothing Like The Sun • We'll Be Together, They Dance Alone, Be Still My Beating Heart, more. A&M 273965

Mozart, Overtures • Academy of St. Martin/Marriner. Marriage Of Figaro, 8 more, Angel DIGITAL 134267

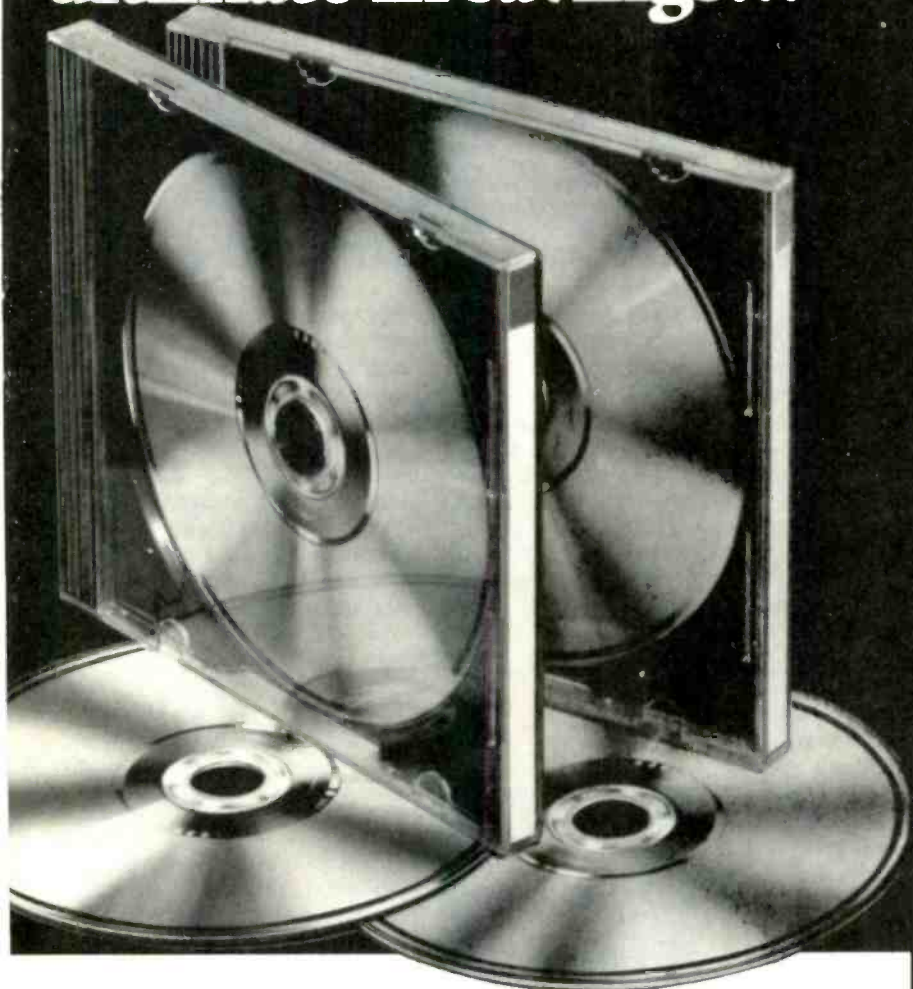
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Johnny Cash: **Classic Cash** • Folsom Prison Blues, Ring Of Fire, I Walk The Line, Get Rhythm, Cry, Cry, Cry, more. Mercury 100595

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Bang & Olufsen Turntable

The tangential-tracking arm of the Beogram 9000 turntable automatically senses the record size and adjusts playback speed accordingly. With the Beolink 1000 remote control, it can be moved in or out across the record in $\frac{3}{8}$ -inch increments, for quick location of favorite tracks or passages. All Bang & Olufsen Moving

Micro-Cross (MMC) cartridges plug directly into the low-mass arm. The turntable has a special control that allows its platter to rotate without lowering the arm, for easy record cleaning. Prices: Beogram 9000, \$450; Beolink 1000 remote control, \$175; MMC cartridges, \$70 to \$490. For literature, circle No. 100



Symphonic CD Changer

Up to 32 selections can be programmed from the six discs in the CD 3000's magazine. The unit uses 16-bit linear D/A conversion, at 44.1 kHz.

Included with the CD 3000 are a compact remote-control transmitter, one six-disc magazine, audio cables, and batteries for the remote. Price: \$225. For literature, circle No. 101



Technics Amplifier

In addition to inputs for all the usual analog sources (including MM and MC phono), the SU-V90D has both electrical and fiber-optic inputs for digital bit streams. Those digital signals are then fed to a converter section that uses four D/A chips (one each for the positive and

negative halves of each stereo channel's signal) and 18-bit, four-times oversampling digital filtration. The D/A section automatically switches to match input-signal sampling frequencies of 48, 44.1, or 32 kHz. Power output is 100 watts per channel. Price: \$1,300. For literature, circle No. 102



Jetset In-Flight Headphone System

Tired of stuffing plastic tubes in your ears when listening to music on airplanes? The Jetset

Airdaptor lets you use your favorite compact headphones, or the ones supplied. A pickup with small built-in microphones plugs into your seat's air-tube sockets, then feeds electronic signals to a compact amplifier which drives the headphones. To save batteries, the amplifier operates only when headphones are connected to its 3.5-mm stereo jack. When the unit is not in use, the pickup fits a socket in the amplifier and its cord wraps around the amplifier body, preventing tangles. The Airdaptor is made by Lotus Developments, and is sold in the U.S. by Executive Travelware. Price: \$19.95, plus \$3 shipping. For literature, circle No. 103

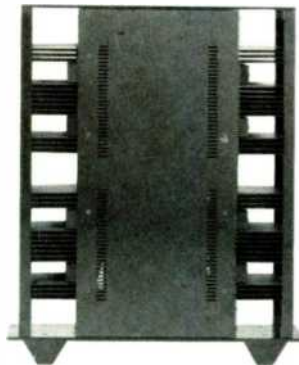
Music

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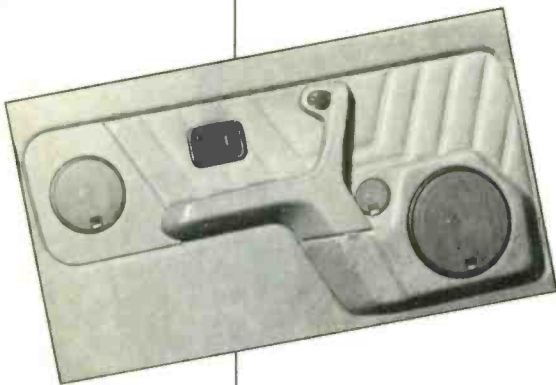
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Audio Design Associates A/V Switching System

Designed for centralized control of complex audio/video systems, ADA's IMC-85 Integrated Media Controller can route eight A/V inputs to any of eight outputs, and also can switch three r.f. sources to any of five r.f. outputs. The

audio circuits have S/N of 100 dB and frequency response from d.c. to 100 kHz, ± 0.25 dB. An option allows switching "S-format" video. The IMC-85 can be mounted in a standard 19-inch rack. Price: \$2,195. For literature, circle No. 104



MB Quart Speaker Panels

To ensure a factory-installed look, MB Quart now offers some of its car speaker systems pre-installed in replacement door and rear-deck panels. The panels are finished in the same leather as the cars they are designed to fit (various Mercedes-Benz,

BMW, and Porsche models so far), and the speaker grilles are painted to match the car interiors. The door shown here is for 3-series BMWs and uses MB's 328 CS three-way system. Prices: Door systems, \$1,400 to \$2,000 per pair; rear-deck systems, approximately \$2,200 each. For literature, circle No. 106



Proton Audio System

Little larger than a table radio, the base unit of the AI-3000 incorporates an AM/FM stereo receiver, auto-reverse cassette deck, and programmable CD player. To keep the panel simple with all those functions, infrequently used

controls are concealed behind a front panel. The major controls can also be operated from a remote transmitter whose head is

angled for easier use. The amplifier section delivers 20 watts per channel, from 20 Hz to 20 kHz, at 0.2% THD, and drives a pair of matched two-way speakers. The CD player can be programmed for up to 20 selections and has three-speed scanning (with

audible cueing at the two slower speeds), a repeat function, and four-times oversampling. The cassette deck has Dolby B NR for an S/N of 62 dB, and a sensor sets bias and equalization for each tape type. Price: \$1,249. For literature, circle No. 107

Recoton CD Adaptor Rings

These three-inch CD adaptor rings allow the new CD-3 format to be used on players designed to handle standard 4 $\frac{3}{4}$ -inch discs. Price: \$4.99 per pair. For literature, circle No. 105



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HISTORY REWINDS



Illustration: Douglas Andelin

If you will turn to this column in the November 1987 issue ("Preservation of the Speakies"), you will find my first brave thoughts on the enormity of audio as an agent in history—since 1877. The history of the human race is enormously complex and we would not be what we are if it were not passed on beyond the tiny span of a single life. Yet before 1877, back for thousands and even millions of years, history was deaf. One of the major aspects of life on earth as we have known it had vanished with no trace and can never be recovered.

Well, enough of that high-sounding rhetoric, true though it may be! In contrast, the little audio "show" I described last month, the sounds of recorded voices over a span of 40 years played back to an audience that knew those voices and even included some of them, right on the spot, was minuscule. And yet, as they say, it was a microcosm of what is new, from here on out—the extraordinary impact of sound as a part of history.

The 1877 date is mostly symbolic. We don't even have Edison's own "Mary had a little lamb" on tinfoil, though he ceremoniously re-did that solemn poetry for the press at a very much later date, and this version does

exist. You've probably heard it. We can even recognize Edison's unmistakable voice, just as many of us know the punchy strength of Theodore Roosevelt's high-pitched tenor. Bully! But the real importance of sound in history only began with the era of tape and LP (the movies having an earlier side effect as entertainment history). Because it was with tape that we began to have *time continuity*—enough recorded time so that the past could "come alive." Not merely as the quick sonic snapshots of earlier recordings, so like the frozen photographs of the early 19th century, mere points in time.

Thus we are now just passing 40 years of full-time sonic history, and that is where my sonic show in a barn last summer becomes oddly significant. By no coincidence, it covered precisely that time span (more or less two generations of human beings), which is pretty much the maximum actual contact from people *now* to people *then*.

Let me tell you, from this personal experience, sonic history is going to be *different*.

What was so startling to me as the M.C. of my own little show, as well as the maker of all its tapes, was that for a couple of hours there, in the summer of '88, there was a *simultaneous* time

continuity between "now" and "then"—many thens, thanks to favorable audio equipment (even 40 years back) and enough length so that we could easily become involved in those past episodes, as one becomes involved in a play or a novel. Except that these were literal and real. We got the sense of "real time" going on as the voices came out of the loudspeakers; we were *there* without strain.

But we were also "here"—that is, in the present. And there were human bodies in that old barn which were involved in both time segments—now, and then—two voices, one person.

Up front in the loudspeakers, for instance, there was a small boy of 5½ speaking in a silvery little soprano. It was 1950. An interviewer asked him some fatuous questions (I cringed—it was me, speaking from the exact same spot) just to get him to sound forth in front of an audience precisely like that of 1988. Alas, I'm not much good at evoking sense from small children. "Now, Jeremy" (said I), "tell everybody what your name is and where you live." And poor little Jeremy obliged, though he couldn't remember his phone number. But at least he managed the street, even the town—Leonia, New Jersey—with high-pitched aplomb. "And my father is Edward," he added. "Not 'Daddy'?" "No—Edward." To this day, Jeremy calls his father Edward.

About 6 feet to one side of my speakers sat an older man with flying white hair (my age) and a bemused smile on his face. It was Edward. Yes, I think he remembered the occasion, which had taken place in that very room. A few feet away from him I had asked a middle-aged man, bearded, touch of gray, to stand up. It was Jeremy! He looked apologetic, as well he might. Did he remember this other self of his, at 5½? He shook his head sadly. What did he think of his childhood voice? (Another fatuous question.) That got a quick answer: "Average neutral small child." The human link, you see, was broken, as between these two equal times. The recording made in 1950 was clear as a bell and hi-fi (good-quality reel to reel, I forget which machine).

As for me, I sounded very much like myself, but much too fatuous. What *do* you say in public to a small child?

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Julian Hirsch—Stereo Review, Sept. '88

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Henry Kloss, creator of the dominant speaker models of the '50s (Acoustic Research), '60s (KLH), and '70s (Advent), brings you Ensemble, a genuinely new kind of speaker system for the '90s, available factory direct from Cambridge SoundWorks.

The best sound comes in four small packages.

Ensemble consists of four speaker units. Two compact low-frequency speakers reproduce the deep bass, while two small satellite units reproduce the rest of the music, making it possible to reproduce just the right amount of energy in each part of the musical range without turning your listening room into a stereo showroom.

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What Henry Kloss tells his friends:

Every time I came out with a new speaker at AR, KLH, or Advent, my friends would ask me, "Henry, is it worth the extra money for me to trade up?" And every time I would answer, "No, what you've already got is still good enough."

But today, with the introduction of Ensemble, I tell them, "Perhaps now is the time to give your old speakers to the children."



Unlike satellite systems which use a single large subwoofer, Ensemble features separate compact bass units for each stereo channel. They fit more gracefully into your living environment, and help minimize the effects of the listening room's standing waves.

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With tape, we began having time continuity—enough recorded time so that the past could “come alive.”

Then, a few minutes later, there was a little girl's voice, even younger, who gave her full name—three names—but was a bit confused as to where she lived. “Here,” she said, in a vague sort of way. In the back of the room, a woman with her two children, the oldest aged 17, stood up and laughed at herself. Again, it was the person we had just heard.

Then another small boy, older at 8, took me on (in 1950) in a bored tone. When I asked him what the year was—after he had reeled off everything, including phone number—he got exasperated. “Nineteen-fifty, of course. Who doesn't know *that*?” said he. And right there you have a real bit of sonic history.

Everybody always knows what year it is. And so we practically never record it, in print or voice. Why bother? It's always *now*, isn't it? No wonder historians have to go to such lengths in sorting out the past.

That 1950 recording had never before been played in public, because, at the time, I thought it was awful—that is, my managing of it. I had the bright idea, back then, that if I could put the microphone—I think it was the first and famous Altec “bottle-nose” condenser mike (tall, black, and thin, with a vacuum tube in the bottom and a tiny mike “head” about a half-inch across with a flat protective cap on top, which, it turned out, produced serious distortions)—if I put that Altec inside a lampshade on a standing lamp and then replaced the light bulb, I could get the kids to center their speech at proper mike distance. So I called it the “magic lamp.”

Little did I know what would happen, though a number of experienced mamas came to my rescue. The instant I turned on the tape recorder, a howling, shrieking mob of children rushed pell-mell at the magic lamp, screaming “Me first!” and so on. I am distinctly heard to mutter, “This is awful—what am I going to do?” as a commanding mother-voice suddenly says, “Now, children, calm down.” Instantly, there was a hush. You really do have to know how to manage kids!

On an inspiration (I'm an entertainment genius), I played that sequence to the 1988 audience. There were howls of laughter—in 1988, it all

sounded so very familiar. Some things do persist, history or no history.

I also played, for the drama of it, an unidentified tape definitely made by me in the same area—but where and when? It was recorded at 3¾ ips. I could not play it, except at 7½, so I did. A great roar of hysterical conversation in high-pitched soprano, going on and on for many minutes. A party, double-time? Lots and lots of people. Utterly unintelligible. No date. No place. I pointed out that here was a typical sample of *historical raw material*, ready for the scholar to untangle, unravel, and identify—if he could. A million library manuscripts present exactly the same puzzle. But this was in sound. A whole new area.

As you may understand, it is not easy to get down useful recordings of human voices ad-lib, like the photographs we all take, just for personal remembrance (or even for professional reasons). A whole new historical science is now developing in order to put famous personalities extemporaneously on tape for posterity, in such a fashion as to be both informative and interesting. This, of course, is merely an extension of the familiar press or radio/TV interview, now invariably made via tape of one kind or another. It is still a hybrid art, often using the sonics as a basis for a printed (should I say *visible*?) transcription, as in fact featured in this magazine. I have written in the past about one of the early examples of this sort of deliberately recorded history—featuring my own father. At that time, to my horror and shock, Columbia University made what must have been hours of tapes of my father reminiscing (*The Saturday Review*, Book of the Month Club) and then, having laboriously transcribed what they wanted onto paper, *erased* the entire thing. They did that regularly with all the celebrities they recorded. I still cannot believe it—such a total lack of insight into the future! Okay, printed transcriptions (like ours) are fine and dandy, but if the voice has a possible historical significance, *keep the tapes*. Did you know that Oxford University, along about the 18th century, sold its full-size first-edition Shakespeare volumes because they were too clumsy and big, and because newer quarto or octavo editions of the same were available?

One of those big volumes would now be worth an absolutely dizzy fortune!

By sheer good luck, I had been involved, around 1970, at this same summer community, in a large-scale “happening” (how dated!)—very multimedia but somewhat on the amateur side. We used two slide projectors and a movie between them, plus four channels of surround sound (me), and no overall sync—all was done by hand, requiring three people. The soundtracks were supposed to be full of bits of interviews and quotes from well-known people—now from one channel, now another, sometimes simultaneously. Very far out. But the lady who was doing the basic voice recording was so inept with her early Sony cassette recorder that I set up my own sessions in my small sound-treated studio and invited the voices over. By that time, they were mostly doing prepared texts, not ad-lib, so after many “takes,” I could get a long and really professional voice tape, parts of which would be copied off for the final production.

Eighteen years later, these nicely recorded voices were wonderfully helpful in my show, all of them clear and intelligible without background noise. But I think the most astonishing and real impact was the role of the dead. Wow—did that bring home the uniqueness of sonic history.

I assure you, though, this was for me a touchy bit of sonic history to present in public! On tape, the people were as natural and lively as could be—yet here, in my audience, were the relatives of the now-dead, their children, friends, even grandchildren. The voices were all too familiar. The dead had returned to life.

Frankly, I was a bit scared. I did not want to offend. So I made a preliminary speech pointing out that in such recordings, the dead are really *alive* and on an absolute equality with other voices which, after 18 years, were still present in the flesh at the very moment—that we must make *no* distinction between the dead and the living, even as they talked casually to each other on the tape. It helped. There were no emotional scenes.

So this is the impact of sonic history, now and to come. More real than any photograph. A vital aspect of every video too? Maybe. 4

True Story

KLIPSCH® speakers weren't the first I owned. Fact is, I had another 'highly touted' brand and thought they were wonderful. Those speakers were almost new when a friend came to live with me for a few days between apartments.

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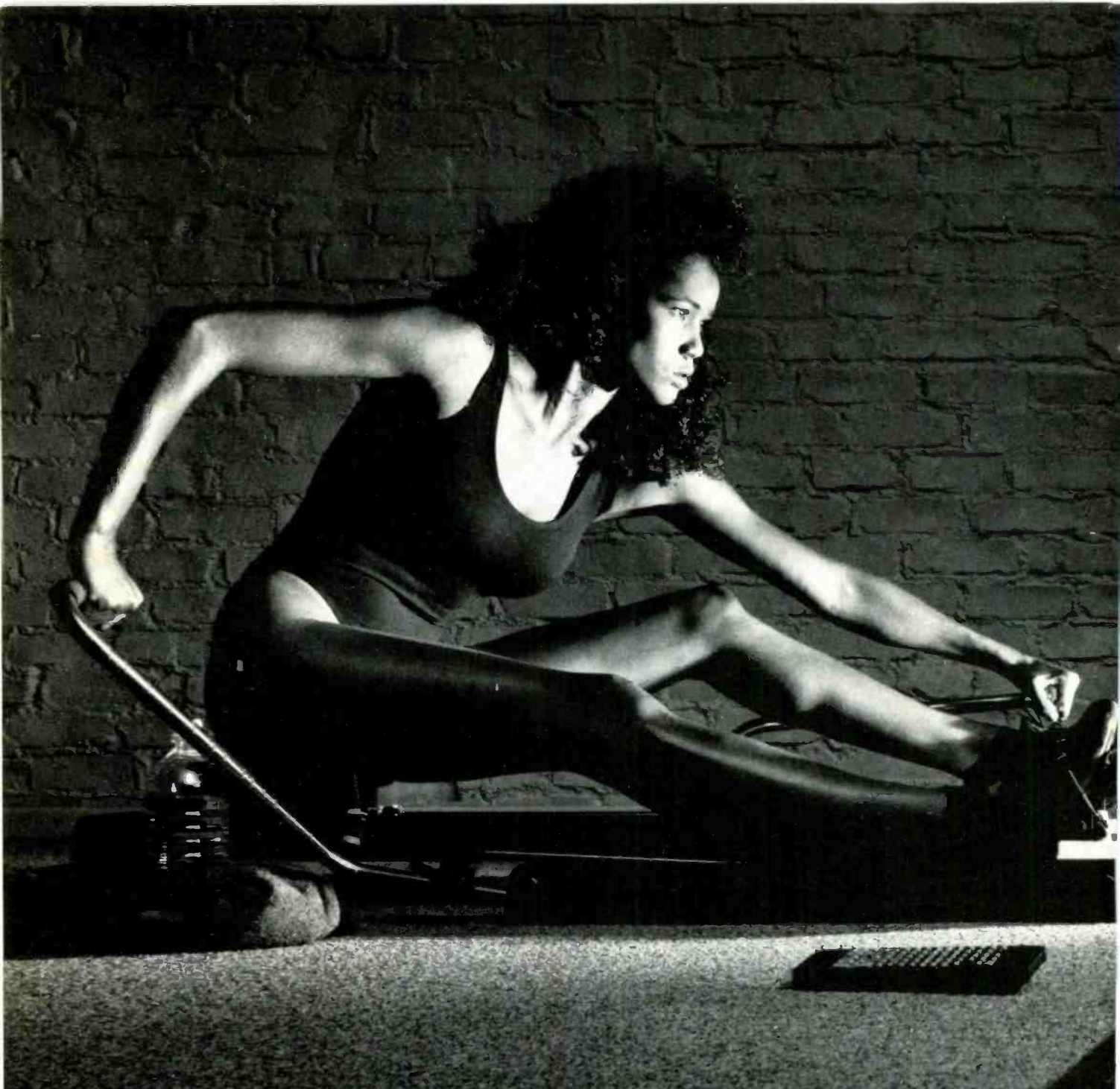
As soon as my friend moved on, I sold my speakers and bought a new pair of FORTÉs. I was pleasantly surprised at the price. I could have bought them to begin with and saved some money.

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MORE THUNDER FOR THE BIRD

Dearborn Has Its Day

Starting with the '89 models, Ford JBL sound systems are now available for the popular Ford Taurus and Mercury Sable and for the newly redesigned Ford Thunderbird and Mercury Cougar.

The Taurus and Sable system uses the same Premium head unit and 4 × 35-watt amp as the Ford JBL system in the Lincoln Continental ("Equipment Profile," May 1988) but with different equalization. Speaker complements are similar, too, with 6 × 9-inch three-way systems in the rear parcel shelf and 5¼-inch coaxial speakers in the doors. As in the Continental, the system has an excursion-control circuit which rolls off low frequencies at high levels, to prevent overload distortion. Ford claims bass response down to 25 Hz. The Ford JBL option costs about \$500 over and above the optional Premium sound system, or about \$800 above the car's stock radio.

But Ford's real pride and joy is the system for the Thunderbird and Cougar (about \$500 in the LX, which comes with tape, and about \$800 in the other models, which come with radios). These are Ford's first car designs to have been heavily influenced by audio requirements. Surveys showed that the most frequently used mid-dash controls were those for the stereo, so the head unit (a restyled version of Ford's hyper-ergonomic Premium radio) is now mounted high up in the dash for easier access. The optional CD player, however, is mounted about a foot below the head unit.

While the old T-Bird's front speakers were in the instrument panel, the new Bird has them high up in the door, for better imaging. This took a year's collaboration between Ford Audio engineer Julie Kolehmainen and the engineers and stylists in charge of the door's design. In the process, manual window cranks lost out to audio—power windows are now standard.

The rear speakers are not mounted on the parcel shelf but in the side panels above the armrests. As a result, back-seat passengers aren't blasted by speakers right behind their heads. They also get better imaging,



Head unit is mounted high in the Thunderbird dash for easy access, but the optional CD player mounts about a foot below.



In the Thunderbird and Cougar, rear-speaker placement gives back-seat passengers about the same sound quality as front passengers get.



New subwoofer enclosure provides deep bass without taking up much trunk space or interfering with the fold-down seat.

not only because the sound now comes from in front of them, but also because the distances from a listener to each speaker are now more nearly equal. At the center position of the system's fader, the level fed to the rear speakers is lower than that fed to the front, so the image will stay front

and center. "The back seat," boasts Ford, "now has sound quality equal to the front seat—a first in cars."

In both front and rear, the speakers are two-way systems, using 4-inch midrange drivers and 1-inch tweeters in oval, 5½ × 7½-inch sealed enclosures. Each speaker is driven by an amp that delivers 15 watts at 2% THD (13 watts at 0.08%). This setup obviously won't deliver as much bass as would more typical systems whose rear speakers are larger and can use the trunk as their enclosure. Instead, bass (down to 20 Hz, according to the specs) comes from a 7-inch subwoofer, in a 10-liter sealed enclosure mounted below the parcel shelf, and driven by an amp that delivers 85 watts at 2% THD, 80 watts at 0.08%. (Apparently, frequencies below 200 Hz don't bother a nearby rear-seat passenger as much as higher frequencies do.) Since the subwoofer is isolated from the trunk, bass response doesn't change as the trunk is filled, emptied, or even opened. And the enclosure is off to one side, so the other side of the split rear seat can fold down for access to the trunk.

Frequency response of each satellite is controlled by a four-band parametric equalizer, and the subwoofer has two-band parametric EQ. Front-speaker equalization is optimized for the front-seat passengers, and rear-speaker equalization is optimized for those in the back seat. I asked why all this attention was paid to back-seat sound in these two sports coupes and not in the company's sedans. (Equalization is optimized for the front passengers in the Continental, Taurus, and Sable.) "Because Ford Audio got in on the ground floor with this one," was the company's response.

For the 1989 model year, Ford is also expanding its system options in other cars. The DAT player for the Continental is now available for \$1,540. Compact Disc players are available for the Continental, Thunderbird, Cougar, and Probe (there's also a subwoofer for the Probe). And Ford now offers Sony's DiscJockey changer for a total of about 10 Ford, Lincoln, and Mercury models.

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The Acura/Bose sound system puts the most-used stereo controls where the driver's fingertips can reach them from the steering wheel.

Bose Branches Out

More and more car manufacturers are getting together with audio specialty companies to produce premium sound systems. Now that the GM-Delco/Bose, Ford JBL, and Chrysler/Infinity systems are well established, it was time for more car companies to get into the act. In the past year and a half, three other car makers—Acura, Nissan, and Audi—have done just that. Their partners were Bose, Bose, and Bose, respectively.

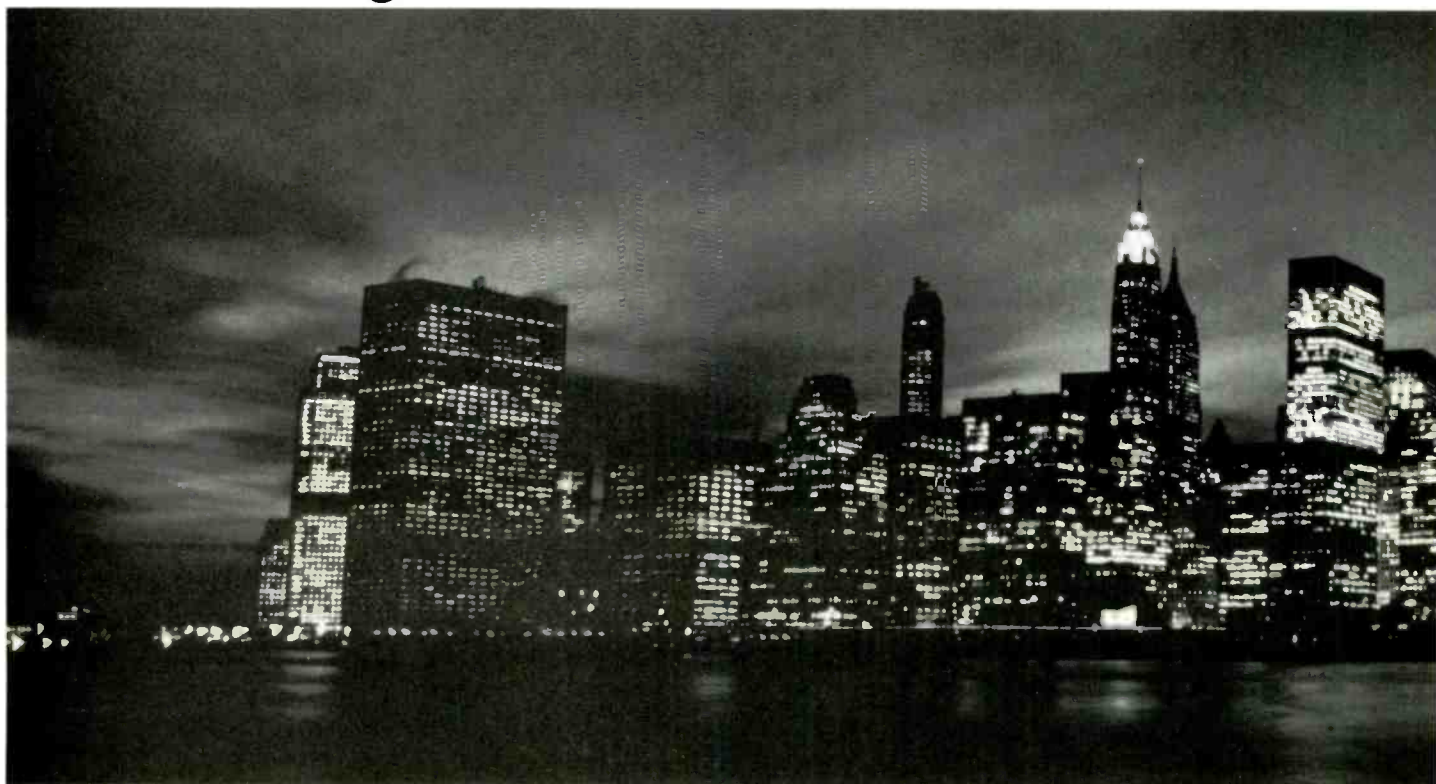
The Acura system, which is now standard equipment on the Legend LS Coupe and Legend Sedan, has two 4½-inch speakers in tuned, ported enclosures mounted in the doors. The Legend also has two 6 × 9-inch drivers under the rear package shelf. As is usual in Bose systems, the drivers are full-range, and the amps are attached to the speakers or their enclosures. Again as is typical for this company, those



amps are specially equalized to compensate for the car's acoustics, the speakers' characteristics, and, I gather from a lecture by Dr. Bose, the ear's directional frequency characteristics (see "How We Hear Direction," December 1983). Power is 25 watts per channel. The tuner/cassette head unit, from Alpine, incorporates Bose-patented tone, dynamic-loudness, and fader circuits. A duplicate volume up/down switch and a button that changes tuner presets or advances a tape to the next selection are located on a small subpanel built into the projecting rim of the instrument pod. Thus, a driver can operate them without taking a hand from the wheel.

The Nissan/Bose system is standard on the Maxima SE and optional (as part of an \$1,800 accessory package) on the Maxima GXE. The speaker complement is the same as the Acura's, though the

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The Delco/Bose Gold Series systems offer more power, deeper bass, higher volume, and smoother response, plus an optional CD head unit.

enclosures are different. The amps have 50 watts per channel and are custom-equalized for this car. The tuner/cassette units, from Clarion, include the same three Bose-patented circuits as on the Acura. An optional CD player can be installed by Nissan dealers.

The Audi/Bose system will be standard equipment on the 1989 Audi 200 and optional (price not yet available) on the 100 Series. Here, too, 4½-inch speakers are used in front and 6 × 9-inch speakers in back; the specially equalized amplifiers deliver 25 watts per channel. In this case, the head unit is a Blaupunkt, again modified with Bose circuits.

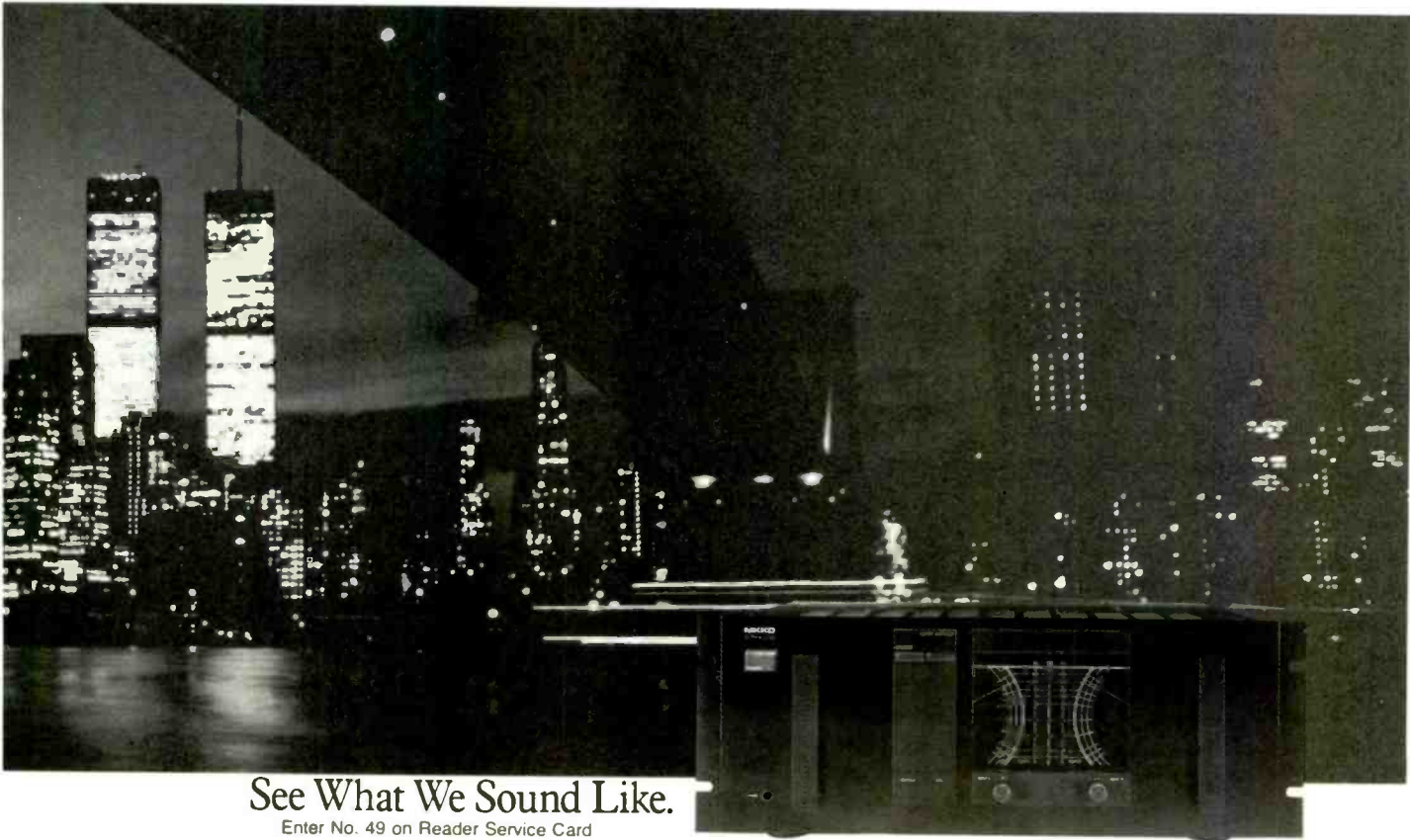
Back at GM, Cadillac will debut the Delco/Bose Gold Series Music System. Speaker complements are the same as in the other systems mentioned, but there's more power on tap—a total of 200 watts in the De Ville, 170 watts in the Seville and



Delco/Bose Gold Series front speaker and CD head unit.

Eldorado. For a signal source, buyers can choose between gold-finished Delco tuner/cassette and tuner/CD units—the latter with switchable compression. They can also have the dealer install a floor-mounted DAT player controlled by an in-dash tuner/cassette unit. According to Bose, the Gold Series produces higher maximum sound pressure levels than the company's previous systems, plus deeper bass and smoother frequency response. Based on a few spins around the GM test track, I'd say those claims are true and that the Gold Series also has more extended treble than most previous Bose systems I've heard. The Gold Series Music System is optional on the Cadillac De Ville, Fleetwood, Eldorado, and Seville, for \$576 over the base stereo system.

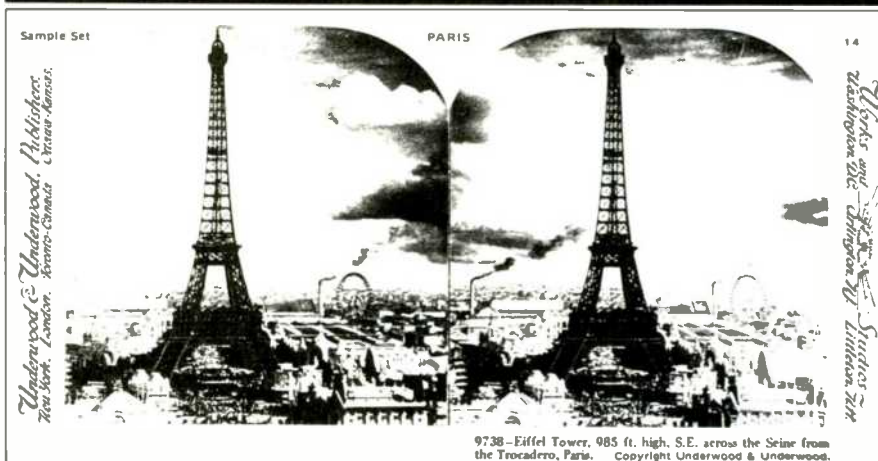
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THE EIFFEL TRUTH

**Staring at Stereo**

As the controversy over the monophonic Beatles CDs showed, understanding stereo might have been easier for our great-grandfathers than for us. By looking at stereopticon photos, like the pair shown here, our forebears could plainly see that a stereo image consisted of two separate but similar images of the same thing, registered from slightly different perspectives.

We cannot, however, stand back from two stereo tracks to "read" them together. Through speakers or through headphones, our brains act just as they do when each eye receives a different stereopticon image—they blend the two into a three-dimensional image.

This has led to decades of confusion as to just what stereo is. Commercials for the first stereo discs and systems bragged, "The violins are on the left! The brass is on the right!" That directionality was more obvious than the feeling of space which stereo brought—even though spaciousness was the basic reason stereo pleased us. In real stereo

recordings, the violins and brass are actually on *both* sides, though each is more on one side than the other. If the violins were recorded on one monophonic track, and the brass on another, playing each track through a separate speaker would create no sense of three-dimensionality. It would be like dropping two unrelated pictures into your stereopticon and trying to get your mind to fuse them into an illusory solidity.

You could not make stereo by mixing the violins-only and brass-only tracks together. You could fake it plausibly enough to suit the casual ear, but not the critical ear. For instance, one might mix each signal—delayed, with reverb added, and at a slightly lower level—into the opposite track.

You can mix any number of tracks to mono, regardless of how they were recorded. But the only tracks which can be mixed down to true stereo are the ones that were recorded that way—i.e., by two or more microphones picking up the same sounds simultaneously, from different perspectives.

Ambisonic Opera

Opera lovers with Ambisonics UHJ decoders were able to hear four operas in surround sound last October, courtesy of KWMU-FM, St. Louis, and 300 public radio stations around the country. National Public Radio's "World of Opera" series began by broadcasting Samuel Barber's *Vanessa* and Carl Maria von

Weber's *Oberon*, performed by the Opera Theatre of St. Louis. These performances had been recorded four months earlier, at the Loretto-Hilton Theatre in Webster Groves, Missouri. The series also broadcast William Mayer's *A Death in the Family* and Rossini's *A Journey to Rheims*, both of which KWMU had recorded ambisonically in 1986.

Cool Music

Musical-instrument strings which have been slowly cooled to -300°F , then slowly rewarmed to room temperature (the process takes 50 hours) appear to need less frequent tuning in some instruments and to make others sound better. Or so says Applied Cryogenics, of Newton Upper Falls, Massachusetts. The company has treated strings from several types of instruments, on an experimental basis. They've also gotten good results with woodwinds and brasses. If this technique catches on in the instrument business, there's no doubt that someone will try it on audio transducers, too. Speakers don't go out of tune (if anything, some sound a bit better with age), but the treatment could conceivably affect their tone, for good or ill.

**Giving It Back to Music**

For the second consecutive year, TDK has commissioned a poster for the Juilliard School as a contribution to the artistic life of the United States. The poster, designed by Milton Glaser (who also did last year's), will be sold to raise money for the school of music, dance, and drama. Posters are available for \$20 at the Juilliard Bookstore in Manhattan, or for \$25 postpaid from Whiteprint Editions, 207 East 32nd St., New York, N.Y. 10016.

"It is a far greater engineering challenge for speaker designers to build a great-sounding speaker for \$200 than \$2000. When cost is no object, they can include whatever they need to get the quality they're looking for.

"However, that kind of quality doesn't always filter down through their product line. At Boston Acoustics, we take pride in designing *every* system to measure up to the highest standards. To show you what I mean, let's look at the T830, our most popular tower system.

"We designed the T830 to deliver exceptional performance at a very reasonable price, and did it by making knowledgeable and intelligent choices. We custom-designed all three of its drivers: an 8" high-compliance woofer, 3½" midrange and 1" dome tweeter. No compromises here.

"The midrange and tweeter are ferrofluid cooled for greater power handling capacity. The diaphragms of all three drivers are made of copolymer. Although it is more costly than conventional materials, we used copolymer because of its structural uniformity and immunity to atmospheric changes.

"We make all these drivers under our own roof, using specialized machinery and jigs that we've designed or adapted ourselves. This helps us maintain consistent high quality, *and* save through efficiency.

"For the enclosure, we used the same dense, non-resonant structural material as in our highest-priced system. To keep the cost down we used wood-grain vinyl instead of costly wood veneer. It looks rich, and makes absolutely no difference in sound quality.

"More important than what we put into our systems is the quality of sound that comes out—and how that matches your expectations.

"From our very first product to our latest, audio critics have appreciated what we've accomplished—delivering demonstrably high performance at truly affordable prices. Here's what Julian Hirsch said about the T830 in *Stereo Review*:

'In all measurable respects, the Boston Acoustics T830 delivered outstanding performance. Few speakers we have tested have had such a flat frequency response or such low distortion, for example, and most of those were considerably more expensive...we were enormously impressed.'

"When you compare the T830 against similarly-priced systems, you'll also find it sounds better in a number of ways. More musical, smoother, its imaging more precise. And it can play louder without distortion.

"What we've accomplished is no trick. It's knowing what to do, then doing it.

"If you'd like to know more about the T830 and other Boston Acoustics speakers, please write or call. We promise to reply promptly."



"It's no trick to make a great speaker when price is no object"

Andy Petite, chief designer, Boston Acoustics



The 3-way T830 Tower System.
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Back Tracks

Radio stations have long had a simple trick to keep certain record tracks from being broadcast: Just stick transparent tape or adhesive labels across the restricted tracks. Mores, however, change, and many cuts which stations were reluctant to air a few years ago are now deemed more or less acceptable. Even when the tapes or labels would come off, they'd leave a gluey residue on the record surface.

Jack Dobbs, chief engineer of KSON AM/FM, a country-music station in San Diego, says he's found a solution. He first treats the tape or sticker with warm soapy water to loosen its paper or cellophane, and then gently wipes it with a clean cloth until the glue is exposed. Next, he sprays the glue with WD-40, a lubricating and cleaning spray, lets it soak for a minute or two, and then works in the WD-40 with a toothbrush. Finally, he wipes the WD-40 away



with a clean cotton cloth and washes the disc again with warm soapy water.

According to Dobbs, this treatment does not harm the record. In fact, says he, it "cleans and restores" old

records! As with all home remedies we'd recommend trying this on an LP you don't particularly treasure before attacking one you do. But if you have adhesive stuck across your tracks, it's worth a try.



The search for the ultimate sound system inevitably leads to speaker systems employing electronic crossovers ahead of the amplifiers, since this places the individual drivers under much more direct control than is otherwise possible.

The only difficulty, in the past, has been the task of obtaining a crossover unit with sufficient flexibility to control these speakers correctly.

Bryston's Model 10B Electronic Crossover com-

bines ideal signal-handling with an enormously flexible control function. Simple, direct front-panel switches allow any crossover curve to be set instantly, and listening quality is vastly improved over passive, in-speaker networks.

The Model 10B features independently selectable crossover points for high-pass and low-pass. You can also independently select crossover slope, from 6, 12, or 18 dB/Oct., where one driver requires a different cutoff from another in the same system.

Strictly speaking, dynamic range is a function of the music and its performance, while S/N depends on how the hardware performs.

Dynamic Ranging

Colloquially, the terms "dynamic range" and "signal-to-noise ratio" are frequently interchanged, but they're not quite the same thing.

S/N ratio refers to the range, in dB, between the system's noise floor and a specified reference signal level. In digital systems, the reference is usually specified as the highest the system can take, the level at which every bit of every data "word" is a binary "1."

In analog systems, the reference level is specified somewhere in the range where slight increases in signal level begin to bring slight but noticeable increases in distortion. Within limits, you can set that reference arbitrarily. A tape-deck manufacturer, for instance, might choose to measure S/N from the signal level which produces 1% THD or from the level which produces 3% THD. Measuring from the 1% level would lower the rated S/N a few dB

but would yield better specifications for distortion and for headroom (the difference between the rated signal limit and the point where distortion becomes unacceptable). Measuring from the 3% level would make S/N look better at the expense of the other two figures.

Dynamic range, strictly speaking, represents the range between the loudest and softest sounds; it is really a function of the music and performance rather than (with one exception) hardware. Under most circumstances, dynamic range is not as large as S/N, because the music is not recorded all the way down to the noise floor. A CD with a 96-dB S/N might include music with a dynamic range of only 60 dB or so. Nothing's wasted by this, since the CD's 96-dB S/N keeps the noise a good 36 dB or so below the music's lowest amplitudes, and the utter hush between selections makes the impact of the din more impressive.

On the other hand, there are ways to record the full dynamic range of music even when it exceeds the rated S/N of the system it's recorded on and played through. With analog systems, you can take advantage of headroom to squeeze in a few more dB of signal. In extreme cases, you may even eke out another dB or so by letting a few hot peaks distort a bit, trusting on their fleeting nature to keep the level of distortion tolerable.

In digital systems, of course, the reference level is the absolute limit. However, in both analog and digital, some signals are audible below the noise floor, because the ear can pick out coherent sound from a background of random noise.

That's why there's an exception to my statement that the term dynamic range applies to music, not to hardware: Dynamic range is specified for CD players, and that spec is always a few dB greater than the same player's spec for S/N.

Introducing: Bryston's Model 10B Electronic Crossover



All crossover selections are extremely accurate and repeatable, being implemented with 1% selected metal-film resistors and polystyrene capacitors. All switches are heavily gold-plated, for lifetime protection from corrosion. The level-controls are in precise 1dB increments, also derived from gold-plated switches and 1% metal-film resistors. All internal buffer and amplification stages are Bryston's exceedingly linear and superbly quiet discrete op-amp circuitry. This means the signal is always maintained with stability and freedom from

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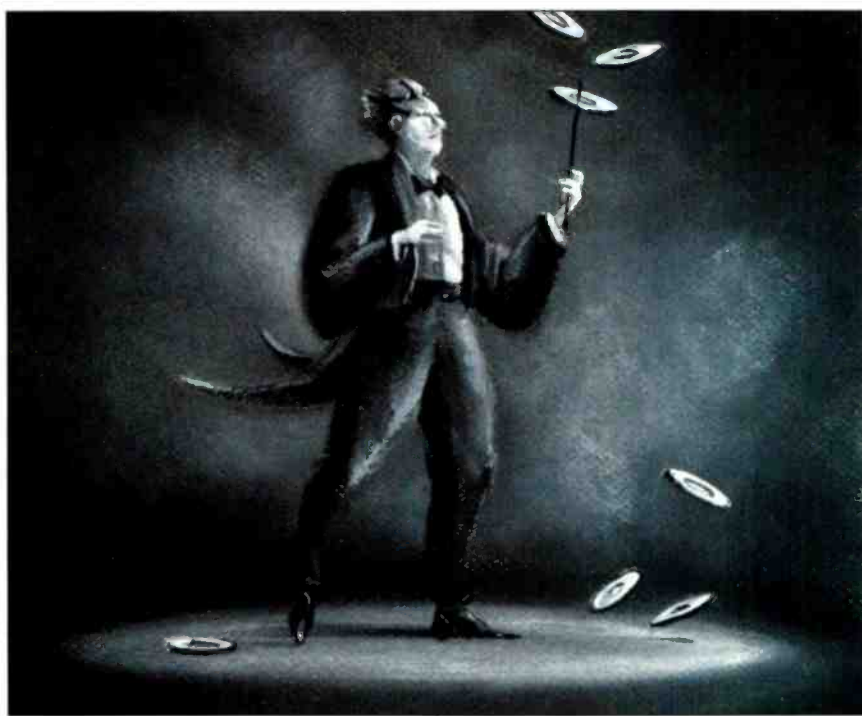


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BERT WHYTE

SPINNING OUT CLASSICS



In the earliest days of the Compact Disc, a common complaint was the scarcity of classical titles. To many who had enthusiastically welcomed the new format, the difficulty of purchasing specific releases was quite frustrating. They would read a favorable review of a recording but have little success in buying the CD. This scarcity of titles existed even in the big record retailers in major cities.

In part, the problem was caused by limited CD production facilities. What the buying public didn't know was that there were a relatively small number of discs pressed on the initial release—anywhere from 3,000 to 5,000 copies, and rarely more than 10,000. This was so despite the fact that these quantities were for worldwide distribution. For quite a long time, it was difficult to find so-called "catalog music," the staples of the symphonic repertoire.

