

# Audio

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POLARITY INVERTER

DECEMBER 1987 • \$2.50

## ONKYO DAT RECORDER THE NEXT LOGICAL STEP



## A LIFE IN RADIO BROADCASTING

## TESTED

## FORTÉ MODEL 1 AMP

## CLASS A ON A BUDGET

## TECHNICS SL-P1200

## CD PLAYER

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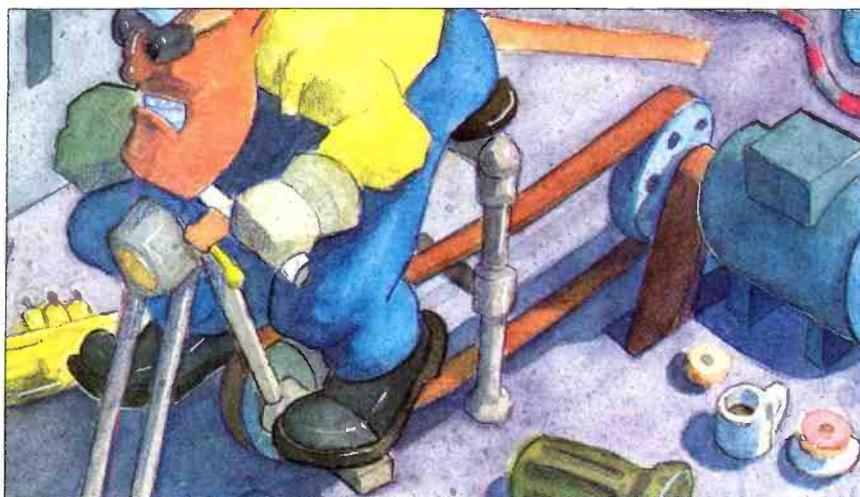
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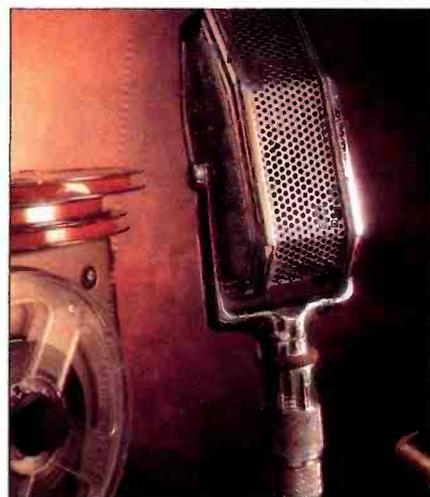
# Audio

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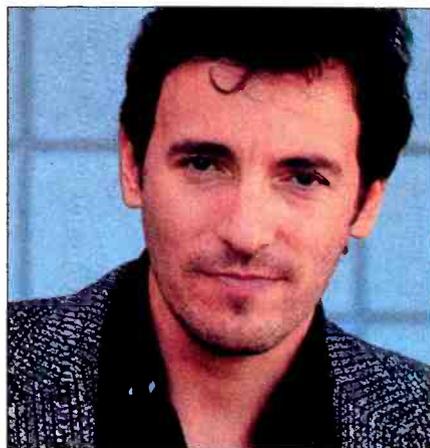
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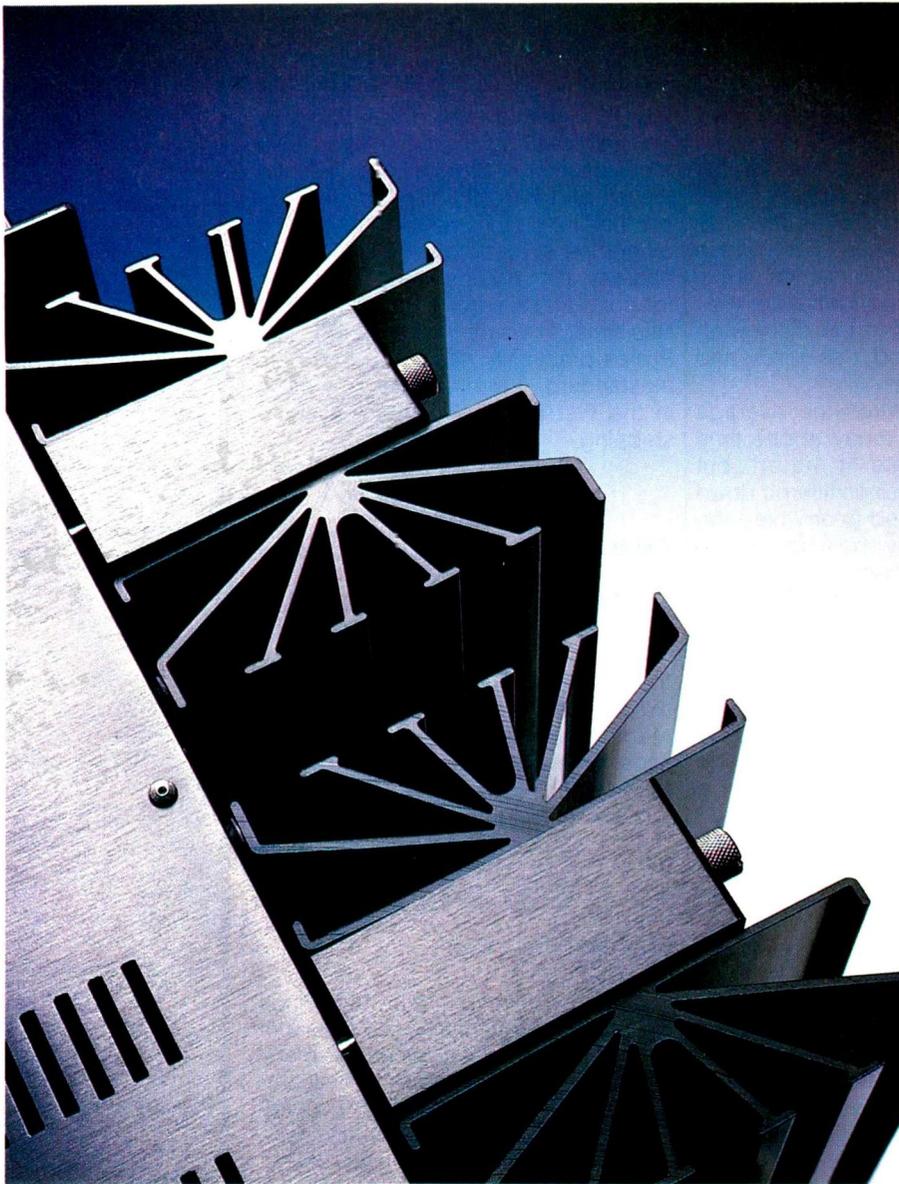


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HEATSINK—July 1986

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## Glimpse into the Future

Dear Editor:

I was disappointed to see, in the October issue, the letters of complaint about *Audio's* reviews of sophisticated, high-dollar equipment. Everyone in the mid-fi and bargain-basement realm owes the level of performance their equipment provides to the pioneering research of high-end designers and manufacturers.

Many of the features the average consumer looks for today at one time represented the state of the art, but these features have since filtered down into moderately priced gear where the rest of us can enjoy them too. Items like MOS-FET amplifiers, digital tuners, quartz-locked turntable drive motors, dome tweeters and midrange drivers, high-quality interconnects, and low-feedback audio circuits are just a few of the formerly esoteric features that are now available to the masses. By keeping its readers aware of the trends in esoteric gear, *Audio* gives them a glimpse into the future of high fidelity.

The reader who called such items "obscenities" is ignoring the debt he owes to the uncompromising high-end designers. Does he expect us to believe that he wouldn't own an Audio Research SP-11 preamp if he had five grand to spare? It is difficult to have sympathy for such sour grapes.

To the designers of such "obscenities," I say thank you and keep up the superb work. To the editors of *Audio*, I ask that you keep an open mind for the rest of us.

Matthew Reiner  
Silver Spring, Md.

## Small Investment, Big Difference

Dear Editor:

I just finished making the modification described in "The Magnavox 16-Bit Series: Making Good Players Better" in the June issue. I own a Magnavox CDB650 CD player. The sound before the modification was great, but now it's unbelievable—this difference just by substituting a few parts. Neither my brother nor I have any kind of electrical background. The only experience we have between us is knowing how to use a soldering iron, which, for this, was all we really needed.

The one thing that confuses me is

this: Why do I have to void my warranty and risk blowing my CD player for a modification that should come with the player, and with all Philips-made players that are on the market? I mean, the difference in sound quality is like night and day. If it only cost me a few dollars for parts and a service manual, plus a little time, I'm sure that it would cost Philips practically nothing to have this as standard. If the technology is there in the first place, why are they half-stepping?

Joseph Predlo  
New York, N.Y.

## Extra, Extra!

Dear Editor:

I have enjoyed *Audio* for many years now, and I really treasure the older issues that I have accumulated over the past several decades. I have many extra older copies of *Audio* which other readers may wish to add to their personal collections. These issues extend from 1956 through 1986.

Many thanks for a fine magazine!

Freeman H. Matthews  
505 King Ave.  
Columbus, Ohio 43201

## Oughta Write a Book

Dear Editor:

Ted Fox's interview with Alfred Lion of Blue Note in the June 1987 issue of *Audio* was fantastic. I learned many things about the great Blue Note record label that I never found in the three jazz periodicals I subscribe to.

To echo the sentiments of critics, Blue Note did indeed leave behind a rich legacy of recorded jazz and, in the process, maintained a high standard of recorded sound quality which, in my opinion, has not been matched by any other record label since then. Perhaps Mr. Fox could provide a more in-depth report on the history of Blue Note in the form of a book.

Bill Zimprich  
Milwaukee, Wisc.

## Lion Lines

Dear Editor:

"Lion's Pride" by Ted Fox (June 1987)—what a title! And what a story about jazz and some of its people. Thanks.

Raleigh Yancy  
Bruce, Wisc.

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## Bound for Extinction

Dear Editor:

Regarding L. A. Schwartz's letter, "Save the LP!" (June 1987 "Signals & Noise"), he has my agreement completely! Let the LP become the realm of the collector, for that is swiftly becoming its place.

Face the facts. Sound as interpreted by an LP is produced by dragging the earth's hardest mineral through a modulated, equalized waveform that spirals through something used to make automobile seats, creating sufficient G-force to turn a man into a jellyfish. The signal is then demodulated, re-equalized, and amplified—all in addition to the recording and listening stages, which have their own inherent shortcomings.

Mr. Schwartz clearly states his point by saying, "Sure, the CD sounds great" and "... we can save history." His interest lies not with superior sound reproduction, it lies with preserving antiquity. Look at it this way. When LPs suffer their demise (a *long* time away), his collection may be worth more.

Digital encoding is simply logical—or is it logically simple? Thomas Edison himself probably dreamed of the premise behind digital reproduction but was stymied by the requisite speed and volume of information. The terms "mega" and "giga" now have applications for more than aircraft-carrier shopping lists. We can quantize sound 44,100 times per second and then re-read that information—is it four times we are up to now?—faster than that. Let's see a *phonograph* compensate for all those dust motes (dare I mention the stylus?) that etched a record's groove the last 10 times you played it.

Michael W. Thies  
Sikeston, Mo.

## One for the "1"

Dear Editor:

As a very satisfied user of the Yamaha DSP-1 sound processor, I thought I might offer some addenda to your excellent product review (June 1987).

While the secondary speakers need not be as large, or as expensive, as the main channel speakers, careful thought should be given to the choice. The DSP-1 produces ambient signals whose average level is as great or

greater than that of the main channels (program dependent). Power handling ability is thus of great importance, as is accuracy. Frequency extremes are of less importance, since deep bass is nondirectional and can be carried by the main speakers and because very high frequencies are usually not found in a reverberant field. Also, it is good to be aware that the DSP-1 produces a low-level "wind" that can be exaggerated by an otherwise good speaker which happens to have a treble peak in just the "wrong" frequency. (I had to return an otherwise excellent set of speakers for this reason.)

Another advantage of the DSP-1 is the effect it has on monaural sources, be they early Beatles or Furtwängler rereleases. The subjective distancing provided by many of the DSP-1's programs makes the monaural aspect of the original source less apparent, and a 3-D aspect is restored by the very realistic hall sound.

I hope these observations are helpful to fellow readers.

I thank you for the continuing excellence of *Audio* and congratulate you in your 40th year.

Don Sucher  
Brighton, Mass.

## DAT's Not All

Dear Editor:

I am continually amazed that, all through the DAT anti-copy debate, so little is mentioned about the fact that digital products already have anti-copy protection via their subcode data. It seems to me that CBS simply wants a system to protect all prerecorded material and that DAT is just used as an excuse to push the point. I'm sure that if it is incorporated, CBS will then want anti-copying chips in all analog recorders too!

Technically, there is another item which seems to get overlooked. Is this notch filter that the anti-copy chip incorporates going to be digital or analog? If it is analog, then a digital master tape would have to be converted to analog, passed through the filter, then converted back to digital to make either CDs or DATs. We would then not only have a notch taken out of the music, we would also have an additional D/A and A/D conversion. That would be the end of direct digital recordings (DDD).

I would like to compliment *Audio* on its coverage of this topic, editorially and technically, since you were, until recently, a division of CBS Inc. I have written CBS and my state representatives on this subject, and I have discontinued buying CBS products. It's not hard to see why U.S. companies can't compete with Japan and others when CBS spends so much time designing backward technology.

Brad Smith  
Seattle, Wash.

## Worth the Wait

Dear Editor:

Thanks for the excellent article, "Designing a Home Listening Room," by B. V. Pisha and Charles Bilello in the September issue. That article has real substance which is bound to have great effect in future listening rooms. Thanks also for Ken Pohlmann's review of my *Auditory Perception* training course. He has done a fine job—better than I could have done myself!

F. Alton Everest  
Whittier, Cal.

## A Cheer for AM Stereo

Dear Editor:

Thanks for taking an innovative step and including information on AM stereo in your Car Stereo Directory (May 1987). To some of us, it's very important, and your advanced attitudes make a great statement about your publication.

Paul Gundlach  
Fallsington, Pa.

## Doubly Lucky

Dear Editor:

It was kind of you to forward the "Coda" on Richard Heyser's life—and, so sadly, his death. Frankly, I cannot think of one whose brainchild assisted more—if indeed as much—to the advancement toward the goal of perfection in audio, whatever branch one considers. He was a lucky man to be born with such an intellectual gift, but perhaps even more lucky because of his ability to share it.

I am completely confident that the Wellington Audio Club will join with me in expressing sorrow at the loss of this fine engineer and most likable man.

Norman A. Williams  
Lower Hutt, New Zealand

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When you hear the fidelity and accuracy of the AKG K 240DF Studio Monitor Headphones, you'll know why it's become a standard for Digital Compact Disc recording engineers and professional musicians around the world. The K 240DF establishes a uniform sound quality, free from environmental variables. It has been created to meet a recently proposed international standard. It's so smooth and flat that AKG engineers in developing digital reference headphone studios.

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## Bigger Bass from Smaller Woofers

*Q. Is it true that some 8-inch woofers can produce more bass than 12-inch woofers can?—Wonseok Lee, Tarrytown, N.Y.*

A. Yes, some can. Bass output depends not only on the size of the woofers but upon their compliances, their free-air resonances, and the characteristics of the enclosures in which they are housed.

## More on Sibillance

*Q. My problem is as follows: High-frequency sounds—especially "s" sounds—are harsh, more so than when I began using my system, about 15 months ago. If I use the "high" filter or switch to mono, the problem is less noticeable. What can I do to cure it altogether?—Name withheld*

A. Sometimes, the sound quality of an audio system may appear to change over a period of time when, in fact, it is the listener's ears that are becoming more critical. Assuming this is not the case, there are several things you can do to determine the source of the problem.

If the sibillance is apparent only when playing phonograph records, it is possible that the stylus is worn and should be replaced. This is especially true if you have inadvertently dropped the cartridge onto a record or perhaps onto the turntable at some point.

Is the harshness you describe heard from both loudspeakers? If it is heard from only one, then there could be a defective tweeter in the "bad" channel. It is also possible that the amplifier/receiver has a problem in one channel. By interchanging loudspeakers, you can determine what is taking place. If, after switching speakers, the harshness is still found on the same channel, you will know that the problem is not in the loudspeakers. If, on the other hand, the harshness moves to the other channel when you switch speakers, you will know that the problem lies in the loudspeaker system.

If this kind of distortion is heard only when listening to FM broadcasts, I would suspect that the problem is multipath distortion. The distortion would be heard on both channels but could be eliminated by switching to "mono" as you have described. The problem might not have been present when you

purchased your equipment. If there has been building construction in your area, the new buildings might cause reflections of the desired signals, leading to multipath distortion. Along these same lines, perhaps you have moved your antenna to a less desirable location. This is especially likely if you use the folded dipole supplied with most equipment.

Problems of this latter kind are probably more likely than loudspeaker problems, considering your sound improves when you use a filter or switch to mono. Still, it's perhaps worth exploring the loudspeaker situation too.

## Balancing Channels

*Perhaps your readers would be interested in the simple way I obtain perfect channel balance:*

*If the preamp, amp, or receiver in question has a mono switch which controls all input sources (not just the tuner), switch it in. Then connect a loudspeaker between the two "+" terminals of your amplifier output (but don't do this if it has "floating grounds"). This speaker connection effectively cancels out all but the differences between the two channels' signals. Adjust the balance control for minimum sound, and channel balance should be perfect.*

*If there is no mono switch on your equipment, don't despair. You can use the same procedure with the help of two Y connectors, one to merge the left and right outputs of a program source into one output, another to feed this output into both the left and right inputs of the amplifier or receiver.—Mike Prachar, El Sobrante, Cal.*

## Amplifier Classes

*Q. Could you tell me what the difference is among Class-A, Class-AB, and Class-B amplifiers?—Kiumars Boubour, Carlsbad, Cal.*

A. The differences among these amplifier classes relate to the ways in which bias is applied to their output stages. The current flow through a tube or transistor depends on the voltage or current applied to it. This current or voltage can come from the input signal, a fixed bias from the amplifier's own power supply, or, more usually, a combination of the two.

It is possible to bias the circuit to a

point where, in the absence of input signal, little if any current flows in the output circuit; this is Class-B operation. It is also possible to set the bias voltage so that output current is always flowing, with or without signal being applied to the input; this is Class-A operation. In Class AB, bias voltage may be set so that output current always flows when a signal is applied and sometimes flows when there is no signal.

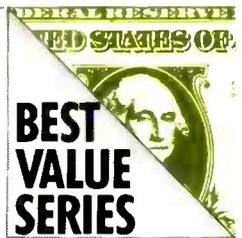
In a Class-A amplifier, the operation of the tube or transistor is always linear. In other words, a change in the input signal's amplitude will produce a corresponding proportional change in the amplitude of the output signal. Current flows in the output circuit of such an amplifier even when there is no signal present. When an a.c. signal is applied to the input, the output current rises and falls above and below this idling current.

The Class-B amplifier is biased just to the cutoff point, where current stops flowing in the output circuit. If an a.c. signal is applied to the input of a tube or transistor with Class-B bias, current will flow in the device for one half cycle but not during the opposite half cycle. In this latter half cycle, the signal being applied to the input adds to the bias already present, keeping the device's output current cut off. You can imagine that the loss of every second half cycle of an audio signal would result in very severe distortion. There is no way that a Class-B output stage consisting of a single device could be usable for any audio application. To overcome this, a second device is added, also biased to the point just sufficient to cut off output current. The polarity of the signal feeding the first device in the pair is opposite that of the signal feeding the second device in the pair. Therefore, when the first device is being driven beyond cutoff, the second device is drawing current, and vice versa. A circuit of this type is known as a "push-pull" circuit.

If a very small signal is applied to this configuration, current will flow as

**If you have a problem or question about audio, write to Mr. Joseph Giovanelli at AUDIO Magazine, 1515 Broadway, New York, N.Y. 10036. All letters are answered. Please enclose a stamped, self-addressed envelope.**

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A Class-A amp may have less distortion than a Class-B design, but the latter yields more power, other things being equal.

described, but it will not be linear. The output waveform will not be a faithful reproduction of the waveform of the original input signal. To overcome this, massive amounts of negative feedback are applied, reducing the nonlinearity of the Class-B output stage to such a degree that distortion becomes

very low; such a circuit can be used for high-fidelity applications.

The Class-A amplifier can also be (and usually is) made as a push-pull stage. This results in more power output than is available from a single device, as well as a decrease in the circuit's already very low distortion. The

addition of negative feedback lowers distortion still further.

The Class-A amplifier can be made to produce somewhat lower distortion than a Class-B stage. However, the Class-B amplifier can produce more power than a Class-A circuit when both circuits employ the same devices. Also, because the Class-B amplifier does not draw output current in the absence of input signal, it operates much more efficiently than a Class-A stage (which draws output current at all times).

The Class-AB amplifier stage is made by biasing the input of the device halfway between the linear portion of the input/output curve and current cutoff. It will, therefore, draw current at all times but will draw much less current than the Class-A circuit. This makes it more efficient than a Class-A stage but not quite as efficient as a Class-B circuit. As you might guess, distortion in the Class-AB stage is higher than for a Class-A circuit but less than for a Class-B circuit. In all these biasing arrangements, when the rest of the circuit is designed with high-fidelity applications in mind, distortion can be very low.

#### Multiplying Mixer Inputs

*Q. I do a lot of mixing and recording. My difficulty is that my mixer does not have enough inputs to handle all of my equipment. What I need is a mixer having perhaps a dozen inputs (rather than the six I now have). I'd like to keep the cost under \$1,000.—Al Brown, Melrose, Mass.*

*A. You did not say whether you need more microphone or more line inputs. Also, you did not mention whether you want to be able to mix a dozen inputs simultaneously or whether you mix only a few signals at a time but need to be able to choose from a large number of sources.*

*If you want to mix 12 simultaneous signals or require more than six microphone inputs at a time, I don't know of any mixers in your price range which have enough inputs to satisfy you. If your needs are not that demanding, you will find a number of nice mixers for less than \$1,000. My suggestion is that you stay with your present mixer but add to it.*

*You might consider adding a sec-*

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**Money**  
MAY 1987

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*Rolling Stone Magazine*

Polk's critically acclaimed, 5 time AudioVideo Grand Prix Award winning SDA technology is the most important fundamental advance in loudspeaker technology since stereo itself. Listeners are amazed when they hear the huge, lifelike, three-dimensional sonic image produced by Polk's SDA speakers. The nation's top audio experts agree that Polk SDA loudspeakers always sound better than conventional loudspeakers. Stereo Review said, “Spectacular... the result is always better than would be achieved by conventional speakers.” High Fidelity said, “Astounding... We have yet to hear any stereo program that doesn't benefit.” The new SDA 1C and SDA 2B utilize new circuitry which allows the drivers to more effectively utilize amplifier power at very low frequencies. This results in deeper, more powerful bass response, greater dynamic range and higher efficiency. In addition, the new circuitry makes these new speakers an extremely easy load for amplifiers and receivers to drive. Lastly, the imaging, soundstage and depth are more precise and dramatically realistic than ever.

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Stereo Review confirmed the unqualified sonic superiority of Matthew Polk's revolutionary SDA Technology when they wrote, “These speakers *always* sounded different from conventional speakers — and in our view better — as a result of their SDA design.

Without exaggeration, the design principals embodied in the SDAs make them the world's first true stereo speakers. The basic concept of speaker design was never modified to take into account the fundamental difference between a mono and stereo signal. The fundamental and

basic concept of mono is that you have one signal (and speaker) meant to be heard by both ears at once. However, the fundamental and basic concept of stereo is that a much more lifelike three-dimensional sound is achieved by having 2 different signals, each played back through a separate speaker and each meant to be heard by only one ear apiece (L or R). So quite simply, a mono loudspeaker is designed to be heard by two ears at once while true stereo loudspeakers should each be heard by only one ear apiece (like headphones). The revolutionary Polk SDAs are the first TRUE STEREO speakers engineered to accomplish this and fully realize the astonishingly lifelike three-dimensional imaging capabilities of the stereophonic sound medium.

**“A stunning achievement”**

*Australian HiFi*

Polk SDA Technology solves one of the greatest problems in stereo reproduction. When each ear hears both speakers and signals, as occurs when you use conventional (Mono) speakers to listen in stereo, full stereo separation is lost. The undesirable signal reaching each ear from the “wrong” speaker is a form of acoustic distortion called interaural crosstalk, which confuses your hearing.

**“Literally a New Dimension in the Sound**

*Stereo Review Magazine*

The Polk SDA systems eliminate interaural crosstalk distortion and maintain full, True Stereo separation, by incorporating two completely separate sets of drivers (stereo and dimensional) into each speaker cabinet. The stereo drivers radiate the normal stereo signal, while the dimensional drivers radiate a difference signal that acoustically and effectively cancels the interaural crosstalk distortion and thereby restores the stereo separation, imaging and detail lost when you listen to normal “mono” speakers. The dramatic sonic benefits are immediately audible and remarkable.

**“Mindboggling, astounding, flabbergasting”**

*High Fidelity Magazine*

Words alone cannot fully describe how much more lifelike SDA TRUE STEREO reproduction is. Reviewers, critical listeners and novices alike are overwhelmed by the magnitude of the sonic improvement achieved by Polk's TRUE STEREO technology. You will hear a huge sound stage which extends not only beyond the speakers, but beyond the walls of your listening room itself. The lifelike ambience revealed by the SDAs makes it sound as though you have been transported to the acoustic environment of the original sonic event. Every instrument, vocalist and sound becomes tangible, distinct, alive and firmly placed in its own natural spatial position. You will hear instruments, ambience and subtle musical nuances (normally masked by conventional speakers), revealed for your enjoyment by the SDAs. This benefit is accurately described by Julian Hirsch in Stereo Review, “...the sense of discovery experienced when playing an old favorite stereo record and hearing, quite literally, a new dimension in the sound is a most attractive bonus...” Records, CDs, tapes, video and FM all benefit equally as dramatically.

**“You owe it to yourself to audition them.”**

*High Fidelity Magazine*

SDAs allow you to experience the spine tingling excitement, majesty and pleasure of live music in your home. You must hear the remarkable sonic benefits of SDA technology for yourself. You too will agree with Stereo Review's dramatic conclusion: “the result is **always better than would be achieved by conventional speakers...it does indeed add a new dimension to reproduced sound.**”

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If your volume control action seems odd, check with a dealer. It may be working just the way the manufacturer intended.

ond six-input mixer to your present unit. If both your old and new mixers have bus extension jacks, you'll be able to link them so that one mixer's master controls will affect all signals coming through the mixing system. Even without such bus connections, you can gang both mixers' controls by routing one mixer's output through a line input on the other mixer. If you can't spare that input, you can still use the two mixers simultaneously, but without having the convenience of ganged master controls.

If you primarily use line-level sources and don't need to mix more than six at a time, then you only need to add some sort of switching system so you can conveniently select the sources you want to mix. You might try using some of the sound-routing boxes that are made to permit a single set of inputs/outputs to serve many components. Two or three of these boxes, each designed to work with a particular pair of mixer inputs, could solve your problem. To make the best use of all this equipment, make a list of all of your gear and the various mixing arrangements you use. You will likely discover that some jobs require a particular arrangement of components and that other projects require different arrangements. Assign the components to inputs on the routing boxes which can permit the mixing you need. Merely by pressing a few switches, you will be set up for the next project.

#### Turntable Intermittents

*Q. I have an automatic, direct-drive, quartz speed-controlled turntable which will stop playing in the middle of a record for no apparent reason. If I hit the start button, it will go to the beginning and play just fine. This failure occurs about once a month. What can I do about it?—Robert Mayberger, Rosedale, N.Y.*

A. I do not think the problem is serious. In all likelihood, it is only a matter of dirty contacts on either the stop or the start switch. Other contacts which can cause problems are those between the sliders and elements of the speed-setting potentiometers. My turntable has speed adjustment controls on its operating panel; your turntable might also have these, as well as internal speed-adjust trimpots. Go over all

of these contacts with suitable contact cleaner.

If cleaning the contacts does not solve the problem, perhaps you should change the transistor or IC which controls the clock frequency; low feedback may be causing oscillator drop-out. There is also the possibility of a hairline crack in a circuit foil. Examine all circuit boards with a strong light and solder any suspicious-looking foils. Don't overlook poorly soldered connections between the foil and the components.

#### Odd Volume Control Action

*Q. When turning the volume/gain control on my receiver from "0" to "6," there is a gradual and minimal change in volume level. From "6" up to "9," however, there is a great change. Please explain why this occurs.—June E. Thomas, Wantagh, N.Y.*

A. This behavior is probably a function of your volume control's "taper," the rate at which its resistance changes as it's turned, and the way this control interacts with your amplifier's other circuitry.

Volume control action is dependent on the particular potentiometer used by the manufacturer. Perhaps this odd action is an intended characteristic of the make and model of equipment you are using. Check a dealer's "demo" unit to see if its volume control acts the same way yours does. If it does not, try cleaning the control on your unit with a suitable contact cleaner. It is possible that the action of the control is being influenced by dirty contacts. If cleaning doesn't help and you find the condition hard to live with, replace the volume control on your unit with the correct factory replacement.

I have seen instances in which the action of a volume control changed when loudness compensation was switched on. Does the volume control's action you describe take place only when this circuit is being used? If so, there's not much you can do about it.

#### High- and Low-Level Phono Cartridges

*Q. What is the difference between a high-level phono cartridge and a low-level one?—Name withheld*

A. The difference between high- and low-level cartridges is in the output

voltage they produce. I am not at all sure that there is a definite line drawn between the two types, though these days I tend to think of it as being around 2 or 3 mV. Incidentally, most of today's moving-coil cartridges fall into the low-level classification.

#### Remote Speakers For a Biamped System

*Q. My audio system is biamped, using the following amplifier configuration: The left and right bass drivers are powered by separate stereo amplifiers, each in its bridged mono mode. The mid/high drivers are powered by a single stereo amplifier in its two-channel mode.*

*I would like to use extension speakers at a different location and to power these extension speakers by my existing amplifiers. I need the ability to select either the main or remote speakers and would also like the remote speakers to have separate level controls. Is this setup possible?—R. Johnson, Kendall Park, N.J.*

A. If the remote speakers are biamped, your system can work fine. The only problem will be that of independent level control for those speakers. Switching between main and remote will involve switching two sets of speakers rather than one, so a four-gang switch will be needed.

If the remote speakers are not biamped, you will need a third power amplifier to feed them. You'll also need a second preamp output or Y connectors in each output channel of your preamp to feed signals both to the remote amplifiers and to the electronic crossover in your main system. The third amplifier must be a power amp with input level controls or an integrated amp; the latter would also give you control over tonal and left-right balance. This amplifier should be located in the same room as the remote loudspeakers. It is unlikely that the extra cable run would adversely affect the system's sound quality.

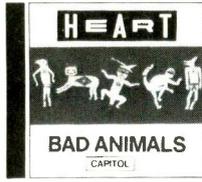
If the remote-speaker amplifier has no level controls, passive controls can be connected between its output and the speakers. However, these waste a lot of amplifier power. Additionally, they can change the remote system's sound by reducing the amplifier's damping effect. 

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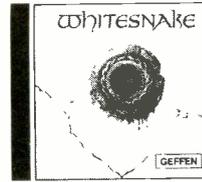
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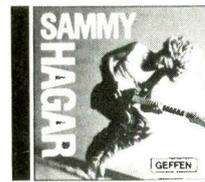


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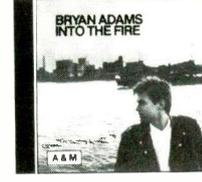
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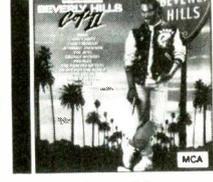
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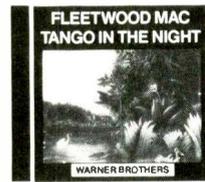
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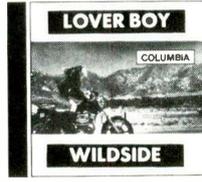
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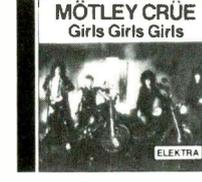
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359901. Mick Jagger—Primitive Cool. (Columbia)  
352534. Holst: The Planets—A. Davis, Toronto Symp. (Digital—Angel)  
347955. Huey Lewis & The News—Fare! (Chrysalis)  
348979. Tina Turner—Break Every Rule. (Capitol)  
346478. Madonna—True Blue. (Sire)

356287 Suzanne Vega—Solitude Standing. (A&M)  
355958-395954. Beethoven: Symphonies Nos. 8 & 9 (Choral)—Michael Tilson Thomas, English Chamber Orch. (Digital—CBS Masterworks)  
357871. Tchaikovsky: Waltzes—S. Comissiona and Houston Symphony (Digital—Pro Arte)

357889. Copland: Billy The Kid; Appalachian Spring; etc.—Bernstein, NY Phil. (Digitally Remastered—CBS Masterworks)  
287003. Eagles' Greatest Hits 1971-1975. (Asylum)  
346957. Steve Winwood—Back In The High Life. (Island)  
345777. Peter Gabriel—So. (Geffen)

308049. Creedence Clearwater Revival Featuring John Fogerty/Chronicle. 20 greatest hits (Fantasy)  
326629. Bruce Springsteen—Born In The U.S.A. (Columbia)  
348649. Pachelbel Canon & Other Digital Delights.—Toronto Chamber Orch. (Digital—Fantasy)

219477. Simon & Garfunkel's Greatest Hits. (Columbia)  
348318. The Police—Every Breath You Take—The Singles. (A&M)  
336222. Dire Straits—Brothers In Arms. (Warner Bros.)  
355156. Vladimir Horowitz Plays Favorite Chapin. (Digitally Remastered—CBS Masterworks)

341073. Steely Dan—A Decade of Steely Dan. (MCA)  
346544. Kenny G—Duotones. (Arista)  
345751. Paul Simon—Graceland. (Warner Bros.)  
356279. Gloria Estefan And Miami Sound Machine—Let It Loose. (Epic)  
336396-396390. Billy Joel's Greatest Hits, Vol. 1 & 2. (Columbia)

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## More on Tape Counters

In the May 1987 issue, I mentioned some formulas from reader Jeff Bonwick, a math major at the University of Delaware, which could be used to determine elapsed time on a tape from the numbers on the tape deck's counter. Now, reader Michael P. Lucido of San Jose, Cal. has incorporated this information into a computer program written in BASIC for PC compatibles (and for some other computers that speak the same language). Copies of the program are available by mail to anyone who sends a stamped, self-addressed envelope (#10 or larger, please!) to: BASIC Tape Program, c/o Karen Clark, Audio Magazine, 1515 Broadway, New York, N.Y. 10036. (Copies of the original formula and procedure are also available; request "Tape Formula" instead. If you want both, send only one envelope with a request for both.)

For those who lack access to a computer, or whose computers use a different dialect of BASIC than PC compatibles, Mr. Lucido is willing to prepare charts for any tape and recorder combination, for \$2 each. Interested readers should send him the following information: The tape brand, variety, and length (e.g., Maxell XLII-S, C-90); the tape-counter reading after 10 minutes of play, and the counter reading after 20 minutes of play. Payment and a self-addressed, stamped envelope should accompany the information. Mr. Lucido may be reached at Lucid Enterprises, P.O. Box 32436, San Jose, Cal. 95152.

Please do *not* address requests for any of this material to me, since only *Audio* has copies of the program and formula available for mailing, and only Mr. Lucido is equipped to prepare the custom charts.

## Feeding Multiple Decks

*Q. Through separate outputs, I have connected an open-reel deck and a cassette deck to my control amplifier. However, this leaves me without an output to feed my VCR. Would it cause distortion if I were to connect the cassette deck and the VCR through a Y-connector to one of the outputs of my control unit? Assuming that I would operate only one deck at a time, would I degrade the quality of the signal being*

*recorded?—Ernst K. Renner, Mount Vernon, Ohio*

A. Your proposed connection has a good chance of working without significant audible effects, but I cannot promise this. Sometimes two pieces of audio equipment connected to the same jack of another unit will load each other significantly, but often they will not. Effects of loading may include loss of treble response as well as distortion. I suggest that you experiment, for no harm will come to your audio components.

A better solution is to purchase a tape-deck switchbox (available from several companies, including dbx, Russound, and Radio Shack). These permit three or more decks to be connected to one set of tape inputs and outputs. One of these switchboxes would permit you to connect one deck at a time or all decks at the same time. Thus, to satisfy your curiosity, you could play around to learn the effects of loading, as far as your equipment is concerned.

## Taping Via VCR

*Q. What do you think about using a VCR for recording sound only? I have many old records which I would very much like to put on some form of tape. Because audio tapes have limited capacity, it is impossible to get more than a very few records on them. I have read that a VCR's frequency response, even a state-of-the-art machine's, is very poor. I need your advice.—Clifton T. Chadwick, Wheat Ridge, Colo.*

A. If you use a *Hi-Fi* VCR, whether VHS or Beta, you can get excellent performance in every respect, even at the slowest videotape speed. Frequency response will be wide and flat, signal-to-noise ratio will be very high (in the vicinity of 80 dB), distortion will be very low, and motion (speed accuracy, wow and flutter, etc.) will be excellent. Just be sure to use good tape, for minimal dropouts.

The *Hi-Fi* VCR is a relatively new breed and is substantially more expensive than the ordinary VCR. In *Hi-Fi* mode, it records the sound on the same diagonal tracks as the picture, as a frequency-modulated r.f. carrier. (This is the same technology that is used in FM radio but with different carrier frequencies.)

*Hi-Fi* VCRs also record audio directly, like ordinary audio tape decks, along one edge of the tape. This is done to maintain compatibility with conventional VCRs, which have only these longitudinal soundtracks. If you record audio on the longitudinal tracks of either type of VCR, performance will be substantially below that of a *Hi-Fi* recording. For example, signal-to-noise ratio will be on the order of only 45 dB, and frequency response will be appreciably degraded from about 10 kHz up.

Do not confuse *Hi-Fi* VCRs with *HQ* VCRs. The *HQ* label refers to four circuits which improve picture quality. If a VCR has at least two of these circuits, it can boast the *HQ* emblem.

You might also be interested in what another reader has to say about the pros and cons of taping audio on videocassettes:

*Having transferred my open-reel tape library of over 200 hours to videocassette, I have had appreciable experience with the process. My reason for transferring from open-reel to videocassette is that, by the time the heads wear out in my open-reel deck, it is likely that replacement heads or a replacement recorder will be unavailable. The convenience of a videocassette, its longer playing time, and the absence of tape squeal or tape rubbing against the reel are all bonuses. Also, I have never seen a recorder with a flatter frequency response from 20 Hz to 20 kHz. For this, I guess I can live with a dropout about every 25 hours.*

*Dropouts (and impulse noise) are most likely to occur on the initial portion of the tape. Prerecorded videocassettes leave the first 45 S blank, and this is also good policy for audio recording. Some dropouts will disappear with rerecording, but occasionally one will persist at a given place on the tape despite all precautions. Also, some dropouts will appear on the second playing of a tape that did not appear on the first playing.*

*The dropout problem seems to vary with the videocassette and the VCR.*

**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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Wow and flutter's audibility depends on an individual's sharpness of hearing as well as on the program material.