Now, five years into the CD era, we have several dozen facilities around the world which manufacture Compact Discs. The market is literally deluged with a torrent of recordings of every imaginable kind of music. According to the October 1988 issue of the *Schwann Compact Disc Catalog*, nearly 20,000 titles are now available. True, this is nothing compared to the count-

less titles available on LP. However, the embarrassment of riches confronting the music lover in the current catalog is truly formidable. How many audiophiles know that there are, as I write, 41 different CD recordings of Beethoven's Fifth Symphony, 34 versions of his Third Symphony, a mind-boggling 45 recordings of Vivaldi's "Four Seasons," 39 renditions of Musorgsky's "Pictures at an Exhibition," and 31 of Dvořák's "New World" Symphony?

Faced with such a choice on Beethoven's Fifth alone, what criteria do you use in deciding what disc to buy? Among the pertinent factors is economics: Does your budget restrict you to a single version, or can you afford several recordings that have equally compelling virtues? Are you an audiophile and therefore more concerned with the sonic verities, or are you musically erudite and thus pay more attention to performance values? Of course, these days there are many people with expertise in both areas. Perhaps your choice would be dictated by "big names"—glamorous conductors and world-renowned orchestras. Those who consult music critics must always consider the publication in which those reviewers air their opinions. Is it an

August specialty music journal, a hi-fi magazine, or an old-line respected newspaper? There is always the peril that those who are strong on music know little of audio and consequently review their CDs on low-fi equipment. The obverse, of course, is the critic with a state-of-the-art audio system and a limited musical perspective.

As you would expect, virtually every major company, and many of the smaller labels, are represented among the aforementioned 41 recordings of the Fifth Symphony. You can hear this masterpiece performed by the New York Philharmonic, Boston Symphony Orchestra, Chicago Symphony Orchestra, Philadelphia Orchestra, Cleveland Orchestra, Vienna Philharmonic Orchestra, Berlin Philharmonic Orchestra, Concertgebouw Orchestra of Amsterdam, London Symphony Orchestra, and so on, ad infinitum. You would think that with so many versions of this work, record companies would finally say "enough." But note that Sir Georg Solti is about halfway through a new cycle of all nine of the master's symphonies, as are Claudio Abbado, Herbert von Karajan, and Bernard Haitink. There is also a new set of the complete symphonies on "original instruments" from Nimbus Records, and Christopher Hogwood and the Academy of Ancient Music are almost finished with a similar cycle. It goes on and on, and not just with the music of Beethoven.

To understand this seemingly unending proliferation of CD recordings of mainstream symphonic repertoire, we really have to examine the convoluted history of the classical recording business.

In the 78-rpm era, the record business was dominated by a very few big companies. In America, you could hear symphonic music performed by the likes of Stokowski, Toscanini, Rubinstein, and Horowitz on RCA Victor, or by Szell, Bruno Walter, and Pablo Casals on Columbia. Foreign artists and orchestras could be heard on His Master's Voice or Deutsche Grammophon Gesellschaft. This was the beginning of the "star system," when the glamorous conductors, pianists, violinists, and opera singers were all signed to long-term, exclusive contracts with a particular label.

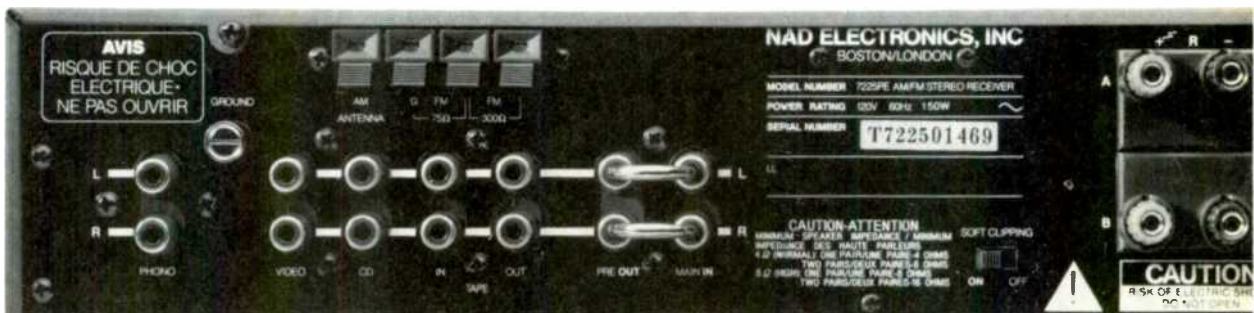
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To obtain a glimpse into the reasons for this, ask your dealer to take the 7225PE off the shelf. Pick it up yourself. You will realize at once that you are holding a very substantial component. As you would expect from NAD, every ounce is there to enhance listening and ease of use.

For example, NAD's renowned Power Envelope amplifier design uses a two-stage "smart" power supply that provides higher power for musical peaks. Up to 85 watts of clean dynamic power. And our Soft Clipping™ circuit (which is defeatable) prevents harsh distortion when the demands of the music exceed most other amplifiers' limits.

In short, the 7225PE is a prime example of NAD's "no-compromises" design philosophy. And, we think, a product destined to become a standard

in its class. The ultimate judgment, however, should be made by listening. We invite you to do so at one of our carefully selected dealers. You may be surprised at what you hear.

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The embarrassment of riches in the current CD catalog is truly formidable. We now have 41 different versions of Beethoven's Fifth alone!

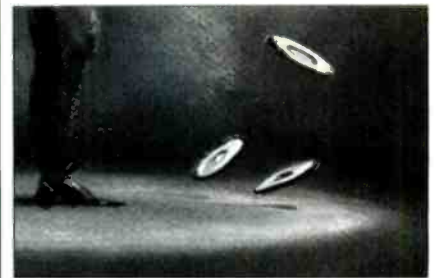
The advent of the LP changed that system a great deal. It was said that anyone with an Ampex tape recorder and the price of a ticket to Europe could start a record label. Many entrepreneurs did, and a host of small labels came into being. Since these fledgling companies had little money

and the doctrine of "exclusive contracts" was still very much in force, the small labels survived by offering a more unusual, musically adventurous repertoire.

In those days, sound quality was not a major consideration. With the parallel development of the hi-fi audio busi-

ness, however, sound quality finally became a "salable" factor. Pioneering audiophiles still fondly remember such highly respected sound-oriented labels as Westminster Records, Bob Fine's famous Mercury Olympian series, and London/Decca's frrr.

In the late 1950s, many recording engineers were enamored of the famous Telefunken U-47 condenser microphone, which makes for an interesting historical aside. Bob Fine was in



Alsace, recording the great Albert Schweitzer on some organ works. A German engineer who was at the sessions suggested that Fine try this new Telefunken mike because of its especially good bass response. Fine later brought several of these mikes back to the U.S. He used the U-47 in his famous "single-point" monophonic Olympian recordings, the first of which featured Rafael Kubelik conducting the Chicago Symphony Orchestra in Musorgsky's "Pictures at an Exhibition." Not long after that, I met Fine. On quite a number of sessions with the Chicago, Minneapolis, and Detroit Symphony Orchestras, I made experimental stereo recordings with a pair of U-47s while Fine made his own mono recordings using his single-point technique.

The advent of stereo discs in 1958 further brought sound quality to the fore. Everyone was looking for some technical advantage in a never-ending game of one-upmanship. When Harry Belock and I co-founded Everest Records in 1958, we briefly used modified three-channel, half-inch Ampex recorders before going on to the Westrex 35-mm magnetic-film recorders. This was state of the art indeed, as each of the three channels was equivalent to full-track, quarter-inch tape. The tape was 5 mils instead of 1.5 mils thick, and its thicker oxide permitted much higher signal levels. The sprocket-hole drive of the film afforded better wow

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It seems to me digital recording is the "great leveler." Few machines have a significant edge in performance values.

and flutter and, at 90 feet per minute, was running at 18 ips rather than the usual 15 ips, thus giving better high-frequency response.

In the heyday of the LP, sound quality was a highly competitive factor. With the advent of digital recording and the introduction of the CD, many things changed in the recording business. I consider digital recording the "great leveler." In other words, whether you record classical music using the Colossus system, the ubiquitous Sony 1610 and 1630 recorders, a Soundstream, 3M, JVC, or Mitsubishi, few would argue that any of these machines has a significant advantage in any of the usual performance parameters. The emphasis today is more on the choice of microphones and the skill in deploying them, the selection of halls with desirable acoustics, and a new thrust in the direction of acoustic treatment of halls. These are very arcane skills. Despite the industry's domination in the old days by a few large and powerful recording companies, mere size and financial clout do not necessarily lead to technically superior results. A fine example of this are two recent recordings of Richard Strauss' monumental "Also sprach Zarathustra." One was made by John Eargle for the Delos label, the other by Jack Renner of Telarc. Both are magnificently recorded, thrilling expositions of the music. While they differ in certain aspects, these CDs should please music lovers and audiophiles alike.

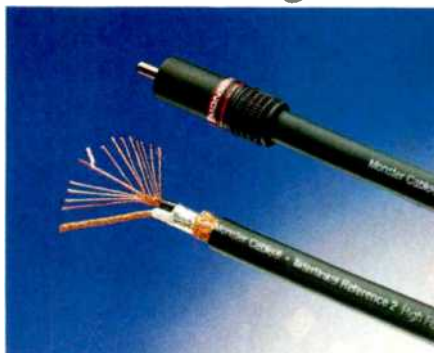
Although the days of the exclusive long-term contracts are all but a memory, certain conditions still exist which greatly influence *what* music will be recorded and which artists will perform. While the record companies try to keep certain orchestras and conductors in their stables, and certain conductors try to maintain a degree of loyalty to a given label, the exigencies of modern orchestra stewardship and jet-setting concert life have become difficult to resolve.

The old game of "musical chairs" can cause the most problems. Allow me to cite some recent examples. Famed conductor Bernard Haitink, a Philips artist, left his post of many years with the great Concertgebouw Orchestra of Amsterdam to become Musical Director of London's Royal

Opera, Covent Garden. The members of the Concertgebouw chose Riccardo Chailly, a London/Decca artist, as their new conductor. Now, it is common knowledge that most big-name conductors have their share of artistic temperament and, of course, have very definite ideas on music and how it

should be performed. Most are also considered specialists in the music of particular composers. If a record company wants to keep the peace, satisfy the conductor, and assure good sales, it will invariably bow to his desires and record some of his specialties. The label may have recently recorded

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Several British record stores rent CDs for the equivalent of 75¢ to 80¢ a disc, per week. Sadly, this is illegal here.

Beethoven's Fifth with another conductor, but if the new maestro wants to record the selfsame work—so be it!

Thus, London/Decca has been busy recording Riccardo Chailly and the Concertgebouw in repertoire staples as well as more venturesome pieces. What of friend Haitink? Well, Philips


isn't about to lose the services of so prestigious a conductor, so they will continue to record him with the Concertgebouw, too! Having just issued the last CD of Haitink's Mahler cycle with the Concertgebouw, Philips has announced the release of Mahler's First Symphony with Haitink conduct-

ing the Berlin Philharmonic. This marks the start of a new Mahler cycle with another fabled orchestra.

In the meanwhile, Deutsche Grammophon has been recording *their* new Mahler cycle with Leonard Bernstein conducting such orchestras as the New York Philharmonic, Vienna Philharmonic, and Concertgebouw. CBS is all agog because their *Wunderkind*, Michael Tilson Thomas, has nabbed the post of principal conductor of the London Symphony Orchestra. A flurry of recordings of Thomas' specialties is already underway. The San Francisco Symphony Orchestra has a new conductor at the helm—Herbert Blomstedt, formerly of the Dresden Staatskapelle. London/Decca promptly recorded two of *his* specialties, the Nielsen Fourth and Fifth Symphonies. And so it goes. . . .


The only hope in trying to decide on multiple CD choices of a given work is to audition likely candidates on your own home system. Obviously, such a procedure presupposes the availability of CDs that can be rented or borrowed.

In fact, this column was prompted by a number of advertisements in that venerable and estimable British journal, *Gramophone*. Several U.K. record retailers who sell Compact Discs also rent them—for the equivalent of 75¢ to 80¢ per disc, per week. With the relative indestructibility of the CD, this service offers British music lovers a chance to audition specific recordings from a very large library.


I had thought there might be similar services in the U.S. After all, consider the booming prerecorded videocassette rental market. Much to my chagrin, I learned that the rental of CDs and, for that matter, vinyl records and audio cassettes, is *illegal* in the U.S.! It seems that the Recording Industry Association of America (RIAA), the same folks who are trying to thwart the introduction of R-DAT in this country, supported 1984 legislation to prohibit rental of copyrighted music formats. The law is to expire in 1989, but legislation is underway for a five-year renewal! At the moment, the only recourse is a local public library. Many of the more progressive branches are now loaning CDs to their members. This procedure is exempt from the 1984 law and has the tacit blessing of the RIAA. 




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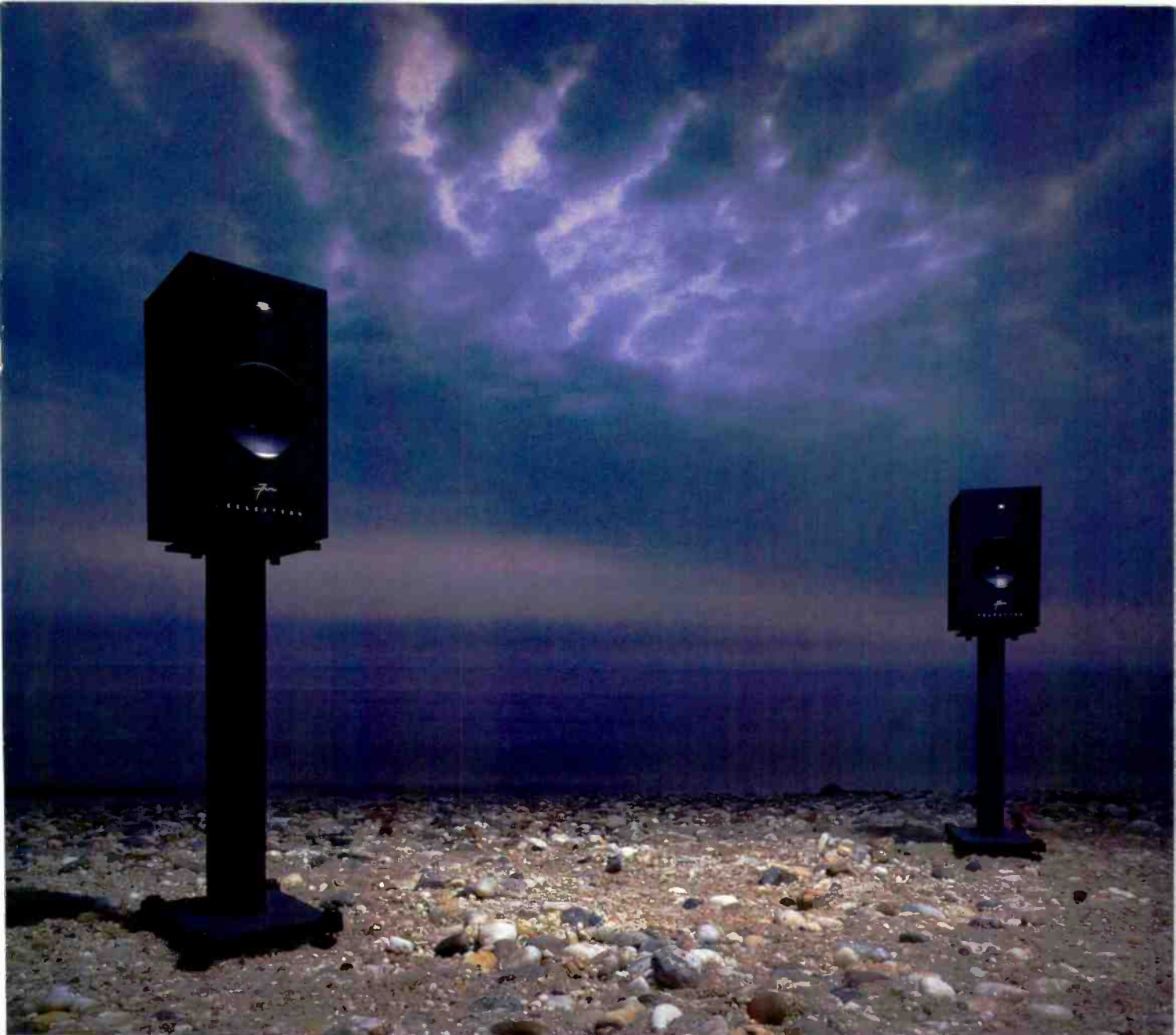
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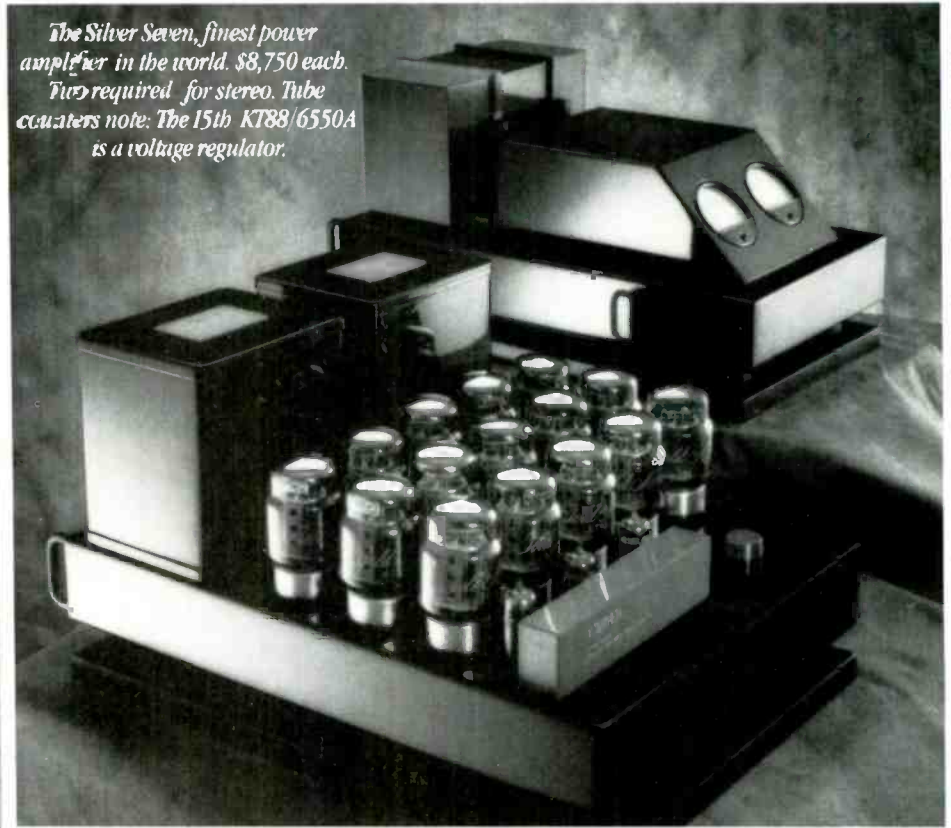
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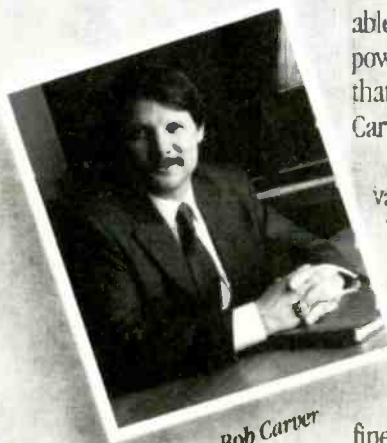
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The Silver Seven, finest power amplifier in the world. \$8,750 each. Two required for stereo. Tube acquirers note: The 15th KT88/6550A is a voltage regulator.



Before you meet the new M-4.0t, Bob Carver wants you to meet its inspiration, the money-is-no-object Silver Seven.



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“One of my important design precepts is that power amplifiers should be easily affordable but last year, when I began designing a powerful new amplifier, I temporarily set aside that precept of affordability. The result is the Carver Silver Seven Mono Power Amplifier.”

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- *Wonder Cap capacitors throughout.*
- *Interconnects are Van den Hul Silver.*
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- *Gold input connectors and high current gold output connectors.*

The Silver Seven’s polished granite anti-vibration base floats on four Simm’s vibration dampers. The separate power supply’s power transformer end-bells are machined from a solid block of high-density aluminum.

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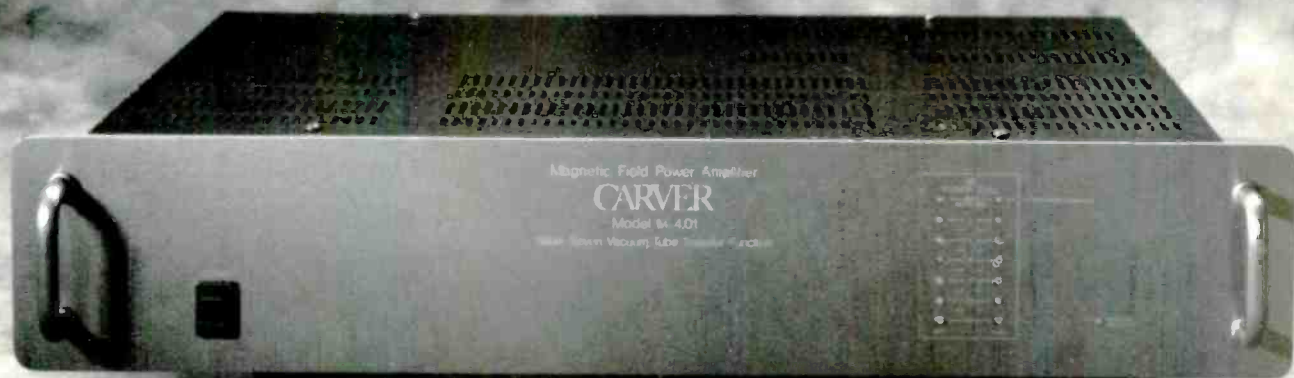
Sonically, a pair (for stereo) of the flawless Silver Sevens almost defies description.

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transfer function of a set of \$5000 esoteric tube amps several years ago.

This time he's gone one better. Or two.

He's used this powerful scientific method to duplicate the transfer function of the Silver Seven in the new M-4.0t (now you know what the "t" signifies). Mind you, we are not saying the M-4.0t is *identical* to a pair of Silver Sevens. An M-4.0t weighs 23 pounds versus the Silver Seven at 300 pounds a pair. The Silver Seven stores 390 joules of energy while the M-4.0t stores none. As a Magnetic Field Power Amplifier the M-4.0t instantly draws the power it needs directly from the AC line.

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Each can float a full symphony orchestra across the hemisphere of your living room with striking realism.

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RAYMOND




PHOTOGRAPH: ROBERT LEWIS

KURZWEIL

Revolutionary Tradition

DAVID LANDER



On Lexington Common, not far from the site of Raymond Kurzweil's Waltham, Massachusetts office, a small band of armed citizens faced down a British detail one April morning in 1775. The redcoats had been marching all night toward a patriot munitions dump in Concord, and there must have been considerable flint in the voice of their commander when he ordered his antagonists to disperse. The minutemen held their ground.

Kurzweil is a direct spiritual descendant of those rebellious and determined Americans. Boyish, indeed almost cherubic, dressed in a sleek Italian suit and sporting a Mickey Mouse watch, he hardly fits the image of a revolutionary. Nonetheless, this 40-year-old M.I.T. graduate has been compared to Edison and Marconi, and is a veritable prophet of change. Raymond Kurzweil, who dreamed the future and is now helping to create it has announced that the second industrial revolution is at hand.

The key difference between this new industrial revolution and the one that preceded it, Kurzweil explains, is that "the first involved machines which multiplied our physical capabilities and extended the reach of our muscles. The new age is multiplying our mental capabilities."

THE AUDIO INTERVIEW

Kurzweil is an artificial-intelligence specialist who invents machines that think: "Power tools for the mind," he's fond of calling them. In the early '70s, he developed a device that may be the most important innovation for the blind since Braille. Using a technique known as pattern recognition, which allows a computer to identify the most basic

characteristics of sounds or images—in this case, the letters of the alphabet—his machine identifies the words on a printed page, regardless of typeface, and reads them aloud.

More recently, Kurzweil produced what might be seen as the converse of his reading machine, a voice-activated word processor. As you speak to it, your words appear on a computer screen, and, if you wish, they can be printed out in hard copy. The device can recognize 20,000 words.

Between these two inventions, Kurzweil took a detour through the world of computerized musical instruments. Prompted by singer Stevie Wonder, an appreciative user of his reading machine, he developed a synthesizer known as the Kurzweil 250. Through digital sampling techniques, it not only reproduces the sound of a grand piano but can be programmed to sound like any instrument played into its memory.

WE CAN EDIT OUT MISTAKES AND MAKE MODIFICATIONS AFTER THE FACT, MASSAGING THE MUSIC AS A WRITER WOULD MASSAGE A PIECE OF PROSE.

Moreover, a single person can use the device to imitate dozens of instruments played simultaneously. In one instance, the 250 was programmed to simulate a 61-piece orchestra and was then used by an opera company in two choral works. Not surprisingly, this capability has led to controversy. When Broadway producers negotiated with the musicians' union in 1987, the technology this synthesizer embodies was a focal point in their bargaining sessions.

Not long after Local 802 of the American Federation of Musicians hammered out its pact with the barons of Broadway, Kurzweil addressed a convocation of students entering Boston's Berklee College of Music. After reminding his audience that their art has always employed "the most advanced technologies available, from the cabinet-making crafts of the 18th century ... to the digital electronics and artificial intelligence of the 1980s and 1990s," the inventor noted that "the advent of this most recent wave is making historic changes in the way music is created."

It was to ask about these historic changes, to gain insight into their implications, both for music and for those who create it, that I went to Waltham for a talk with Raymond Kurzweil. *D.L.*

Music has been more or less a lifelong interest of yours.

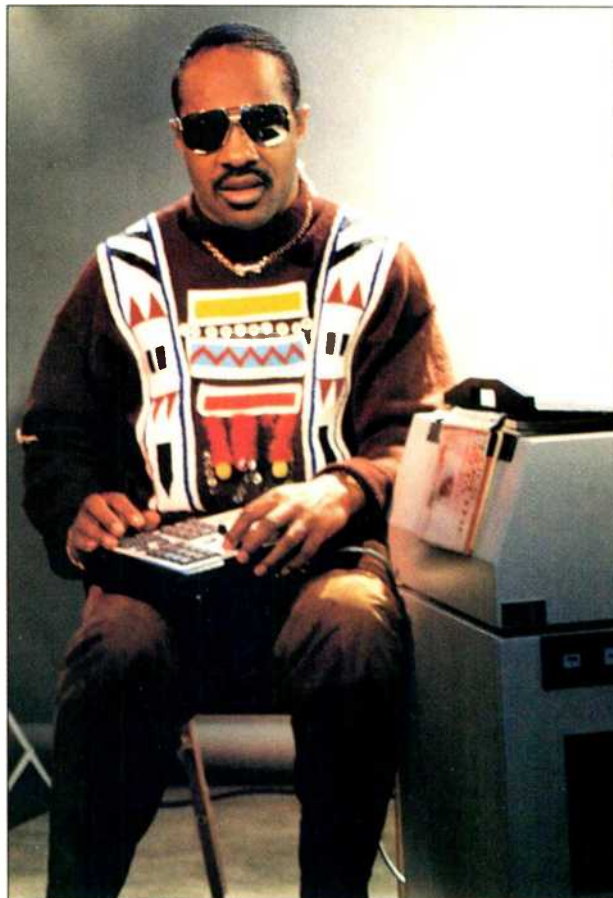
It has. I come from a musical family. My father was a concert pianist, a conductor with the Bell Symphony, the Queens Concert Orchestra, and opera companies in Pittsburgh and in Mobile, Alabama. He was founder and chairman of the Queensborough College Music Department. I learned the piano from him starting at age 6, and I was constantly going to concerts where he and his colleagues were performing.

And your interest in computers goes almost as far back.

I've been interested in computers since around the age of 12 and quickly became interested in pattern recognition. In fact, I did a project in high school applying pattern recognition to the structure of melodies, trying to determine what makes a certain sequence of notes and rhythms a pleasing melody and what makes other sequences displeasing. I particularly wanted to find those patterns that characterize different styles of music.

Stevie Wonder
Using the Kurzweil

Reading Machine, an innovative device developed to assist the blind.



MARTIN L. SCHNEIDER

You were involved in pioneering work in the field of artificial intelligence when Stevie Wonder got you back into music. Tell us how that came about.

I had known Steve for a number of years, since he was a fan of the Kurzweil reading machine and one of its earliest users. We had a number of occasions to talk about technology in general and, in particular, technology applied to the creation of musical sounds. He's quite knowledgeable about electronics, computers, synthesizers, and other elements of music technology, and at one point he was lamenting the fact that there were two worlds of musical instruments without any viable bridge between them. There was the world of acoustic instruments, which at that time—and this is still the case today—provided the musical

sounds of choice, sounds which are complex, rich, and musically relevant. But it did not provide very effective means for controlling those sounds. Most instruments, such as the saxophone or violin, cannot even be played polyphonically. You can only play one note at a time; there are limited means for sound modification. You can do vibrato on a violin and not much else. In fact, most musicians can't even play most instruments, since most don't have a wide variety of playing techniques. **You've contrasted this with the world of electronic musical instruments.**

The electronic world was the total converse of this. All the things you could not do in the acoustic world, you could do in the electronic world. All sounds could be played polyphonically, and you could layer any sound with any other sound. You could apply virtually any sound modification technique to any sound source. However, at that time, the sounds that you could apply all these

techniques to were very thin. These sounds had found their place in popular and classical music, but they were of limited complexity and could not capture the complexity and musical depth of acoustic sounds. So basically, Steve's challenge was, "Wouldn't it be neat if we could apply all of these control and sound modification techniques that the electronic world provides to acoustic sounds." You could create a whole new class of sounds which would have the complexity of acoustic sounds, because they would start acoustically but would be so modified that they would not be recognizable as the original instruments. There would be a whole new class of sounds that would have equal relevance to music but would be sounds no acoustic instrument could produce.

This occurred around 1982, when you were headed in a different direction. What impelled you to actually go to work on a synthesizer that could do this?

Shortly before my father died, he began to get excited about the application of computers to music, which at that time was not a very popular concept. He felt that someday I would combine these two interests. And I've always had in the back of my mind that there was some linkage between computers and music. I became excited about what Steve was talking about and understood the potential it would have. I began to explore the concept and began to believe that it was feasible. With that realization, I examined the market potential, which seemed explosive. The whole marketplace seemed poised for an historic transformation from what, at that time, was almost entirely acoustic technology to digital electronic technology. And indeed that is now taking place.

What advantages do digital electronics have over analog in the creation of musical sounds?

You have very precise control over sounds—you can create sounds of arbitrary complexity. You can very precisely apply several dozen sound modification techniques, and you can use techniques that are theoretically



MLS/A—JIM ABBOTT

The Kurzweil 250 (in loft at left) is dwarfed by world's largest organ, in a Philadelphia department store.

well grounded. Analog electronics is a bit of a black art. It's not always predictable what the techniques will do, and there's no way of taking a sound, analyzing it, and then resynthesizing it—it's a bit of hit and miss. With digital techniques, we can really understand how the sounds are constructed, analyze them in the frequency domain (which is the way in which our brains understand them), make any modifications we wish, and reconstruct them. In the digital domain, you can emulate all of the techniques that analog synthesis provides, but you also can do a lot more, and you can deal with much more complex phenomena. Using analog techniques, it's really not possible to accurately re-create, for example, a grand piano. But it is possible in the digital domain.

Wasn't the re-creation of a grand piano a key goal when you were working on the Model 250?

That was the quintessential goal. We recognized that the piano was the most difficult instrument to re-create.

Why is that?

The reason is that you can't do it using conventional sampling techniques alone. Let me throw out a few of the technical problems. The overtones in a piano are not perfect multiples of the fundamental; there are what are called

enharmonic partials. A popular technique to save memory in sampling is to just capture the transients in the attack portion of a note and then, once the attack is over, to loop the last one or two waveforms—in other words, to let the note decay while just repeating the last couple of waveforms. When you do this, all of the overtones become perfect multiples of the fundamental and you lose the inharmonicity of the partial. Yet if you don't loop, if you just record the entire 15- or 20-second evolution of each piano note, that chews up too much memory. Because the spectrum actually changes for 15 or 20 seconds. That's one problem. Another is that the sound decays, and fixed-point samplers have a fixed noise floor. As the note decays, the signal decays into the noise. The perceptual phenomenon that occurs is, it sounds like the hiss in the background is actually growing as the note decays. That's quite objectionable and obviously doesn't happen on a real piano. Furthermore, the time-varying sound a particular note makes actually changes at different loudness levels. When you hit middle C hard, a completely different time-varying timbre is produced than when you hit it softly. And the timbres also change quite significantly at different pitches as well. If you were to just use brute force techniques to capture all of these phenomena you would need hundreds, perhaps thousands, of times more storage than is really feasible in a practical digital synthesizer.

What was your solution to all this?

A proprietary technology which is based on sampling but has specific techniques to overcome each of these problems. Our piano notes, for exam-

ple, retain the enharmonicity of the partials throughout the entire duration of each sound. We don't have a fixed noise floor. Our noise floor drops as the signal drops, so our signal-to-noise ratio remains very high even as the notes decay. The time-varying timbre changes at different loudness levels. We have technical solutions to each of these problems which do not involve using massive amounts of storage. We essentially have what amounts to a very complex signal-processing model of the piano.

What about other instruments?

We knew that if we could re-create the piano, we could re-create anything. Because the piano is, in fact, much more complex. These problems I alluded to—and there are others as well—exist in the piano to a greater degree than in some other instruments. If you could solve these problems with a piano, you could do a very good job of re-creating any instrument.

In fact, can't the 250 be used to create any sound at all?

Yes, but the point I want to make is it's not just re-creating sounds. It's re-creating instruments and their entire response to such things as changes in pitch and loudness and to other means of sound modification. An instrument is not just creating a sound; it is creating a myriad of sounds. To simply capture all that by recording it would exhaust computer memories, even at today's low prices.

I'd like to explore some of the implications of this technology. Some people maintain that it's going to put a lot of musicians out of work.

This is the same debate they had in the English textile industry when the flying shuttle and some of the other automated textile machines were introduced in the late 18th century. There emerged a movement—called the Luddite movement—led by Ned Lud, who made the same sort of points. It was patently obvious that employment was negatively affected, and in fact ultimately would be devastated by these new machines, because one machine with one operator could do the work of 10 or 20 persons. You could point to all these people who had previously spun wool thread and woven cloth who now were thrown out of work because of

these new machines. Yet, paradoxically, employment in England at that time rose dramatically, and there was an era of prosperity, which in fact was the main reason the Luddite movement died out. I think that's very analogous to what's happening now. The English textile automation that occurred in the late 18th century and the automation of music today are just two points on a whole spectrum. We've had a couple centuries of automation now, and this has been a very important issue that has continued to be debated.



The Kurzweil 250 synthesizer is a complex signal-processing model of the piano.

So you think this issue should be put in historical perspective.

Let me examine it first in the broad scale of automation, and then let me specifically address the impact on music today. The bulk of automation that has occurred in history has occurred over the last hundred years. That's when we've seen all the dramatic automation of machines that could replace our muscles as well as machines that now begin to amplify our mental processes. And the impact on employment over the last hundred years has been the same as in England when the textile industry was automated. In 1870, we had 10 million jobs comprising 30% of the population. Today, we have 120 million jobs comprising nearly 50% of the population. Moreover, the average wage of these jobs today—in constant dollars—is six times what it was a hundred years ago. There is much more wealth, and this has led to expansion both in the private and pub-

lic sectors. We have huge programs, from Social Security to Medicare, that didn't even exist a hundred years ago. We couldn't have afforded them then, but we can afford them today because of the increases in economic power and efficiency that automation has brought along with it. And interestingly, even though machines seem to put people out of work, there are many more people working.

Albeit at different jobs.

At more interesting jobs. Jobs that require more education. A lot of the new jobs, in fact, have been in education, to provide the higher level of skill that today's jobs require. Today, we have 5 to 6 million college students. We had only 1% of that number a hundred years ago. Let's look at this phenomenon in terms of music, where the same thing is going on. People can create music more effectively and with greater productivity. If you want to weave cloth, as it were, the way it was done 10 years ago, you may find yourself out of work. On the other hand, any musician I know who has bothered to learn the new methodologies of creating music has been besieged with opportunities and is very much in demand. I'll give you just a few examples of new opportunities that didn't exist 10 years ago. There's nearly \$10 billion a year



SOMEONE WHO LOST OR NEVER HAD THE PHYSICAL SKILLS NECESSARY TO PLAY MUSICAL INSTRUMENTS NOW HAS THE POTENTIAL TO CREATE MUSIC.



spent in this country on making industrial, government, and training films. Ten years ago, all these films used public domain recordings for their background music. Today, they actually hire someone to create an original soundtrack on a synthesizer, and that provides a musician with a job which didn't exist before. There's a whole cadre of musicians who do nothing but create new musical sounds, whereas 10 years ago, people pretty much limited themselves to the handful of timbres that were available from conventional instruments. Today there's a whole industry of creating new timbres, and there's hardly a pop song that comes along that doesn't have some entirely new sounds. Pop groups I know that acquire these types of synthesizers don't immediately halve their group's size. They keep their size the same, but they put out a more interesting, more dramatic sound. They feel that's good for their business—and indeed it is. Music is becoming more exciting because of this technology, and thus the overall demand and market for music has expanded, and revenues in the music and recording industries have gone up. Overall, the employment opportunities for musicians are greater now than they were 10 years ago—and are more diverse.

Just how complicated is learning these new methodologies likely to be for people trained on traditional instruments?

A strong understanding of the fundamentals of music—of music theory, playing techniques, music traditions—continues to be the best possible preparation for creating music, regardless of the instrument used. Musicians who have a solid grounding generally have little trouble adapting to the new technology. Computer-based keyboards, for example, have been engineered specifically to support the playing techniques that have come before them. We'd have a hard time selling our instruments if piano keyboard technique were not so widely known.

Sampling makes it possible for an artist to exactly reproduce someone else's sounds. Frank Zappa, in fact, has taken to printing a specific prohibition against this on his recordings. What are the legal implications here?

The copyright protection that's available is implied, in any event, whether Frank Zappa stamps a copyright notice on there or not. The copyright laws are fairly clear, although their interpretation is less so. If somebody produces some original work that shows ingenuity and creativity, he or she owns that. And if somebody copies a substantial enough portion of a musical work, then that would be an infringement. In an extreme case, if you sample 30 seconds of a recording, I don't think anybody would disagree that that's infringement. Exactly what point constitutes infringement—you can't copy 30 seconds, but can you copy 1 second? Is a tenth of a second too much? These are questions the courts will have to sort out. The principle is, if you're copying enough to be really borrowing some unique expression of creativity from another artist, you're probably infringing. The opportunity to do that certainly existed before samplers.

With the increasing availability of sampling, will infringement become more widespread?

I personally don't feel it's going to be a major problem. Musical expression is not something you can easily copy just by lifting a second or two of someone else's performance. Musical expression is a whole vocabulary, a whole language, and a great musical artist evidences that by the way he or she responds to a broad diversity of musical situations. I don't think you can capture the essence of a musical artist in 1 or 2 seconds.

As the inventor and manufacturer of the 250, have you ever been or do you see yourself becoming party to a copyright suit?

No more than the manufacturer of a photocopier would be liable for someone copying printed material.

In a sense, music performers have historically been forced into a role similar to that of bodybuilders or other athletes; they've had to spend an inordinate amount of time perfecting technique. It would seem the interaction of computers and electronic instruments can free them from this, at least in part.

This is one of the key changes that the new musical technologies bring forth. There are many dramatic changes in the way music is and can be created with the new tools we have now. The barrier of fine motor coordination is certainly being overcome. A great deal of music required nearly superhuman feats of coordination and could not be produced otherwise. Today, with sequencers, we have the ability to play a line of music at a slow speed and then speed it up without changing the pitch or other characteristics. We have the ability to edit out mistakes, to make modifications after the fact, to massage a piece of music the same way a writer would massage a piece of prose. This is dramatically changing the way music is created and is allowing people who do not have highly developed technical skills to create music. There are many people who may not have highly developed motor coordination but who nonetheless can express ideas in a musical form. There are other changes in the way music is being created. For centuries, there has been a strong link between playing technique and the sounds created. If you wanted flute sounds, you were stuck with flute-playing technique; if you wanted violin sounds, you had to master violin technique. Now, it's really possible to use any technique and create any sounds. You could have the technique of a wind instrument and [with a device known as a wind controller] create the sounds of virtually any acoustic or electronic instrument. It's obvious you can do that from a

THE DAY ISN'T FAR OFF WHEN 90% OF THE MARKET WILL BE DIGITAL. ACOUSTIC INSTRUMENTS WILL HAVE THE ROLE THAT HARPSICHORDS DO NOW.

keyboard. There are music controllers that are emulating the playing technique of many acoustic instruments. We're really breaking that link between playing technique and the sounds created, because we're no longer restricted by the physics of creating the sounds acoustically.

You've demonstrated a genuine interest in helping handicapped people. Do you envision these new music technologies helping someone who has developed arthritis of the hands?

There's no question that somebody who has lost—or never had—the coordination or physical skills necessary to play an instrument now has the potential to create music.

Computers have wrought enormous changes in the process of musical composition as well as performance, haven't they?

Right. Composing is now an interactive process. You can hear the work as it's being composed, alter it, try out ex-

periments, and hear them in real time. You can go through dozens of experiments in a matter of an hour or two in the comfort of your own bedroom. My father was a composer, and the process was incredibly difficult. He had to write a piece of music and imagine the whole thing in his head. He'd write out the notation, which was a very elaborate process, get it reproduced, gather a group of musicians—there'd be arguments about funding—and then fi-

nally he would get to hear his work and realize he wanted the bassoons to come in four measures earlier. So he'd dismiss all the musicians, gather up the notation, write the whole thing out again—and you literally had to write the whole thing over because there were no music notation processors that would just modify it—make the changes he wanted, have more arguments about funding, and get the musicians back again. Finally he'd hear the bassoons coming in earlier, but he'd have some other idea. Today, he could make that change at the touch of a few buttons and hear it immediately.

How does artificial intelligence fit into all this?

Well, we are developing "musicians' assistants" and "composers' assistants" which can perform some of the chores of creating music through systems that are programmed with knowledge of music theory and other elements of music. For example, there are very advanced notation packages coming out now that actually have a knowledge of music and therefore can intelligently take a computer's music sequence and properly notate it. There are systems that can take a melody and generate a walking bass line, an appropriate rhythm pattern, or harmonic progressions which may only be suggestions to the human composer. The human composer can take these ideas and modify them or add his or her own creativity. But these systems essentially improve the productivity of the composition process by doing some of the rote work automatically.

Computers have given birth to something known as algorithmic composition. Precisely what is that?

In algorithmic composition, the composer doesn't specify explicitly all the notes to be played but lays out rules or procedures called algorithms that will, in turn, generate the music. This allows the music to perhaps be different every time it's heard. It's a different way of expressing musical ideas, of expressing them at a different level and using the computer essentially as a collaborator.

Does the emergence of a technique like this indicate that we're heading

Robert Moog, of synthesizer fame and V.P. of Kurzweil Music, and the Kurzweil Ensemble Grande.



MLS/A—VERNON L. SMITH

toward music that's more mathematical than emotional, more expressive of rules than of human feeling?

Let's get back to fundamentals. Music is, and will remain, a special form of communication between the artist and his or her audience, using elements of sound, melody, rhythm, harmony, and timbres. The new technology which computers are providing is greatly expanding the expressive possibilities that musicians have at their disposal. Musical instruments which are computer based provide greater modalities of expressiveness than acoustic instruments. In fact, acoustic instruments are very limited in this respect. Each acoustic instrument provides a rather limited repertoire of ways for controlling the sounds and modifying them and translating human expressivity into sound, whereas computer-based instruments provide more freedom for control over musical expression. Twenty years ago, the number of different timbres that a musician had to use for orchestration was measured in dozens, whereas today there are many thousands of timbres that we actually hear in music. And there are means readily available for creating a virtually unlimited number. In fact, musicians can now craft their own sounds, which was never possible before. Musicians can use a wide range of music controllers which are very expressive. We now have keyboards that not only measure the velocity of the flight of each key, but actually measure the amount of pressure each finger places on it. This is a very powerful form of expressiveness that an ordinary piano keyboard doesn't have. A piano keyboard only measures velocity. Even the fairly superficial use of a modern synthesizer provides levels of expressivity and choices that go beyond what a conventional piano offers.

I attended a symposium recently where several leading recording engineers addressed the issue of new technology. One of them said that there's still no substitute for a good keyboard player. Do you agree?

Absolutely. The technology is not in any way replacing the musician. The musician remains an irreplaceable part



MLSA—MURRAY

Olga Espinola, one of the first blind professionals to use the Xerox/Kurzweil Personal Reader, which can read printed material aloud.

of the process. In fact, he or she is the communicator of human ideas and emotions. The reason that a musical group of, let's say, five people, after they acquire this type of technology and are able to put out a much richer sound, do not reduce the size of their group is because they need five people's worth of musical ideas.

Do you see live performances, as we know them, becoming obsolete?

Performing music live and in real time will continue to be a special form of expression.

And acoustic instruments? What future do you see for them?

There's no question that acoustic sounds will be around for a long time. I see variations of those sounds also in common use. A lot of sounds we call synthetic will actually have an acoustic base to them. Somebody will have started with an acoustic piano or some other sound and modified it, so it sounds totally original but nonetheless gains its complexity and musical relevance from the fact that it started as an acoustic sound. However, I think we're rapidly moving toward a time when electronic instruments will be able to provide all the functionality and tone quality of acoustic instruments, along

with many layers of capability that they do not provide. I don't think we're that many years from the point where 90% of what has been an acoustic market will be a digital market in which acoustic instruments will have the role that harpsichords do now. They'll still be made in small quantities, but they won't be the primary way that music is created.

As time passes, what are some of the things we can expect to see in electronic musical devices?

The quality of sound is certainly improving. There's a great deal of work being done on the human factors of these instruments, because creating music is a very personal activity and optimizing the interaction of musician and instrument is vital. Optimizing expressiveness is a major issue now. Another major challenge is to make these instruments use music terminology and techniques, and not have them appear to be computers—to make them appear less technical and more intuitive. A lot of work is going into that aspect of these instruments.

It's tempting to compare you to Bartolomeo di Francesco Cristofori, the inventor of the piano. How do you see your historic role in the creation of musical instruments?

Well, our goal was to re-create the functionality of acoustic instruments in a digital, computer-based instrument. We feel we've achieved that objective. Our second goal has been to cost-reduce that technology so that a very large number of people can actually gain access to it. Our objective is to build up a major company with a worldwide scope and to be a leader of what we feel is an historic transformation of musical instruments. **A**

DATs THE WAY IT IS

A recent five-week visit to Japan and Hong Kong revealed a number of small but, one would venture, important new wrinkles in the Digital Audio Tape scene. Any *big* breakthroughs? No, and none anticipated as this issue goes to press. Nevertheless, there are enough cracks in the DAT dam to send those standing on top of it scurrying for solid ground once the extent of the format's actual appeal to the public becomes more apparent.

In East Asia—the enlightened term most people now prefer to the old term, the Far East—sales of DAT hardware and software are soft. Real soft. East Asian manufacturers are waiting for the North American market to bring prices down and make Digital Audio Tape a global format. It looks as if their wait—and the world's—will continue, but not indefinitely. Repeated trips to Tokyo's audio ghetto, Akihabara, turned up initial discounts on list prices for recorders that were a little encouraging but not as attractive as they might have been. Keen haggling and some shuttling back and forth between Akihabara and Shinjuku, across town on the other side of the Yamanote National Railway circle, eventually turned up some very good deals. The big, famous stores—LAOX, Yamagiwa, Ishimaru, and others—quoted Sony's second-generation consumer deck, the DTC-500ES, at the official list price of 160,000 yen (about \$1,230 or so then) and gave “between you and me” discounts of 130,000 to 140,000 yen. A lot of legwork knocked the price (and the salesman's good humor) down even further. Finally, I walked out of Yodobashi Camera, in Shinjuku, with my Sony DTC-500ES for 123,000 yen. Similar shoe-leather wear got the first mini portable recorder, the Casio DA-1 (148,000 yen, list) down to 108,000 yen and into my heavy luggage bound for Narita airport. In Hong Kong, bargaining was almost nonexistent in the stores. Their stated price for the DTC-500ES was their final price. With the exchange rate at that time, 7,500 Hong Kong dollars was about \$962.



I L L U S T R A T I O N : W E N D Y B R A U N

On prerecorded DATs, labels make slim profits, dupers do all right with low volume, but dealers really clean up.

The brands of home and portable recorders on view in Japan included four Sonys, two Kenwoods, Victor (JVC here), Aurex, Pioneer, Aiwa/Excelsia, A&D, two Technics/Matsushitas, Alpine/Luxman, Casio, Sharp, and one or two others that were obviously relabelled versions of the above. A closer look revealed that some of the companies had their own faceplates on innards supplied by a few of the bigger names.

Who was buying? *Gaijin*, like you and me—especially Germans and

Dutch, but also well-heeled Japanese consumers.

Tape made by Maxell, TDK, Sony, Fuji (Axia), That's, DIC (U.S.), Just, BASF, Agfa, 3M (U.S.), Technics, Denon (Nippon Columbia), Audia, JVC, and one Korean maker (whose name eludes me) were around, but Sony, Maxell, and That's had the most visibility on store shelves. I saw DAT blanks (D-46 up to D-120) in many more stores on my October '88 trip than during the preceding winter and spring, and the stock was moving, if slowly.

HOW'S DAT DOING HERE?

Although DAT recorders are neither illegal nor unavailable in the U.S., they aren't on the shelves of most neighborhood audio stores yet. So far, no DAT deck maker has begun importing recorders for home use, but a few manufacturers do sell their decks (often including home models) through dealers of professional equipment.

A few enterprising retailers have begun importing machines and tapes directly from Japan, advertising them in *Audio* and other national magazines. We asked three such dealers (Brian Bielski of Audio Gallery and Jesse Jacobson of The DAT Store, both in Santa Monica, California, and Bob Grindlay, a salesman at American International Audio/Video, in East Windsor, New Jersey) what today's DAT market is like. All three companies sell mostly by mail or phone order, though American International also does direct sales to pros.

The recording industry has been fighting tooth and nail against the introduction of home DAT recorders, but all three dealers agree that recording industry professionals have accounted for most DAT sales. Since the Los Angeles area is full of recording studios, it's no surprise that both Santa Monica dealers told us that the pros make up 90% to 95% of their market.

In Southern New Jersey, where studios are comparatively rare, the market isn't quite the same. "We're seeing a lot of music professionals, both studios and musicians," says Bob Grindlay of American International, "but we're seeing a lot of professionals in general—lawyers, doctors—too. And most particularly, Grateful Dead fans."

The hot-selling items vary a bit from store to store. At Audio Gallery, "the Sony DTC-1000ES is moving. Studios prefer them. Also the Technics and Sony portables and Sony's PCM-2500 pro unit. There's also a new Technics 18-bit machine," says Brian Bielski. Down the street at The DAT Store, the best-sellers are the Sony DTC-500ES and the new Technics SVD-1100, "because it's an 18-bit machine and definitely sounds better than any previous DAT I've heard," says Jacobson. "One of our partners just got back from the show in Japan, and says companies are coming out with 18-bit machines which will be out in early '89. But until then, the Technics is the state-of-the-art machine."

At American International, there are two distinct markets, according to Grindlay. One is the portable market, where "there's no clear favorite between the Sony D-10, the Technics D1, and the Panasonic SZ-250. The Panasonic is a pro unit with XLR in-

puts. It's a newcomer on the scene, but people are starting to look for it. The Technics and Panasonic portables have MASH 64-times oversampling input filters and multi-stage noise shaping, so you lose zero-cross distortion. They sound warmer," Grindlay explains.

"In home decks, far and away our best-seller is the Sony DTC-500ES," continues Grindlay. "But the 18-bit machines—the Technics SVD-1100 and Panasonic SV-3500—are both starting to pick up more sales now, particularly to professional music people."

The dealers disagree as to the state of the car-player market. Brian Bielski says, "I understand car players aren't selling well. Probably when there's more software and prices come down, they'll do better." But Bob Grindlay reports, "We're getting second-generation calls, people who bought machines as long as 14 to 16 months ago and are now calling back to buy car units."

Sales of blank tapes are booming at all three stores. That's only logical, since most sales are to pros, who use a lot of tape, and tapes can't be purchased in many other places. American International generally sells anywhere from 10 to 50 blank tapes with each machine, then gets reorders for anywhere from 20 to 100 pieces. The folks at Audio Gallery say they're not selling many prerecorded tapes but are selling a lot of blank tapes. The DAT Store's sales figures for blank tapes are just about identical to American International's—but their

Who has the machines? Every studio seems to own several. Even the major labels in the U.S., in some cases, are now using DAT tests of their masters rather than the considerably more costly test runs of CDs. It is a pro tool of enormous convenience and relatively affordable cost, especially now that prices of the pro decks (available everywhere in the world, including the U.S., during most of 1988) are reflecting the effects of competition and volume sales. Sony, for instance, had just dropped the price of their PCM-2500,

experience with prerecorded tapes is far different from that of their neighbor, Audio Gallery.

"This is a DAT-only store, and we sell a lot of units, blank tapes, fiberoptic cables, test DATs, and all the prerecordeds we can find. We're on the prowl for prerecorded tape, but as you know, there's a short supply," says Jacobson. "The Enigma releases are selling well—there are so few rock titles available." Jacobson is hoping to get more prerecorded tape from abroad, soon: "I'm sure we'll get a lot of orders when it gets here." Meanwhile, Jacobson reports that The DAT Store is selling "a lot of the more esoteric things, like the Japan Audio Society's *Stakkato* DAT [actually a reissue of a CD produced by the German magazine *Audio*] and their *Audio Check* DAT. They also have some Mozart piano music, recorded at [a sampling rate of] 48 kHz. A lot of the prerecorded tapes are at 44.1 kHz, which to me defeats the purpose. They sound great at 44.1, but they sound better at 48.

"I'm surprised," adds Jacobson, that companies who record New Age and classical music haven't jumped on DAT, considering their demographics. Of the home buyers we have, the titles that lean in those directions are the hottest sellers. Both appeal to a slightly older audience, slightly wealthier. These are people who were brought up buying a lot of records. Now they want something to buy, because they have the money—but not New Wave or heavy metal."

Ivan Berger

the double-decker professional DAT recorder, from about \$5,000 to \$3,200 as this issue was going to press. (*Editor's Note:* Look for a review soon, maybe next month.) Audio/Design, in the U.K., offers modified consumer decks from Sony—the \$3,500 Model Pro-DAT-1 and \$5,000 Model Pro-DAT-2. Both of these decks record at the pro sampling rate of 44.1 kHz as well as at the consumer format rate of 48 kHz (which is also the sampling frequency of the Mitsubishi recording/editing system). The more expensive of the two British pro decks is compatible with the Sony 1630 editing system, thus eliminating the incredibly slow and rather bulky Sony U-Matic from at least some steps in editing and transferring for CD—or for prerecorded DAT.

The pros are sufficiently impressed by the better consumer table-tops and portables to put home units from Luxman, Sony, Matsushita, and some other makers into their racks. In a lot of studio and location sessions, PCM-F1/VCR systems have quietly ceded their place as "safety" systems to DAT recorders. This makes playback for artists a lot easier: You just tap out the track number you want (if you've re-





membered to punch address codes into the deck and note them in your session log), and zot, you have the desired take.

One of the signs that home units are now reaching studios in the U.S. as well as overseas is that Allied Broadcast Equipment, in Richmond, Indiana, now offers a Harris DAT recorder (actually an Aiwa consumer unit) together with a popular Otari open-reel studio analog recorder as a \$4,349 package. The Harris recorder costs some \$2,400, has digital inputs and outputs, and records only at the 48-kHz sampling rate.

But what about prerecorded DAT? It is selling, not just slowly but abominably, in many of the world markets it has entered. The prices for DAT cassettes dubbed in real time are astronomical—in the \$28 (if you're lucky) to \$35 range here, and from 4,000 to 5,500 yen in Japan. The labels are making quite slim profits, the duplicators are taking a good slice but doing relatively low production runs, and the retailers are nailing down very high per-unit commissions. This is certainly not a good short-term outlook by any means.

But, and there is a but, an increasing number of labels are announcing the re-

lease of DAT albums. Not to bang my own drum, but my label, Classic Masters, sold 500 copies of our first DAT release, a Mozart piano album, to the Japan Audio Society for sale at the Japan Audio Fair (early October) and expanded our release plans from four to seven more albums. Capriccio/Delta, despite soft sales, is beefing up their 50-title catalog with additional releases. New guys on the scene are Dorian (six titles, all classical), Albany Records (two initial releases of contemporary orchestral music), Rykodisc USA (*Steal Dis DAT*, a \$19.95 sampler that's probably the lowest priced prerecorded DAT cassette available), Sheffield Lab (*Direct from the Masters* demo), GRP (seven jazz/cinema titles), dmp (a respectable, small, all-digital jazz catalog), JCI (three pop albums from California), Sea Breeze (three band albums), Direct-to-Tape (a sizable catalog of classical titles), Simax of Norway (Bach gamba sonatas), Sonata of West Germany (five titles, from Bach organ to Chick Corea), and a few English pop/rock companies. Ford Motor Co., after making their landmark decision to market DAT players (by Sony) in their Lincoln Continental last June, has gone on to help their customers find software by providing a catalog of what's available. Ford also includes, with each player, DAT samplers from Capriccio, dmp, and Soundwings (a jazz/pop label).

The real news in prerecorded DAT, though, is Chandos' release of 50 classical titles in October and November. Drawn from the most popular of their 400 stunningly recorded albums, these tapes are on sale in the U.K. for 20 pounds and are also moving in the Japanese market. Chandos dupes them in real time on their own DAT- or 1630-driven Sony machines. All "pops"? No way. Virtually all of this music is either serious orchestral repertoire, explorative early 20th-century material, or good baroque/classical. This looks like quite a challenge to Capriccio, and to the rest of the industry.

The tapes available so far are made by real-time duplication, which is expensive but of very high quality—and the only way to make DAT albums at the moment. The high-speed systems from Sony (at least one has been shipped), BASF, 3M, one rumored to be on the drawing boards of a certain

Sales of DAT albums have not merely been slow in many of the worldwide markets, they have actually been abominable.

large Netherlands conglomerate, and others have not yet been seen to be enough of a presence to change the present staggering retail prices of the albums. Also, the computer industry is consuming just about every ounce of barium ferrite, the magnetic medium used in high-speed DAT duping. Until that demand eases or production of the expensive substance swells, bulk high-speed tape could be too costly or too rare for the marketplace.

The high cost of duplication isn't the only problem. Most of the few stores willing to carry DAT cassettes have been unwilling to sell them without a huge markup. The DADC/Sony plant in Indiana is offering duplication now but saying nothing about the mother company's high-speed duper. The most informative and active of all the duplicators has been Loran, in Warren, Penn-

sylvania. They have kept abreast of the world DAT situation and been quite generous with information, contacts, and materials for professionals and writers in the field. They did the Ford tapes and have associations with many of the labels listed above, but acknowledge the present stillness in the marketplace. Kate Campana of Loran was quietly optimistic about the 1989 albums the company is lining up with their clients.

So whither DAT in the short term? As even *Billboard*, the vocal, visible weekly of the U.S. record and video industry, has predicted—and, in the case of a few guest editorials, urged—the DAT logjam may be handled best by a marketplace trial of the new format. Since the ignominious death of CBS Copy-Code (it did not perform as claimed), conflicting copy-guarding systems proposed else-

where have found only confused resonance in the industry. Further, the U.K.'s Parliament rather tidily trounced a royalty which was to have been collected from blank-tape taxes. So the situation remains frustratingly at an impasse. The rest of the world can buy and record DAT. It is not illegal here—and everyone's *finally* admitting that the format itself not only poses no danger to the CD format but probably is a supportive complement—but the stalling goes on. The big labels will eventually have to coexist with a consumer digital recording system, whether it be DAT, bubble memory, or optical disc. So why not embrace the inevitable and reap the benefits *now*?

The hardware manufacturers, mostly in Japan, will not bring in recorders (playback car decks are around, of course) until the RIAA's threat of a lawsuit over copyright infringement is somehow removed or resolved worldwide. There we languish, for now.

But, one is tempted to dream: What if someone *does* say the hell with it and introduce recorders in the U.S.? No one in Japan appears to have the bravado to test the legal and marketing waters at this point. What if some bold, perhaps brash, board in a company based in that waking electronics giant, Korea, were to beat everybody to the punch and challenge the stalemate head on? Well, I'm not making any predictions, because there's too little to go on, and the latest rounds of talks between the two industries remain secret. But even if DAT is a tempest in a teapot, when viewed in dollar potential and compared with the CD or video markets, it is highly visible. The company that successfully negotiates safe passage 'round and through the complex issues surrounding DAT will get a lot of attention. Do you wonder who it will be? We *all* do. **A**

PRERECORDED DAT LABELS

Albany Records

Classical Music Inc.
P.O. Box 355
Albany, N.Y. 12201

Capriccio/Delta Music

2008 Cotner Ave., Suite 2
Los Angeles, Cal. 90025

Chandos Records

Koch Import Service
111 Hicks St., 25-C
Brooklyn, N.Y. 11201

Classic Masters

41 Fourth Place
Brooklyn, N.Y. 11231

Direct-to-Tape

14 Station Ave.
Haddon Heights, N.J. 08035

dmp (digital music products)

Box 15835, Park Square Station
Stamford, Conn. 06901

Dorian Recordings

17 State St., Suite 2E
Troy, N.Y. 12180

Enigma Records

11264 Playa Court
Culver City, Cal. 90231

GRP Records

555 West 57th St.
New York, N.Y. 10019

JCI Records

5308 Derry Ave., Suite P
Agoura Hills, Cal. 91301

Rykodisc USA

Pickering Wharf
Building C-3G
Salem, Mass. 01970

Sea Breeze

P.O. Box 11267
Glendale, Cal. 91206

Sheffield Lab

P.O. Box 5332
Santa Barbara, Cal. 93150

Simax

Qualiton Imports
24-02 40th Ave.
Long Island City, N.Y. 11101

Sonata

Music Distributor
Rahlau 4-6
2000 Hamburg 70
West Germany

earning a deaf ear:

LOUD MUSIC & HEARING LOSS

Leigh Silverman

“God protects musicians. Otherwise, they’d all be deaf.”

—Dr. Mead Killion

I can't hear you!" screamed the tour manager for the heavy metal group Overkill, as guitar riffs ripped through the phone receiver. "Whatdida say?"

"I'm doing a piece for *Audio* magazine on hearing loss," I yelled back, holding the phone a foot away from my ear. "Can you spare an interview?" Drums rilled in over the guitars, drowning out our screaming match completely.

It is possible that as Mike Osgerby was talking on the phone, the hair cells in his inner ear were being damaged by the loudness of the sound check being done by the band in the same room. Unfortunately, we don't always know when our hearing is being damaged. When we do recognize a loss, it is often too late.

It is difficult to measure just how much damage pop musicians and their listeners have incurred, and susceptibility to hearing loss varies. We do know, however, that hearing loss is contingent on the duration and intensity of exposure. The Occupational Safety and Health Administration (OSHA) determined in 1970 that repeated exposure to 85 dB for more than eight hours could cause permanent loss, although OSHA regulations (Table I) permit exposures to 90 dB for eight hours a day, five days a week, over 40 years. For such exposure, the possibility of experiencing permanent loss is great, though the damage would be slight. The maximum continuous level permitted for two hours under OSHA regulations is 100 dB. Rock concerts expose

most audience members to about 105 dB and often last longer than two hours. According to Dr. Alvin Katz, surgeon director at the Manhattan Eye, Ear, and Throat Hospital, "Someone exposing themselves to fewer than 10 rock concerts would probably develop hearing loss." Dr. George Haspiel of St. Luke's Hospital in San Francisco agrees: "Kids exposed to rock music—their ears look very much like those of war veterans who have been exposed to artillery."

Nobody wants to admit they have a hearing impairment, especially a musician whose livelihood depends on his ability to hear. But performers such as 44-year-old Commander Cody, a veteran Bay Area rock musician, are now recognizing the problem. Cody, a professional musician since 1969, suffers from tinnitus, a ringing sensation in the ears that can last for days after exposure to loud noise. Chuck Stevens, former drummer with the San Francisco-based rock group Addie, was forced into early retirement when he developed tinnitus and a physical intolerance to loud music. "Whenever I played," recalls Stevens, "pains would travel up my arms, into my neck, and into my ears." Bassist Jay Morse, previously with his namesake group Morse Code, gave up playing when he began noticing aural discomfort during rehearsals. (His band rehearsed at levels up to 134 dB.) Now Morse's ears are so sensitive that he has to wear earplugs when he walks down the street.

The human ear can distinguish frequencies between 20 Hz and 20 kHz, roughly equivalent to the range from the lowest note on a pipe organ to the highest overtone on a violin. A normal pair of ears is most sensitive to sounds

Leigh Silverman is a contributing editor to EAR, a magazine for New Music, and plays keyboards in a new rock group, Thin Ice.



**TABLE I—
PERMISSIBLE NOISE
EXPOSURES ACCORDING
TO OSHA**

Daily Duration, Hours	Sound Level, dBA SPL
8	90
6	92
4	95
3	97
2	100
1½	102
1	105
½	110
¼	115

Figures given are for daily exposures per working day, over a 40-year working life. Hearing-conservation programs are mandated whenever steady-state noise exposures per eight-hour period exceed 85 dBA. Impact noise may not exceed a peak level of 140 dB SPL.

between 1 and 4 kHz, and less sensitive to frequencies outside of this range. From 0 to 140 dB, the scale for sound pressure level (SPL) approximates the range of sound audible to the human ear without pain. Because we are able to perceive such a wide spectrum of acoustic energy, the units of intensity used for measurement are compressed by using a logarithmic scale (based on powers of 10) on which the sound power multiplies by 10 with every 10-dB increase. For instance, the sound of a motorcycle at 25 feet (90 dB) would have 1,000 times the power of two people carrying on a conversation in the same room (60 dB). A-weighted measurements of sound level (expressed as dBA) are made using a filter on the sound-level meter which matches its frequency response to that of the human ear.

The ear is an efficient, delicate instrument which converts sound energy—in a series of rapid, complex procedures—into electrical impulses which the brain interprets as sound. The outer, cartilaginous flaps of skin

(pinnae) located on either side of the head serve to harness sound energy from the air and funnel it into the ear canals. The pinnae help us determine the direction from which sound is travelling. The auditory canal resonates at about 3 kHz, which is why the ear is most sensitive near that frequency.

The middle ear acts as an energy converter and safeguard against high amplitudes. As sound bumps up against the eardrum, which separates the inner and middle ear, this membrane oscillates in response to the changes in air pressure. These vibrations are translated to the oval window, a much smaller membrane opening onto the inner ear (or cochlea), via the three smallest bones in the body: The hammer, the anvil, and the stirrup. As high-intensity sound waves pass through these three ossicles, a muscle contracts, inhibiting the vibration of the stirrup. This process is known as the acoustic reflex.

The inner ear is the sound receiver in this complex, high-fidelity system. A spiral-shaped chamber filled with fluid, the cochlea contains the basilar membrane, on top of which lies the organ of Corti, composed of about 20,000 hair cells. As sound passes through the oval window into the cochlea, it sweeps across the delicate hair cells, each of which is tuned to individual frequencies. When a hair cell is stimulated by acoustic energy at or near the frequency to which it is tuned, it sends electrochemical neural impulses to the brain, which reads the signals as sound. As intense sounds enter the ear canal, they bend the delicate hair cells along the basilar membrane. Usually, a good night's rest will restore them to normal. However, repeated exposure to loud noise will cause them to stiffen and die.

Noise doesn't have to be painful to be too loud. As high-intensity sound waves pass over hair cells, they first damage those that respond to upper frequencies. "The portion of the basilar membrane that controls high-frequency sounds," according to Dr. Maurice Miller, chief of audiology at Lenox Hill Hospital, "is extremely vulnerable because the blood supply to that part of the cochlea is not good, in addition to the fact that this region absorbs the greatest brunt of vibratory insult." Dr.

**TABLE II—
TYPICAL SOUND LEVELS**

Level, dBA	Source
194	Theoretic maximum for pure tones
188	Rocket launching pad
150	Jet engine test cell
140	Gunshot

Pain Threshold

130	Air-raid siren
120	Live rock music Thunderclap Propeller aircraft Auto horn (3 feet)

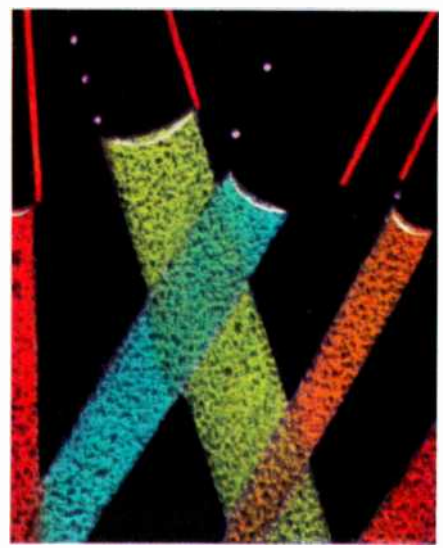
Discomfort Threshold

110	Pile driver Snowmobile (from driver's seat) Sandblaster
100	Subway train Pneumatic drill Diesel truck Police siren (100 feet)
95	Ride in convertible on freeway
90	Electric lawn mower Motorcycle (25 feet) Heavy truck (50 feet) City traffic
85	Average factory Electric shaver

Hearing Loss Risk Threshold

80	Hair dryer Alarm clock (2 feet) Garbage disposal
70	Freeway traffic Noisy restaurant Vacuum cleaner
60	Conversation Air conditioner (20 feet)
50	Light auto traffic (100 feet)
40	Quiet office Quiet home
30	Audible whisper
20	Rustling leaves Broadcasting studio Soft whisper
10	Barely audible
0	Threshold of hearing

*Hearing loss can develop
in rock fans after
fewer than ten concerts.
Musicians, whose careers
depend on their ability
to distinguish sounds,
are unfortunately at far
greater risk.*



Mead Killion of Etymōtic Research, a manufacturer of hearing-protection devices, agrees: "It is highly likely that the reason most people exhibit noise-induced hearing loss is because vascularization at the cochlea is not good, making it more susceptible to damage." Often, the initial hearing damage goes unnoticed until we harm our ability to hear the middle frequencies—those in the range of 1 to 2 kHz, which allow us to distinguish speech. Usually the first warning sign is the onset of a temporary threshold shift (TTS)—the muffling sensation that you sometimes get after a rock concert or high-level listening on your stereo. This means that if you normally can hear, say, a 1-kHz tone at 0 dB SPL, then after one to two hours of high-level listening, your shifted threshold for that frequency may be 40 to 50 dB. Typical recovery can take anywhere from a few hours to several days. Repeated exposure may result in a permanent threshold shift (PTS), in which hair cells undergo irreversible damage.

Sound reaches the inner ear via two pathways. It is either conducted by air into the ear canal, or it vibrates at the temporal (temple) bone, thereby stimulating the cochlea directly. Hearing loss associated with the outer and middle ear, in which something prevents the mechanical transmission of sonic energy, is called conductive loss. Some causes of conductive loss are perforation of the eardrum, infection, allergy, a bad head cold, and wax buildup. People with a conductive loss often show some or all of the following symptoms: Tolerance of loud sound, soft-spokenness (their own voice resonates in the inner ear, but everyone else's enters through the outer ear, so they often soften their voice to match others'), and the ability to hear speech well over background noise (their loss prevents them from hearing "white" noise and therefore allows them to concentrate on the person addressing them).

A more serious kind of hearing loss is the sensorineural type, which directly affects the cochlea or the nerve pathways from the inner ear to the brain. The main cause of this kind of loss is exposure to high-level sound. A person with sensorineural loss may hear voices clearly, but might have

trouble understanding what the voices are saying because consonant sounds are high-pitched and weak in intensity. Words such as "laugh" and "gaffe" or "cake" and "bake" would start to sound alike. Someone with this type of loss might also speak unusually loudly. A person hears his own voice through bone conduction, and an inner-ear or nerve malfunction reducing bone conduction would make his own voice sound softer. Therefore, he would speak louder to compensate.

Tinnitus, a ringing sensation in your ears, can be caused by the ear nerves responding to noise trauma. It is a very common and early felt condition associated with sensorineural loss. This problem can also occur with conductive loss, however. Musicians should think of tinnitus as a danger signal. Although this condition may be episodic at first, it can evolve into a permanent condition after repeated exposure to excessive noise. The duration of tinnitus depends on the severity of the damage. A conductive loss may be medically treated or surgically repaired, so with this kind of loss, tinnitus can be temporary. Sensorineural losses, with rare exceptions, cannot be cured, so tinnitus in this case can well be permanent. The pitch of tinnitus is higher in sensorineural impairments than in conductive types, and it has been reported to reach levels as high as 70 dB. That's like listening to a vacuum cleaner placed right against your ear.

Another symptom that accompanies sensorineural hearing loss is recruitment, which is characterized by a sharp increase in a sound's perceived loudness after a relatively small increase in that sound's intensity. A person with this condition might hear 50 dB very faintly, while 60 dB might seem inordinately loud.

Pitch distortion, also a symptom of sensorineural dysfunction, can be especially detrimental to musicians.

When this occurs, certain tones sound higher or lower than they really are. In other cases, one ear hears a tone normally while the other perceives the pitch as unusually loud or as noise instead of a pure tone.

A mixed type of loss combines conductive and sensorineural damage. An example of this is a person with a hereditary sensorineural loss who has an ear infection.

While excessive noise is primarily associated with hearing disorders, whatever sound enters the ear often affects the rest of the body. When the body registers loud noise, all parts of the organism stand alert. According to an article in *Science News*, Volume 121, June 1982, "The Environmental Protection Agency sums it up: 'The body shifts gears. Blood pressure rises, heart rate and breathing speed up, muscles tense, hormones are released into the bloodstream, and perspiration appears.'" It is evident that the body reacts to loud noise as it does to other types of stress.

The heart receives the most stress from noise. High-level sound can cause blood vessels to change in size (vasoconstriction), impeding normal blood flow. It can also produce a significant rise in blood pressure and an increase in cholesterol and triglycerides, which are known to create blockages in arteries.

The digestive tract also suffers from noise stress. One byproduct of hormonal activity is an increased secretion of hydrochloric acid in the stomach. In certain people, this can cause ulcers. Another recognized symptom is spasms along the intestines, leading to diarrhea or irregularity. As Martin Polon of Polon Research International points out, "One notices increased bathroom trips in roadies and rock musicians." Polon terms this phenomenon "disco dump."

The respiratory system remains reasonably unaffected by excessive



The first warning sign of hearing loss is usually temporary threshold shift, which makes sounds seem muffled as you leave a noisy club or remove your headphones after high-volume listening.

noise, but the reproductive system can become greatly influenced by sound-induced hormonal output. In men, research indicates that sound can increase sexual drive while diminishing sexual potency. In pregnant women, sound can alter the rate and form of fetal development.

Another hazard of high sound levels is a distressed immunological system. Research indicates that agents in our immune system—such as eosinophils, the white blood cells that fend off allergies, and gamma globulin, a plasma protein that fights various diseases—become scarce when the body is subjected to high noise levels.

Psychological effects range from irritability, tension, and insomnia to symptoms as severe as epilepsy. A high amount of sonic exposure can also induce unwanted levels of chemicals in the brain.

With these facts in mind, one wonders how detrimental sound levels could be all but ignored by the music world. Perhaps the biggest factor is fear. Says Dr. Michael Santucci, audiologist with the Chicago-based Sensaphonics Inc., "Rock musicians are afraid of what might have already been done. Or they want to be able to say that they can play loud and it doesn't bother them." An unavoidable stigma surrounds hearing loss. We tend to associate rock and roll with youth, while deafness evokes old age. And even those who are concerned aren't always willing to wear hearing protectors, especially on stage. Jimmy Matheos, guitarist with the heavy metal group Fate's Warning, wears earplugs during practice sessions. But when it comes to performing, he says, "It takes away from some of the energy I feel on stage." Perhaps in some cases, sheer neglect prevents musicians and those who engineer their music from conserving their hearing. In a survey performed by Sensaphonics on the Engineering and Recording Society (EARS)

of Chicago, 94% of the respondents felt they had experienced hearing loss, but only 14% had ever been tested for it. Only 66% had ever used a sound-level meter to monitor their work environment.

In a 1986 audiometric survey, members of the Los Angeles chapter of the Audio Engineering Society—which includes some professionals who are regularly exposed to high-level sound—were found to exhibit some hearing loss. Among those tested were recording and mixing engineers, managers, manufacturers, salespeople, students, teachers, and clerical workers. Over 10% exhibited impairment at 4 kHz, and all groups showed some damage in the range from 4 to 6 kHz. The loss averaged 15 dB, and it was considered significant enough to be attributed to noise exposure and not simply to aging. Results of this screening were consistent with surveys performed in 1975 and 1976.

Some musicians, however, are taking the issue into their own hands. Bassist/vocalist Kathy Peck decided to do something about her hearing after suffering an acute case of tinnitus following a San Francisco performance by Duran Duran and her own group, The Contractions. Peck heard "bongo drumming" in her ears for days and finally saw a physician, who informed her that she had suffered a 40% loss. Her loss was a gradual one, resulting from otosclerosis—the growth of a spongy bone over the stirrup, impeding its movement. Loud music had aggravated her condition. Peck teamed up with Dr. Flash Gordon (yes, that is his name), medical director of the Haight Ashbury Free Medical Clinic, to form the H.E.A.R. Project (Hearing Education and Awareness for Rockers). Peck and Gordon have plans to initiate a free screening program and to make information on hearing conservation available to the rock industry. Recently, the organization sponsored

a benefit at the Rock Bowl in San Francisco. Participants heard lectures, read about hearing conservation, and received free earplugs. Peck, who has a conductive loss, concedes that a lot of people in the industry are hard of hearing. "It's a sad thing," she says, "because rock musicians aren't really invincible. We're human."

At a rock concert, much of the potential sound damage depends on the size and structure of the performance space. Says Polon Research International's Martin Polon, "Some halls eat up more sound than others." Large arenas tend to have long reverberation times—especially since, unlike small clubs, they're not usually equipped with sound-absorbing material such as curtains or carpeting. Professor Steven Berman of the Medical College of Pennsylvania says that "a lot of these places want the music to stay loud, so they're not acoustically treated." At outdoor stadiums, of course, the volume has to be turned way up because there are no walls for the sound to bounce off.

A typical sound system used in an arena is powered by 50,000 to 100,000 watts of amplification, says John Stillwell of Dawk Sound. Stillwell, who has engineered Bruce Springsteen's concerts, says The Boss regularly uses 100,000-watt sound systems. The speakers are aimed at the audience, but sound pressures on stage, near the speakers, can be as high as, or higher than, those reaching the audience. In addition to the 200 to 220 speakers aimed at the crowd, there are monitors pointing at the musicians from no more than 3 or 4 feet away. Further, the bodies and clothes of the audience tend to sponge up the sound; as a result, according to a 1974 report in *Acta Oto-Laryngologica*, sound levels in the sixth row have been measured at approximately 15 to 20 dB less than on stage. Dr. George Hapsiel of St. Luke's Hospital confirms this: "The lead singer gets the blast sooner than the audience. Sound loses its power as it travels, so he gets it worse than the crowd." Jimmy Matheos of Fate's Warning feels that drummers may be at greater risk than other musicians: "Our drummer is not right in the main line of action, but he's got a drum monitor aimed right at his head."

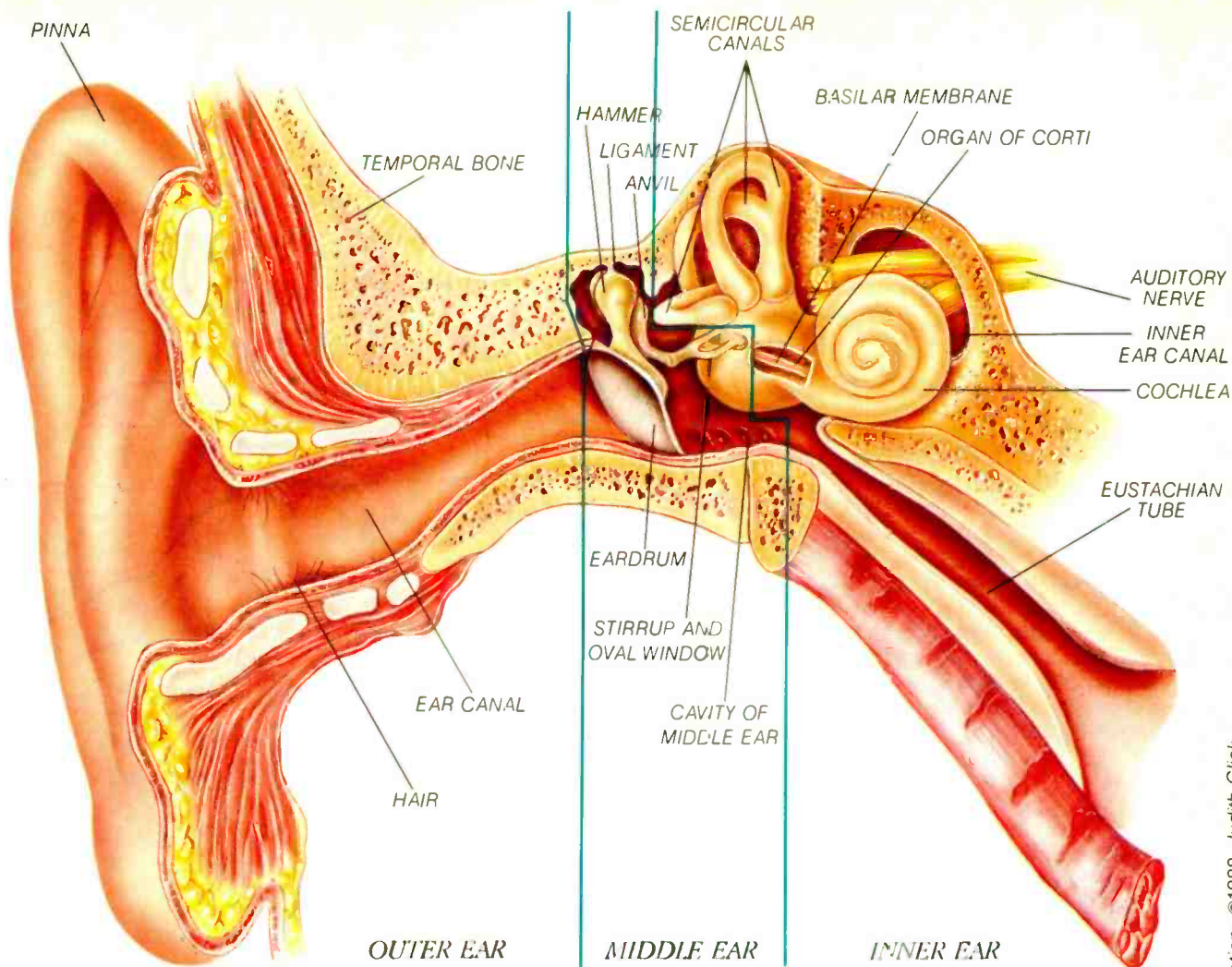


Illustration: ©1988, Judith Glick

The human ear is a complex, valuable, and vulnerable organ.

Manowar has been documented as the loudest band in the world by the *Guinness Book of World Records*. Claims the group's bassist, Joey DeMaio, "Rock music has to be played at a certain level to be appreciated." Commander Cody agrees: "Part of the political statement of rock 'n' roll is that it's loud and parents don't like it." But unlike many groups, the members of Manowar take the necessary precautions to preserve their hearing by wearing earplugs.

With over 125 types of hearing protectors in the market today, it's not difficult to find one to suit your individual requirements. Hearing-protection devices (HPDs) come in many shapes and sizes, and you will need to experiment, through trial and error, in order to find one that offers the optimum comfort and protection.

There are three different types of HPDs. Earplugs are inserted directly into the ear canal and come in various types of material, including foam, rubber, wax, plastic, and fine mineral fi-

ber. Earmuffs are worn over the head, with a cup over each ear. Canal caps are held against the outer ear by a headband. Earmuffs and plugs both provide high attenuation, but most rockers choose earplugs for their combination of convenience, cosmetics, and comfort.

The most important thing to remember when trying various earplugs is to find a brand that will provide a tight seal. As Elliott H. Berger of E.A.R. Division has pointed out, sound can easily pass by a loosely fitting plug, lowering attenuation by 5 to 15 dB. A well-fitting plug will reduce the sound pressure level anywhere from 20 to 35 dB. All HPD manufacturers supply Noise-Reduction Ratings (NRRs), indicating their product's effectiveness. Always read the accompanying instructions in order to get the proper fit and to ensure maximum attenuation. Foam plugs, such as the E-A-R or Husher brands, provide a comfortable fit and high protection, and can be purchased at any drugstore. They're not messy,

like wax inserts, and mold to any ear canal. Rubber plugs—such as the Sonic II, manufactured by North Co.—can be used regularly. Although these don't offer the comfort of E-A-R plugs, they have a built-in diaphragm which slightly reduces the muffled effect often associated with hearing protectors. Richard Sanders, manager of the bands White Lion and Overkill, finds that Sonic II earplugs help him endure what he terms "painful" rehearsals. Custom-made ear molds provide less attenuation (usually 15 dB), but they are designed specially for your ear and therefore can provide maximum comfort. While no plug can deter sound from entering your inner ear via skull bone or tissue, custom ear molds are designed so that the plug does not vibrate within the ear canal, thereby transmitting the vibrations to the cochlea.

Though not cosmetically suitable for performing musicians, earmuffs are often used by roadies and sound engineers. Rich Breen, head recording en-

*Loud sound makes
the body shift gears:
Heart rate speeds up,
blood pressure rises,
and muscles tense.*

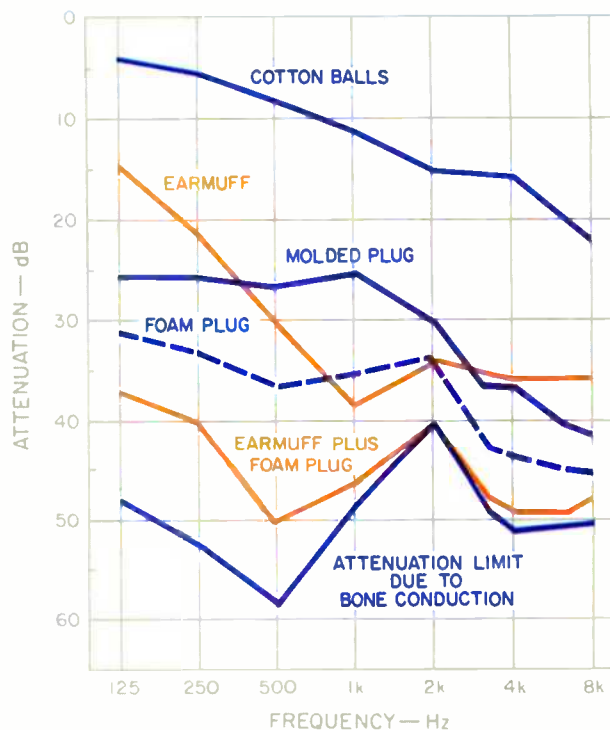
gineer for Manowar, notes that the group always carries aircraft protectors with them. "They're the only band that gave me a pair of hearing muffs in the studio," he says. Earmuffs don't provide much low-frequency protection, but they work better than earplugs in the range around 1 kHz. During rehearsals, they also provide an excellent alternative for people who are unable to wear earplugs due to excessive wax buildup. It should be noted that, for maximum attenuation (up to 40 dB), a combination of earplugs and earmuffs can be used. However, the attenuation achieved by both devices worn simultaneously does not equal the sum of the attenuation of each device when worn individually.

Canal caps should not be used as a substitute for earplugs or earmuffs because they provide minimum protection and comfort. However, for someone exposed only intermittently to high noise levels, they can be easily worn around the neck and don't have to be inserted into the ear canal.

In addition to lessening the intensity of sound waves entering your inner ear, HPDs can also help you discriminate sounds better in noise environments exceeding 85 dB. The ear, like an amplifier, goes into a distortion mode at high levels. This phenomenon is called clipping. An HPD reduces the sound level so that the ear can function adequately. According to Dr. Gordon of H.E.A.R., "Just as an amp can clip at high output levels, the transducers in your inner ear can also distort by having the input energy at too high a level. By putting earplugs between the inner ear and the sound source, you can avoid that clipping." HPDs also cut fatigue, allowing musicians to play for longer periods.

One complaint often heard from rock musicians is that HPDs make them feel as though their head were in a barrel. This condition is called the occlusion effect. When the ear canal is blocked, sounds conducted through the skull are more easily heard, causing the HPD-wearer's voice to resonate inside his head. Inserting an earplug deeply into the ear canal diminishes this muffling sensation, but no earplug can completely skirt the occlusion effect. As Dr. George Haspiel says, "The more stuffed up you feel, the better job

Attenuation provided by various hearing-protection devices. After Elliott H. Berger, High Fidelity (July 1988).



the plug is doing." Elliott H. Berger, however, adds that inserting a plug more deeply will offer increased protection as well as diminished occlusion. Members of Manowar avoid the sensation of stuffiness by wearing one earplug, alternating ears daily.

Some recent developments have been made in HPDs to reduce occlusion. Etymotic Research has designed an earplug called the ER-15, which attenuates at low frequencies as much as it does at high frequencies. This custom-fit ear mold blocks out 15 dB, and it can provide the listener with clearer, more balanced reception. It is recommended by the manufacturer for "the person whose hearing is not really at risk, but who would prefer to hear without discomfort at amplified music concerts." Another recent development is now available from Sensaphonics. This custom earplug has a flat response (attenuation is constant at all frequencies), knocks out 23 dB, and has a built-in valve that allows for ventilation within the ear canal. Dr. Santucci notes that all custom earplugs shrink and need to be replaced every 10 to 12 months.

But hearing conservation goes beyond earplugs and earmuffs. It is an attitude, and an awareness. Dr. Santucci recommends that anyone exposed to loud music on a regular basis take precautions. First, educate yourself as to the possible dangers. Next, measure your sound environment with respect to loudness, duration, and proximity to the sound source. Reduce your exposure by wearing personal ear protectors and by taking longer breaks between loud playing or listening sessions. (Studio engineers and musicians should use headsets which have independent volume controls.) Also, have annual or semiannual hearing checkups for air-conducted and bone-conducted sound, speech understanding, and proper functioning of the middle ear and Eustachian tube. These checkups will help ensure the effectiveness of your program and will monitor any hearing problems unrelated to loud sounds. Finally, use common sense. As bassist Jay Morse advises, "Anyone who goes to dance clubs, rehearsals, or concerts should listen to their ears. If things sound too loud—they are." **A**

Mondial's contract-built Aragon amplifiers have shattered the high-end price barrier. Ken Kessler wonders: are they the bargains of the decade?

THE ARAGON 4004 amplifier is the result of what Mondial's management call the Aragon Audio Project Team. By delegating aspects of the products' design to outside specialists, the company has produced two amplifiers and a preamp which meet a set of very tight standards.

First, Mondial pegged the goods to sell at above mid-fi levels but way below the lunacy point. Then, the stuff had to have the kind of finish and appearance which wouldn't drive away non-tweaks (see the Primare review in March for further thoughts on this approach). It had to be reliable. It had to sound amazing. And it had to be made in the USA.

Despite such seemingly opposed goals—good sound *and* good looks? Street cred *and* reliability? — Mondial accomplished all of the above by using hired guns. The key player is Krell's Dan D'Agostino, who designed the circuits, specified the parts and established the quality-control programme. When word leaked out about his involvement, the Aragons were dubbed instantly as 'poor man's Krells'. This causes problems for neither, for Mondial admits that the Aragon amplifiers are not surrogate Krells, selling as they do for a much lower tariff. As for Dan D, he is quite happy making his cost-no-object beauties; his consultancy simply proved that he can cook up a storm even with price constraints.

Having decided that all Aragon units must fit into a space no deeper than 14in and no wider than 19in to ensure that domestic acceptability would not be an issue, Mondial enlisted Robbii Wessen to provide the aesthetics. Wessen, cover artist for *The Absolute Sound*, is one of those rare individuals who can marry visual style with hi-fi purpose, a far better choice than, say, a pure industrial designer or a mere hi-fi nut. Wessen added class to what is basically a box by keeping it absolutely simple, yet incorporating touches like the chamfering around the on/off switch, subtle badging and the 'signature' V-groove in the top of the case. Jokes aside (a built-in notch filter, a holder for your Watts Preener), this is not merely a styling conceit, it's a ventilation port. Although this is a Class AB design — one of the primary differences between an Aragon and a Krell — the 4004 runs warm. The groove means that customers who insist on placing something on top of it won't be cutting off all avenues of ventilation.

Yes, the vent, coupled with 'flow-through' openings below, does work. I ran the 4004 for eight hours a day into a 3 ohm load in a big room, the unit suffering only 1.5in of clearance between its top and the shelf above, and it never misbehaved, shut down, or blew up.

To complete the project, Mondial subcontracted the construction to a company specialising in military and medical equipment. Rather than buying and setting up a plant, training staff and suffering a learning curve, Mondial was able to initiate production through an up-and-running concern. This automatically guaranteed price control through the economies of scale, and quality control because of an existing regimen. This in itself is not a new idea; what's unusual is that Mondial stayed in the USA rather than seek help from the Far East.

D'Agostino has designed what is effectively a Krell without the Class A operation or the overkill power supplies. The power supply in the 200W/channel 4004 consists of two massive toroidals, one per channel, specified to fit when stacked into the 6.5in high case and to work from a US 15 amp AC line without tripping every circuit breaker in the house. There's no drama when switching on, no lights dimming. (The 100Wich 2004 uses a single dual-wound toroidal and fewer active devices, but is otherwise identical.) While Mondial doesn't suggest running the 4004 into the Apogee Scintilla's sub-1 ohm load, the amp is judged as able to play with nastier systems; neither the WATs nor the Divas caused problems.

There are no capacitors in the Aragon's signal path; but the Aragon does incorporate a digital protection circuit to prevent DC from the output and other unpleasantnesses. Whether an Aragon is as bomb-proof as a Krell I don't know, but I'd rather trust my home and speakers to this than to a couple of UK-made powerhouses I could name.

Nosey types who take the lids off amplifiers to see what makes them tick are going to find what look suspiciously like ICs in the driver stage, but they aren't — or so I gather. They're transistors installed in IC cases and are supposed to be more compact, easier to trim and much easier to match than conventional semi-conductors. Manufactured by Sprague, they're described as Quad Transistor Arrays, and Mondial points out that the tolerances are far tighter than bulk-purchase, garden variety transistors which have to be tailored for a circuit with heavy negative feedback or feed-forward tweaking.

As long as you've got the lid off, you may as well note the superb construction and componentry, including military-grade, glass-epoxy boards, 1% film resistors, gold-plated Teflon-insulated input connectors (sounds like a phrase from a rap record), fastidious cable routing and even the modular construction.

Externally, the piece is gorgeous, belying its price tag. The fascia, finished in a handsome charcoal colour, is machined from a 3/8in thick metal slab. The front sports only the on/off switch and a green indicator lamp. The back is fitted with Monster Cable's superb five-way binding posts (which accept industry-standard spaced bananas) and gold-plated Tiffany phono sockets. Another nice touch is that the legends on the back are printed both right-side-up and upside-down for people like me who lean over amplifiers when we're connecting the leads. Mains reaches the unit through an IEC three-pin connection. The fuse holder resides just above the mains input.

Using the Aragon exclusively for a couple of months, I've had it share signals with Primare, Sumo, Vacuum State and Rose preamplifiers, the Alphason Sonata-Ortoton combo and the AR Legend/Grado, Nakamichi CR-3E and CR-4E cassette decks, Yamaha and Sony CD players, and a load of speakers. Most of my heavy sessions involved the

Apogee Divas, but adaptability was measured through periods with the WATs, the new Monitor Audio R300s, AR's exotic cousins, the Rowens, Celestion SL600s and Myriad JBLs. Wires consisted of Lieder leads throughout, as well as some Sony ES cable, stretches of Monitor PC and some of that cheapo cable I refuse to identify. As for warm-up, I found the unit to reach optimum performance after a few hours, but cold listening isn't as bad as I've found in other designs.

Look, gang, this amp is a revelation. Mondial's Aragon 4004 is simply the biggest bargain in high-end audio, even if — when it's finally imported — the price suffers through tariffs. Though I wanted to get melodramatic and save the price for the very closing, I have to tell you that this retails for a truly approachable \$1495 in the USA. I want you to know this so that whoever grabs the agency doesn't kill it by trying to get £2000 for it over here. Even with the usual formula of \$1 = £1 (which at today's exchange rate of around \$1.80 = £1 *definitely* covers shipping, handling, duty, VAT, distributor's margin and retailer's margin), it's still a bargain relative to what else is on offer at £1500 in the UK.

With the possible exception of the Scintilla, this amplifier seems capable of driving any speakers to which it's attached. Hammering the hell out of it into the Divas and in a 7.1x7.4m room, I heard little that even remotely sounded like clipping, squashing or compression of dynamics, or lack of 'steam.' While this is not a match for the Krells I've used — even those rated at 100W rather than 200W — you're unlikely to need more oomph, and I value my ears too much for that. On a most basic level, that of sheer drive capability, the 4004 should deal with all but the most spacious of installations, filled with the hungriest of speakers and operated by masochists.

Sonically, whew, this is a real sweetheart. Run side by side with the lovely Nestorovic valve amps, I was knocked out by the 4004's tube-like grace and freedom from minor nasties. It's a characteristic D'Agostino trait, and one of the reasons why tube fanatics find little difficulty in moving to Krell designs. The warmth in itself is not the whole story — there are plenty of solid-state designs these days which can mimic the lushness and bloom of valve gear; rather, it's the civility which is evident regardless of the complexity, speed or dynamic demands of the material. At no point did the Aragon sound confused or reach its limitations, either in terms of dynamics or its ability to deal with subtle details amidst a near-chaotic performance.

The most impressive aspect of its performance, again keeping price in mind, is its lower registers. Both the Divas and the Rowens plumb the depths, and I've some recordings like the recent Willy DeVille 12in mix of 'Assassin Of Love' which will stretch any system in a downward direction. Extension? About the only thing lower is a TV evangelist. There's absolute control, superb transients without too much aggression, and a richness that's going to have you reaching for a copy of the Kodo drummers' CD. I know, some prefer things even tighter, but for that I prescribe alum root. Or a shrink.

The 4004's midrange skill is something to behold, with transparency that I've heard bettered only by designs costing two or three times the price, e.g. the Krells. Crystal-clear portrayal, virtually grain-free textures (and silences) — you will not believe how real a voice can sound, especially at this price point. The Juice Newton track on the Technics/EMI/HFN/RR CD compilation is a favourite test (for transients as well as vocals) because it hovers on a fine edge between acceptability and teeth-jarring sibilance. The Aragon resolved all that the cut can offer, and its freedom from additives kept Newton's 'T's and 'S's from spraying imaginary saliva against the grilles.

The smoothness extends all the way to the top, and I don't recall any time during my sessions where the upper frequencies manifested signs of traditional solid-state nastiness. Despite this seemingly forgiving nature, it was ruthlessly revealing of failings in recording technique and pressing quality, a trait some reviewers believe to be a fatal demerit. As I'm not of the school that says certain products can make bad recordings sound good (which sounds like a *tomorrow's World* justification for graphic equalisers), I judge this as part of the cost of living with high-end gear.