*As far as the tape is concerned, it seems to depend more on the individual cassette than on the brand. I have used tapes from a number of manufacturers and have encountered dropouts with all of them. After rewinding a videocassette, it helps to blow out the loose oxide that accumulates on the plastic guide at the cassette's head side. Cleaning the heads of the VCR with a head-cleaning cassette does not seem to have an effect on dropouts. However, the brand of VCR does; I have two, and one is better than the other with respect to dropouts.*

*Another disadvantage of VCRs is that unless the machine has flying (moving) erase heads, editing is not practical. There is too much space between the erase and play/record heads to delete an unwanted portion without erasing some later material that might be wanted.*

*There is another reason why editing does not work well with a VCR. In most VCRs, the erase head operates in a line perpendicular to the tape motion, as in open-reel or audio cassette recording. However, recording with a VCR is done on tracks which cross the tape diagonally. Therefore, in deleting a portion of a recording, part of some recording lines are left on the tape at the start of deletion, and there are some partially recorded lines at the end of the deletion. The result is a noisy cut. Recorders with flying erase heads are expensive, but they erase diagonally, track by track, so that clean cuts are possible.—John H. Markell, Sun City, Cal.*

#### **Rating Wow and Flutter**

*Q. I'm confused about what wow and flutter really are, and about their audible effects on music. One manufacturer claims that its cassette deck, with a wow and flutter spec of 0.025% wtd. rms, doesn't exhibit the audible effects of a deck with a wow and flutter spec of 0.05%, especially on piano music. There is a deck I would like to purchase, but it has a wow and flutter spec of 0.05%. How would you rate a value of 0.05%?—Gabriel Vazquez Padua, Bayamon, P.R.*

*A. Wow and flutter refer to cyclic changes in tape speed. Wow refers to changes that occur at a slow rate, say less than 10 times per second. The*

*audible result is a wavering pitch. Flutter refers to more rapid changes in tape speed, say above 100 times per second. The result is a grainy or gargly quality to the sound.*

*My guess is that most people are not sensitive to wow and flutter until they exceed 0.05% wtd. rms, perhaps not until they exceed 0.1% or even 0.2%. It should be noted that the NAB (National Association of Broadcasters) Standard for cassette decks provides that wow and flutter shall not exceed 0.2% wtd. rms. On the other hand, the NAB Standard for open-reel recorders provides that weighted flutter shall not be allowed to exceed 0.05% at the 15-ips speed, 0.07% at 7½ ips, and 0.10% at 3¾ ips.*

*The audibility of wow and flutter depends not only on the individual's sharpness of hearing but also on the nature of the program material. Wow and flutter are more apt to be evident on a single sustained note than on complex tones such as a symphony orchestra going full blast. All in all, I doubt that you will have a problem with a deck that keeps wow and flutter to a maximum of 0.05%, but I can't promise. You should listen to your prospective deck before you buy it.*

#### **Speed and Width Options**

*Q. In open-reel decks, which format provides better fidelity: 7½-ips speed coupled with quarter-track heads or 3¾-ips speed coupled with half-track heads?—P. D. Sharma, Lakeview Terrace, Cal.*

*A. Let's refer to 7½ ips with quarter-track heads as format A and 3¾ ips with half-track heads as format B. Overall it seems that you are better off with format A.*

*At 7½ ips, you have better high-frequency response and better tape motion (less wow and flutter). The wider track of format B gives you a signal-to-noise ratio about 3 dB greater, but this fairly modest advantage tends to be cancelled by the greater tape-head output at 7½ ips. In the matter of high-frequency loss due to azimuth misalignment, format B is at a disadvantage because the effect of a given degree of misalignment becomes more severe as track width is increased and as tape speed is reduced. The effect of tape dropouts is reduced as track*

*width is widened, giving format B an advantage in that respect—but the advantage is slight, because dropouts tend to be minimal when high-quality tape is employed. With respect to headroom, format A has the advantage. At the higher tape speed, less treble boost is needed in recording to preserve treble response. Thus, there is less risk of tape saturation (which results in distortion and treble loss) when recording strong treble frequencies at a high level.*

*Still, very good results can be had at 3¾ ips. Using a high-quality deck, it is quite possible that you would hear little difference, if any, between the two formats. Moreover, format B provides the same recording time per reel as format A but without the need to reverse the reels.*

#### **Effect of Dirty Heads**

*Q. I have read that there is a loss of treble if tapes are played back on decks with dirty heads. Will this happen even if I use a top-quality tape? Will the tape suffer a permanent loss of high-frequency response?—J. Bill Such, Natrona Heights, Pa.*

*A. Dirty heads cause the tape to be slightly separated from the heads, causing treble loss in playback even if the tape is of high quality. However, the loss does not occur on the tape itself; it occurs only in the playback process. Treble response should be restored once the heads are cleaned. However, if the heads are magnetized, this can cause permanent treble loss on the tape itself.*

#### **An Accumulating Problem**

*Q. How long after a tape is wound and stored does the process of print-through begin and become noticeable? Is the process cumulative?—Edward Bauman, San Diego, Cal.*

*A. Print-through tends to occur mostly in the first few hours of tape storage, and cumulatively increases at a slower and slower rate with the passage of time. To illustrate, for a particular tape, print-through might be 54 dB below the desired audio signal's peaks 8 hours after storage; it might rise about 1 dB in the next 16 hours, another 1 dB in the next week, another 1 dB in the next three weeks, 2 dB in the*

*Continued on page 23*

# Magnificent Reception.

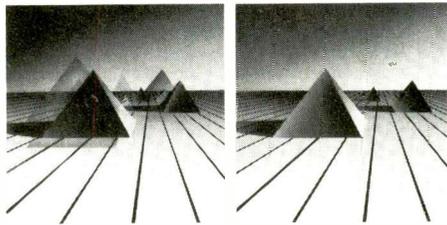
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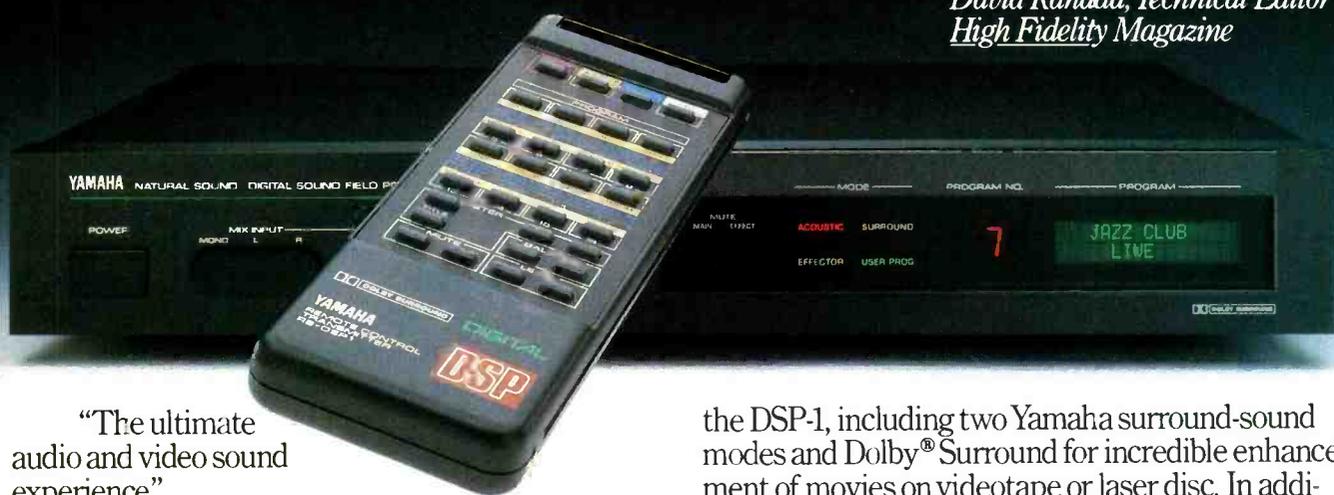
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Smith • Leisure Electronics—Little Rock **CALIFORNIA** Honkers Sound Company—Berkeley • Kustom Hi Fi Music House—Burlingame • Sound Goods—Campbell • The Federated Group—Canoga Park • Rogersound Lab—Canoga Park • Shelley's Stereo Video CT—Canoga Park • Dow Stereo/Video—Carlsbad • Sounds by Dave—Chico • Dow Stereo/Video—Chula Vista • Sound Distinction—Concord • Pacific Coast Audio—Corona del Mar • Audio Video Specialists—Downey • Dow Stereo/Video—El Cajon • The Federated Group—El Cajon • Genesis Audio—El Toro • Rogersound Lab—El Toro • The Federated Group—Hollywood • Tubes N Tunes—Livermore • Act Electronics TV & HiFi—Long Beach • Sound Goods—Mountain View • Pro Audio Electronics—Oakland • Western Audio—Palo Alto • Rogersound Lab—Pasadena • The Federated Group—Riverside • Stereo Showcase, Inc.—Sacramento • Dow Stereo/Video—San Diego (two locations) • Harmony Audio Video—San Francisco • Maybrun's Hi-Fi Video Ctr—San Francisco • The Stereo Store—San Francisco • Tubes N Tunes—San Ramon • The Federated Group—Santa Ana • Burdick's—Santa Cruz • Rogersound Lab—Santa Monica • Shelley's Stereo Video CT—Santa Monica • Golden Ear Hi-Fi Video Ct—Santa Rosa • The Federated Group—Torrance • Rogersound Lab—Torrance • Stereo Showcase, Inc.—Vallejo • Rogersound Lab—Van Nuys • Thrifty Electronics—Van Nuys • Visalia Sight & Sound, Inc.—Visalia • Rogersound Lab—Westminster **COLORADO** SoundTrack—Arvada • SoundTrack—Aurora • Listen Up—Boulder • SoundTrack—Boulder • Sunshine Audio—Colorado Springs • Listen Up—Denver • SoundTrack—Denver • SoundTrack—Highlands Ranch • SoundTrack—Littleton • Sunshine Audio—Pueblo • SoundTrack—Thornton **CONNECTICUT** Tweeter, Etc.—All Locations **DISTRICT OF COLUMBIA** AudioKrafters—Washington **DELAWARE** Sound Studio Inc.—Dover • Sound Studio Inc.—Newark • Bryn Mawr Stereo—Wilmington • Sound Studio Inc.—Wilmington **FLORIDA** Audio Spectrum, Inc.—Altamonte Springs • Sound Advice—Boca Raton • Sound Advice—Clearwater • Sound Advice—Coral Gables • Stereotypes—Daytona Beach • Sound Advice—Ft. 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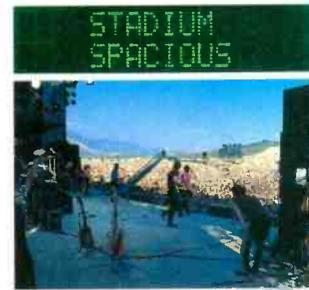
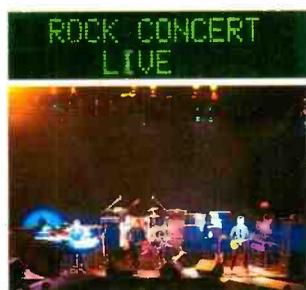
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Playback heads should have narrow gaps and record heads require gaps five times as wide, so combination heads are obviously compromises.

Continued from page 18

following 11 months; and 1 dB in the next 10 years. Thus, print-through might eventually be about 48 dB below the audio level.

### Two Heads Better Than Three?

*Q. I am considering the purchase of a cassette deck which, according to my dealer, is the best in its price range. However, it is a two-head deck and only has Dolby B noise reduction. Is it possible for this deck to perform better than others in the same price range which have three heads and which offer Dolby C and dbx NR as well as Dolby B? What is the function of a third head?—Glenn Sefton, Carmel, N.Y.*

*A.* In a two-head deck, one head serves for both recording and playback; the second head erases the tape prior to recording. In a three-head deck, separate heads are used for recording and playback. This permits each head to be designed for optimum performance of its single function. A playback head requires a very narrow gap in order to maintain response throughout the upper treble range, whereas a record head requires a gap about five times as wide to achieve best results by fully penetrating the tape's magnetic coating. Where one head serves for both recording and playback, a design compromise must be made. Still, a carefully engineered and well-built record/playback head can achieve very good performance.

A three-head deck has an added function that is often useful: It permits simultaneous monitoring (playback) and recording so that a recording can be continuously compared to the source. This helps guard against poor results due to human error (such as setting bias and equalization for the wrong tape type). And it can be useful in adjusting bias, when the deck provides a variable bias control.

Overall, a well-designed and well-made two-head deck using Dolby B NR can outperform an indifferently designed and indifferently made three-head deck boasting Dolby C and/or dbx NR. It stands to reason that no moderately priced deck will be state of the art even if it does boast three heads and three NR options.

Extended frequency response (made possible by a separate play-

back head) and very low noise (made possible by Dolby C or dbx NR) are not the sole attributes of good performance. Other important attributes include flat frequency response over most of the audio range, low distortion, low scrape flutter, and steady and accurate tape motion. Perhaps it is in

these respects that the recommended two-head deck outperforms the three-head decks in the same price range. There is also the question of reliability: How long will the deck continue to give good service before requiring head replacement, repair, etc.? Again, the recommended deck may excel here. **A**

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*//*Compared with many other speakers, on first hearing the Signet SL-100 had a warm character, with an impressively deep bass output. At higher frequencies the sound was seamlessly blended and well dispersed.

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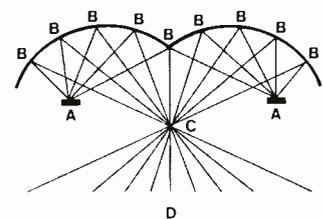
• Julian Hirsch, Hirsch-Houck Laboratories, *Stereo Review*, July 1987

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Sound from two matched 1" tweeters (A) is directed at the Ferralipse Acoustic Lens. Highs are then reflected (B) to a central focal point (C), which radiates through a 120° horizontal angle (D) with far greater uniformity and efficiency than traditional designs.

*//*We listened for any signs of beaming or comb-filtering effects as we walked past the front of the speakers, using both music and pink-noise signals, but we could find none.*//*

• *Stereo Review*, July, 1987

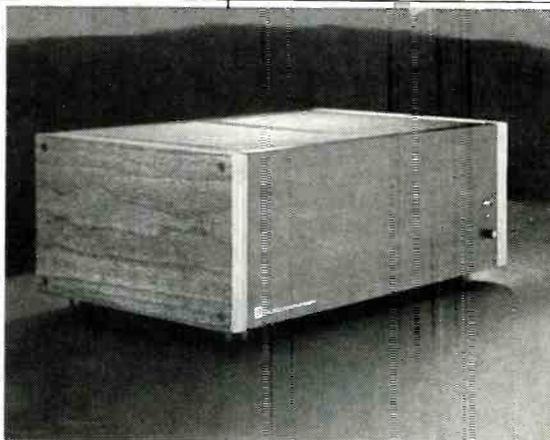
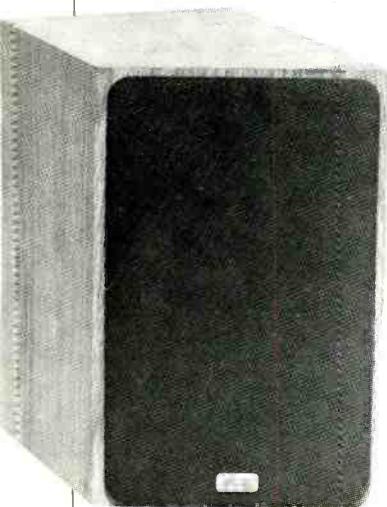
†U.S. Patent No. 4,421,200.

Ferralipse is a registered trademark of Phase Coherent Audio, Inc.

## Now Hear This Speaker

That's not a command, but a brand name. The NHT Model I, from Now Hear This, is a compact, two-way bookshelf system designed by Ken Kantor. The speaker has an inward-angled front baffle designed to reduce wall reflections, maintain the stereo sound stage across the room (via time-intensity trading), and minimize interaural cross-correlation for centrally placed listeners. The company calls this design technique Focused Image Geometry. Rated frequency response is 65 Hz to 23 kHz,  $\pm 3$  dB, and maximum power handling is 150 watts. The 6-inch woofer and  $\frac{3}{4}$ -inch dome tweeter are shielded to prevent interference with video screens. The cabinet measures 12 x 7 x 10 $\frac{3}{8}$  inches and is available in white oak, maple, or walnut veneer. Price: \$349 per pair.

For literature, circle No. 100



## Belles Power Amplifier

The polished wood sides of the Belles 250 frame a power amplifier delivering 125 watts per channel into 8 ohms (250 per channel into 4 ohms) at less than 0.05% THD and IM. The dual complementary circuitry includes Class-A driver stages and features van den Hul mono-crystal silver wiring, Wonder Caps, Tiffany connectors, and other high-quality components. Price: \$995. For literature, circle No. 102

## Tree Dimensions Media Rack

The CD250 rack can hold 260 CDs or 160 cassettes; its top tier can hold up to 19 videocassettes. Two removable sliding dividers are supplied to organize sections or hold unfilled rows of discs upright. The solid-oak unit comes fully assembled. Price: \$89.95. For literature, circle No. 101



## Linear Power Car Amp

Not all car stereo applications require high power, nor do all installations have room for big amplifiers. This is the rationale behind the Runt, a small amplifier (1.3 inches by 4 inches by 4.5 inches) that delivers 16 watts per channel into 4 ohms at less than 0.75% THD from

40 Hz to 30 kHz. Input sensitivity is adjustable from 80 mV to 6.6 V rms; this allows compatibility

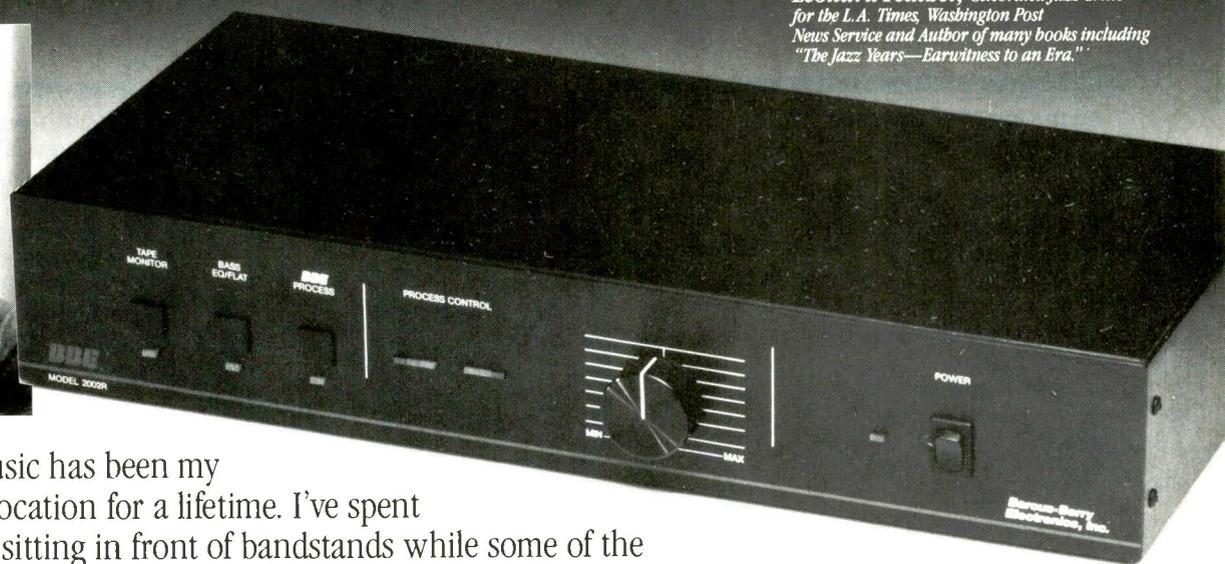


with systems using amplified or preamp-level head units and facilitates level matching when driving a tweeter in multi-amped systems. Output is protected against thermal overload and short circuits, and damping factor is rated as 100 at 4 ohms. Price: \$130.

For literature, circle No. 103

# “BBE made my audio system sound better than I ever dreamed possible!”

—**Leonard Feather**, Celebrated Jazz Critic for the L.A. Times, Washington Post News Service and Author of many books including “The Jazz Years—Earwitness to an Era.”



“Listening to music has been my vocation and avocation for a lifetime. I’ve spent countless hours sitting in front of bandstands while some of the world’s greatest musicians mesmerized me with their artistry.

At home, I listen to and review new recordings, searching for tomorrow’s major talent or simply enjoying the magic of great music.

Listening to recorded music, of course, falls short of the delights of listening to a live performance. I was therefore skeptical when told that BBE could make a dramatic improvement to virtually all audio systems and I had to hear for myself.

I was amazed at how much better the BBE 2002 made my music system sound! There was a presence, a *being there* sense of excitement. The rich textures of instrumental sounds, the subtle nuances and details in the music come through with clarity and authenticity.

BBE is clearly one of the most important advances in the electronic reproduction of music to come along in my lifetime. **Bravo, BBE! Encore!”**

## The Great Professional Music Magazines Love BBE:

“The difference in processed audio and non-processed audio is like the difference between high-fidelity speakers with and without pillows placed in front of them.”

—Radio World

“There was no doubt the BBE processor added more spatial quality, more transients and more clean highs. This is the first black box that actually helped make my music sound the way that I *knew* it should. The effect is shattering!”

—Music Technology

“Whether you are playing LPs, CDs or tapes, the system comes alive. Stereo imaging seems improved and overall clarity is enhanced. Put it between your source and your amplifier, and you’re in aural heaven.”

—Music & Sound Output

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- La Salle Electronics, Chicago, IL
- Stereo Center—Flint, MI
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- Audio Junction, Pittsburgh, PA
- Hillcrest High Fidelity, Dallas, TX
- Audio Craft, Cleveland, OH
- Import Audio—Las Vegas, NV
- Federated, Los Angeles, CA
- Audio Exchange, New York, NY

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(In Canada Contact Daymen Audio, 3241 Kennedy Road, #22, Scarborough, Ontario M1V2J9 or call **416-298-9644**.)  
or write us at:

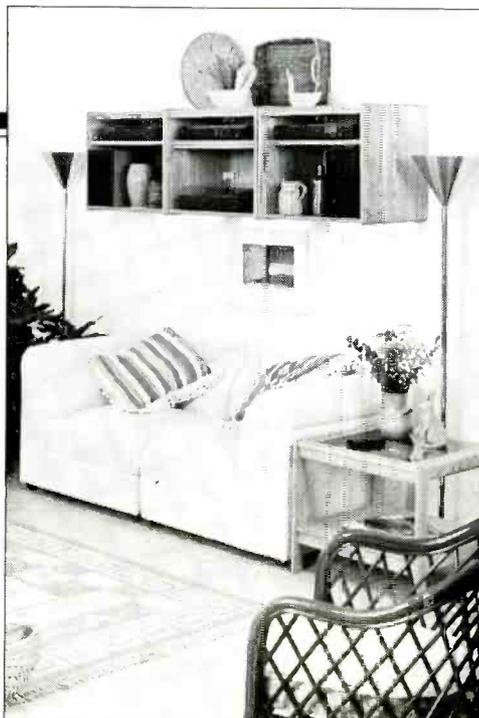
# BBE™

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## Koss Cordless Speaker

Using the same infrared technology as in Koss' cordless headphones, the JCK/5000 speaker system can operate with no physical connection to the signal source and only temporary connection to a power source. The amplifiers built into the speaker cabinets can be powered from a.c. lines or by eight D-cell batteries, either regular or rechargeable (chargers are built into each speaker). The speakers, which have 6½-inch woofers and 2-inch tweeters, feature front-panel tone and volume controls and power switches. Rated frequency range is 40 Hz to 20 kHz, with less than 1.5% distortion. The transmitter (which is a.c. powered) is designed to cover rooms of up to 250 square feet. Price: \$349.95, including two speakers, the transmitter, and three a.c. adaptors.

For literature, circle No. 104



## CWD Wall Mount

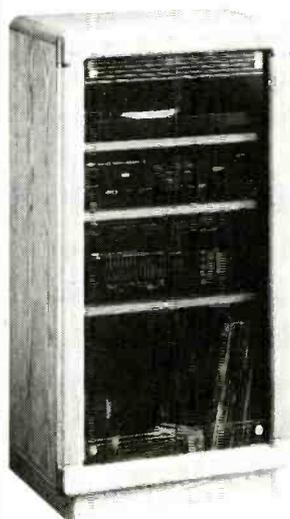
You can't see the Wall Mount System holding up the cabinets in this photo and that's the point. The system, consisting of metal strips that fasten to any secure wall, plus four or more brackets per cabinet, is designed for use with this and other cabinets from Custom Woodwork & Design. Cabinets in a multi-unit arrangement can be removed individually. Price: Approximately \$35, depending on specific configuration.

For literature, circle No. 106

## Bush Audio Cabinet

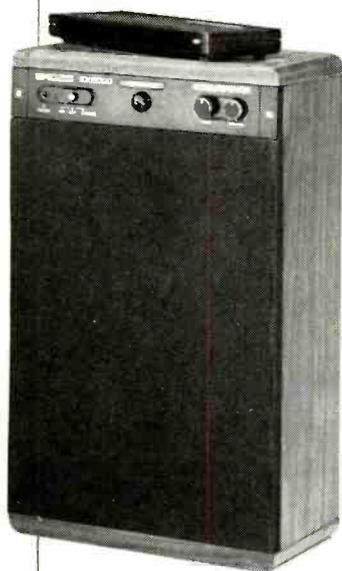
Part of Bush's "Oak Elegants" series, the Model A1665 is finished in natural wood and oak veneers with a multi-lacquer topcoat. The interior holds three shelves, two of which are adjustable. Casters are hidden beneath the plinth base. Dimensions are 45 inches high, 23 inches wide, and 16 inches deep. Price: \$269.95.

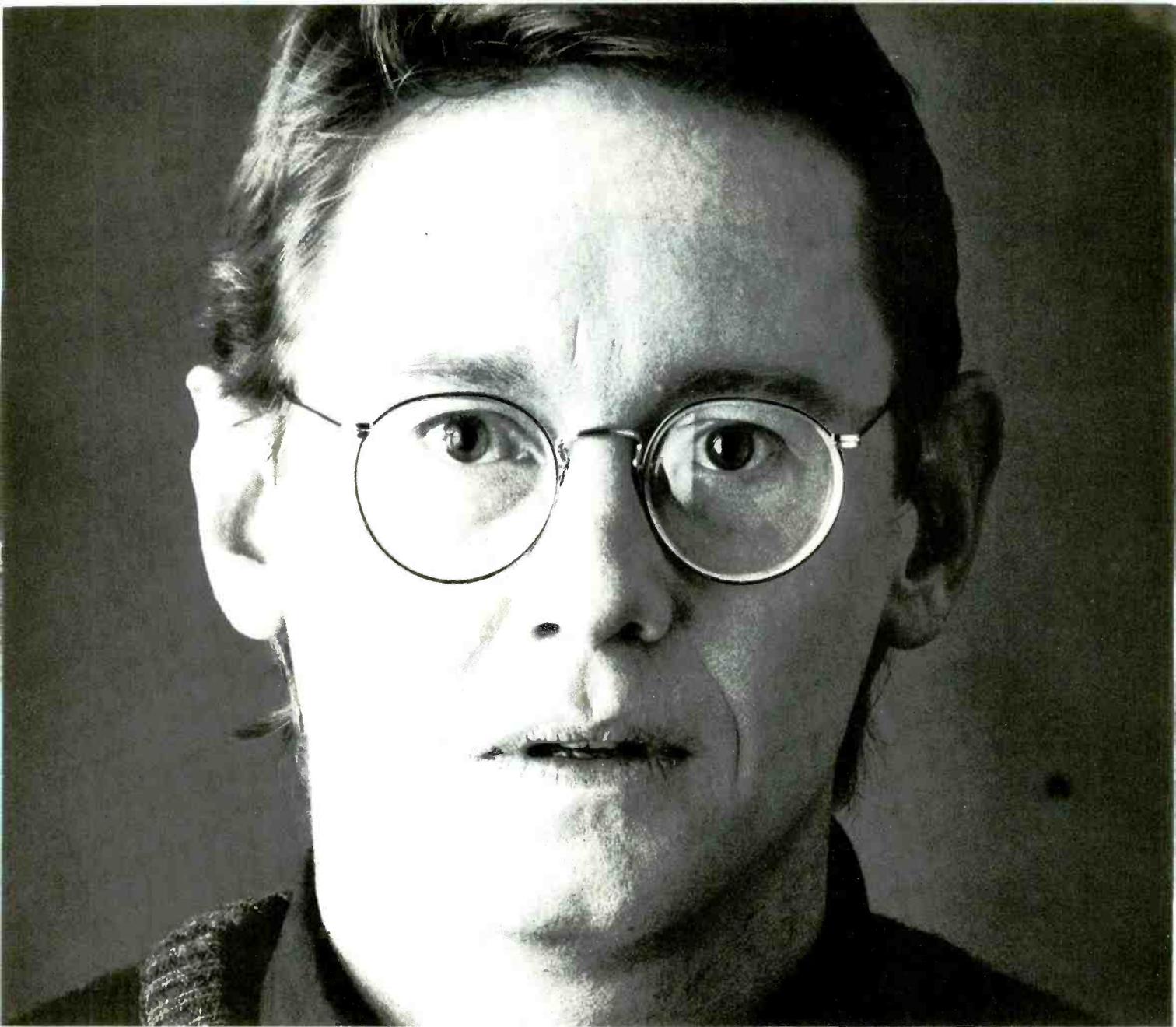
For literature, circle No. 105



## Nakamichi Cassette Deck

The CR-3A is Nakamichi's least expensive deck to offer three discretely packaged heads, a design that yields better shielding and the capacity for individual gap alignment. Its Asymmetrical Dual-Capstan transport has capstans and flywheels of different diameters rotating at different speeds to prevent common-mode resonances. As the dual capstans maintain tape-to-head contact, a lifter disengages the cassette's pressure pad to reduce scrape flutter and modulation noise. The CR-3A has Dolby B and C NR, 13-segment peak-level meters with a 50-dB range, and concentric level and balance controls for recording. Bias frequency is 105 kHz, and bias level is manually adjustable by a front-panel knob. The deck can be controlled by the optional RM-5 remote unit or through Nakamichi's CA-7A control amp. Price: \$750; RM-5 remote, \$45. For literature, circle No. 107





## “How Much Do I Have To Spend For Good Speakers?”

Audio engineers find good-natured argument in just about everything. But they agree that speakers are the most important part of your system and create the greatest sonic difference.

Yes, it makes good sense to have good speakers. And that makes us happy at KLIPSCH® because making good speakers is our only business. But for the next few moments, forget this is a KLIPSCH advertisement and consider how your system compares with what many experts describe as an “ideal balance.”

Some suggest that 40% to 50% of a basic system's cost should be allocated to speakers. Another

formula is to spend twice as much for your speakers as your amplifier. Spend less and you probably won't realize the full potential of your system.

The issue is really one of value. Once you're in the proper price range, a little shopping will help you find the speakers that give you the most for your money. Compare various models for sensitivity, freedom from distortion, smoothness of response, wide dynamic range, quality of cabinetry, critical acclaim, a time-honored design – all are important characteristics. While you're shopping, you'll note that it's tough to find one speaker that wins in every category.

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So how much should you spend for good speakers?

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## Ambria Loudspeakers

The Ambria S-1000 and S-2000 speaker systems, by MDS of Sweden, are designed to provide good sound while blending into a room's decor. Each system consists of a tall, thin, rear-firing subwoofer plus small two-way satellites that may be mounted on the wall or on optional pole stands.

The die-cast satellite housings, each slightly larger than a hand, are made of nonresonant material and are curved to further minimize resonances. The S-1000 system, which includes two satellites and a four-driver subwoofer, has a rated response of 35 Hz to 20 kHz. The S-2000 (shown here), with four satellites and a six-driver subwoofer, is rated at 30 Hz to 20 kHz. Additional satellites can be added to each system. Price: S-1000, \$900; S-2000, \$1 750.

For literature, circle No. 108



## Phase Linear Car Amp

High headroom is particularly useful in cars, where high continuous amplifier power is harder to achieve than it is in homes

Phase Linear's Turbo 150 is rated at only 30 watts per channel of continuous power. However, according to the manufacturer, its 7-dB headroom allows it to deliver more than 150 watts on peaks and to sustain about 140 watts per channel for up to about 175 ms, all into 4 ohms at less than 0.05% THD. With 2-ohm loads, the amplifier delivers 40 watts per channel continuous, 140 watts peak. Price: \$275. For literature, circle No. 110

## Audio Authority Cable

Regardless of how good a cable is, the less you use of it, the better. Audio Authority has produced a premium cable that's easily made just long enough for any application. Instead of coming in predetermined lengths, the Excellerator cables are sold by the foot and can be cut by the user to the shortest practical length. Gold-plated RCA plugs are twisted on, with no soldering required. The cable's response itself is said to be linear, with minimal signal loss from d.c. to 6 MHz. Rated capacitance is 13.8 pF/foot. Price: \$1 per foot; plugs, \$3 each.

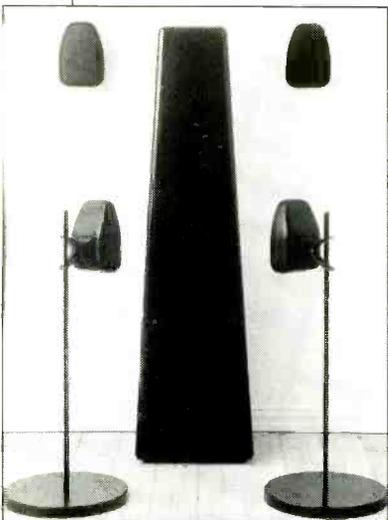
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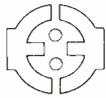
## Sansui CD Changer

The CD-X310M can hold up to six CDs in its interchangeable magazine, and it can play up to 32 randomly programmed selections from those discs. Other features include audible manual search and three types of repeat play:

Repeat of the current track, of all discs, or of all tracks programmed into memory. All functions, including programming, can be performed with the supplied remote control. Price: \$399; extra magazines, \$20 each. For literature, circle No. 111



# WINNER, AGAIN?



COUNTERPOINT builds the best amplifiers and pre-amplifiers you can find at any price, anywhere. Our products deliver superb sound with unsurpassed stereo imaging. Each of our amplifiers—from the inexpensive (\$595) SA-7 on up—is the best in the world in its price range.

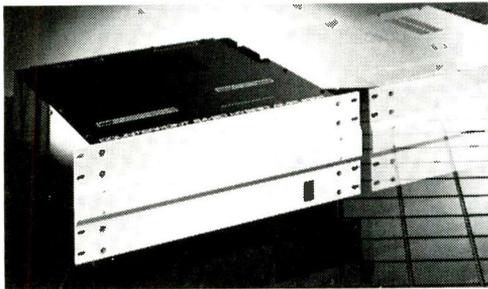
## Says who?

In the audio world, it seems most everyone claims ultimate quality. Luckily, there are three proven ways to sort the wheat from the chaff:

### 1. Ask the experts

For the past 3 years, each new Counterpoint product has won a prestigious award—both at home and abroad. For instance, our SA-20 Power Amplifier just won Japan's Component of the Year Award (not too bad these days, for a designed-and-made in the USA product!)

*SA-20 Power Amplifier... hybrid technology at its best*



*SA-4 Power Amplifier... Golden Sound Award; Stereophile, 1986 Class A Rating*



*Recent Counterpoint Awards — (clockwise from bottom) Golden Sound Award, SA-4, Class 1A Rating, IAR, SA-2, Class 1A Rating, IAR, SA-12, Component of the Year, SA-5, Component of the Year, SA-3, Component of the Year, SA-20, Design & Engineering, SA-1, Design & Engineering, SA-4, Innovations '86, SA-9/11.*

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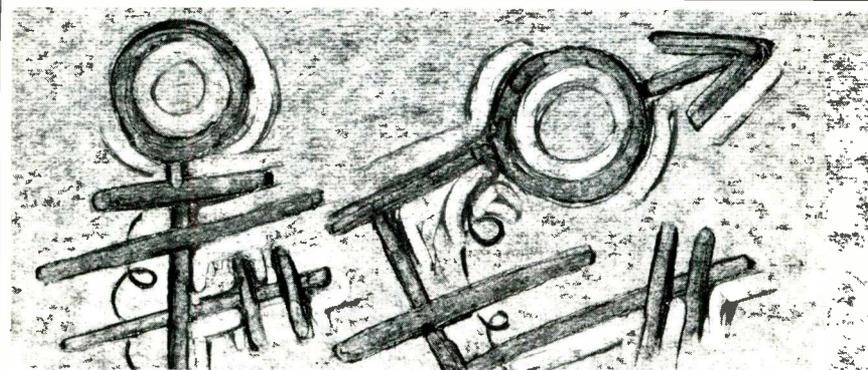


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## DOMESTIC DIVERSITY



### Diversity, Come Home

Diversity tuning, a system that constantly samples signals from two antennas to select the better one at any moment, is slowly gaining popularity in car stereo. However, it started out at home. The first diversity product I ever heard of was an H. H. Scott tuner, made about 20 years ago.

The Scott was also the last diversity consumer product that I came across for a long time. For listening in private homes with roof antennas, diversity

did not seem worth its higher cost. Why constantly compare signals when the distance between antenna and signal remained constant and the signals did not fade or fluctuate? If antenna switching was needed, a cheap manual switch could do the job just fine. Where signal fading did occur (for instance, in short-wave communication), diversity tuning continued to be used, but that was the extent of it.

With the advent of ICs and the popularity of mobile FM stereo,

diversity tuning found its way into consumer products once again. It's still not cheap; the three diversity car stereos I know of—Blaupunkt's Berlin, Carver's TX-Nine, and Clarion's Audia 2000E—range in price from \$775 to \$1,499. But since signals received by a moving car do fluctuate, and since most cars are big enough to allow the requisite antenna spacing of 6 feet or so, the system does a worthwhile job.

Well, signals at home can also fluctuate—not in homes with roof antennas but in apartments, where indoor antennas are usually the only kind allowed. As all of us in this situation know, precise adjustments of indoor antennas become imprecise or downright wrong the instant we step back to our listening positions. By moving about the room, we change the pattern of radio waves reaching the antenna. It's not exactly the same as the car situation, but it's the same in principle—and just as bad.

What we apartment-dwellers need is a good diversity home tuner. Any takers out there, manufacturers?

### Sound into Words

How do you evaluate audio products when you're auditioning them, and how do you compare two products when you can't hear them at the same time? I find it useful to put my impressions into words. Reading my notes will often bring those impressions back to me; even if I don't take notes, the words are easier to remember than the impressions.

It also pays to make a list of things to listen for, so you don't forget any aspect of the sound. Bose and Pioneer apparently agree; at listening evaluation sessions, they've both given me forms to fill out with my comments. Both forms were structured on a plus/minus basis; that is, for various parameters, listeners were asked to mark on a bad-to-good continuum where a speaker's performance fell. You might want to use this format as the basis of a listening list of your own.

With reference to imaging, both companies asked about sound-stage width or narrowness and depth or shallowness. Bose's scale ran from "Too Narrow" to "Too Wide";



Pioneer's just ran from "Narrow" to "Wide," with no suggestion that excess was possible. Bose's questionnaire, the longer of the two, also asked about spatial quality when listening off center and about the amount of ambience.

For high-frequency response, Bose asked about "Very High Treble (Openness, Airiness)" and "Brightness"; Pioneer asked how pleasant or unpleasant, smooth or peaky, and extended or lacking it was. In the midrange, both companies asked about smoothness and presence; Pioneer also asked if the midrange was pleasant or unpleasant. At the low end, Bose's questionnaire asked if there was too little or too much bass and whether

the sound was too thin or too full. Pioneer wanted to know if the bass was extended or lacking, flat or boomy, fast or slow.

For overall response, Pioneer's questionnaire asked if the sound was balanced or unbalanced, pleasant or unpleasant, smooth or harsh, warm or thin, neutral or colored, and fast or slow. Bose's questionnaire inquired about sound quality when listening off center and when the sound was very loud.

The Bose form also listed potential problems, allowing listeners to indicate if the sound was boomy, chesty, hollow, tube-like, boxy, honky, hooting, nasal, shrill, metallic, sibilant, muddy, buzzy, or distorted. The same section also asked about ragged cymbals, vague or unstable images, a hole in the middle, port noise, channel imbalance, and loss of sound quality in the near field.

The last question on Bose's list asked for an evaluation of the speaker "as a BOSE product." I daresay you'll never find that question on any other company's list or need it on your own.

WE'LL CHANGE YOUR IDEAS

# B&W CONCEPT 90 B&W

## B&W REVISES AN EQUATION. THE RESULT IS UNBELIEVABLE.

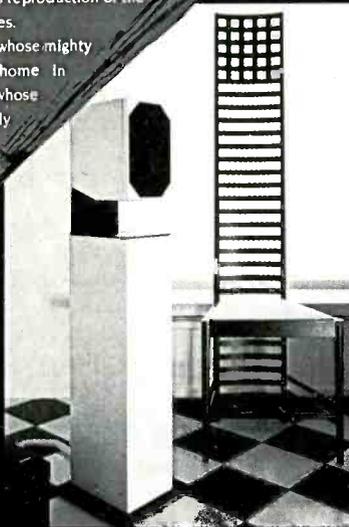
B&W have taken the Matrix quantum leap a stage beyond. They challenged the view that only a sizeable and intrusive enclosure could possibly produce a sound of true monitor quality.

That equation between size and sound quality is now rewritten by B&W in their Concept 90 series CM1/CM2 loudspeakers. Giving an incredible response to the wide dynamic range of today's compact discs.

At one end a rich and satisfying bass output.

At the other, fastidious reproduction of the most delicate passages.

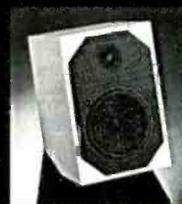
Here is a loudspeaker whose mighty performance is at home in limited rooms... whose appearance is perfectly attuned to design-conscious living.



## THE MATRIX REVOLUTION. SETTING SOUND FREE.

The Matrix revolution – an historic breakthrough in enclosure design – has lit the fuse. The honeycomb Matrix structure has virtually eliminated unwanted radiation characteristics. Setting you free to enjoy the pure, uncoloured sound of the drivers.

With one of the last great barriers to perfect sound reproduction lifted, B&W have undertaken an intensive development programme using the latest Computer Aided Design techniques. This has brought about a new generation, demonstrating B&W's sensitive shaping of audio for the rest of the century. It's called Concept 90. CM1 and CM2 are the latest progeny of the state of B&W art.



## CM1. AN INCREDIBLE SOUND SYSTEM.

By moulding the CM1 enclosure and Matrix in one piece and using a new glass-fibre reinforced polyester material, B&W have drastically reduced cabinet thickness – normally 15mm – to just 5mm. The result: a gain of 46% internal volume and a bass output which completely belies the CM1's diminutive size.

Bass/midrange performance has been refined by the introduction of a new version of the woven Kevlar cone (used in B&W's celebrated 801 monitor). System sensitivity of 85dB. Maximum sound pressure level of 135dB (in 2,000 cu.ft). The perfect expression of the Concept 90 philosophy.

## CM2. THE POWER. THE GLORY.

For the resolute perfectionist, Concept 90 reserves a further dimension. The supreme power and bass extension (a full 1½ octaves more) of the CM2. The CM1 element crosses to the slender sub-bass module of CM2 at only 150Hz, leaving performance unimpaired and giving a fully omnidirectional pattern of sound radiation. Drivers are reflex loaded and deliver perfect optimisation of output and bass extension. In CM2 the maximum sound pressure level is raised to 107dB with superlative accuracy and stereo imagery.

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For people who carry tapes in their pockets, the snag is not the tape but the shape of the case it's in.

### Nicely Cut Corners

Even in the world of hi-fi, product improvements need not be high tech to be useful. Sometimes you can make progress simply by noticing an everyday problem and coming up with a logical fix. Hence a new tape box introduced by TDK for the Japanese youth market: The box has rounded corners, so customers who carry tapes in their pockets won't snag their jeans.



### Dubbers' Delight

As long as people dub recordings onto tape, manufacturers will find ways to speed and simplify the job. The main convenience so far, the double-well deck, was originally designed for quite a different function: It was intended for use by *karaoke* fans who wanted to hear how their own voices would sound when dubbed over tapes of musical accompaniment. It wasn't until later, when buyers found a new use for these decks, that such dubbing conveniences as auto reverse and double-speed operation appeared. (Technics, in fact, has shown the European press a dual-well deck that works at six times normal speed.)

For dubbing from LPs, many one-

brand music systems have circuits that start and stop the cassette deck in synchronization with the turntable. Some separate components have had this feature too. For dubbing CDs, which are often longer than LPs, Denon has just introduced a C-100 tape length; they expect other companies to follow suit. One or two companies make CD players that show track-time totals as you program, so you can tell when you've got just enough music to fill one side of a tape. Technics' European showing included a player that calculates what track order will best fill two sides of a tape. Teac has a component that combines a cassette deck and CD player, and several companies have similar tabletop systems.

### For Long-Hairs Only

Are men's hair styles and audio developments in sync or 180° out of phase? It strikes me that hair worn long, over the ears, should form a natural high-frequency filter. So it may be appropriate that many men wore their hair that way in the analog '60s and '70s, when there was less to hear at the uppermost audio frequencies. Yet if we men wore our hair that way today, perhaps we could filter out enough to obviate the need for those pesky output filters on CD players.

Without those CD filters, every music lover would need long hair, and bald folks who sported toupees could claim the cause was audiophilia, not vanity. Women, alas, might protest, wanting both the right to hear their music without pain and the right to vary their hair styles at will. Tweeters should protest too, as a matter of survival.

### Lazy Perfectionism

Unless I'm in a tearing hurry (trying to tape a radio program that's already on, for instance), I never make recordings without first pressing my tape deck's calibration button. A friend noticed me doing it the other night and commented on my dedication to getting the best possible recording.

He gave me too much credit. If optimizing my deck's bias, equalization, and sensitivity settings were my only motive, I'd do it only when I started using a new batch of tape—certainly not just before recording side 2 of a tape when I'd already calibrated the deck for side 1. On my deck, however, the calibration process has a side benefit that makes it worth using all the time: When calibration is finished, it leaves the tape cued up just past the point where the leader ends.

### From Right to Wrong

The march of time can make things that were correct when written just a bit off by the time you read them. For example:

In a November "Spectrum" item, I pointed out that the sale of the RCA and GE consumer product lines to the Thomson Group of France would put GE, formerly a maker of component audio gear, into the same stable as component-maker Dual. No sooner had that appeared in print than I received word that Thomson plans to sell Dual to Schneider, a German company.

I also cited Rykodisc's \$6.98 sampler as a record low price for a CD, which it was, albeit by just a single penny. (Moss Music Group has a sampler, *The Best of Vox Prima*, for \$6.99.) Since then, Motown has announced *An Introduction to the Motown Elite 9000 Series* for just \$3.98.

Eric Toline, an old acquaintance now living in Chicago, caught something that was wrong when I wrote it (and stayed that way). In the December 1986 issue, I gave the time for one revolution of an LP as 1.8 S; I had it backwards (or, rather, upside-down). The correct formula is 1 divided by 1.8, or 0.556 S.

### Mail Booth

In the August 1987 issue, I praised a few record stores that are taking advantage of CDs' resistance to wear by offering customers a chance to hear discs before deciding whether to buy them. Many stores offer the same option indirectly by buying and selling used CDs. Barclay-Crocker, a major source of open-reel tapes until that market dried up, offers a used-CD service by mail. Music lovers who enroll in the company's Sound Exchange program (\$15 per year, \$5 for a six-month trial) can buy one used CD for every one they send in, for \$5 each. Available discs are listed each month in a newsletter; the discs in the issue I saw were predominantly classical, but there was a smattering of jazz and New Age music and even two Culture Club albums. (Barclay-Crocker's address is 313 Mill St. Poughkeepsie, N.Y. 12601.)

Illustration: Michael A. Donato

# A MATTER OF BALANCE.

We believe the new NAD Monitor Series Preamp and Power Amplifiers are the best you can buy. Not because of one feature or specification—but because of a thousand design decisions, correctly made.



Rack handles are optional equipment.

Like everything in our new Monitor Series, the 1300 Preamp and 2600 Power Amplifier are high-performance components that will challenge the best in the market. But what makes them world-class products can't be isolated to one feature or one specification. It's the balance of thoughtfully selected controls and superior performance. Each stage of each component has been designed with a no-weak-links strategy so that the performance of each section actually enhances the performance of every other. Every feature, every subcomponent, every circuit was analyzed and re-analyzed, tested and re-tested.