If this sounds like I'm presenting a case for the demise of all amplifiers costing above, say £1500 or £2000, let me point out that there are areas in which the 4004 is bettered. Having optimised my judgements around recordings of my own making, I know what some products are capable of doing when it comes to resolving the sense of space, of the actual venue in which live recordings are produced. I'd be the last to say that spatial considerations are as important as the tonal/sonic aspects of sound reproduction, but they are an integral by-product of accuracy. While the Aragon could reassemble a convincing soundstage in all three planes, its scale was level-dependent and less precise than most of its once-removed cousins, the Audio Research amplifiers I've used, and a host of other much dearer units. As its price point, though, I can name *nothing* which even comes close. Within that soundstage are rock-solid, three-dimensional images, which more than makes up for any vagueness at the stage extremities.

I know the maths for US imports, and I know what this *should* sell for over here. Unfortunately, I also know that the Aragon performs so well that — had I not splattered its US price over these pages — you'd be excused for thinking that it's a steal at £2500. Assuming that the distributor selected by Mondial is a *mensh*, you've just read about the best-value, smartest-looking, best-constructed, finest-sounding amplifier to the south of a Krell. And that, my friends, is a gift from hi-fi heaven.

To order your Aragon, write or call Mondial Designs LTD, 2 Elm Street, Ardsley, New York 10502, USA. Tel. (914) 693-8008.

1

PHILIPS CD880 COMPACT DISC PLAYER

Manufacturer's Specifications

D/A Conversion: Four-times oversampling (176.4 kHz) with digital filter and dual 16-bit D/A converters.

Frequency Response: 20 Hz to 20 kHz, ± 0.01 dB

Phase Linearity: $\pm 0.2^\circ$, 20 Hz to 20 kHz.

Dynamic Range: Greater than 96 dB.

S/N Ratio: Greater than 103 dB.

Channel Separation: Greater than 103 dB at 1 kHz.

THD: Less than 0.002% at 1 kHz.

Ultrasonic Noise Rejection: Greater than 60 dB above 24.1 kHz.

Output Level: Digital (electrical), 0.5 V peak to peak; optical, 780-nm wavelength; analog output, 2.0 V rms (fixed and variable in 64 steps of 1 dB each).

Headphone Impedance Range: 8 to 2,000 ohms.

Number of Programmable Selections: 20 "program blocks" (see text).

Power Requirements: 120 V a.c., 60 Hz, 30 watts.

Dimensions: 16¹³/₁₆ in. W x 3¹/₂ in. H x 14¹/₂ in. D (42.7 cm x 8.9 cm x 36.9 cm).

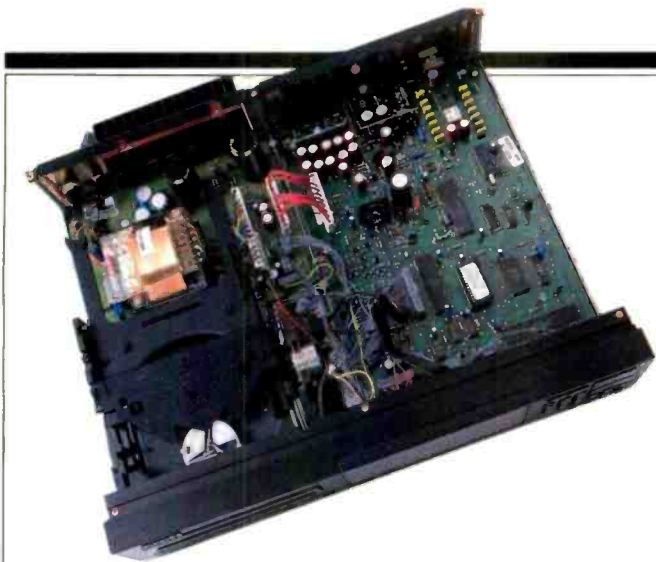
Weight: 22¹/₂ lbs. (10.2 kg).

Price: \$749.

Company Address: 1 Philips Dr., P.O. Box 14810, Knoxville, Tenn. 37914.

For literature, circle No. 90





In the June 1988 issue, I reported my test results for the Models CD960 and DAC960, the first CD player and separate D/A converter to be sold in this country under the Philips name. Of course, almost from the start of the Compact Disc era, we've had some excellent CD players available from Philips under the Magnavox brand name. It was rather unfortunate that the first Philips-labelled player proved to be less than state of the art when it came to linear, distortion-free reproduction of program material at all amplitude levels. Readers who follow these test reports may recall that when I played low-level, dithered test signals, the CD960 exhibited deviation from linearity of almost 15 dB at -90 dB recorded level on one channel and deviation of around 6 dB on the other.

I have learned that Philips is now "grading" their D/A converters. The best, in terms of linearity and freedom from other forms of distortion and noise, are used in top-of-the-line units such as the CD880 under review here; somewhat poorer converters are relegated to low-end players. I have been assured, however, that even the lower grade D/A converter chips are now coming off the line with better linearity performance than was the case in the CD960. When the top-grade D/A chips are used, as in the CD880, I can attest to the fact that linearity is superb, as are the player's other performance characteristics.

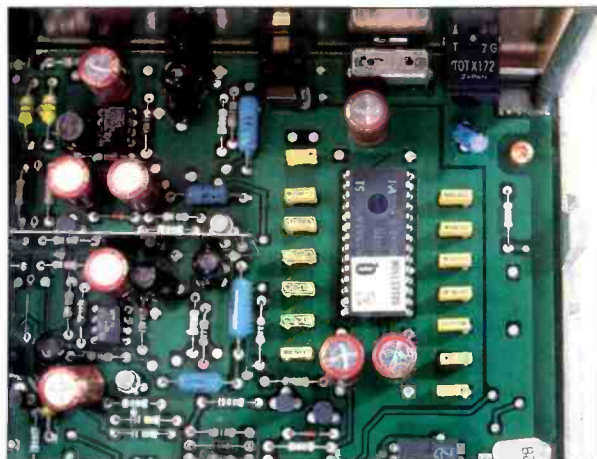
One thing that has been carried over from the earlier unit is Philips' innovative Favorite Track Selection. Well worth having, this feature allows you to store desired tracks of a great number of CDs in the player's memory. Once you have done so, the next time you insert one of those discs, you can elect to have only the previously designated tracks or selections played. The FTS system, as incorporated in the CD880, will accept up to 1,757 entries, eight of which are used to identify the disc itself. The number of discs that can be stored with FTS depends on the number of tracks per disc that you program. For example, if you program five tracks per disc, then you will use $5 + 8$ entries per disc, or 13 entries. This would allow you to use FTS on 135 discs ($135 \times 13 = 1,755$.) Tiny numbered stickers supplied with the CD880 enable you to correlate the FTS number encoded in the player with the disc itself.

FTS should not be confused with regular programmed play. The CD880 can be programmed for a maximum of 20 memory blocks. Each track number takes up one block, while an index point takes up two. It is also possible to program play on the basis of start and stop time within a given track, although doing so uses up five blocks of program memory.

In addition to the usual convenience features—such as moving from track to track, fast search in either direction for a particular passage, moving to the next or to a specified index number within a track, and several forms of repeat play—this unit offers "Scan" play. With this function, the first 10 S of each track are played in turn, and track numbers can simultaneously be stored for programming. Finally, activating the "Shuffle" switch causes the tracks of a disc to be played in random order until the command is cancelled.

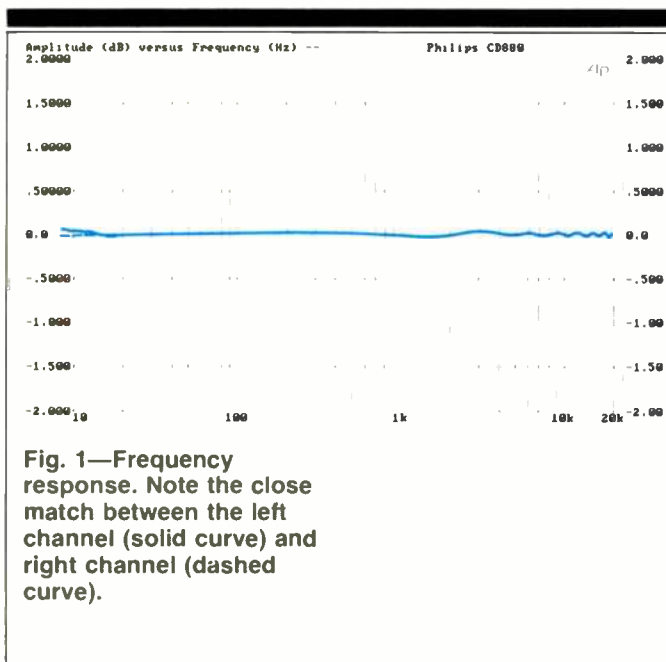
Control Layout

The front panel of the CD880 seemed particularly uncluttered and neat, in part because some of the functions, such as index access and variable output level adjustment, are available only on the supplied remote control. A power switch, stereo headphone jack, and phone level control are all positioned below the disc tray, which is opened by lightly touching a button on the front of the tray. A large display area to the right of the tray provides information about the number of tracks on the disc, the playing time, the state of play at any given moment, and the status of the player's special functions. It also indicates when no disc has been inserted or when a mistake is made in operating the player. A "Play Mode" switch beneath the display area has three settings. The first of these, "Norm," is self-explanatory. The "Copy" function inserts time gaps between tracks when dubbing onto tape, for use with tape players which have track-seeking facilities to detect such gaps. The "Auto" setting automatically puts the CD880 in pause after playing a track. The other controls beneath the display are pushbuttons for "Shuffle," "Repeat," "Time" (for choosing the type of time display, such as remaining track time, total remaining time, or elapsed track time), "A-B" repeat, "Scan," and



The CD880 uses a specially selected D/A converter, as shown by the "Q" sticker.

The front panel was neat and uncluttered, partially because some functions are available only on the remote control.



the left channel and 114.42 dB for the right. Bear in mind that these readings relate to the analog stages of the player, since, when playing the "no-signal" track of the CD-1 test disc, no digital circuitry is exercised. Spectral analysis of the residual noise (Fig. 3) shows excellent isolation from any hum-inducing components in the power supply. The rise in noise level at 60 Hz (or at its multiples), which I typically encounter with other CD players, is absent. This is true regardless of how low the level of those hum voltages is.

Dynamic range was measured in accordance with the proposed EIAJ Standard. EIAJ dynamic range is obtained by adding 60 dB to the THD measurement, expressed in dB, for a 1-kHz signal at -60 dB recorded level. Both channels yielded identical results for this test, with a THD reading of -36.9 dB and therefore a dynamic range of 96.9 dB—almost exactly as specified by Philips.

Figure 4 is a plot of THD + N (sometimes referred to as quantization noise or quantization distortion) versus signal level, referred to maximum recorded level. The slight rise at higher levels may be due to limitations of the analog stages or to the presence of out-of-band "beats," but even at 0-dB (maximum) recorded level, THD + N was still more than -86 dB. This would correspond to less than 0.005%, which

"FTS." Controls for track advance and reverse, play, pause, stop, and fast search are at the far right of the panel, as are the switches and numbered keys for programming desired selections.

The remote control duplicates all of the front-panel functions, with the exception of opening the disc tray. The remote also has buttons for index access and output level adjustment.

Optical and electrical digital outputs are provided on the rear panel, in addition to the fixed and variable analog or line-level outputs. An optical coupling cable and the usual shielded analog audio cables are supplied. Due to the proximity of the digital and analog outputs, an on/off switch for the digital output is provided, just in case the digital signal interferes with the analog signals. There are also remote-control jacks on the rear panel, an input jack for use with an external infrared remote sensor, and an output jack to control related Philips stereo components. A pair of easily removed clamps beneath the CD player protect and lock the disc tray's mechanism during shipment.

Measurements

Figure 1 is a plot of the frequency response of the CD880. Even the expanded scale of this graph cannot verify Philips' claim of amplitude linearity to within ± 0.01 dB. However, I can certainly attest to the fact that the departure from flat response from 10 Hz to 20 kHz never exceeded ± 0.1 dB, which ought to satisfy even the most demanding purist. The response curve was generated again for Fig. 2, along with a plot of interchannel phase versus frequency. It is obvious that there was no measurable interchannel phase difference, at any audio frequency, thanks to the use of two carefully matched D/A converters and proper time compensation.

A-weighted S/N ratio was about the highest I have ever measured for any CD player, with readings of 113.65 dB for



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H

A Harman International Company

The amazingly high stereo separation shows how much care was taken to minimize cross-coupling in this player's analog stages.

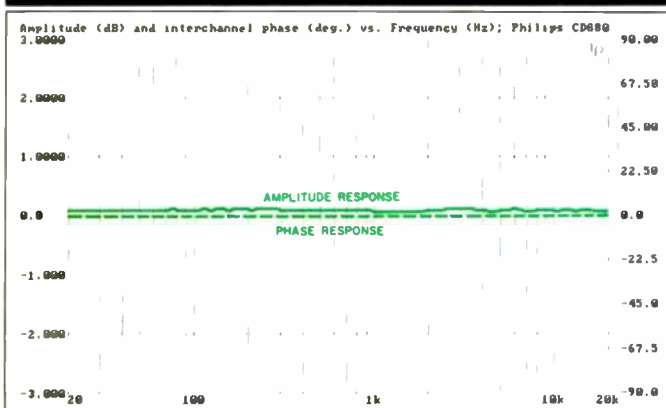


Fig. 2—Comparison between amplitude response of one channel and relative phase and phase response of opposite channel. Results show

careful matching of the D/A converters and proper time compensation. Phase, in degrees, can be read from right-hand scale.

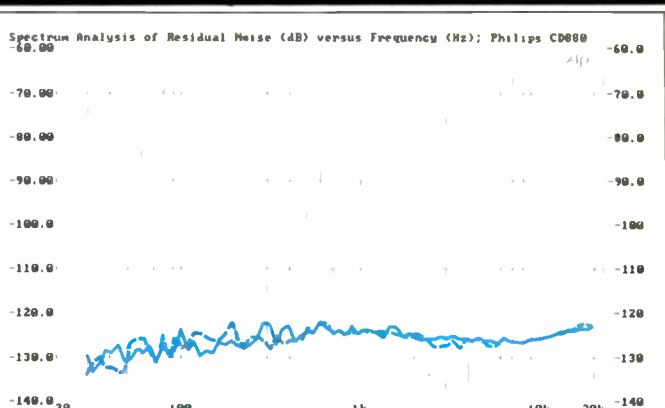


Fig. 3—Residual noise vs. frequency of left channel (solid curve) and right channel (dashed curve) for "quiet" track of CD-1 test disc. Note low noise

level at 60-Hz power-line frequency and its multiples.

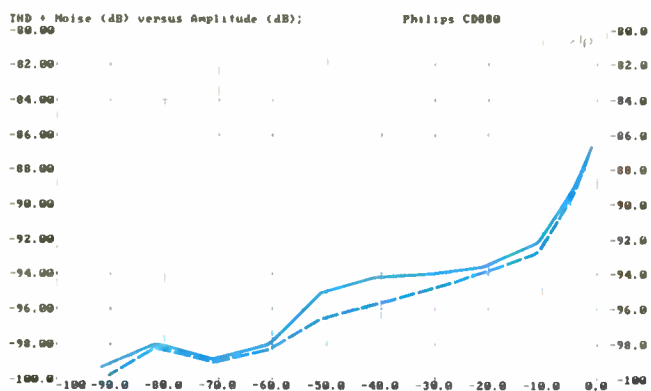


Fig. 4—THD + N vs. signal level for left channel (solid curve) and right channel (dashed curve).

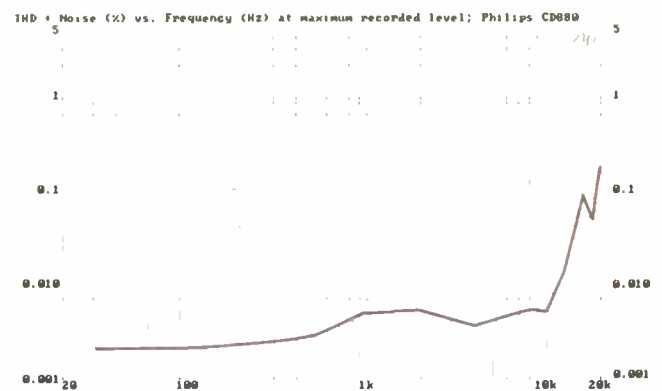


Fig. 5—THD + N vs. frequency at 0-dB signal level.

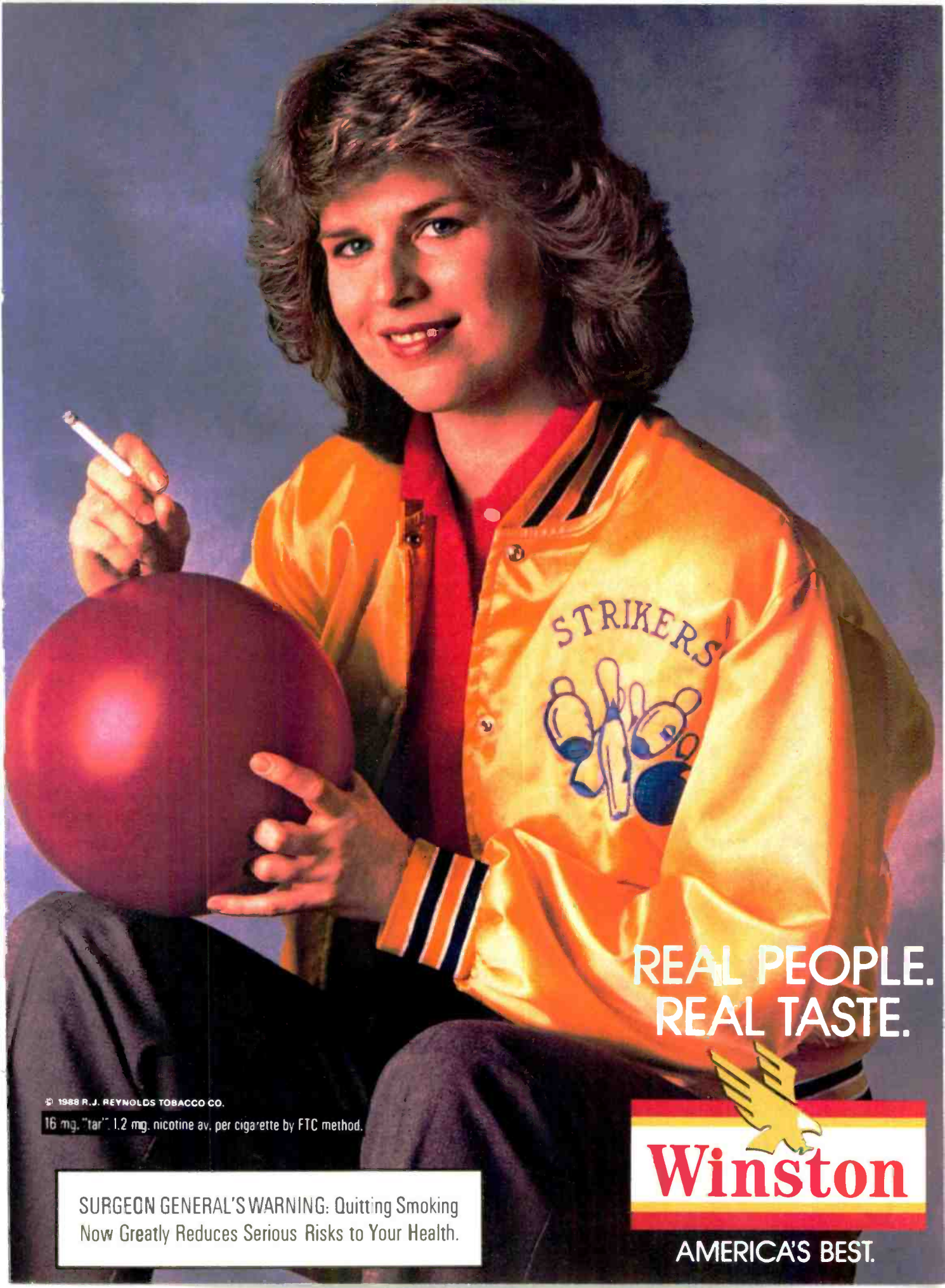
was confirmed when I plotted THD + N versus frequency for a signal at maximum level (Fig. 5). A spot check of SMPTE-IM distortion was also made, and the readings were extremely low: 0.00305% for the left channel and 0.00250% for the right.

I next played a 20-kHz test tone at maximum recorded level and used a spectrum analyzer to scan from 0 Hz to 50 kHz. The only spurious or unwanted product evident was the now-familiar "beat" at around 24.1 kHz. This is caused by the heterodyning between the signal itself (20 kHz) and the CD sampling frequency (44.1 kHz). The results are shown in Fig. 6.

At 10 kHz, the CD880 yielded over 100 dB of separation on either channel (Fig. 7). Although not a basic indication of sound quality, the amazingly high levels of separation pro-

vided by the Philips, even at high frequencies, give an indication of the care with which it was laid out and assembled. Crosstalk usually arises in the analog stages, where coupling between channels can occur. Obviously, steps were taken to minimize such signal cross-coupling to a degree seldom encountered with lesser players.

Perhaps the most outstanding aspect of the CD880's performance, and the one which distinguishes it from most of the competition, regardless of price, is the superb linearity it exhibits at low levels. Figure 8 is a plot of deviation from linearity, using undithered signals from 0 down to -90 dB. Even at the lowest levels, deviation from perfect linearity was barely greater than 1 dB for either channel. Even more remarkable is the deviation from linearity using the dithered signals available on the test disc, from -70 to -100 dB



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Winston

AMERICA'S BEST.

This unit's tracking and error-correction system is one of the most sophisticated that I've seen in five years of testing CD players.

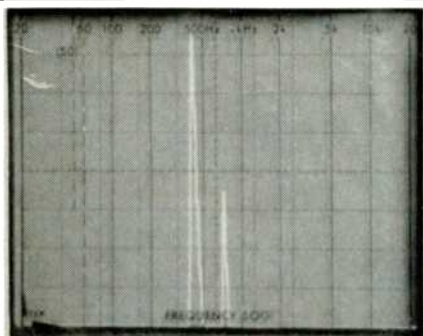


Fig. 6—Spectrum analysis of the CD880's output when reproducing 20-kHz signal. Note absence of spurious signals other than the common, 24.1-kHz "beat" tone.

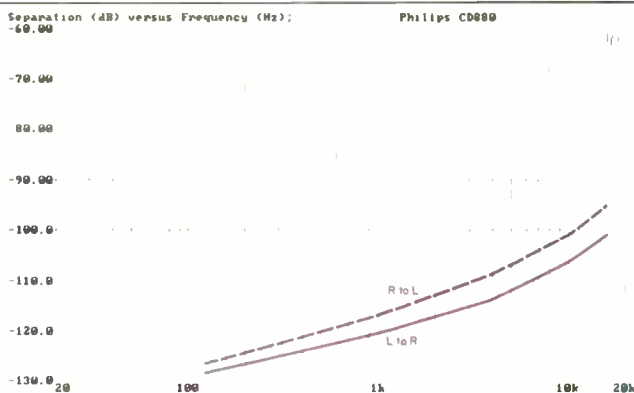


Fig. 7—Interchannel separation was unusually high.

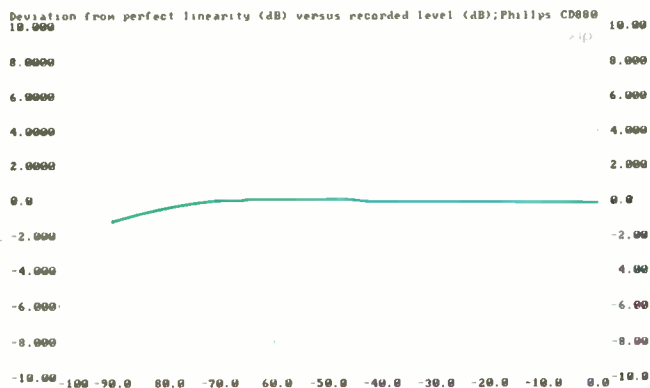


Fig. 8—Deviation from perfect linearity for undithered 1-kHz signal was maintained within about 1 dB almost all the way down to -90 dB recorded level.

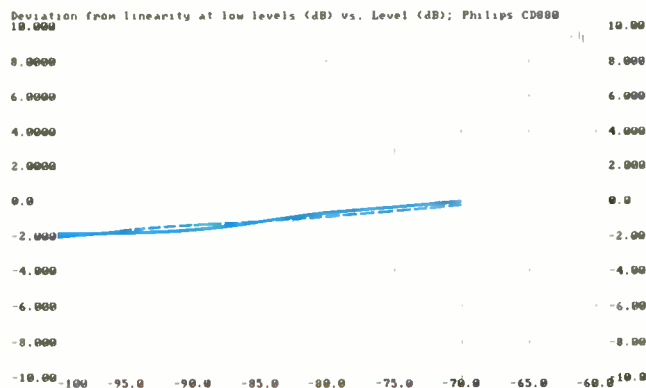


Fig. 9—Deviation from perfect linearity for dithered signal was within 2 dB from -70 down to -100 dB recorded levels for both left channel (solid curve) and right channel (dashed curve).

(Fig. 9). The Philips player was able to maintain linearity within 2 dB all the way down to -100 dB!

Further confirmation of the CD880's superb linearity was obtained when I ran the "fade-to-noise" test, using a 500-Hz signal that decreases in amplitude over a period of 30 S, from -60 to -120 dB. Discounting the noise that naturally shows up at the low-level extremes of this test, the CD880 was linear within about 3 dB down to signal levels well below the -100 dB mark, as shown in Fig. 10. In addition, the CD880 reproduced the steps of the monotonicity test signal (Fig. 11) with nearly perfect equality and symmetry. A very slight degree of asymmetry in the lowest step of this rising series can be detected. However, the waveform's appearance is far closer to perfection than I have obtained with most players recently subjected to this test.

The square wave reproduced by the CD880, shown in Fig. 12, is typical of that from players which employ digital filtering and oversampling as is the unit pulse of Fig. 13. The polarity of the unit pulse shows that this CD player does not invert polarity of music signals.

Use and Listening Tests

As I might have expected, the CD880 employs one of the most sophisticated tracking and error-correction systems I have run across since I began testing CD players nearly five years ago. There was little I could do to make the laser pickup misbehave—whether by tapping on the sides and top of the enclosure or by playing the assortment of "defects" discs I have now acquired. With such tests out of the way, I settled back to enjoy some of my most recent CD

SONOGRAPHE®

SC 1
SA 120



Designed and manufactured by conrad-johnson design, inc., the SONOGRAPHE® SC1 preamplifier and SA120 power amplifier derive from a proud heritage of musical accuracy and incomparable value.

The SONOGRAPHE approach to product design is uncommonly straightforward. Carefully conceived circuits designed with a minimum number of active devices and executed with first quality component parts will achieve both musical excellence and high reliability at moderate cost. Field effect transistors were chosen for the SC1 and SA120 because their distortion components are more musically natural than those of bipolar transistors. Careful device matching allows the use of low negative feedback circuits, resulting in clean, dynamic transients. Low impedance discrete regulated power supplies eliminate power supply induced distortions. Elegantly simple circuits, selection of essential features, and careful attention to production requirements make it possible to offer remarkable sonic refinement at an affordable price.

THE SC1 FET PREAMPLIFIER

The SC1 is a flexible all FET preamplifier featuring switching for one phono and five line level inputs, including two tape monitor/record loops. Its excellent signal to noise ratio and high gain permit the use of most moving coil and all moving magnet cartridges. Metal film resistors and polypropylene or polystyrene capacitors are used throughout the circuit. The FETs are hand selected for conformity to design specification. The musical performance of the SC1 will embarrass many solid state units at up to ten times its price.

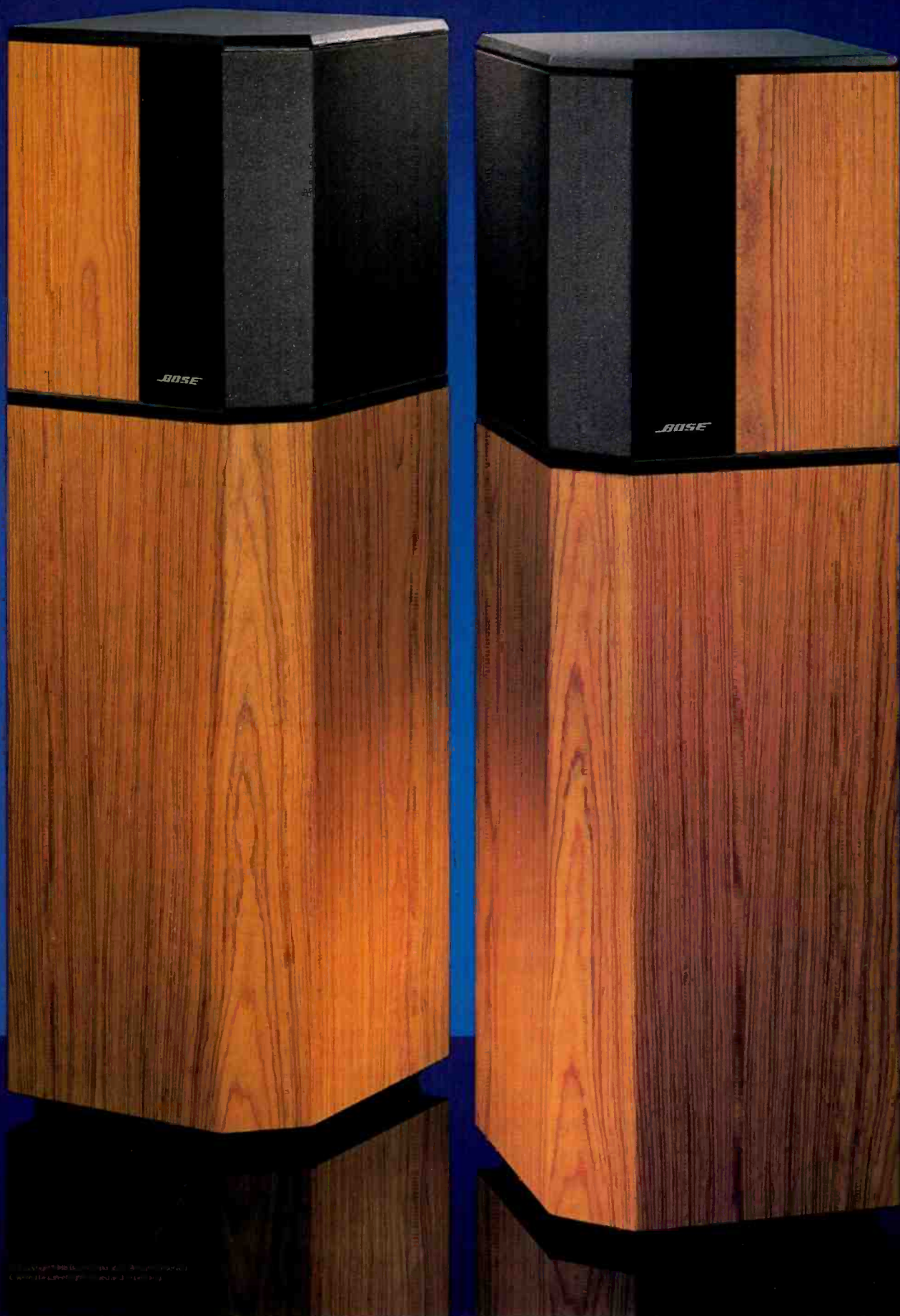
THE SA120 FET POWER AMPLIFIER

The SA120 is a gutsy, high current MOSFET amplifier able to deliver sufficient power and current for nearly any high quality loudspeaker system. The unique approach of the SA120 entails 40 to 60 db less negative feedback than typical transistor designs, allowing dramatic dynamics without a trace of hardness. The audio circuitry is executed entirely with metal film resistors and polypropylene capacitors.

G

the conrad-johnson group 2800 R Dorr Ave. Fairfax, VA 22031 703-698-8581

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Introducing the most powerful expression of a new technology:

The Bose® 10.2™ Series II Direct/Reflecting® system with Acoustimass® speaker technology.

Inside and out, it's a speaker unlike any other.

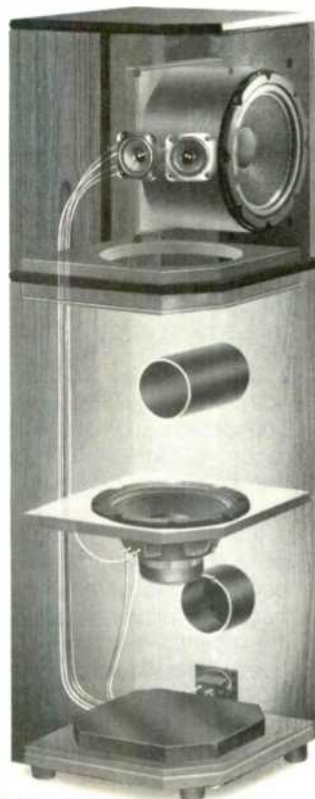
The new Bose 10.2 Series II speaker successfully harnesses a series of audio technologies to take the listener one step closer toward the goal of all speakers: the realism of live music. The 10.2 Series II speaker combines the most powerful version of Acoustimass speaker design available for the home with the proven, critically-acclaimed benefits of a Bose Direct/Reflecting® system. The result: a musical listening system with *no compromises*—one that's at home in any environment.

Technology in harmony with home aesthetics.

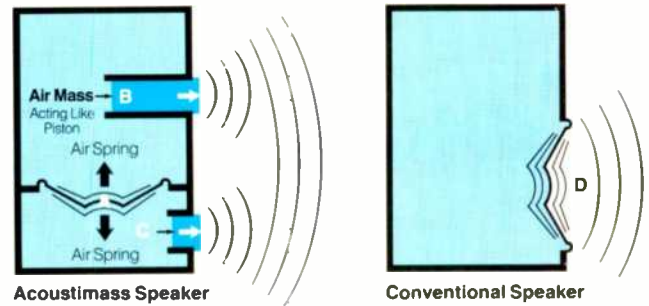
Moreover, the 10.2 Series II system brings lifelike sound into the living environment without overwhelming it. Each speaker's genuine wood veneer, hand-crafted Acoustimass enclosure produces the bass necessary to make even the most demanding music come to life, yet requires just *one square foot* of floor space. The system's Stereo Targeting® arrays precisely shape and control sound, providing listeners—regardless of where they stand or sit—with full, balanced stereo sound from both speakers. Where the speakers look best is also where they *sound* best.

Greater musical realism with any sound source.

Like all Bose Direct/Reflecting® speakers, the 10.2 Series II system is designed to accurately reproduce much of the clarity and spaciousness of live music. This strict attention to sonic detail is carried through to the lowest notes, where Acoustimass speaker technology provides much of the realism and impact normally experienced *only* in the concert hall. The system's purer sound provides the dynamic range and high power capability required for optimum results with any audio or video system and software—especially digital.



How an Acoustimass® speaker works.



Improving speaker performance means first reducing distortion. The design of an Acoustimass® speaker *substantially* reduces distortion (see diagrams and graph). The benefits of this patented speaker technology are purer sound and an increase in the dynamic range of bass performance.

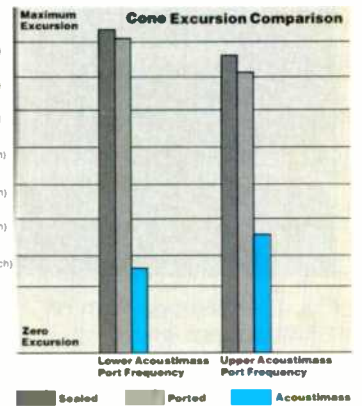
Left: An Acoustimass speaker *launches* sound into the room using two masses of air working like pistons (B&C, darker blue), rather than by a surface vibrating directly into the room. *The sound launched into the room by the Acoustimass speaker's air pistons is the purest sound that can be produced by present technology.*

Right: A vibrating cone radiating directly into the room (D) produces unfiltered sound.

Cone Excursion Comparison.

(lower excursion means lower distortion)

Graph: The distortion produced by any speaker rises dramatically with its cone motion, or *excursion*. At port-tuned frequencies, a typical Acoustimass speaker's cone has less than 1/16 the maximum excursion* of sealed and ported cones. Inside an Acoustimass speaker, the interaction of the air springs with the air masses in the ports produces a very high pressure at the surface of the cone. This greatly reduces the cone's excursion, and therefore reduces distortion. The air springs act with their respective masses to form low-pass filters, removing any small distortion components generated by the cone.



*based on cone level measurements at 128 watts input

Judge for yourself.

Ask your authorized Bose dealer to demonstrate the new Bose 10.2 system with Acoustimass speaker technology against any other speaker—and hear the difference for yourself. For more information, call Bose Corporation toll-free at 1-800-444-2673 between 9 a.m. and 5 p.m. EST.

BOSE
Better sound through research.

Driving an amp directly, the CD880 came about as close to total realism as I have yet heard from electronic sound gear.

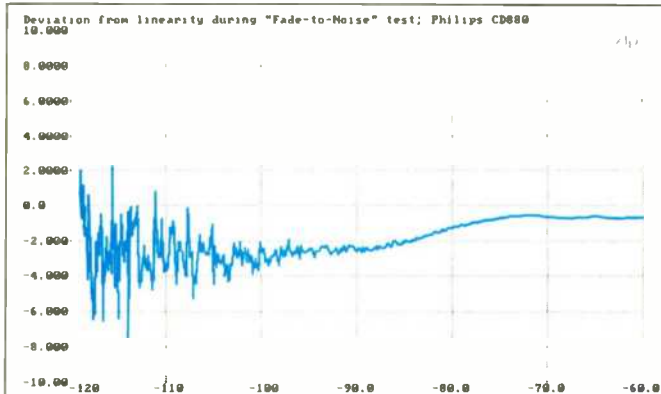


Fig. 10—Linearity deviation for EIA "fade-to-noise" test of dynamic range was within 3 dB to well below -100 dB.

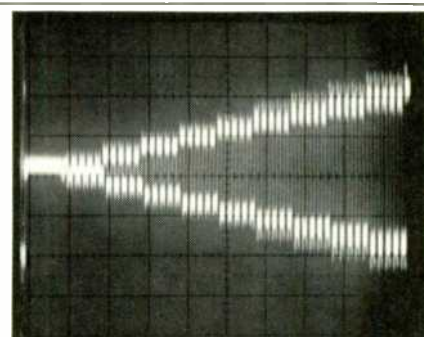


Fig. 11—Monotonicity test. Note the unusually high degree of symmetry.

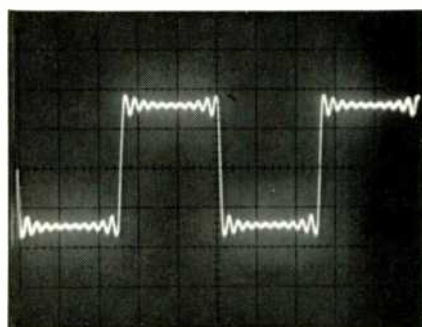


Fig. 12—Reproduction of 1-kHz square wave.

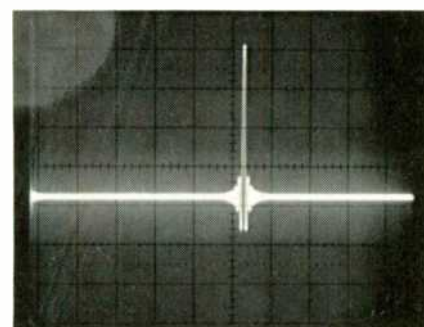


Fig. 13—Single-pulse test.

acquisitions. Among the discs I used were a pair of recordings of Clara and Robert Schumann's works for piano and strings, one of which also includes a piece by Johannes Brahms (Pro Arte CDD 395 and CDD 396). The clarity of these digitally mastered discs has to be heard to be believed.

For the listening evaluations, I used my reference Infinity RS 9 Kappa speaker systems and a high-powered Hafler amp that was in the lab for testing. I did not use any sort of intervening preamp, for the CD880's variable outputs enabled me to change volume level from my listening position via the remote control. With this setup, I came about as close to total realism as I have yet come with any electronic sound-reproduction equipment. The selection of spectacular overtures on a third Pro Arte disc, *Light Cavalry* (CDD

402), including the Von Suppé for which the disc is named, puts demands on your system's dynamic range as only well-recorded Compact Discs can. The CD880's clarity and transparency, especially on low-level passages, was distinctly audible.

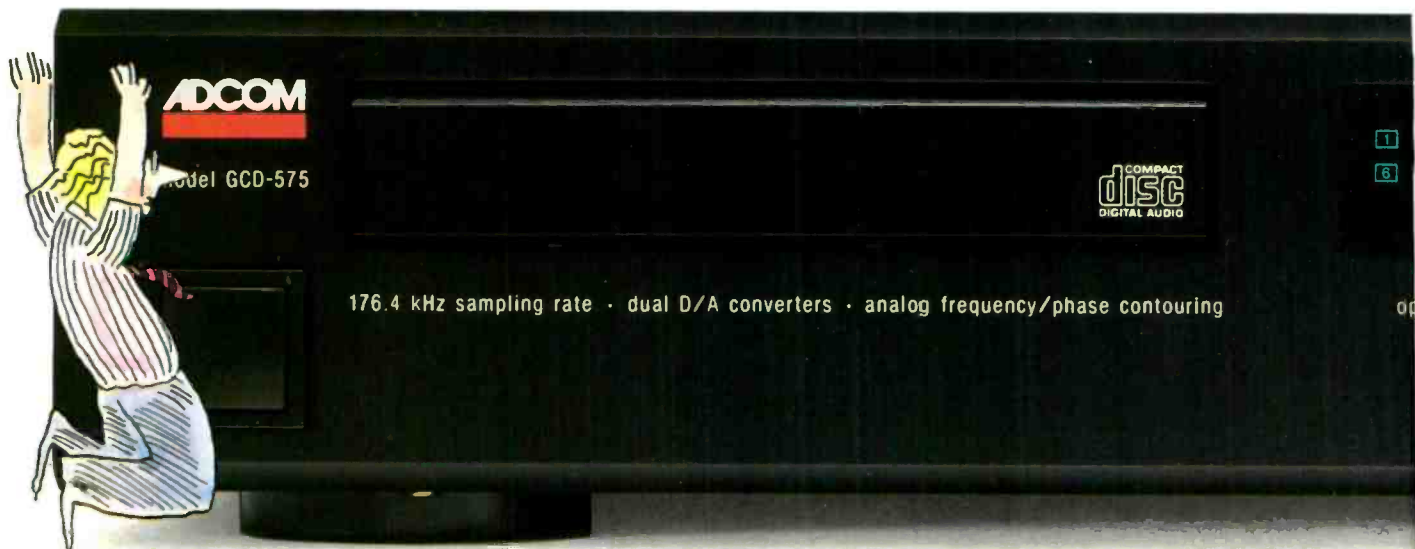
It is clear that one does not need high-multiple oversampling (eight times, 16 times, or higher) and 18- or 20-bit D/A conversion to guarantee superb performance from a Compact Disc player. As so many authorities have been stressing recently, if a "perfect" 16-bit D/A converter were developed, there would be no need for more "bits" or more digital multiplication than is provided by four-times oversampling. Philips, in the CD880, has come about as close to that perfection as any player I've evaluated thus far.

Leonard Feldman

All good
things come
to those
who wait.



Finally. A that reproduces not just bits a



Adcom's new GCD-575 Compact Disc Player has been worth waiting for. Now there's a CD player with analog audio circuits as technically advanced as its digital stages.

Since the human ear can only appreciate musical sounds in their analog format, Adcom began with the objective of producing the first affordable CD player whose direct-coupled audio output would deliver the long anticipated technical benefits of digital sound.

Class "A" Makes A Difference

Designers and engineers usually use Class "A" audio circuits where price is no object. In its purest form, Class "A" offers a highly sophisticated level of audio amplification, often demanded by those who can distinguish outstanding sonic performance from the merely average. Adcom's GCD-575 employs a no-compromise, Class "A" analog audio amplifier section which provides superior resolution by more clearly defining low-level information.

CD player all of the music, and bytes of it.



This higher resolution makes an audibly dramatic difference in the musicality of CD reproduction. To achieve this result, the analog audio circuits in the GCD-575 were based on the same proprietary high speed linear amplifiers used in Adcom's GFP-555 preamplifier, universally recognized for its outstanding musical integrity.

No other CD player at any price uses these superb audio components.

Digital Sound At Its Best

Adcom's selectable analog frequency/phase contour circuit enhances the musicality of CD's which have been poorly mixed, or digitally over equalized. Subtly contoured by the AFPC, many of these CDs become more listenable, with much of the fatiguing harshness and "glare" reduced. In addition, the stereo image and sound stage becomes more focused allowing for a more natural sonic presentation.

(Over please)

The Adcom GCD-575

Details You Can Hear

Importantly, Adcom's CD player is designed with a low output impedance (100 Ohms) so that it can operate up to its maximum capability with a wide variety of associated equipment. It is not only compatible with virtually all input stages of amplifiers, preamplifiers, tuner/preamplifiers, etc., but also permits the use of longer interconnecting audio cables, when required, with minimal signal deterioration.

Additionally the GCD-575 is supplied with a high quality, low-loss audio cable to prevent the sonic smear that conventional audio cables tend to cause. The use of this special cable and the 100 Ohm output impedance permits the GCD-575 to be used with Adcom's SLC-505 passive straight line controller. If no other source equipment will be used, the variable output (front panel controlled) can be used directly into your power amplifier, bypassing the preamplifier circuits normally required by other CD players.

A multi-winding power transformer, connected to three separate tightly regulated power supplies for the audio, digital and display circuitry, insures isolation of the different functions and optimal operation of each without interference.

The four special heavy feet installed on the GCD-575 are reversible metal castings. On one side, the flat surface insures a wide contact area. The reverse side is cast with built-in "Iso-points" which, when used in a three-foot configuration, operates as a "tripod" support system.

A special polarity-inverting switch permits you to reverse the normal positive polarity to negative (inverted) polarity. This corrects playback of CDs in which the polarity was incorrectly recorded (inverted), or for use in systems in which one of the components causes a reversal of correct polarity.



Full Function Remote Control

Specifications

Frequency Response: 5Hz - 20kHz, +0.1, -0.5dB

Signal-to-noise Ratio: 105dB

Dynamic Range: 98dB

THD: 0.0025%

IMD (70Hz difference): @ 5kHz
0.00018%

Channel Separation (1kHz): 95dB

Interchannel Phase Shift:
@ 20kHz Less than 1.8°

Output Impedance: Fixed 100Ω/
Variable 100Ω/Digital 75Ω

Output Level: Fixed 2.5V RMS
Variable Greater Than 4.5V RMS
Digital 0.5V peak-to-peak

Sampling Rate: 176.4kHz

Quantized Bits: 16-bit linear

Power: 120VAC/60Hz
(Available in 220/240V, 50Hz)

Dimensions: 17" (430mm)W ×
11-1/4" (285mm)D ×
3-7/16" (87mm)H

Weight: 12 lbs. (5.5 kg.)

Optional: Model RM-3 rack mount
adaptors. Available with white front
panel.

*Specifications subject to change
without notice.*

More Features For Better Value

Other features include a full function remote-control system with random access track capability; low group-delay digital and analog filters; triple-beam laser format; a direct digital output; playback of 3-inch discs without an adaptor; and a very-high-quality headphone output.

The GCD-575's advanced facilities include:

- Programming of up to 24 tracks
- Programming of any phrase
- Audible fast forward and reverse
- Adjustable introscan
- Auto space

Display functions include:

- Elapsed time on track or disc
- Time remaining on track or disc
- Programmed tracks
- Track being played
- Number of tracks up to 20

Why Should You Listen To Us?

Over the years, Adcom has earned a reputation for delivering superb performance at a modest price. The GCD-575 keeps faith with this tradition.

Once again, Adcom clears an innovative path through the jungle of confusing claims about "digital" sound, and provides a logical and direct path to musical purity.

If you've been waiting for a CD player which faithfully reproduces all of the music, not just bits and bytes of it, you'll want to visit your nearest authorized Adcom dealer right now... because while it may be true that all good things come to those who wait, you've waited long enough for a CD player this good.

ADCOM[®]
fine stereo components

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Pointe Claire, Quebec H9R 4X5

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2

AUDIO CONTROL TEN PLUS EQUALIZER

Manufacturer's Specifications

Frequency Response: 3 Hz to 100 kHz, ± 1 dB.

S/N: 120 dBA.

THD: 0.005%.

Input Impedance: 100 kilohms.

Output Impedance: 150 ohms.

Subsonic Filter: 18 dB/octave below 20 Hz.

Warble-Tone Bandwidth: One octave.

Warble-Tone Frequency Accuracy: $\pm 5\%$.

Warble-Tone Output Level: 150 mV.

Microphone Response: 20 Hz to 20 kHz, ± 1.5 dB.

Dimensions: 17 in. W \times 3 $\frac{1}{4}$ in. H \times 7 $\frac{1}{4}$ in. D (43.2 cm \times 8.3 cm \times 18.4 cm).

Price: \$329.

Company Address: 22313 70th Ave. West, Mountlake Terrace, Wash. 98043.

For literature, circle No. 91



The Ten Plus is one of the latest models in Audio Control's series of equalizers. This octave-band unit includes a sophisticated response analyzer which uses a warble-tone test signal. The supplied microphone and a front-panel meter function as the sound-level detector and indicator. The tone's frequency is swept back and forth over an octave, covering the same span as one of the equalizer filters. The analysis starts with the 1-kHz band and then is stepped up or down, octave by octave, via front-panel switches.

In addition to the usual tape input and output, and line input connections, the Ten Plus has an extra stereo input, selected by a front-panel button. This input is labelled "Video In" because the sound from many video sources can benefit from equalization; it can also be used for any other high-level audio source. The helpful subsonic filter has a sharp roll-off of 18 dB per octave below 20 Hz, a better design than many other such filters. The octave-band sliders are arranged in left and right pairs at each frequency, rather than having all the left filters in one group of 10 and all

The Audio Control Ten Plus is thoughtfully designed, down to the unusually helpful labelling of its controls and connections.

the right-channel filters in another. A red LED on each slider knob shows slider position, even in the dark. This might be an advantage to some users, and it also looks nice. In the analyzer mode, the only sliders illuminated are those at the warble-tone frequency—a very helpful feature that should minimize adjustment errors.