The process took over three years—and involved a combination of current technology and new concepts, fine-tuned by a thousand thoughtful and (we think) correct decisions. A very few examples . . .

- The 2600 uses NAD's innovative "Power Envelope" technology to produce 4 dB of dynamic headroom. Conservatively rated at 150 watts, it is capable of 700 watts per channel of useable, real-world music power. It will generate very high sound pressure levels (an average of over 114 dB SPL) with most loudspeakers.
- In its bridged mode, the 2600 yields 500 continuous watts and 1200 to 1600 watts of dynamic power.
- A "Null" switch in the preamp subtracts the right signal from the left signal, thus removing any monaural information. This elegantly simple feature allows you, by ear, to easily align your FM antenna or phono cartridge for optimum stereo sound.
- Every circuit in the 1300 is designed with very high headroom and extremely low noise to handle any signal source, present or future. Its total dynamic range, measured with respect to the output of a CD player, exceeds 110 dB.
- We chose professional quality, semi-parametric tone controls for the 1300. They provide genuinely useful corrections, without veiling or coloration.



The new NAD 4300 stereo tuner matches the Monitor Series preamp and power amplifier in modular dimensions, design, and performance—it is the world's most sensitive FM tuner.

In short, what makes the 1300 Preamp and 2600 Power Amplifier combination special . . . is a long story. If you'd like to know more about it, write for our Monitor Series brochure.

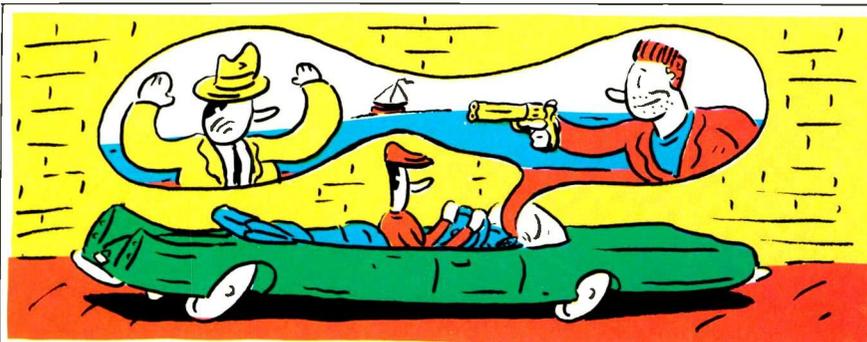
Or visit your authorized NAD dealer—and hear the result of a thousand design decisions, correctly made.

## The Monitor Series From NAD

For more information send this coupon to NAD (USA) INC. 1575 UNIVERSITY AVE. NORWOOD, MA 02062

Name \_\_\_\_\_  
 Address \_\_\_\_\_  
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## TUNING IN THE TUBE



### TV with a No-Inch Screen

It was the final episode of a mystery series, and I was glued to my chair at a friend's house, watching the tube. Of course the hero's plane would make it across the ocean in time for him to present in court the evidence that would save his brother's life—but what was the evidence? Suddenly, my friend tapped me on the shoulder and handed me my coat. It was time for me to drive her to the airport to catch a plane, and no way could I stall for half an hour till the episode's end, nor could I get to my home VCR to tape the ending. The next day, I bought a TV sound converter for my car stereo system.

It's not surprising that such a converter was available, nor that Proton now sells a stereo (the DS275)

with VHF TV-band tuning, nor that Ford has been test-marketing a stereo with similar facilities in some Lincoln Continentals. After all, most television is only illustrated radio. Turn off the picture, and you can understand most programs by their soundtracks—but turn off the sound, and you're very often lost.

Nonetheless, while TV sound in audio equipment has long been at least intermittently available, it's never become popular. One reason may be our preference for stereo over mono sound. Now that there's stereo TV, perhaps we'll get stereo-sound TV tuning for the car.

In some areas, it might be useful if these tuners picked up UHF as well as VHF stations. Now if only there were some way to pick up cable and satellite channels too. . . .

### Car-Free Listening

The first mobile sound equipment I ever installed was for a BMW, but I didn't install car stereo equipment until several years thereafter.

The BMW was a motorcycle, and the sound equipment was a portable AM/FM radio. Unlike most portables, especially back in the '60s, it had automatic "seek" tuning plus a remote volume and tuning control. I taped the remote to my handlebars, with the cord running down onto the tank. When I wanted sound, I attached the radio to the tank with rubber straps, plugged in the remote, and rode off into the sunset.

The radio, as I recall, had a fairly hefty output, about one-half watt or so, and BMWs were very quiet bikes. So the system did work, after a fashion. And by making the radio portion removable, I anticipated a current car stereo trend by about 20 years.



Illustrations: Phil Marden

### West Meets East

Despite the strong presence of Japanese car audio gear in the U.S., the Japanese and American markets are quite different. Here, elaborate installations tend to be based on multiple amps, speakers, and crossovers, all contributing to the sound quality but mostly installed out of sight. In Japan, apparently, fancy installations take a different form. A few years ago, for instance, car stereo systems using separate amplifiers, tuners, equalizers, and cassette decks, all with their own control panels, were popular in Japan, but they never caught on in North America. Perhaps Japanese drivers spend less time speeding on freeways and more time stock-still in traffic; this would make the ergonomic problems less horrendous. Certainly Japan's lower theft rate makes such



showy displays less impractical than they are over here.

In any event, Japanese tastes may be changing. Last September, Alpine North America sent a Lincoln crammed with carefully concealed equipment to the Japan Audio Fair. The car alone must have been a big attention-getter (I've seen fewer Lincolns over there than Ferraris over here), but the installation probably had even more impact. Though it included 18 speakers driven by

1,800 watts of amp power, the only visible equipment was the CD player in the dash. The equipment was all Japanese, so the difference between this and typical Japanese setups, according to Rich Coe, Alpine's director of technical development, was "in the crazy installation techniques we have in the U.S."

At the Fair, the Lincoln caused some controversy. According to Coe, "Older audiophiles wouldn't even come near it. They like a lot less bass." Younger listeners, who are more into rock and other Western music, were more enthusiastic.

Because Japanese audiophiles are not used to the power or the bass capacity of systems like this, Coe took the precaution of gluing the tone controls in flat position so that incautious operation "wouldn't blow the listeners out of the car."

# Challenging Design.

**FOR UNDER \$600 YOU CAN OWN AN AMPLIFIER JUDGED TO HAVE THE EXACT SOUND CHARACTERISTICS OF AN ESOTERIC \$3000 MODEL.**

Bob Carver recently shocked the staid audiophile world by winning a challenge that no other amplifier designer could ever consider.

The new M-1.0t was judged, in extensive listening tests by one of America's most respected audiophile publications, to be the sonic equivalent of a PAIR of legendary, esoteric mono amplifiers which retail for \$3000 each!

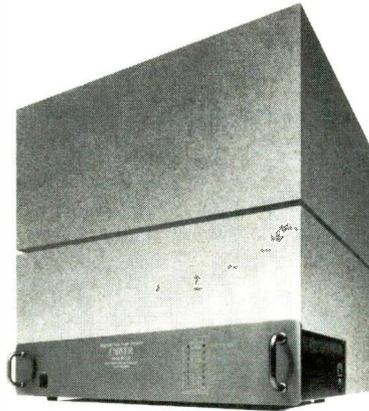
**CARVER'S GREAT AMPLIFIER CHALLENGE.**

Last year, Bob Carver made an audacious offer to the editors of *Stereophile Magazine*, one of America's exacting and critical audio publications. He would make his forthcoming amplifier design sound exactly like ANY high-priced, esoteric, perfectionist amplifier (or amplifiers) the editors could choose. In just 48 hours. In a hotel room near *Stereophile's* offices in New Mexico! As the magazine put it, "If it were possible, wouldn't it already have been done? Bob's claim was something we just couldn't pass up unchallenged."

What transpired is now high fidelity history. From the start, the *Stereophile* evaluation team was skeptical ("We wanted Bob to fail. We wanted to hear a difference"). They drove the product of Bob's round-the-clock modifications and their nominees for "best power amplifier" with some of the finest components in the world. Through reference speakers that are nothing short of awesome. Ultimately, after exhaustive listening tests with carefully selected music ranging from chamber to symphonic to high-impact pop that led them to write, "...each time we'd put the other amplifier in and listen to the same musical passage again, and hear exactly the same thing. On

*the second day of listening to his final design, we threw in the towel and conceded Bob the bout. According to the rules... Bob had won."*

**BRAIN CHALLENGES BRAWN.** Below is a photo of the 20-pound, cool-running M-1.0t. Above it are the outlines of the pair of legendary mono



amplifiers used in the *Stereophile* challenge. Even individually, they can hardly be lifted and demand stringent ventilation requirements. And yet, according to some of the most discriminating audiophiles in the world, Bob's new design is their sonic equal.

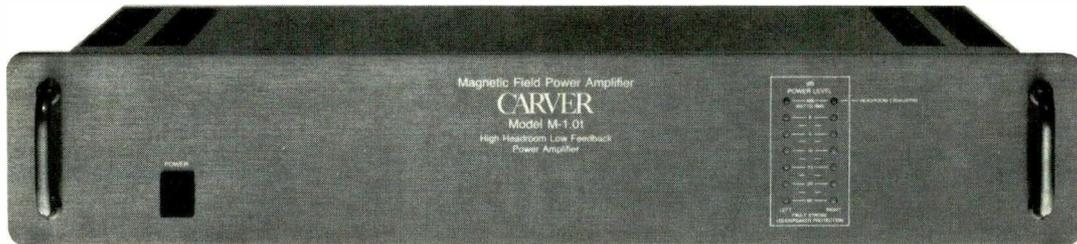
The M-1.0t's secret is its patented Magnetic Field Coil. Instead of increasing cost, size and heat output with huge storage circuits, Magnetic Field Amplification delivers its awesome output from this small but powerful component. The result is a design with the dynamic power to reproduce the leading edge attacks of musical notes which form the keen edge of musical reality.

**A DESIGN FOR THE CHALLENGES OF MODERN MUSIC REPRODUCTION.** The M-1.0t's astonishingly high voltage/high current output and exclusive operation features make it perfect for the demands of compact digital discs, video hi-fi and other wide dynamic range playback media. The M-1.0t:

- Has a continuous FTC sine-wave output conservatively rated at 200 watts per channel.
- Produces 350-500 watts per channel of RMS power and, bridged, 800-1100 watts momentary peak power (depending on impedance).
- Delivers 1000 watts continuous sine wave output at 8 ohms in bridging mode without switching or modification.
- Is capable of handling unintended 1-ohm speaker loads without shutting down.
- Includes elaborate safeguards including DC Off-set and Short Circuit Power Interrupt protection.

**SHARE THE RESULTS OF VICTORY.** We invite you to compare the new M-1.0t against any and all competition. Including the very expensive amplifiers that have been deemed the M-1.0t's sonic equivalent. You'll discover that the real winner of Bob's remarkable challenge is you. Because world class, superlative electronics are now available at reasonable prices simply by visiting your nearest Carver dealer.

**SPECIFICATIONS: Power, 200 watt/channel into 8 ohms 20Hz to 20KHz, both channels driven with no more than 0.15% THD. Long Term Sustained RMS power, 500 watts into 4 ohms, 350 watts into 8 ohms. Bridged Mono power, 1000 watts into 8 ohms. Noise, -110dB IHF A-weighted. Weight, 20 lbs.**



**CARVER**

P.O. Box 1237, Lynnwood, WA 98046

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MUSICAL

ACCURATE

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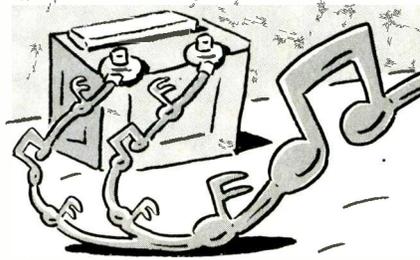
Distributed in Canada by: **evolution technology**

Available amplifier power in low-cost sound systems will increase if (and when) car voltages are raised.

### More Power to You

Tomorrow's cars will have electronically controlled engines, suspensions, brakes, four-wheel steering, automatic transmissions, and much more. Between the control circuits and the actuators governed by the control impulses, there will be far more demand on the car's electrical system. With today's nominal 12-V standard, that means a lot of copper to carry the high currents involved.

Tomorrow's systems, therefore, may not operate on 12 V. Lucas Industries, Britain's leading supplier of car electrical components, has suggested that raising the voltage would allow smaller currents to carry the same total power. According to the

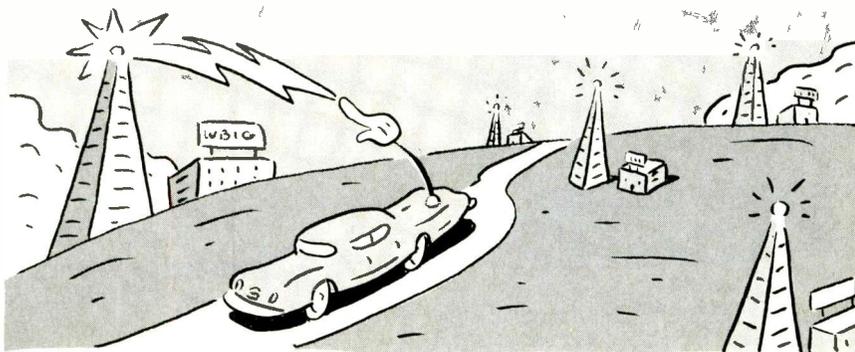


company, using 48 V, the highest voltage they consider safe, would cut the weight of a car's wiring harness from 15.5 kg (34.1 lbs.) to 11.9 kg (26.2 lbs.). This would save money on copper and make the wiring easier to run. The higher voltage would also allow less costly semiconductors to

be used. There would be a gain of about 4.8% in gas economy, due less to reduced electrical power losses than to reduced wire weight.

More to the point of this column, it also means that the amplifier power available for low-cost sound systems would increase. An amplifier working directly from today's 12-V power system can produce about 4 watts per channel; to produce more, it must have a bulky and expensive power supply to raise the voltage further. Working from a 48-V system, the same type of amplifier could theoretically deliver up to 72 watts per channel. (In practice, however, various circuit losses would limit the available power to slightly less than the theoretical maximum.)

Illustrations: Phil Marden



### Chip Thrills

Integrated circuits have made many new features possible in audio gear, and nowhere is this more noticeable than in car stereo, where there isn't room for the thousands of discrete components that one IC replaces.

One feature now becoming commonplace, under several names, is designed for travellers. Drive to a new area, push a button, and all the stations you memorized back home are saved in a second set of memories, while the presets fill up with the strongest stations in your new locale. If you're far enough into the boondocks that stations are few and far between, this is a wonderful convenience. Used in an area where the dial starts crowding up with stations, it's still useful—if your tastes are sufficiently catholic or run to whatever kind of music is most

popular thereabouts. Ironically, if your tastes are somewhat specialized (leaning toward classical or jazz, for instance), this feature helps you least in the major urban areas where there are most likely to be stations that you'd like to listen to. This is because rock stations not only predominate but often can afford the strongest transmitters.

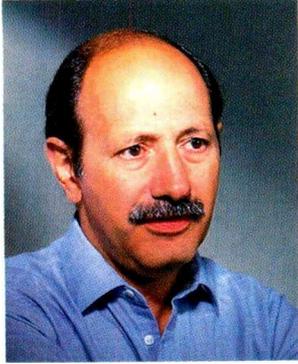
A system with a reject button might help. After the strongest local stations were logged in, the tuner would play each one for a few seconds; if you didn't like the programming, you'd press "Reject" for each station you disliked, and the tuner would search for reasonably strong replacements. Then it would play the new stations for you, in case you wanted to reject some of them.

Another way to get around the selective listener's problem would be

to adapt to U.S. requirements the BBC's new Radio Data Signalling system, which is also making headway elsewhere in Europe. Using a subcarrier at 57 kHz, RDS carries station identifications, clock time, date, notice of other stations carrying traffic announcements or other useful messages, and a list of nearby stations carrying the same program. In Europe, where radio networks still predominate, radios could be designed to switch to other stations on the "same-program" list when the current signal begins to fade; here, that wouldn't help much except for National Public Radio stations and some sportscasts. More useful to us would be to include program names and format codes—then you could have your radio search for the kind of music you like best or even have it turn itself on when a program you're waiting for begins. Blaupunkt's Automatic Radio Information (ARI) system, used by a growing number of U.S. stations, already has the automatic turn-on feature, but just for traffic announcements.

### Not Just the Blues

Pioneer has introduced some speakers in Japan whose model name ("Carrozzeria") lights up in blue while you drive—and in red, when you put your brakes on.



## “It’s no trick to make a great speaker when price is no object.”

Andy Petite, chief designer, Boston Acoustics

“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 our newest model, the T830 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.

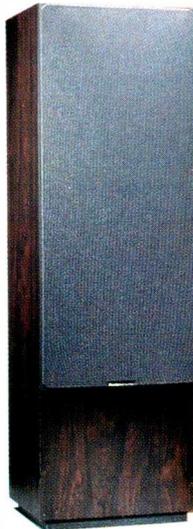
“From our very first product to our latest, audio critics have appreciated what we’ve accomplished—delivering demonstrably high performance at truly affordable prices. Here’s what Julian Hirsch said about the T830 in *Stereo Review*:

*‘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.”



**The 3-way T830 Tower System.**  
It needs only 10 x 9¼” of floor space, only 32” in height. Suggested retail: \$480 a pair.

### **Boston**Acoustics

247 Lynnfield St., Dept. A, Peabody, MA 01960  
(617) 532-2111

## WHO KNOWS WHERE OR WHEN



Illustration: Karen Barbour

This is where it started! Copy your discs onto tape and don't ever play the originals, except to make another copy. Copy your friends' records. Small potatoes, I suppose, compared to current VCR operations. But the audio entertainment business was already well scrambled by the time the first VCR appeared.

For such a proliferating medium, the cassette has always been somewhat delicate in the technical aspects, its engineering more fragile, nearer the edge of danger, than the relatively sturdy LP. It surely wasn't conceived as the precision mechanism it has become, almost against its mechanical and magnetic nature. Cassette progress has been perilous—a batch of engineering tightropes. It was barely rescued from its inherent noise problem by the ingenious Dr. Dolby and his Dolby B noise reduction; only the most agonizing precision has kept the mechanics abreast of current hi-fi stability in the sound and the all-important azimuth. Then again, the fi itself would never have been enough to match high-end standards if the tape manufacturers and duplicators had not made continued micro-improvements, the very underpinning of the cassette system. The slightest overt failure in any of these areas might at any time have lopped off vast segments of business. This cassette has gotten where it is by sheer dint of engineering persistence, always available if the profits continue. It has been touch and go, as I see it, from the beginning.

For all of this development, the cassette by now is a dismally outdated system in the face of our new technology, more seriously so than the LP itself, which has had a curious ability to go on getting better in solid and reliable ways. The metal LP master, for instance. The strain on the ever-critical cassette tolerances is now getting obvious; the cassette has about hit its engineering ceiling. Only its incredibly wide usefulness and popularity keep it afloat as a big business. (Fortunately, the fi isn't too important in plenty of cassette areas.)

What this little audio device has had all along, what made it revolutionary when first introduced, is a pair of attributes that are more vital than ever today: Automation and miniaturization.

**S**ometimes the audio writer, what with the endless parade of new products, gets dreadfully jaded; you might call it the "just another . . ." syndrome. But to compensate, there are also moments of instant revelation when, suddenly, great vistas open up clear and sharp—it can happen in moments. Wham, *wham*, like the blows of a pile driver. R-DAT!

Of course, I had long been hearing those improbable initials, more of Al Smith's well-known alphabet soup. I knew what the letters stood for: Rotary-head Digital Audio Tape, in some cassette-like form. So they're reconverting the VCR to audio, I thought lazily. Or maybe it's one of those add-on conversions for your good old analog audio cassette system, the sort of gadget that always comes along when new technology is on hand. I've seen 'em all, from the 78-to-33 turntable converter to the present add-ons to make stereo for your mono TV. Exercises in futility, mostly. You can't convert your old cassette machine to digital! You can't convert an LP to a CD. Yawn.

End of yawn. Those letters kept coming back at me. I got to feeling a bit uneasy as I put them firmly out of mind. Then it happened. Len Feldman, the Great Explainer himself—to my mind

one of the best, most fluent writers on audio technicalities in the business—wrote a test report on four DAT recorders for the July issue of *Audio*. Upon reading it I had a whole new picture of the audio future, sparked by Mr. Feldman's admirable examination of R-DAT in the digital flesh. Blew my mind sky high for hours.

Background. Keep in mind that the analog cassette took a whale of a long time to find its place in the consumer audio market, not as a low-scale miniature system (the original idea), not as a *replacement* on tape for the LP, but, rather, as something to complement the LP in various ways from the low end of the fi department all the way up to the top. Remember the Nakamichi 1000? The proliferation of uses for this handy miniature tape system was remarkable. With it, at last, "live" personal recording took off, from college lectures to concerts. Today's Walkman-type miniatures in all their variety could not exist without that cassette base, nor could thousands of educational and industrial applications. Nor, most significantly, could the prerecorded music cassette, which today parallels the LP right through the catalogs. And then, long before the VCR, there was copying.

# The **Boston** Acoustics

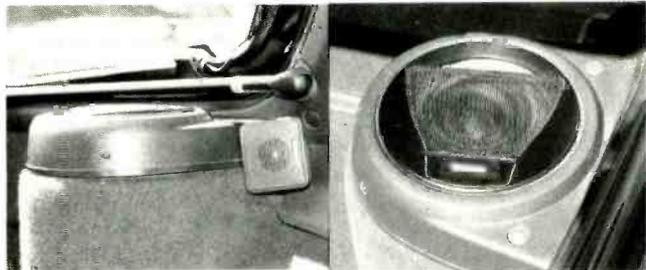
## Installation of the Month Contest



1986 Mazda RX-7 with the winning Boston Acoustics Installation of the Month.



Passenger-side door with 751 system: (left) angle-mounted 1" Varimount tweeter; (circled) 5/4" woofer mounted behind fabric.



751 system in rear shock tower. Left: 1" Varimount tweeter angled to fire forward. Right: 5/4" woofer mounted beneath factory grille.



Before-and-after view of custom-made enclosure for 780LF 8" subwoofers.

**Our final winner:** Jeff Cole, Wichita, Kansas

Jeff Cole had two goals for the stereo system to go into his 1986 Mazda RX-7. He wanted high performance with full bass, *and* he wanted the entire system to be inconspicuous. To fulfill both parts of that goal, Rolling Thunder of Wichita, Kansas, used existing speaker mounting locations, and created a special enclosure for the bass drivers. Two pairs of Boston 751 component speaker systems were easily concealed in the doors and rear shock towers. A custom-made enclosure was cleverly designed to house two Boston 780LF subwoofers. This enclosure uses the air volume of the spare-tire well in the rear, and only a very close look at the perforations in the original factory carpeting suggests the powerful bass system below. As a result, the performance *and* the appearance of the entire system gave Jeff everything he had hoped for.

**The winner's dealer:** Rolling Thunder, Ltd. Wichita, Kansas

**The winner's salesperson:** Dennis Stovall

**The winner's installation expert:** Roger Smarsh

**The winning system:**

**Boston Acoustics speakers:**

751 systems in doors, including angle-mounted 1" Varimount tweeters and 5/4" woofers mounted behind fabric. 751 systems in rear shock towers. Varimount tweeters positioned to fire forward; 5/4" woofers mounted under factory grilles. Two 780LF subwoofers in custom enclosure in spare tire well.

**Alpine:** 7902 compact disc/tuner. 3528 amplifier (4 x 30 w/ch) driving 751 systems. 3533 (60 w/ch) driving 780LF subwoofers. 3311 graphic equalizer w/subwoofer crossover.

### ... and our Grand Prize Winner!

Susan Codega, Fort Collins, Colorado

**The prize:** A cruise for two to the Caribbean. (Value: \$6000.)

Ivan Berger, Technical Editor and car stereo columnist for *Audio*, plucked Susan Codega's name at random from all contest entrants. Susan's good fortune continues, as she was also the August contest winner.

### What makes a winner.

Our thanks go to all who participated. Throughout the contest, we saw again and again what it takes to achieve the best in mobile sound performance. It starts with a dealer who can be relied upon for system expertise and product knowledge. Equally important is the choice of speaker systems. Just as in the home, a mobile sound system can only sound as good as the speakers. Beyond great sound, the speaker system must provide installation flexibility (so each speaker can be placed for best sound and looks), durability (to handle the power as well as the environment), and attractive cosmetics to enhance the interior.

Boston Acoustics speakers bring all these qualities to your mobile sound system, whether you simply replace existing factory speakers, or create a custom installation. It makes no difference what you drive—subcompact, exotic sports car, luxury sedan, 4X4, van or boat—there's a Boston system that's right for you. What *does* make a difference is knowing that with Bostons, you're assured of the best in mobile sound.

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## **Boston**Acoustics

247 Lynnfield Street Peabody, MA 01960 (617) 532-2111

The new cassette is close to the old in its outward functioning, but this just makes the real contrasts that much greater.

Philips was the first here to promote a successful no-hands tape-handling system. For a long time we all thought that magnetic tape would push the old disc right off the scene, but as long as you had to thread your tape by hand, reel to reel, the consumer public wouldn't concede. The Compact Cassette, the most thoroughly radical of numerous attempts at solving this problem, was in the end the all-out winner and for the best of reasons: It worked. It bested the competition, which was less imaginative, less flexible, less versatile, and, especially, less miniature.

Big news, then, that R-DAT already far outperforms the present cassette. The relationship is not unlike that of the CD to the LP. A generation of rapid technical progress, a new era in electronics, and suddenly the dams break open, the flood is let loose in commercial product. You know about CD; R-DAT is more of the same, in fact very much the same. But R-DAT isn't here yet—at least as of this writing.

It is indeed a shock to discover how far this R-DAT technology has already gotten. Where? In Japan, of course. First things first—those clever innovators managed to get agreement on R-DAT standards, *one* set of them, among more than 80 companies, before the prototypes got too far. And then they went on to the commercial products. In March 1987, the R-DAT cassette system was actually launched onto the market for the Japanese public. Not one brand, one company, but several of them, and all the equipment as compatible as anything we have in analog audio cassette.

Unlike the CD, which is so visibly different in operation from the old LP, this new cassette is much closer to the old in its outward functioning, if only because the Compact Cassette did achieve some of the automation we now find everywhere. But the real contrast is merely the greater because of the outward similarity. Everything the old cassette can do, item by item, the R-DAT cassette can do better by a huge margin. Except (at the moment) to provide for those handy, low-priced little boxes, so easy to buy. That would take time and, as in the CD, might run into the real limitations inherent in a more complex system. All in all, the

contrast between the old and the new is breathtaking.

Well, I thought, when I first understood all this, so what? So the Japanese like it. Do we want it? Lots of things are on the market there, quite unneeded here. They had two-channel audio for their TV years ago. We didn't think we needed it (until the recent upheavals). Most of all, in our country, there is the enormous vested interest of a mature industry in millions of extant cassettes that need players, and in players that need cassettes. In particular, the record-making industry is heavily involved at the present in cassettes, to match almost every LP now on the market, and the record dealers are just as thoroughly involved. What—still another new format? Even the ancient and utterly savvy Schwann catalog has already been pulled in a new direction by the present rush towards CD even before a thought of still more formats. And what about the home user and his boxes and boxes of analog? No, R-DAT would cause an awful disruption, so soon after CD, and a lot of people don't want to hear anything about it. (Shades of the "double inventory" flap back in the 1940s, when both 78s and LPs were on sale. This would be quadruple.)

Moreover (to continue the argument), because the R-DAT cassette is disconcertingly the same as the standard analog cassette in outward configuration and purpose (though utterly different in technology), its introduction could lead to endless public confusion, worse than the "digital LP" that still has many people all mixed up. No, R-DAT is not *exactly* the same in any parameter, nor compatible. The cassette itself is not the same size, nor does it look precisely like the old model, but I can envision a dealer's showcase with the new cassettes, when and if, looking all too familiar to most eyes, with the same pair of little reels, the same flat plastic case, to be loaded into a slot or a well in the familiar way. No, you just *can't* sell two kinds of cassettes that so obviously do the same thing in the same way.

I went through these arguments and more of the same in about 20 seconds, in the midst of that revelation I was talking about. True, *very* true! R-DAT can cause a horrendous mess, all sorts

of economic convulsions and much unrest in every segment of our world, including the home. *Forget it.*

After those 20 seconds, I stopped forgetting it.

We are very unlikely to be able to stop progress, as we call it, when it is so obviously there and available, for pleasure, profit, and general utility. Our world moves on and even the law has to redefine fundamental values, such as the concept of property and the copyright, when new situations arise. Dogmatic prohibition is never going to work, right or wrong. Not in our society! People are going to copy video on their VCRs and audio on their cassette decks, as they have for years, and nothing much can be done about it. Except to declare, somewhat lamely but pragmatically, that maybe it is okay as long as you don't sell your copies for profit. That would be piracy. Millions of us will copy simply for our own convenience and pleasure, and we really see no reason why we shouldn't. That is the way we are.

There are so many things about the R-DAT audio cassette that are astonishingly better than the old cassette model, to serve that same convenience, that the system just has to recommend itself to all of us. Go back and read Len Feldman's quiet, unsensational account and add your own exclamation points. I will only point out one special feature that you may have missed in R-DAT accounts—and shouldn't. How do you prevent even more flagrant "borrowing" of copyright material, considering that an all-digital R-DAT copy would be a near-clone, not really a copy but virtually an actual original? You might issue your own records straight from that master.

Well, you can't. A little digital blip can be added, inaudibly, to the audio signal on any digital recording. This is detected by the R-DAT recorder and the machine immediately stops. You can't erase this signal. Feldman himself, you'll note, was foiled when he tried to copy a CD to see what an R-DAT clone might sound like. If you want to copy, you'll have to go through an analog stage; the result will simply be excellent audio, but no clone.

My overwhelming thought is, let's get on with R-DAT. It is much too good to miss!

A

Artistry in Sound

**ONKYO®**

# Compact Disc Players

**Integra** Series

DX-530 • DX-330    DX-230 • DX-130 • DX-C600



**OPTO-COUPLING**

# An Enlightening Experience. Listen to Onkyo's New Line of CD Players with Opto-Coupling\*.

The technology behind the great sound of CD is optical technology, but there's no reason to limit it to the laser pickup. Onkyo realized that something more was needed to obtain the best possible sound from compact disc, so they invented Opto-Coupling. It separates the CD player's digital and analog blocks of circuitry electrically to eliminate DSI (digital signal interference) and bring you CD sound free of digital pulse noise. Just as important as what happens to the digital data signal midway between the laser pickup and the output terminals, however, is the integrity of its source — the laser pickup itself. Onkyo's special vibration damping system helps prevent tracking errors and the inevitable deterioration in signal quality that occurs when the error correction circuitry must operate excessively.

This introduction to Onkyo's new CD player lineup ends, as it began, with light — infrared light, that is. All of Onkyo's CD players (with the exception of the DX-130) include remote control units for extra convenience. In addition, the displays have been upgraded to give you more information in an even easier-to-read format.

In the dark about which CD player is for you? Just audition one of these brilliant performers. You're sure to be enlightened.



## Light Bridges the Gap between Digital and Analog

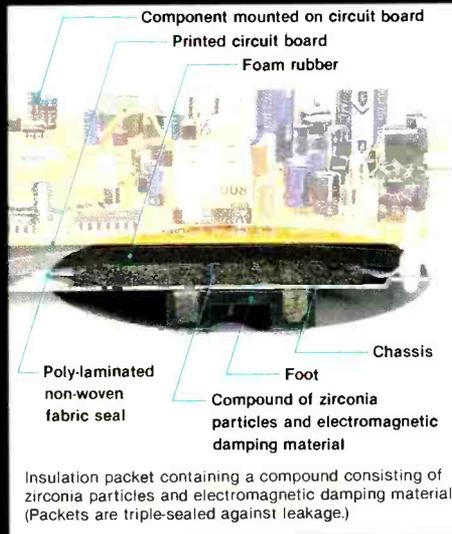
**Onkyo's Opto-Coupling\* with the Exclusive Opto-Coupling Module**  
 All CD players contain both digital and analog blocks of circuitry. If stray digital pulses from the digital circuit block find their way into the analog block, however, they can interfere with the music signal and cause your CDs to sound edgy and unnatural. Opto-Coupling keeps digital pulse noise out of the analog circuitry by electrically isolating the digital block. The music signal must nevertheless be transferred to the analog section somehow, and this is where the "opto" of Opto-Coupling comes in. Beams of light, not electricity, transmit the necessary signals via a "bridge" composed of photocouplers and Onkyo's revolutionary "Opto-Coupling Modules." These modules, an Onkyo exclusive, each use an 11mm strand of optical fiber to link the emitting and receiving photodiodes. This design reduces high-frequency signal leakage by approximately 13dB compared with conventional photocouplers. Since there is no electrical contact at all between the digital and analog blocks, DSI (digital signal interference) doesn't even have a chance to develop. The resulting sound is clear and lifelike, without the harshness sometimes associated with the CD format.

## Ladder-Network Type Integra Linear Converter

Conventional integrated D/A conversion systems require a quartz oscillator — yet another possible source of extraneous pulse noise. Onkyo overcame this problem by eliminating its root: the quartz oscillator in the analog block. The ladder-network type D/A converter in the DX-530 and DX-330 was developed specially for systems like Onkyo's which employ serial optical transmission. This "Integra Linear Converter" doesn't need a quartz oscillator in the analog circuit block in order to operate, so it generates no pulse noise.

## Light that Never Wavers Special Vibration Damping

While any CD player's correction circuitry can protect you from data read errors so that you aren't exposed to the constant clicks and pops that plague analog records, it can't fully make up for the absence of the correct signals. The result is that you lose some of the detail you would have been able to hear if the correction circuitry had not had to operate in the first place. Clearly, the less correction needed, the better. Onkyo's IFS (Isolated Floating Suspension) system separates the disc drive section from the chassis and suspends it on springs and four rings made of special vibration-absorbing material. The cover, which is the part of the unit with the largest surface area, is also specially damped by a protective layer of mica particles, bitumen and resin which kill vibrations by converting them into heat energy and thereby stop outside vibrations from being transmitted to any sensitive systems. Finally, the underside of the analog block's printed circuit board is protected by a specially designed insulation packet containing a compound consisting of zirconia particles (a new, high-tech material) and electromagnetic damping material. In addition to fighting vibrations in the same way as the cover's protective layer, it also absorbs stray electromagnetic flux from the components mounted on the circuit board — another possible cause of interference and distortion.

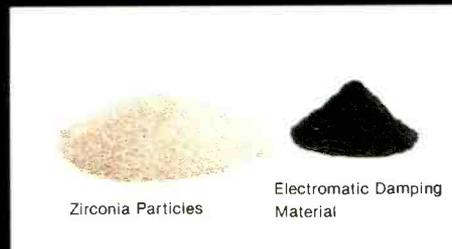
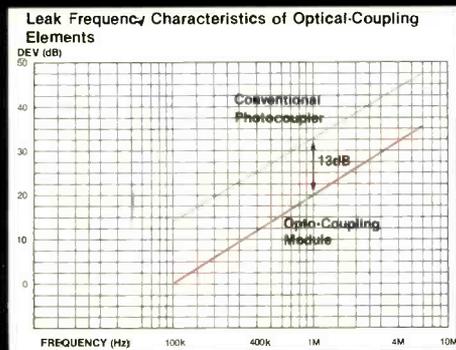
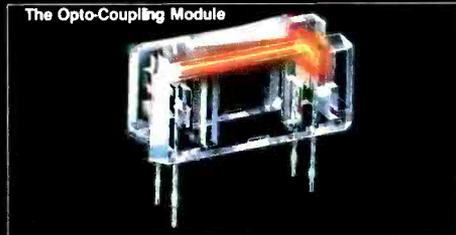


## Light Controls All Major Functions

**Infrared Remote Puts You in Full Command of The World's Only Random Music Calendar.**  
 Onkyo's light connection extends as far as your listening chair: all our CD players with Opto-Coupling come complete with infrared remote controls that give you full mastery over all major functions. The DX-530's remote control even lets you adjust the volume of the output signal. In addition, the displays have been upgraded to make it even easier to keep track of what's going on. Onkyo felt that the standard indications of current track, playing time, etc. weren't enough. So they set out to make their new displays even easier to read and even more informative.

## Random Music Calendar

The Random Music Calendar Display is another Onkyo innovation. Unlike some "fixed digit" displays that simply show the numbers of the tracks in memory, the Music Calendar shows you the track numbers in their playing order. It can display up to 19 track numbers at once. As soon as one track finishes, it vanishes and the following tracks each move up one notch. Best of all, the Random Music Calendar works in all play modes: normal play, memory play and even random (shuffle) memory play. In addition to the Random Calendar, the DX-530's display also shows the number of the track in play, index number, sequential memory indication (a track's position in the memory sequence) and elapsed/remaining time for both the track in play and the disc (or memory play sequence).



# SPECIFICATIONS

	DX-530	DX-330	DX-230
D-A Conversion	16 bit with two-times oversampling	16 bit with two-times oversampling	16 bit with two-times oversampling
Signal Readout System	Optical non-contact	Optical non-contact	Optical non-contact
Reading Rotation	About 500 — 200 r.p.m. (Constant linear velocity)	About 500 — 200 r.p.m. (Constant linear velocity)	About 500 — 200 r.p.m. (Constant linear velocity)
Linear Velocity	1.2 — 1.4 m/s	1.2 — 1.4 m/s	1.2 — 1.4 m/s
Error Correction System	Cross interleave readsolomon code	Cross interleave readsolomon code	Cross interleave readsolomon code
Decoded Bits	16-bits linear	16-bits linear	16-bits linear
Sampling Frequency	88.2kHz two-times oversampling	88.2kHz two-times oversampling	88.2kHz two-times oversampling
Number of Channels	2 (stereo)	2 (stereo)	2 (stereo)
Frequency Response	2 — 20,000Hz	5 — 20,000Hz	5 — 20,000Hz
Harmonic Distortion	0.003% (at 1kHz)	0.003% (at 1kHz)	0.03% (at 1kHz)
Dynamic Range	93dB	93dB	93dB
Signal to Noise Ratio	96dB	96dB	96dB
Channel Separation	90dB (at 1kHz)	90dB (at 1kHz)	87dB (at 1kHz)
Wow and Flutter	Below threshold of measurability	Below threshold of measurability	Below threshold of measurability
Output Level	2 volts r.m.s.	2 volts r.m.s.	2 volts r.m.s.
Power Supply Rating (4-types)	<ul style="list-style-type: none"> <li>● AC120V, 60Hz</li> <li>● AC 220V, 50Hz</li> <li>● AC 240V, 50Hz</li> <li>● AC 110/120/220/240V switchable, 50/60Hz</li> </ul>	<ul style="list-style-type: none"> <li>● AC 120V, 60Hz</li> <li>● AC 220V, 50Hz</li> <li>● AC 240V, 50Hz</li> <li>● AC 110/120/220/240V switchable, 50/60Hz</li> </ul>	<ul style="list-style-type: none"> <li>● AC 120V, 60Hz</li> <li>● AC 220V, 50Hz</li> <li>● AC 240V, 50Hz</li> <li>● AC 110/120/220/240V switchable, 50/60Hz</li> </ul>
Dimensions (W x H x D)	435 x 92 x 364 mm 17-1/8" x 3-5/8" x 14-5/16"	435 x 92 x 359 mm 17-1/8" x 3-5/8" x 14-1/8"	435 x 88 x 357 mm 17-1/8" x 3-7/16" x 14-1/16"
Weight	5.6kg 12.3 lbs.	4.8kg 10.6 lbs.	4.8kg 10.6 lbs.

	DX-130	DX-C600
D-A Conversion	16 bit with two-times oversampling	16 bit with two-times oversampling
Signal Readout System	Optical non-contact	Optical non-contact
Reading Rotation	About 500 — 200 r.p.m. (Constant linear velocity)	About 500 — 200 r.p.m. (Constant linear velocity)
Linear Velocity	1.2 — 1.4 m/s	1.2 — 1.4 m/s
Error Correction System	Cross interleave readsolomon code	Cross interleave readsolomon code
Decoded Bits	16-bits linear	16-bits linear
Sampling Frequency	88.2kHz two-times oversampling	88.2kHz two-times oversampling
Number of Channels	2 (stereo)	2 (stereo)
Frequency Response	5 — 20,000Hz	5 — 20,000Hz
Harmonic Distortion	0.03% (at 1kHz)	0.03% (at 1kHz)
Dynamic Range	93dB	93dB
Signal to Noise Ratio	96dB	96dB
Channel Separation	87dB (at 1kHz)	87dB (at 1kHz)
Wow and Flutter	Below threshold of measurability	Below threshold of measurability
Output Level	2 volts r.m.s.	2 volts r.m.s.
Power Supply Rating (4-types)	<ul style="list-style-type: none"> <li>● AC120V, 60Hz</li> <li>● AC 220V, 50Hz</li> <li>● AC 240V, 50Hz</li> <li>● AC 110/120/220/240V switchable, 50/60Hz</li> </ul>	<ul style="list-style-type: none"> <li>● AC 120V, 60Hz</li> <li>● AC 110/120/220/240V switchable, 50/60Hz</li> </ul>
Dimensions (W x H x D)	435 x 88 x 359 mm 17-1/8" x 3-7/16" x 14-1/8"	435 x 115 x 330 mm 17-1/8" x 4-1/2" x 13"
Weight	4.8kg 10.6 lbs.	6.0kg 13.2 lbs.

## Onkyo System Remote Control Compatibility Chart

	Compact Disc Players						Turntables				
	DX-330	DX-320	DX-230	DX-220	DX-200	DX-130	CP-1057F	CP-1055FII	CP-1055F	CP-1046F	CP-1044F
TX-108	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
TX-88	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
TX-84/TX-84M	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
TX-82/TX-82M	▲	▲	▲	▲	▲	▲					
P-3150V/M-5150	▲	▲	▲	▲	▲	▲					

	Cassette Tape Decks										
	TA-2140	TA-2130	TA-2090	TA-2058	TA-2056	TA-2048	TA-2036	TA-2028	TA-W460 (r.a)	TA-R260	TA-R240
TX-108	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
TX-88	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
TX-84/TX-84M	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
TX-82/TX-82M	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
P-3150V/M-5150	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲

▲ Remote control compatible  
▲ Only U.S. and Canadian models are compatible.

# ONKYO CORPORATION

ONKYO U.S.A. CORPORATION  
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Tel 201-825-7950 Fax 201-825-8150

● Specifications and design are subject to change with or without notice.  
● Consult your ONKYO dealer for the power supply in your area.

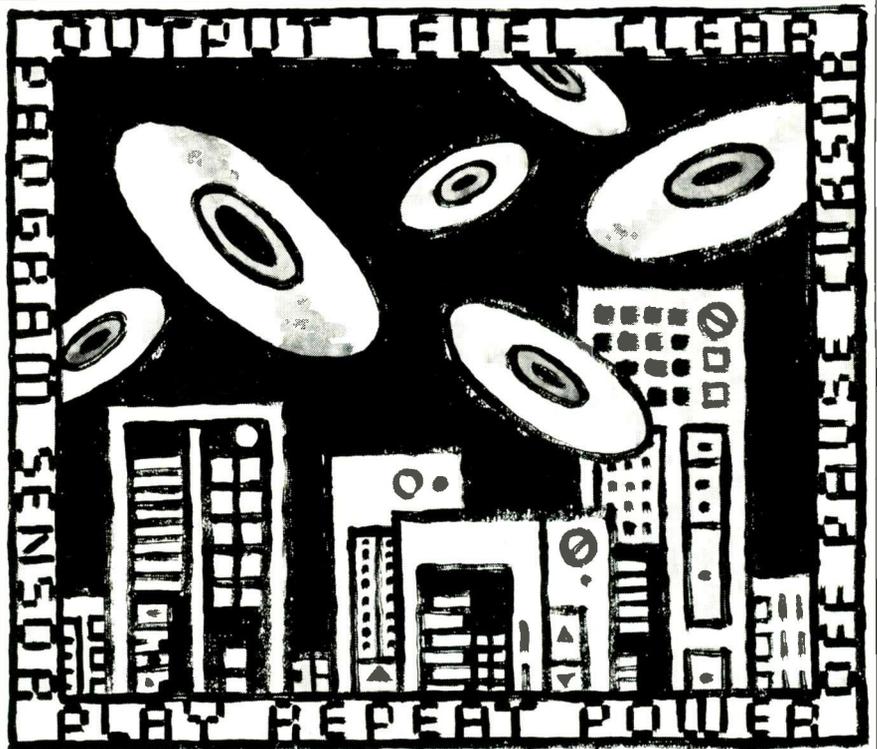
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## COMPACT DISCANT

**A**s I write, the furor continues unabated about the inclusion of a Copy-code chip in all R-DAT recorders imported into this country. At the present time, the matter rests with the National Bureau of Standards, which will be conducting tests to determine whether the Copy-code notch has an audible effect.