Control Layout

The power switch is at the lower left of the front panel. To its right are five pushbuttons. The first two, "Equalizer In/Out" and "Program/Tape," are not interlocked, but a line connecting the legends reminds the user that the functions are interrelated. The next three pushbuttons are "Subsonic Filter," "Video/Audio Input," and "Tape Monitor." Each of the five controls has a red LED which indicates "on." The LED for "Program/Tape" flashes as a reminder that "Tape" is not the normal setting and that the recording is being equalized. Pushing "Tape Monitor" will turn on its LED; if "Video/Audio Input" has been previously actuated, its LED will go off automatically, confirming the precedence of "Tape Monitor."

Above these switches is the analyzer control and display section. The jack for the measurement microphone is on the far left. (The manufacturer points out that voltage is applied to the jack terminals and that other microphones might be damaged if plugged in.) To the right are three pushbuttons for "Analyze," "Frequency Up," and "Frequency Down" as well as the meter for calibration level. When you push "Analyze," a red "Calibrate" indicator just below it turns on and the blue meter scale to the right is illuminated. At the same time, the LEDs in the slider knobs turn off, except for those on the two sliders for the 1-kHz band. Calibration is best started with all sliders in center detent for zero equalization. The warble-tone level is adjusted by the user's preamp/receiver volume control to get a meter-zero indication with the microphone at the normal listening position. As an aid when making this adjustment, Audio Control included a red "Zero dB" LED just to the left of the meter.

Covering the right two-thirds of the front panel are the 10 sets of left- and right-channel filter sliders. Legends below the sliders divide the controls into "Bass," "Midrange," and "Treble" sections. In addition to showing the center frequency, each pair of sliders has a label for "Lo," "Mid," or "Hi." In the four-band midrange section, the 500- and 1,000-Hz sliders are both labelled "Mid." On each side of the left/right pairs are scales from -15 to +15 dB, in 3-dB steps. The sliders have little ears on the right of the left-channel controls and on the left of the right-channel controls. The spacing between each same-band pair is less than the spacing between left/right slider sets. These design features provide visual clues for correct slider selection. The center detents were slightly stiff, but small adjustments from zero were not hard to make and general slider movement was smooth. All legends are in beige, making them very legible against the matte-black background.

The back panel has stereo phono jacks for, from right to left, "Main In," "Video In," "Tape In," "Tape Out," and "Main Out." I found the arrangement quite logical. The rear panel also has helpful extra notations to aid the user. Next to the main inputs, a legend reads: "From receiver record output

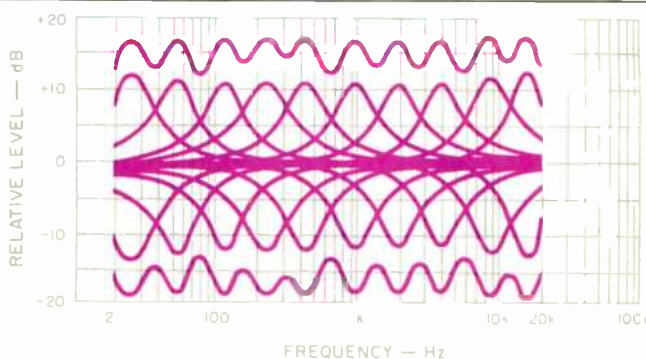


Fig. 1—Swept-frequency responses of each filter section at maximum boost and maximum cut, and with all sections at maximum boost and cut.

(Tape outputs)." Above "Video In," and with an arrow pointing to it, is: "Audio from VCR, video disc, etc." Above the tape in/out jacks is a block marked "Tape Recorder," with "In" and "Out" labels and connecting lines to the jacks. Next to the main output jacks, a label reads: "To receiver tape monitor input." Since quite a few users having limited experience get confused about input and output designations, Audio Control shows consideration for the neophyte by including this information.

I gained access to the interior by removing the top cover. The power transformer, which was barely warm after hours of use, is mounted on the rear panel next to a fuse in clips. Frankly, I like having fuses accessible rather than soldered to p.c. boards—even if the chances of their blowing is very small. However, I prefer externally accessible fuse-holders even more.

The two p.c. boards are at the left end of the chassis, a few inches from the transformer. The analyzer board is above and is somewhat smaller than the filter-circuit card which is mounted next to the bottom panel. I would have preferred an additional card support, but the boards proved less springy than I had expected. There is a long, vertical board behind the filter sliders. Interconnections are made with ribbon-type, multi-conductor cabling soldered directly to the cards. The boards and components are of good quality, but the components are not labelled. The soldering was excellent, in general, with slight flux at some of the hand-soldered points. The chassis was quite rigid with the cover off, and even more so with it back on.

Measurements

The first set of frequency responses was measured with all EQ sliders at their 0-dB detents. Switching equalization in caused a 0.5-dB drop in level. The responses relative to 1 kHz were down 0.5 dB at 20 Hz, with and without equalization. At 20 kHz, the response was down 0.04 dB with EQ in and down 0.02 dB without it. The points where response was down 3 dB were 6.0 Hz and 295 kHz with EQ in and 4.0

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The warble-tone EQ system is easy, unconfusing, and less distracting than RTAs which can't be turned off.

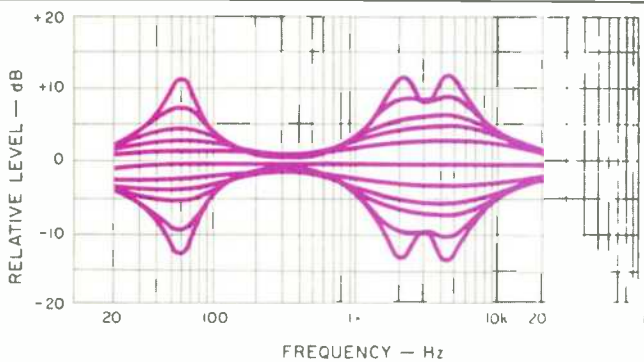


Fig. 2—Swept-frequency responses with 63-Hz, 2-kHz, and 4-kHz filters set successively for steps of 3 dB from nominal -15 to +15 dB.

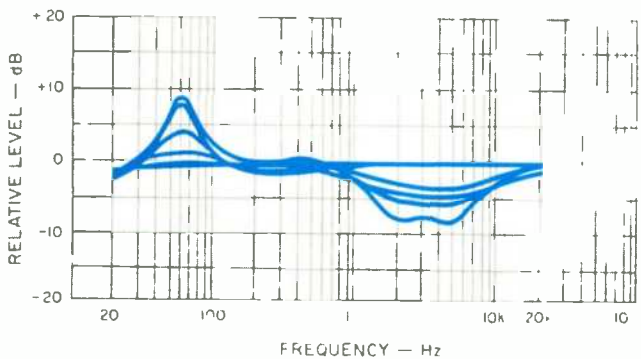


Fig. 3—Same as Fig. 2 but with boosts and cuts sharpened by small opposite adjustments of adjacent filter bands; see text.

Hz and 498 kHz with EQ out. These results are slightly at variance with the manufacturer's specifications, but the differences are insignificant.

Figure 1 shows responses for each of the 10 filters at maximum boost and maximum cut, and for all filters at maximum boost and cut. Filter shapes and relative positions across the band are quite consistent, but some differences can be seen here and there. The total spread in the maximum boosts and maximum cuts is about 1.5 dB, and none of the individual boosts or cuts reached the nominal 15 dB shown on the front-panel scales. The spread is more than for many octave-band equalizers, but it is not significant in actual use. In my view, 12 dB of boost and cut is plenty, so I see the 15-dB scale figures as unnecessary and unimpor-

tant exaggerations. The center frequencies of the filters were all within 5% of the stated frequency, with the exception of the 500-Hz filter. This one was about 10% low, which is just acceptable.

Figure 2 shows the swept-frequency responses obtained with the 63-Hz, 2-kHz, and 4-kHz filters adjusted in 3-dB steps (according to the front-panel scale) from maximum cut (-15) to maximum boost (+15). Note that the correspondence between setting and effect is closer with the two adjacent filters than with the single filter. This graph also shows that the boosts and cuts are rather flat and extended in effect until the settings reach ± 6 dB. At this point, the curves begin to sharpen slightly. Reducing bandwidth to one octave ($Q = 1.4$) required a boost of 9.8 dB. To ensure against the possibility of ringing when boost is used, Q should be no more than 1 (bandwidth = 1.4 octaves). On the Ten Plus, this would require limiting boost to 7.9 dB, a higher boost figure than can be used with equalizers whose filter responses are more sharply peaked.

The bandwidth of a filter's boost or cut is also affected by the use of adjacent filters. The 63-Hz responses in Fig. 3 which are narrower than those in Fig. 2, were obtained by lowering the 31.5- and 125-Hz sliders as the 63-Hz slider was raised. The 31.5-Hz filter was set to -3 dB for the shallowest boost shown and to -6 dB for all the others. The 125-Hz filter was set at -3 dB for all but the highest boost, when it was set to 0 dB. Settings for the 63-Hz slider were (from least to most boost) +9, +12, +15, and +15 dB.

Similarly, the cut at 2 and 4 kHz was squared off a bit by boosting the 1- and 8-kHz bands. For the shallowest dip shown, the 1- and 8-kHz bands were set at +1.5 dB, while the 2- and 4-kHz controls were set to -6 dB. For all deeper cuts, the 1- and 8-kHz bands were set at +3 dB; the two middle bands were set at -6, -10, and -12 dB, respectively.

As Fig. 3 shows, using this technique reduces the maximum boost or cut available. However, reducing the spread of the filter effect is often needed, and maximum boosts and cuts usually are not.

Cutting in the subsonic filter reduced level by 0.2 dB across the band. Response was down an additional 0.7 dB at 30 Hz, 3.6 dB at 20 Hz, 23.1 dB at 10 Hz, and 34 dB at 7 Hz. This is a very effective filter for controlling problem resonances. The microphone/meter combination was flat within ± 1.5 dB across the band. A sound pressure level of about 80 dB at the microphone was required for a meter zero indication. This is a good level for analysis because it is well above normal external noise but is not so high that it overwhelms the user. Although I could see the white needle against the blue scale clearly, whatever the room illumination, the "Zero dB" indicator was still a definite aid and was consistently accurate.

Figure 4 shows the third-octave spectra of the 125-Hz and 2-kHz warble tones. Each tone's spectrum was slightly more than an octave wide, but the bandwidth was consistent for all filters, so the extra span was not significant. The output level of the 1-kHz warble tone was 160 mV, and the levels for all other tones were within ± 1 dB of that. A check with the 16-kHz warble tone demonstrated that the microphone was relatively nondirectional. This is desirable as it ensures



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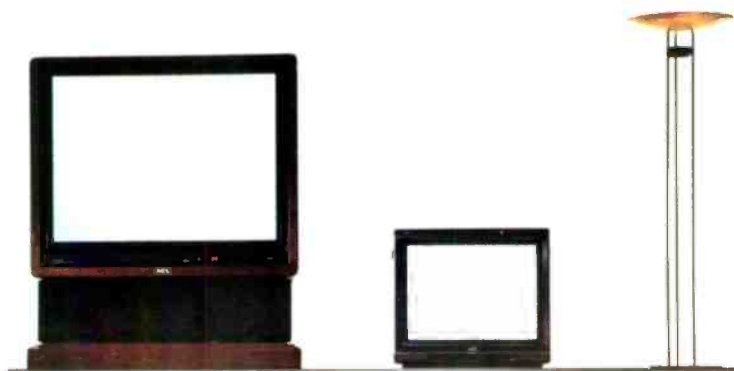
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The Ten Plus is reasonably priced, and its additional stereo input and flexible switching increase this unit's value even more.

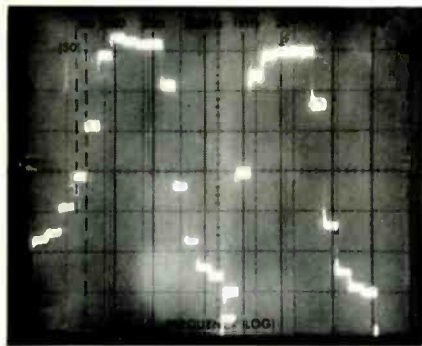


Fig. 4—Third-octave spectra of warble tones at 125 Hz and 2 kHz. Vertical scale: 5 dB/div.

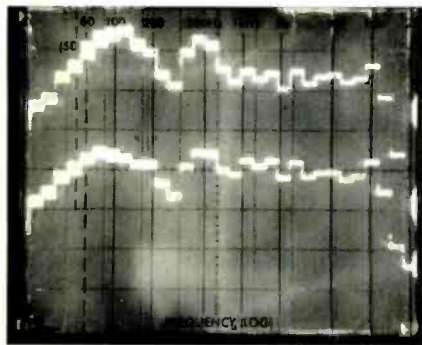


Fig. 5—Third-octave response of small bookshelf loudspeaker before equalization (top trace) and after equalization with warble tone (bottom trace). Vertical scale: 10 dB/div.

that accuracy in aiming the mike, relative to speaker locations, will not be critical. The microphone's 20-foot cable should be long enough for most listening rooms.

Maximum input was 7.8 V; maximum output was 7.4 V open-circuit and 7.2 V with a 10-kilohm load. Clipping was symmetrical. The 91-kilohm input impedance was unaffected by any slider adjustments. The output impedance was a desirably low 149 ohms. Harmonic distortion was 0.0017% across most of the band, rising at the highest frequencies to 0.0084% at 20 kHz. No slew-rate limiting was observed for 2-V output at 100 kHz. S/N ratio was 98.5 dBA relative to 1 V. The manufacturer's figure of 120 dBA is measured relative to maximum rated output. At normal output levels, and with various slider settings, 92 dBA would be more typical in actual use.

Use and Listening Tests

The owner's manual is written in Audio Control's inimitable style, combining humor with a lot of practical information. The figures are simple line drawings, but they demonstrate well the points made in the text. The discussion on what the various filters do is better than what appears in most such manuals. The recommendations on how to position and adjust speakers are generally right on the mark. Most equalizer manuals, unfortunately, do not cover these essential factors. The manual also gives needed cautions about using excessive boost in the lower frequency band, pointing out that careful listening for speaker stress is necessary. Audio Control recommends that the subsonic filter be left on at all times, which is probably a good idea if there is much 31.5-Hz boost—particularly with some turntables. On the other hand, very low organ tones and good subwoofers might call for the filter to be off.

All of the switches and controls on the Ten Plus were completely reliable throughout the testing period. I used the unit to equalize the responses of two Ramsa WS-A70Ks which I had set up for use as surround speakers. Because of the shape and furnishings of my listening room, I could not place the speakers symmetrically or in the same relationships to the walls. This required that the equalizations be different for the two speakers—a situation not discussed in the manual. The equalization, of course, was done by means of the warble-tone analysis system of the Ten Plus.

Figure 5 shows the third-octave response of one speaker, before and after equalization, using pink noise as the source. The results shown were displayed on an Ivie IE-30A RTA, but only the equalizer's own microphone and meter were used to achieve these curves. The process took about 3 to 4 minutes for each speaker, plus another minute or so for trimming with both speakers energized. The results shown are for the speaker which exhibited the larger response variations. Note the considerable reduction in total response variations and the great reduction in the 80- and 500-Hz response peaks. A bit of boost with the lowest filter kept the deepest bass from dropping further. Greater boosting was judged to be inadvisable with these particular speakers. For the channel shown, the settings of the filter bands were: +3, -6, -13, -5, -10, +1, +3, -3, -10, and +2 dB. Settings for the other channel were similar. The sound quality was greatly improved, and the excessive bass became a thing of the past.

In some ways, I missed the octave-band RTA display which appears on higher cost units such as Audio Control's C-101. Nevertheless, the warble-tone equalization was easy to perform. There was no confusion as to what was happening, especially with the help of the "Zero dB" LED and the automatically switched LEDs on the sliders. Further, I remember times when I have been annoyed by RTA displays that were in view while I was listening. With the Ten Plus, I didn't have to close my eyes to keep from being distracted.

This is a well-performing equalizer; its distortion and noise are low. The warble-tone analysis system and its good microphone work very well, and the process is convenient and accurate. The price of the Ten Plus is very reasonable, and the unit's flexible switching and additional stereo input increase its value even more.

Howard A. Roberson

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3

YBA₁ DUAL MONO AMPLIFIER

Manufacturer's Specifications Rated Output (From 115-V Line

Power): Continuous power, 85 watts per channel into 8 ohms, 170 watts per channel into 4 ohms; pulse power, 1.8 kilowatts per channel into 0.7 ohm.

THD: Less than 0.09% from 20 Hz to 20 kHz, at 20 watts per channel.

Frequency Response: 5 Hz to 80 kHz, +0, -3 dB.

Rise-Time: 3 μ S at 10 kHz.

S/N: Greater than 100 dB, unweighted.

Input Impedance: 27 kilohms.

Input Sensitivity: 1.1 V for full rated output.

Damping Factor: Greater than 800 at 100 Hz.

Power Consumption: Quiescent, 100 VA; 1,000 VA at full rated power, both channels driven.

Line Voltage: 115 or 230 V (factory set), 50 to 60 Hz.

Dimensions: 16¹⁵/₁₆ in. W x 5³/₁₆ in. H x 13 in. D (43 cm x 13.2 cm x 33 cm).

Weight: 46½ lbs. (21 kg).

Price: \$6,000.

Company Address: c/o Sumiko, P.O. Box 5046, Berkeley, Cal. 94705.

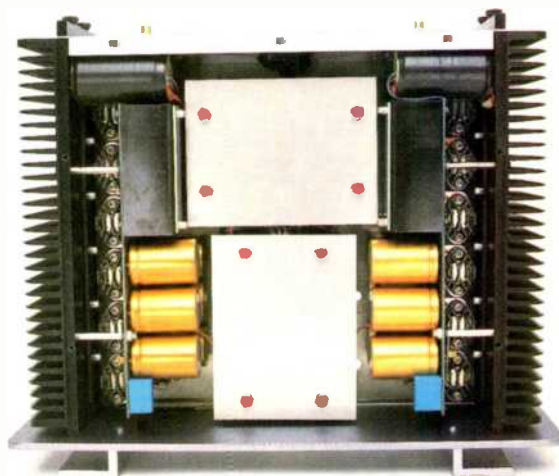
For literature, circle No. 92



The YBA₁ is the larger of two solid-state power amplifiers manufactured by Phlox Electronique of France and imported and distributed in the U.S. by Sumiko; a pair of companion preamps are also available. YBA stands for the initials of Yves-Bernard André, the designer of these four electronic units. Also designed by André, under the Vecteur name, are a turntable and loudspeaker.

Physically, the YBA₁ is about normal in its dimensions for its power rating, but, weighing in at 46½ pounds, the system is definitely heavy for its size. This dual-mono unit is solid, very nice to look at, and built like the proverbial brick outhouse. A number of unusual ideas and great attention to detail are incorporated in the YBA₁'s engineering, making it clear that the designer intended this amp to function properly for a long time. Some of the design features include: Topology and positioning of components to limit their interaction, orientation of each of the amp's two-terminal passive components in the best-sounding direction (i.e., in which direction a part should be aimed with regard to signal flow), common-ground star network, minimum internal cable and signal-path length from input to output, and the use of noble nonmagnetic materials with oriented crystal structure, internal wiring of long-crystal oxygen-free copper, power transformers with two C cores, and custom-made passive components. Still more design features will become apparent in subsequent discussions of this amplifier's circuit design and performance.

The amp is built with the two side heat-sinks as its main anchoring pieces. Separate front and rear panels and top and bottom covers bolt to the heat-sinks to form the complete unit. A power switch is hidden behind the front panel's left-side handle, and a single red LED below the logo in the panel's center indicates power on/off. On the rear panel are two pairs of female sockets for speaker cable connection via specially supplied gold mating plugs. Also found on the back of the unit are two special-design phono input connectors, two test-tip jacks for setting quiescent idling current, two circuit breakers, and a combined three-wire power connector/fuse-holder. Two separate C-core power transformers, mounted at right angles to each other and isolated by rubber bushings and grommets for minimum mechanical hum, take up about half of the interior space. Filter capacitors and rectifier diodes are on the unit's p.c. boards, which are mounted parallel to the heat-sinks with standoffs. Driver and output devices are on L-shaped ledges that bolt to the inside surfaces of the heat-sinks. The tops of the TO-3 devices (six per channel) have cast finned radiators attached for added cooling and mechanical damping. Small p.c. boards holding some of the bias-regulator components are mounted between the radiator fins, atop one TO-3 device in each channel. A rather sizable plastic box, taking up slightly less than half of each amp's p.c. board, houses each channel's front-end circuitry. These boxes are filled with carborundum granules to help ensure even temperature of all internal components and to assist with mechanical damping of the circuitry. Six 4,700- μ F, 63-V filter capacitors take up most of the rest of the space on the p.c. boards. Some film bypass capacitors for the main electrolytics and a pair of 10-watt power resistors are at the front-panel end of the p.c. boards.



Circuit Description

A complete schematic wasn't supplied with the YBA₁ I received for testing, nor was one asked for. A generalized schematic, however, appears in the owner's manual. This unit's overall topology is very much like that of many other solid-state amplifiers—with a few, and perhaps sonically significant, twists. A complementary dual-differential amp serves as the input stage. Constant-current sources for the emitter pairs are indicated but not detailed. An input coupling capacitor and a shunt feedback capacitor of some 10 μ F each are housed in what appears to be an aluminum can mounted on the heat-sink near the input and output connectors. Input impedance is about 30 kilohms and is set by a base-to-ground resistor after the input coupling capacitor. Cutoff frequency for this high-pass, first-order filter should be about 0.5 Hz. However, assuming a 30-kilohm series feedback resistor, a shunt value of about 1 kilohm would be appropriate for the closed-loop gain this amp has. A 1-kilohm resistor and 10- μ F capacitor form a low-frequency cutoff of 16 Hz, which doesn't jibe with the excellent square-wave response this amp exhibits at low frequencies. The 10- μ F film shunt feedback capacitor is probably paralleled with an electrolytic cap housed inside the enclosure for the front-end's circuit parts.

Inverting output collectors (the NPN and PNP devices whose bases are connected to the signal input) are direct-coupled to a complementary pair of devices. These devices' emitters are referenced to the appropriate supply rail, and their collectors are tied together through a bias-spreading regulator. These complementary devices appear to be mounted without heat-sinks to the printed side of the p.c. board and are not included among the enclosed front-end components. Resistive loading of each of these last-voltage-amplifier (LVA) collectors to ground limits the open-loop gain along with emitter degeneration in the input stage. Output of the LVA is direct-coupled to a pair of complementary TO-3 drivers that are connected as emitter followers

Although overall circuitry is like that of many other solid-state amps, it has a few, perhaps sonically significant, twists.

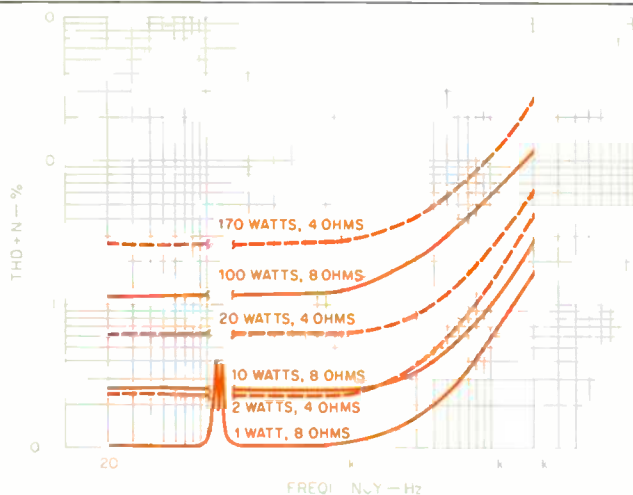


Fig. 1—THD + N vs. frequency for 8- and 4-ohm loads, each at three power levels.

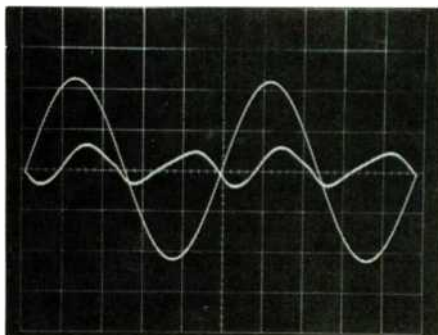


Fig. 2—Sine wave at 1 kHz, plus distortion products, for 10 watts into 8 ohms; here, THD + N is 0.029%. Note the slight kink in the distortion trace; see text. The polarity of the distortion waveform has been reversed by the analyzer.

mal stability are not used here. Incidentally, all the devices in this circuit are bipolar transistors.

Instead of the usual insulating washers for the driver and output devices, which are usually thin pieces of mica or plastic, this unit has insulators made up of a sandwich of mica and copper sheet—i.e., mica/copper/mica. The copper pieces are bussed together and tied to the +50 V supply. The designer says this scheme's purpose is to bypass power-supply hash back to the center tap of the power transformers. (If I had been the designer, I would have connected the copper pieces directly back to the transformer center taps.) What the bussed-sandwich technique may alternatively be doing is preventing power-supply noise on the power-transistor cases from getting back to the power supply's center tap through chassis metal. Otherwise, this noise could be induced into the amplifier circuitry by capacitive and/or inductive coupling along the way. I don't really claim to understand this scheme.

No stabilizing series RC network from output to ground is used in this design, and no series RL buffer network, per se, exists. The two NPN output emitters are tied together and, along with the connection of the mating PNP output emitters, are led through two separate wires wound around the metal can surrounding the input and shunt feedback capacitors to form a coil with a small number of turns. These wires are then connected to the hot output terminal! This unusual connection is said to provide some "air feedback" and to stabilize the amp, obviating the need for the usual stabilizing network elements. André makes a point about having a minimum number of passive elements in the signal path from input to output, the devices in this path are predominantly active.

The power transformers' C-core construction may improve isolation from high-frequency noise in the power line. In such a transformer, primary and secondary coils are wound on opposite sides of a square-sided O core made up of the interleaved C pieces. Because the primary and secondary coils are not wound over or interleaved with each other, capacitive coupling between the windings is greatly reduced.

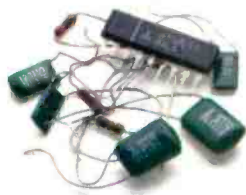
The six filter capacitors on each amp p.c. board add up to about 15,000 μF on both the positive and negative power rails of each channel—a medium to fairly high amount of capacitance in terms of energy storage for the amplifier's power rating.

The two 10-watt power resistors on the end of each amp p.c. board, mentioned earlier, are 1.5 kilohms in value. One is connected from +50 V to common; the other is connected from -50 V to common. The 30 or more mA of current flow and 3 to 4 watts per channel of power dissipation are said to pre-load the power supply and to provide some of the sonic advantages of Class-A operation without dissipating power in the output transistors themselves.

Measurements

I first ran the YBA, at one-third power (28.3 watts per channel) into 8-ohm loads for one hour. The heat-sinks got quite hot to the touch—I could only hold onto them for 2 to 3 S before having to let go. I did not run one-third power into 4-ohm loads, as I felt I might get the amp too hot and didn't

and mounted on the main heat-sink ledge along with the output devices themselves. A resistor is tied between the emitters of the drivers to set their idling-current level. The drivers' emitters are direct-coupled to the bases of the output transistors, which consist of two NPN and two PNP TO-3 devices connected as emitter followers. The emitter resistors usually used for feedback and for increased ther-



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The YBA₁'s sound was clear, transparent, and refined, with incredible definition and a wide, deep, natural soundstage.

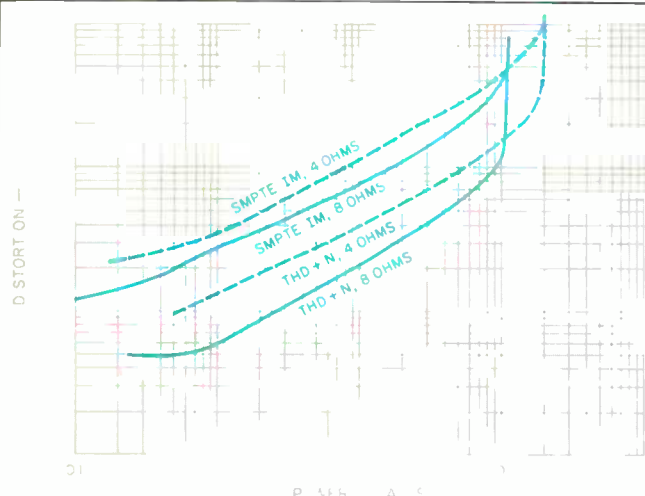


Fig. 3—SMPTe IM and THD + N vs. power for 8- and 4-ohm loads. THD + N is for a 1-kHz test signal, with distortion products measured from 400 Hz to 80 kHz.



Fig. 4—Frequency response at 1 watt output into 8-ohm load.

want to risk damaging it. In all of my listening tests, this amp never got hotter than just warm.

Main power-supply voltage within the amp was ± 50.5 V with 120-V a.c. line input. Voltage gain was $24.4\times$ and $24.2\times$ for left and right channels, or about 27.7 dB. IHF sensitivity for 1 watt into 8 ohms worked out to be 116 mV.

THD + N versus frequency, as a function of power and load, is shown in Fig. 1 for the right channel. This channel was slightly lower in distortion than the left. The lowest curve in this figure shows a nonlinearity caused by the beating of the test-signal frequency against the 120-Hz power-supply ripple. The percentage increase in distortion caused by this nonlinearity decreases as power output increases. For clarity, it has therefore been omitted from all but the 1-watt

curve. I have seen this beat phenomenon in other amps in the past, and when it's present, I mention it and show it on the distortion curves. Harmonic distortion residue predominantly consists of even harmonics below 1 to 3 kHz. Above these frequencies, a distortion spike of increasing magnitude near the waveform's zero crossing causes the distortion to increase rapidly with increasing frequency. Typical harmonic distortion residue for the YBA₁ at low to medium frequencies is illustrated in Fig. 2 for 10 watts into 8 ohms at 1 kHz. Due to polarity reversal in the distortion meter's monitor output, the signal polarity of the output waveform is reversed from its actual polarity with respect to the distortion waveform. In other words, imagine the output waveform going negative in the first half-cycle displayed. The distortion glitch mentioned above is just noticeable here as a slight kink in the distortion waveform near its zero crossing in the negative-to-positive direction. Both THD + N at 1 kHz and the SMPTe-IM distortion, as functions of power and load, are plotted in Fig. 3.

Crosstalk versus frequency, with the undriven channel terminated in 1 kilohm, proved to be quite symmetrical in both directions. Results were better than -90 dB from 20 Hz to 6 kHz, decreasing to -82.5 dB at 10 kHz, -71.6 dB at 20 kHz, and -58.2 dB at 50 kHz.

Frequency response at 1 watt into 8-ohm loading appears in Fig. 4. With 4-ohm loading, the high-frequency response was within 0.1 dB of the 8-ohm response shown. Rise- and fall-times at 10 V peak to peak into 8 ohms were 3 μ s. The waveform was exponential (normal) and essentially constant in rise- and fall-times from small signals up to voltage clipping. Figure 5 shows square-wave performance. The top trace is for 10 kHz into 8 ohms. The middle trace is also for 10 kHz, but into 8 ohms paralleled with a 2- μ F capacitor. In the bottom trace, the test frequency is 40 Hz. Notable in these waveforms is the very low tilt at 40 Hz and the relatively low ringing, in the middle trace, for an amp without the usual output RL buffer network. All waveforms are at 10 V peak to peak.

Damping factor versus frequency is plotted in Fig. 6. Even though there is no RL output-buffer network per se, the turns of wire around the input capacitor's case form an inductor of some value and, along with a possible reduction in loop gain versus frequency, cause the output impedance to rise with frequency above 1 kHz. The reduction in damping factor (increase in output impedance) in the right channel below 100 Hz was really there in the measurement, and I have no idea what could have caused it.

IHF dynamic headroom was 1.74 and 1.53 dB for 8- and 4-ohm loading, respectively. Clipping headroom was 1.04 and 0.48 dB for 8- and 4-ohm loads, while clipping power for these conditions was 108 and 190 watts. Using the same tone-burst signal as in the other headroom tests, driving one channel into a 1-ohm load resulted in ± 30 amperes of peak current—a respectable figure indeed.

IHF S/N ratio (A-weighted noise below 1 watt into 8 ohms at 1 kHz) was 99 and 98 dB for left and right channels, respectively.

A few final observations: 20-kHz clipping was clean, with no evidence of "sticking." Thermal stability, regarding quiescent current draw from the a.c. line, had some noticeable

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The YBA₁ is the best solid-state amp I've heard so far. At \$6,000, it's not a best buy but could well be worth it.



Fig. 5—Square-wave response. Top trace is 10 kHz, with 8-ohm load. With 2- μ F capacitance across the 8-ohm load (middle trace), ringing is unusually low for an amplifier with no RL buffer. The tilt at 40 Hz (bottom trace) is notably low. Scales: Vertical, 5 V/div.; horizontal, 20 μ S/div. for top two traces, 5 mS/div. for bottom trace.

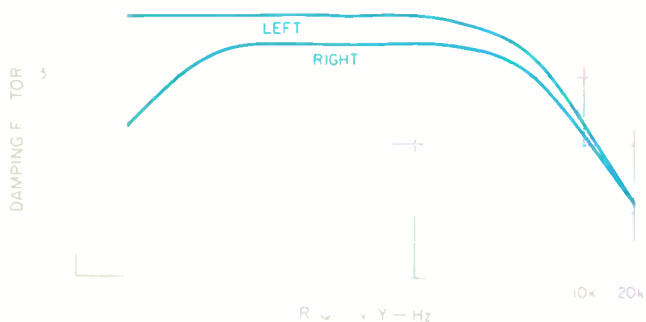


Fig. 6—Damping factor vs. frequency. Note the difference between channels; see text.

hysteresis. That is to say, if the amp was turned on and allowed to idle for a long time, current draw was about 0.4 ampere a.c. If the unit was heated up by making it produce one-third power for a while, line current could be as high as 1 ampere a.c. (or more) immediately upon cessation of the drive. Line current would then quickly drop, finally settling at

about 0.6 ampere a.c. In my listening tests of the amp, I found it was predominantly cool in operation and was drawing the lower, 0.4-ampere current.

Use and Listening Tests

Equipment used to evaluate the YBA₁ included an Oracle turntable fitted with a Well Tempered arm and Koetsu Black Goldline cartridge, a California Audio Labs Tempest CD player, a Nakamichi 250 cassette deck, a Cook-King reference tube phono preamp, a Meitner PA-6i preamp, my 845 Class-A tube 100-watt mono amps, and Motif MS50 and MS100 power amps driving Siefert Research Magnum III speakers.

The YBA₁ is one of those amplifiers that sounded good to me right at the outset. I knew I had something special very quickly. André's distinctive and unusual ideas, and his attention to detail, really paid off in the sonic department.

One prong of the a.c. power plug is marked red by the factory; an interesting instruction in the owner's manual advises inserting this prong in the hot or live slot in the wall socket. With this particular amp, the marked prong was the one that would go to the longer slot, which is neutral by socket-wiring convention. Since the plug is a three-wire type, I used a three-wire to two-wire adaptor and reversed its orientation. The power-plug orientation which yielded the lowest chassis potential, when checked with a Namiki DF-100 a.c. plug-connection direction finder, agreed with the manufacturer's polarization. In use, especially when fed from the Cook-King tube phono preamp and playing records, it was easy to tell the difference between power-plug orientations. The sound was more open and natural with the plug used according to the instructions.

I would describe the sound of this amplifier—or its *lack* of sound—as very clear, transparent, and refined, with incredible definition and with very low irritation levels. Music sounded more simply "there" and real. One could unravel complex goings on with ease. Spatial replication was very good, and a wide, deep, and natural soundstage presented itself with appropriate source material. With the YBA₁ in residence, I quickly retired my 845 tube amps, as the YBA₁ sounded better. Now those 845 tubes are gathering lots of dust.

I tried the amp with IRS Beta speakers in Infinity's sound room. Although the sound with the YBA₁ wasn't quite as lush and big as it had been with the Audio Research M-300 and VTL 300W amplifiers, the YBA₁ sounded very refined, open, and spacious on the Infinity speakers.

I also tried the amp on a friend's system, one which has Apogee Acoustics Duetta Signature loudspeakers. These speakers like a lot of power, and the YBA₁ couldn't really drive them very loud. Nevertheless, within these power limitations the sound was outrageously good.

I believe that this is the best solid-state amplifier I've heard so far—certainly in my own setup. My associate, Geoff Cook, tends to agree. At \$6,000 and 85 watts per channel, the YBA₁ is not everyone's best buy, but with loudspeakers of reasonable efficiency, this amp could well be worth the money. I know I am going to sorely miss the YBA₁ when I have to give it up. Thanks, Yves-Bernard André, for a very nice experience.

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4

HARMAN/KARDON HD800 COMPACT DISC PLAYER

Manufacturer's Specifications

Frequency Response: 4 Hz to 20 kHz, ± 0.5 dB.

THD: 0.02% at 1 kHz.

Dynamic Range: 90 dB.

S/N Ratio: 96 dB.

Channel Separation: 83 dB at 1 kHz.

Wow & Flutter: Not measurable.

Number of Programmable Selections: 36.

Line Output Level: 2.0 V.

Power Consumption: 15 watts.

Dimensions: 17 $\frac{3}{8}$ in. W \times 3 $\frac{3}{4}$ in. H \times 10 $\frac{1}{8}$ in. D (44.2 cm \times 9.5 cm \times 25.7 cm).

Weight: 8 $\frac{1}{2}$ lbs. (3.9 kg).

Price: \$529.

Company Address: 240 Crossways Park West, Woodbury, N.Y. 11797.

For literature, circle No. 93





Control Layout

The uncomplicated panel layout of this unit should prove to be less intimidating to first-time buyers of CD players. The panel is equipped with the usual transport controls (play/pause, stop, both directions of track skipping, and the aforementioned search buttons). Display, repeat, and programming buttons are found near the multi-display window that shows track number, status (play, pause, program, disc repeat, or program repeat), and three time modes. When the CD tray is first closed with a disc in place, the display shows total time in minutes and seconds as well as the total number of tracks on the disc. When a disc is playing, the display normally shows elapsed time of the track being played. Depressing the "Display" button once shows track and index numbers, and a second push restores the normal elapsed-time display.

The power on/off pushbutton is at the left end of the panel, adjacent to the disc tray. This tray, activated by a nearby open/close button, is one of the fastest acting I have ever seen. Push the button, and the tray opens before you can lift your finger; the same speed is evident when closing the tray. A headphone jack and the combination phone/line output level control complete the front-panel layout. The panel is finished in matte black, and the nomenclature is a sort of buff color that stands out very well.

All front-panel controls—with the exception of the power switch, the open/close button, and the level control—are repeated on the supplied remote. In addition, there are number keys on the remote, so you can directly access any track on a disc without having to use the skip buttons repeatedly. A pair of AA batteries is supplied for the remote.

Measurements

Harman/Kardon did not go overboard in making outrageous performance claims for this CD player. The claimed frequency response of 4 Hz to 20 kHz is accompanied by a tolerance of ± 0.5 dB. If one wants to be generous, one could say that the claim is met. The response curve of Fig. 1 never rises above 0 dB, even though it drops to -0.7 dB at 20 kHz. (The upper curve, for the right-channel response, is



For a while there, it looked as though Compact Disc players would become more and more complicated and offer more and more features (at higher and higher costs). Evidently, Harman/Kardon has elected to return to less-complex formats with their HD800. Although its layout is simple, for the most part the HD800 offers all the convenience features users are likely to want or need. Most listeners don't require such fancy operating features as segment or A-B repeat, random program play, and the like. But with an increasing number of CDs now incorporating index points within a track, being able to access them is important. The Harman/Kardon HD800 can be directed to move to a given index point within a given track but only if that selection is made before play begins. Once the unit has begun playing a disc, the search control—previously used to access index points—now moves the laser pickup assembly ahead rapidly, increasing the search speed if the button is held down for more than a couple of seconds.

In their effort to keep things simple, Harman/Kardon's designers may have gone a bit too far in having just one front-panel control adjust both the line and headphone output levels. I found that normal line output levels required fairly high control settings; for headphone listening, I had to turn the control way down. I think Harman/Kardon would have done better to lower the headphone gain or to provide separate level controls for each output. This minor inconvenience can, however, be forgiven when one considers the relatively low price of this unit.

The HD800's linearity at low levels, perhaps the most revealing indicator of player quality, is about the best I have seen.

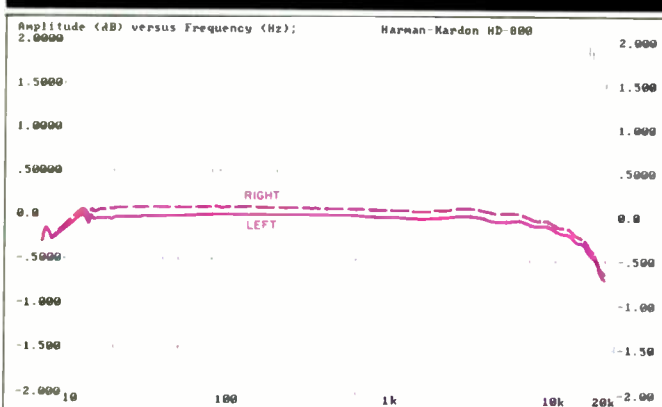


Fig. 1—Frequency response.

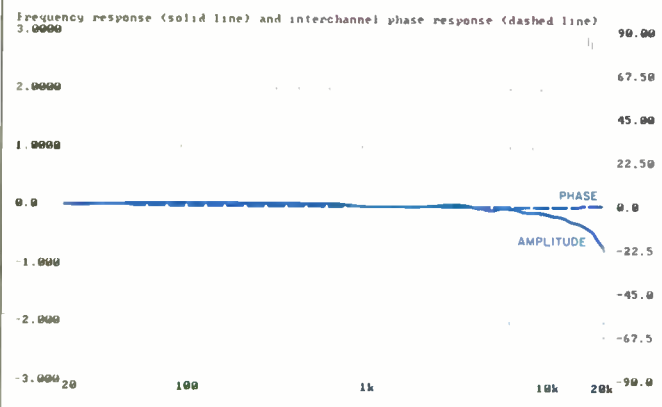


Fig. 2—Comparison between amplitude response of one channel and relative phase response of opposite channel. Phase, in degrees, can be read from right-hand scale.

displaced because of the slight difference in output levels between the two channels.) It's an old audio game to say that this one-way drop of 0.7 dB falls within the rated spec of ± 0.5 (or even ± 0.35) dB.

Figure 2 repeats the response plot of one channel (solid curve) and adds the interchannel phase response, which was absolutely flat. This suggests that separate D/A converters were used for each channel and that there is accurate time compensation between the two data channels, which are interleaved on the disc's single track.

A-weighted S/N, measured while playing the "quiet" track of my CD-1 test disc, was 96.6 dB for the left channel and 95.7 dB for the right. It should be emphasized that this reading represents the S/N of the analog section. The D/A converters are not being exercised when the disc's quiet track, which consists of digital "words" made up of 16 zeros, is played. A spectrum analysis of the residual noise output from that track, as scanned with a $\frac{1}{3}$ -octave filter, is shown in Fig. 3. Unlike what we have seen with a great many CD players that are more expensive, there is very little noise contribution at the power-line frequency of 60 Hz or at its harmonics.

Track 18 of the CD-1 test disc offers 1-kHz signals at various recorded levels, from maximum (0 dB) to -90 dB. A plot of quantization distortion versus recorded level is shown in Fig. 4. Note that the quantization distortion (sometimes referred to as quantization noise) is always referenced to maximum recorded level and is expressed in dB. Quantization distortion remains fairly constant at signal levels from around -5 to -80 dB, but it rises significantly for signals from -5 to 0 dB. This can only be attributed to the beginnings of overload in the system's final analog stages. This explanation is confirmed by the results in Fig. 5, for which I plotted THD + N versus frequency, at a uniform 0-dB recorded level. At 1 kHz, THD + N was 0.0165% for the left channel and 0.027% for the right. Both values are far higher than one would expect if the distortion came solely from the player's 16-bit D/A converters. At higher frequencies, THD + N rises still more, reaching 0.1% at 20 kHz. Confirmation of this rise can be seen in the spectrum analysis in Fig. 6. Here, a steady-state, 20-kHz tone, as reproduced from the test disc, was analyzed. The tall spike near the center of the screen is the desired 20-kHz output; the spike immediately to its right is the familiar, 24.1-kHz "beat" often encountered in these analyses and is not truly "harmonic" distortion. However, further to the right you can see another component. It is the third harmonic of 20 kHz and is about 60 dB lower in amplitude than the 20-kHz signal; -60 dB, expressed in percent, is exactly 0.1%.

Figure 7 is a plot of channel separation versus frequency. At 1 kHz, the unit more than meets its published specification, with separation readings of 87.5 dB from the left to the right channel and 85.5 dB from the right to the left. However, at higher frequencies, separation decreased rapidly. Though certainly adequate from an audible standpoint, separation at 16 kHz was only 65 dB from the left to the right channel and 62.5 dB from the right to the left. The linear manner in which separation decreased with frequency suggests that the cause of this decrease is in the analog stages. It is more than likely the result of some capacitive coupling between channels—possibly between adjacent wires carrying signals from opposing channels.

Perhaps the best indication of the quality of a CD player these days is its ability to reproduce low-level signals at their correct relative amplitudes. Any deviation from linearity at low levels must be viewed as a form of distortion. In this regard, the Harman/Kardon HD800 provided a superb example of how the choice of high-quality D/A converter chips can make a difference. Consider Fig. 8, which shows deviation from linearity, measured in dB, from maximum record-

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The error-correction and tracking ability of this player go far beyond the standards required for makers of CD players.

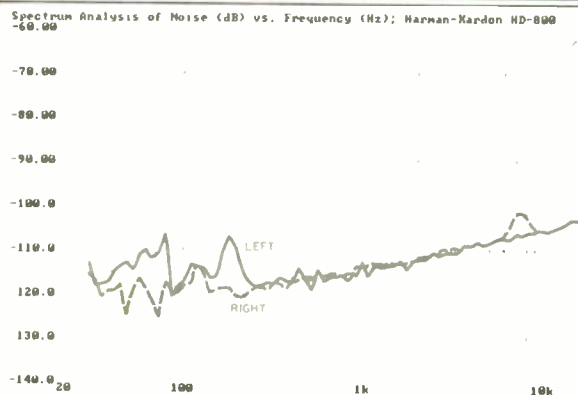


Fig. 3—Residual noise vs. frequency for "quiet" track of CD-1 test disc. Note the absence of noise peaks at the 60-Hz power-line frequency and its harmonics.

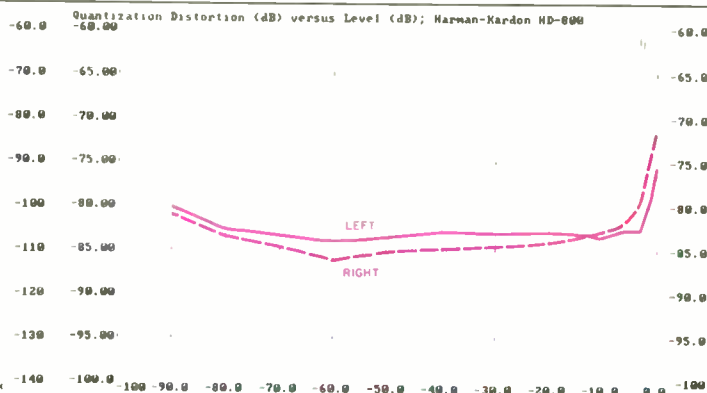


Fig. 4—Quantization noise and distortion as a function of recorded level.

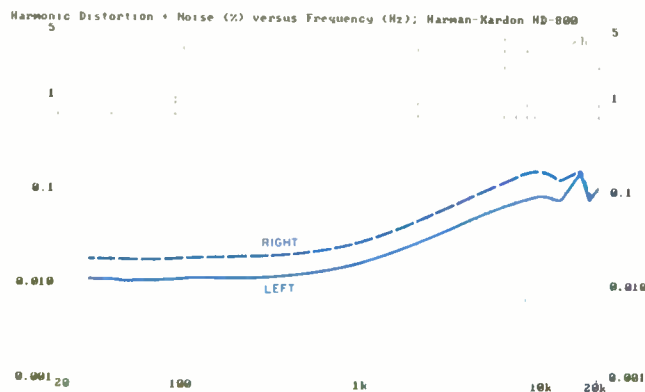


Fig. 5—THD + N vs. frequency at 0-dB signal level.

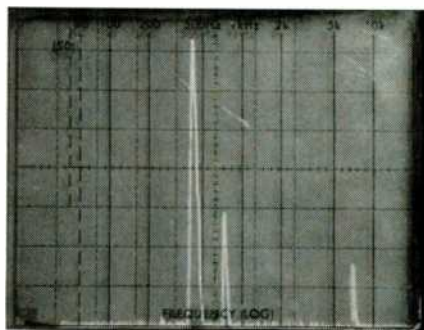


Fig. 6—Spectrum analysis of HD800's output when reproducing 20-kHz signal. Sweep is linear, from 0 Hz to 50 kHz. Note the "beat" component at 24.1 kHz and the 60-kHz third harmonic of the 20-kHz test signal.

ed level to -90 dB. At that lowest level, deviation from perfect linearity, using undithered signals, was a fairly insignificant -1.7 dB. This is about the best I have ever measured in any CD player, regardless of price.

A more meaningful indication of linearity is obtained from Fig. 9. Here, the test signals were dithered and extended from -70 to -100 dB. Even at -100 dB, signals were easily recovered, and deviation from linearity was approximately -3 dB.

Further confirmation of the excellent linearity of this player was obtained during the "fade-to-noise" test (Fig. 10), in which a gradually decreasing signal from -60 to -120 dB is played through the unit under test. If conditions were

ideal, the curve would run straight along the 0-dB line, from -60 right down into the noise level. In this Harman/Kardon unit, signals were still easily separated from the noise (i.e., the noise spikes were within ± 3 dB in amplitude) at -100 and even at -110 dB.