While the future of DAT is unclear, the "here and now" of consumer digital audio, the Compact Disc, will soon mark the sixth anniversary of its introduction. With the single exception of CD-Video, which thus far has not generated much interest since its introduction at the 1987 Summer Consumer Electronics Show, the future prospects for CD and its various derivative formats would appear to be very bright indeed, with significant developments on a number of fronts.

Philips apparently has been making rapid advances towards the realization of a recordable/erasable Compact Disc. The Philips Magnetic Optical Disc (MOD) system uses a disc coated with a recording substrate consisting of a number of rare earths, including tellurium, plus cobalt and other, undisclosed materials. The MOD process uses so-called "vertical" or perpendicular recording, wherein the magnetic particles stand at a right angle to the plane of the disc, rather than lying flat, as they do on conventional magnetic tape. In the recording process, a high-powered laser beam operating in a weak d.c. magnetic field is modulated by the digital signals. The pulses of the beam actually superheat a microscopically tiny, discrete spot on the magnetic substrate to the point where a reversal of magnetic polarity occurs. Thus, a stream of data pulses, analogous to the data pits on a conventional CD, is "burned" (recorded) into the magnetic surface. A special polarized laser beam of lesser strength is used for playback, and the reflective differences between the areas of normal and reversed polarity on the disc enable the recovery and reconstitution of the original digital information. The MOD can be erased and prepared for a new recording by applying a strong reversed d.c. field, as in conventional magnetic tape recording. Philips is claiming the MOD would be capable of 10 million record/erase cycles! If an



MOD recorder is marketed, it would also be capable of playing conventional CDs, but existing CD players would not be able to play MODs.

Philips has not indicated when an MOD recorder would be available, nor what it would cost. Some observers feel the MOD recorder is a hedge against the R-DAT recorder. Whether this is the case or not, it would have to be competitively priced with R-DAT. Considering the sophisticated technology of the MOD recording discs, one presumes that they would command a fairly substantial price, say \$12 to \$15 each. One could also presume that the MOD discs would be able to record up to 70 minutes, consistent with present CD playback. If this were so, R-DAT would have an advantage with its 120-minute recording capability. On the other hand, R-DAT could never compete with MOD in the number of recording and playback passes it can withstand, not to mention access time and programming versatility.

Philips has also been working on a number of developments employing CD-ROM technology. Foremost among these is an automotive routing system called "CARIN." It is, in essence, an

inertial navigation system; road maps stored on CD-ROMs are displayed on a CRT, and the driver follows the route on the map through preset coordinates. The problem of CRT legibility under bright daylight conditions is claimed to have been solved by the use of a very high-intensity green phosphor. Since it could be dangerous for the driver to take his eyes off the road to view the map on the CRT, a voice chip announces key checkpoint directions. Of course, optimum use of the system would require a second person in the car to act as a "navigator." In the most recent version of CARIN, the metal wheels of the car are the sensors for the satellite navigational signals. Apparently, the CARIN system has been brought to the point where Philips could market it as early as the spring of 1989!

As an additional comment on developments in CD-ROM, it is fairly well known that storage density is so high that 250,000 pages of text can be accommodated on a single CD-ROM. A friend of mine has just returned from the Japan Audio Fair, and he tells me that Mitsubishi has developed a new microchip which can increase the stor-



These anti-resonant chassis spacers are made with Kyocera's proprietary Fine Ceramics.



Fine Ceramics laser guide shafts hold their tolerances five times longer than other materials.

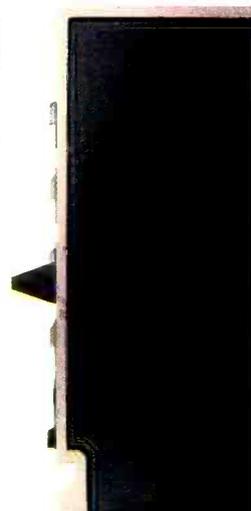
# These are the CD features they'll be copying next.



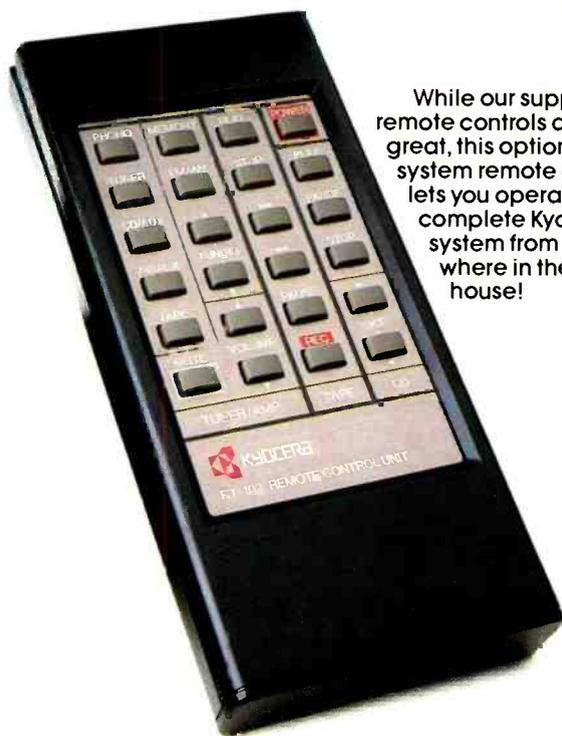
3rd-order analog filters cause less phase shift than the 7th- and 9th-order designs that others use.



Since Day One, every Kyocera player has had true 16-bit oversampling.



The front fascia of all our players is brushed aluminum, not plastic.



While our supplied remote controls are great, this optional full system remote control lets you operate a complete Kyocera system from anywhere in the house!



Our real wood side panels help damp resonance. They also look good.

In May of 1983, Kyocera introduced a CD player with true 16-bit digital filters. Today, the competition's calling this circuit "the latest thing." Years ago we had four-times oversampling. This year every high-end player worth mentioning has a similar design. In September, 1984 Kyocera raised some eyebrows with the world's first Fine Ceramics anti-resonant CD chassis. Now the stores are full of flimsy imitations.

How did all these innovations happen to come from Kyocera, and not some household name? Perhaps because Kyocera's knowledge of digital circuitry comes from years of building computers for some of the best-known names in electronics. Perhaps because Kyocera is a world leader in Fine Ceramics, the technology used to house circuitry in aerospace and other advanced applications. Or perhaps because some top-rated CD players from other brands were actually made by Kyocera.

Now Kyocera has four world-beating Compact Disc Players, ranging in suggested retail price from \$350 to the \$800 model DA-710CX shown here. Each boasts technology so advanced, it's a preview of what the competition will be selling in 1989. After all, history does repeat itself.



Built right from the ground up.



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Kyocera Canada, Inc., 7470 Bath Road, Mississauga, Ont., L4T 1L2, Canada (416) 671-4300

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Producing CDs via the DMM method can reduce costs, and some claim that the technique also makes for superior sound.

age density of CD-ROM a thousand fold. Thus, a CD-ROM disc will soon be able to store a mind-boggling 250 million pages of text! Even with lavish use of graphics and illustrations, one disc could handle the complete *Encyclopaedia Britannica*, dictionaries in dozens of languages, and a lot more; how

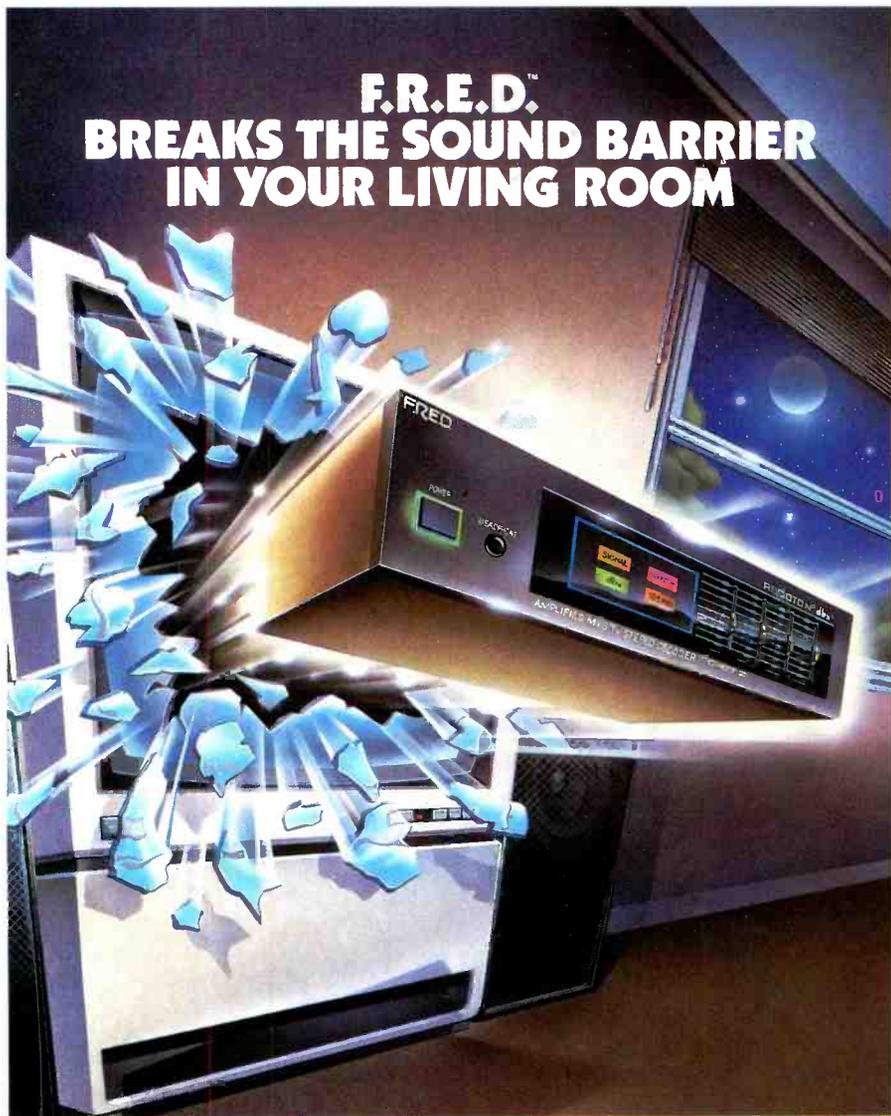
about a discography of every classical recording that has ever been made, complete with printed scores of all the works recorded on these discs? Of course, the task of entering all this data would be monumental in terms of time and money. Perhaps it could be a labor of love for a new generation of

computer-equipped monks and abots, a sort of medieval discipline brought up to date!

Of more immediate interest to audiophiles, the world of music continues to be well served by the ubiquitous Compact Disc. There have been advances in CD technology and quantum leaps in the availability and scope of music in this format.

In my December 1986 column, I described Teldec's Direct Metal Mastering process for the mastering and production of CDs. Thus far, Teldec has produced about a half-dozen DMM CD projects at their facilities in Hamburg, West Germany. Perhaps a little too optimistically, the Teldec people had expected to make DMM embossing cutters and ancillary equipment available to others by June 1987. I have now been given information which indicates that deliveries of DMM CD equipment will commence in January 1988. Capitol Records in Los Angeles will be the recipient of the first DMM CD system in the U.S.; several other major record companies will soon follow, and then gradually such major cutting houses as Bob Ludwig's Masterdisk, Jim Shelton's Europadisc, and Sterling Sound will go on-stream with DMM CD equipment. I have been told that when DMM CDs are produced in quantities of 10,000 or more, significant cost reductions can be expected. Another interesting claim is that on inexpensive CD players, the sound of DMM CDs is superior to that of CDs made in the conventional manner. I hope to acquire some sample DMM CDs soon, and I am looking forward to auditioning them.

When first announced, CD-Video was ballyhooed as "the successor to the 45-rpm single," but with discs at \$8 or \$9 each and with dedicated players at \$500, CD-V is not likely to set the world on fire! Much more likely to replace the 45-rpm single is the new 3-inch audio CD championed by Sony. This little gem is capable of providing up to 20 minutes of music. It can be played directly on any CD player that has an accessible center spindle, including top-loading units. For most front-loading players with motorized disc drawers, an adaptor for the 3-inch CD is necessary; otherwise, it would fall through the loading tray.



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Change your home viewing from dull to dynamic with the breakthrough technology of Recoton's F.R.E.D. family of MTS Stereo Decoders. Easy to install, each F.R.E.D. thrusts the action beyond your TV screen—delivering theater-like sound that surpasses the best stereo TV on the market.

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Available in amplified and non-amplified models for use with home stereo systems or self-powered speakers, F.R.E.D. decoders can also synthesize dynamic stereo sound from non-stereo broadcasts. Some models also offer SAP bi-lingual programming capability.

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The McIntosh XRT 22 is the purest expression of the loudspeakers scientist's endeavors. It is the one *right combination* of component parts that has eluded the diligent searcher for the loudspeaker bridge to the dominion of reproduced musical reality. The high-frequency radiator column is an illustration of the *right combination*. The 23 tweeter elements can reproduce 300 watts sine wave input power at 20 kHz, with the lowest measured intermodulation distortion. Because each tweeter mechanism handles a small quantity of the total power, extremely low quantities of distortion are developed. The total column radiates the energy in a half cylindrical time-coordinated sound field. The low distortion, transparency of sound, coherence of sound images, definition of musical instruments, and musical balance is simply a revelation that you must experience.

**Extra Realism**  
**Extra Depth**  
**Extra Spaciousness**  
**Extra Smoothness**



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**Handcrafted with pride in the United States  
by dedicated, highly trained craftspeople.**

Power. Precision. Performance. The new generation of Citation separates goes far beyond its predecessors to create the ultimate listening experience.

Designed and developed by Harman Kardon, one of the most respected names in audio, every generation of Citation has earned a reputation of excellence with audiophiles around the world. A true testing and proving ground for the most revolutionary audio concepts, Citation's innovations have ultimately been featured in all Harman Kardon

**components**

Steeped in audio breakthroughs and advanced designs, Harman Kardon's Citation division introduced the world's first Ultrawideband amplifier in 1963—the Citation 2 vacuum tube amplifier. In 1972, the Citation 14, the first FM stereo tuner with Phase Locked Loop (PLL) MPX decoding



Dr. Sidney Harman, Founder and Chairman of Harman Kardon.

was introduced. In 1977, the 150-Watt-per-channel Citation 19 became the first power amplifier to feature low negative feedback. 1981 saw the introduction of the Citation XX. Its exclusive High Instantaneous Current Capability (HCC) design provided the instantaneous current required to precisely drive and control any loudspeaker system.

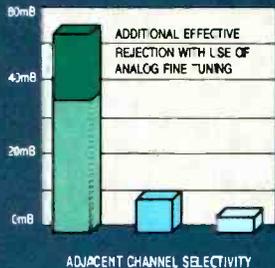
Now, just as the original Citation separates established design innovations that were years ahead of their time, the new Citation series sets the standards for the decade to come.

The new Citation twenty-three makes tuner design history as the world's first Active Tracking tuner and the world's first synthesizer tuner with Analog Fine Tuning. This patented system delivers two aspects of tuner performance that were previously mutually exclusive: high selectivity and high fidelity. Its superior adjacent and alternate channel rejection lets you tune in more stations with more fidelity than was ever before possible.



A thorough analysis of internal layout and a strict code of symmetrical circuitry ensures rapid, accurate reproduction of the music signal.

A thorough analysis of internal layout and a strict code of symmetrical circuitry ensures rapid, accurate reproduction of the music signal.



■ CITATION TWENTY-THREE ■ TYPICAL SINGLE IF TUNER  
■ NARROW MODE OF TYPICAL WIDE/NARROW TUNER

In contrast to traditional methods, the Citation twenty-three's Active Tracking circuitry provides previously unheard of adjacent channel selectivity, with little or no sacrifice in stereo separation or THD.

As the world's first High Voltage/High Current power amplifiers, the 200-Watt-per-channel\* Citation twenty-two and the 100-Watt-per-channel\* Citation twenty-four redefine amplifier design. With just the flick of a switch, their exclusive High Voltage/High Current technology lets you select the optimum mode for driving either 8-Ohm or 4-Ohm loudspeakers. The result is higher power output and cleaner, clearer sound than any traditional design, without distortion, overheating or current limiting.

In an area where the smallest interference can result in the biggest problems, the new Citation twenty-one preamplifier further ensures accurate signal reproduction. Its symmetrical circuitry and many design refinements offer the most precise amplification for a difference you can hear.



Gold-plated input jacks on the Citation twenty-one preamplifier provide reduced signal loss and improved long-term conductivity.

Citation's attention to detail can be seen as well as heard. The heavy rolled-steel, rubber-mounted chassis creates a solid, vibration-free environment that combines world class styling with sophisticated American industrial design.

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**Citation**  
harman/kardon

\*20Hz-20kHz = 0.08% THD into 8 Ohms and into 4 Ohms

# Citation. The next generation.



The mini-CD makes sense to me. At \$3.99, it would seem to have broad appeal for teens and newcomers to classical music.

Tom Jung, the ever-venturesome president and chief engineer of Digital Music Products (DMP), jumped on the 3-inch CD bandwagon and sent several of us an experimental disc containing selections from his superbly recorded CDs of Flim and the BBs, the Bob Minter Big Band, and New York

Cats Direct. The quality is absolutely identical to that found on Tom's standard CDs, and he will be offering a series of these mini-CDs shortly.

Delos Records, too, is offering 3-inch mini-CDs, in a series called "Pocket Classics." The first release, entitled *2001—A Sonic Odyssey*, con-

tains music from "Also Sprach Zarathustra" and other classical numbers taken from Delos CDs. A free adaptor for the 3-inch disc is included. Delos has an initial release of twenty 3-inch Pocket Classics drawn from its digital music catalog, and they will be available for a suggested price of \$3.99 each.

This new mini-CD makes sense to me. Its 20-minute length can certainly provide a generous serving of pop music and can accommodate many short classical pieces or movements of longer works. Most likely, this format will stimulate the production of recordings specially tailored for it. At a price of \$3.99, it would seem to have broad appeal for teenagers and for people just getting into classical music.



Finally, while I have, in previous columns, addressed the matter of older recordings reissued on CD, there have been some significant changes in the way many record companies are processing their reissued material. Rather than continuing the earlier practice of just transferring the cutting master—which, after all, was equalized and tailored to the dynamic range inhibitions imposed by the vinyl medium, the more conscientious companies are going back to original master tapes and making CD transfers directly from them. Consequently, if you have been holding on to some favorite recordings on LP because you thought they were irreplaceable, you may no longer have to do so: Much of what is being transferred to CD is superior in sound, especially in terms of dynamics and transient response, making the great performances newly attractive. **A**



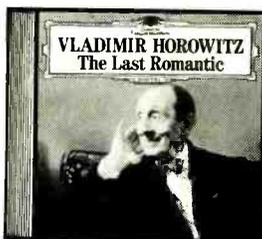
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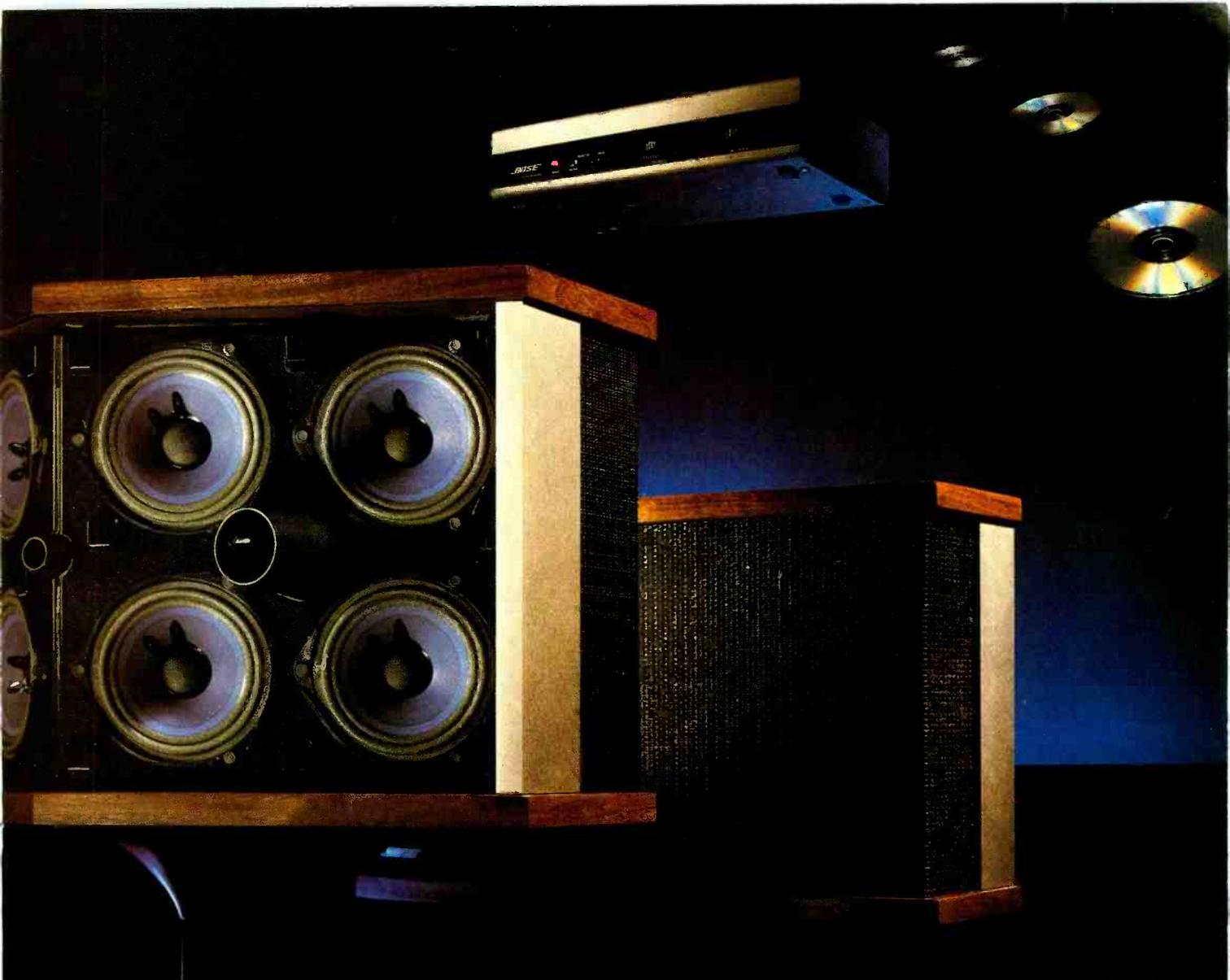
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# LUXMAN

KEN POHLMANN

## A FIXED STAIR



Illustration: Philip Anderson

I get asked a lot of questions. The question that gets asked the most, and the one I find the hardest to answer, concerns the workings of digital oversampling filters. More and more CD players employ this method for output low-pass filtering, but I find that few people really understand what's going on. The situation hasn't been helped by the hocus-pocus advertising inflicted on consumers by some of the manufacturers trying to elevate their digital filter designs over those of the competition. Lackluster explanations in the audio press also haven't helped. I know I've tried, but I've never been satisfied that I've gotten the message across. This month (and next), let's delve into the topic of filtering, and specifically digital filtering. Although it's somewhat tricky, rest assured that when you understand digital filters, almost everything else in your CD player is cake.

Filtering is an unfortunate fact of life for digital audio systems. A recorder input anti-aliasing filter must precede the sampling circuit to uphold the Nyquist theorem's criterion for lossless sampling, i.e., the input signal must be band-limited to no more than half the

sampling frequency. Similarly, a recorder or CD player must have an anti-imaging output filter following the D/A converter, again to filter out all frequencies above the half-sampling frequency, but its function differs. The analog signal at the output of the D/A converter is a pulse-amplitude-modulation waveform, easily spotted by its staircase appearance (Fig. 1). The sudden shifts in amplitude, which give it this shape, represent high-frequency components not present in the original analog waveform. These components include infinite series of multiples of the sampling frequency and of images of the original signal spectrum. Although above the highest audible frequencies, they are artifacts of sampling which must be removed to re-create the original, smooth waveform. The output filter is, in fact, sometimes referred to as a smoothing filter.

Sharp-eyed readers might question the need to worry about frequencies such as 88.2 or 176.4 kHz, since they lie so far above the limits of audibility. Why waste money on such a filter when the ear itself is rather effective at filtering everything beyond 20 or 25 kHz? The original waveform is repro-

duced without filtering, but it is accompanied by image bands that could stress a CD player's or DAT recorder's output amplifier or cause intermodulation in downstream analog equipment through which the signal passes. For example, the high-frequency components might intermodulate with the base-band frequencies to cause audible distortion or beat against an analog tape recorder's high-frequency bias signal to produce spurious tones. Filtering is mandated.

Thus, a low-pass filter must follow every audio digitization system. At first glance, this means an analog filter suitable for processing the analog signal as it leaves the digitization system. Engineers have been designing analog filters for a long time; there would seemingly be little trouble with this particular assignment. Ideally, we would like to attenuate all audio frequencies above the half-sampling frequency yet not affect the lower frequencies in the audio band. Moreover, we would like the transition from the unfiltered to the filtered frequencies to be very sharp. This would let us make the usable band space as broad as possible to yield an extended and flat frequency response.

An ideal filter would have a flat pass-band (the audio range which the filter passes), a steep or brick-wall filtering characteristic, and a stop-band (the frequencies which the filter eliminates) attenuated to below the system's quantization resolution. In addition to these criteria for frequency response, an ideal filter would not affect the phase of the signal or any other time-domain characteristic.

In practice, implementing such an ideal filter presents a number of engineering challenges: A brick-wall design means compromise in other parameters, such as flat pass-band and low phase distortion. To alleviate the problems inherent in a brick-wall response, we could design filters with more gradual cutoff; these, for example, would not exhibit phase nonlinearities. However, the frequency of the half-sampling point would have to be raised, to place it in a sufficiently attenuated part of the filter characteristic. Therefore, a higher sampling frequency, much higher than that required for a sharp cutoff filter, would be needed

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## TECHNICS TECHNICAL REPORT



**THE NEW TECHNICS AV RECEIVER COMBINES SOPHISTICATED REMOTE CONTROL TECHNOLOGY WITH ADVANCED AMPLIFIER CIRCUITRY.**

### NEW CLASS A AMPLIFIER CIRCUITRY

Technics New Class A Amplifier circuitry varies the bias across the output transistors in accordance with the signal level. This is designed to allow an amplifier to combine the low distortion of Class A operation with the high efficiency of Class B. Additionally, Technics Synchro-Bias system is designed to help reduce amplifier distortion by keeping the power transistors in a ready state at all times, so they don't switch on and off.

### COMPUTER DRIVE AMPLIFIER TECHNOLOGY

This design uses sensors to monitor the amplifier's output stage. Using the input data from the sensors, a microprocessor constantly adjusts the operating characteristics of the output transistors. When combined with New Class A circuitry, this amplifier technology helps provide accurate reproduction of music.

### ELECTRONIC GRAPHIC EQUALIZER

With an electronic graphic equalizer, such as the one in the SA-R510, you have powerful control. The listener can pre-program and store various equalization curves into memory and then recall any one of them at the touch of one button. One equalizer setting might be used for listening to rock, another for jazz, etc.

#### TECHNICAL SPECIFICATIONS FOR SA-R510

**AMPLIFIER SECTION:** Rated minimum sine wave RMS; power output, 20Hz–20kHz; both channels driven, 100W per channel (0.007% THD, 8 ohms).

**DYNAMIC HEADROOM:** 1.2 dB (8 ohms).

**GRAPHIC EQUALIZER SECTION:** Band level controls, +12 dB – 12 dB (2 dB step); center frequencies, 63Hz, 160Hz, 400Hz, 1kHz, 2.5kHz, 6.3kHz, 12.5kHz.

**Technics**  
The science of sound

The use of digital filters puts the burden on digital processing, which is stronger and more versatile than analog circuitry.

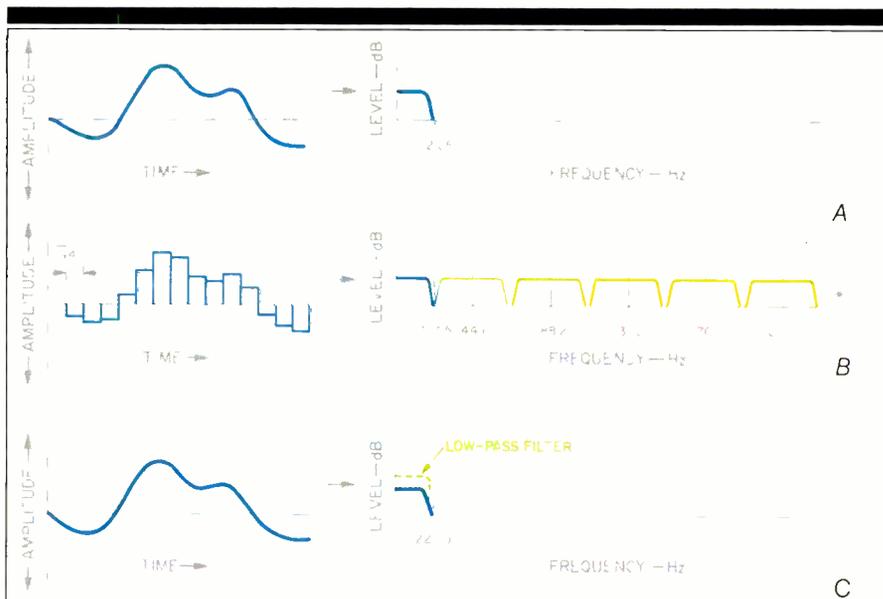


Fig. 1—In digital playback, a smooth waveform containing only audio-band signals (A) is reconstructed by the D/A converter into a staircase shape (B). This contains the sampling frequency plus an infinite series of sampling-

frequency multiples and images of the original signal's audio-band spectrum. Low-pass filtering smooths the waveform (C) and removes the images.

to achieve the same flat frequency response. To limit the sampling rate and make full use of the band space below the half-sampling point, brick-wall filters at both input and output of the system are a necessity. Our problem is now stubbornly defined.

Basic filter elements of various types can be cascaded (repeated in series) to sharpen the cutoff. The greater the number of repeated stages, the steeper the filter—until the ideal filter frequency response is approximated. Unfortunately, as the cutoff steepens, the phase shift increases as well. Compact Disc players might require ninth-order filters; the cutoff would look like the North Rim of the Grand Canyon (that's good), but the phase shift might exceed 360° at 20 kHz (that's bad). Such a phase shift would introduce nonlinear time delay across the audio frequency band.

The resulting group delay, which measures the change of phase shift with respect to frequency, causes high frequencies to be delayed relative to lower frequencies. The delay increases toward the cutoff frequency of an analog filter, creating a kind of "time smear" in the signal. With an analog

brick-wall filter, this frequency-dependent group delay at 20 kHz might be 100  $\mu$ s relative to 0 Hz. Whether grossly audible or not, it is certainly measurable. Obviously, it is preferable to avoid any such group delays in the frequency response of a CD player.

Given the problems with analog filters, we might wonder, is there some way of interfacing digital storage with the analog world without using analog filters? The answer is yes and no. When the output filter is placed after the D/A converter, it is necessarily an analog device. But there's an alternative: Filtering can be implemented in the digital domain before the D/A converter. Using digital filters, we can place the burden on the back of digital signal processing—a stronger and more versatile beast than analog circuitry. With clever manipulation of the numerical data itself, we can alleviate the need for an output brick-wall filter. And yet, even then, we'll still need an analog filter, albeit a fairly harmless variety.

Next month, we'll see how digital filters work and what they and analog filters have in common. The delay until then is, as you'll see, appropriate. **A**

# NOW TECHNICS LETS YOU CREATE AN AUDIO/VIDEO EMPIRE AND CONTROL IT FROM FAR, FAR AWAY.

Start with the new 100W A/V remote control receiver that puts you in complete control.

Imagine. Commanding an audio/video empire with just one remote control device.

Imagine. Controlling a compact disc player. And a cassette deck. And a turntable. All from across the room.

Then imagine expanding this remote control empire to include compatible Panasonic TV's, VCR's and even other brands.\*

Now it is all a reality. With the new Technics 100W AM/FM stereo remote control receiver (100 watts per channel at 8 ohms, 20Hz-20kHz with 0.007% THD) and compatible components.

The new SA-R510 has also been engineered with a built-in electronic graphic equalizer/spectrum analyzer.\*\* So you can make precise adjustments to bass, treble and mid-range sound. There are even 24 AM/FM station random access presets for instant recall.

The new Technics remote control receiver. The beginning of an audio and video empire you can control from far, far away.

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\* See dealer for details.  
\*\* Equalizer not operable by remote.

Enter No. 47 on Reader Service Card

# A Life In Radio Broadcasting

Techniques and equipment used in broadcast have varied over the years, but they all had to provide a smooth, realistic show.



Talk shows have been one of radio's enduring formats, and often their hosts have become quite famous. Here Arthur Godfrey interviews Adele Jergens, who was notable first as a Broadway showgirl and later as a movie star before breaking into television.

**Mortimer Goldberg**

**M**y life in broadcasting ran the gamut from the relatively primitive to the ultra-sophisticated. I'm fortunate to have experienced a taste of each.

I joined the CBS Radio Network as a broadcast engineer in 1951. While television was firmly on the scene with ever-increasing popularity, it had not yet lessened the popularity of radio. Dramatic, variety, and music programs were still on the network schedule, and I was lucky to have been part of that "old-time radio."

Though I spent most of my career as a tape editing specialist, I was also involved in the live radio soap operas—*Helen Trent*, *Our Gal Sunday*, *Ma Perkins*, *Guiding Light*, *Wendy Warren and the News*, etc. The dialog, commercials, and sound effects originated from one studio in New York; an organist, providing theme and bridge music, worked out of a second studio. A second studio was necessary because, due to the musicians' union rules at the time, the organist in New York could be heard only in the Eastern time zone. Therefore, while the output from the cast studio was distributed on separate lines to A.T.&T. facilities in each of the three time zones, the output from the New York organist's studio went only to the Eastern facility. For Central/Mountain and Pacific time zones, organists at the CBS stations in

Chicago and Los Angeles supplied the missing musical components.

Scripts of episodes were supplied in advance to the organists. Aside from the established opening and closing themes, which had specific time allotments, the virtuosity of each organist was depended upon to provide the mood music for scene setters, punctuation for scene endings, and background music behind the dialog, where appropriate. Once the complete program reached each A.T.&T. facility, it went out over the line network to affiliated stations in each time zone. Sounds complicated? It certainly was, but it worked for many years.

The soap operas continued in sequence through the course of an afternoon, and usually six studios were active for the broadcasts. It was the responsibility of master control to properly interconnect the studios and route the programs to the proper lines to A.T.&T. at the scheduled broadcast times.

The engineer in the cast-studio control room mixed all the elements of the drama. In the studio itself, another engineer was responsible for playing commercials, which were usually on 12- or 16-inch transcription records. The engineer had two turntables and a small mixing console, and he wore a split headset, which provided program in one ear and turntable output for re-





The documentary was one of the new forms of radio broadcasting made possible by magnetic recording.

cord cueing in the other. In addition to the recorded commercials, it was also not uncommon to have a commercial delivered live by an announcer.

A minimum of two sound-effects men were assigned to a program, with one responsible for "manual effects" and the other for effects on records. If a script called for extra-complicated sound patterns, additional help was assigned.

The area where the manual effects were produced showed great likeness to a garage sale. A variety of doors were individually mounted in wooden frames; the frames were on wheels to provide mobility. The assortment included automobile, wood, and screen doors, and each could be easily operated from a gentle open and close to a forceful slam. Slate slabs, sheets of hard wood, and gravel-filled boxes were arranged on the floor; these were walked upon in order to simulate various types of footsteps. Also on hand was a five-step staircase. An assortment of shoes with different sole and heel materials were used to provide authentic sound. The difference between male and female walking patterns also had to be considered. Creating the sounds of footsteps moving from a gravel path, to a stone walk, up

some steps, and across a wooden porch to the front door resembled a Fred Astaire dance routine.

A wide mixture of paraphernalia covered a table for numerous needs. These included a door knocker, a doorbell chime, and a telephone mounted on a box with a two-position key, which offered a telephone bell ring on one side and a busy signal on the other. The hand manipulation of cellophane created a reasonable facsimile of the sound of a crackling fire. All of this coupled with whistles, sticks, paddles in water, and so on contributed to the ambient sound requirements.

The sound-effects record console consisted of three adjacent turntables with variable speed control. The tonearms were of the same vintage as the old home phonograph, which used a changeable steel needle as the stylus. However, we used "cactus" needles instead. These sharply pointed fibers required frequent change, but they caused less record wear and were less prone to producing objectionable surface noise. The record speed was 78 rpm, and a change of pitch for a sound was accomplished by adjusting the variable speed control. For instance, the sound of an automobile slowing and coming to a stop was achieved by reducing the speed of one record to lower the pitch of the engine; segueing to another record provided the braking sound of the car coming to a stop.

An interesting technique was employed to cue a record to areas other than the beginning. Back slipping a record with a cactus needle was not recommended because of its delicate tip, so a mark was made near the desired position with blackboard chalk. With the normal clockwise motion of the table, the stylus would etch a visible line in the chalk at the desired point of pickup. These cueing aids were prepared in advance; when ready for use, the stylus was placed in the slotted mark on the record. A dampened cloth removed the marks afterwards.

The cast microphone was the famous RCA 44BX, which was a ribbon-element, pressure-sensitive (velocity) microphone. It had a figure-eight pattern, providing full pickup in front and back, with decreased sensitivity on each side. Various vocal perspectives were achieved within a 1- to 2-foot ra-

dus of the microphone. An actor, entering the scene from across the room, would project his voice to the side of the mike while gradually moving to its front and continuing his dialog.

A valuable production aid was the isolation booth. An enclosure about twice the size of a telephone booth, it contained a microphone and a baffle-enclosed earphone which was attached to the microphone stand. The earphone provided cues to the actor and was adjusted for proper hearing level without the danger of feedback. The microphone could be filtered to simulate a voice on the telephone or any other effect that couldn't be achieved with the regular cast mike.

Echo or reverberation effects were produced in an echo chamber. This was a long, narrow room, approximately 25 feet in length and about 4 feet wide, whose walls were covered with angled and highly polished wood panels. A microphone was located at one end, and a speaker was at the other end. All control rooms had a pair of lines to and from master control which were designated "Reverb Line" and "Reverb Return." Master control would patch a control room to and from any of the three echo chambers. An amplified bridge of the sound source to be echoed was fed to the speaker in the chamber. The sound traversed the polished panels with directed compounding and bounce, arriving at the microphone at the opposite end. The amplified output of this microphone terminated at a control-room console position. The degree of reverberation was determined by the amplitude of the microphone output, which in turn was controlled by the setting of the reverb return pot.

During this period, I was involved in an incident which in retrospect I consider funny, but at the time I was sure it would prematurely terminate my career at CBS. I was assigned, as vacation relief, to the famous police story, *Gang Busters*. The usual complement of sound-effects equipment, and then some, was present. While in the studio setting up the mikes, etc., I noticed a box and a telegraph key on the sound table. The sound-effects man, noticing my interest in it, said, "Don't touch it, it's hot." He then left to pick up a cable from the stock room. I wondered what

was the big deal about a telegraph key and oscillator being "hot."

The cast and the director were seated around a table, engaged in the first script reading, prior to the "on mike" rehearsal. Physically, they were no more than 10 feet from where I stood. I decided to practice a bit of Morse code, feeling that the sound would be unobtrusive and would not interfere with their script reading. However, the attempt resulted in a barrage of gunfire, the sound of which had not been equalled since World War II. What nobody had told me was that this telegraph device replaced the usual handgun for gunshot effects. A tray of blank shells was housed in the box, and the shells were fired by the action of the telegraph key.

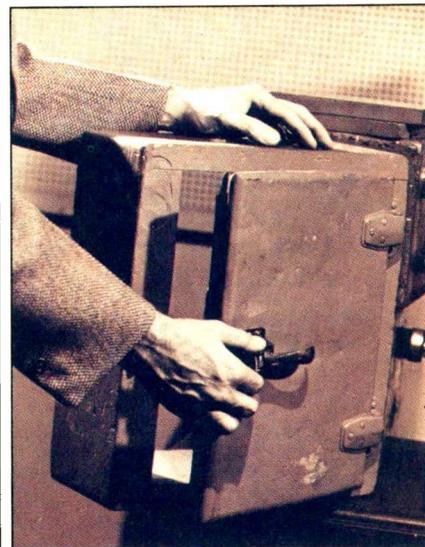
Everyone jumped to their feet at the barrage I unleashed, with the exception of two, who fell off their chairs and onto the floor. Scathing comments were directed at me, none of which I heard because I had been deafened by the noise. (As a matter of fact, everyone suffered from temporary hearing impairment.) The sound-effects man heard it all in the corridor, came running in, and screamed, "I told you it was hot!" That he did, but it would have been better if he had told me what it was. Everyone's composure was eventually restored, and we proceeded with the task at hand—the show. Fortunately, the mishap occurred early, and there were hours of rehearsal before air time. By then, all was forgiven but not necessarily forgotten.

Live broadcasts were quickly replaced as the benefits of tape recording became apparent. The shows then were prerecorded and aired from tape. This resulted in a much more flexible production schedule, one that was not dependent on precise broadcast times. Another advantage, in terms of economy, was that the shows no longer had to be re-enacted for the West Coast; all we had to do was run the tape again. It's interesting to note that tape recording had a psychological effect on the actors. Continuity was mandatory in a live broadcast, and in order to maintain that continuity, quickly improvised ad libs often covered a miscue in script reading. Once they realized that tape could be edited and



imperfections repaired, the actors and actresses became more relaxed. Two or three takes became common; later, in an editing session, the show could be assembled to perfection. The mistakes would find their way to the cutting-room floor. The same later applied to music programs, where skillful tape editing repaired the "clinkers."

As I mentioned at the outset, the majority of my 35-year career in Technical Operations at CBS Radio was devoted to developing skills in tape recording and editing, and to applying those skills to the production of many programs. One of my assignments was a program called *World Music Festivals*. This was a summer replacement for the live New York Philharmonic broadcasts. The year was 1952; for the first time, concerts and recitals from the major music festivals of Europe (Salzburg, Amsterdam, Edinburgh, London, etc.) were being broadcast in the United States on a regular weekly basis. Jim Fassett, CBS Radio's Director of Music, who also served as commentator for these programs, attended the European concerts and selected the works for our broadcasts. He recorded his commentary separately, and all was shipped back to the U.S. for assembly into the final product.



Following scripts closely, the sound-effects men would slam doors, which sometimes were the real thing simply brought into the studio and mounted. In other cases, miniatures were built specially for the purpose.



On radio, it was possible to commit murders by firing blanks in real revolvers, throwing bags filled with sand down steps, and chopping cucumbers with an axe. It was a test of ingenuity.

At the time, tape recording was still in its infancy, and international standards were not yet established. Bias frequencies and equalization methods varied among manufacturers in Europe and the U.S. As a result, when tapes of these magnificent symphonic performances were played on American machines, the quality was poor. Excessive or insufficient bass, lackluster highs, a strident conglomeration of over- or underemphasized frequencies, all indicated that the frequency response curve of the recordings was not flat.

To correct the problem, we requested that the various recording organizations provide us with a sweep of frequencies from 100 Hz to 12 kHz, with a 1-kHz reference. This tape was included with every shipment, and with the use of a program equalizer, the boost or attenuation of frequencies, as required, restored the sound to a true reproduction of the originally recorded concert. All the tapes were dubbed through the equalizer before the mixing and editing began. Of course, by today's standards, 100 Hz to 12 kHz is not considered high fidelity, but at that time it was rated very good.

The difference in equalization standards was but one obstacle that had to

be overcome. The physical characteristics of the tape itself also varied considerably. It was made of acetate, which easily broke apart. This was not a real problem, as splicing tape corrected that. The oxide coating and its inadequate adherence to the acetate backing was the major pitfall. As the tape travelled across the playback head, residue oxide was left in the gap, and a static charge built up. This caused audible pops and clicks, which of course required that the dubbing process be stopped and the heads cleaned. The clear audio segments were but 10 minutes in duration; this clear period was extended to 20 minutes by using absorbent cotton against the tape before it entered the head assembly. The cotton captured the oxide residue sufficiently to delay its adverse effect on the playback head. It was only the European-made tapes that presented this problem. The three leading American brands at the time—3M, Audio Devices, and Soundcraft—did not.

Another problem was that some of the European recorders had their head assemblies facing the back of the machine. Tapes recorded on these machines were received with the oxide out on the reel. Rather than reverse winding all the tapes before working with them, we would flip the tape 180° before it entered the head housing. This flip was done prior to the tape guides, so proper tape alignment to the heads was unaffected. This same flip was repeated during the rewind process so that the reels were returned as originally shipped.

It has been said that necessity is the mother of invention, and this certainly applies to the way we played back tape to air. The *World Music Festival* broadcasts were 2½ hours long. The leading professional-type recorder of the day was the Ampex 200, which was the size of two modern-day console machines placed side by side. The Ampex operated at 30 and 15 ips, with 15 ips being the standard speed used in our operation. At 15 ips, a 4,800-foot, 14-inch-diameter reel was required for each hour. The low motor torque of the machines required about 3 seconds of run-in for stabilization in order to render a wow-free start. For the top of the program, the few sec-

onds required was easily compensated for by backtiming. However, the *World Music Festival* programs often had lengthy works which did not readily accommodate themselves to convenient reel changes. Segueing from one reel to the next often was required within the music, and effective "wowless" crossover was mandatory. We devised a foolproof solution by placing a 3-inch stripe on the back of the Reel 1 tape, with a red china marker, 5 seconds before the end of modulation. This was spliced to leader tape to end the reel. A long length of leader tape started Reel 2, with a mark 5 seconds before the start of modulation. This mark on Reel 2 was lined up directly on the playback head. In the process of playback, when the mark on Reel 1 entered the head housing, Reel 2 was started. The pot on the console for Reel 2 was left open, and the crossover between the reels resulted in a smooth continuity of the music. Since each reel ended with leader tape, watching for the mark was no hardship, as the end of the reel was readily visible.

During the course of the New York Philharmonic broadcast season, live from Carnegie Hall on Sunday afternoons, we had opportunities to exhibit the versatility of tape recording. There was a 20-minute intermission during the concerts, and Jim Fassett and I collaborated in presenting "Experiments in Sound" for some of the intermission features. (Others were devoted to interviews with celebrities of the concert world.)

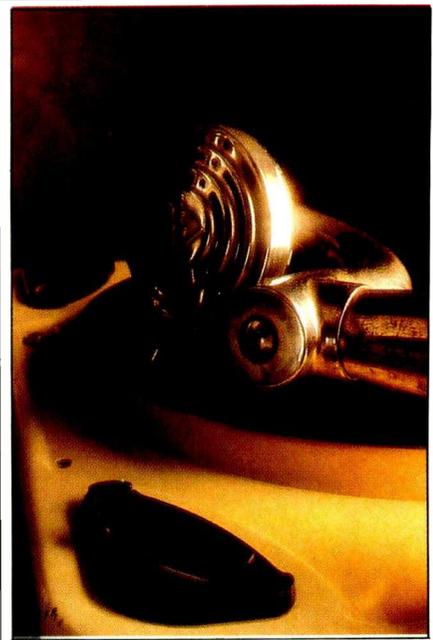
Some of our experiments involved changing tape speed, which yielded vast changes in the pitch, timbre, and duration of common sounds. A bicycle bell was transformed to a fire gong, a tugboat whistle to an ocean liner's horn, a woman's sobbing to a baby's cry. These were all created by changing the recorder to a speed above or below the recorded speed of the original sound. The speeds of a tape recorder (30, 15, 7½, 3¾, 1⅞ ips) are equal multiples of each other. An equal-multiple change in speed results in an octave change, relative to the original pitch. In addition, for each halving of speed, the time duration of the sound is doubled.

One of our intermission features was

devoted to an experiment with a canary and a flute. The recording of a canary trill was reduced in speed by a factor of four. This reduction lowered the pitch four octaves and quadrupled its original duration. The high-pitched rapid trill was converted to a mid-frequency range of individually discernible notes. The transformed sequence was played for the first flutist of the New York Philharmonic Orchestra. He listened carefully with a headset and played his flute in harmony with the canary. This was by no means an instant event, but took considerable rehearsal time to perfect. The excerpt ran 1 minute and was divided into 15-second segments to facilitate a successful blend. The completed segments were edited together to form a 1-minute canary/flute duet. The speed of the final mix was increased by four times, to match that of the original canary trill; this effected a 15-second sequence of sound that resembled harmonizing canaries. The demonstration and description of each step filled the 20-minute intermission.

The canary/flute feature led to a more ambitious undertaking, which was one of the most acclaimed intermission features in the series. This was called the "Symphony of the Birds." From among hundreds of bird species monitored, 21 were selected for the sustained note content of their songs. We recorded the songs and changed pitch and duration as with the canary, but variable capstan speed was used to create harmony between the calls. A one-third difference between the frequency of vibration of sounds results in harmony when the sounds are mixed together. To illustrate: "A" above middle "C" on the piano is a 440-Hz tone. This is the note struck when members of an orchestra tune their instruments. The one-third variation below the fundamental frequency is at 293 Hz, and the tone one-third above the fundamental is at 587 Hz. A mix of 440, 293, and 587 Hz results in harmony above and below the fundamental frequency of 440 Hz. If a 440-Hz tone were recorded at 15 ips and played back at 10 ips, we would get a 293-Hz tone; if played back at 20 ips, a 587-Hz tone would result.

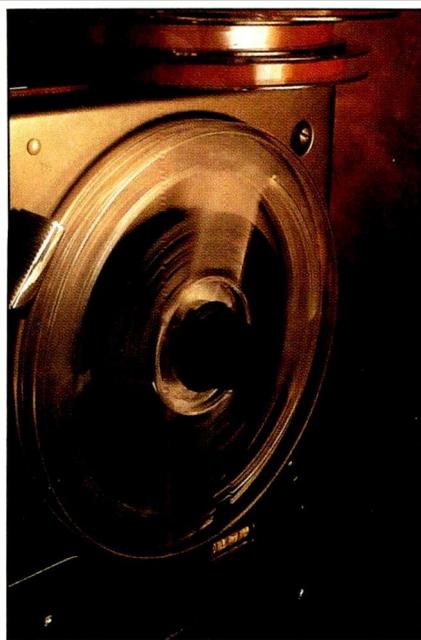
Capstan motors are hysteresis types and are frequency sensitive for speed



Maintaining integrity of speech flow with natural sounding pauses was a difficult task for the tape editors.

regulation more so than to voltage changes. They lock in on the power line frequency of 60 Hz, which is very stable. A variable oscillator-controlled power amplifier provided the power source to the capstan motor; by going from the 60-Hz standard to 40 Hz and to 80 Hz, we obtained the desired pitches. All mixes from the variable-speed machines were recorded to the "show tape" at the standard 15 ips. The melody formed was derived from the tonal structure of the original bird call. Through these manipulations, a three-movement symphony was created, with 21 bird species comprising the orchestra.

Broadcasting possibilities knew no bounds as a result of this magnetic strip called tape, and it contributed greatly to the emergence of the radio documentary. One of the first, and perhaps the most significant, was the Edward R. Murrow *Hear It Now* series. The coverage of the McCarthy hearings in the Senate was among the best remembered episodes. I was fortunate to be one of the tape editors on this series along with two colleagues, Ed Gille and Joel Tall. (It was Tall who developed the tape-editing block known as the EdiTall. A masterpiece in its simplicity and effectiveness, it has



Experimental tapes made by changing speeds could turn a simple bicycle bell into a ringing gong.

maintained its worth through continued use to this day.)

Time and deadline pressure is common to all business and industry, but I don't believe any other area has to contend with quite as much of it as broadcasting does. In the radio documentary, massive amounts of recorded material had to be condensed into the relatively limited time allotted to the broadcast. Scores of interviews, actuality with natural sound, and transitional music bridges all required blending with the narration of the host. The amount of pertinent material that we could fit into a broadcast was increased considerably by the editing out of the "uhs," "ahs," and other hesitations of the interviewees. In some cases, one-third of the total time of an interview was wasted by these thought-seeking utterances of no consequence. We were careful to maintain the pacing and the normal cadence of speech; by preserving normal breathing patterns, regardless of the eliminated portions, a well-articulated statement resulted.

No editing was ever performed that would alter the intended meaning of a statement. One of the most difficult aspects of maintaining this integrity was dealing with voice inflection. Often the

needed comment would be in the midst of a continuing sentence of unrelated subject matter, so attempting to remove it would produce a comment ending with an upward inflection. Cutting at that point was impossible because it was completely unnatural, and it would be very obvious that further comment had been eliminated. Very often it was possible to retrieve from "outtakes," or to borrow from within the interview, a matching syllable which ended with the proper downward inflection. Dubbing out this desired syllable at a level matching its new location and splicing it in place did the trick. These operations always kept the juices flowing.

The recording of material in the field was accomplished with the aid of portable recorders such as the Nagra and the Uher. Both were reel-to-reel recorders; when taken into the field, a technician would have to accompany the reporter to tend to the machines. In 1967, the appearance of the cassette recorder was a definite boon to radio news coverage. The ease of loading and operating, ample recording time, light weight, and excellent audio quality all favored its use in the hands of the reporter.

The instant success of convenient recording "on location" prompted improved means of getting material back to the studio. Reporters always used the telephone for transmitting their reports back to the base. The tinny sound quality was accepted, because with it came immediacy and, in most cases, the good intelligibility that this method afforded. While the cassette recorder vastly increased the variety of material which could be broadcast, the limited frequency response of the telephone made this method of transmission less and less trustworthy.

It has always been difficult to obtain complete reliability in the phone company's lines for remote broadcasts. Out of the necessity for improved audio quality, one ingenious piece of equipment emerged, the Comrex low-frequency extender. The pass-band of an ordinary telephone circuit is about 300 to 3,000 Hz. The extender shifts upwards, by 250 Hz, the frequency of all audio fed to it. As a result, audio with content from 50 to 100 Hz is shifted upward to a range of 300 to 350 Hz,

which places it in the pass-band of the normal telephone circuit. The size of the unit used in the field is about the same as that of a standard-sized portable cassette recorder. Back at the studio, a decoder accepts the audio from the telephone and down-shifts the frequencies by 250 Hz, restoring everything to normal. As a result, the strident, tinny sound is transformed to a more natural timbre.

The success of the extender prompted Comrex, and others, to apply the same theory to the upper frequency band, where the higher frequencies are down-shifted to place them within the telephone's pass-band. When both high and low frequencies are being shifted, two telephones are required. A comparable two-telephone configuration is used at the studio for the decoding process. The end result is audio quality from 50 to 5,000 Hz, which equals a good voice-grade broadcast line. Who ever said that you can't make a silk purse out of a sow's ear?

Like the tape cassette, the cartridge was another big development for the broadcast industry, revolutionizing the airing of music, sound signatures, news pieces, and commercials. The cartridge contains a closed loop of tape and comes in various time durations, from 10 seconds to 10 minutes. Sizes are chosen to satisfy specific needs, i.e., 35 seconds for a 30-second commercial, 65 seconds for a 1-minute commercial. Record cuts run about 3 minutes, on average, so a 3½-minute cartridge can cover many of a disc jockey's music selections.

As a cartridge is started in record mode, a 1-kHz pulse known as the primary cue is automatically applied on the control track. The intended audio is recorded on the program track, and at its conclusion the cartridge is permitted to continue running, since the primary cue will automatically stop the cartridge. The cartridge is now cued to the start of the audio and is ready for play. Once the audio source is transferred to cartridge, reliable playback is achieved merely by pressing a button.

The clean, instant pickup of audio is certainly what prompted the cartridge's use for music. Cueing of records is eliminated, as disc jockeys play their music by conveniently slip-

ping cartridges in and out of the playback units. The key factor in cartridge operation is never to manually stop it, but to allow an automatic stop. There is no visible indication to determine if the cartridge is properly cued; therefore, premature stopping would result in up-cut audio or dead air on the next play.

In addition to the primary cue, provision is made for two other cues for automation needs: The 150-Hz secondary cue and the 8-kHz tertiary cue. These are applied on the control track by pressing buttons to apply the pulse where needed. In the playback of the cartridge, a relay contact is closed when the pulse is sensed off the tape, and this starts the automation control circuitry. There is no interaction between the pulses because of the wide frequency difference between them and because of the sharp filtering between the involved circuits.

Today, the broadcast cartridge plays a large role in the computer-controlled audio switcher used by the CBS Radio Network master control. In 1982, I was directly involved with the installation of this automation system, which has a complement of 40 cartridge machines. Every commercial and program recorded on cartridge has a secondary cue applied at the end of modulation. This pulse supplies a variety of required switching functions, which are determined by the program events entered in the computer. Programs on the CBS Radio Network are "time zoned." This means that they play at the same hour of the day on Eastern, Central/Mountain, and Pacific stations. Three plays are required for each program. The hourly newscasts are fed to the full network, but the commercials are "time zoned," so three different commercials must be simultaneously fed to the stations in the three time-segmented areas of the country.

The commercial cartridges are placed in their designated cartridge machine positions. The computer switches the news studio to air at the scheduled time. When the first commercial is called for, a "next event" button is pressed on the console. This starts the commercial cartridges, and the audio is routed to the proper transmitting channel for each time zone. The transmission to the affiliated stations is via satellite, with each station



having its own downlink. The secondary cue at the end of each commercial cartridge returns control back to the studio for the continuation of the newscast. The process is repeated for the second commercial position. Perfect timing is always maintained because the placement for the secondary cue is time-identical on all the commercial cartridges.

Digital techniques, in conjunction with computers, make possible the storage of audio with selective recall capability. This is an innovation made to order for storing a library of commercials. Imagine commercials being played directly to air, with the computer being the audio source. It is in development at the present time, and there's profound interest within the network world.

Electronic editing of taped material is a reality, and the mystique of the process is compounded by the fact that the cutting room floor is clean. Instant results are attained by the meager motion necessary in communicating with a computer. The starting of tape machines and cartridge machines, studio functions, and complex distribution of programming are all handled by this humming box of chips. Tell it right, and it will do it right. "Aye, there's the rub!" 



Falling bodies and heavy punches to the heel of the hand almost turred the effects men into stunt men as they provided very realistic sounds for fights. The jail scenes required a door, with a frame, to strike just the proper note of anxiety.

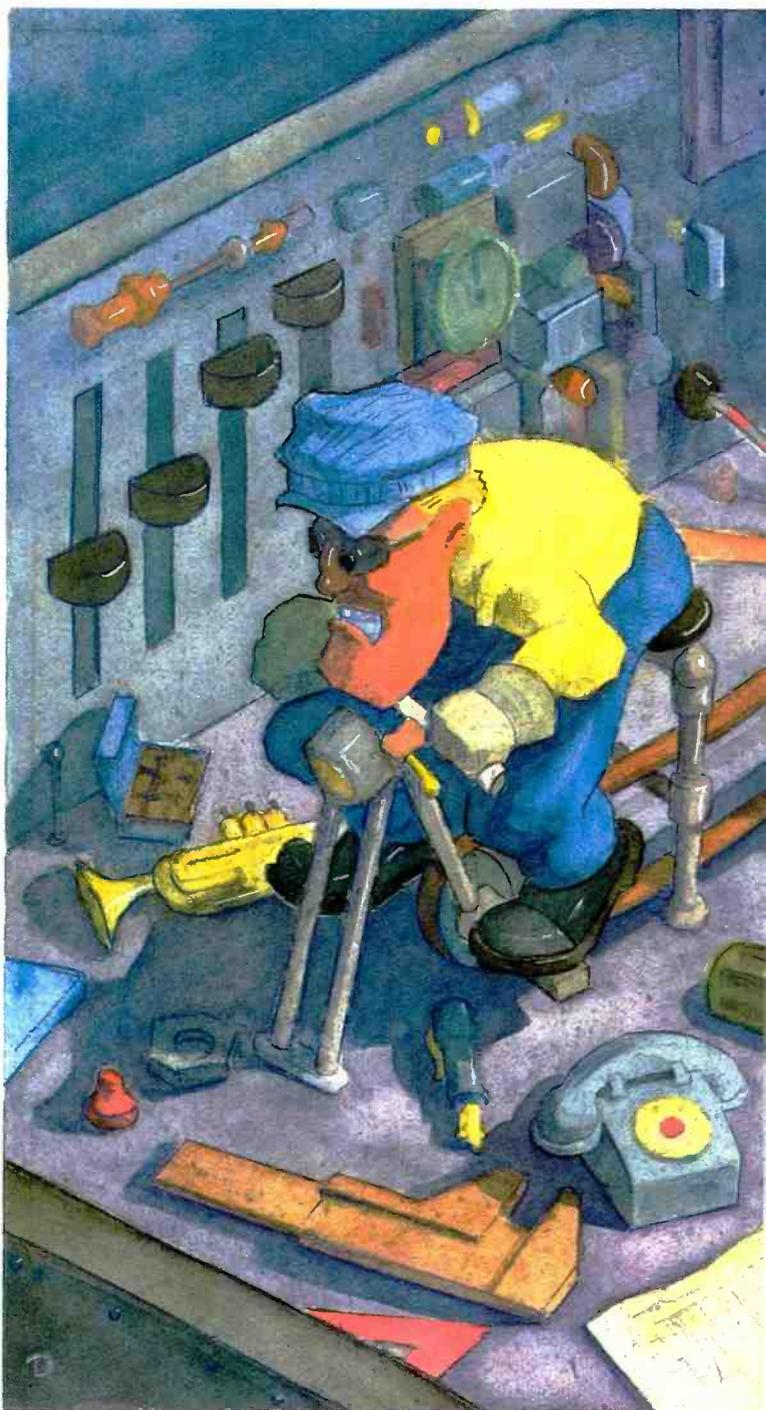
# SIMPLE CONSTRU

## BUILD A POLARITY INVERTER

**T**his article describes how to build an inverting circuit—that is, one in which a positive-going input signal reappears at the output as a negative-going signal of the same magnitude, and vice versa. It is a simple circuit to build, ideally suited for a beginner's first construction project, yet offers sophisticated functionality.

Why, one might ask, would anyone want to invert an audio signal? Studies have shown that inversions of absolute phase are audible, especially with recordings of the human voice. With some pieces of music, too, listeners are generally able to distinguish an inverted signal from a normal one, though they don't always know which is which. Many CD players and other audio components invert signals, and some discs are recorded in an inverted mode. An inverter, shown in Fig. 1, is one way to correct this situation. By using a double-pole, double-throw (DPDT) switch to choose between the input signal at R1 and the output signal at R3 (and the corresponding parts in the second channel), it is possible to flip back and forth very quickly between inverted and noninverted signals, experimenting to find which sounds most natural to you.

Another use for this circuit is to "bridge" a power amp. In theory, this allows one to convert a stereo amp into a super-power mono amp, with up to four times the power of the unit's single-channel rating. (Bridging doubles the voltage drop across the speaker. Since  $P = V^2/R$ , power is increased by a factor of four, assuming the amp can supply enough current.) In practice, the available power is somewhat less,



# CTION PROJECTS



## RICHARD J. KAUFMAN

due to limits on the output transistors' ability to supply adequate current.

For bridging, use the inverter in the circuit configuration shown in Fig. 2. (Grounds have been omitted for clarity.) In this setup, the speaker's ground terminal is no longer connected to the amp's ground terminal, but receives an inverted version of the signal it sees at its positive terminal. This inverted signal comes from the second channel's positive or "hot" terminal.

In general, amps capable of delivering in excess of 60 watts per channel can be bridged successfully; low-power amps with limited current capability are not well suited to this application. If a manufacturer warns against using a particular amp to drive two sets of speakers in parallel, it too should be considered unsuitable for bridging. Of course, some stereo amps are already bridged (the information should be available in the owner's manual), in which case further bridging will not change the power available.

The parts required for building the inverter will cost less than the bridging kits available for some amps and will produce the same results. **One word of caution:** Amps that use feedback through the speaker to lower distortion may overheat and will distort if they are bridged. Dual mono amps, whose channels are isolated from each other, *must have* both channels' speaker grounds connected for bridged use; do not attempt bridging unless you have first determined that there is no more than a few millivolts of a.c. or d.c. potential between the speaker grounds (check both) and the amplifier chassis. If the amplifier's manufacturer does not specifically recommend bridging, run your amp at low power once the circuit is built, watching for overheating, distortion, and other signs of distress before running at full power.

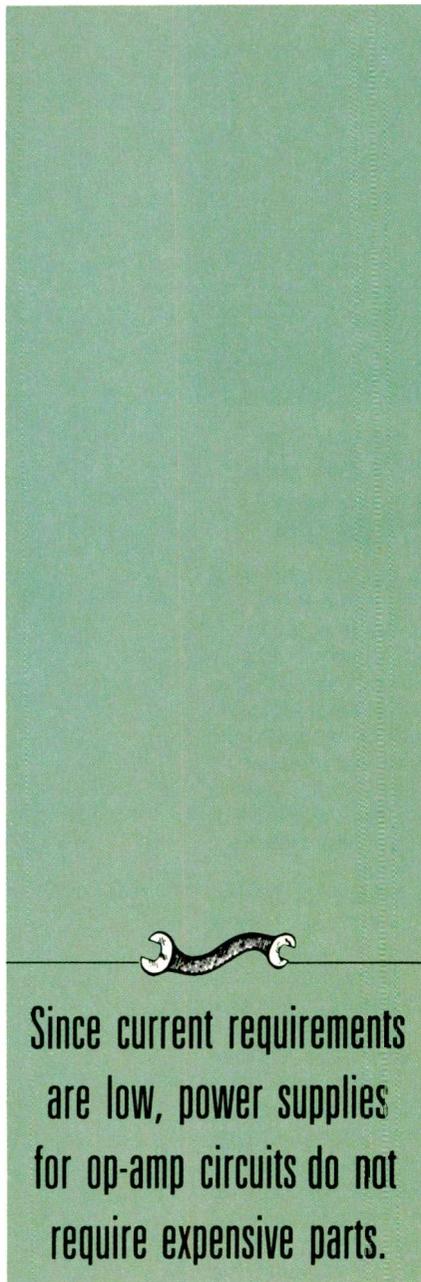


Fig. 1—The inverter circuit. Supply voltages  $V+$  and  $V-$  should be  $+15\text{ V}$  and  $-15\text{ V}$ , although other voltages are acceptable (see text).

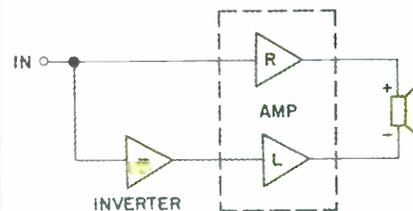
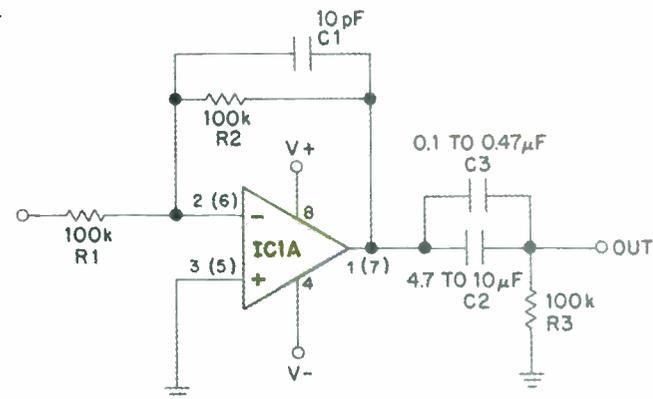


Fig. 2—Amplifier bridging, using the inverter of Fig. 1.

## BUILD AN OP-AMP POWER SUPPLY

An op-amp power supply has a straightforward job: It must convert 120 V a.c. to both positive and negative d.c. while maintaining a reference ground precisely between the two voltages. Expensive parts are not needed since current requirements are low.

The heart of the supply, shown in Fig. B1, is its positive and negative regulators, either for  $\pm 15\text{ V}$  (the preferred voltage for the inverter circuit described above) or for  $\pm 12\text{ V}$ . Use the positive 7815 regulator and negative 7915 for a 15-V supply, or the positive 7812 and negative 7912 for a 12-V supply. (Note the different pin outs for the positive and negative regulators!) The regulator chips contain dozens of transistors, providing a level of sophistication that would be costly and complex in a regulator made from discrete parts. In addition to voltage

regulation, they provide current-limiting and overload protection. This keeps the regulators and other components from burning out in the event of a short or other malfunction.

### PARTS LIST

- IC1—7815 (or 7812) positive regulator.
  - IC2—7915 (or 7912) negative regulator.
  - C1, C2—100- $\mu\text{F}$  electrolytic.
  - C3, C4—10- $\mu\text{F}$  electrolytic.
  - C5, C6—0.1- $\mu\text{F}$  film.
  - D1—50-PIV, 1-ampere bridge rectifier (e.g., Radio Shack #276-1161 or #276-1151).
  - T1—24- or 25.2-V, center-tapped transformer (e.g., Radio Shack #273-1366).
- Power cord and case.

If these symptoms occur, disconnect the inverter before fuses blow or permanent damage is done. Fortunately, few amps will exhibit these problems.

Construction is simple, using a general-purpose printed circuit board. For easy soldering, the board should first be cleaned with a solvent intended for the purpose. Perchloroethylene is not readily available, but I've found Carbona brand spot remover to be a good substitute. The use of a DIP socket is recommended instead of soldering the IC in place. The schematic shows one channel; IC pin numbers for the other channel are in parentheses.

## PARTS LIST

IC1—TL072 dual op-amp. See text.  
C1 (C4)—10-pF ceramic.

C2 (C5)—Any value from 4.7 to 10  $\mu$ F, nonpolarized (e.g., Radio Shack #272-998 or #272-999). See text.

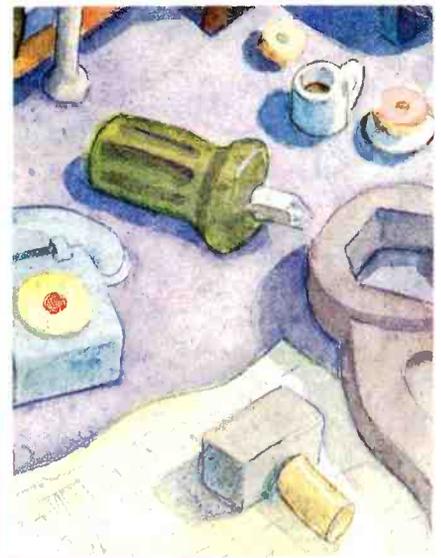
C3 (C6)—Any value from 0.1 to 0.47  $\mu$ F, plastic film (e.g., Radio Shack #272-1053). See text.

R1 through R3 (R4 through R6)—100 kilohms.

Power supply (see below), p.c. board (e.g., Radio Shack #276-024), DIP socket, input and output jacks, and case.

All parts are available at Radio Shack. In the Parts List, components for the second channel are in parentheses. The specified IC is the TL072, which has two op-amps in an eight-pin DIP package; TL082 and LF353 will also work in this circuit. The circuit will function without capacitor C1 but at the expense of increased overshoot on impulse signals. Bypass capacitor C3 is intended to counteract any roll-off, distortion, or phase effects which may be caused if C2 is an electrolytic (the easiest type of capacitor to find in the recommended range of values). If you can find a plastic-film capacitor of an appropriate value for C2, then C3 is unnecessary. Some authorities maintain that bypass capacitors, such as C3, have no audible effect in any case. You may wish to experiment. If your amp has its own input coupling capacitors rather than being d.c. coupled, both C2 and C3 may be omitted. Their function is to block any offset voltage produced by the op-amp.

You can construct your own power supply for the inverter circuit (see accompanying project). However, since current requirements are minuscule, any supply delivering  $\pm 5$  to  $\pm 15$  V will be acceptable; a supply of  $\pm 15$  V is preferable. Using  $\pm 18$  V may also work, but it can cause problems if the transformer or IC is marginal.  $\Delta$



The signal-inverter circuit can correct absolute phase or bridge stereo amps for high-power mono use.

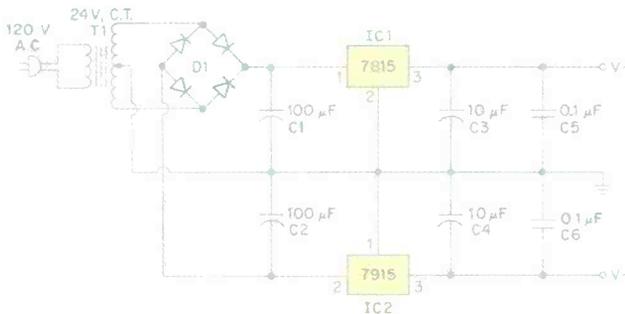


Fig. B1—  
Power supply  
for op-amps.

Capacitors C1 and C2 perform the initial smoothing of the ripple present in the rectified voltage. The regulators provide a steady 12-V output. Capacitors C3 and C4 smooth any residual ripple still present as well as any spikes or glitches that might get through the regulators. Capacitors C5 and C6, though shown as part of the power supply, should actually be mounted as close as possible to the op-amps. These decoupling capacitors remove any noise that might be picked up by the power leads on their way to the op-amps. A pair of these capacitors are used on each board fed

by the power supply. For critical applications, a pair should be used for each op-amp chip on the board. Even if the power supply is on the same board as the rest of the circuit, use these decoupling caps; a rule of thumb is to use a pair for every 4 inches of power-supply leads.

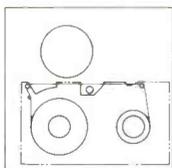
The power supply may be built on a predrilled p.c. board. I have also built it on perfboard with holes but with no copper plating, using the components' leads and pieces of wire to hold the parts to the board and to provide the connections. Soldering is necessary, as for any electronic project.  $\Delta$

# Why it took a to build a better

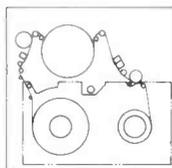


## AKAI'S QUICK START: THE MOST SIGNIFICANT ADVANCEMENT IN TAPE HANDLING SINCE THE VHS CASSETTE.

Today's VHS cassettes may give you eight hours of programs. But today's VHS decks make locating those programs a real bore. That's because conventional decks must slowly thread the tape around the head drum every time you go from Fast Forward or Rewind into Play. And slowly pull the tape back into the cassette whenever you return to Fast Forward or Rewind.



Unloading for conventional VCR



Full-loading for Quick Start

Of course, most VCRs have visible scan. But can you imagine scanning through a two-hour movie? Pass the aspirin.

Akai's exclusive Quick Start system gives you fast, fast, fast relief. For the first time, the VHS tape remains fully threaded — even during Fast Forward and Rewind. So switching between

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Sound great? Seem simple? Wonder why no one ever did it before?

## WHY IT TOOK AKAI TO PERFECT VHS TAPE HANDLING.

Simply stated, Akai has been building tape recorders for over 35 years. And what is a VCR if not a tape recorder? People may forget that it



Akai has over  
35 years of experience building  
tape recorders of all kinds.

# hi-fi company er VCR.



VS-M930U-B

was Akai that built the first home video tape recorder in 1965 and the first lightweight helical-scan portable video tape recorder in 1969. Compared to Akai, even the biggest names in video recording seem like "Johnnies-come-lately?"

To invent Quick Start, Akai invented a completely new tape transport with better tape tension control, more precise guide poles and specially conductive fine ceramic tape guides. The entire transport is under the intelligent control of a micro-processor that only years of tape deck experience could develop. The Akai Quick Start Transport. Sure it's simple... when you know how.

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Akai, a leader in on-screen programming, now takes ease-of-operation one step further. On our new decks, most programming functions require no more than one touch. Nothing *could* be simpler.

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Universal Wireless Remote is programmable independently of the VCR. You can "download" programmed information.

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Where audio and video are one.

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The Mitsubishi E-5000R may not look like your idea of a musical genius, but we're confident it sounds like it. With 150 watts per channel and so little harmonic distortion we don't even know why we brought it up.

It's got a digital tuner with 16 presets and auto-stop signal search. Along with a 10-band graphic equalizer.

You can play up to seven cassettes in a row for hours of uninterrupted music. With dual transports and high-speed dubbing. And you can

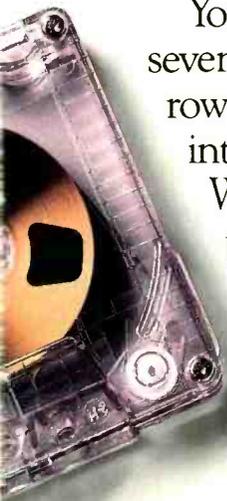
spin your vinyl on a linear tracking, fully-



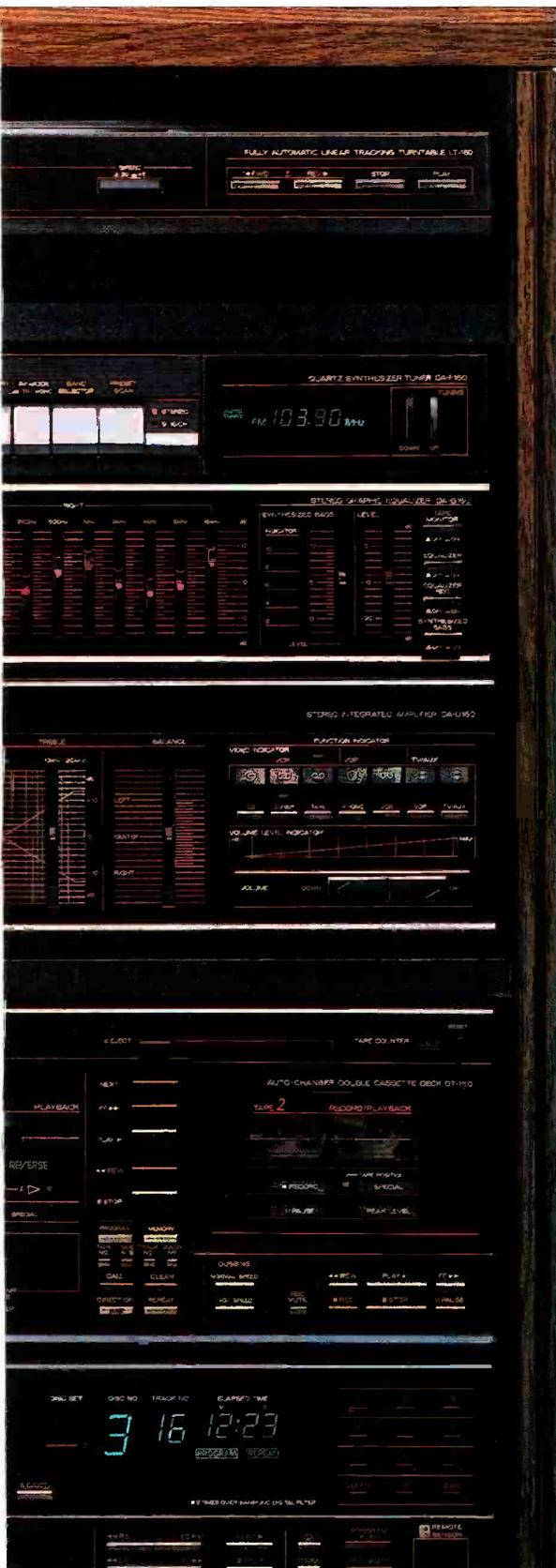
*You can load up to five discs into the optional DP-411R CD player and either play all of them in order, or up to 30 segments (a segment can be a single track or an entire disc). Plus you can random access all five discs.*

automatic turntable.

In fact, this genius will get along quite well with your television. Thanks largely to the video/audio interface and on-screen displays. Its 12-inch three-way speakers are even magnetically shielded to prevent interference with the TV's picture. The 30-function remote control handles primary audio and video features including those of most



# cal genius looks like.



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For the ulti-  
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subtle passages. From  
crystal-popping so-  
pranos to neighbor-  
rattling bass.



*The E-5000R's speakers include a 12-inch  
woofer, a 4-inch midrange and a 3-inch  
tweeter with a 12-inch passive radiator.*

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disc player. With a  
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E-5000R. For all those  
who believe that a  
musical genius is born,  
not made, it is proof to  
the contrary.

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Enter No. 84 on Reader Service Card

# 1

## ONKYO DT-2001 DIGITAL AUDIO TAPE RECORDER

**Manufacturer's Specifications**  
**Frequency Response:** Line, 2 Hz to 22 kHz,  $\pm 0.5$  dB; microphone, 20 Hz to 20 kHz,  $\pm 1.5$  dB.  
**S/N:** Line, 92 dB; mike, 70 dB.  
**Dynamic Range:** 90 dB.  
**THD at 1 kHz:** Line, 0.005%; mike, 0.05%.  
**Wow and Flutter:** Below test-equipment limits (less than 0.001%).  
**Input Sensitivity:** Line, 200 mV; mike, 250  $\mu$ V.  
**Input Impedance:** Line or mike, 47 kilohms.  
**Digital Input Level:** 0.5 V (peak to peak).  
**Digital Output Level:** 0.5 V (peak to peak).  
**Digital Input/Output Impedance:** 75 ohms.  
**Line Output Level:** 2 V.  
**Line Output Impedance:** 220 ohms.

**Headphone Output Level:** 50 mW at 32-ohm impedance.  
**Power Requirements:** 120 V, 60 Hz, 38 watts.  
**Dimensions:** 18½ in. W  $\times$  4¾ in. H  $\times$  16⅝ in. D (47.1 cm  $\times$  12.2 cm  $\times$  42.1 cm).  
**Weight:** 30.8 lbs. (14 kg).  
**Price:** Not determined.  
**Company Address:** 200 Williams Dr., Ramsey, N.J. 07446.  
 For literature, circle No. 90

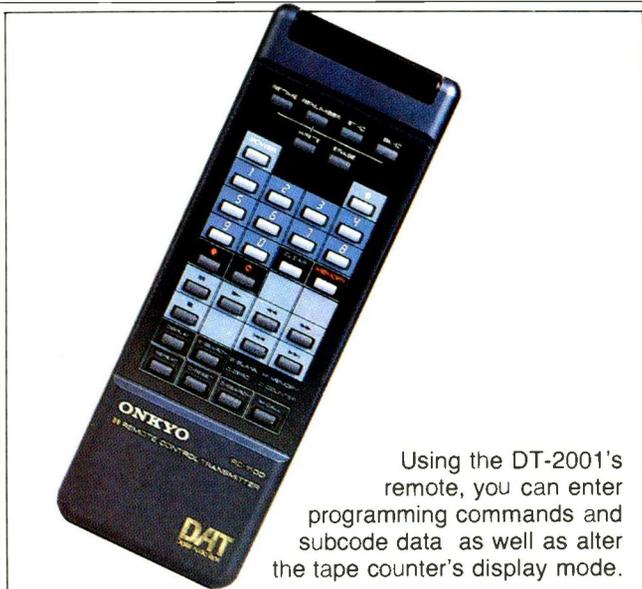


This is the fifth DAT machine that I've had the pleasure of testing (the fourth, if you count only those that can record as well as play back). It's already becoming obvious that while most digital tape recorders we'll be seeing some day will share many features, there will also be significant differences. For example, the Onkyo DT-2001 offers at least three features that I had not seen on any of the machines I had previously tested. First, there are analog microphone inputs on this model, with individual input level controls for each mike and the ability to mix microphone signals with line inputs. Second, although all of the earlier machines tested featured electronic, wired digital inputs and outputs, this is the first to also incorporate an optical digital input and an optical digital output. The optical connections are the Toshiba "Toslink" connectors now used by the few companies offering consumer products with optical links. According to Onkyo, no optical connection standards for consumer product use have yet been ratified by the EIAJ. Still, the Toslink system is likely to become the standard by default, just as RCA phono plugs became the analog standard years ago.

However, these digital inputs and outputs *cannot* be used to transcribe CDs, even if your CD player has a digital output jack. As I explained in my "Forum" column in the August 1987 issue, CDs use a sampling rate of 44.1 kHz, whereas the sampling rate for making your own recordings on DAT is 48 kHz. Digital-to-digital transfer of copyright materials is also prevented by a copy-inhibit flag, found on all CDs, which tells the DAT machine not to record. (Don't confuse that flag with the frequency-notch Copy-code system that some members of the recording industry are trying to foist upon us.) You won't be able to transcribe prerecorded DAT software via the digital connections either, because such software will use the 44.1-kHz sampling rate and will probably have copy-inhibit flags as well. The Onkyo DT-2001 is, however, able to record anything (Compact Discs, other DAT cassettes, radio broadcasts, records, etc.) via its line inputs, and most of my tests involved such analog-to-digital recordings.

That being the case, why the digital input and output terminals? Well, for one thing, if you have made your own Digital Audio Tapes at 48 kHz, they can be copied, if you have access to a second DAT recorder, by connecting the digital output of one deck to the digital input of the other. Also, you can use these digital connections with the small but growing number of amps and preamps with direct digital inputs, which may (or may not) have better D/A converters than those in CD players and DAT recorders. (Onkyo, in fact, has just introduced an integrated amplifier in Japan which incorporates a linear 18-bit D/A converter.) In all of these instances, only a single cable is required, since the digital data is transferred serially and is multiplexed between left-channel and right-channel data blocks, just as it is on Compact Discs.

The third innovation on the DT-2001 is a two-speed fast-search system. Access time on a DAT is extremely fast—so fast, in fact, that on the machines I tested previously, using the fast-forward or fast-rewind modes to get to a specific tape-counter point would more often than not result in an overshoot. Onkyo has solved this problem by providing two fast-winding speeds. Press the fast-forward or the rewind



Using the DT-2001's remote, you can enter programming commands and subcode data as well as alter the tape counter's display mode.

button once, and tape motion seems no faster than on an analog audio cassette deck. Press either button twice, and the tape really takes off, much as it did on the other machines I tested, going from one end of a two-hour tape to the other end in about a minute flat!

Onkyo also informs me that the DT-2001 makes unusually extensive use of optical coupling between internal stages, using no fewer than 13 discrete fiber-optic connections which they claim are superior to the simple opto-isolators used in some other digital components. Most often, such optical connections carry digital signals, but in the DT-2001 they are also used between the microphone preamps and the input stage. This is Onkyo's first use of fiber optics to transmit analog signals.

#### DAT Subcode Features

This machine is able to do many of the things that I can do with my own DAT recorder. (Fortunately, I get to Japan fairly often, where one can buy a DAT recorder without having to say "Joe sent me!") Specifically, you can assign numbers to selections as you record them, in addition to automatically applying a start-ID code. Once you have numbered selections on a tape, you can easily access them, or you can program the machine to play selections in any order you choose. You can even renumber the selections if you want to, or have the machine skip selections. The nice thing is that all of these operations can be done even after a recording has been completed (so long as the erase-protect tab on the tiny DAT cassette is not in its "no record" position). The audio itself is unaffected, since the instructions are recorded onto special subcode areas that are totally separate from the audio data blocks.