The monotonicity test on track 21 of the CD-1 provides steadily increasing square-wave signals that start at "digital zero" and increase by 1 LSB after every five cycles, to a maximum of 10 LSB. The averaged steps should, in an ideal situation, show up in the 'scope photo as symmetrical and uniformly increasing above the zero axis and as uniformly decreasing below the zero axis. That is almost the case in Fig. 11, where, upon close examination, you can see that

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The benefits of excellent low-level linearity were clearly audible in the reproduction of quiet musical passages.

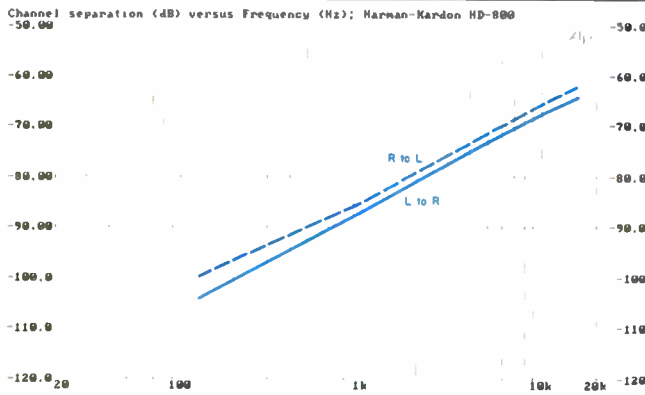


Fig. 7—Interchannel separation.

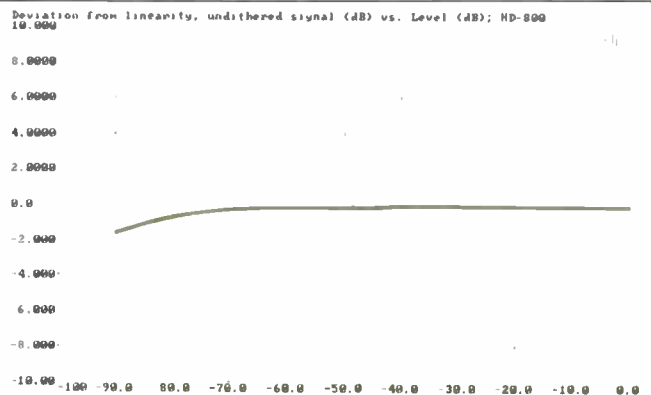


Fig. 8—Deviation from perfect linearity for undithered, 1-kHz signal at levels from 0 to -90 dB.

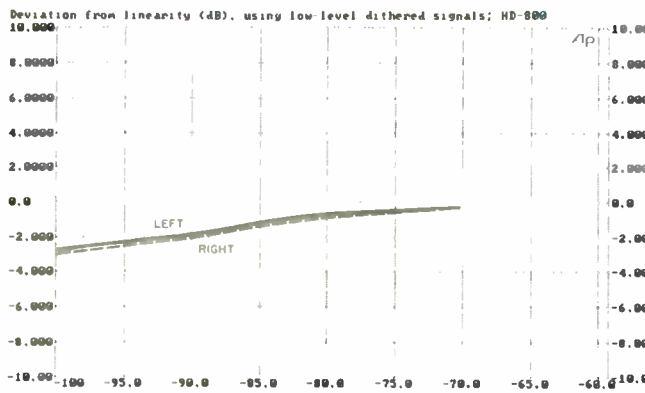


Fig. 9—Deviation from perfect linearity for dithered, 1-kHz signal at levels from -70 to -100 dB.

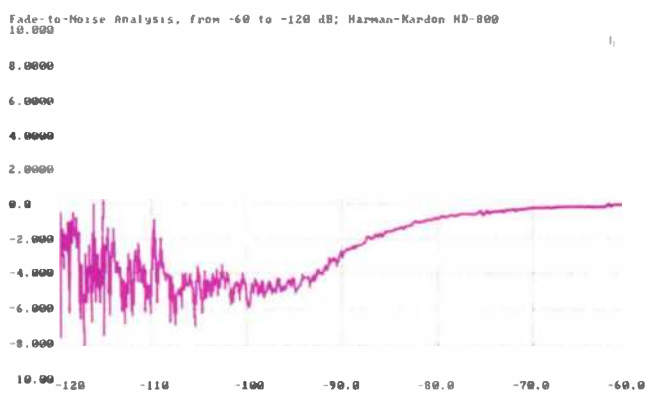


Fig. 10—Deviation from linearity for EIA "fade-to-noise" test of dynamic range, using dithered signal.

only the very first step shows a bit of asymmetry. All remaining steps are uniform in their incremental positive and negative directions.

The EIAJ dynamic range for this player measured 85.5 dB for the left channel and 87.3 dB for the right; both figures fall somewhat short of the 90 dB claimed by Harman/Kardon. Clock-frequency accuracy, a factor that determines how accurately musical pitch is reproduced, was off by a negligible -0.015%. Figure 12 shows how a 1-kHz square wave was reproduced by the HD800. The resulting waveform is typical of those obtained from CD players which employ

digital filtering and oversampling. Figure 13 shows that the Harman/Kardon HD800 inverts signal polarity; in a noninverting CD player, the signal would appear as a positive-going unit pulse.

At long last I have obtained a test disc that taxes the error-correction and tracking capabilities of even the most sophisticated Compact Disc players. If you have been reading my test reports for a couple of years, you may remember that I started off with a "defects" disc produced by Philips. That disc had an opaque "wedge" inscribed on its surface, whose widest dimension was 900 microns (0.9 mm). Many



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With its high S/N ratio, wide dynamic range, and nearly flat response, the HD800 can outperform many players costing far more.

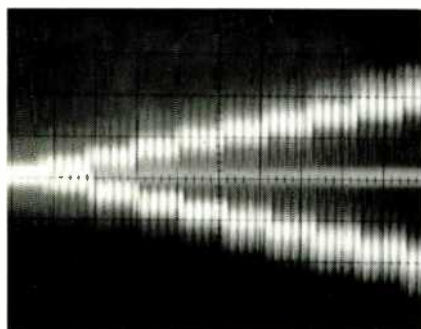


Fig. 11—Monotonicity test.

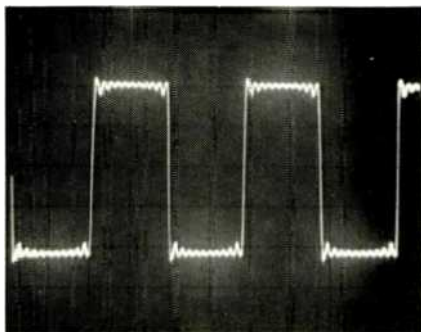


Fig. 12—Reproduction of 1-kHz square wave.

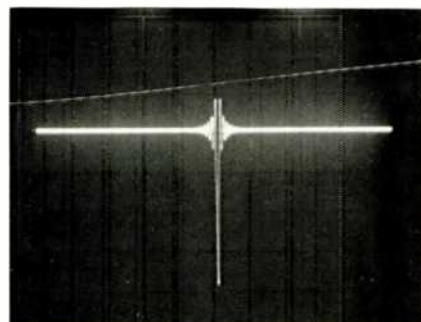


Fig. 13—Single-pulse test.

of the earliest players I tested could not traverse the entire wedge without mistracking or, at the very least, getting "hung up" in a spiral, repeating the same instant of music over and over again. After a time, however, more and more players were able to play right through the entire wedge without so much as a single glitch. Eventually, I simply stopped using the disc, as just about every player I tested was immune to the opaque area. I longed for a more meaningful check of error-correction capabilities, but no such test disc was available. Until now!

From France came a pair of masterfully produced test discs bearing the Pierre Verany label and distributed in this country by Harmonia Mundi. The discs contain a wide assortment of test signals and also offer a variety of excellent material that is useful for checking out the musicality of any or all parts of a stereo system.

Of particular interest to those who test CD players are the tracking and error-correction tests that go far beyond those of the earlier Philips test CD. One series of recorded signals tests how well a player performs when presented with discs having variations of linear "cutting" velocity. Another series combines variations in velocity with changes in track pitch (the space between two adjacent "spirals"). A third series varies track pitch alone. The tracks which interested me most were those containing various forms of dropouts. I must say that the Harman/Kardon HD800 did as well in these tests as my very best reference CD player. With normal track pitch, there was no audible evidence of mistracking—even for a gap in the data that measured 1,250 microns (1.25 mm). When the HD800 was subjected to test tracks having smaller than normal track pitch, it was able to get through 1-mm wide areas of missing data without any audible discontinuities. The same held true when I played tracks in which there were two such defective areas per disc rotation. The ability of the Harman/Kardon HD800 in this regard goes far beyond the standards required by Philips and Sony of their CD licensees.

Use and Listening Tests

Since the two test discs which provided the extended tracking and error-correction tests also contain a wide variety of musical selections, I decided to use them in my listening tests as well. For those "purists" who believe that no correlation exists between bench measurements and listening tests, let me say that the benefits of the excellent low-level linearity which I had measured on the bench were clearly audible when I listened to music via the HD800 and my reference system. These sonic advantages were especially apparent during quiet passages of a guitar solo and during a clear soprano vocal selection (tracks 4 and 6, respectively, of the first of the two Verany discs). I sensed a clarity of reproduction that I had not heard on Compact Disc players which exhibited poor linearity. To be sure, you have to listen very carefully to hear such subtle differences, but they are nevertheless evident.

The HD800 earns high marks for ease of operation and simple panel layout. And with its high S/N ratio, relatively wide dynamic range, and nearly flat frequency response, the HD800 outperforms many Compact Disc players costing considerably more.

Leonard Feldman

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High Fidelity

●● *The Velodyne subwoofer is one of those rare components I can recommend to almost anyone . . .*

The Velodyne Subwoofer is the most interesting product I have reviewed to date. When asked about 20 Hz bass response and distortion, audiophiles traditionally mumble something about "no musical information below such and such" and change the subject. The craftsmen who built church organs in centuries past did not agree with this opinion, and they provided pipes with output down to 16Hz. Velodyne recognized the problem of reproducing low bass and engineered a solution. This feat required multi-disciplinary ability, intuition, craftsmanship, organization of priorities, and common sense. I rank the quality, if not the magnitude, of this small California company's achievement up there with Dolby noise reduction and the Compact Disc. ●●

David L. Clark
**Audio Magazine

●● *Impressive as the specifications and measurements for the Velodyne ULD-12[™] are, they are overshadowed by its performance in a music system . . .*

We had expected to find a major improvement when using the ULD-12 with smaller speakers, ones whose lower limit was perhaps 45 to 60Hz. What we did not expect was the tremendous improvement it provided even with the largest, most bass-potent systems at our disposal, which went down to 30 or 35Hz without external help. Possibly the very low distortion of the Velodyne system was responsible for the improved bass we heard, or perhaps the fact that its output could be boosted above normal woofer levels, compensating for their natural rolloff at the lowest frequencies. Whatever the explanation, we are convinced that there are very few speakers whose low-bass performance could not be improved by adding a ULD-12 to the system.

It is an attractive, compact, intelligently designed product. And be warned—it can be habit forming! ●●

Julian Hirsch
***Stereo Review

If you want true bass—bass with power, depth, and clarity, you want a Velodyne. And that's the bottom line.



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5

TEAC V-970X CASSETTE DECK

Manufacturer's Specifications

Frequency Response: 25 Hz to 17 kHz, to 19 kHz with Type II tape, to 20 kHz with Type IV tape.

S/N Ratio: 70 dBA with Dolby B NR, 80 dBA with Dolby C NR, 92 dBA with dbx NR.

Input Sensitivity: Line, 60 mV.

Output Level: Line, 300 mV.

Flutter: 0.025% wtd. rms.

Fast-Wind Time: 100 S for C-60 cassette.

Dimensions: 17 $\frac{1}{8}$ in. W x 4 $\frac{7}{8}$ in. H x 11 in. D (43.5 cm x 12.4 cm x 28 cm).

Weight: 13 lbs. (5.9 kg).

Price: \$799.95.

Company Address: 7733 Telegraph Rd., Montebello, Cal. 90640.

For literature, circle No. 94



The V-970X is TEAC's best-performing deck, though not its most expensive (an auto-reverse model is available at a higher price). The V-970X offers the considerable convenience of Dolby B and C NR as well as dbx NR. It has three heads, facilitating better magnetic design and allowing playback monitoring during taping. The record and playback heads, although mounted right next to each other, are separate structures. The tape transport utilizes a dual-capstan drive for controlled tape tension and lower flutter.

The built-in calibration system has individual channel pots for both level and bias. This design approach aims for the

best record/playback responses with good Dolby NR tracking. The V-970X includes Dolby HX Pro for better recording of high-frequency energy at high level. The owner's manual does not mention punch-in (flying-start) recording, but this deck has it, and it can be a great convenience for the serious recordist.

"Auto Monitor" automatically switches between source and tape, depending on the deck's operating mode. Manual monitor selection can be made at any time. There is a headphone level control, which can be so helpful in setting a good monitoring level without affecting the line output

level. Left and right "Preset" controls and a master control set the input levels.

"CD Level Check," an unusual and interesting feature, helps the recordist preset input levels when recording from CDs. With it, you can read a CD's maximum level while manually fast-scanning the disc. The deck's meter levels are boosted automatically to compensate for the fact that CD players normally reduce their output levels during fast scan. The level meters are peak-responding, which is essential for good level setting. The auto-mute function is flexible, spacing longer or shorter mutes, as desired.

Finding something on a cassette is easy with "Intro Check," which fast winds to play the first 10 S of each selection. Two program search modes, "CPS" and "CDS," allow fast winds to the start of a selected tune anywhere on the tape. "CDS" counts from the beginning of the tape, and "CPS" counts in either direction from the current position. "Block Repeat" plays a specified section over and over until the deck is stopped. The counter has a time mode (minutes and seconds) as well as the normal turns counter. A very flexible remote control, which I'll describe later, is supplied.

Control Layout

At the far left of the front panel, from top to bottom, are the power switch, the large eject button, the "Timer (Play/Out/Rec)" slide switch, and the infrared remote sensor. The cassette compartment, to the right, moves out smartly but smoothly with a push of the eject button. When the door was open, access to the tape path for cleaning and demagnetizing was fairly good. Access was somewhat better with the door's window removed, but I still needed some dexterity. While making these observations, I noticed that the deck's capstan shafts have matte finishes. This would reduce any possible tape slippage at the pinch rollers.

To the right of the tape compartment, the large display panel shows much helpful information, mostly in a clear, bright, bluish white. The four-digit counter display, at the upper left, shows either turns or play/record time in minutes and seconds. Fast winding the deck or removing the tape does not change the time display, which will continue adding time if play or record is resumed. Just to the right of the counter display is the monitor status display, which shows either tape or source. Next on the right, from the top down, are annunciators for "Start Memo," "Stop Memo," and Dolby HX Pro.

To the right of the status indicators are horizontal bar-graphs for the peak-responding channel meters, with six bluish-white indicators from -20 to -2 and six red indicators from 0 to +12. The scale calibrations between the two bars have matching colors, and the combination is very easy to read in any light. Above the meters, indicators for "Norm," "CrO₂," or "Metal" (each with a red underline) illuminate as the deck senses the tape type inserted. "Metal" remains on if no tape is in place, and the "NR System" legend, under the bar-graphs, is always on. Depending on the choices made, "MPX Filter" (to the left) and/or Dolby "B," "Dolby C," or "dbx" noise reduction (to the right) will illuminate. Having the NR status displayed next to the meters certainly helps the recordist. In this respect, the V-970X's layout is quite superior to many other decks.



Under the display panel is the "Counter" switch, with "Clear" and "Mode" pushbuttons just below. To the right is "Block Repeat," with its associated "Start M" and "Stop M" buttons below. In block operation, these switches set the point where play starts and the point where play stops; the tape then rewinds to the first point. Stop memory is set automatically at the start of calibration mode so that rewind will end at the original start point. Start and stop memories work with either direction of fast wind, but they must be set with the deck in play, play/pause, record, record/pause, or record/mute mode. Unfortunately, they cannot be set with the deck in stop mode, which can be the most convenient time. Stop memory does not work in record but does work in play, where it is really needed. These memories can be set at any counter number; it is not necessary to return to zero.

Further to the right is the "CPS/CDS" program search button. A push while in stop, play, or record gets "CPS" mode and changes the counter display to "CP 1"; successive pushes will increase the number to the maximum of 15. A push of fast forward or rewind will then cause a fast wind to the beginning of the tune which is that number of selections away from the present position, and then play starts. Blank spaces of 4 S or more are needed between selections for proper counting. One push of "CPS/CDS," and then rewind, is a fast and convenient way to get back to the beginning of a recording that somehow went awry.

If the user wants to find a selection that is a certain number of tunes away from the beginning of the tape, a push of "CPS/CDS" while in rewind gets "CDS" mode and a "PL 1" in place of the normal counter display. Successive pushes will increase the number—to a maximum of 15—until the desired tune number is reached. After rewind to the start of the tape, the deck fast forwards to the beginning of the selected tune, and play commences.

The "Intro Check" button is next on the right. Pushing it in any transport mode gets an immediate fast forward that allows you to sample, in succession, the first 10 S of all tunes following on the tape. This feature is very handy for finding a tune or reviewing what's on a tape.

"CD Level Check," an unusual and interesting feature, lets you find the highest level on a CD and preset the deck's recording level accordingly.

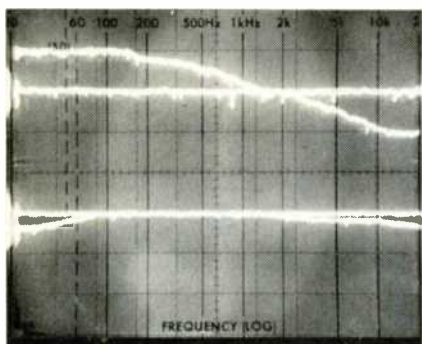


Fig. 1—Range of bias-control effects for two tapes. Straight traces show output level of 7.7-kHz test signal after using TEAC's calibration system. Curved traces show changes in 7.7-kHz output level as bias calibration pot is turned from minimum to maximum (clockwise). Test signal's output decreases smoothly with increasing bias for Maxell XLI tape (top traces) but not for Triad EM-X (bottom traces); see text. Vertical scale: 4 dB/div.

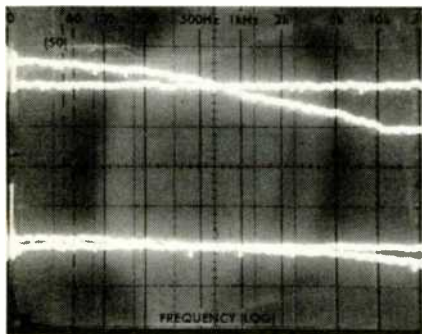


Fig. 2—Same as Fig. 1, for Fuji FR-II (top traces) and TDK MA (bottom).

The transport controls are under the switches just described. Rewind, stop, and fast forward are all of good size, and the play button is actually twice as large. All are clearly marked and angled for easy actuation. When play is pushed, a right-pointing, triangular arrow appears under the counter numbers in the display. To the right of fast forward is a horizontal bar for record, with a legend in red. Below are the pause and "Rec Mute" buttons.

In any pause mode, the word "Pause" and its double-bar symbol illuminate under the monitor status indicators. From pause mode, simultaneously pushing play and record initiates record/pause. As mentioned earlier, record can be punched in during play in the same way. When in record mode, the inside of the display-panel arrow turns red. In record/pause, the white outline goes off, and only the red arrow remains.

If "Rec Mute" is pushed, the red flashes for the duration of muting, which is normally 4 S. This period can be shortened by pushing pause or lengthened by holding in "Rec Mute." Although this description may sound a bit complicated, operation becomes quite straightforward after a little practice. The system's flexibility is excellent, and its status displays are among the best I have seen.

Below the transport and record switches are five pushbuttons for noise reduction. From left to right, they are "MPX Filter" (in/out) and the interlocked "Out," Dolby "B," Dolby "C," and "dbx" noise reduction.

At the upper right of the front panel are controls for bias and level calibration, both with left and right pots. Each pot has a small bar knob and a soft center detent. The calibration process begins in record/pause mode. A push of "Cal Start," below the bias pots, gets the deck recording a 400-Hz tone and simultaneously sets "Stop Memo." At the same time, "Level" illuminates just above the two level-calibration pots, and the left and right meters show playback with a level around zero. The left and right level pots are adjusted until the first red segments above zero turn on. Then "Cal Start" is pushed again, "Level" goes off, and "Bias" goes on. The test tone switches to a high frequency (7.7 kHz), and the meters show a level around zero. The bias pots are then adjusted as the level pots were. Clockwise rotation increases bias, which actually reduces the output signal level. This is opposite in effect to the level pots but shouldn't be confusing to those who know what changing bias does. Another push of "Cal Start" allows a rechecking of level calibration; yet another push, of course, checks bias again. Pushing rewind ends calibration and rewinds the tape to the "Stop Memo" point. This memory is retained, allowing for an easy return if something goes wrong.

Below "Cal Start" is the "Auto Monitor" button, which actually defeats the auto function by manually switching monitor mode. When the deck's operating mode changes, the monitor setting usually switches automatically to whatever monitor mode logically matches the deck's operation.

To the right of "Cal Start" are "Set" and "Reset" buttons for "CD Level Check." In "Set," a red indicator goes on, the monitor is automatically switched to source, and the meter indications are automatically increased by 12 dB. (As discussed earlier, this compensates for the way CD players reduce their output levels during fast scan. The 12-dB boost matches TEAC's CD players, but TEAC says it's a pretty close match for other makes, and I found it worked well with my own player.) After setting levels based on such scanning, "Reset" returns the metering and monitoring to normal operation. I wondered how accurate the level check would be and planned later tests to find out.

The "Master Rec Level" control, with its left and right "Preset" pots, is just below. The master knob has a bevel



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The muting system, a little more elaborate than most, offers excellent flexibility, and the status displays are among the best I've seen.

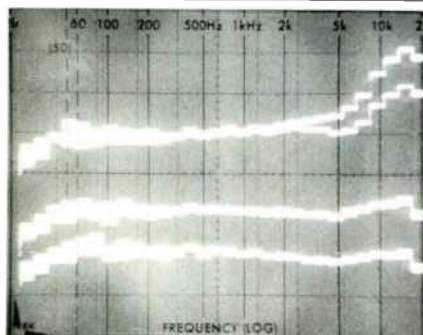


Fig. 3—Using Triad EM-X tape, the bias settings that met the deck's calibration criteria varied enough to produce this range of record/playback responses. Top: With minimum calibration bias, with and without Dolby C NR.

Middle: With Dolby C NR and maximum calibration bias. Bottom: With Dolby C NR, after using test instruments to adjust bias and level for best overall response. Vertical scale: 5 dB/div.

and an index line which aid in accurate setting. To its left, the helpful headphone level control has the same small, smooth knob and hard-to-see index used on the "Preset" controls. These are not the most important things, but a larger size or a little knurling plus a bright-line index would help in setting levels. The headphone jack at the lower right is somewhat away from the level control, but adjustments would probably be slightly more difficult if the plug were close to the control.

The back panel is very simple, having just gold-plated stereo input and output jacks and the power cord.

I removed the top and side cover to get a look at the inside. There was one large p.c. board (about two-thirds chassis size), a few small vertical cards plugged into it, and a board behind the display panel. The main board was well supported, in general, but the power supply end was springy. The function sections were labelled, and all parts and adjustments were identified. What could be seen of the soldering was excellent. Multi-pin plugs were used for the interconnections between sections.

The power transformer was mounted at an angle—to minimize hum pickup—in the left rear of the chassis. It was warm to the touch after some hours of operation. Two chassis side rails make the construction good and rigid. The transport has three motors, one for the dual-capstan drive, another for the tape-hub drive, and the third for actuation of the transport cam. Fast wind sounded a bit tonal, but with the cover replaced, it was much less distracting. The sound level of the transport was very low in play—only 45 dBA just 1 inch from the cassette compartment's door.

The remote control appears rather simple when compared to units for surround-sound systems, but the TEAC RC-311 does much more than the remotes available for

most tape decks. It controls all of the basic transport functions, of course, and has buttons for "CPS," "Auto Monitor," "Intro Check," "Start Memo," "Stop Memo," and counter "Clear," as well. The RC-311 has even more goodies: "Rec Mute," with complete duplication of the flexibility offered by the front-panel control, and two "Record" buttons that also allow flying-start recording. (The RC-311 also carries a third "Record" button and an extra playback button. They are obviously intended for use with TEAC's auto-reverse decks and have no effect on the V-970X.) The remote facilities are not just lazy-recordist conveniences. If cassette decks are physically separated, a good remote control can make dubbing and editing much easier.

Measurements

The 120- and 70- μ S playback responses of the V-970X, using TDK and BASF test tapes, ranged from very good to excellent at all points (Table I). Most deviations were within ± 0.7 dB. Tape play speed was 0.3% fast, which is very good and better than many decks.

Dolby level indicated meter zero, with the first red segment just faintly on. I tried the level and bias calibration system for about 50 tapes. The results were then evaluated, using what I call "PN/Music" as a test signal. This is pink noise, band-limited below 20 Hz and above 20 kHz, with a complex equalization designed to simulate typical music spectra. The equalization begins with a roll-off above 2 kHz that slopes down to -5 dB at 5 kHz, then slowly drops to -8 dB at 10 to 16 kHz. This decrease is followed by a sharp drop, to about -15 dB at 20 kHz. A mirror image of this equalization is applied to the deck's playback output, so flat record/playback responses will appear flat on my RTA.

The great majority of the Type I tapes calibrated easily and had good record/playback responses with and without Dolby C NR. Maxell XLI was judged to be the best overall, with Fuji FR-I Super very close.

I had more of a problem with the Type II tapes, many of which showed puzzling characteristics in calibration that I'll explain shortly. Fuji FR-II was judged the best of the Type IIs, with Maxell XLII, Memorex HBX-II, SKC QX, Sony UX-ES, and TDK SA almost as good. The responses from Fuji FR-II Super, Maxell UDS-II, and Sony UX were somewhat poorer. All other Type II tapes tried were judged to be unsatisfactory because of a peak of 4 dB or more from 12 to 16 kHz.

TEAC states that this deck cannot be calibrated for optimum response with Type IV tapes, but I found it could be properly calibrated for some metal-particle formulations. The best of these, in my view, was TDK MA; Fuji FR-Metal, Maxell MX, Nakamichi ZX, and SKC ZX were also quite good. A number of other metal tapes had the same sort of high-frequency peak as the Type IIs.

At this point, I decided to examine the calibration process more closely. I didn't have any questions about setting the Dolby reference level, but I did check the test tone used. Its frequency was 379 Hz, and it was recorded about 20 dB below Dolby reference level (200 nWb/m). The high-frequency bias test tone was 7.7 kHz at about -20 dB. The deck includes a 20-dB amplifier for these test signals, so the recording level meter will read zero for them when the deck is calibrated.

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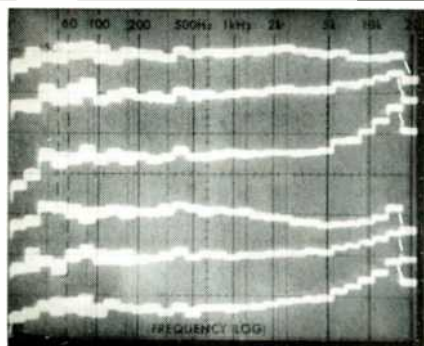


Fig. 4—Record/playback responses for PN/Music, after calibration, with Dolby C NR. Top three traces are at 0 dB for (top to bottom) Maxell XLI, Fuji FR-II, and TDK MA tapes. Bottom three traces are at -20 dB for same tapes in same order. Vertical scale: 5 dB/div.

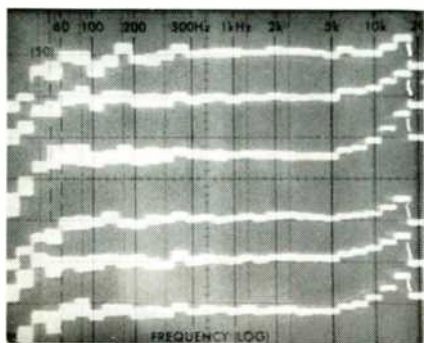


Fig. 5—Same as Fig. 4 but with dbx NR.

To see what was happening with the level of the 7.7-kHz bias test tone, I tuned my spectrum analyzer to 7.7 kHz and checked the deck's test-tone playback level over time as I changed bias settings. For each tape tried, I stored the tone level produced when the deck's bias was set according to the calibration system. I then made a second set of measurements while varying the setting of the bias pot from its minimum to its maximum. One should expect that the level would be highest with minimum bias and would drop with increasing bias.

Figure 1 shows the results from the two scans for both Maxell XLI and Triad EM-X, one of the questionable Type II tapes. With XLI, the test-tone level is higher with low bias; the level decreases smoothly as bias is increased. However, in the case of EM-X, low bias gets a low level, there is little change in tone level during a large increase in bias, and the highest bias gets a slow drop in level. Figure 2

shows the results of the same test with Fuji FR-II and TDK MA tapes. You can see a good range of 7.7-kHz level control with the Type II tape, but the total change for the metal tape is just about the same as the segment on the meter.

Using Triad EM-X tape in the V-970X, the level of the test tone changed slowly as the bias was changed, so proper calibration was indicated over a range of bias levels. Figure 3 demonstrates the different record/playback responses that are possible with EM-X, all meeting calibration criteria. The top two traces are with minimum calibration bias, with and without Dolby C NR. The higher peak is with NR. The middle trace was obtained using Dolby C NR but with bias increased to the maximum possible for a calibration indication. The bottom trace shows a slight further improvement, which was made by adjusting both bias and level for the best RTA display. Without the RTA, the top traces would be the most likely responses for EM-X. My explanation is this: Even though the test-tone level is 20 dB down, it is actually in saturation, which causes a drop in output level when the input level is increased. Because test-tone saturation is occurring, bias is actually set at a lower level than it ought to be. When recording music (or pink noise) with lower high-frequency levels which are not in saturation, the resulting record/playback will be peaked at the highest frequencies.

Figure 4 shows the record/playback responses for PN/Music, using Dolby C NR, for rms levels equivalent to meter zero (reading +6 on the deck's peak-reading meters, due to peaks in the noise signal) and at a level of -20 dB. The three tapes used were Maxell XLI, Fuji FR-II, and TDK MA. Each recording was made after following the calibration process as carefully as possible. It was easy to verify that the responses were flatter for the Type II and IV tapes if the bias was set slightly higher than was called for in calibration. Figure 5 shows the generally similar results for the same three tapes at 0 and -20 dB using dbx NR. With slightly higher bias, the high-frequency peaks would be much lower. Do note, however, the roll-off below 40 to 50 Hz, which is typical of dbx II NR.

Table I lists the -3 dB points for the three tapes without NR and with Dolby C and dbx NR, at 0 and -20 dB. The high-frequency end points could not be measured with simultaneous record/playback because of coupling between the record and playback heads, which are very close.

Table I—Record/playback responses (-3 dB limits).

Tape	With Dolby C NR				Without NR			
	Dolby Lvl		-20 dB		Dolby Lvl		-20 dB	
	Hz	kHz	Hz	kHz	Hz	kHz	Hz	kHz
Maxell XLI	10.6	11.6	10.0	18.5	10.5	9.8	10.5	19.9
Fuji FR-II	10.9	12.6	9.9	17.1	10.9	9.9	10.2	19.3
TDK MA	10.5	18.7	10.3	20.4	10.5	18.7	10.0	20.6

Tape	With dbx NR				Without NR			
	Dolby Lvl		-20 dB		Dolby Lvl		-20 dB	
	Hz	kHz	Hz	kHz	Hz	kHz	Hz	kHz
Maxell XLI	32.1	11.8	32.3	17.3	10.5	9.8	10.5	19.9
Fuji FR-II	32.3	12.3	32.0	17.2	10.9	9.9	10.2	19.3
TDK MA	32.2	18.4	31.8	21.2	10.5	18.7	10.0	20.6

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The S/N with Dolby C NR was good, but with dbx NR it was outstanding—2 to 3 dB better than for any other deck I've tested with this NR system.

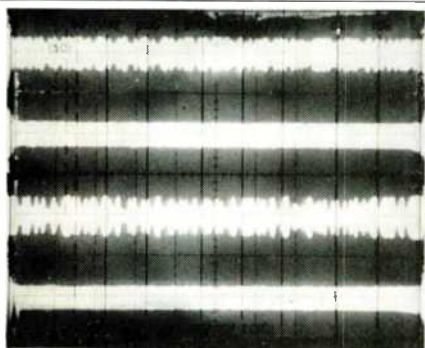


Fig. 6—Effect of coupling between record and playback heads when monitoring the playback head while recording. The upper trace of each pair shows output variations while monitoring; the lower trace shows smooth response when playing back the recorded signal. See text. Top pair of traces is for a 14.5-kHz tone; bottom pair is for 16.5 kHz.

As shown in Fig. 6, when the test tone was monitored from the playback head during recording, signal coupling from the record head made the monitor levels bounce up and down. However, when recording ceased, rewinding and playing back the tape showed excellent smoothness of output. Obviously, the bouncing level does not affect the recording. In my subsequent listening tests, using music instead of steady test tones, I did not detect any effects that I could ascribe to coupling between the heads. The lowest frequency for an observable effect was about 10 kHz. There were specific points where the bouncing was low, and 16.5 kHz was a point where it was quite high.

Table II lists a number of record/playback characteristics, all of which were excellent except for the 100-Hz erasure with Dolby C NR, which I wish were 5 dB better. Notice the improved results for erasure, separation, and crosstalk with dbx NR. I'm not certain how far down crosstalk was—I gave up at -110 dB.

Table III shows the third-harmonic distortion levels with Dolby C and dbx NR for the three tapes, from -10 dB to the level where $HDL_3 = 3\%$. All of these results are very good, especially the low distortion at low levels with dbx NR and Maxell XLI tape. The 3% limits for the Maxell and TDK tapes with dbx NR were actually the points at which the electronics clipped.

Table IV lists the MOLs for 3% distortion attained with the three tapes, using Dolby C and dbx NR. An HDL_3 limit was used for 40 Hz, 100 Hz, 400 Hz, and 1 kHz, and a TTIM limit for 2.5, 10, and 15 kHz. The Dolby C NR figures were pretty much what I expected for the Type I and II tapes, with some evidence of HX Pro at work. The results for TDK MA were very impressive, with the 15-kHz level actually higher than that for 10 kHz. This tape was also the most impressive performer with dbx NR, despite the large drop in maximum levels from 10 to 15 kHz. The XLI and FR-II tapes had very

high MOL figures from 100 Hz to 2.5 kHz with dbx NR, but a large drop in the MOLs occurred at 40 Hz and at 10 and 15 kHz. Therefore, with these tapes, the very high MOLs for dbx at 400 Hz cannot be taken advantage of when recording music with organ, obvious bass drum (40-Hz limit), or loud cymbal crashes (15-kHz limit).

Table V shows S/N ratios for the three tapes, using Dolby C and dbx NR, with both IEC A and CCIR/ARM weightings. The results for Dolby C NR are very good and somewhat better than the average for other decks. The dbx figures are outstanding—2 to 3 dB better than any previous ratios for this NR. At first, I wondered if my measurements were off, but rechecks confirmed the data shown.

Table VI lists some miscellaneous input and output characteristics. My numbers were higher than specified by TEAC for both input sensitivity and output level, but these differences are of minor importance. The right and left sections of the master input and headphone level pots tracked within 1 dB for 45-dB attenuation, which is fairly good. The level was quite high on all headphones tried, and it was very nice to have this pot to set a comfortable listening level. I confirmed that "CD Level Check" increased the displayed meter level by 12 dB. Next, I tried this feature with two CDs I knew would be challenging, Stravinsky's "The Firebird Suite" and Tchaikovsky's "1812 Overture." The "CD Level Check" provided some clues to the disc's peak levels, but the actual peak levels were 4 dB higher for the Stravinsky and 6 dB higher for the Tchaikovsky. After a little practice, the user might find that setting the level to -4 would be close for similar classical music. The level check was quite good, within 1 or 2 dB for pop/rock CDs because of their rather consistent high levels.

The bar-graph meters were 3 dB down at 4.7 Hz and 20.2 kHz—better than meters on quite a few other decks. The scale calibrations were accurate, with most segments within 0.2 dB. For example, the +8 segment turned on at +7.9 dB; +12 was the exception, turning on at +10.0 dB. The response time of the meters was very short, meeting the requirements for peak program meters, but the decay time was just 0.6 S, about one-third the recommended time. The meter was full peak responding and gave the correct in-

Table II—Miscellaneous record/playback characteristics.

NR Type	Erasure At 100 Hz	Sep. At 1 kHz	Crosstalk At 1 kHz	10-kHz A/B Phase		MPX Filter At 19.00 kHz
				Error	Jitter	
Dolby C	55 dB	64 dB	-100 dB	5°	15°	-37.0 dB
dbx	83 dB	68 dB	< -110 dB			

Table III—400-Hz HDL_3 (%) vs. output level (0 dB = 200 nWb/m).

Tape	NR	Output Level						$HDL_3 = 3\%$
		-10	-8	-4	0	+4	+8	
Maxell XLI	Dolby C	0.08	0.09	0.21	0.36	1.26		+6.6 dB
	dbx	0.05	0.07	0.10	0.18	0.27	0.38	+17.3 dB
Fuji FR-II	Dolby C	0.08	0.14	0.30	0.79	2.51		+4.6 dB
	dbx	0.16	0.20	0.25	0.32	0.56	0.80	+16.9 dB
TDK MA	Dolby C	0.08	0.13	0.32	0.82	1.58		+6.6 dB
	dbx	0.14	0.19	0.24	0.34	0.47	0.70	+17.5 dB

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The V-970X combines excellent performance in all areas with many real conveniences. It's worth comparing to decks that sell for twice its price.

Table IV—MOL (0 dB = 200 nWb/m) for 3% distortion vs. frequency.

Tape	NR	Frequency (Hz)						
		HLD ₃ = 3% (dB)				TTIM = 3% (dB)		
		40	100	400	1k	2.5k	10k	15k
Maxell XLI	Dolby C	-3.9	-6.5	-6.6	-5.0	-3.4	-3.2	-8.4
	dbx	-0.3	+17.2	-17.3	-16.4	-9.9	-1.8	20.4
Fuji FR-II	Dolby C	-0.8	+3.9	-4.6	-4.5	-2.1	-3.7	-8.5
	dbx	-4.7	+11.6	-16.9	-15.7	-8.3	-2.3	-17.9
TDK MA	Dolby C	-2.8	-6.0	-6.6	-7.1	-7.0	-3.6	-3.9
	dbx	-8.7	-15.3	-17.5	-17.4	-15.0	-11.0	-1.6

Table V—Signal/noise ratios with IEC A and CCIR/ARM weightings.

Tape	IEC A Wtd. (dBA)				CCIR/ARM (dB)			
	W/Dolby C NR		W/dbx NR		W/Dolby C NR		W/dbx NR	
	α DL	HD=3%	α DL	HD=3%	α DL	HD=3%	α DL	HD=3%
Maxell XLI	68.0	74.6	81.3	98.6	68.9	75.5	77.7	95.0
Fuji FR-II	71.2	75.8	82.5	99.4	71.0	75.6	78.7	95.6
TDK MA	70.0	76.6	82.0	99.5	70.6	77.2	78.4	95.9

Table VI—Input and output characteristics at 1 kHz.

Input	Level			Imp., Kilohms	Output	Level			Imp., Ohms	Clip (Re: Meter 0)
	Sens.	Overload				Open Ckt.	Loaded			
Line	99 mV	>31 V		58	Line	440 mV	345 mV	3.0k		+15.7 dB
					Hdphn.	469 mV	319 mV	22		

creases in reading when the tone burst was offset in either direction from zero voltage. Very few other cassette decks have meters that meet this criterion. In source mode, the signal polarity was the same at both the input and the output. In tape mode, polarity at the output was reversed.

Typical measured flutter was 0.032% weighted rms and ±0.046% weighted peak. The rms figure is slightly higher than specified, but it is excellent nonetheless. There was no measurable change in tape playback speed with line voltage anywhere from 110 to 130 V. There were small speed variations with time that were limited to about ±0.02%. The TEAC owner's manual specifies 100 S for fast winding a C-60 cassette, but the tested unit did it in 80 S; it even wound a C-90 in 104 S. Transport mode changes required less than 1 S.

Use and Listening Tests

The four-language owner's manual provides good detail on most things, and a fold-out page with diagrams provides a lot of helpful information. The manual has an explanation of HX Pro which most users would find of interest, although more information about setting record levels would certainly be beneficial.

Tape insertion and removal were very easy, and I did not find myself confusing the power and eject buttons, as on some decks. I did need a bit of a training period to learn all of the various functions and variations, although it all seemed very logical after some practice. I was going to list

one or two things I really liked, but there are more than a few: Complete control of auto-mute time, Dolby and dbx NR systems, an excellent remote control, three heads, head-phone level control, bias and level calibration, peak-responding meters, and the admirable display panel. The memory modes were also very useful, even if I did wish the elapsed-time counter would count time when fast winding. Other functions, such as "Intro Check," worked very well and were most convenient when used with tapes of pop/rock music. All controls and switches were completely reliable during the testing.

Timer start in play or record had about a 2-S delay before the transport was engaged. This seemed a rather short time for the transport to get up to speed, but I didn't detect any problems. Record, pause, and stop sounds with Dolby C NR were all very low in level and hard to detect by meter or ear, even when well amplified. The sounds were even lower with dbx NR.

The calibration system worked very well, but I decided to make pink-noise comparisons between source and tape while adjusting bias and listening carefully. Without NR, the change in level at the highest frequencies was obvious for small changes in bias; it was much more so with Dolby C NR. With dbx NR, bias changes had less effect on high-frequency peaking but more on overall level. I also used the RTA to recheck the peaking effect versus small changes of bias. My general conclusion was that Type II and IV tapes had the flattest responses when bias was increased enough to get a slightly lower meter indication than TEAC recommends in their calibration instructions.

I used CDs for the record/playback listening tests. During quiet passages, the noise background with dbx was slightly less noticeable than it was with Dolby C NR. With dbx NR, it was possible to record at very high levels without gross distortion. At normal recording levels, however, clarity and musical detail were better with Dolby C NR. On Stravinsky's "Firebird Suite," with Robert Shaw and the Atlanta Symphony (Telarc CD-80039), TDK MA tape showed its advantages at higher record levels with both NR systems. The bass drum beats near the end of the music were slightly subdued with dbx NR, but the cymbal crashes, at very high recording levels, were cleaner than I expected. Beethoven's "Piano Concerto No. 3" and the "Choral Fantasy" with Rudolf Serkin, Seiji Ozawa, and the Boston Symphony (Telarc CD-80063) confirmed the excellent flutter performance of the TEAC deck. The chorus was reproduced very well, and I did not detect modulation effects with soprano voices. Saint-Saëns' "Symphony No. 3," played by Michael Murray with Eugene Ormandy and the Philadelphia Orchestra (Telarc CD-80051), fared best with Dolby C NR. This noise-reduction system provided a fuller organ tone on the lower pedal notes and better articulation in the loud passages than did dbx NR.

The V-970X offers many real conveniences and delivers very good to excellent performance in all areas. Trimming bias for the best record/playback will be aided by careful listening. This deck is a potent combination for those who do lots of recording/dubbing, and it is certainly worthy of comparison to decks costing up to 50% more.

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The Yamaha CX-10000 "natural-sound digital control amplifier" is undoubtedly the most complex preamplifier I have ever encountered. It combines virtually every video and audio switching feature I can think of with a built-in, 18-bit D/A converter, six-channel digital sound processing including 16 different preset room and hall effects, and a highly sophisticated parametric equalizer. The only thing the CX-10000 lacks is a phono gain and equalization stage, and this is avail-

able in a matching phono equalizer unit, the Model HX-10000. You can get the CX-10000 for \$7,500 and the HX-10000 for another \$2,500. If this initially seems expensive, read on. The units are cheap if you accept a standard of value based on dollar per feature.

The CX-10000 is techno-glitz with a vengeance. There are roughly 52 controls on the front and 57 input and output jacks on the back. (You try and come up with a precise count while holding a 53-pound preamp in your lap!) Included are an 8-bit microcomputer—necessary simply to help you operate a few of the features—two complex front-panel data displays, and a 52-button remote control.

At a bare minimum, you can spend several weeks just setting this unit up and learning to understand how all its different features allow you to change the sound of music or switch the signals from your video equipment. While

the CX-10000 may then be less interesting than sex, it will unquestionably be a more interesting companion than a law partner, spiritual advisor, or new president.

This issue of *Audio* isn't large enough to fully describe all the features, and I don't get paid by the word. Even a short list of what this unit can do, however, should whet the appetite of any serious audiophile. You get:

- A three-transformer power supply with separate power supplies for the digital, analog, and video sections;
- Double-sided glass-epoxy circuit boards;
- Solid dual-chassis construction with isolated digital and analog sections and with all amplifiers separately enclosed in aluminum units;
- Eleven audio and video inputs, which provide the ability to operate two VCRs, two videodisc players, two analog tape decks, two DAT recorders, a



CD player, a phono amp, and a tuner. Switching is accomplished by the aforementioned 8-bit digital microprocessor, and discrete transistor switching is used instead of contact switching;

- The ability to vary the sensitivity of each input by up to 6 dB;

- Electronic, rather than electromechanical, gain control;

- Digital parametric equalization with three separate bands, covering 61 central frequencies, adjustable by bandwidth (in $\frac{1}{6}$ -octave increments), by level, and by sharpness of slope (Qs of 0.7, 1.4, 3.0, and 6.0 are available);

- High and low variable-slope cutoff filters;

- Digital sound processing with 16 different acoustic mode settings, each of which can be varied by room size, and ranging from concert hall to rock concert and from church to warehouse loft. (I am a tad perplexed by the setting for warehouse loft. I've seen music abused in some strange places, but I can scarcely say I've found this one common enough to be immortalized on a front panel.) The user can vary the parameters in each setting to adjust them to personal taste, and can even create his own (may I suggest elevator, brothel, or closet?);

- A full 18-bit D/A converter to allow a direct input from a CD player or DAT recorder, four-times oversampling, and 16-bit conversion of the ambience information. There also are two digital record outputs with built-in dither capability;

- Outputs for two front and two rear presence (or ambience) channels. This requires four additional channels of power amplification and four more speakers, although you can use only the two rear channels in a pinch;

- User naming of the input or program on the data display;

- Published specs of less than 0.003% harmonic distortion, 110 dB of S/N ratio, and a bandwidth of 15 Hz to 100 kHz.

If you add the HX-10000, you get another unit with two separate FET/MOS-FET phono amplifiers, each of which can switch between moving-magnet and moving-coil operation. You can switch between 100- and 300-pF capacitive loads for the moving-



HX-10000 phono preamp

magnet input and 10-, 30-, and 100-ohm loads for the moving-coil input. The moving-magnet setting has a sensitivity of 120 mV and an S/N ratio of 99 dB; the moving-coil setting has a selectable sensitivity of 3.4 or 12 mV and an S/N ratio of 94 dB.

The HX-10000's rated harmonic distortion is less than 0.002% at any setting, and equalization is claimed to be accurate within ± 0.2 dB. The moving-magnet separation is 66 to 86 dB, and the moving-coil separation is 50 dB. Like the CX-10000, the HX-10000 is built better than the average battleship. It weighs 44 pounds, has four separate mechanically isolated circuit boards, and uses two-box chassis construction.

This list of features will be fascinating to most *Audio* readers but may be intimidating to a few. Let me assure you, then, that anyone who can read an instruction book can rapidly learn how to operate the key functions of this unit. Further, all of this preamp's features are eminently usable. The CX-10000 is particularly easy to operate if you are only using the unit as a two-channel preamp. For proof, I asked my daughter to hook it up without the in-

struction book. This took a mild bribe (use of the car), but she got it right the first time. No one who ever hooked up a system is going to have trouble using this unit as an audio preamp.

The CX-10000's video features are straightforward, although operating them may require that you actually read the instruction book. I also found, as with some other units which are this complex, that I got noticeably better picture quality when I grounded all my video components and used an isolation device to filter the a.c. line. You may need the help of an expert technician in setting up a complex video system using this sort of filtering device. Many cable installations lack the signal strength to prevent a loss of picture quality when the signal is passed through such a system. Ghosts, vertical bars, and noise are easy to create—even if one is only dubbing the video from unit to unit.

The video features are all useful, but the CX-10000 also has the same basic ergonomic problem as every other Japanese video switching device I've encountered. There are no separate circuits for the TV monitor tuner's video and audio outputs. However, given the

The CX-10000's parametric equalizer is more useful than conventional types, because it lets you tackle your specific problems.

number of inputs, this is minor, since most users can give up one videodisc input and still hook up a videodisc player and two VCRs.

The parametric equalizer and variable high- and low-pass filters are slightly more difficult to use, but the instructions are straightforward and easy to understand. The CX-10000 is also capable of correcting most major room problems and some tonal balance problems in speakers.

This Yamaha preamp's equalizer section is far more useful than most stand-alone equalizers, which typically have 12 to 24 controls. Rather than trying to use a combination of fixed-octave controls, the Yamaha allows you to attack the specific problems in your system. The bass control is particularly helpful in removing typical room-resonance problems. However, it suffers from the fact that most problem installations will have several major peaks and valleys in bass response, and the CX-10000 can only correct the worst of these.

The sole difficulty in using the parametric equalizer lies in deciding which adjustment is right. The best results often come from a sharp, narrow-band bass cut to correct the worst peak in bass response, minimal adjustment of the midrange, and choosing a point in the upper midrange where you can adjust the overall balance of your system to what you feel is musically natural. Remember, even a 1-dB change can fine-tune many systems. If you have too much overall treble energy, use the high-pass filter and find the slope that sounds best. The fact is, very few audiophiles listen well enough to adjust such a control on their own, and no one can achieve a technically correct setting without a measurement device having at least $\frac{1}{3}$ -octave resolution.

My advice is: Get assistance from several good listeners, and don't try to create measured flat response in the upper octaves. With few exceptions, any system that measures flat in the listening position will have so much upper midrange and treble energy that it will sound unbearably bright. On the whole, if careful and slow experiment produces results which sound right to several good listeners, then you have it right.