According to the somewhat abbreviated translation of the owner's manual that I obtained from Onkyo, the DT-2001's D/A conversion system employs four-times oversampling, a 225-stage + 41-stage digital filter, and independent left and right D/A converters. No such claims are made for the A/D system, and my measurements, as you will soon see,

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19"W x 2 3/4"H x 12"D, 10 lbs. .... **\$299**

## Preamplifiers



**PRO-CONTROL FOUR** Preamplifier, with digital CMOS switching. Ten total inputs, 5 tape monitors, 2 signal processing loops. Direct mode, Auto-Bridge circuitry, Bass and Treble Controls.  
19" W x 3 1/2" H x 11" D. .... **\$699**



**DX4200 Preamplifier/Equalizer**, with Compact Disc Player and Video/Audio inputs. Phono preamp has Variable Cartridge Loading (50-80C pF, 100/47,000 ohm); phono level controls for adjustable  $\pm 20$  dB gain; MC variable reluctance or MM cartridge inputs, 3-way Tape Dubbing; 2 external Signal-Processor Loops, conventional line outputs plus separate Autobridge Line Outputs for Mono Bridging of Most Amps; EQ S/N 114 dB; Passive-Coil filters with 15 dB boost or cut for each octave, max 22 dB, Differential Comparator circuitry for True 0.1 dB Unity-Gain EQ balancing; includes Frequency Spectrum Analyzer test record and instant reset Computone Charts.  
19"W x 5 1/4"H x 11"D, 20 lbs. .... **\$699**

**DX4000 Preamplifier**. Same as DX4200 without phono cartridge matching controls and Equalizer, but with 3 external loops.  
19"W x 3 1/2"H x 11"D, 15 lbs. .... **\$439**



**DX3000 Preamplifier**, Inputs for CD player, Video/Audio, Tuner, Phono, Two Tape Decks with dubbing, Bass and Treble controls, and signal processor loop. THD  $< 0.01\%$ , S/N 95 dB.  
19"W x 2 3/4"H x 10"D, 10 lbs. .... **\$329**

## Power Amplifiers



**PRO-REFERENCE TWO**, Studio Monitor quality MOSFET Stereo Amplifier. LED Meters monitor output of each channel in dB from -40dB to +3dB (200 Watts per channel into 8 ohms). True Clipping indicators, switching for two pairs of speakers. **Power Output:** 100 W/ch into 8 ohms, 190 W/ch into 4 ohms continuous RMS, 20-20kHz at  $< 0.05\%$  THD. S/N  $> 105$  dB.  
19"W x 5 1/4" H x 10 1/2" D, 30 lbs. .... **\$699**

**PRO-REFERENCE ONE**, Same as above except no meters and no speaker switching, 23 lbs. .... **\$599**

## Power Amplifiers



**PRO-POWER FOUR**, MOSFET stereo power amp 300 Continuous RMS Watts per channel @ 4 ohms, 205 Continuous RMS Watts per channel @ 8 ohms, 20-20kHz, 450 Watts RMS @ 2 ohms, 900 Watts RMS @ 4 ohms Bridged. THD  $< 0.05\%$ , Hum and Noise: -105 dB, Front Panel switching for 2 pair of speaker systems. 40-LED 0-1600 Watt Power Meters.  
19"W x 5 1/4" H x 11"D, 30 lbs. .... **\$799**

**PRO-POWER THREE** MOSFET stereo power amplifier, same as Pro-Power Four, except no 40-LED power meters. 30 lbs. .... **\$699**



**PRO-POWER EIGHT** MOSFET stereo power amp. 600 watts per channel continuous RMS, power into 4 ohms; 375 watts per channel continuous RMS power into 8 ohms, 20-20,000 Hz with no more than 0.05% THD; 900 watts per channel RMS into 2 ohms; Freq. resp. 20-20,000 Hz  $\pm 0.1$ dB; S/N -105dB; slew rate 50V/msec; TIM unmeasurable, 1M 0.05%.  
19"W x 5 1/4" H x 16 1/2" D; 67 lbs. .... **\$1,499**

**PM840 Power Amplifier**, MOSFET stereo, features no-current-limiting power supply, 300 w/p/c RMS into 4 ohms; 450 w/p/c RMS into 2 ohms; 205 w/p/c into 8 ohms @  $< 0.05\%$  THD; Freq. resp. 20 to 20,000 Hz  $\pm 0.1$ dB; S/N  $> 105$ dB; slew rate 50 V/microsec; TIM unmeasurable; damping factor 200.  
8 1/2"W x 5"H x 12"D; 22 lbs. .... **\$549**



**A5002 Power Amplifier**, Class-H Vari-Proportional circuitry and Autobuffer for continuous operation into 2 ohms. Features auto crowbar protection circuit for output protection without current limiting, 40-LED 0-1,000 Watt power output Meters; Front-Panel switching for 2 pairs of speakers; True Clipping indicators; Input Level controls. Output power 250 W/ch into 8 ohms, 375 W into 4 ohms continuous RMS, 20-20,000 Hz at  $< 0.09\%$  THD; S/N  $> 105$  dB; slew rate  $> 50$  V/microsec, TIM  $< 0.02\%$ .  
19"W x 7"H x 12"D, 50 lbs. .... **\$949**

**A5001 Power Amplifier**, Same as A5002 except no Meters and no Input Level controls. 50 lbs. .... **\$799**

**PCX-2 19" Rack Mounting kit**, for two PCR800 or PM840's, 2 lbs. .... **\$49**



**PCX-1 19" Rack-mount. Panel/Cabinet Kit** for PCR800, PM840, as shown above. .... **\$49**

## Signal Processors



**AE2000 Real Time Analyzer/Equalizer**, World's most accurate (0.1dB) Real-Time Analyzer/Equalizer. The first and only analyzer with: Two independent real-time analysis systems, (a Direct 100-LED display with 2dB readout and a 0.1dB readout Differential/Comparator) Pink-noise generator, 10-octave Real-Time Display with Adjustable Decay rate, Mic. preamp, input for analysis for any Signal Processor, Autoscan mode Center frequencies 32, 64, 125, 250, 500, 1k, 2000, 4,000, 8,000, 16,000 Hz; display accuracy 0.1dB; Auto-Scan sweep rate 0.1-10 secs/octave; Mic. preamp input impedance 2K ohms; Frequency response 20-20,000 Hz  $\pm 0.1$ dB; includes 20-Band all-Passive-Coil Equalizer, with boost/cut range  $\pm 15$ db, max. 22db, 0.1dB Differential/Comparator readout accuracy LED's for instantaneous and precise in/out signal balancing, THD  $< 0.01\%$ , TIM unmeasurable, Hum and Noise -114dB at full output. EQ Bypass/Defeat, Monitor and Record selectors on front panel.  
19"W x 5 1/4" H x 11" D, 21 lbs. .... **\$799**



**DC4415 Third-Octave Equalizer**, stereo with 21 controls/channel. Center frequencies 40, 50, 63, 80, 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1,000, 1,600, 2,500, 4,000, 6,300, 10,000, 16,000 Hz; Features EQ defeat; Infrasonic filter; Tape Monitor and Tape Record; Differential/Comparator circuitry for Unity Gain setting to within 0.1db accuracy for highest Dynamic Range capability. THD and IMD 0.01% at 2 V; S/N 114dB at full output; input imp 47,000 ohms.  
19"W x 5 1/4" H x 11" D, 16 lbs. .... **\$699**

**DC2215 Differential/Comparator Equalizer**, Stereo 10-band, with Differential/Comparator True-Unity-Gain circuitry for Input-to-Output balancing accuracy to within 0.1dB. Equalizer filter circuits use precision wire-wound Passive-Coil inductors for high gain, low noise and distortion. Front panel controls include Tape monitor, LED defeat/EQ defeat and EQ Tape Record. THD and IMD  $< 0.01\%$  at 2 V; S/N ratio 144 db at 10V; boost/cut range  $\pm 15$  dB, max 22dB. Includes Frequency Spectrum Analyzer Test Record, Computone Charts, Cable.  
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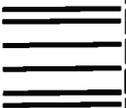
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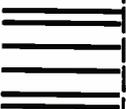
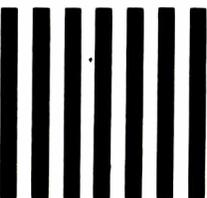
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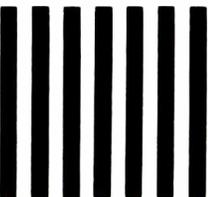
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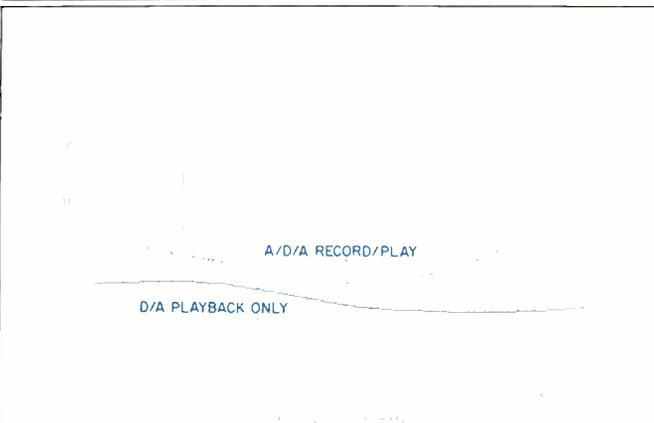
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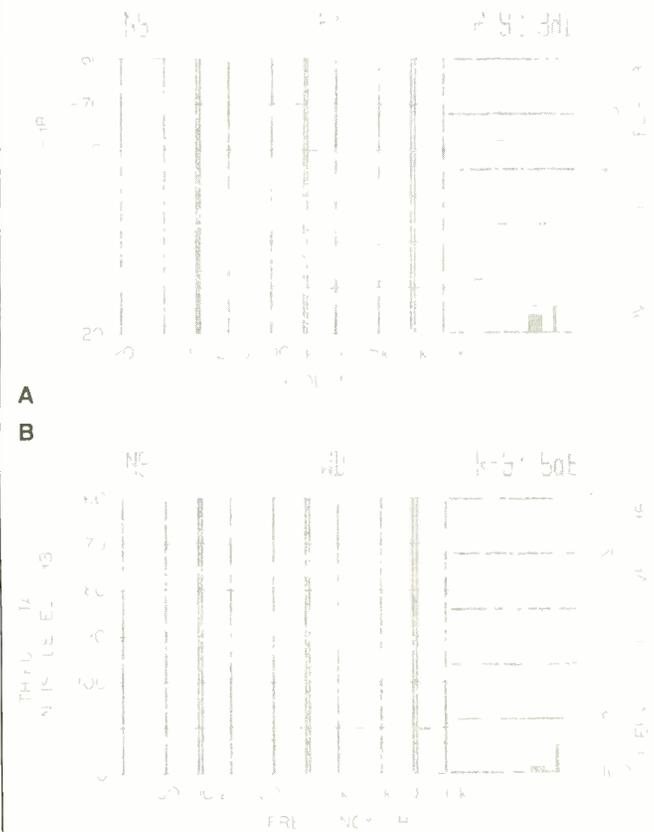
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The DT-2001 has features I hadn't seen on a DAT unit before: Microphone inputs, optical connections, and two-speed fast search.



**Fig. 1—Distortion (THD + N) vs. frequency for playback of direct digital recording (solid curve) and recording made via analog inputs (dashed curve).**



**Fig. 2—S/N analysis, both unweighted (A) and A-weighted (B), using "silent" track of digitally produced test tape.**

suggest that the A/D stages use analog filtering. The DT-2001 has four separate direct-drive motors for the capstans, the head drum (which, incidentally, rotates at a standard 2,000 rpm in all R-DAT machines), and the two reels.

### Control Layout

The left end of the front panel has a headphone jack and level control, the main power on/off button, and a three-position "Timer" switch for setting the deck to play or record when its power cord is plugged into an external timer's a.c. receptacle. The horizontal cassette loading drawer (similar to a CD drawer, but of course much smaller) comes next, with an "Open/Close" button to its right. Further to the right is a display window that shows selection numbers, program numbers, and four types of time indication. (On all tapes it shows total program time and elapsed time from the beginning of the tape; on prerecorded DATs with table of contents sections, it can show time remaining to the tape's end and total time including pauses between tracks.) The display also includes fluorescent peak-level bar meters for left and right channels.

At the upper right of the panel are concentrically mounted left and right record "Input Level" controls. These are effective only for the analog line-level inputs and not for the digital inputs, since the latter require no level adjustment when digital data is being recorded directly. Beneath the record level controls are small buttons for altering the time display, selecting analog or digital inputs, switching in the microphone inputs, and turning on the "Skip Play" function. If this latter button is pressed during playback, the tape will fast forward to the next selection whenever the tape heads encounter a skip-ID signal that you've applied (for example, at the beginning of a commercial recorded off the air).

Just below the display area is a row of 10 numbered buttons, a "Memory" button, and a "Clear" button. The numbered buttons can be used alone to access any selection on a tape or, in combination with the "Memory" and "Clear" buttons, to program as many as eight selections to be played in any order you choose.

Along the bottom edge of the panel are the buttons needed for subcode operations: "Write," "St(art) ID," "Sk(ip) ID," "Erase," "Renum(ber)," and "Retime." There are also a "Counter Reset" button, a "Blank Search" button (for finding the end of a recording on a partially recorded tape, so the balance of the tape may be used), the regular tape-transport buttons (fast forward, fast rewind, "Pause," "Stop," and "Play"), and buttons labelled "JF" and "JR." These are used to "jump forward" or "jump reverse"—i.e., to move forward to the next selection or backward to the start of the current selection. If these buttons are pressed more than once, the tape travels the appropriate number of selections forward or backward.

Additional, smaller buttons mounted above the main transport buttons are used for memory recall, repeat play, and search for the start of a tape. "Rec" and "Rec Mute" buttons complete the front-panel layout. When the record button is pressed, the transport goes into the pause mode and a record light comes on. It is at this time that you can assign a number (which need not be "1") to the initial

*Continued on page 87*



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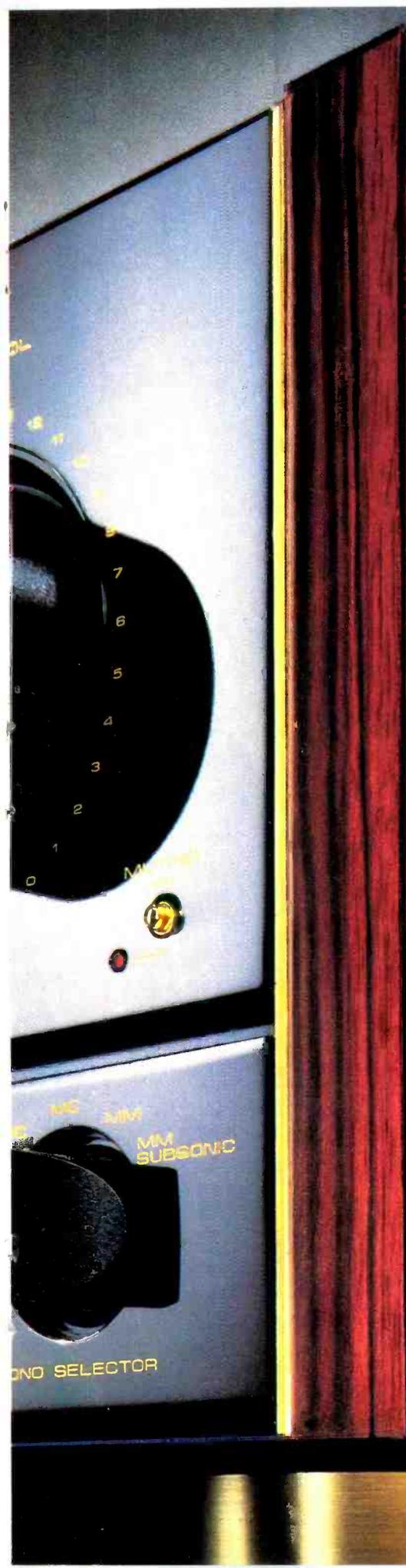
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distortion. What's more, critical signal paths are kept extraordinarily short for less electronic interference and cleaner sound.

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The A-91D is not only ready for digital, it's ready for the future. With six digital inputs (2 optical), and three digital outputs (1 optical).

So if you want your digital sound to drive you to new heights, you need to drive your digital components with the Elite A-91D.

For more information, call 1-800-421-1404.

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It became obvious as I tested this unit that the record industry's concern about "perfect clones" is just nonsense.

Continued from page 82

selection you are about to record. Subsequently, all selections recorded on the tape that have more than a 3-S pause preceding them will be numbered sequentially from your starting number. Various small indicator lights above some of the key operating pushbuttons let you see at a glance the status of the DAT recorder's functions.

The wireless remote control supplied with the DT-2001 has some 35 buttons, so you can duplicate just about any function (including subcode operations, play, record, and random-access programming) from across the room. You can even alter the tape-counter display mode with the remote control.

The rear panel of this remarkable recorder is equipped with line inputs, a pair of 1/4-inch phone jacks for microphone inputs, coaxial-connector and photo-optical digital inputs and outputs, and individual microphone input level controls.

### Measurements

When I first measured DAT recorders, for the July issue of *Audio*, about all I could do was record some test tones using the analog inputs of those machines and my own signal generators. I even went so far as to transcribe tracks of several test CDs (again via the analog inputs, since all CDs have the double prevention scheme that inhibits us from doing digital-to-digital transfers). Now, I am happy to report that I am able to go a step farther. Thanks to Sony, I have a test tape that was recorded digitally (at 44.1 kHz); it contains several essential test signals as well as some great musical samples. Even this test tape, however, cannot be copied in digital-to-digital mode, so I'm going to take special care of it. I hope that by the time it wears out, such test tapes will be readily available!

In addition to using the test tape, I did want to examine the DT-2001's complete record/play cycle—both analog-to-digital and then digital-to-analog signal processing. What became obvious at once was that the recording industry's concern about "perfect clones" is nonsense. For example, consider Fig. 1, a plot of distortion versus frequency at 0-dB recorded level. The lower curve represents the results obtained when playing back the digital test tape. The upper curve, depicting higher levels of distortion, represents what happened when I played back a test tape I had made via the analog inputs of the DT-2001. The difference cannot be attributed to my signal generator, whose inherent distortion is less than 0.002%. Using the digitally produced test tape, THD + N at mid-frequencies measured only 0.0055%, while with my "home brewed" tape, THD + N increased to 0.008%. A much greater difference showed up at high frequencies. At 10 kHz, THD + N for the test tape was still only 0.0055%, yet it was 0.013% for my analog-digital-analog tape. All of this may seem rather insignificant, to be sure, but now consider the signal-to-noise measurements shown in Figs. 2 and 3. Figures 2A and 2B show results obtained when measuring the "silent" track of the digital test tape (92.8 dB unweighted, 97.5 dB A-weighted); Figs. 3A and 3B show S/N using the silent track (inputs short-circuited during recording) on my analog-digital-analog tape (87.6 dB unweighted, 90.2 dB A-weighted).

When I measured separation between channels, the dif-

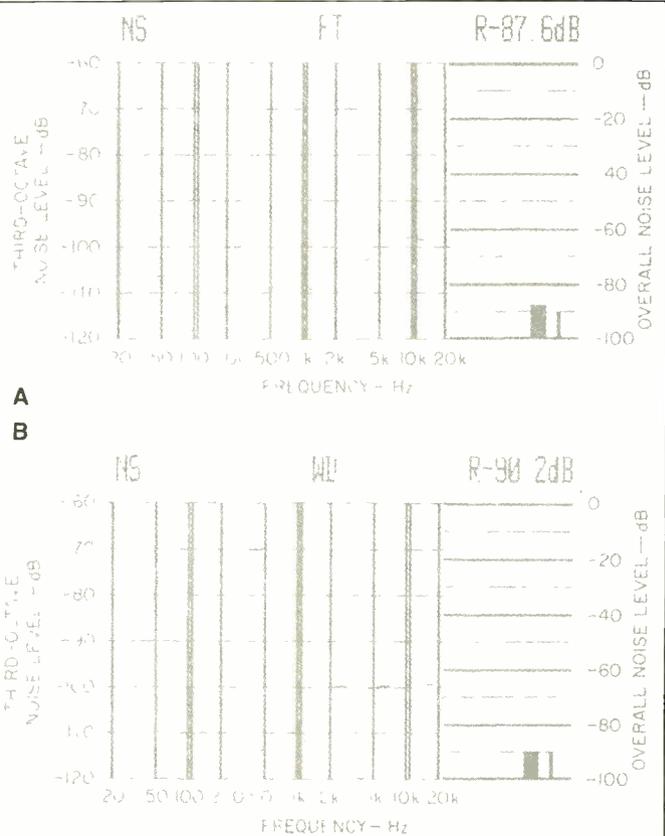


Fig. 3—Same as Fig. 2 but for test tape made using analog inputs.

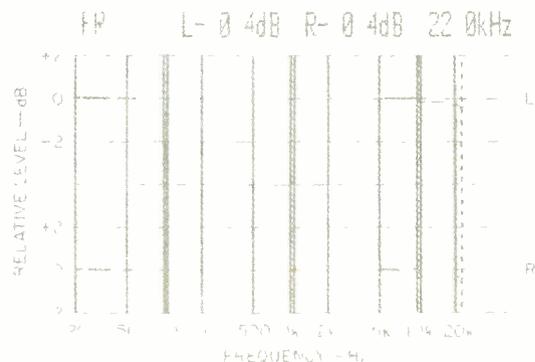


Fig. 4—Playback frequency response, left (top) and right channels, for recording made via analog inputs.

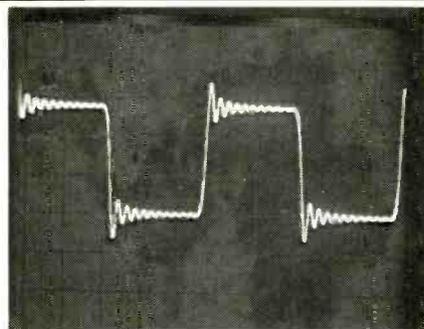
The playback filters are digital but the recording filters are analog, just as they are in professional recording studios.

ferences between the all-digital test tape and my analog-digital-analog tape were even more significant, though neither result can be faulted in terms of audible quality. The digital test tape showed channel separation of 91 dB at 1 kHz for the left channel and 93.5 dB for the right. My tape, when played back, yielded separation of 79 dB for the left channel and 76 dB for the right. Greater differences showed up at high frequencies. At 10 kHz, the digital test tape showed separation of 91 dB for the left channel and 88 dB for the right. By contrast, my tape yielded values of only 67 dB for the left channel and 60 dB for the right.

I was not able to make a similar comparison of frequency response measurements, since the digital test tape contains only a few spot frequencies (rather than a continuous sweep). My test tape, onto which I recorded a sweep from 20 Hz to 40 kHz, proved that, as far as frequency response is concerned, DAT machines can do even better than CD players. (They should, since the higher sampling frequency of 48 kHz allows the frequency response to remain flat to a bit beyond 20 kHz.) As shown in Fig. 4, response extended all the way out to 22.0 kHz on each channel and was down a mere 0.4 dB at that frequency.

I checked linearity and found no deviation from 0 dB all the way down to -80 dB. The Sony test tape provides a signal recorded at -60 dB level, and I used that to examine dynamic range according to the method proposed by the

Fig. 5— Playback of 1-kHz square wave recorded via analog inputs.



EIAJ in their CD measurement Standard (but not the alternate method proposed by the EIA, which I have begun to use in testing CD players). To obtain the EIAJ figure, I measured THD at the -60 dB recorded level; it was 0.45%, which translates to -46 dB. Adding that to the -60 dB we started with, we come up with a dynamic range of 106 dB. Using my own analog-digital-analog test tape, results were 6 dB poorer, or an even 100 dB.

I mentioned earlier that while Onkyo is using digital filtering in the DT-2001's D/A processing, they are probably



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.

At no time was I able to distinguish between original program material and DAT recordings made from radio, CD, and tape.

using conventional analog filtering for its A/D conversion. I came to this conclusion after recording and playing back a 1-kHz square wave. The reproduced waveform is shown in Fig. 5. As you can see, it is reminiscent of the square-wave pictures I used to get when I measured first-generation CD players, before most manufacturers switched to digital filtration and two- or four-times oversampling. This is no surprise, as the purpose of the input filtering is to remove high frequencies, which could cause aliasing, before they get into the digital domain. In that respect, Onkyo's DT-2001 is really no different from the digital recorders used in professional recording studios.

I couldn't resist the temptation to measure wow and flutter, despite Onkyo's claim that it is below the measurable limits of test equipment. I needn't have bothered. My Sound Technology test set simply kept flashing the now-familiar notation "Signal Level Too Low" over and over again. So much for wow and flutter in DAT recorders!

#### Conclusions

I wouldn't pretend for a moment that this is a comprehensive and total evaluation of the Onkyo DT-2001. There were many tests I would have liked to perform, but I lacked software with which to make them. I did, however, spend several wonderful days making a variety of recordings via the DT-2001's analog inputs from radio, CDs, and the very

few prerecorded DATs I have managed to get my hands on. At no time could I distinguish between the original program material and the resulting DAT recordings that I made.

The only negative comment I have concerning the DT-2001 has to do with its microphone inputs. They met their specifications, all right, but I don't regard a signal-to-noise level of 70 dB as being consistent with the otherwise superb performance of this unit. If you end up owning this remarkable machine and want to do live recording, I'd suggest you get hold of the very best professional microphone mixer you can and forget about using the mike inputs. Of course, if you just want to have some fun and see what sort of recordings you can create on Digital Audio Tape, mixing your own sounds and narration, perhaps, with the sound of CDs or other program material, the mike mixing facilities provide an added bonus.

Onkyo has certainly put their expertise and innovation into this, their first production DAT machine. Although no price has been given (nor has a date for delivery to the U.S. been mentioned as of now), I'll put my own value on it. It's easily worth at least \$2,000—possibly even more, in my opinion. Like so many other DAT machines available in other parts of the world, the DT-2001 represents state-of-the-art technology that we Americans ought to be able to enjoy. Let's hope we'll be able to buy this DAT recorder, or some other model, in this country before very long.

*Leonard Feldman*

## Introducing: Bryston's Model 10B Electronic Crossover



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## 2

FORTÉ AUDIO  
MODEL 1  
AMPLIFIER**Manufacturer's Specifications**

**Rated Output:** 40 watts per channel into 8-ohm loads, 20 Hz to 20 kHz; 70 watts per channel into 4-ohm loads.

**THD:** 0.1% at 8 ohms, 0.2% at 4 ohms.

**Bandwidth:** -3 dB at 1 Hz and 100 kHz.

**Slew Rate:** Greater than 30 V/ $\mu$ S.

**Input Impedance:** 47 kilohms.

**Maximum Output Current:** 30 amperes (peak).

**Output Impedance:** 0.02 ohm at 1 kHz (damping factor = 400).

**Output Noise:** 300  $\mu$ V.

**Dimensions:** 19 in. W x 7 in. H x 11 in. D (48.3 cm x 17.8 cm x 27.9 cm).

**Weight:** 26 lbs. (11.8 kg).

**Price:** \$950.

**Company Address:** 1955 Industrial Dr., Auburn, Cal. 95603.

For literature, circle No. 91



As I understand it, Forté Audio is a "budget perfectionist" subsidiary of Threshold. Its products are designed by Threshold's Nelson Pass and are inspected at the Threshold factory but manufactured elsewhere in California. I recall with much pleasure the experience of testing and listening to Nelson Pass' first "Stasis" designs from Threshold a few years ago. Since then, the Stasis concept has gained ac-

ceptance and has even been licensed to other high-end manufacturers, such as Nakamichi.

The Forté amplifier that I tested is, however, a pure Class-A design. This accounts, at least in part, for the rather large bulk of this relatively low-powered unit as well as for its weight. Then too, unlike many Class-A amplifiers that I've tested, the Model 1 is cooled entirely by convection to avoid

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Temperature sensors are used to monitor thermal conditions, but there were no thermal shutdowns during my bench testing.

the noise normally produced by even the quietest of internal cooling fans. Fans in amplifiers often have a way of drawing in dust that lands on components, circuit boards, and heat-sinks, so there's another clear benefit in avoiding them if possible. In the case of the Model 1, avoiding fans has meant using rather large heat-sinks. Their size and weight suggest a much higher power output than is actually delivered by the amplifier.

For those who have forgotten just how a Class-A amplifier differs from Class-AB and Class-B designs, it's important to remember that in a Class-A amplifier, current drawn by the output stages remains substantially constant regardless of signal output level. Unlike more efficient designs that dissipate more total power as signal levels increase, Class-A amplifiers actually dissipate *less* power internally when more power is fed to the load.

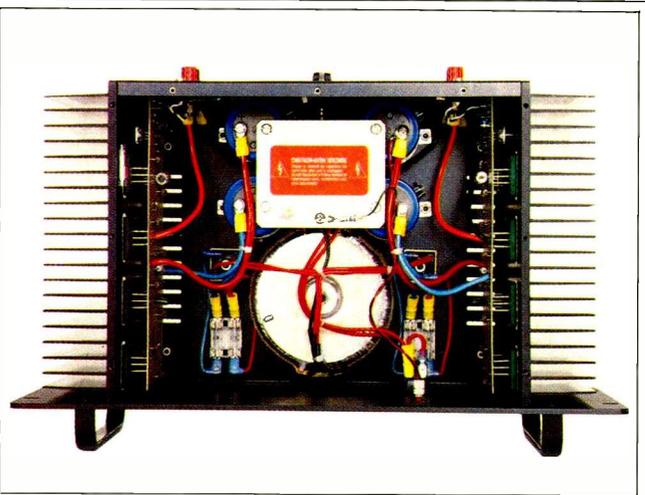
The constant high current—a penalty paid for *all* Class-A designs—necessitates special care in placement of the Model 1. Its makers recommend at least 3 inches of air space on either side and above the amplifier if it is installed in an open-back rack or cabinet. If it is placed in a closed-back cabinet (or a cabinet positioned right up against a wall), other openings or an external forced-air system should be provided to ensure that heat is carried away. I learned, too, that the heavy toroidal power transformer centered between the two channels of circuitry inside the amplifier produces a fairly strong local magnetic field. For this reason, a turntable/cartridge combination should not be positioned too close to the unit.

Another precaution which should be observed involves the a.c. power cord. In most audio systems that employ separate power amplifiers and preamplifiers, it is convenient to connect the power cord of the amplifier to the switched a.c. outlet often provided on the preamplifier's rear panel. Forté, however, does not recommend connecting the Model 1 in this fashion because of the amount of continuous current it draws and because of the even greater surges of current that occur on turn-on. You'll have to turn on the amplifier and the preamplifier separately.

### Circuit Highlights and Layout

The amplifier itself is a noninverting, complementary-symmetry design. The front-end employs for each channel a direct-coupled input stage consisting of matched NPN differential transistors biased by regulated, constant-current sources. These input stages, in turn, drive gain transistors loaded by regulated constant-current devices. This circuit topology allows distortion levels to be low even with a minimum amount of negative feedback applied.

The amplifier's output stages employ fast output transistors which have extremely large safe-operating areas. Each transistor runs at one-tenth its rated capacity. Forté has therefore neither incorporated active protection circuitry to safeguard the output stages nor added output fuses between the output devices and the speaker terminals. The company has also chosen not to use an isolation coil between the power output stages and the speaker terminals. The absence of such a component means that the high damping factor measured at low or mid-frequencies is maintained even at high frequencies.



The power supply for the Model 1 employs what appears to be a custom-manufactured toroidal transformer. Forté's brief owner's manual states that this power transformer is capable of supplying twice its rated current for long periods of time. The output of the transformer is converted to d.c. by 35-ampere rectifying diodes and then is smoothed by computer-grade electrolytic capacitors.

All circuit boards are made of glass epoxy, and all connections appear to be hand-soldered. Metal-film and wire-wound resistors as well as silver mica capacitors are in evidence throughout the circuit boards. Temperature sensors are used in each channel to monitor thermal conditions of the amplifier. However, during my entire bench-testing time (which included long stretches of operation at and above full rated output levels), I never experienced a thermal shutdown.

There are no adjustment controls on the Forté Model 1. A large rocker switch on the front panel turns power on and off. The rear panel is equipped with gold-plated RCA-type phono jacks and heavy binding posts intended for speaker-cable connections. The a.c. line fuses are accessible at the rear panel for replacement, should that become necessary, but fuses in series with the d.c. supplies are located inside the amplifier.

### Measurements

Connected to 8-ohm loads, the Model 1 delivered 46.5 watts per channel of continuous power at its rated THD of 0.1% for a 1-kHz test signal. At the frequency extremes of the audio band, power level was a bit lower: 45.1 watts per channel at 20 Hz and 42.6 watts at 20 kHz. Backing off to the rated power output of 40 watts per channel, THD + N measured only 0.01% at low and mid-frequencies and 0.065% at 20 kHz. SMPTE-IM distortion at rated output was 0.03%, and CCIF IM was only 0.002%.

Switching to 4-ohm loads, I measured an output of 77.0 watts per channel for the rated distortion level of 0.2%. At 20 Hz and 20 kHz, maximum power output under these load conditions was 72.2 watts per channel for the same level of distortion. At the rated output of 70 watts per channel, THD + N measured 0.023% at 1 kHz, 0.03% at 20 Hz, and



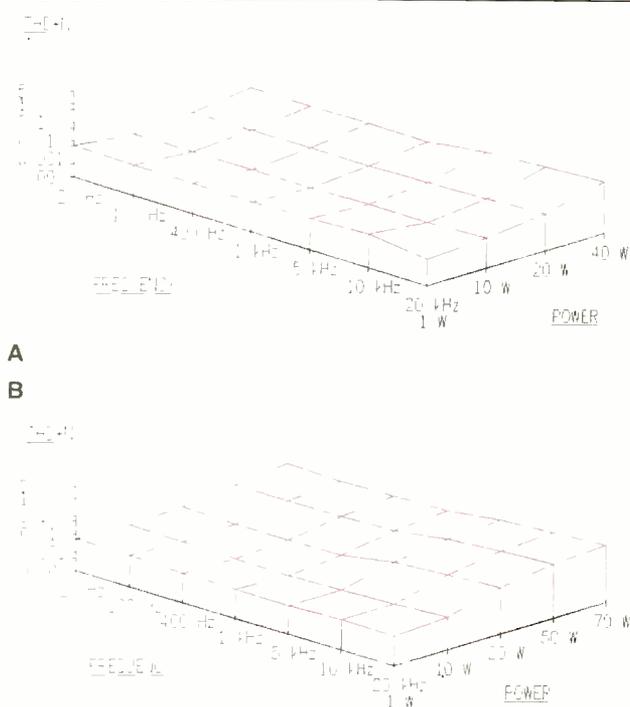
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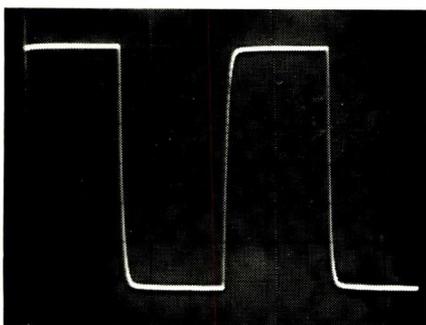
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Although the sound of the Model 1 is superb, you may find that it lacks the power to drive your loudspeakers as hard as you'd like.



**Fig. 1—Power output vs. THD + N and frequency with 8-ohm loads (A) and 4-ohm loads (B).**



**Fig. 2—Reproduction of a 20-kHz square wave.**

0.14% at 20 kHz. SMPTE IM was 0.067% at the equivalent of rated output. How harmonic distortion varied as a function of power output and frequency is shown in Fig. 1A for 8-ohm loads and in Fig. 1B for 4-ohm loads.

Dynamic headroom was minimal, around 0.4 dB with either 4- or 8-ohm loads. This is indicative of a fairly stiff or well-regulated power supply. Damping factor using 8-ohm loads and referred to a 50-Hz test signal was well above 250 (the highest damping factor I can measure with any great degree of accuracy).

Input sensitivity for 1 watt output into 8-ohm loads measured 0.13 V. This corresponds to an input voltage require-

ment of approximately 0.82 V to produce the rated output of 40 watts per channel. Frequency response was flat within 1.0 dB from 3 Hz to 100 kHz; a -3 dB roll-off occurred at 2 Hz and at 190 kHz.

Forté quotes residual noise in absolute terms, as the number of microvolts appearing at the speaker output terminals with no signal applied. They claim a figure of 300  $\mu\text{V}$  or less for this noise measurement; I obtained only 250  $\mu\text{V}$ . A-weighted signal-to-noise ratio, measured using conventional methods, was 88 dB below an output reference level of 1 watt. If you want to express this in terms of dB below 40 watts, simply add another 16 dB, the difference between 1 watt and 40 watts.

Figure 2 is a 'scope photo of the amp's output when a 20-kHz input signal was applied. The almost perfectly square waveform attests to the wide bandwidth and exceptionally fast rise-time of this amp. Normally, I would expect to see this sort of wave shape from most amplifiers if the input frequency were 1 kHz or, at best, perhaps 5 kHz, but keep in mind that you are looking at a 20-kHz square wave here!

#### Use and Listening Tests

The first thing I became aware of when I connected the Forté Model 1 to the rest of my reference listening system was that *it does run hot*. Compared to the way old vacuum-tube power amplifiers ran, I suppose the Model 1 isn't all that warm during continued operation; it's just that I've gotten used to Class-B and Class-AB solid-state units. On the positive side, you will quickly discover, as I did, that if given adequate ventilation, the amplifier will eventually reach a stable operating temperature, after which it will get no hotter. Such are the peculiarities of Class-A designs, and they take a bit of getting used to.

The Model 1's sound quality was certainly as clean as anything I've heard. However, to say that it was audibly superior to some of the better Class-AB amplifiers I've listened to over the past few years would, I think, be something of an overstatement. The advantage of Class A is best heard at very low listening levels or during very quiet passages of music. It is during such moments of sound reproduction that any residual crossover or switching distortion can become offensive. Of course, by their very nature, Class-A amplifiers exhibit neither crossover distortion nor any other nonlinearities characteristic of amplifiers whose individual output stages must go into and out of cutoff.

For all its superb sound qualities, you may find, as I did, that the Model 1's relatively low power may not be enough to drive your speaker systems as hard as you would like. This is especially true when listening to digital program sources. If you own reasonably high-efficiency speakers having nominal impedances of 4 ohms, the 70+ watts per channel that this amplifier provides will probably do just fine. If, on the other hand, your speakers eat up power (as my reference speaker systems do), you'll either have to settle for somewhat lower (albeit clean-sounding) levels or for a Class-AB amplifier that can pump out more power. Of course, Forté or other amp makers may well come up with even more powerful Class-A units—but if they do, I dread to think how heavy they will be or how much they will add to the electric bill!

Leonard Feldman

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# 3

## AR MODEL X-10 RECEIVER

### Manufacturer's Specifications FM Tuner Section

**Mono Usable Sensitivity:** 11.2 dBf.

**50-dB Quieting Sensitivity:** Mono, 14.6 dBf; stereo, 37.2 dBf.

**S/N, A-Weighted:** Mono, 80 dB; stereo, 75 dB.

**THD, 30 Hz to 7.5 kHz:** Mono, 0.2%; stereo, 0.3%.

**Frequency Response:** 50 Hz to 10 kHz,  $\pm 0.5$  dB.

**Capture Ratio:** 1.0 dB.

**Alternate-Channel Selectivity:** 75 dB.

**Spurious-Response Rejection:** 90 dB.

**Image Rejection:** 70 dB.

**I.f. Rejection:** 100 dB.

**AM Suppression:** 60 dB.

**Stereo Separation:** 40 dB, 100 Hz to 10 kHz.

### AM Tuner Section

**Loop-Antenna Sensitivity:** 500  $\mu$ V.

**Selectivity:** 40 dB.

**S/N:** 50 dB.

**Image Rejection:** 40 dB.

**I.f. Rejection:** 40 dB.

### Amplifier Section

**Power Output:** 100 watts per channel, continuous, both channels driven into 8-ohm loads, 20 Hz to 20 kHz; 130 watts per channel into 4-ohm loads.

**Rated THD:** 0.03%.

**Rated SMPTE IM:** 0.03%.

**Damping Factor:** 120 (1 kHz, 8 ohms).

**Input Sensitivity:** MM phono, 2.5 mV; MC phono, 200  $\mu$ V; high level, 120 mV.

**S/N, A-Weighted:** MM phono, 80 dB; MC phono, 70 dB; high level, 90 dB.

**Phono Overload:** 150 mV.

**Frequency Response:** Phono, RIAA  $\pm 0.3$  dB, 20 Hz to 20 kHz; high level, 20 Hz to 20 kHz,  $\pm 0.5$  dB.

**Tone-Control Range:** Bass,  $\pm 8$  dB at 100 Hz; midrange,  $\pm 8$  dB at 1 kHz; treble,  $\pm 8$  dB at 6 kHz.

**Loudness Contour at -30 dB:** +5 dB at 100 Hz, +3 dB at 10 kHz.

### General Specifications

**Maximum Power Consumption:** 500 watts.

**Dimensions:** 16<sup>15</sup>/<sub>16</sub> in. W  $\times$  4<sup>5</sup>/<sub>16</sub> in. H  $\times$  14<sup>9</sup>/<sub>16</sub> in. D (43 cm  $\times$  11 cm  $\times$  37 cm).

**Weight:** 30.8 lbs. (14 kg).

**Price:** \$829.95.

**Company Address:** 330 Turnpike St., Canton, Mass. 02021.

For literature, circle No. 92



You may still think of Acoustic Research (AR, for short) as a company that makes only high-quality loudspeaker systems and, from time to time, brilliantly designed and excellent-performing turntables. If so, you're in for a surprise when you check out AR's top stereo receiver, the X-10. Its design embraces all of the features that have come to be regarded as essential in this central audio component. Yes, a perfunctory pair of video inputs and outputs have been provided so that the unit can be called an audio/video receiver (these are really nothing more than a pair of stereo inputs for the audio soundtracks of video program sources, and a means for transcribing video signals from one VCR to another). The most impressive elements of this receiver, however, are its amplifier performance and features and its external appearance and design.

The amplifier has been designed to deliver high current (as much as 40 amperes) to loads of various impedances. The design also provides high dynamic headroom—more than 2.0 dB of extra power beyond its 100-watt rating when driving 8-ohm loads and nearly 2.5 dB above its rating of 130 watts per channel when driving 4-ohm loads.

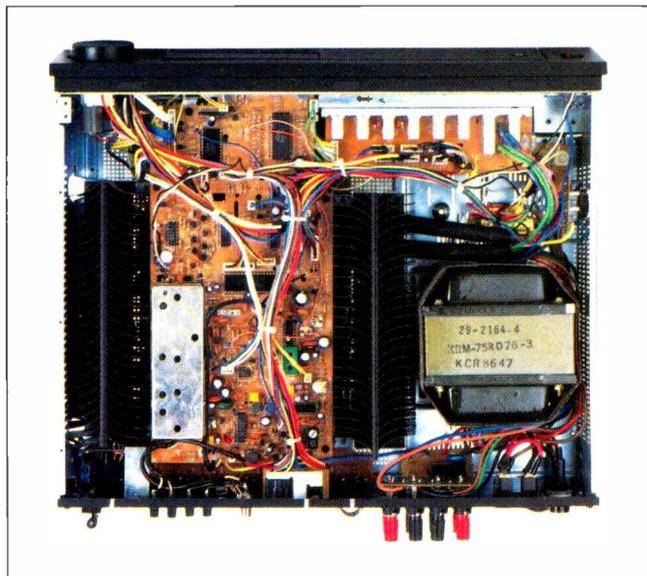
As for the tuner section, its convenience features are more impressive than its basic performance, which is only average. Still, frequency-synthesized tuning with a total of 16 presets (eight AM and eight FM), manual and automatic (scan) tuning, digital frequency displays, and the like all contribute to ease of use.

Visually, the X-10 does not present the cluttered look that is so common in full-featured receivers these days. Instead, controls that are seldom used are neatly hidden behind a hinged, swing-down panel—a trick learned, no doubt, from designers of VCRs, who have long used this technique to make their products look less intimidating. Furthermore, the entire front panel is sloped gracefully rearward, so you don't have to stoop to see and use the controls and switches.

The remote control supplied with this receiver will also activate functions on a number of other AR components, such as the CD-04 and CD-06 Compact Disc players. A rear-panel jack can be used to interconnect the X-10 and the CD player, so the player won't react to remote commands when the X-10 is set to some other input. Another rear jack can be used to control a possible future AR cassette deck or DAT deck, which may not have its own remote-control sensor. Although the X-10's remote control cannot access preset stations, it does adjust volume (activating a motor-driven control), select inputs, search up and down the tuning scales, operate the audio muting switch, and turn the receiver on and off.

### Control Layout

With the hinged panel closed, the only control visible on the left half of the front panel is the large power on/off button. A ring of subdued light surrounds this button when power is on. A stereo headphone jack is located near the lower left edge of the panel. The panel's right side houses the digital frequency readout, a signal-strength indicator consisting of four vertical LED bars, a tuning indicator light, eight numbered preset buttons, five input-selector buttons, the audio muting button, up and down tuning buttons, and an auto/manual tuning selector button. Most of these but-



tons are accompanied by indicator lights to show which functions have been activated. I have one complaint with this arrangement: AR attempted to make the indicator lighting so unobtrusive that I had to squint to see if any of the light green indicators were actually on. The problem was less annoying in subdued lighting, such as might be used in a living room when listening to music; in my well-illuminated lab, it was rather difficult to determine if a given indicator was on or not. A large, conventional rotary volume control is at the extreme right side of the panel.

Secondary pushbuttons and small rotary controls come into view when the black hinged panel is swung down. A row of eight pushbuttons will select either or both pairs of speakers, mono or stereo operation, tone-control defeat, subsonic filter, loudness compensation, tape 1 or tape 2, and VCR 1 or VCR 2. Another button selects AM or FM tuner bands; there is also a "Memory" button for setting up station presets. Four small knobs handle channel balance and the bass, midrange, and treble tone controls.

A separately supplied AM loop antenna is easily attached to the rear panel and can be pivoted for best AM reception. Within the area surrounded by this loop, when it lies against the panel, are the AM antenna terminal, the 75- and 300-ohm FM antenna terminals, and two jacks for the remote-control links mentioned earlier. If you have a 75-ohm transmission line coming from your antenna, you'll be pleased to find that *both* an F-type (coaxial) connector and screw terminals are provided for it. The usual array of phono and high-level input jack pairs is augmented by VCR 1 and VCR 2 audio input and output jacks, a VCR 2 video input jack, and a VCR 1 video output jack (for dubbing video signals). To the left of the jack pairs is an MM/MC selector switch. Stiff wire jumpers complete connections between a pair of "Pre(amp) Out" jacks and the corresponding "Main (Amp) In" jacks. Removing these jumpers permits connection of another signal-processing component, if desired. Color-coded terminals for two pairs of loudspeakers are located near the right end of the X-10's rear panel. Farthest to the

Yes, video connections are provided, but the most impressive aspects of

AM frequency response was better than average, and loop sensitivity seemed to exceed the published specification.

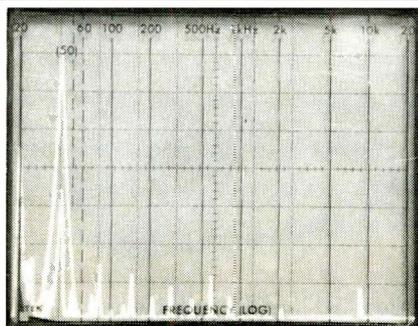


Fig. 4—Separation and crosstalk components for a 5-kHz FM modulating signal, FM tuner section.

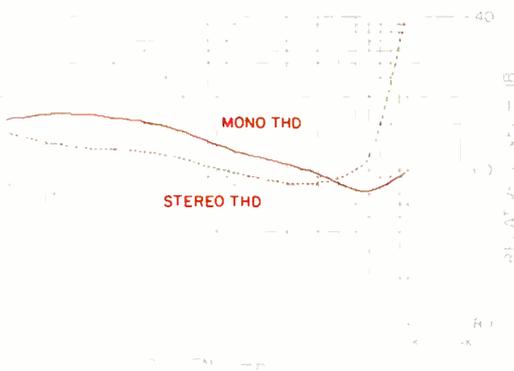


Fig. 5—THD + N vs. frequency, FM tuner section.

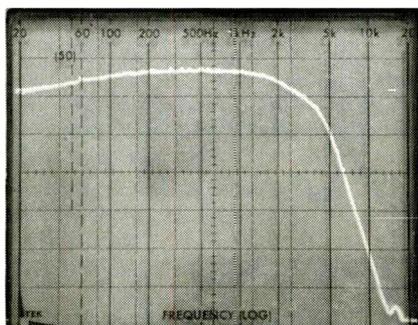


Fig. 6—AM frequency response.

Frequency response of the AM tuner section (Fig. 6) was somewhat better than average, extending out to approximately 4 kHz for the  $-6$  dB roll-off point. Loop sensitivity seemed considerably better than the  $500 \mu\text{V}$  specified by AR, but my test setup did not allow me to verify that. I was able to measure direct input sensitivity (connecting a signal directly to the AM antenna terminal); this yielded a sensitivity figure of  $25 \mu\text{V}$ .

#### Amplifier Measurements

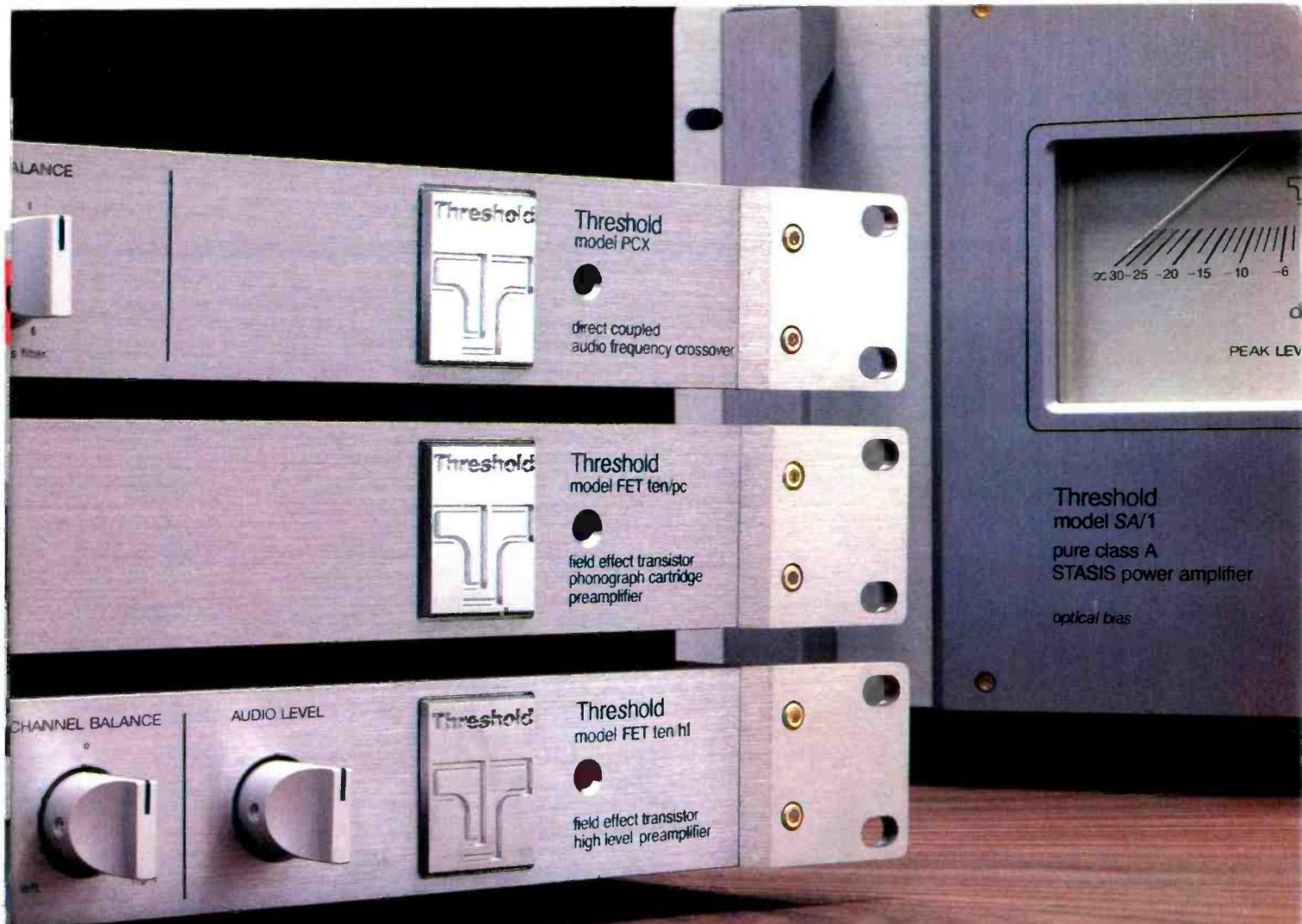
The power amplifier section exhibited high dynamic headroom: More than 2.0 dB with 8-ohm loads and nearly 2.5 dB with 4-ohm loads. Given the nominal continuous power rating of 100 watts at 8 ohms and 130 watts at 4 ohms, it means that the amplifier can deliver short power peaks as high as 158 watts per channel when driving 8-ohm loads and as high as 230 watts per channel when connected to 4-ohm loads.

As for continuous power output, with 8-ohm loads the amplifier produced nearly 115 watts per channel at mid-frequencies, 108 watts per channel at 20 Hz, and just over its rated 100 watts per channel at 20 kHz. At rated output of 100 watts per channel, THD + N at mid-frequencies measured 0.0055%, increasing slightly to 0.01% at 20 Hz and 0.021% at 20 kHz. All of these results are well within the 0.03% limit set by the published specification. With 4-ohm loads, the amplifier delivered just over 170 watts of continuous power per channel for a 1-kHz test signal, 147 watts per channel at 20 Hz, and 138 watts per channel at 20 kHz. At 130 watts per channel (the rated power output for 4-ohm loads), THD + N was only 0.0075% at 1 kHz, 0.008% at 20 Hz, and 0.02% at 20 kHz. A "three-dimensional" graph (Fig. 7) shows how THD varied as a function of frequency and power output for 8- and 4-ohm loads.

SMPTE IM at rated output measured 0.015% with 8-ohm loads and 0.02% with 4-ohm loads. Results for CCIF IM (twin-tone IM) at rated output levels were only 0.0025% for 8-ohm loads and 0.0023% for 4-ohm loads. Damping factor was surprisingly low, only 30 with a 50-Hz test signal referred to 8-ohm loads. I am at a loss to explain why my figure was so low in comparison to AR's claimed damping factor of 120. The difference cannot be attributed to the fact that they use a 1-kHz test signal while I use the EIA-specified frequency of 50 Hz; even when I used AR's test frequency, damping factor did not change substantially.

Figure 8 shows the maximum boost and cut range of the bass, midrange, and treble tone controls. The bass and treble action seemed quite conventional, yet I found that the midrange control affected bass frequencies fully as much as did the bass control itself. While a midrange control is normally a very useful addition to an amplifier or receiver, the X-10's will prove effective only if you find that you need a tonal lift in both the bass and midrange regions. At that, the control affects a much wider swath of frequencies than it should, extending well up into the lower treble range as well as down into the bass. Fortunately, there is a tone-defeat button behind the hinged panel cover!

Figure 9 shows the usual characteristics of a loudness control coupled to the master volume control. If you have output level controls on the program sources connected to



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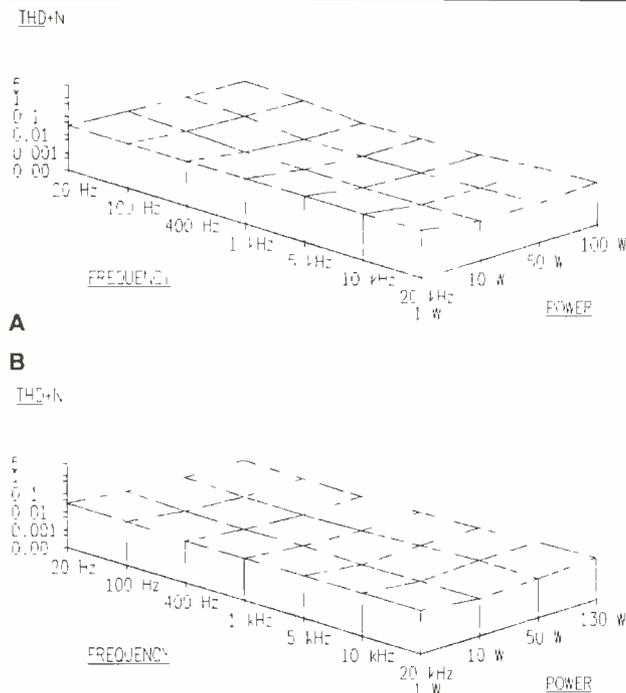


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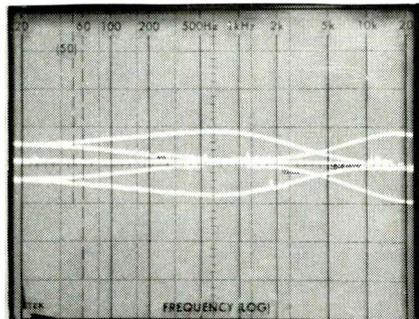
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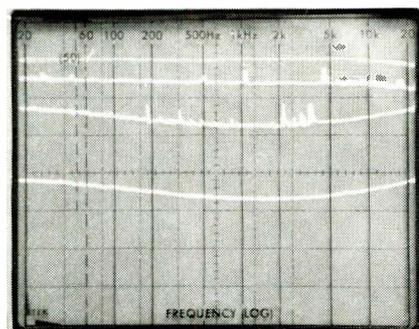
My first impression when listening to the X-10 was that it has considerably more power output than its rating would suggest.



**Fig. 7—THD + N vs. frequency for four power levels with 8-ohm load (A) and 4-ohm load (B).**



**Fig. 8—Tone-control characteristics. (Note midrange action; see text.)**



**Fig. 9—Loudness-compensation control characteristics.**

the receiver, you may be able to adjust them for proper low-level loudness compensation. If not, chances are slim that this loudness control will afford proper compensation.

High-level input sensitivity for 1 watt output measured 15 mV. For the same 1 watt of output, 0.25 mV was needed at the MM phono inputs (using a 1-kHz test signal), and 20  $\mu$ V was required at the MC inputs. MM phono input overload measured 160 mV, somewhat higher than the 150 mV specified. RIAA equalization was accurate to within  $\pm 0.2$  dB from 30 Hz to 15 kHz. The  $-3$  dB cutoff point of the subsonic filter occurred at 15 kHz.

Signal-to-noise ratio for all the high-level inputs measured a very high 80 dB referred to 0.5 V input and 1 watt output. With the volume control set to minimum, S/N improved still further, to 83 dB. There is no direct way of correlating these results to AR's figures, since the published specifications are referenced to rated output with the volume control set at maximum. Phono S/N measured 78 dB referred to 5 mV input and 1 watt output, with the rear-panel switch set to the MM cartridge mode. It was 72 dB for the MC mode referred to 0.5 mV input and 1 watt output.

#### Use and Listening Tests

My first impression, when listening to the AR X-10, was that it had considerably more power output than its continuous power rating would suggest. FM tuning was precise. Even though the tuner was not particularly sensitive compared to others I have tested over the years, its signal-pulling ability was adequate in my location, some 18 miles from most of the FM transmitting antennas serving New York City. The synthesized-tuning system was well aligned with respect to the i.f. section; LED indications of proper tuning corresponded precisely to the points of lowest distortion for any incoming FM signal.

The amplifier section had no trouble reproducing the wide dynamic range of digital program sources, including CDs and some recordings made on a DAT recorder. The Deutsche Grammophon CD of Mozart's "Magic Flute" (410 967-2) was reproduced flawlessly by this amplifier driving my reference KEF 105.2 loudspeakers. Vocals sounded particularly natural, as long as I refrained from using the tone controls. (All my listening tests were done with the tone controls fully defeated and at listening levels that, in any case, would not have warranted use of any loudness compensation.) The only aspect of sound quality not completely up to my expectations was the extreme low end, which lacked the kind of tightness I have come to associate with high-powered, solid-state amplifiers. I would stress, though, that this is entirely a matter of taste; I have several friends, for example, who would probably prefer the somewhat mellower bass output that the X-10 seems to provide.

Taking into account this receiver's excellent human engineering and allowing for the fact that my sample's FM tuner section may have been slightly misaligned, I am ready to conditionally rank the AR X-10 with some of the other fine receivers in its power and price class. With more and more people combining their audio and video components, I will even concede that the video input and output terminals may prove useful to those who have no other easy way to organize their video dubbing efforts. *Leonard Feldman*

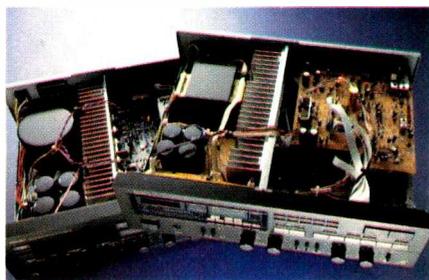
# How Denon turned receiver design inside out.

Audio companies must have a fairly low opinion of the receiver customer. How else to explain the bewildering array of buttons, lights and winking fluorescent displays that festoon so many of today's receivers? These outward trappings may impress the innocent, but they contribute not one iota to better sound.



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With their rugged anodized metal front panels, Denon receivers are certainly as handsome as any on the market. But Denon never forgets that it's inside, among the transistors, power supplies and heat sinks, that sound quality is determined. That's why Denon takes the typical priorities of receiver design... and turns them inside out.



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High Fidelity Magazine

The circuit topology of every Denon receiver truly epitomizes the Denon credo, "Simple is Best." For example,

Of equal importance, though, is the fact that much of the circuitry used in the DRA-95VR was developed for the company's exotic components, and the result is a full featured receiver that will delight even the most ardent component separatists.

integration a practical reality. Anyone with an easy chair will enjoy the remote control supplied with Denon's top two models. It operates not only the receiver, but also a choice of Denon cassette decks and CD players.

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# 4

## TECHNICS SL-P1200 COMPACT DISC PLAYER

### Manufacturer's Specifications

**Frequency Response:** 4 Hz to 20 kHz,  $\pm 0.1$  dB.

**Dynamic Range:** Greater than 96 dB.

**S/N:** 106 dB.

**THD:** 0.0025% at 1 kHz, 0-dB level.

**Channel Separation:** 106 dB at 1 kHz.

**Channel Phase Balance:** Less than 5°.

**Number of Programmable Selections:** 20.

**Output Voltage:** 2.0 V (at 0 dB).

**Output Impedance:** 200 ohms.

**Recommended Load Impedance:** More than 10 kilohms.

**Pitch Control:**  $\pm 8\%$ .

**Power Requirements:** 120 V, 60 Hz, 29 watts.

**Dimensions:** 16<sup>15</sup>/<sub>16</sub> in. W  $\times$  6<sup>5</sup>/<sub>8</sub> in. H  $\times$  14<sup>15</sup>/<sub>16</sub> in. D (43 cm  $\times$  16.8 cm  $\times$  38 cm); 9<sup>1</sup>/<sub>16</sub> in. H (23 cm) when disc compartment is open.

**Weight:** 32 lbs. (14.5 kg).

**Price:** \$1,300.

**Company Address:** One Panasonic Way, Secaucus, N.J. 07094  
For literature, circle No. 93



Although most audio enthusiasts have finally conceded that the Compact Disc and CD players can deliver sound quality equal to or better than any other program source yet devised, there's one group of people who still find fault with the new medium. No, they aren't debating sound quality; their problem is purely mechanical. I'm speaking about professional disc jockeys who work at radio stations, discos,

and the like. Their complaint is that they are unable to cue up Compact Discs with the same precision that they can achieve manually with LP records. Indeed, that's true. I've heard many a broadcast in which the desired CD track was preceded by the last second or two of the previous track, or in which the first note or two of the desired track was missed.

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

**Mozart, The Piano Quartets** Beaux Arts Trio, Bruno Giuranna, viola. "Absolutely indispensable."—Stereo Review Philips DIGITAL 115271

**Beethoven, Symphony No. 3 (Eroica)** Academy of Ancient Music/Hogwood. "Best of 1986"—Time L'Oiseau-Lyre DIGITAL 115535



**Dvořák, Symphony No. 9 (New World)** Chicago Symphony/Solti. London DIGITAL 115168

**Rimsky-Korsakov, Scheherazade** Vienna Philharmonic Orchestra/Previn. Philips DIGITAL 115415

**Ravel, Daphnis et Chloé (Complete)** Montreal Symphony/Dutoit. London DIGITAL 115520

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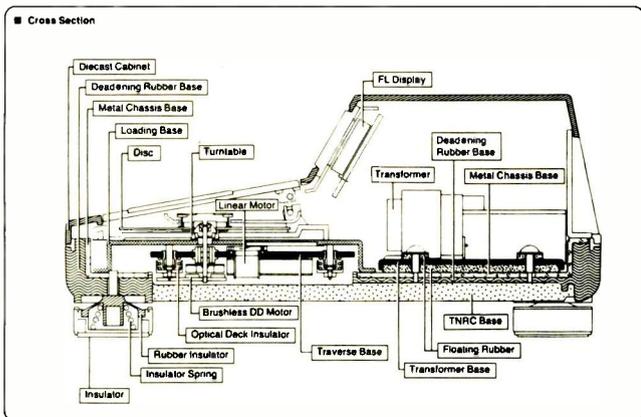
Now Technics has come to the rescue of these professionals. In doing so, they have produced a CD player that will appeal to many serious audio enthusiasts as well. The SL-P1200 is one of the most feature-laden and best-performing players that I have seen to date. The engineers who designed it must have been told to forget about costs and simply come up with a player which is as resistant as possible to external or internal vibration and shock and which takes advantage of every bit of subcode data on the Compact Disc.

Just consider these features: By turning a smoothly rotating dial with your fingertip, you can cue forward or backward in precise 0.1-S increments at two search speeds. A switch lets you "lock out" this feature to avoid accidental miscueing. Beyond that, there's an auto-cue button which, when pressed, finds the beginning of actual music at the start of a track. Since a delay of a second or two often occurs between the time a track starts and the time the music begins, this is especially useful for tight, precise cueing. The fast-search keys, in addition to performing their

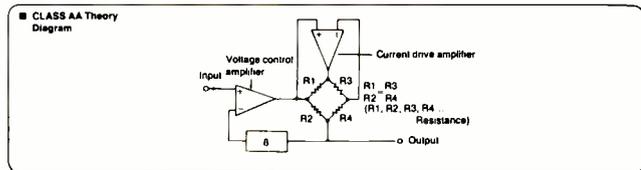
normal audible-search functions, allow you to shift the laser pickup forward or backward one pit track (about 0.1 S) while in play or pause mode. This facility reminded me of the reel-rocking capability of reel-to-reel tape recorders; Technics has even labelled the keys "Rocking/Search."

Here's another problem addressed by the SL-P1200: Have you ever wanted to play (or record onto tape) a disc that ran, say, 45 minutes and 22 seconds, when you had exactly 45 minutes of time or tape to work with? No problem, with this machine! Its precise pitch control allows you to vary pitch (and therefore playing time) by as much as 8% in either direction. That's something which can be done on many professional turntables, but only a very few CD players have the same capability, and the few I've seen didn't have calibration scales as accurate as the one provided on this unit.

Of course, all of the usual CD features are here too, such as 10-key direct access to tracks or index points. You can access by time too, in 0.1-S increments. Random programming by track number is also available, with memory of up to 20 tracks. You can repeat a single track, the entire disc, or a memorized random program. If you are recording a CD onto tape, an "auto-space" function adds 3 S of silence to whatever gap already exists between tracks. This helps the music-search systems on many tape decks and car players find where each track begins on the tape, and the feature can be used even when playing back a memorized program. "Skip" keys are provided for moving quickly from track to track.



**Fig. 1—Cross-section view of SL-P1200 construction. (TNRC: Technics nonresonant compound; DD: Direct drive.)**



**Fig. 2—Schematic diagram of Technics Class-AA circuitry.**

### Construction and Circuit Highlights

A cross-section of the SL-P1200 is shown in Fig. 1. To suppress airborne vibrations, the base uses a metal chassis with a special damping rubber and a proprietary nonresonant compound. This combination of materials converts vibration into thermal energy while providing stability and strength without causing secondary resonances. The cabinet is made of a zinc die casting with vibration-damping material between it and the three-layered base. Four large rubber insulators and coil springs help block out vibrations that might be carried through the platform on which the player rests. Inside, double insulator construction floats the optical deck, isolating it further from vibration. Power transformers are floated in a rubber damping material to avoid vibrations at power-line frequencies.

Some time ago, Technics developed an audio amplifier circuit which they call Class AA. Featured in the company's high-end amplifiers, this circuit tends to avoid the influence of speaker load impedances upon the performance of voltage amplifier stages. In the SL-P1200, Class-AA circuitry is used in the sample-and-hold circuits and in the buffer amplifier. The sample-and-hold circuit is placed after D/A conversion, where it removes switching noise from the signal. Here, the Class-AA circuitry is used for isolating the voltage-control amplifier from the current-drive amplifier which charges and discharges the capacitive load that follows. This isolation enables the voltage amplifier to transfer the CD format's high-density data to later circuits with greater accuracy, according to Technics. In the buffer amplifier prior to the audio output, Class-AA circuitry serves to isolate

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for such performance in the CX series units goes to our Dual Azimuth Matched Phase™ Tape Head. In addition, our servo controlled tape

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Focus your attention now on our legendary amplifiers. How does a 2/4 way amp with 50 watts total maximum power sound? Very, very good. No tape deck amplifier gives you more power.

What's really remarkable is the fact that without using any low-pass filters, I measured THD at 20 kHz of only 0.009%.

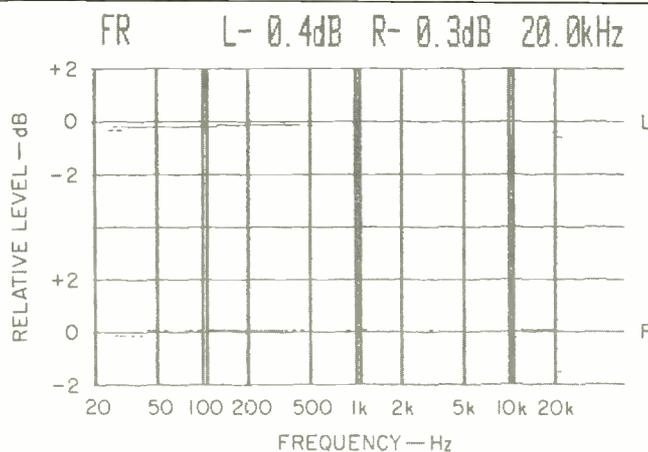


Fig. 3—Frequency response, left (top) and right channels.

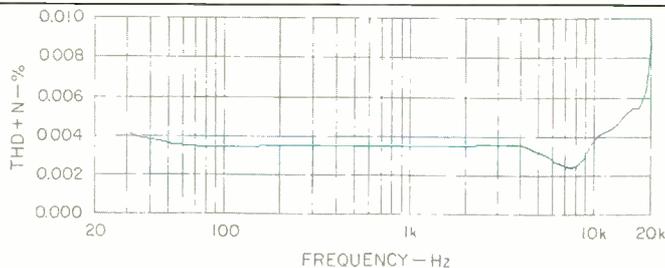
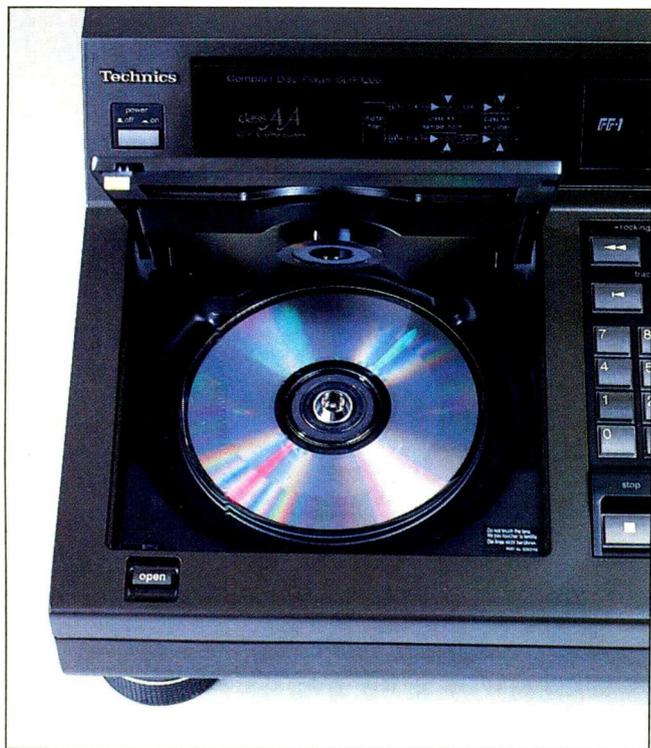


Fig. 4—THD + N vs. frequency at 0-dB recorded level.



the voltage-control amplifier from the preamplifier and from the capacitive loads it would encounter in the connection cables. (A simplified diagram of the Class-AA circuit is shown in Fig. 2.) Dual D/A conversion is used in this player, as are two-times oversampling and digital filtering.

#### Control Layout

The SL-P1200 housing is shaped like a small studio console. User controls and the top-loading disc compartment are up front, on a gently sloped horizontal surface; the major display area and power switch are on a more sharply sloped vertical section toward the rear of the unit. The centralized multi-function display has, first of all, a nine-digit readout showing track number, minutes, seconds, and tenths of seconds. When level attenuation is operated from the supplied remote control, attenuation is shown in decibels. A "music matrix" of 20 illuminated numerals indicates program content and the track being played. There are also indicators for repeat, standby, auto-cue, music scan, elapsed/remaining time, and track/total time. If a disc recorded with pre-emphasis is played, that fact is also indicated at the extreme right of the display area.

The disc compartment occupies the left side of the SL-P1200's front sloped panel. To the compartment's right are the numeric keys used for track and index accessing and for programming the player. Forward and reverse "Rocking/Search" buttons, forward and reverse "Track Skip" buttons, "Stop," "Pause," and "Play" buttons are also found here, as are the "Repeat," "Auto Space," "Index," "Clear," "Memory," and program "Recall" buttons. A "Time Recall" button confirms starting time when playing a disc from a specific point.

Farther to the right are "Auto Cue" and dial "Search" buttons, "Time Mode" buttons, the large search dial itself, a two-position dial-search speed button, a slider control for pitch adjustment, and a "Pitch Control" on/off button. Even with activation of the pitch control, you can return to correct pitch by setting the slide control at its midpoint, which has a detent for easy location. For precise operation, the search dial has a depression near its edge into which the tip of a forefinger fits. A headphone jack and an accompanying headphone-level slider control are near the right end of the player's front apron.

The rear panel of the SL-P1200 has the usual pair of gold-plated output jacks plus a pair of DIN-type connectors. One of these connectors provides subcode output for future use

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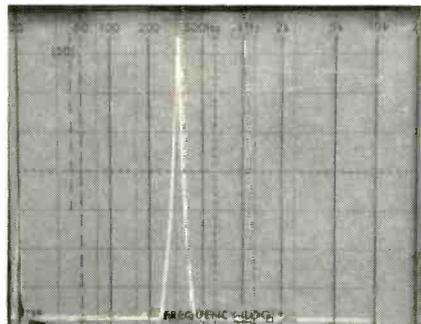
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Separation was excellent, nearing or exceeding 100 dB at all but the highest frequencies.



**Fig. 5—**  
Spectrum analysis of 20-kHz test signal. Sweep is linear from 0 Hz to 50 kHz.

with CD-I or graphics interface boxes; the other is for wired remote control. A schematic in the owner's manual shows how a wired remote can be built to handle play, pause, and stop functions. I'm not quite certain why anyone might want to wire up such a remote for home use, in view of the fact that a multi-function wireless remote control (which does much more than those few basic functions) is supplied with this player. In a studio or other setup where you want to operate the unit remotely but do not have a direct line of sight from your listening position to the player's infrared sensor, I suppose a wired alternative would be useful. (A studio version with wired remote and balanced outputs, the Model SL-P1200X, is available for \$1,500.) Incidentally, one function of the supplied remote control, digital volume attenuation, is not found on the player itself. This can be used to change output level in 2-dB steps from 0 to -12 dB. All settings of the attenuator are shown on the main unit's display.

#### Measurements

Figure 3 shows frequency response of each channel as reproduced from the sweep tracks of the EIA CD-1 test disc. Maximum deviation from perfectly flat response at 20 kHz was -0.3 dB on one channel and -0.4 dB on the other. Harmonic distortion at maximum recorded output level measured only 0.0035% at mid-frequencies, but what's really remarkable is the fact that without using any low-pass filters whatever (or at least none with a cutoff below 80 kHz), THD + N at 20 kHz measured only 0.009%. Figure 4 shows how THD + N varied with frequency. If you have been following my CD player test reports, you know that nonharmonically related out-of-band components for most players often result in 20-kHz THD + N readings several orders of magnitude higher than this. The absence of spurious components (out of band or within the audio band) is clearly evident from the 'scope photo of Fig. 5; the only output seen is the desired 20-kHz test signal itself, with not a trace of anything else on either side of it!

Figures 6A and 6B depict the results of the S/N analysis that I performed using the "silent" track of my EIA test disc.

## DITHERED LINEARITY CD TEST SIGNALS

In any digital audio system, the quantization process produces errors in the output waveform. These errors are constant in level, so their relative magnitude increases as the signal level decreases, even if the D/A converter is perfectly linear. In order to accurately judge the linearity (or non-linearity) of a particular D/A conversion system, it is necessary to add an appropriate amount and type of dither to the test signal.

Dither is simply a form of low-level noise. Specifically, it is of constant level (half the signal amplitude that would be encoded by the digital signal's least significant bit) and of randomly varying frequency.

On the new EIA CD-1 test disc, two series of signals have had such noise added to the original sine wave before quantization. The spectrum of the resulting test signals on the disc therefore consists of a signal compo-

nent, at the reference frequency and the specified level, superimposed upon a low-level signal containing random frequencies from 0 Hz to 22.05 kHz at equal levels. With this set of test signals, it becomes possible to demonstrate that digital audio is capable of reproducing signals at any level, including those well below an amplitude of 1/2 LSB (least significant bit). The dithered test signals extend from -60 to -100 dB. L.F.

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Don't let the SL-P1200's rugged construction fool you; its superb sound was akin to some of the more delicate high-end units.

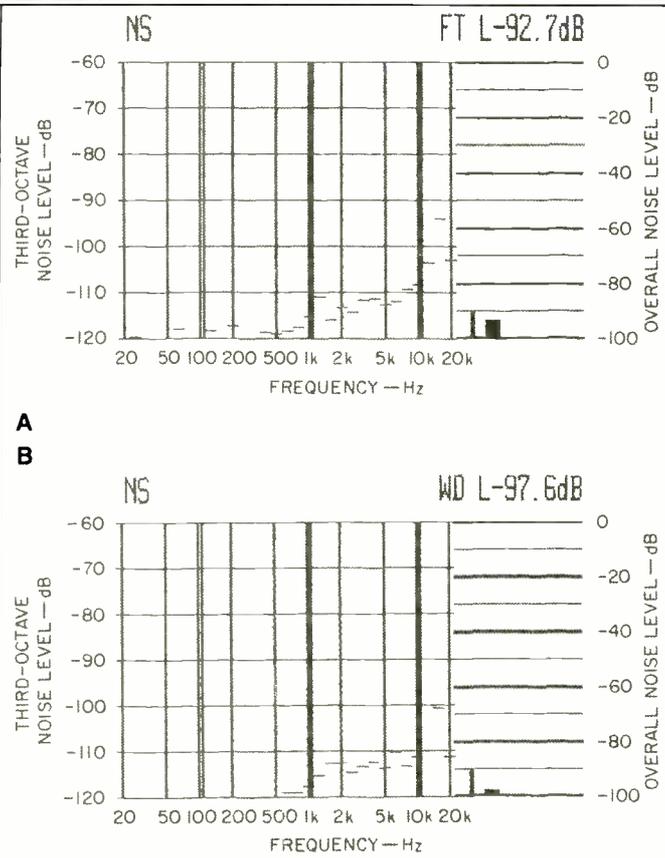


Fig. 6—S/N analysis, both unweighted (A) and A-weighted (B).

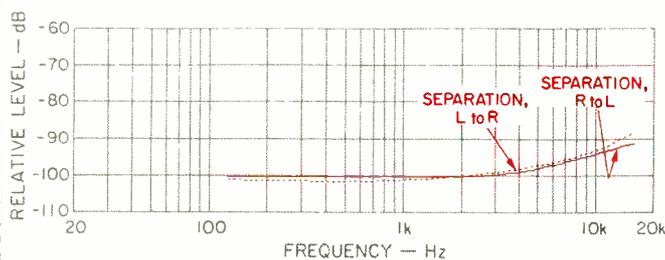


Fig. 7—Separation vs. frequency.

Unweighted S/N measured 92.7 dB, and A-weighted S/N was 97.6 dB. Dynamic range, measured in accordance with the recently suggested EIAJ method, was a remarkably high 114 dB.

A newly suggested EIA method for measuring dynamic range, however, yielded a more conservative result of 97.5 dB. This method requires a dithered 500-Hz test signal altered from 60 to 120 dB below maximum recorded level. To reject noise, the player's output is then passed through a 1/3-octave filter tuned to 500 Hz, and the output at the two test levels is measured in dB relative to the output at maximum recorded level. In practice, these two output levels will be less than 60 dB apart since, because of the dither added to the signal, no player is actually capable of reproducing a signal at -120 dB. The ultimate determination of the noise floor is made by finding the recorded signal level for which the player's output is 3 dB above the reading obtained for the -120 dB level on the disc (the dithered noise level). This signal level (N) is the lowest which can reliably be distinguished from the player's background noise.

Maximum signal level is 60 dB above the output reading for the -60 dB test tone (R), and from this one subtracts the output level recorded at 3 dB above the noise level (N). In other words, dynamic range is defined as  $60 + R - N$ . I will be using this new procedure for measuring dynamic range in all future test reports of CD players.

Stereo separation was superb, approaching or exceeding 100 dB at all but the highest frequencies, as shown in Fig. 7. These results include any crosstalk that may have occurred between output cables in my measurement setup. It is quite conceivable that if the cables had been eliminated, I could have easily achieved the claimed separation figure of 106 dB.

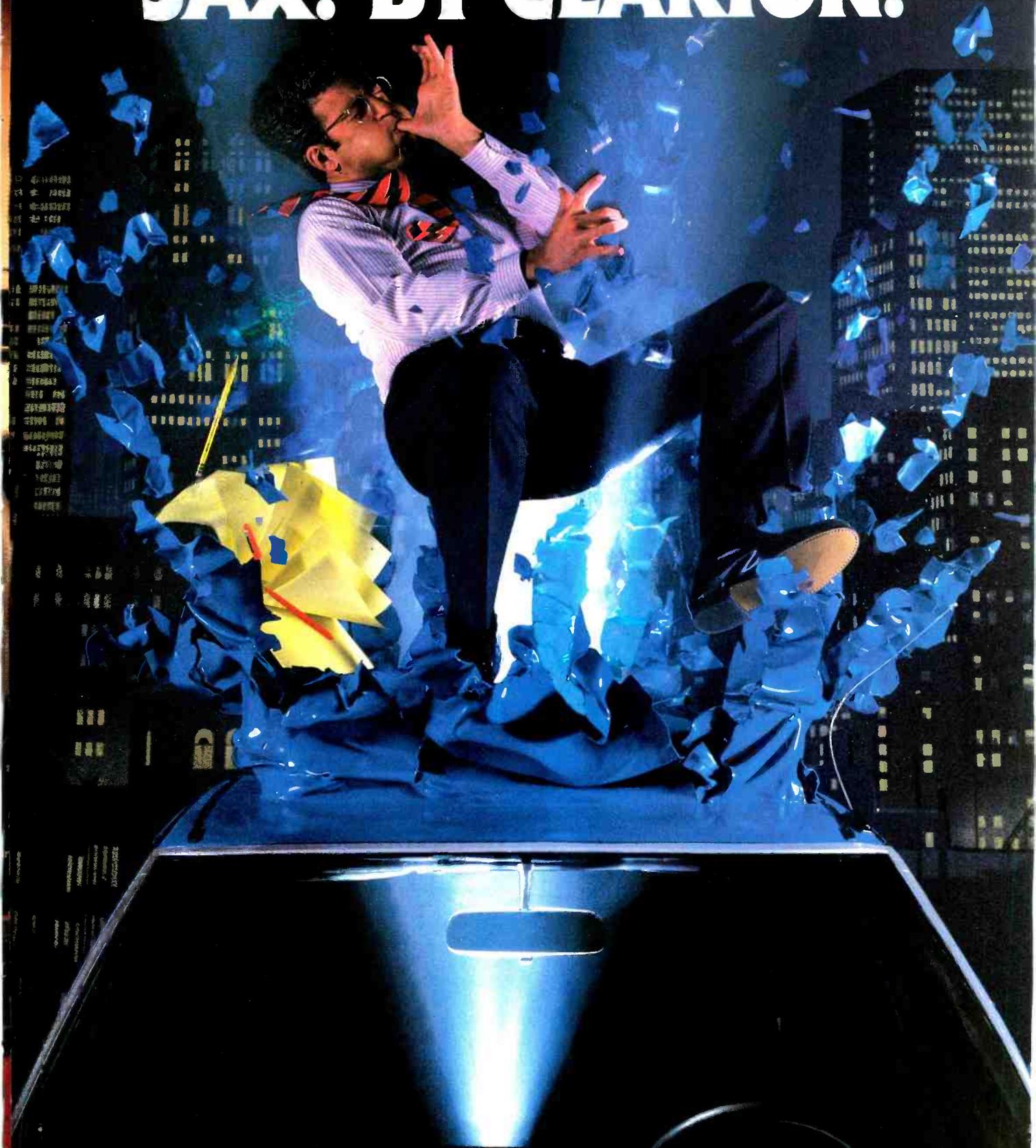
Linearity was measured in two ways. For undithered signals, linearity was accurate to within 1.1 dB down to -70 dB. Using a dithered test signal in the range from -70 to -100 dB, I was able to read down to -96.5 dB (see sidebar). SMPTE-IM distortion for this player measured 0.0085% at maximum recorded level, and CCIF-IM distortion, using twin tones of equal amplitude separated by 1 kHz, was 0.0045% at maximum recorded level and 0.0016% at -10 dB.

Figure 8 shows a 1-kHz square wave reproduced by the SL-P1200; it is typical of those reproduced by all CD players that employ digital filtering and oversampling. The same holds true of the unit pulse depicted in Fig. 9. Note, however, that this player does invert signal polarity. Finally, the Lissajous pattern of Fig. 10 confirms the fact that two D/A converters are used in this player: There is no evidence of any time or phase displacement between left and right 20-kHz output signals.

You probably won't be surprised to learn that the SL-P1200 had absolutely no trouble tracking the various sections of my "defects" test disc. Furthermore, external vibration of rather large magnitude caused no mistracking of any of the discs I used during subsequent listening tests. This player is one of the most ruggedly built units I have yet encountered. It was clearly designed to operate even in the most hostile environments, such as discos, where nearby dancing feet can set up quite a lot of mechanically borne

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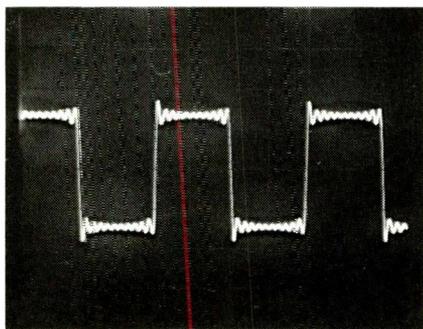


Fig. 8—Reproduction of a 1-kHz square wave.