Rear and interior view of HX-10000

The D/A converter features are not particularly complex and work quite well, but they are something of a mixed bag. The user should be aware that it is not possible to dub digitally from CD players to DAT units. As for the value of using the D/A converter in the CX-10000, I would strongly suggest you experiment before you bypass the converter in your CD player or DAT deck. Regardless of the theoretical and technical merits of Yamaha's 18-bit, four-times oversampling system, it did not always produce for me the same sonic clarity, natural dynamics, or upper octave tonal balance as the regular D/A converter in a Sony DAT unit. It did improve the sound of NEC, Denon, and stock Philips CD players, but it degraded the sound from the Mod Squad and top-of-the-line Sony CD players auditioned with it.

By and large, I question the value of this converter because so many changes are taking place in this technology, it may quickly become obsolete. I also do not know of any CD or DAT units that do not come with D/A converters. Even Yamaha's CDX-10000 CD player comes with its own 18-bit, four-times oversampling converter. Further, no one is really going to use a \$7,500 preamp with an older or nonaudiophile CD player.

For many, the CX-10000's digital sound-field processor will be its most attractive and useful feature. It's worth pointing out that much the same component, in separate form—the DSP-1—sells for nearly \$1,000. Among the major features in this Yamaha preamp, however, the sound-field processor is also unquestionably the most difficult to use properly.

You need four *identical* channels of amplification in addition to a normal

stereo power amp. The CX-10000 also requires four *identical* full-range speakers. In addition to the two main speakers, few things in high-end audio are more pathetic than a complex sound system using low-grade ambience speakers which do not match each other exactly and which do not match the main speakers. Ambience then comes at the direct expense of smearing and confusing the music. This is particularly true in the case of the CX-10000. Getting the best results requires the use of high-frequency output to the ambience speakers, and even the low-frequency output goes up to 1 kHz and thus has a great deal of midrange data. Poorly matched speakers will be clearly audible.

Even an experienced audiophile is going to find this kind of system a bit ambitious, and hookup will be difficult. You also need to make a prolonged effort to get all volume adjustments correct. Trying to simply use the default settings in the CX-10000 is an almost certain recipe for getting an unbalanced system and unrealistic hall effects. You can use the CX-10000 to adjust the volume to each of the four ambience speakers, but the process is laborious. I would like to be able to easily pan the gain for these four speakers as well as to adjust their overall levels, using the remote control. In many systems, adjustment may be needed for each recording to get the best results, and music with badly mixed artificial reverb can be a bit of a trial.

In most cases, the ambience speakers will have to be mounted on stands taller than a standing man or in the upper corners of the room. Further, the room will require careful treatment to minimize reflection. Odd-shaped rooms, or those with one or two open ends, may require special treatment. The instruction book only hints at the amount of speaker setup adjustment that may be required to get the best out of the digital sound-field processor, and an experienced technician may be required to get the best results.

Finally, I do not recommend the use of the sound-field processor with bipolar speakers in anything but the largest home listening rooms, nonbipolar main speakers with exceptionally narrow listening areas, or only the front or rear ambience speakers. The use of bipolar



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I would enjoy owning the CX-10000. Even judged without its special features, this is a good preamp.

speakers and the ambience speakers can result in a bloated soundstage that is more than a little overdramatic. The use of the ambience speakers with two main speakers that have a narrow listening area can produce odd shifts in the soundstage with minor shifts in head position, and the use of only a pair of ambience loudspeakers yields sharply inferior results to the use of four.

Because the setup is difficult, it may mean the creation of a dedicated listening room. Nevertheless, the end result may well be worth it. Every audio dealer and club should have one such installation to show what modern signal processing can do. I might argue about some of the labels selected by Yamaha to describe different types of listening areas, and I would caution that the digital sound-field processor cannot reproduce the directional data on Dolby-processed films with the utmost degree of realism. Still, it is generally possible to find a remarkably convincing hall effect for virtually any music or video material, and the results are sufficiently impressive to overcome prior conditioning against such devices in the most dedicated purist.

While you cannot really re-create the concert hall in your home, you can come close to the ambience of live music. As a classical music buff, I preferred "Hall 1," "Munster," and "Chamber," but the less enlightened members of my family loved the modes for rock concert and "Stadium." Our garbage man, who has upgraded his career from lowly beginnings as an investment banker, preferred "Disco."

More seriously, if audio is supposed to mix realism with sheer fun, the sound-field processor does what it is supposed to do. Unlike four-channel sound and reverberation devices, the effect does not get boring or irritating with prolonged exposure. The processor can also correct for many types of recording abuses and can salvage many great performances which lacked equally great recording techniques. If it produces some occasional sonic oddities, only a Grinch could really complain—provided the system is properly set up in the first place.

If it sounds like I would enjoy owning the CX-10000, well, I would. I think anyone who prefers getting the emo-

tional impact of sound over ultimate transparency will be happy with this unit. It will also be of interest to musicologists and to those interested in the effects of different hall and listening room conditions. This preamp allows a tremendous amount of processing of any given performance, and it can correct for a very wide range of faults in the source material without inflicting the sonic suffering which is common in most signal processors.

Even judged without its special features, the CX-10000 is a good preamp. It has good frequency extension in the treble and bass, excellent S/N performance, good dynamics, and a pleasant overall tonal balance without upper midrange harshness or veiling. Overall transparency is good, and the soundstage is adequate in terms of depth, width, and placement of instruments—even without the ambience speakers.

Let me also say, however, that you do pay for all these features in terms of ability to provide the transparency, dynamics, and life found in the best high-end preamps, including some that cost considerably less than \$1,000. The CX-10000 slightly blurs and softens the sound, adding a touch of dullness to musical transients and removing some fine detail. This is particularly true when you add the phono stages in the HX-10000 to the preamp. The HX-10000 is smooth and silent, but it also has more than a slight touch of grain. Further, I suspect that many American audiophiles would prefer a high-impedance loading for moving-coil cartridges, not simply 10, 30, and 100 ohms.

The real issue in judging the CX-10000, therefore, is whether you desire its special features. It is not the ultimate preamp for an audio purist, in terms of sheer transparency and life, but few people live in homes or own audio systems that will not benefit from the parametric equalizer. Further, the fortunate few who can really afford a proper digital sound-field setup—and this probably includes anyone who can pay up to \$10,000 for a CX-10000 with the HX-10000—may well find that the processor is worth some minor sonic trade-offs. To quote one of the century's more obscure occidental philosophers, "The issue is whether more is less, or more is more."

Anthony H. Cordesman

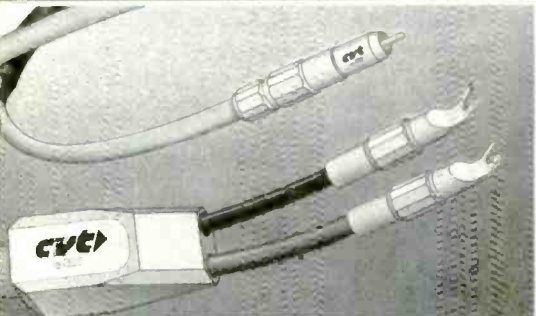
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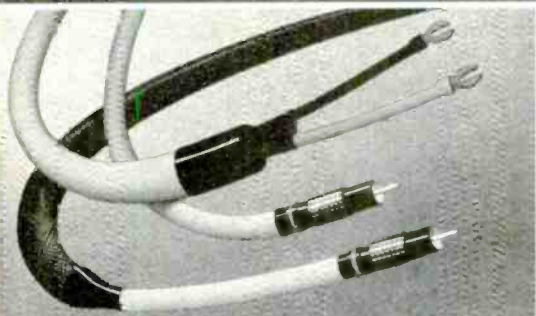
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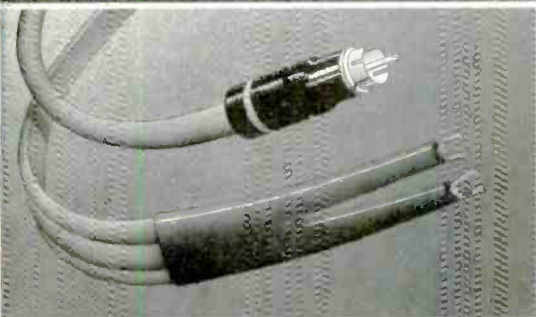
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PAST FORWARD



Then and Now: Grover Washington, Jr. Columbia CK 44256, CD.

Sound: A Performance: A - /B +

Saxophonist Grover Washington, Jr. has been galvanized by constant musical and commercial flux throughout his career. A resolute refusal to be categorized has allowed him to explore and promulgate different formats and to escape, at least artistically, the restrictions imposed by preconception. Washington's style is a synthesis of influences that have enabled him to create an ideology of his own. The development of his musical persona owes as much to R&B's King Curtis, and even to Motown's Jr. Walker, as it does to the more traditional lineage associated with the saxophone—that of Charlie Parker, Coleman Hawkins, Lester Young, Ben Webster, and John Coltrane.

Despite his success and impressive record sales, and perhaps because of his diversity, Grover Washington, Jr. has yet to attain the same high-visibility recognition of a latter proponent like Kenny G, who in the past has been accused of copying more than a few GWJ licks. Nonetheless, Washington has achieved the creative freedom to record the kind of music that he feels passionate about. His newest album, *Then and Now*, seems to be a commitment to the straight-ahead jazz vernacular. It is an affirmation of where the

artist is at now, musically, and also a rediscovery of jazz of the past rather than a return to it.

From *Inner City Blues*, his first album as a group leader for CTI in 1971, Grover Washington, Jr. gained popular recognition beyond jazz fusion circles. It was through a coterie of highly sought-after musicians, including Ralph MacDonald, keyboardist Richard Tee, guitar virtuoso Eric Gale, and drummers Idris Muhammed and Grady Tate, that the saxophonist was able to make the transition from session man to club player to concert performer. The big breakthrough came when his 1980 Elektra album, *Winelight* (which featured some of the same musicians), easily went platinum, and one of the cuts, his duet with vocalist Bill Withers ("Just the Two of Us"), was nominated for a Grammy as best R&B song.

Then and Now, Washington's 20th album and his second for Columbia Records, has the feel and atmosphere of spontaneity that is derived especially from playing live. It conjures up images of the dark shades of cool, somewhat reminiscent of what a late set at Birdland must have been like. Washington plays with such a relaxed confidence that on the first cut, Ron Carter's "Blues for D.P.," he is able to fashion an easy-sounding blues into an 8½-minute extemporization that comes around without having been rendered trite. Conveying a sense of proportion

and structure in his playing that is never less than satisfying, his tone and intuitive sense of good taste prevail unerringly throughout.

Grover Washington, Jr. has always surrounded himself with forceful musical personalities. The interplay between his saxophone and the grand piano voicings (interpolated by either Tommy Flanagan, Herbie Hancock, or James "Sid" Simmons) provides the fulcrum on which pivots the cohesive, muscular playing of an outstanding ensemble. These musicians include Ron Carter on upright bass; Gerald Veasley on five-string electric bass; Richard Lee Steckler on electric guitar; Grady Tate, Marvin Smith, or Darryl Washington on drums, and Miguel Fuentes on percussion. Several are members of Washington's regular touring band. Together, they always hit the groove.

Grover Washington, Jr. alternates tenor, soprano, and alto saxes throughout the 60-minute set, and he introduces a second tenor sax, played by Igor Butman, on three cuts: "French Connections," which Butman wrote, Oliver Nelson's "Stolen Moments," and the standard "Stella by Starlight." Other titles include Duke Ellington's "In a Sentimental Mood"; a composition by Herbie Hancock, "Just Enough"; one by Tommy Flanagan entitled "Something Borrowed, Something Blue," and "Lullaby For Shana Bly," Washington's dedication to his daughter.

Then and Now, cut at Sigma Sound in Philadelphia, was produced by Washington himself, and he should be complimented for the democracy of the proceedings. The sound is remarkable for its intimate clarity.

Michael Aldred

James Cotton Live

Antone's Records ANT0007, LP. (Available from Antone's Records, 2928 Guadalupe St., Austin, Tex. 78705.)

Sound: B Performance: A

James Cotton won the title "Mr. Superharp" by blowing his competitors off stage almost from the beginning of his professional career at age 9. He gained fame in a 12-year stint with the Muddy Waters band, where he followed in the footsteps of Chicago's most famed harp man, Little Walter Ja-

Photograph: David Gahr

COMPACT DISCLOSURES

January CDs of Note:



In 1987, after four long years of waiting, PINK FLOYD fans got their first listen to the band's "A Momentary Lapse Of Reason." Not only did the recording sell over two and a half million copies, the tour in its honor was seen by over three million fans on four continents. Tickets went fast. So fast, you may not have gotten in. Now, however, you can hear what all the excitement was about on Pink Floyd's latest release, a live in-concert recording of the now-legendary tour. "Delicate Sound Of Thunder" mixes songs from as far back as 1973 ("Dark Side Of The Moon") with the latest and best from the perennially popular supergroup.



Not a retrospective, not a greatest hits album, but an event nonetheless is NEIL DIAMOND'S latest release, "The Best Years Of Our Lives." It's aptly titled. Insiders are calling it Neil Diamond's best album of the past ten years. Neil wrote or co-wrote all of the songs himself, except for one cut, "Baby Can I Hold You," which was written by Tracy Chapman of all people. The album will be available on CD this January, just when Neil begins a major national tour.

HOT PINK

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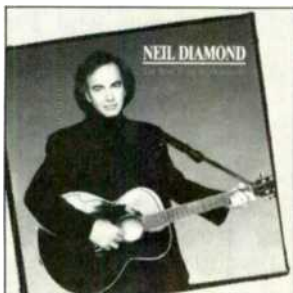


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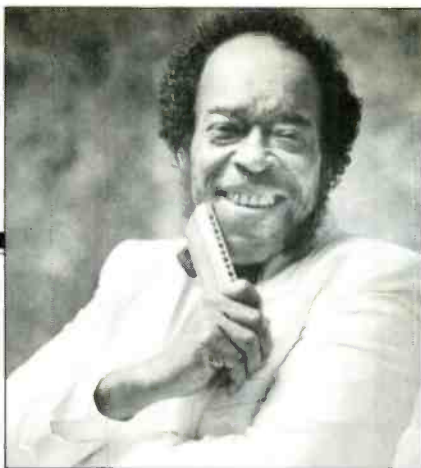


OTHER JANUARY CD RELEASES:

- JOURNEY "Journey's Greatest Hits"
- EARTH, WIND & FIRE "Best Of Earth, Wind & Fire, Vol. II"
- SARAH VAUGHAN "The Divine"
- Sarah Vaughan: "The Columbia Years 1949-1953"
- VARIOUS ARTISTS "Metal Giants"
- RAY CHARLES "Just Between Us"



James Cotton is in great form on his new LP. Even though you can hear traces of Cotton's mentors, the raw solos are clearly his.



cobs. As a bandleader, however, Cotton proved to have a gift for absorbing contemporary influences without losing touch with his past, winning new converts to the blues while crisscrossing the country on lengthy tours.

James Cotton Live is a return to his roots, and it could justly be subtitled

"The Lost Muddy Waters Sessions" or "Tribute to Little Walter." Not only is virtually all the material synonymous with those two legends ("Hoochie Coochie Man," "Juke"), but Cotton's sidemen consist of graduates of both of those bands. The performances would fit right into Muddy's last albums. There's no unusual rhythms or guitar pyrotechnics, just a bunch of seasoned professionals jamming the heck out of classic material.

Cut in one night at the famed blues club Antone's, the disc marks the first time that Cotton has brought together two of his most famous guitarists: Luther Tucker, once a Little Walter band member, and Matt "Guitar" Murphy, longtime foil for Memphis Slim and a Chess studio musician. The rhythm section is that of Muddy's final band: Pinetop Perkins on piano, Willie Smith on drums, and Calvin Jones on bass. All these musicians are as familiar with the material as they are with each other, and the band's never at a loss for the perfect fill or just the right riff.

Cotton, at 53 the youngest of veteran bluesmen, is in great form. You can hear traces of his mentors, but the harsh, raw solos are instantly identifiable as his. The performances build such freight-train velocity that it comes as a surprise when the record ends with applause instead of an explosion. *James Cotton Live* is one of those sets that usually survives only in memory. Don't miss it.

Roy Greenberg



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Magic Sam Live at Ann Arbor & in Chicago

Delmark DL-645/646, two LPs. (Available from Delmark Records, 4243 North Lincoln, Chicago, Ill. 60618.)

Sound: C Performance: A

Today's guitar-driven blues was born on Chicago's South and West Sides in the late '50s. Muddy Waters represented the first wave of Southern migrants who settled on Chicago's South Side and amplified the music of their Mississippi Delta homes. Later arrivals, who relocated to Chicago's West Side, absorbed the crackling energy and relative harshness of their new home in creating rough-edged music that couldn't survive without electricity. For the West Side's struggling guitarists, a bass and some

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Although there's a history of great records behind Etta James, she continues to create works which can stand up to her classics.



drums were as much rhythm section as they could afford. Dense chording replaced the horn sections they could hear only in their heads. In forgotten bars, they took on the world, armed just with their guitars—three sets a night, no holds barred. To survive, you needed the rare technical expertise of

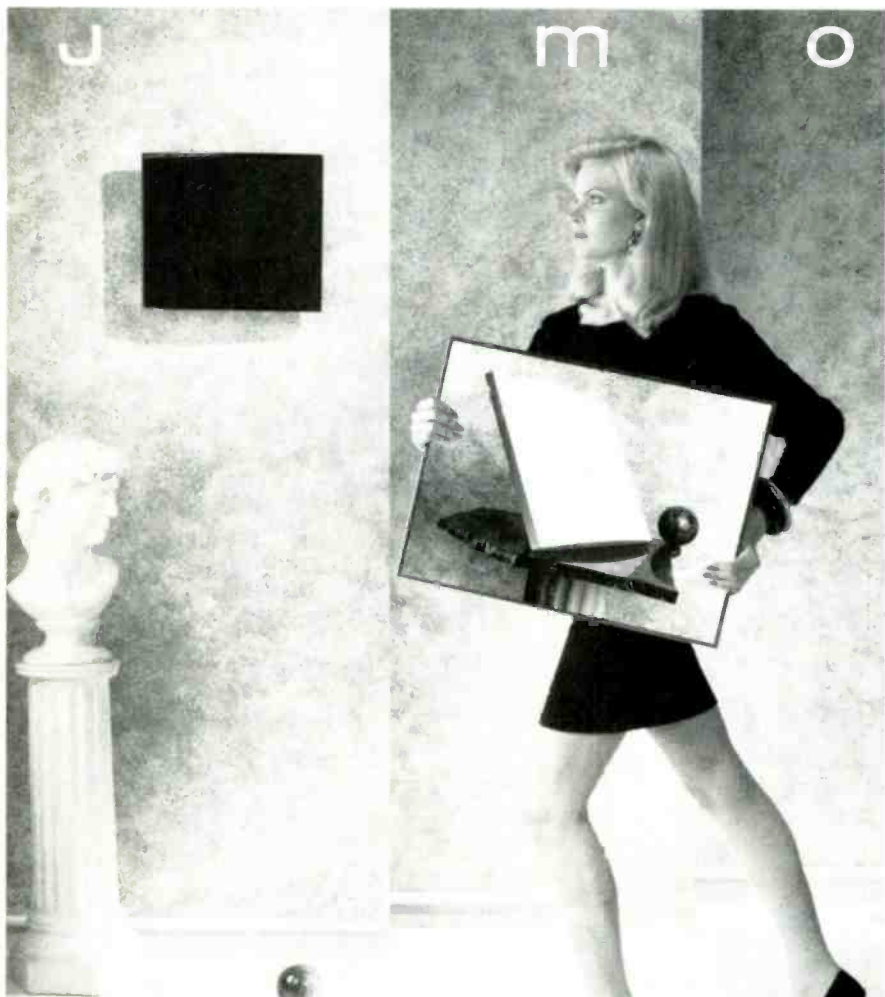
a Buddy Guy, Otis Rush, or the late Magic Sam (born Sam Maghett).

Magic Sam's performance at the 1969 Ann Arbor Blues Festival captured him several months before his untimely death, as he won over a new audience. His stinging guitar work, reminiscent of a busier Freddy King, and soaring vocals remain fresh 20 years later. "I Feel So Good" is the prototype for the numerous boogies of later blues/rock bands.

The real treat, however, is the second disc in this package, recorded live at The Alex Club in the winter of 1963-1964. To hear this set, complete with stage chatter, is one of those rare opportunities to pass through a hole in time. The fidelity leaves much to be desired, but the atmosphere is priceless. Few blues heroes were recorded in performance in their prime—fewer still without any concessions to alleged commercial requirements.

The original tapes of this album were destined for oblivion when they were first released in a limited pressing in 1981. They've deservedly been reissued in a package with informative liner notes that typify a classy production. If you missed this wonderful album the first time, don't make the same mistake twice.

Roy Greenberg



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**Seven Year Itch: Etta James
Island 91018-1, LP.**

Sound: B+ Performance: A

Anyone who saw the Chuck Berry documentary film *Hail! Hail! Rock 'n' Roll* can testify that Etta James can still sing most blues-wailers under the table. Finally, there's a new record from her that allows more than a momentary glimpse of this mammoth talent. Although it would have been very easy to make a wrong turn and try to modernize or bastardize her sound, producer Barry Beckett did not compromise her rootsy approach. Using his pals Roger Hawkins and Reggie Young from The Muscle Shoals rhythm section as the core of the band—augmented by Memphis' two finest guitarists, Steve Cropper and Teenie Hodges—Beckett has put together a fine record.

It's readily apparent that Etta James' voice is well suited to modern recording techniques; it actually sounds more full-bodied and sonically richer than it

Patti Austin put so much heart into *The Real Me*, from conception through execution, that wonderful things just had to happen.



has on earlier recordings. The song selection is remarkably astute: "I Got the Will," "Shakey Ground," and "Come to Mama" show off this world-class vocalist to great advantage. The latter cut and two others were produced by Ricky Fataar and Rob Fraboni. Although they were recorded with a completely different set of players, the consistency of all the tracks is amazing. It's the singer, not the producer—to misquote Mr. Jagger—who really puts her stamp on this record. James' phrasing, attack, and choice of notes is strictly one of a kind, and she makes use of the supporting cast but never lets them take the show away.

Of course, there's no knocking these players, and it's a rare occasion indeed when they get to back up someone as dynamic as James and to step out as much as they do here.

There are very few blues/soul singers of Etta James' caliber left, and fewer still who continue to make records which can stand up to their classic works. Etta James has not only a history of great records behind her, but is still creating a body of work which is vibrant and accessible. What more can one ask?
Jon & Sally Tiven

The Real Me: Patti Austin
Qwest 25696-1, LP

Sound: B+ Performance: A

Once in a rare while, everything falls into place on an album. The singer, the songs, the players, producers, engineers, and everybody else all the way down to the gofers contribute to make the experience very, very special. That is just what happened with Patti Austin's *The Real Me*.

The singer has a big personal stake here. Along with each selection, Austin lists its "inspirational source." These include the likes of Morgana King, Ketty Lester, The Mills Brothers, Fred Astaire, Julie London, Duke Ellington, The Platters, Nancy Walker in *On the Town*, Quincy Jones, Bing Crosby, and George and Ira Gershwin.

Not content merely to replicate her back pages, Patti has thankfully contemporized the arrangements while remaining faithful to their original spirit. Both Nancy Walker's "I Can Cook, Too" and The Mills Brothers' "Across the Alley from the Alamo" have an up-

tempo feel, but "Cook" retains some of the period swing. It should be noted that players such as Bruce Hornsby and David Lindley helped to bring about the lively sound of "Alley." Patti's rendition of "Smoke Gets in Your Eyes" is lovely and soulful, more intense than The Platters', and her reading of "True Love" is remarkably clear-eyed and yet emotional. Here, as well as on Julie London's signature song, "Cry Me a River," and "How Long Has This Been Going On," there is a 30-piece string section that the David Benoit and Marty Paich charts never allow to lapse into schlock. Patti's multi-tracked voice on Quincy's "Stockholm Sweetnin'" and the Duke's "Mood Indigo" form daring yet effective tours de force. "Lazy Afternoon" allows Patti to sing in a supple, sexy, jazzy style and also features a sweet Jon Faddis fluegelhorn solo. "Love Letters" opens with a direct, soulful read that evolves into an intricate lattice with James Ingram, Michael McDonald, and co-producer David Pack.

Throughout, Patti is in top form, inspiring her many accompanists to some of their very best work. When so much heart goes into a project, from conception all the way through execution, wonderful things happen.

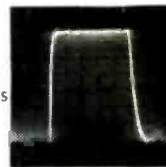
The analog recording conveys great warmth. Patti's voice gets a slightly soft focus, and the instruments sound crisp and clear; it's an excellent mix.

I've always looked upon Patti Austin's vocal chops with highest regard. She is undeniably a sensational singer, but I've never liked her repertoire until *The Real Me*. With songs she has known and lived with all her life, the personal stakes were higher, and she responded with spectacular work that inspired everyone around her. When everything falls together so well, can the results be anything short of a masterpiece? The answer is obvious, and you can hear it on Patti Austin's *The Real Me*.
Michael Tearson

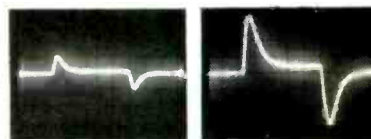
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Kevin Eubanks' new album has an almost nostalgic feel and provides a good, easy listen—in the best sense of that term.



The Benny Goodman Yale Archives, Volume I

Musicmasters CIJ 60142Z, CD.
(Available from Musicmasters, 1710 Highway 35, Ocean, N.J. 07712.)

Sound: A— Performance: A

At the time of his death in 1986, Benny Goodman bequeathed to Yale University a large cache of privately recorded music performed by various combos and big bands which he led from the 1950s until he died. The collection represents some 400 hours of music, and Yale has now released the first of many packages through Musicmasters.

There are 50+ minutes of well-chosen music, selected and programmed by the fine young tenor saxophone player and bandleader Loren Schoenberg. (Goodman led the Schoenberg big band in the last years of his life.) Fifteen cuts range from dates done in 1955 with hard-swinging small groups to big band recordings from 1986.

Although Goodman is probably best remembered for his sterling performances of jazz and popular tunes of the '20s and '30s, this CD should help audiences realize that he always kept his ears open to new sounds and made good use of those he warmed to. Two fine big band cuts feature original compositions by Yugoslavian jazz musician Bobby Gutesha. Gutesha, who came to Goodman's attention at the 1958 Brussels World's Fair, wrote and



arranged "Macedonia Lullaby" and "Bantunga Train." The former is a relaxed piece which features fine work by pianist Roland Hanna and wonderful lead trumpet work by John Frosk.

Often performed by Goodman over the years was Edgar Sampson's "Lullaby in Rhythm," a half-step chromatic exercise that was considered daring in 1936. On this 1967 sextet version, there is fine tenor work by Zoot Sims, guitar by Attila Zoller, and some of Goodman's finest playing of that time against George Duvivier's supple bass work.

Goodman probably enjoyed playing in small groups more than anything else, and about half of the cuts are devoted to bands of eight men or less. Try "Slipped Disc" for some hair-raising playing by Goodman, trumpeter Ruby Braff, trombonist Urbie Green, tenor man Paul Quinichette, and Goodman's favorite pianist, Teddy Wilson. (Schoenberg's notes indicate that all of this material was performed by Goodman and his sidemen without a single scrap of sheet music in sight.)

The liner notes feature reminiscences by Morton Gould, Goodman's close friend and musical collaborator, and Helen Oakley Dance, one of Goodman's earliest and biggest boosters, as well as introductory notes by Harold Samuel, the Yale University music librarian.

There is fine playing throughout by those mentioned above and good work elsewhere by pianist Dave McKenna, trombonist Bill Harris, tenor man Flip Phillips, trumpeter Joe Newman, and pianist Russ Freeman. Available in all formats, this is an auspicious debut of Goodman's rich legacy from Yale and Musicmasters. *Frank Driggs*

Shadow Prophets: Kevin Eubanks
GRP CRD-9565, CD.

Sound: A Performance: A—

Swinging gently through a light jazz set, *Shadow Prophets* showcases Kevin Eubanks' growing affinity for acoustic guitar, paradoxically coupled with MIDI'd guitar synth effects. The result is a style lying somewhere between the music of Charlie Byrd and Earl Klugh.

Featuring essentially instrumentals, Eubanks' crisp steel-stringed guitar bounces along brightly from the snap-

py tempo of the mildly funky "Mice Mobsters" to the soft balladry of "Twilight Tears" and the bossa of "He Smiled the Sea." Mark Ledford's occasional scat vocals add an early '60s dimension, especially notable in the Benson-like duet of "Eye Spy." For hot scalar workouts, check out the title cut and the syncopated, CD-only "G-Town Hang." Eubanks uses the MIDI for string-like washes; however, these are highly guitaristic, or maybe more like strings than a typical keyboard treatment. (Compare "Village Dance" to "Jenna's Dream," with Onaje Allan Gumbs on keys.) Also notable are the interesting medieval chant-like MIDI'd vocal effects on "Songhouse."

Eubanks doubles his guitar throughout, placing his lines close to either side of the center space, with the rhythm section hovering above. A slight reverb adds an intimate, somewhat ethereal presence. Digitally recorded, mixed, and mastered, the sonics are excellent.

With its curious mix of new technology and good old-fashioned acoustic blowing, Kevin Eubanks' *Shadow Prophets* has an almost nostalgic feel and provides a good, easy listen, in the best sense of the term.

Michael Wright

Blazing Redheads
Reference Recordings RR-26CD, CD.

(Available from Reference Recordings, P.O. Box 77225X, San Francisco, Cal. 94107.)

Sound: B Performance: B—

Blazing Redheads is a San Francisco instrumental group of seven women. They write and play music rooted in jazz and liberally laced with doses of Latin music and light funk. The instrumentation includes reeds, acoustic drums, Latin percussion, electric bass, and keyboards. These players seem to

have an excellent grasp of Latin music. However, on this release, their grasp of the genre manifests itself as little more than musical mimicry. While the compositions are original and the playing is very good, this 13-song (58:45) collection is riddled with Latin-music clichés. Anyone who has listened to the Latin sound over the years, as delivered by musicians such as Eddie Palmieri, Tito Puente, Ray Barretto, Rubén Blades, Carlos Santana, or even such now-defunct West Coast acts as Malo and Azteca, will recognize all of the riffs and phrases on this CD. Even the timbale rolls have been done before.

However, nearly all New Music is derivative (this is not the problem here); creative musicians are able to absorb what they hear and transform it to another level. Blazing Redheads have not taken their music to that next level. They've created music that contains too many licks previously performed by individuals who simply play it better. And that's a pity, because the Redheads have talent. What they don't have is musical direction.

It's obvious that Reference Recordings is not averse to taking chances. First they sign an all-female jazz act and then decide to record the music live in the studio to 2-track. Much of the recording equipment was customized by the date's engineer, Keith O. Johnson. There was no overdubbing, although multiple miking was used. The multiple inputs were routed to two channels of the mixing console and then, depending on the final format, sent to a Sony PCM-701ES digital encoder (CD), a KOJ (Keith O. Johnson) focused-gap analog recorder (LP), or a DAT recorder for possible future release. Mixing was done on the fly, as the music was being played and recorded. The result is sonically very good and dynamically strong, although some of the tunes—especially the excellent "Mozambo"—could have used the extra power of overdubbed horn parts.

Despite its problems, *Blazing Redheads* is a worthwhile listen. The music is skillfully played, and the performers convey a genuine love for the music. If listeners have not previously taken the opportunity to appreciate Latin jazz, then maybe they should start with this CD and work backward through the



Latin archives. Blazing Redheads need to step back and take a look at their music, redefine their goals, and trust in their talent. If they do so, their next release should prove to be very interesting. *Hector G. La Torre*

Neo Geo: Ryuichi Sakamoto
Epic EK-40994, CD.

Ryuichi Sakamoto won an Oscar for his score for *The Last Emperor*. Until then, his music was not well known. I encountered it by accident about five years ago, when I happened to walk into a Japanese bookshop in New York where they were playing a Sakamoto import. The inventiveness and sonic imagination I heard led me to buy the recording immediately.

His sound has since evolved from a Japanese pop blend of avant-garde and folk music to a more Westernized fusion of New Age, pop, punk, rock, soul, Balinese, Japanese, and many other styles. The title, *Neo Geo*, suggests a New Age/Global Village musical style—one that incorporates influences from all over the world and is accessible to both Eastern and Western audiences. I am especially fascinated to hear the punk elements, with their obvious allusions to a post-nuclear holocaust kind of Global Village. (This is a darker side of the New Age that doesn't often get expressed musically.) Sakamoto also has an active

sense of humor, which was one of the primary factors that caught my ear in the bookshop. Like Tomita, he has a typically Japanese playfulness in dealing with sounds. His arrangements are often like musical cartoons.

Sakamoto presents a fascinating range of styles, sounds, and techniques on *Neo Geo*. The opening track, "Before Long," is expansive and upward-bound, a typical New Age piece. The brightly infectious "Okinawa Song" leads to the naive innocence of the concluding track, "After All." But between them, Sakamoto slips in some surprising sounds. In "Neo Geo," a heavy techno-punk background accompanies a Japanese pop tune, interrupted by a passage that sounds like the Balinese monkey chant made famous on a Nonesuch Explorer LP. "Risky" has that expansive voice-over character of Isaac Hayes ("Shaft") and Lou Rawls. "Shogunade" combines samurai growls with a heavy rock beat, and "Parata" is a kind of big band arrangement for synthesizers. Amazingly, it all fits together.

The sonic environment is appropriately different for each of these tracks, and always clean. You have the feeling that you are passing through a series of rooms with different acoustics. In all, *Neo Geo* is a delightful listening experience. If you liked Sakamoto's contributions to *The Last Emperor*, you'll like *Neo Geo* too. *Steve Birchall*

THE SHOUTING SAGE



The Shouting Stage: Joan Armatrading
A&M SP 5211, LP.

Sound: B Performance: A

If, as the show-business adage goes, "Timing is everything," then surely Joan Armatrading should have missed the boat. First, the singer/songwriter arrives on the recording scene in the early '70s, well after similar artists (e.g., Joni Mitchell) had already established themselves, and during the dance/disco era, when the beat, not the lyrics, was king. Then, during the recent period of singer/songwriter resurgence, she doesn't record for 2½ years. Here is a musician who obviously doesn't care about trends.

Joan Armatrading's newest collection, *The Shouting Stage*, is both a departure from, and a continuation of, her past work. She still involves us in her introspective tales of love, infidelity, and deep emotion, but she has gone back to the smoother, jazzy-pop style

of her earlier albums, such as *Show Some Emotion* (1977), as opposed to the later, more uptempo, synthesizer-driven rock of *Walk Under Ladders* (1981).

Few singers can control their voices as can Armatrading; she shouts out words one moment and caresses them the next. Listen to her sing the lines, "Don't worry Joanie, I'll be a little bit late tonight/But I worry . . ." from "The Devil I Know." Or, "What will I feel if you say/It's over; Please don't/Don't say it's over . . ." from "Words." This is strong, emotional music, of the same high quality Armatrading has been producing for 15 years.

Other similar singer/songwriters, such as Tracy Chapman and Suzanne Vega, are very talented but certainly have not reached Armatrading's level of performance. Yet they are garnering kudos by the bushel, while, amazingly, Armatrading continues to appeal to a much more modest-sized audience. Timing . . . it's all in the timing.

The Shouting Stage is ably supported by excellent musicians. Mark Knopfler (Mr. Dire Straits) is of special note because his style fits neatly into Armatrading's lyric-oriented arrangements—no hype, no flash, just support the singer. Joan does not usually call in superstars to play on her releases, but this time she did, and it works. Knopfler is capable of maintaining and building the mood of the music, and he does so especially well on the title track. "Shouting Stage" winds through a once-strong relationship which has arrived at "the shouting stage"—that point when the only "communication" comes at full volume.

Joan Armatrading has self-produced her albums since 1986's *Sleight of Hand*. (The recordings were done in her home studio, Bumpkin, and mixed at Olympic Studios, both of which are in England.) Graham Dickson recorded and mixed the album, and the results are excellent. The mix is especially well balanced. However, the resulting LP is, as is too often the case, not up to the mix due to several surface imperfections.

Those record buyers who have made Suzanne Vega and Tracy Chapman's efforts such successes should stop and listen to Joan Armatrading. She is a musician who deserves to be heard. And *The Shouting Stage* is a perfect place to start listening.

Hector G. La Torre

Taking It Home: Buckwheat Zydeco
Island 90968-1, LP.

Sound: B Performance: A-

Taking it home is right! Following his pop-oriented *One Night Like This*, Stanley "Buckwheat" Dural checks back in with a much more down-home album chock full of his thrill-packed, accordion-driven zydeco music. With the accordion and Herman "Rat" Brown's New Orleans-style off-beat drums mixed up front, there is plenty of life in the sound. The opening pair, "Creole Country" and "Down Dallas Alley," kick off the set in overdrive. Later, things really heat up with the instrumental "Drivin' Old Glory." Side two begins with the record's lone cover, the Derek and The Dominos cut, "Why Does Love Got to Be So Sad," with Eric Clapton sitting in for a blazing guitar

lead. The song sizzles, but it's Dural's squeeze box that keeps it down in bayou country. The heat from this opening stays turned on till the LP's end.

One nice touch that adds energy to the album is the unusually short pause time between tracks. You hardly have a moment to breathe. This quick pacing helps make *Taking It Home* a dandy party album. So what else is there to do but take Buckwheat home, roll back the carpet, turn the record player up loud, and disturb the neighbors? They'll probably come over to join the party.

Michael Tearson

Outrider: Jimmy Page

Geffen GHS 24188-1, LP; 24188-2, CD.

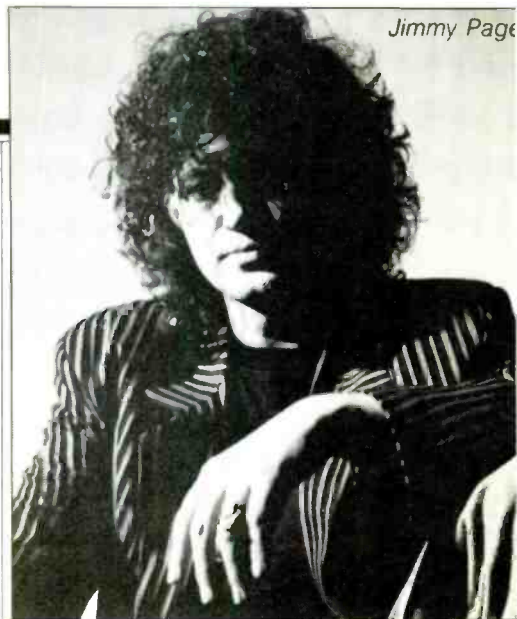
Sound: A-/B+ **Performance:** B+

Revived Led Zeppelin? Close, but not yet, despite Robert Plant's reciprocation after Page's appearance on *Now and Zen*. Nevertheless, Zep fans should enjoy Jimmy Page's first-ever solo album, *Outrider*. At least this re-

cording offers glimpses of the band's old glory.

What you will hear is that big, familiar Led Zeppelin sound, with Page's thickly distorted guitar moving in and out of the calculated grunge. That Page was primarily responsible for Zep's trademark sound is evident on cuts like "Wasting My Time," with its nasty slide guitar and John Miles' gritty vocals; the Plant contribution, "The Only One," a nervous hard-rocker that could easily have been what the band would be doing today, and the down 'n' dirty blues tunes, "Prison Blues" and "Blues Anthem," with Chris Farlow on vocals. While Page avoids extended, self-indulgent solos, there are three tasty instrumentals to show off his chops: "Writes of Winter," "Liquid Mercury," and the *de rigueur* acoustic piece, "Emerald Eyes."

Sonically speaking, Page (who also produced this album) loaded the guitars up on the sides, with singer and rhythm dead center. Despite instrumental distortion and layered multi-



Jimmy Page

tracking, the sound remains open and well separated. Crank up the LP or the CD with equal abandon.

Yet for all the echoes, what you won't find here is Led Zep the band. This is solo Jimmy Page, not a revival. Depending on what you were expecting, you can hardly call that a flaw. Still, *Outrider* invites comparisons and will inspire memories. Page's style may seem slightly dated in the face of today's slicker virtuosos, but it's still classic rock 'n' roll. And after all, wouldn't you wish for just one more Beethoven symphony, if you could have it?

Michael Wright

Out of Africa: Various Artists
Rykodisc RCD 20059, CD.

Sound: A **Performance:** A

An exotic feast of very slick, African, world-beat music—Mbalax, YoPop, soukous, juju, mbaqanga—can be tasted on *Out of Africa*, a compilation of tracks by 11 artists licensed from various American, British, French, and African record labels.

From Senegal comes Youssou N'Dour (who appeared on Peter Gabriel's "In Your Eyes") with a jazzy jam of phased guitar and Arabic scales over a tight horn section. From the Ivory Coast, Jane Agnime mixes solo vocals with polyrhythmic drums, chorus, horns, and ubiquitous guitars. South Africa's Mahotella Queens sound most like the choral music popularized by Paul Simon's *Graceland*. From Cameroon, Ali Baba wails with a wild sax in an experimental jazz that's like Ornette Coleman meets Afro-beat, with some



Buckwheat Zydeco



With his new band Savuka, Johnny Clegg could emerge as a major international star. His is a voice that needs to be heard.

execution, despite the varied Western influences. *Out of Africa* is an enjoyable sampling which should have a wide appeal, and it's well worth checking out.
Michael Wright

Shadow Man: Johnny Clegg & Savuka
Capitol 90411, LP.

Sound: B Performance: B+

great vocal effects punching in from the sides. There's shimmering guitar arpeggios, fore and aft, from Nigerian Segun Adewale, and a Latin-influenced sound from Zaire's Somo Somo.

The highlight of this disc, however, is Poto Doudongo—also from Zaire but now living in Paris. This musician's guitar-driven solo tour de force, "Bolino" (on which he plays all of the instruments), is a hook-laden dance groove which could (and probably should) be a big American hit.

In making the digital masters, Ryko-disc took care to equalize this diverse material in a way that makes it hang together exceptionally well. Despite the many analog sources, it's generally crisp and clean, and uses the Compact Disc's spatial depth and dynamic range nicely.

The many flavors of an entire continent are, of course, impossible to reduce to 11 cuts. But much African music shares a similar mind, which is collective and cumulative in intent and

Johnny Clegg first surfaced as leader of the racially mixed South African group Juluka, which released two albums on Warner Bros. during the early '80s. Their fusion of rock and some reggae with African rhythms, textures, and sounds prefigured Paul Simon's *Graceland* by several years. After Juluka broke up, Clegg resurfaced with his new band, Savuka.

Clegg is a superb songwriter. He is a white South African who writes impassioned, politically charged songs that celebrate the human spirit and the universal experience of mankind without regard for color or other superficial





The new Deep Purple CD, *Nobody's Perfect*, is like a nostalgia show verging on self-satire; it's for hard-core collectors only.

alities. His new band, like Juluka, is half black and half white. They too create music of insinuating counter-rhythms and catchy refrains that all come from a spirit of indomitable hope. This is music that does not describe easily.

Producer Hilton Rosenthal, who previously handled Juluka's albums, has given Savuka a palpable sense of continuity with its predecessor while at the same time instilling a brighter, punchier, more joyous sound.

If *Shadow Man*, as your introduction to Johnny Clegg's music, tickles you, there is good news—this is Savuka's second album. The first, *Third World Child* (Capitol 46778), is equally fine.

I fully expect Johnny Clegg to emerge as a major international star in the '90s. With his positive world vision, his is a voice that needs to be heard.

Michael Tearson

Nobody's Perfect: Deep Purple Mercury 835 897-2, CD.

Sound A— Performance: C

Nobody's Perfect is an ironically appropriate title for this live-concert recording by the re-formed '70s supergroup Deep Purple. Playing primarily greatest hits from both incarnations, Purple lacks the conviction that marked their classic performances. Sure enough, Ritchie Blackmore blazes through the guitar licks on "Highway Star," "Black Night," and, especially, "Lazy," though the histrionics of the extended solo on "Child in Time" are sloppy, pointless, and self-indulgent. Jon Lord shows off the keys, particularly on "Perfect Strangers" and "Knocking at Your Back Door," which begins with a medley of "Für Elise," boogie-woogie and synth noodling more curious than relevant. Ian Gillan's

vocals are also well practiced, although his stage patter is a marvelous combination of insufferable babble and incomprehensible editing (by Roger Glover). For example, perhaps calling "Strangers" "stranglers" might have an amusing anecdotal setup, but the song fades up at the end of the story, so it makes no sense. And I guess you had to be there to appreciate the sexist intro to "Hard Lovin' Woman."

The live recording is passable, though not as crisp as it might be in the rhythm section. The mix, however, is uneven (in addition to the weird intros and outros), with soloists occasionally brought up a bit too forcefully.

Deep Purple's *Nobody's Perfect* leaves the impression of a nostalgia show verging on self-satire. (And another thing, who's that raspberry at the end directed at?) Adolescence from those well beyond it, this one's for hard-core Purple collectors only.

Michael Wright

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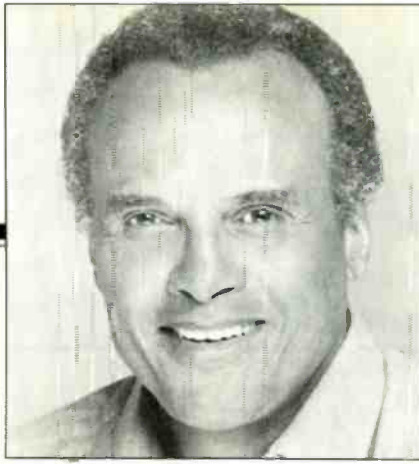
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Harry Belafonte's new CD, *Paradise in Gazankulu*, has moving passages and lovely lilting melodies, but it never really catches fire.



Paradise in Gazankulu: Harry Belafonte

EMI-Manhattan E1-46971, CD.

Passionate causes and earnestness do not of themselves guarantee a great musical result. Throw in some lilting African rhythms, talented native per-

formers, and a fine dusting of highly professional American musicians, producers, and engineers, and you've got a better shot at it. Despite all these elements and the obvious time and concern that went into this anti-apartheid album, Harry Belafonte's *Paradise in Gazankulu* comes across as an attractive record with some passionate moments, but it never really catches fire and never feels wholly authentic.

I suspect this will be an unpopular judgment, based on Belafonte's long history of active commitment to human rights and his charm as both man and performer. Belafonte pioneered the international calypso movement of the 1950s with *Calypso*, the first album in the history of recorded music to sell over one million copies. The man is clearly no bandwagon-jumper, so it is ironic that it took Paul Simon's African-influenced *Graceland* to pave the way for this, Belafonte's first recorded effort in a number of years.

Try, if you will, to forget that this LP was made by the beloved Belafonte, and that it speaks out on behalf of the best of causes. Just listen to it as music and not as a political, humanistic statement. You may find that the effort to "universalize" the original South African lyrics and musical structures has weakened them, and that a song like "Global Carnival" actually echoes Belafonte's calypso period (down to the "back to back, belly to belly" reference), sounding far more Caribbean than African. You might also note that shining moments of authenticity (the inspiring backup vocals on "Move It," for instance) serve to highlight the self-consciousness of the surrounding material.

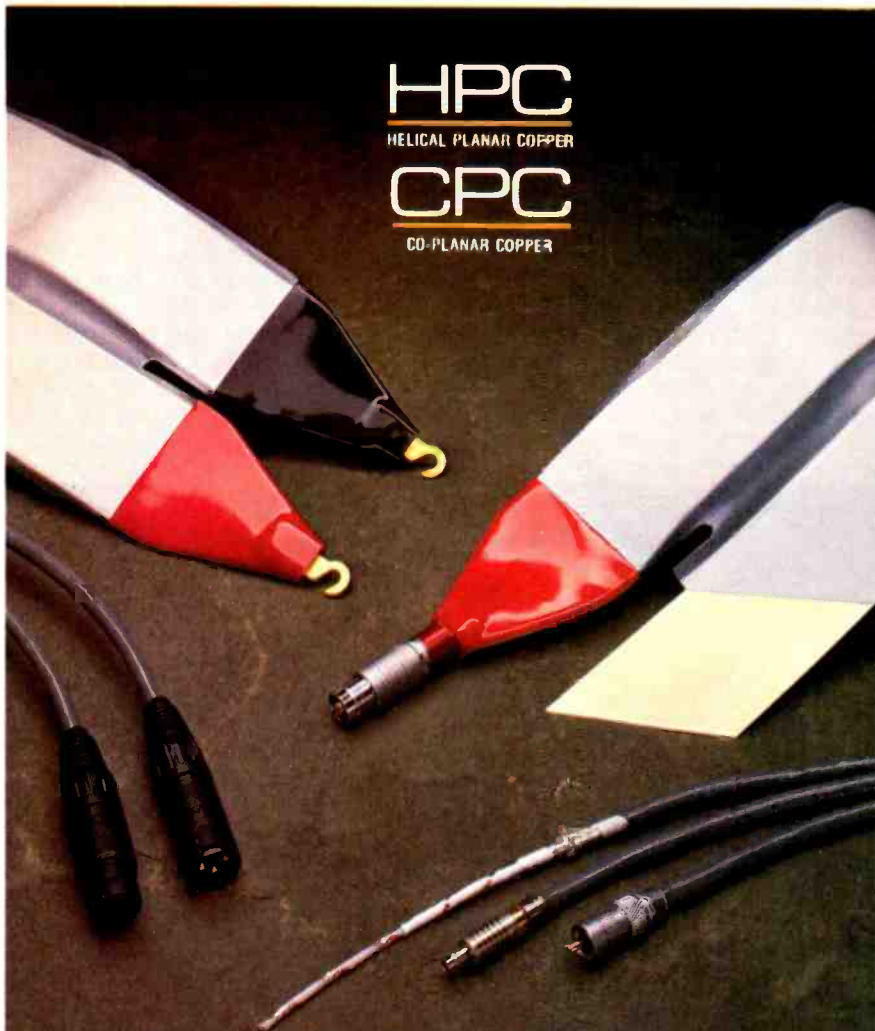
Indeed, there are moving passages and lovely lilting melodies and rhythms throughout. *Paradise in Gazankulu* is by no means a bad album; it simply aspires to more than it achieves, despite the strenuous and admirable efforts taken in its creation.

Paulette Weiss

Other Roads: Boz Scaggs
Columbia CK 40463, CD.

Sound: A- Performance: B+

The new Boz Scaggs, *Other Roads*, has been a long time coming; eight years have elapsed since the singer's

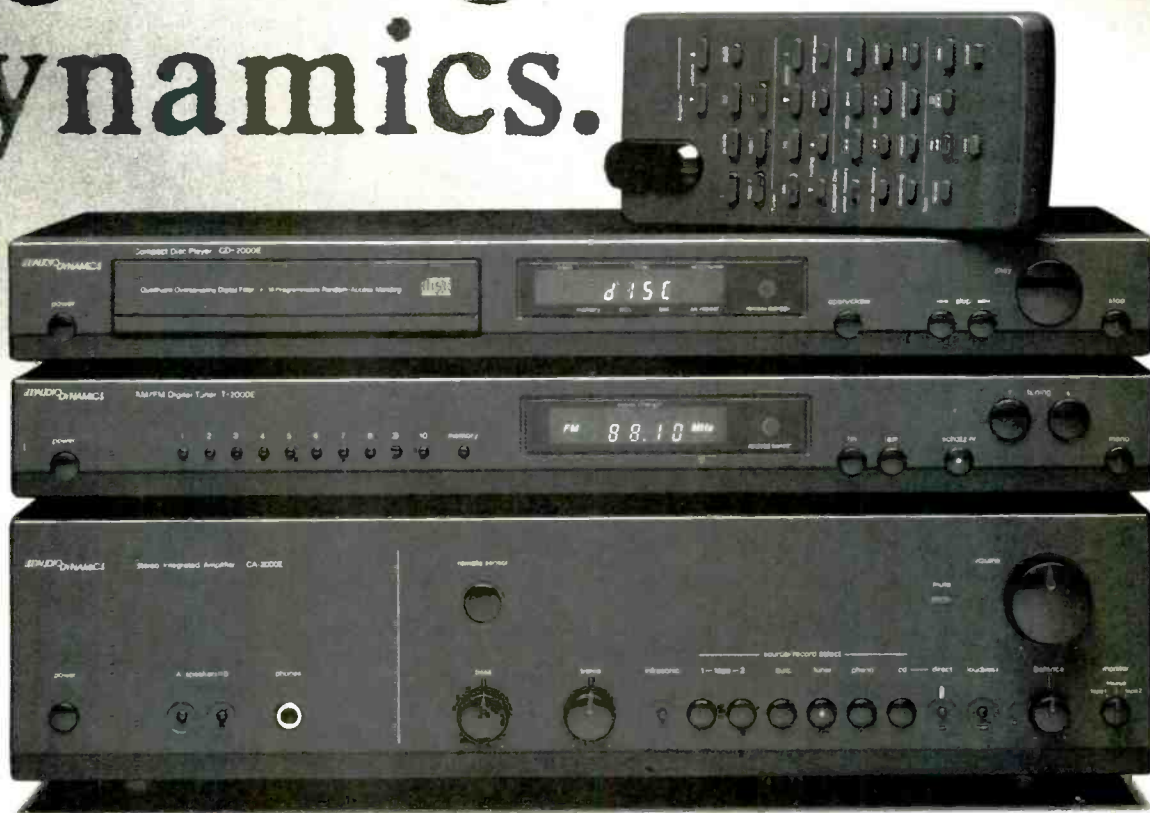


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Although *Brian Wilson* does sound like a throwback to The Beach Boys' glory days, the lyrics are simplistic and banal.

last album. *Other Roads* was actually finished and delivered to Columbia in March of '87. Before it was released, however, the album was reworked at the insistence of the record company—supposedly to gain greater acceptance at radio level and help ensure its success in the marketplace. But in essence, by trying to reinforce Boz Scaggs' credentials as a top-40 hit-maker, this record has instead been weakened. One can only lament that what should have been a truly great album for '80s listening is now flawed by the two tracks designed, not so much to make *Other Roads* more appealing to its intended audience, but to make it fit into a format.

The cuts in question—produced by Stewart Levine, who worked so well with Simply Red and Boy George—undermine the elemental vitality of the original concept. "Claudia" is slick and catchy, but perfunctory. "Heart of Mine," the first single, is no doubt a potential "hit" song, but this version is a miss. In the overall context of the album, these cuts sound disruptive with repeated listening. If they are programmed out, *Other Roads* really kicks.

What does remain of Boz Scaggs' and producer Bill Schnee's *Other Roads*, however, is a crisp, cohesive variety of uptempo motion and intriguing R&B ballads, of which "The Night of Van Gogh" is outstanding. The music has the cutting edge of rock, yet combines the fluid rhythms of jazz, dance, and melody. With contributions from various writers (including poet-rockers Jim Carroll and Bobby Caldwell) to implement Boz's own compositions, the songs are both sharp and capacious, expanding into vivid imagery. Instrumentally, the collaboration takes in a talented array of musicians, including the redoubtable bass player Marcus Miller, the primo L.A. session guitarist and songwriter Dann Huff, Robbie Buchanan and Peter Wolf on keyboards, Madonna cohorts Patrick Leonard and David Williams on guitars, and various background vocalists who ought to be mentioned for their seamless contribution. The production touches are masterly, and to hear the mix in detail on headphones adds another potent dimension to the powerful recording.



Eight years is a dangerously long hiatus for any artist. Boz Scaggs has lost none of his moves, and added a few more. Welcome back, Boz, you sound great!
Michael Aldred

Brian Wilson
Sire/Reprise 25669-2, CD.

Sound: B Performance: B-

There are those who will tell you that Brian Wilson and The Beach Boys defined what came to be known as the California Sound, and that the group's 1966 album, *Pet Sounds*—which to a degree influenced The Beatles' innovative *Sgt. Pepper*—was a milestone in pop music history. Certainly Wilson elevated record production to artistic heights with such classics as "Good Vibrations" and "God Only Knows." But sometime during the late '60s, he burned out.

The recent release of Brian Wilson's first solo album was lavished with almost overwhelming publicity. Most of it focused on the tragedy of his decade-long psychological incapacity and his more recent Lazarus-like return to the recording studio after so many years of creative inarticulation.

Given Wilson's condition, the fact that he has managed to produce any recordings at all is a remarkable feat. However, *Brian Wilson* needs to be listened to in terms of what is, and not what was or what could have been.

The album *does* sound like a throwback to the glory days of The Beach Boys. There is the same simplistic, almost naive quality about the songs which permeated so much pop of that era. However, the flagrant banality of the lyrics—"Night time is delight time/ And it's the right time for me . . ." for example—renders them trite and incongruous. With the exception of a couple of lines in the opening cut, "Love and Mercy," nothing reflects an attitude which would convey this as '80s music. It is more an anachronistic re-creation.

Some may argue that it has never been essential for pop music to be relevant, and that the intrinsic quality which can sometimes make it great and set it apart is that it is simply, but intensely, diversionary. But here, the intention, obviously, was to relaunch Brian Wilson's career, not just to create an album of "ear candy." The cost of this project—there are another seven or eight tracks in the can that didn't make it onto the album—has been put as high as \$1 million! One would sincerely hope this figure is simply part of the hyperbole of Warner Bros. spare-no-expense promotional campaign. That kind of money makes *Brian Wilson* the *Heaven's Gate* of rock 'n' roll.

Fortunately, the *sounds* are everything you would expect: Richly layered vocal harmonies and pumping instrumental textures echo throughout. Evidently Wilson's musical talent and commercial instincts have not been impaired; the album is not totally without its moments. The greatest disappointment, however, is the absence of even one killer song.

Brian Wilson was produced with the immeasurable support of Russ Titleman, E.L.O.'s Jeff Lynne, Warner Bros. president Lenny Waronker, and Andy Paley, whose collaboration, one suspects, was vital. One can only surmise in dismay what kind of contribution was really made by the efforts of the so-called co-writers of the lyrics for five of the songs, namely Eugene E. Landy and Alexandra Morgan.

One cannot deny Brian Wilson's contribution to the heritage of American pop music culture, but one can hope he may yet be afforded an opportunity to contribute to its future.

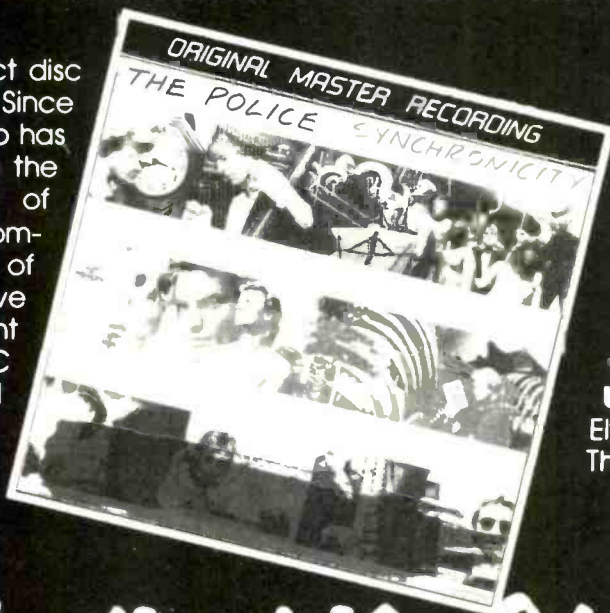
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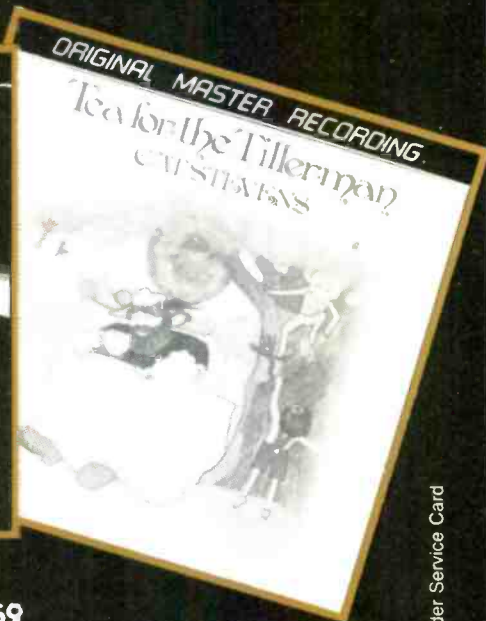
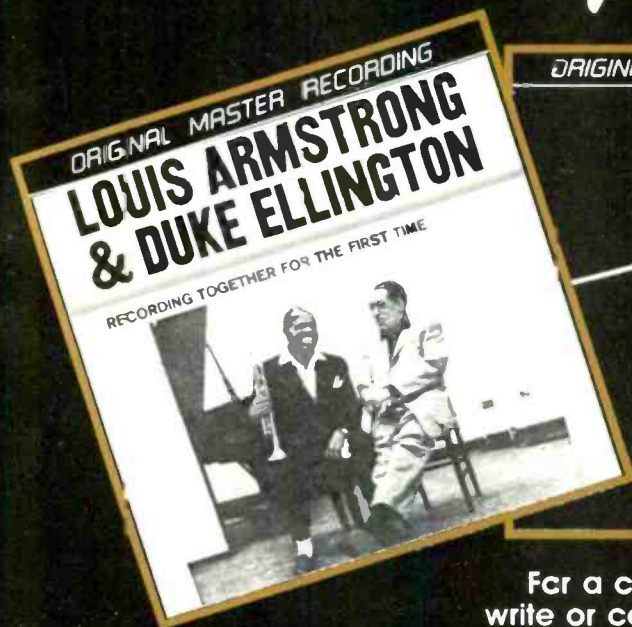
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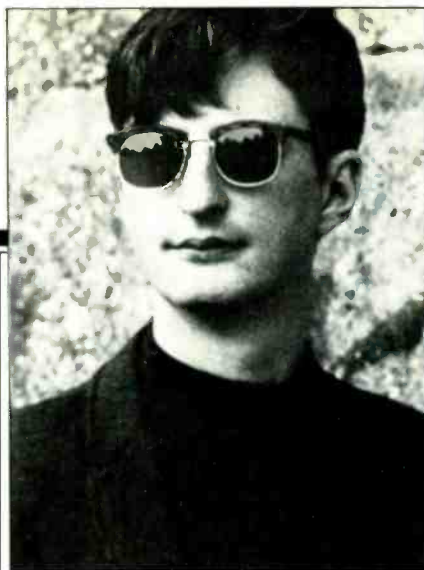
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Billy Bragg is scruffier and less ethereal than U2, more sanguine and artistic than The Pogues, and the most pragmatic of the lot.



Up Your Alley: Joan Jett and the Blackhearts

CBS Associated ZK 44146, CD; FZ 44146, LP.

Sound: A-/B+ Performance: B+

Cynics might say Joan Jett is one of those singers with only one song in her. But while the "I Love Rock 'n' Roll" anthem still reverberates through her latest album, *Up Your Alley* sports some clever variations and a sense of humor that go beyond the average hard-rock clichés.

Jett is refreshing, mainly because she cranks out an unabashedly candid female perspective in a genre dominated by adolescent male posturing—without wimping out. On "Hate Myself for Loving You," she laments her cheatin' man with the ironic self-analysis implicit in the title. "I Still Dream About You" is a randy conversation

with a boyfriend's picture, complete with amusing R-rated slang. On "You Want In, I Want Out," she philosophically explains, "That's what love is all about" with a lyrical twist worthy of Madison Avenue. "Ridin' with James Dean" sets up a witty analogy as she chides her boyfriend's wild recklessness. Two covers underscore Jett's tongue in cheek: Chuck Berry's "Tulane," about a lady who keeps ahead of her men, and Iggy Pop's raunch classic "I Wanna Be Your Dog." Jett's songwriting begins to falter on the last three songs, but at least she had the good grace to put these at the end of the album. Besides, there are enough high spots to forgive the filler.

Jett's band is hard and raw; the arrangements are lean and tough, with a brief guitar solo here, a grungy slide there, and a magnificently huge drum sound carrying things along. Both CD and LP sound crisp and clean, but the extra space of the CD adds a nice, intimate dimension.

Joan Jett is one of the very few women playing the hard rock game at all, much less taking on its macho style and making it feminine, gutsy, convincing, and just plain fun all at the same time. If you like the big beat, it should be *Up Your Alley*. *Michael Wright*

Workers Playtime: Billy Bragg
Elektra 60824-1, LP.

Sound: B Performance: B

A latter-day troubadour with high-tops and a battered guitar, Billy Bragg has often been cast as rock's latest David. Squaring off against the darkest side of the Establishment, the British Bragg picked up the sling dropped by The Clash in the early '80s to take aim at most of the appropriate adversaries. Scruffier and less ethereal than U2, more sanguine and artistic than The Pogues, Bragg's political concerns are the most pragmatic of the bunch. He'd sooner denounce conditions in his local jail than the foolishness of the nuclear arms race. He does so with a beauty mark of a working-class accent that, thankfully, he's never tried to dress up for public consumption.

With his latest album, Bragg has added extra dimensions to his stance, his sound, and his image as a "political" songwriter. He seems to be travel-

ling even closer to the center of the wheel, finding as much political significance in the insincerity of a commercial Valentine as in a May Day parade banner. Often, the distinction between a reprehensible lover and society blurs, and sometimes it's not clear whether the process of protest and revolution is being lampooned or lauded here.

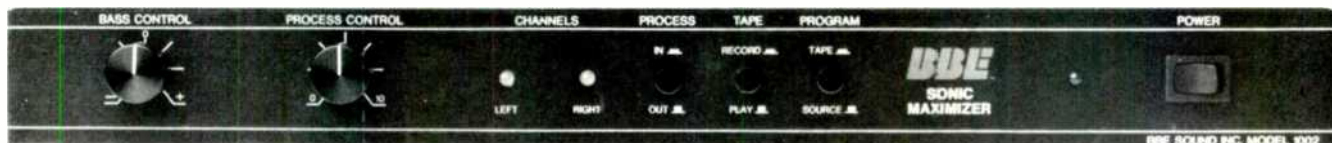
Previously recorded with only guitar as accompaniment, the songs on *Workers Playtime* have been fleshed out with the feathery yet sure-handed piano of Cara Tivey, who also adds backup vocals, and with bass and a sprinkling of strings. Perhaps it's the influence of producer Joe Boyd, who's done wonders with an assortment of bands whose subtle moral sense is expressed, in part, with a gentle sound (Fairport Convention, R.E.M., 10,000 Maniacs). Boyd's methods certainly work for Bragg, who loses none of his edge and gains truckloads of irony from the spare, bold arrangements. On "The Only One," for example, Bragg portrays a fellow indulging in the most insecure of emotions as he waits for his tardy girlfriend. A superbly recorded cello floats with serene merriment in and out of the verses, its solid counterpoint serving both to steady and chide the faithlessness of the singer. Boyd has placed Bragg's vocals way out front in the mix, as they should be, and kept them dry and free of effects. The backup singers, however, often suffer from a muddy sound that seems to come from an equalization oversight.

As time refines both his musical and ideological sensibilities, it looks as if Bragg is opening to all sorts of new directions and that he's gaining steam, not losing it. Wherever he goes, I have a strong feeling that he won't be painting himself into any corners.

Susan Borey



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CLARA FLIES



Clara, Robert & Johannes—Theme & Variations by Clara & Robert Schumann and Johannes Brahms. Veronica Jochum, piano.
Pro Arte CDD 396, CD.

Clara Schumann: Piano Concert. Bamberg Symphony, Joseph Silverstein; Veronica Jochum, piano; Colin Carr, cello; Joseph Silverstein, violin.
Pro Arte CDD 395, CD.

It isn't right to review one of the four Schumann recordings from Pro Arte without the others, so closely related are they—or at least the two that feature the splendid Veronica Jochum, who is just a natural Schumann pianist, whether performing the works of the wife or the husband.

For those who are partial to big early-Romantic music—Schumann, Chopin, a host of "rediscovered" virtuosos of the same early 19th-century period—this is a revealing and excellent program, and I put it that way deliberately. The intertwining lives of Robert and Clara Schumann, the advent of the young (beardless) Brahms into their intimacy, and the hideous decay of Schumann himself into a human vegetable, as Clara and young Brahms looked on, is one of the great stories of music. Their musical interaction is

something else again and equally fascinating, as brought forward here by Veronica Jochum, a splendid Romantic pianist and daughter of the conductor Eugen Jochum.

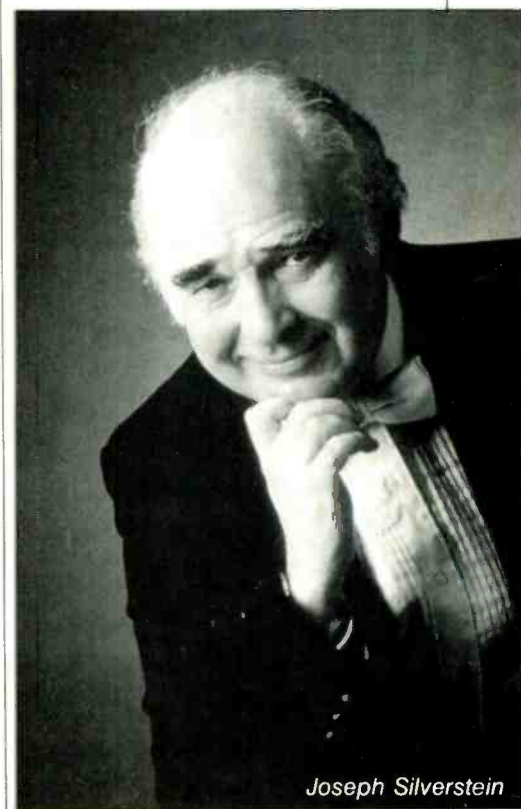
Variations! First Clara writes a little Romance for piano. She was 11 and already had the Romantic style down pat. Her father taught young Schumann, much older than she; Robert wrote a piece based on Clara's music as a sort of older brother/admirer. It's big and a bit too pretentious. He was around 20 and studying with Clara's imperious and dogmatic father. Each was showing what each could do—astonishing. Then, some years later, Robert wrote a mature collection of "pages from an album" ("Albumblätter") for piano; after a long composing silence, Clara in turn wrote *her* variations on one of these as a birthday present. You can hear them. Then along came young Johannes Brahms, who wrote *his* variations on the same Schumann piece! Brillianter and brillianter, so to speak, each set more fancy than the last. It was a real musical hothouse but is wonderfully worth listening to in Veronica Jochum's juxtaposition, where the melodies quickly become familiar from one piece to the next.

What superb things the CD does for piano, and notably with an insightful pianist who knows what she is playing about.

The big sensation in this series is the "Piano Concerto, Op. 7" by Clara, a work with full Romantic orchestra that lasts some 20 minutes in the grand style. I listened to it first (it comes first) and thought to myself—she's good, but not very original; it all sounds like her husband's music, liberally mixed with Chopin in his most unctuous salon manner and maybe Mendelssohn too—not *his* best. She was no first-line composer, I remarked to myself. Though very, very expert in writing big music.

Then I looked at the dates. It was composed in 1833. Clara Schumann was 14!

The other two works are, shall I say, mature, though the concerto is anything but childish. They are also better music. But still not as dashing, as temperamental, as daring, as those of her much more original husband—however erratic he himself was in respect to ultimate quality.



Joseph Silverstein

Illustration: Yvonne Buchanan

I think that most musicians who know Schumann (Robert) have waited in some small corner of their lives for a long time, hoping some day to get at the real Clara, so famous in words and story, Europe's first lady of piano until the 1890's but virtually silent in her role as a woman composer. Here she is!

Edward Tatnall Canby

Franz Joseph Haydn: Keyboard Works, Vols. I & II. Lola Odiaga, fortepiano.

Titanic Ti 156 and Ti 160, CD.

How very much better the music of Haydn sounds when the keyboard instrument is the so-called fortepiano, a modern term for the pianos of various types that existed in the days of Haydn and Mozart, on into the Beethoven era. Especially is this true when that essential element, an understanding artist, is involved! Lola Odiaga fills the bill.

There's a curious paradox here, also observable with the harpsichord and in the "piano" works of Mozart: It is simply that on the big, modern grand piano (pianoforte), both composers sound thin, light, and delicate (and are made more so by deliberate performance), whereas on the earlier instruments the effect is much stronger, more solid, richer. The music is indeed delicate in its high sophistication, but not in the sound. This is especially true via audio reproduction which, of course, has no fixed and absolute volume level.

The first of these CDs ranges over Haydn's long composing career, from 1767 to 1795 in his English years, and includes the superb variations on "Gott erhalte" and various memorable single movements. The second volume is all later works and includes two late sonatas that are remarkable for their half-humorous (but very perceptive) intimations of coming Romanticism à la Beethoven. Great fat chords in the E Flat sonata sound bigger and more pretentious on the fortepiano than they ever do on the modern grand. There are also strange modulations and distant key relationships—the second movement of the E Flat work is in E, a half-tone higher, and the step back down again to E Flat is a thing to wait for, so neatly is it done. That's Haydn all over.

Edward Tatnall Canby

Mahler: Symphony No. 4. Concertgebouw Orchestra of Amsterdam, Leonard Bernstein.

Deutsche Grammophon 423 607-2, CD.

DG has been recording Leonard Bernstein in a new Mahler cycle, using orchestras (like the New York Philharmonic, the Concertgebouw, and the Vienna Philharmonic) which have strong ties to the composer. Thus far, the recordings have been of live performances, a practice some like for its honesty and spontaneity but which others condemn for lack of control and intrusive audience noises. DG has been doing other similar recordings lately, and I must say I marvel at how little noise the audience contributes.

Bernstein, in his 71st year, has changed his views about Mahler. He has added some retrograde ideas, but, for the most part, his conducting represents a more reasoned and mature approach with less extrovert eccentricities. By no means are Bernstein's readings ever dull! This is a wonderfully cogent performance, still



quite intense, still with plenty of heart-on-the-sleeve romanticism. The playing he elicits from the Concertgebouw is simply magical. The strings, woodwinds, and brass are all played with incredible élan coupled with stunning accuracy.



Lola Odiaga

The Hesperus quartet takes a folk approach to music whose tradition has long been dead, lending it new vigor and dimension.

Bernstein breaks with tradition by using a boy soprano. This may epitomize Mahler's idea of youthful innocence, but I still prefer a really good soprano voice on the order of a Jessye Norman or Katherine Battle.

This is probably one of the best DG recordings in years. While still employing many microphones to ensure total delineation of every instrument, the sound has extraordinary presence and a surpassing sense of realism in the golden, lambent glow of the Concertgebouw's fabled acoustics. This splendid disc should find favor with most discerning Mahlerians. *Bert Whyte*

Crossing Over—A Fusion of Medieval & Appalachian Music: Hesperus. Greenhays GR718, LP.

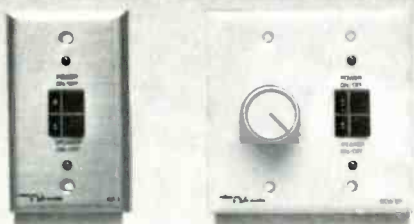
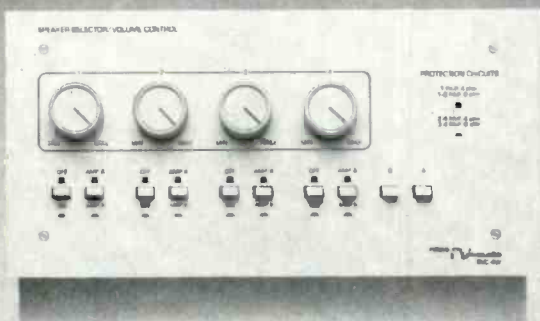
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sounds and albums have since come and gone, from Paul Horn to Mannheim Steamroller. But a few, a very few types of stylistic blend have stayed around *Crossing Over*, from the quartet Hesperus, is an example of a tastefully programmed, performed, and recorded album spanning two worlds of melodic tradition.

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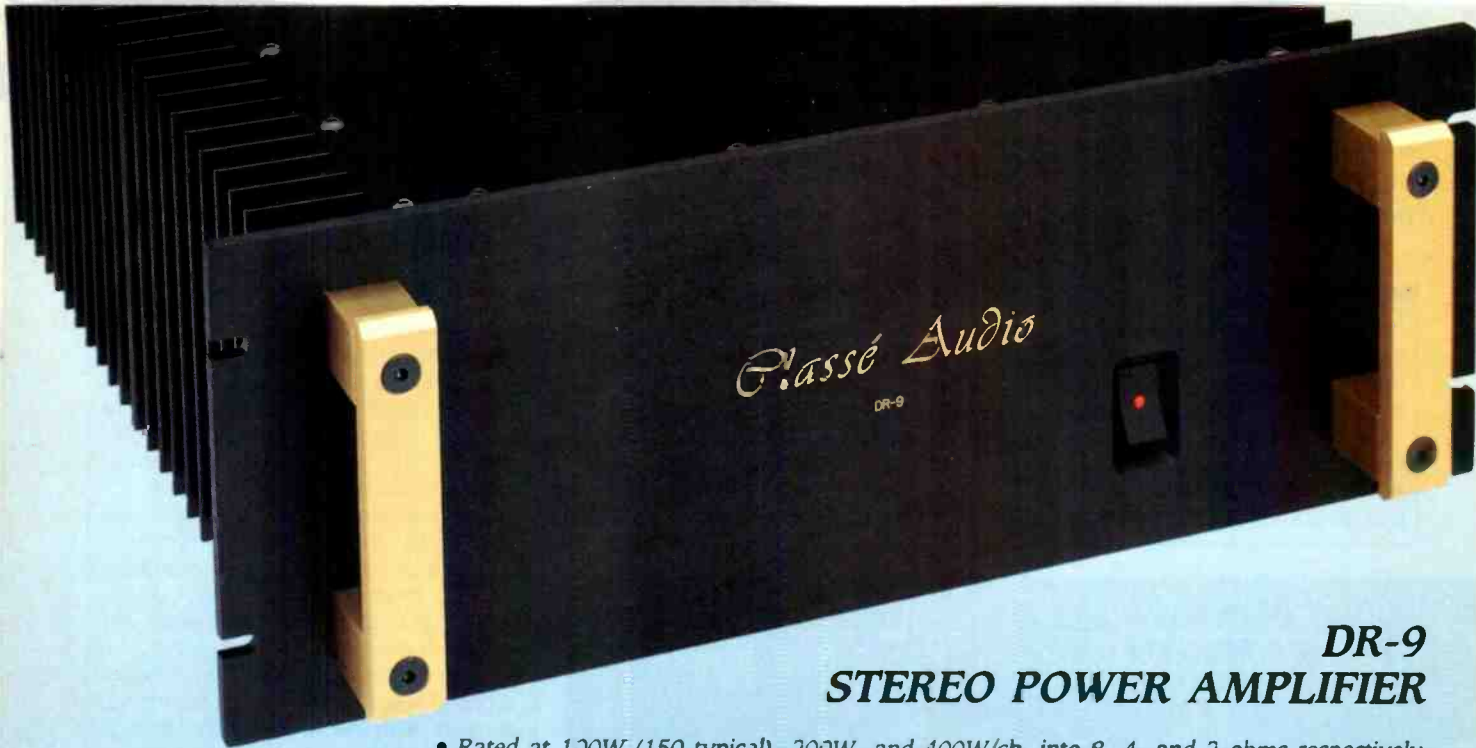
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The new London release of Paul Hindemith's dramatic *Matthias Symphony* is quite outstanding, in both its performance and production.

dance heritage, Scottish ballads, Irish minstrelsy, other Gaelic forms, and formal Renaissance music. It is not much of a surprise, then, that supposedly "folk" instruments are nicely at home with *estampies* and such, and that the *vielle*, rebec, recorder, and Moorish percussion lend a new but hardly

strange timbre to jigs, ballads, and simple songs. All the family resemblances are as if made for each other.

As the album's liner notes state, the music stands sailed right out the window when the band got together to play. For them, the folk approach to a music whose actual playing tradition

had been dead for centuries lent it freshness, vigor, dimension. There's not quite the strained coexistence of styles one encounters with Steeleye Span or John Renbourn. Instead, we've an easy and highly listenable union of forefather and distant descendant.

Engineer Mark Huffman grouped the quartet of singing, bowing, hammering, and plucking Hesperus members around mikes in a church outside Washington, D.C. The sonic results are as unlike anything that comes out of a studio as could be: The acoustic aura is one of reverberant, but not obtrusive, support, with the room nicely filling in gaps, underpinning drum transients, and providing a silken backdrop to the plangent hammered dulcimer.

"Estampie Belicha" and its neighboring cut, a medley of the vocal "Country Blues" and "Los Seis Gotxx," are two delightful items from a generally solid and melodious program. The vocals are easy, very in tune, and relaxed, while the instrumental sets don't have the frenzy or dryness many of us will have heard in a lot of attempts at early music. Should you happen across *Crossing Over*, you'd be missing a good thing if you didn't snag it on the way to the counter of your local store. It happens to be a little contagious, so be warned!

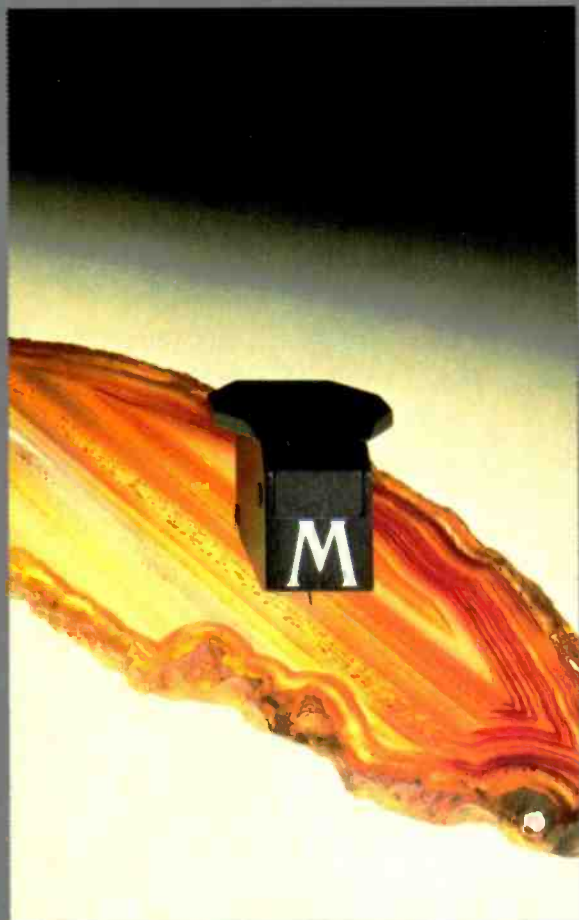
Christopher Greenleaf

Hindemith: *Mathis der Maler*. San Francisco Symphony, Herbert Blomstedt.

London 421-523-2, CD.

Since the beginning of the CD era, I have been waiting for a new recording of Paul Hindemith's *Matthias Symphony*. Finally this one appeared, and it is outstanding in both performance and production. The score is ideal for the CD medium because of its dramatic and dynamic contrasts, colorful orchestration, and intricate layers of counterpoint. Drawn from Hindemith's opera on the life of German Renaissance painter Matthias Grünewald, the three movements depict three of the panels Grünewald painted for the Isenheim Altar. The first movement is a serene, cerebral "Angelic Concert." The slow movement portrays the "Entombment of Christ," and the last movement describes the "Temptation

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For all their prettiness, Ned Rorem's works never collapse into wimpiness; his music, like his prose, does have acerbic edges.

of St. Anthony," complete with demons from hell and a blazing brass finale.

This is one of Blomstedt's first recordings with the San Francisco Symphony, but his musical personality already has made its mark on the orchestra. Its members play with a somewhat mellower, broader sound and have gained a new feeling of power and self-assurance. This orchestra is on the move once again, and it is clearly going to reach new levels. To get a quick overall sense of what each section of the orchestra can do, sample three parts of the disc. For the strings, listen to the "Funeral Music." The San Francisco strings project the rich, full quality that this solemn piece requires. Geraldine Walther's solo viola sings with a wonderfully dark tone. In the first movement of the Matthias Symphony, the winds evoke the sounds of the most amazing pipe organ you can imagine; both brass and woodwinds contribute to the effect. Hindemith calls for subtle color mixtures in the sustained chords of the quiet passages, and the San Francisco musicians play them with polished perfection. The percussion showcase is in the second movement of the "Symphonic Metamorphosis." Most of Hindemith's writing calls for restrained, delicate, coloristic playing, and it is performed here with flair.

The production is outstanding. Some people have philosophical objections to London's approach to recording an orchestra, but if it doesn't bother you, you'll find that this recording is one of the most successful from the still-new Davies Symphony Hall. Producer Andrew Cornell provides the perspective of a relatively close seat but still manages to capture the sound of the hall in a convincing way. He delivers all the intricate counterpoint that Hindemith loved to write, and all the detail of the percussion. Best of all, the sound just feels right, and it lets the music shine through.

Steve Birchall

Ned Rorem: String Symphony; Sunday Morning; Eagles. Atlanta Symphony Orchestra, Robert Shaw and Louis Lane.

New World NW 353-2, CD.

Ned Rorem's melodic gifts have made him one of America's finest living

proponents of the art song. His instrumental work is equally tuneful and spiced with harmonic riches, as evidenced in this collection of premiere recordings by the Atlanta Symphony Orchestra.

Rorem, who recently celebrated his 65th birthday, admits to being more

comfortable when he has a specific source from which to draw inspiration and, sometimes, form. "Sunday Morning" and "Eagles" are both tone poems, the former based on Wallace Stevens' work of the same name, the latter on Walt Whitman's "The Dalliance of the Eagles." But it is the "String Sym-

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phony" that is of primary interest—partly because its abstract nature is a departure for Rorem, but mostly because of its swirling colors and melodic beauty.

The theme of the five-section work, more than slightly reminiscent of Erik Satie's "Gymnopédie No. 1," is stated in

a wide variety of contexts, from the rough-hewn "Waltz," to the urgently expressive "Nocturne," to the jazzy, quasi-contrapuntal "Rondo." Richly hued melodies abound, emerging in particularly high relief in the two slower movements. The poignant "Berceuse" has a pastorale beauty which is put forth ef-

fectively by the Atlantans' lush string sound. This is, in general, a sympathetic, thoughtfully phrased interpretation.

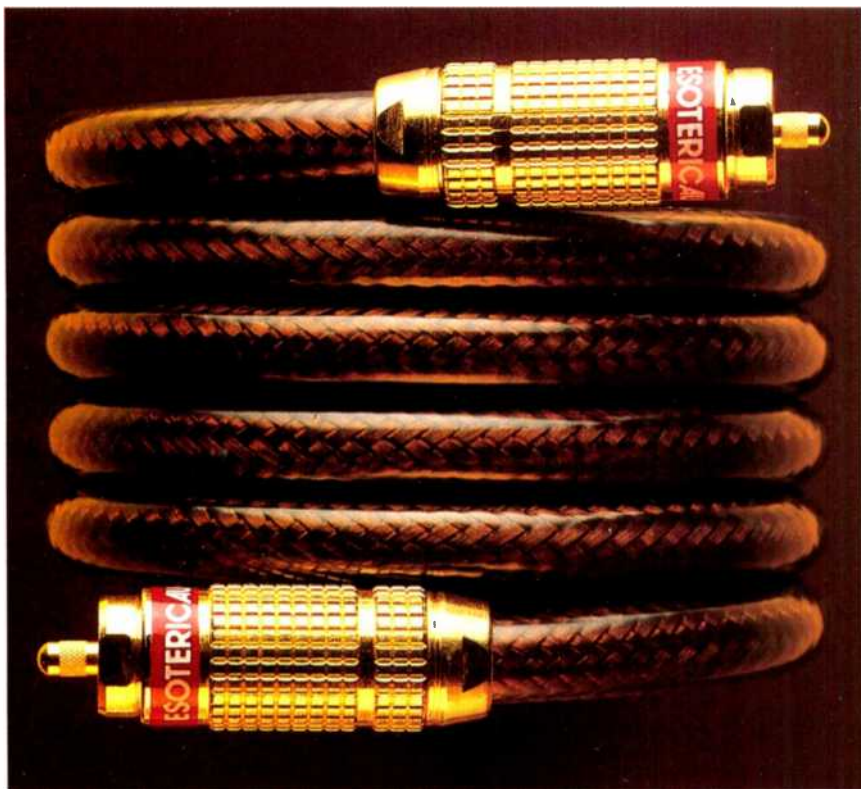
For all their prettiness, the works on this disc never collapse into mere wimpiness. Rorem's music, like much of his prose, does have its acerbic edges, discernible particularly on "Sunday Morning." The work also has a rather active inner life and uses instrumental color effectively to create its images: "... birds, Before they fly" becomes flutes in dialog; "... our insipid lutes" overlays sweeping strings with an ominous, shimmering mandolin; "... a ring of men" is brass and percussion rising to raucous dimensions; "Death is the mother of beauty" moves from dreamy impressionism to overt drama.

Rorem's melodies emerge as petals in an unfolding flower in "... indifferent blue," a moving, elegantly crafted statement featuring some fine solo clarinet and cello work.

"Sunday Morning," like "String Symphony," is a commissioned piece, composed in 1977. The brief "Eagles," written 30 years ago at the MacDowell Colony, is perhaps the most theatrical of the three works. It is certainly the most tonal and, at times, is evocative of Gershwin.

Performances throughout are solidly prepared and committed, though one might have wished for a bit more bite to those acerbic edges. Recorded sound, under the supervision of Telarc's Bob Woods, is refreshingly without ego.

Susan Elliott



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If you liked the high-voltage "space-opera" music of Telarc's *Star Tracks* and *Time Warp* albums, you'll love this follow-up disc, which I must say is clearly the best yet. Jack Renner, Telarc's chief engineer, has really zeroed in on the acoustics of the Music Hall in Cincinnati. The balances he achieves between various orchestral choirs, the high instrumental definition, and the musical perspectives make for a stunningly realistic sound. In fact, there is great sound on every track of this CD.

Particularly outstanding is Erich Kunzel's treatment and the splendid play-

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Joan Morris' delivery is as warm and true as the backdrop it falls against, and Leonard Slatkin gives a polished interpretation.

ing of the orchestra in "Back to the Future" and the "Klingon Battle." Here you have massive brass fanfares, visceral bass drums, and awesome organ pedal counterpoint. The coruscating brilliance of brass and percussion scoring in John Williams' "Space-camp" is also quite thrilling.

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Bert Whyte

William Bolcom: Symphony No. 4; Session 1. The St. Louis Symphony Orchestra, Leonard Slatkin; Joan Morris, mezzo-soprano.
New World NW-356-2, CD.

Bolcom's Fourth Symphony is a grand, kaleidoscopic statement in two movements. The second is a setting of "The Rose," by American poet Theodore Roethke, with whom Bolcom studied in college. This is the composer's first symphony to use a vocal part, and everything appears to revolve around it



and its text. Not surprisingly, it was written specifically for the light-voiced Joan Morris.

According to Bolcom, the first movement is an immense upbeat to the second. Titled "Soundscape," it evokes the craggy cliffs and choppy seas of the Pacific Northwest, gathering mo-

mentum as it moves swiftly along. Driving percussion and virtuosic winds highlight accumulated layers of sound that suddenly give way to calm, sustained passages. But these are mere oases in a raging storm that ends in a wild, dramatic cry.

By contrast, "The Rose" grows increasingly tame, introverted, and tonal. The music is highly evocative of its text, and the vocal line is set in very high relief against a supportive, cleverly wrought orchestration. This is a very accessible work, in the most positive sense, and Morris' delivery is as warm and true as the backdrop against which it falls. She is that rarity among singers—a natural storyteller with superb, but never exaggerated, diction and not one whit of pretense.

This symphony, commissioned especially for the St. Louis Symphony, premiered last year and was recorded one week later. Leonard Slatkin, a champion of American music, leads a polished, indeed glistening, interpreta-



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In these Liszt works for piano, Alfred Brendel's playing is as stunning in its power as in its poetry and lyricism.

tion that does well by the work's internal/external viewpoints. It is a flexible, romantic performance that crackles with energy and coloristic sweep. In Slatkin, Morris has a most sensitive accompanist.

"Session 1" is a highly organized, 12-tone jam session for symphonic instruments that dates to 1965. Its witty construction spotlights various intervals and groups of instruments, which occasionally engage in furtive dialog. It is decidedly the more atonal of the two works and, as one expects from any Bolcom project, is not without ample humor.
Susan Elliott

Liszt: *Années de Pèlerinage (Première Année: Suisse); Isoldens Liebestod.* Alfred Brendel, piano.
Philips 420202-2 PH, CD.

Superstar pianist Alfred Brendel takes us on the first year of Franz Liszt's pilgrimage through Switzerland in his "Années de Pèlerinage" cycle for



solo piano. With four recordings of this work on CD, Brendel's only serious competition is from another Liszt specialist, Jorge Bolet. Although Bolet's Loncon recording is first-rate in regard to performance and sound, Brendel is just a bit more insightful, and his playing is as stunning in its power as it is in its poetry and lyricism.

The Philips engineers have splendidly captured Brendel's huge volume and tonal sonority. Especially noteworthy is the "Orage" section, with Liszt's tumultuous depiction of a thunderstorm. Brendel produces some massive chords at triple fortissimo, and it would be wise to monitor playback levels carefully.

As filler, Brendel gives us a beautifully phrased, very expressive performance of Liszt's transcription of the "Liebestod" from Wagner's *Tristan and Isolde*.
Bert Whyte

Spanish Album: Santiago Rodriguez, piano.
Elan 2206, CD.

All Spanish here, including a pianist with a very Spanish name, the whole thing produced in the U.S. Still another young pianist, unmistakably in the Neo-Romantic tradition (much hesitation, plenty of moodiness, a bit too carefully styled—the older big pianists

Photograph: Clive Barden

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Leon Rosenfield
VP/Circulation

This Palestrina recording does evidence a gorgeous cathedral sound, but the performance is a musical monstrosity.

just ripped ahead, concealing their consummate art). But, nevertheless, this one knows what he is doing, Neo or no. Santiago Rodriguez immediately makes it clear that Spain is his element. Yes, the styling is, shall I say, a bit stretched, but never anything misplaced. The music speaks. I particularly like the Manuel de Falla composition, which comes first.

This piano, an American Baldwin, sounds a bit bangy in the more forceful parts—but *is it?* Here is where the art of the microphone is at its most cryptic! Only a personal and live hearing can sort out the microphone technique from the piano itself and from the player who makes use of it. More power to the recording engineer—he is musically as important as the pianist's fingers.

Edward Tatnall Canby

Palestrina: Missa Papae Marcelli; Stabat Mater. Pro Cantione Antiqua, Mark Brown.
MCA MCAD-25191, CD.

As a long-time "live" explorer of this kind of music, including a lot of Palestrina, I jumped for this recording. It has an extra interest—instead of the usual five movements, the "Ordinary" of the Mass, it also includes the Gregorian chant segments that are sung between, as part of the entire service. The Kyrie, Gloria, Credo, Sanctus/Benedictus, and Agnus Dei are thereby spaced out more, as they actually were in the original usage and as they are in a modern church service.

After a few minutes, I gave up. This is one of those very "authentic," ultra up-to-date performing groups that is all male, and all solo, with no less than three countertenors for the higher parts. Good singers and fine for much music—but not this! Of long tradition, the upper parts must be sung by the small boys, if not females. The music is really not solo music and sounds here as it never possibly could have sounded in the "authentic" original in 16th-century Rome.

But be that as it may (and there are musicological arguments, if you want to get involved), what astonished me was the abysmally slow, solemn speed of the music. I could not believe that any group today could still sing this majestic, vibrant Mass at such a

dreadful snail's pace, however impressive the churchly ambience in the recorded sound. Even the Gregorian chant has too many operatic qualities, for my taste, and is also unnecessarily slow and plodding.

I can say from personal experience that if this church music is sung perhaps *three times as fast* as you will hear it here, Palestrina "comes alive" wonderfully easily—it blossoms. The Latin texts are easily understood (at a natural speed), the varying moods are faithfully reflected, and the music flows smoothly and gracefully. That is what we call internal evidence, and it is powerful. Yes, a gorgeous "cathedral" sound here, but a musical monstrosity.

Edward Tatnall Canby

Franck: Symphony in D Minor. Concertgebouw Orchestra of Amsterdam; Jorge Bolet, piano; Riccardo Chailly. London 417487-2, CD.

Riccardo Chailly, the new conductor of the great Concertgebouw Orchestra, provides a finely wrought, well-paced reading of the Franck "Symphony in D Minor" which makes this old warhorse newly interesting. In less-skilled hands, this piece can sound ponderous, but Chailly keeps everything well delineated and articulate. And his effort is aided in no small measure by a sumptuous recording.

The engineers obviously knew the "Grottesaal" (Great Hall) of the Concertgebouw, and the orchestra is nicely positioned to provide good detail. Full advantage is also taken of this venue's renowned rich ambience. It is heard to marvelous effect in the second movement, which opens with the strings playing pizzicato; an oboe then floats in, a mere phantom image between the speakers. A little further on, there is a wonderful sense of depth as unison first and second violins play with open strings at about a mezzo-piano level. Really quite magical! In the final movement, the sound is very full bodied, with great brass chords.

Jorge Bolet evokes a richly resonant piano in his ingratiating reading of the "Symphonic Variations for Piano & Orchestra." His is a most natural piano sound, balanced perfectly just forward of the orchestra. You can't go wrong with this Compact Disc. Bert Whyte

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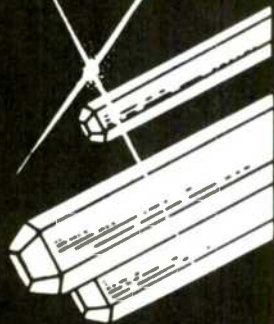
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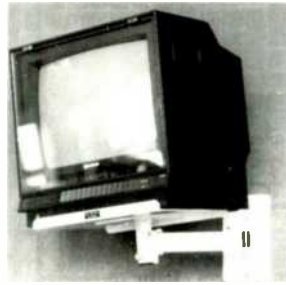
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180	250	200	300	600	180	200	300	600
1000	1000	1000	1000	1000	1000	1000	1000	1000
80-3500	800-7000	500-6000	1200-25000	2000-35000	300-5000	400-8000	1000-30000	1500-45000
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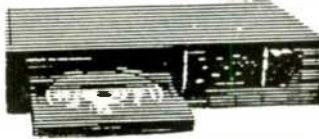
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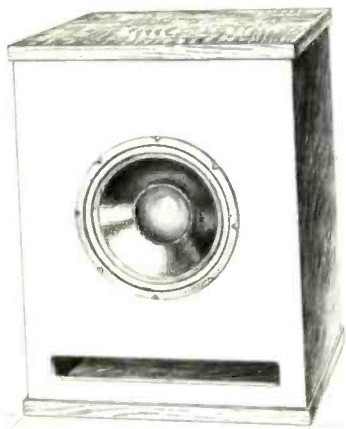
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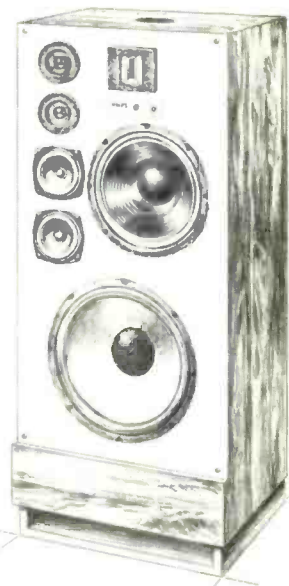
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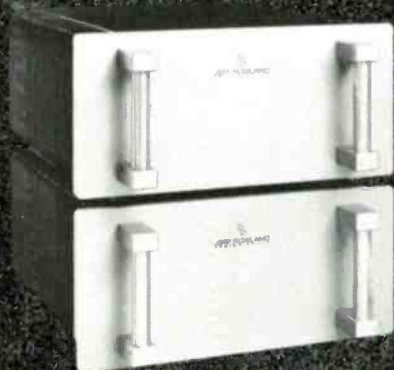
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