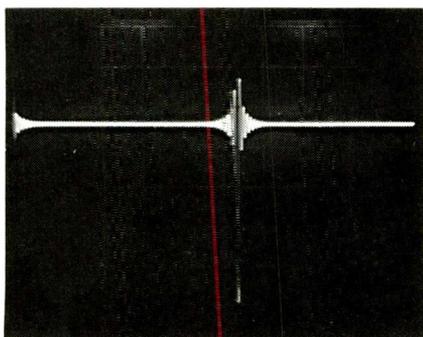


Fig. 9—Single-pulse test.

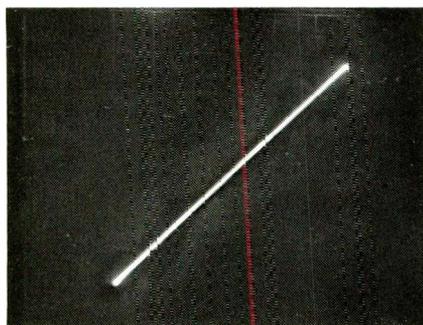


Fig. 10—Interchannel phase comparison at 20 kHz. Straight line indicates absence of time or phase error.

vibration and deafening SPL levels can create airborne vibration that lesser players might not be able to handle.

#### Use and Listening Tests

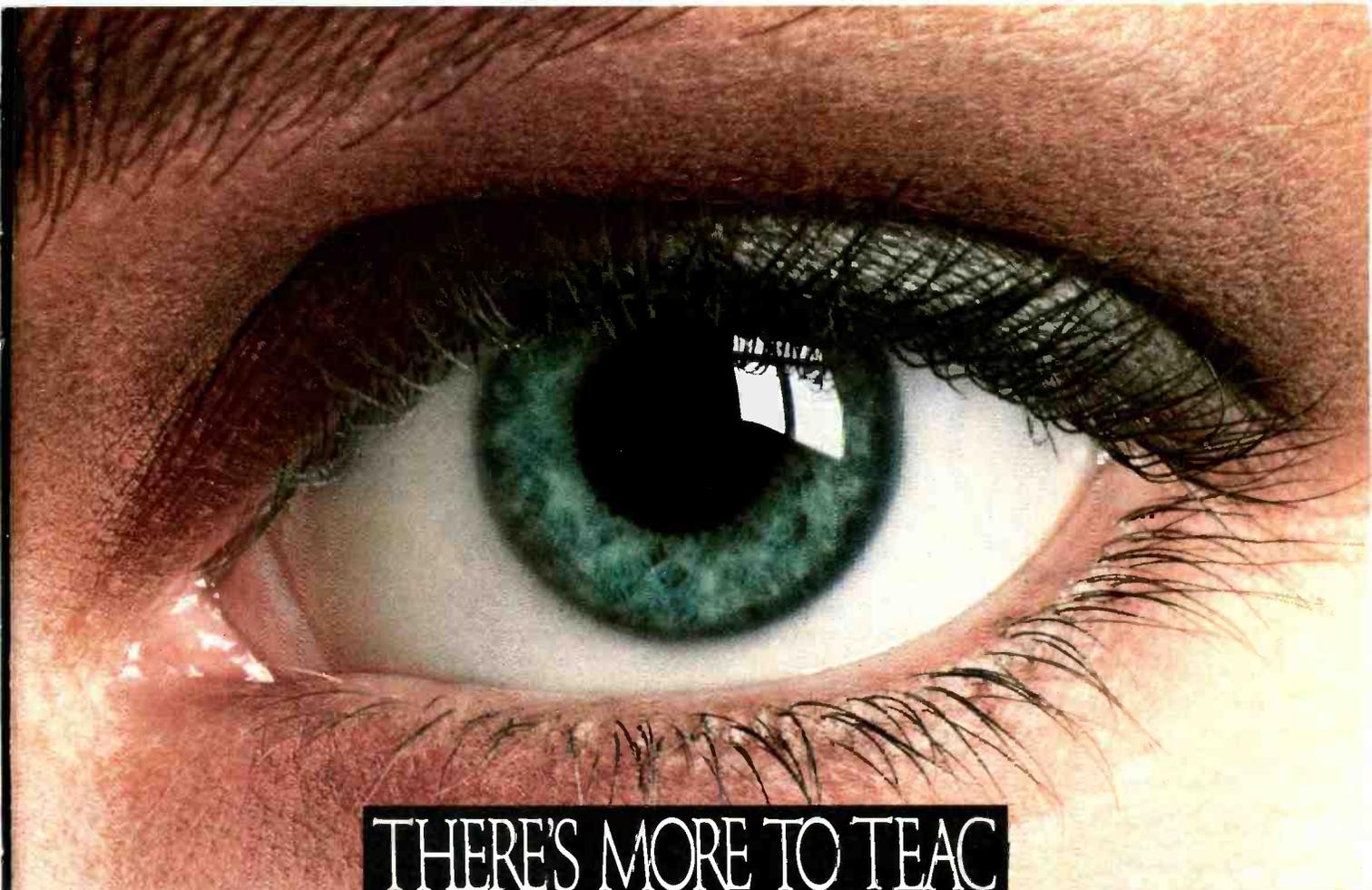
What I found especially interesting about this unit was that, for all its professional features and its rugged construction, the sound quality delivered was superb, akin to some of the more delicate high-end CD players that I've tested. In other words, don't let the rugged construction, the disc-jockey features, and the odd physical configuration fool you into believing that the SL-P1200 is suitable only for commercial applications. Its price is actually lower than that of some high-end home players that don't sound nearly as good.

In using this player, I discovered a couple of things that make it particularly attractive at this juncture in the evolution of CDs and CD technology. You've no doubt heard or read about the new CD "singles" that measure only 8 cm in diameter (about 3 inches) and contain up to 20 minutes of music. These tiny discs will require an adaptor if you want to play them on most drawer-loading players. If you own a unit such as the Technics SL-P1200, with its top-loading format and its centering spindle, no adaptor is required. In fact, two of the discs I used to audition the player were "singles," one from Telarc, containing four selections from their full-sized *Pomp and Pizazz* disc (CD-80122), the other a new sampler from DMP (Digital Music Products) containing three short selections in a more popular vein. I also listened to some longer works, including a recently acquired Deutsche Grammophon recording (three discs) of Mozart's "Magic Flute" opera (410 967-2). Voice reproduction was extremely accurate, and the sense of depth and placement of the opera orchestra relative to the singers on stage very closely duplicated the sensation I get when attending a live performance.

Having convinced myself that this unit's sound quality left nothing to be desired, I spent the rest of my auditioning time playing with its professional features. The search dial is especially well executed and works flawlessly, and each of the two search speeds is perfect for its particular application. At one point during my listening tests, I knew that a specific orchestral crescendo was a bit farther along in the track. I selected the slow search mode and started turning the search dial to find the exact spot I wanted. At this speed, each rotation of the dial advanced the laser pickup by only about 1 S—great for really zeroing in on an exact note, but not good for my purposes. Switching to the fast search mode, one rotation of the dial advanced the pickup by about 20 S of playing time, which suited my needs exactly. A couple of turns brought me right to the point I wanted, and a press of the "Play" button let me hear the phrase of music I'd been looking for. No other CD player I've worked with made accurate cueing quite this easy.

When I recall that my first CD player, back in 1982, had a suggested price exactly the same as this sophisticated professional unit's price, I am amazed at what has become possible in the mere five years that CD players have been available. Whether you are professionally involved in audio or are just a serious music lover, you'd do well to check out this amazing component.

Leonard Feldman



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# EQUIPMENT PROFILE

# 5

## AUDIO CONTROL RICHTER SCALE SERIES III ANALYZER/EQ/ CROSSOVER

### Manufacturer's Specifications

**Harmonic Distortion:** 0.005%.

**Frequency Response:** 18 Hz to 100 kHz.

**Maximum Output Level:** 7 V rms.

**S/N Ratio:** 120 dB re: maximum output level.

**Subsonic Filter:** 18 dB/octave below 18 Hz, Chebychev alignment.

**Input Impedance:** 100 kilohms.

**Output Impedance:** 150 ohms.

**Analyzer Meter Range:** -20 to +6 dB.

**Crossover Slope:** 24 dB/octave.

**Crossover Frequency:** Programmable, 90 Hz as supplied.

**Dimensions:** 17 in. W x 2½ in. H x 8¼ in. D (43.2 cm x 6.4 cm x 21 cm).

**Weight:** 7.6 lbs. (3.5 kg).

**Price:** \$349.

**Company Address:** P.O. Box 3199,

Lynnwood, Wash. 98036.

For literature, circle No. 94



With the Richter Scale Series III, Audio Control continues and adds to the features of the earlier, Series II version, profiled in these pages in August 1983. The half-octave equalizer now has six sections, with filter centers at 22.5 (new), 31.5, 45, 63, 90, and 125 Hz. Each filter slider has a range from -12 to +12 dB. Adjustment of the equalizer is guided by the built-in analyzer with a warble-tone source, a supplied test microphone, and the analyzer's extra-damped VU-style meter. A rotary control sets the warble-tone center frequency anywhere from 250 Hz (for level reference) to 22.5 Hz, the lowest filter frequency. The warble-tone outputs

are fed into the sound system via the normal equalizer outputs when the analyzer function is selected.

The Richter Scale III also has facilities for controlling unwanted low-frequency energy. Switching in the subsonic filter activates a roll-off at 18 dB/octave below 18 Hz. This filter is more effective than many because of its sharp slope. The unit's unusual rumble reducer actuates a cross-feed between channels that cancels out-of-phase signals below 200 Hz. In the lower frequencies, much of the music on a phonograph disc will be in phase, causing lateral stylus motion. Most rumble, however, is in the vertical plane and is

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The Richter Scale III, as supplied, has a crossover at 90 Hz. If a different value is needed, one just changes a plug-in module.

read by the cartridge as out-of-phase information; the Richter Scale's circuit cancels this energy out. The cancellation decreases with increasing frequency at the rate of 12 dB/octave, with no effect at 200 Hz and above. Thus, normal stereo imaging is maintained in the important middle and upper frequencies.

Another major feature, which could be the most important one for some users, is a two-way stereo crossover. The design is the Linkwitz-Riley alignment, which has become popular because of its superior performance. This design is a modification of the fourth-order Butterworth crossover. As in Butterworth designs, the crossover slopes are 24 dB/octave, but the individual filter outputs are 6 dB down at the crossover point instead of 3 dB down. The Linkwitz-Riley alignment yields outputs that sum in voltage (or pressure) to produce flat frequency response, keeps both outputs in phase at the crossover frequency, and yields output phase relationships which allow time correction for drivers that are not in the same acoustic plane.

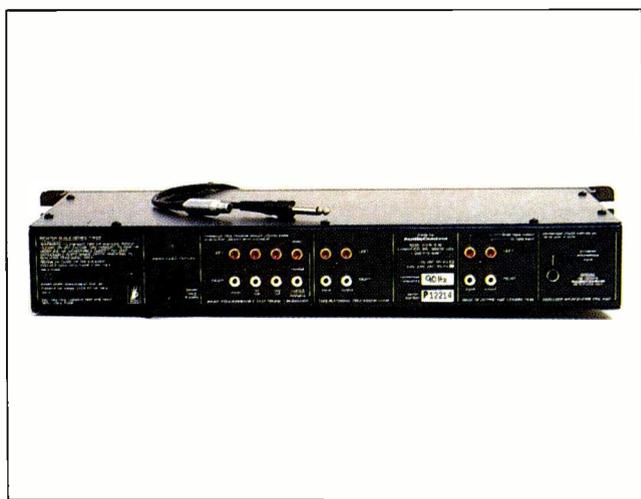
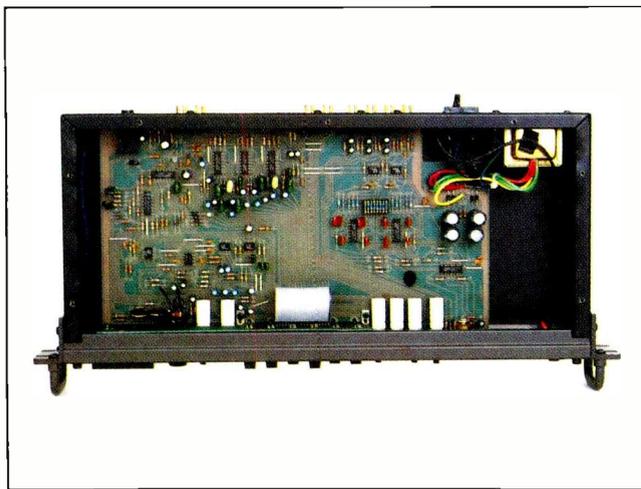
The Richter Scale III, as supplied, has a crossover frequency of 90 Hz, which is appropriate for many subwoofers. If a different value is needed, the frequency is programmable by changing a plug-in 16-pin resistor network. The Richter Scale III comes with a coupon that can be sent in to get another network module at no cost. There are 14 frequencies available, with values from 60 Hz to 3.5 kHz. A blank module is also available for those who want to set their own frequency to any value up to 20 kHz!

The low-frequency output has a level control with a  $\pm 20$  dB range; this obviates the need for a volume control on the subwoofer amplifier. There is also a switchable mute on the crossover output to aid in judging the balance between subwoofer and main speaker levels.

### Control Layout

The front panel of the Richter Scale III is divided into five sections. From left to right, they are labelled "Half Octave Analyzer," "Half Octave Equalizer," "Signal Processing," "Electronic Crossover," and "Power."

Occupying the left side of the "Half Octave Analyzer" section is the "Average Reading Meter" with the notation



"Relative Acoustic Warble Tone Level" below it. The meter has a light-blue, back-lit scale from "-20" to "+6." To the right of the meter is the "Warble Tone Frequency" knob with a notch for the index. There are labels around the knob for each of the equalizer frequencies and for the reference-level setting, which is indicated by "0 Cal" and "250."

The pushbutton switch for the "Analyze" function requires that the test microphone be plugged in and placed at the normal listening position. The amplified level of the warble tone is adjusted to get "0" on the meter with the warble-tone frequency at "250." Then one gradually adjusts the equalizer to get zero readings at each frequency. This good approach will be discussed more fully in the use-test section of this profile.

The "Half Octave Equalizer" section with its six filter sliders comes next. To the left of the sliders is an "Equalize Program" pushbutton for inserting or removing equalization. Normally, the sliders would be adjusted in conjunction with use of the analyzer.

The "Signal Processing" section consists of three button switches for "Subsonic Filter," "Rumble Reducer," and "External Processor." The first two are self-explanatory; a push of the third will connect input/output jacks for any external processor or a tape deck.

The "Electronic Crossover" controls consist of a "Lo Frequency Output Level" knob and a "Mute" switch. (A notation below them states "24 dB/Octave Programmable Crossover.") The output-level knob has a slot for easy turning with a thumbnail, and a small dot lines up with "0" when the control is in the center detent. There is a "-" for the leftmost position of the knob and a "+" for the rightmost position. No dB values are shown, but they're not that important; the low-frequency speaker level would be set with the aid of the analyzer and the mute switch. At the right end of the front panel is the rocker-type power switch. Illumination of the warble-tone level meter serves as the pilot light for the unit.

The designations on the dark brownish-gray panel are silver-gray, which makes them fairly easy to read under most lighting conditions. The Richter Scale is supplied ready for rack mounting, which would certainly be convenient for some users.

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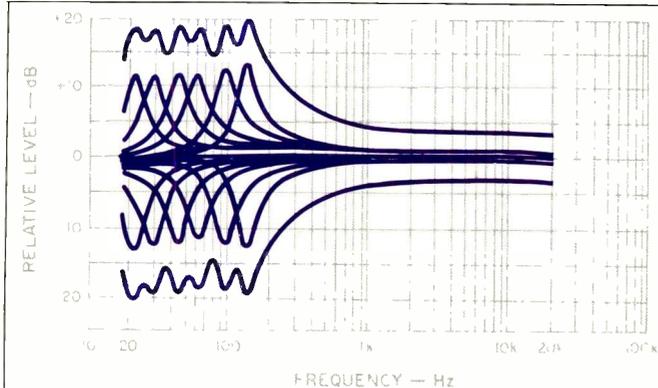
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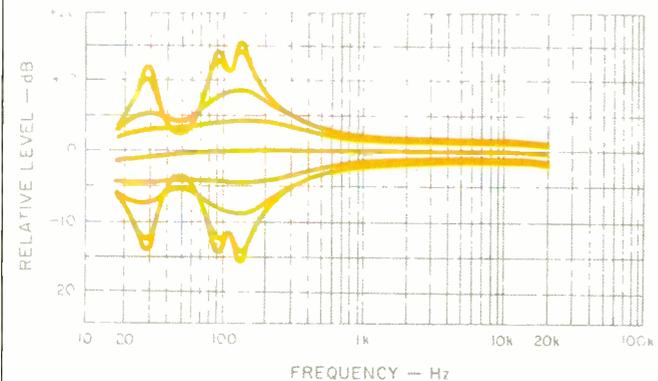
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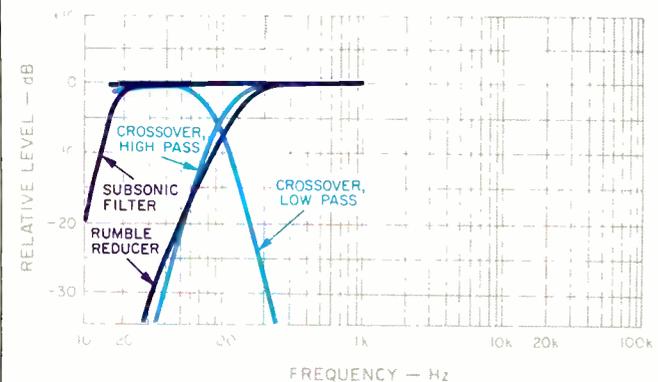
Audio Control gets extra credit for their helpful rear-panel labels and for using input/output jacks of high quality.



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



**Fig. 2—Swept-frequency responses with 31.5-, 90-, and 125-Hz filters set successively for steps of 3 dB from -12 to +12 dB.**



**Fig. 3—Responses of the switch-selectable subsonic filter and rumble reducer, and of the crossover's low- and high-pass filters.**

At the far left of the back panel is an unswitched a.c. outlet. Then come stereo phono jacks for the crossover, for the processor loop, and for the main in/out connections. The phone jack for the analyzer microphone is at the far right. While having this jack on the back panel may help prevent accidental (and possibly damaging) connection of headphones, its location may be quite inconvenient in some installations. On the other hand, analysis will normally be an infrequent task, and because the meter does not operate when the "Analyze" switch is off, the microphone can be left connected if there is a safe and handy place to stow it.

The crossover jacks are for "Input," "Hi Out," and "Low Out"; there are also special "Mono & Bridging" jacks labelled "Normal" and "Invert." The output from both bridging jacks is monaural, the sum of the left and right low-frequency signals. These two jacks allow either signal polarity to be fed to a subwoofer. Also, by feeding the "Normal" output to one input of a two-channel power amplifier and feeding the "Invert" output to the amplifier's other input, many amplifiers can be bridged even if they do not have a switchable bridging mode. (*Editor's Note:* This concept is illustrated in "Build a Phase Inverter" in this issue.) However, the user should check with the amplifier's manufacturer before attempting this, to make sure it will not harm the amp. The inclusion of two opposite-phased outputs is unusual and is potentially valuable in both convenience and performance.

The next set of input/output jacks is labelled "Tape/External Processor Loop," which indicates the two uses for those connections. The jacks that follow, for the equalizer, bear a "Main Rcvr/Pre-amp Connection" label. The "Input" and "Output" jacks in this group are additionally labelled "From Tape Output" and "To Tape Input," respectively. Audio Control gets extra credit for putting these helpful labels right where they're needed. They also deserve some applause for using jacks whose shells *and* center contacts are gold-plated.

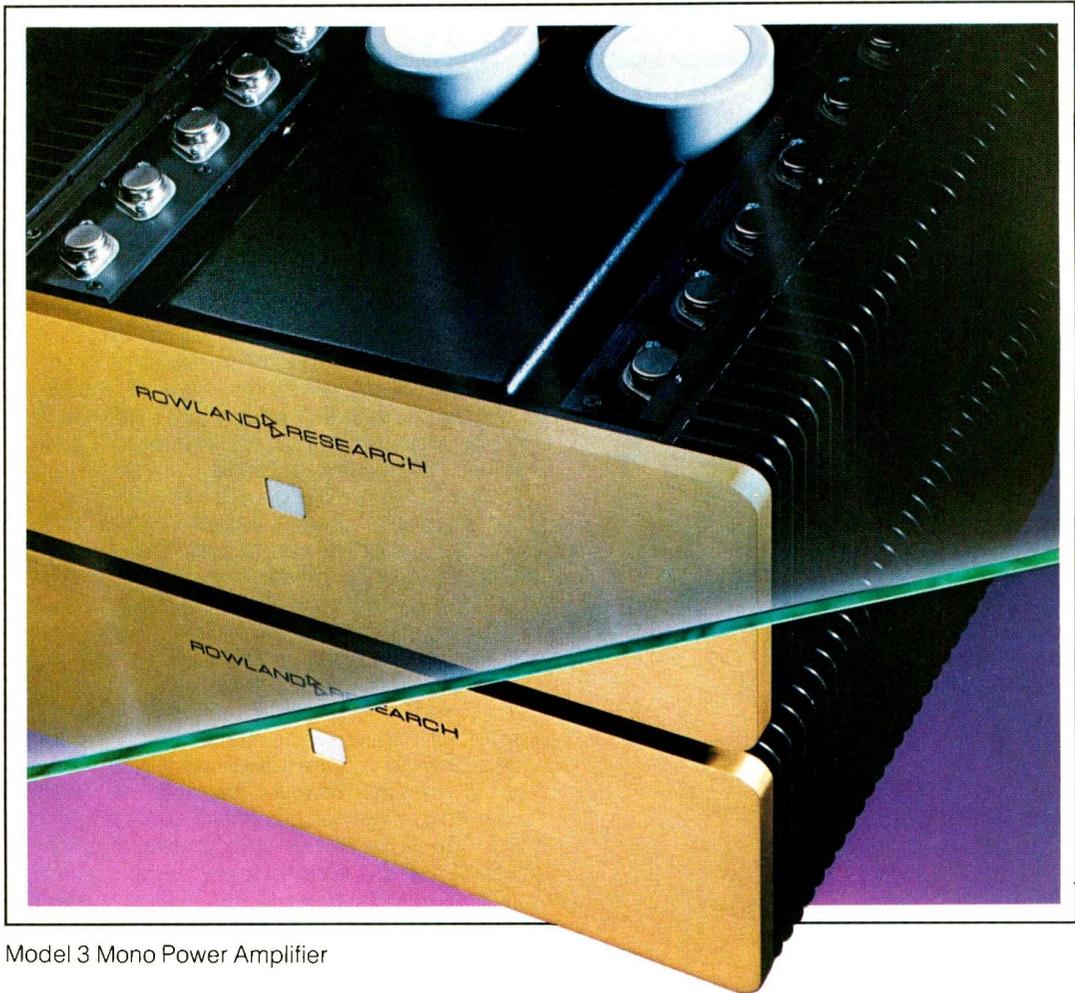
Removal of the steel top cover revealed the main p.c. board, close to chassis size. Soldering was generally excellent with some flux residue at a few hand-soldered points. Components were of good quality with no identification by part number or function. All of the ICs were soldered in place. The 16-pin, crossover-frequency plug-in module with its eight resistors was in plain sight and immediately available for any changes that might be desired. I assume all users would be aware that the module should be unplugged before any soldering is done. In any event, changing the module's resistors is a relatively simple task for most who have done any soldering before.

The front-panel pushbuttons are mounted directly on the main board. The board is fairly well supported, but it is springy at a number of points. A multi-conductor cable connects it to the filter-slider board. A single fuse is mounted in clips next to the power transformer on the back panel. The box configuration of the chassis gives it good rigidity, especially with the covers in place.

### Measurements

With all special functions switched out and the five equalizer sliders in their center detents, I checked frequency response both with and without the equalizer circuits

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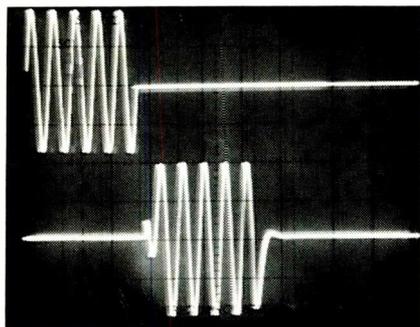
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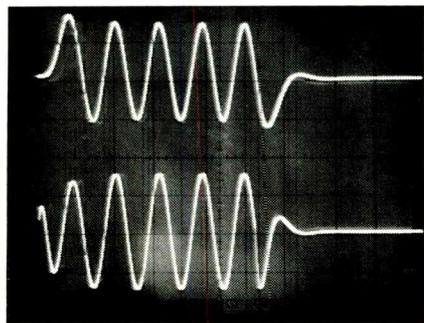
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Center frequencies of all filters were within 6% of their specified values; half were within 3%. This is good accuracy.



**Fig. 4—Tone-burst check of crossover, at measured crossover frequency of 91.7 Hz, showing input (top trace) and summed output of low- and high-pass filters (bottom trace, delayed for clearer display). Note the small leading transient on the output.**



**Fig. 5—Same as Fig. 4, but showing low-pass output (top trace) and high-pass output (bottom trace) individually.**

switched in. Relative to 1 kHz, response was 3 dB down at 2.8 Hz and at 160 kHz with equalization; without, it was down 3 dB at 1.7 Hz and at 160 kHz. At 20 Hz, response was down 0.9 dB with equalization and down 0.4 dB without. At 20 kHz, response was within 0.05 dB both with and without equalization. Switching equalization in resulted in a level shift of just 0.1 dB: +0.1 dB for the left channel and -0.1 dB for the right.

Figure 1 shows the swept-frequency responses of the six individual equalizer filters at their maximum boost and cut settings. It also shows response with all of the filters at their extreme settings. With a single filter at its maximum, level

rose by about 0.5 dB over the entire audio band. This is a fairly common effect with equalizers; it is generally undesirable, but it's not serious in this case. With all of the filters at maximum boost or cut, the wide-band level shift was about 3.5 dB, which is on the high side. It would be unlikely, of course, for all of the sliders to be in such a position in actual use. With a combination of boosts and cuts among the filters, the high-frequency level would shift relatively little.

The measured center frequencies of the filters were all within 6% of their specified values, and half of them were within 3%. This is good accuracy for half-octave filters. The maximum boosts and cuts were all within  $\pm 1$  dB of the specified 12 dB, and half of them were within  $\pm 0.5$  dB. A 4.2-dB boost of the 90-Hz filter produced a Q of 1 (1.4-octave bandwidth); conservatively speaking, boosting beyond this point would pose a risk of ringing on low-frequency transients. A boost of 5.6 dB with the same filter yielded a Q of 1.4 (1-octave bandwidth). Because of the consistent response shapes, these values for boost, bandwidth, and Q would apply to the other filters as well.

Figure 2 shows swept-frequency responses with the 31.5-, 90-, and 125-Hz sliders set in 3-dB steps from -12 to +12 dB, corresponding to the designations on the front panel. There was a rough correspondence between the settings and their actual effects, better than with some equalizers. Little change occurred between the "9" and the "12" boost or cut settings. However, between "6" and "9," there was more than might be expected, particularly for the 31.5-Hz filter. Because of the smoothness of slider movement, I judged that any needed boost or cut would be easy to set.

To check the ability of the Richter Scale to compensate for closely-spaced dips and peaks in system response, I set the six sliders alternately for maximum boost and maximum cut. Due to filter overlap, this alternation reduced each filter's maximum effect, but the reduction was relatively small overall. The actual resulting boosts at 22.5, 45, and 90 Hz were +6.6, +8.9, and +10.4 dB, respectively. The cuts at 31.5, 63, and 125 Hz were -9.6, -9.1, and -7.4 dB, respectively. These figures show that the equalizer could provide considerable compensation for an unlikely but not impossible condition.

Figure 3 shows the responses of the other Richter Scale functions. The subsonic filter rolls off sharply (18 dB/octave) below 20 Hz; the output is lowered by 20 dB at 10 Hz and by 30 dB at 7 Hz. The 20-Hz level is reduced by just 2 dB, but unwanted low-frequency energy (such as that produced by disc warps) would be substantially eliminated. The rumble reducer was checked by feeding matched-level, opposite-polarity signals to the stereo inputs. (As mentioned earlier, turntable rumble is primarily in the vertical plane and therefore generates opposite-polarity signals in the pickup cartridge.) The plot shows the 12-dB/octave reduction in level below 200 Hz with this special test signal. The levels of the in-phase left and right signals are not affected by the rumble reducer.

Also shown in Fig. 3 are the responses of the crossover's low- and high-frequency outputs. The actual crossing point was 6 dB down at 91.7 Hz, which is certainly close to the specified 90 Hz. The filter slopes at the crossover point approach the overall 24 dB/octave slopes. The summed

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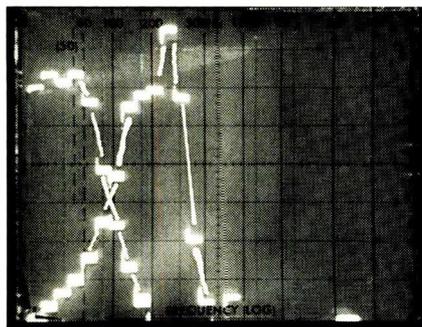
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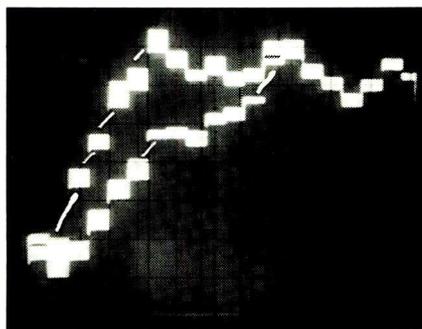
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Even when there was a loss of apparent bass with rumble reduction switched in, the improved clarity made its use worthwhile.



**Fig. 6—One-third octave spectra of warble tones at 31.5 and 250 Hz. (Vertical scale: 5 dB/div.)**



**Fig. 7—One-third octave response, from 25 Hz to 2 kHz, of small bookshelf loudspeaker before equalization (bottom trace) and after equalization (top trace). (Vertical scale: 5 dB/div.)**

voltage was quite flat throughout the crossover region, with a maximum droop of about 0.4 dB at 123 Hz. This indicates that the pressure waves from two correctly aligned speaker components would add similarly.

Figure 4 shows a five-cycle, 91.7-Hz tone-burst test signal (top) and the summed voltage of the two outputs (bottom). The output trace was delayed in the oscilloscope to show the small leading transient. Figure 5 shows the low- and high-frequency outputs individually with the oscilloscope triggered by the high-frequency output. The low-frequency output burst (top) looks fine, but the high-frequency output (bottom) shows the initial transient mentioned above and what appears to be a half-cycle of quickly damped ringing at the end of the burst. The transient is really quite small. The anomalies of the high-frequency output lessened with increases in the frequency of the tone-burst signal.

The low-frequency output-level gain could be set anywhere from  $-19.4$  to  $+20.1$  dB relative to the 0-dB gain at the center detent. The crossover section includes a mute switch to help the user match levels; a quick check showed its attenuation to be at least 100 dB.

Harmonic distortion was 0.005% or less at all points across the band for both the equalizer and the crossover. Checks of the low-frequency section were very limited, of course, because of this section's roll-off. The high-frequency sections of both the equalizer and the crossover had just 0.002% distortion at 1 kHz. The maximum voltages were 8.0 to 9.3 V, with the exact figure dependent upon frequency and output loading. Using a 2-V input signal, no slew-rate limiting was observed out to 100 kHz.

The input and output impedances were almost exactly the specified 100 kilohms and 150 ohms, respectively. The signal-to-noise ratio was greater than 100 dBA relative to 1 V. The equalizer had an effective ratio of 95 dBA re: 1 V for various combinations of boosts and cuts. All of the above figures are excellent, with nothing to fault.

The warble-tone output was about 115 mV, and it was consistent within  $\pm 0.2$  dB, on an rms basis, from 22.5 to 250 Hz. Figure 6 shows the  $\frac{1}{3}$ -octave spectra for warble tones at the 31.5- and 250-Hz settings; I drew in some lines to help show the total response shape. The display demonstrates that the spectrum of each tone covers about  $1\frac{2}{3}$  octaves. The peaky shape of the 250-Hz tone did not occur at other frequencies. This peaking had no effect on the analyzer's accuracy, as the total energy in the associated filter band was about the same as for the other tones and filters.

The analyzer microphone had acceptably flat response over its operating frequency range. The analyzer meter reached a 0-dB indication with an SPL level of about 80 dB. This is a good sound level to use in conjunction with the analyzer; it is above normal levels found in the home yet not so high as to be excessive for equipment or human hearing.

### Use and Listening Tests

The owner's manual is direct and succinct and uses simple illustrations to good effect. It is limited in detail, however, and some sections should be expanded. The portion on equalizing with the analyzer, for example, should point out that if a subwoofer is being used, the low-frequency level control should be set to make a basic level match with the higher frequencies *before* equalizing. The manual includes a simple formula and a chart of resistor values for those who would like to make their own network for a different crossover frequency. While crossovers all the way up to 20 kHz are possible, values are not given for frequencies above 212 Hz. Audio Control states that a new manual is in the works that will provide added information.

All of the Richter Scale's controls and switches were completely reliable throughout the measurements and in-use tests. I made very few switching mistakes, but I did have to look more than once, on occasion, at some of the little black pushbuttons to make certain whether they were in or out.

I confirmed the value of the subsonic filter and the rumble reducer by playing discs that I knew would benefit from the



## Revox B226: Digital at the Vanishing Point

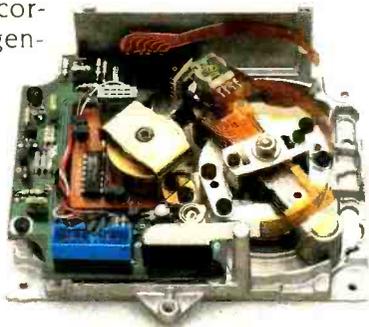
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There is little to fault in the Richter Scale's design or performance. What's more, the price is very reasonable.

use of one or the other. Even though there was at times a loss of apparent bass when the rumble reducer was switched in, the improvement in the clarity of the overall sound was much to be preferred.

To see how the Richter Scale improved low-end response, I chose a small shelf-type loudspeaker. I plugged in the analyzer microphone and placed it in the listening position. After setting the warble-tone frequency to 250 Hz, the reference level, I pushed "Analyze" and increased the sound level from the speaker until the meter indicated "0." I continued to follow the recommended procedure, turning the warble-tone frequency down to each equalizer-filter frequency, in turn. Because the filters overlap, it was necessary to repeat the analysis and adjustment a few times; with each pass, one must adjust the sliders to take out only half of the deviation from zero observed on the meter. It took three runs to get most of the indications to zero on the meter. When I was done, I had boosted the 45-, 63-, and 90-Hz filters to almost +12 and the 125-Hz filter to +6. I had tried boosting the 22.5- and 31.5-Hz filters; there was little change in level at these frequencies, so I put them back at zero boost. The manual warns users not to try to boost what isn't there and to listen for sounds of speaker distress, and these cautions must be heeded.

My listening checks demonstrated that the thin-sounding shelf speaker had been greatly improved in character. It

had a much fuller sound even though the lowest bass was still not in evidence. Figure 7 shows the responses measured in the sound field before and after equalization. Please note that the display goes only from 25 Hz to 2 kHz. Improvements in response can be seen from the 40-Hz to the 315-Hz band. From 63 Hz up, the response has really been made quite flat.

A subwoofer would be in order with the small speaker I used for these tests, and it would be worthwhile to reduce some of the boost to the shelf speaker if a subwoofer were used. I didn't specifically state this earlier, so let me comment now that the output from the Richter Scale's equalizer can be fed into the crossover. This means, of course, that the analysis/equalization process can be applied not only to the main speakers but to the subwoofer as well. Use of the subsonic filter should always be considered when there is significant boost at the lowest frequencies. Without the subsonic filter, an increase of energy would occur at 20 Hz and below, which could be damaging to speakers and perhaps to amplifiers.

The Audio Control Richter Scale Series III provides several features which can help improve low-frequency reproduction. The implementation is very good, and there is little to fault in design or performance. This unit should be of interest to audiophiles and semi-professionals, and its price is very reasonable.

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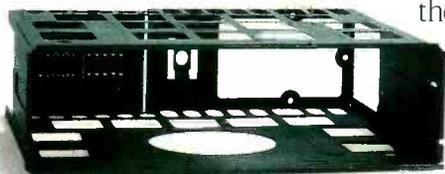
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## ACCUPHASE DP-70 COMPACT DISC PLAYER

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Like writing a column on fine wines, reviewing high-end equipment has its special pleasures, such as being able to audition a \$5,000 CD player like the Accuphase DP-70. The only drawback is that, unlike wine reviewers, those of us who write about audio equipment have to give our samples back.

The Accuphase DP-70 is one of those audio components you'd probably want to try out even if you knew nothing about the price and technol-

ogy. The styling is excellent, and if you like gadgets at all, you will be instantly impressed by the look of the player. You will also be impressed by the feel. The key controls are visible and conveniently located on the front of the unit (and on the supplied remote), while all the programming controls are hidden behind a swing-down panel. The back panel is not a simple black surface with two RCA jacks. It has both optical and conventional digital output jacks; balanced outputs; fixed, unbalanced RCA outputs, and a variable RCA output. Even the weight of this unit is impressive. The moving mechanism is mounted on a ceramic composite, and the unit weighs 46.2 pounds. The drawer is actually metal, not the near-ubiquitous plastic which looks like it belongs in a toy store.

The DP-70's attributes are more than skin deep. Its drive system has exceptional stability and very sophisticated damping. A 16-bit design with four-times oversampling, the DP-70 is one

of the few CD players—if not the only one—to employ a precision *discrete* D/A converter. It also uses four optical converters for each channel to isolate digital noise and r.f. from the audio section.

The analog stages have received as much attention as the digital stages. Advanced Butterworth filters limit the audio signal to the audible range, and special circuitry reduces switching noise. The de-emphasis circuit is passive, and a buffer amplifier maintains sound quality. One master clock is used to avoid any "beat" that could interfere with sound quality. There is a separate power transformer for the analog stages, and each channel has a separate power supply. In concert with the latest thinking in high-end audio design, this player has a balanced XLR-type output.

What really makes the Accuphase DP-70 impressive, however, is its sound quality. Many expensive CD players have a host of technical fea-



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The DP-70 has the best upper midrange and treble, the best sweetness and air, and the best depth of any player I've heard to date.

tures but fail to sound significantly better than their less costly competition. The DP-70 sounds like it *should* cost \$5,000.

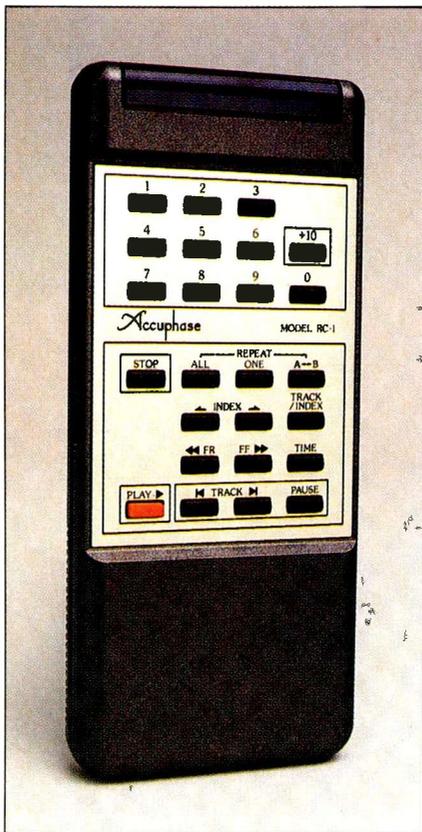
Its most important advance is in the upper midrange and treble. The CD medium, for all its advantages in terms of linear frequency response and lack of measurable distortion, still tends to produce a flat upper-octave sound that lacks sweetness and harmonic detail. At its worst, it is hard and unpleasant; even at its best, it lacks much of the natural air and sweetness of many analog tape and record units that theoretically should sound much worse.

These problems emerge in direct proportion to the overall transparency of the rest of the electronics used with the CD player, and also in proportion to how flat and quick the associated speaker is in handling upper-octave data. With many mid-fi cone speakers and low- to medium-quality electronics, the effect is masked by other distortions and by the significant treble roll-off common in such speakers. The Accuphase DP-70 is one of the few CD players that is fully compatible with the sonics of even the best electronics and speakers. More important, its achievement indicates that CD can audibly as well as technically outperform analog records and tape in the area where CD had formerly been the weakest. These improvements in the treble and upper midrange also improve the rest of the midrange, where the DP-70 has remarkable neutrality.

The DP-70 also has an exceptionally wide sound stage with a great deal of natural depth. Once again, this has been an area where even the best CD players generally did not do as well as their analog counterparts. This has led to speculation that the depth in analog records is some kind of euphonic coloration. The DP-70 strongly indicates that it isn't. If one compares the sound of the CD and LP record versions of "How High the Moon" on *Jazz at the Pawnshop* (Proprius 7778/9), the DP-70 shows that CD can equal or surpass even the best vinyl disc. In fact, the depth and sound stage provided by this player make other top-quality, high-end units sound a bit flat and two-dimensional by comparison.

The DP-70 not only has excellent depth; it also has exceptional imaging

capability, placing instruments from left to right without any hole in the middle or lack of width. This shows up very clearly in the reproduction of percussion instruments, which many CD players and cartridges make sound wider than they should. It also shows up in complex choral music, where good reproduction is essential to understanding the interplay among different voices and sections of a choir.



The DP-70 performs well in all other respects, but there are two areas where my listening to other CD players—including the more complex \$8,000 Accuphase DP-80/DC-81—does indicate that the sound can be further improved. The most obvious area is the middle and deep bass. The DP-70 is one of a handful of CD players that have real force and power in the deep bass. It does not, however, have quite the warmth in the mid-bass that it should. Further, a few competing units can discriminate the details of bass instruments better. This is likely to be apparent only with those few speakers that can deliver real power below

40 Hz, but it will be important to true bass fanatics.

The second area is dynamics. The DP-70 is slightly restricted in its ability to reproduce dynamic transients. I had the opportunity to compare it to several new DAT recorders, other top CD players, and a top-ranking turntable/arm with a number of cartridges, using some new digital recordings on the GRP label. Once again, the DP-70 did very well. It outperformed or equalled all of the DAT recorders. Several top cartridges and at least one CD player, however, had a significantly more realistic sound when confronted by sudden changes in loudness or the sound of a cymbal. The DP-70 was just slightly lacking in apparent speed and impact.

To justify its existence, a \$5,000 CD player must be able to define the state of the art and explore the practical limits of how good a Compact Disc can sound. If it fails to do so, the best technology in the world is useless. The DP-70 meets these standards in several important respects. It provides the best upper midrange and treble, the best combination of natural musical sweetness and air, and the best depth of any CD player I have heard to date. However, while it is an outstanding player in every other respect as well, there are areas where other CD players do better. The bass is deep, powerful, and extended, but a few of the DP-70's rivals provide this performance with more detail and a better ability to reproduce the bass viol and cello. Some other players reproduce the rapid dynamic changes in music more realistically and reproduce the lower midrange and upper bass more accurately.

No piece of high-end equipment I have ever heard, however, has done *everything* better than its rivals. The Accuphase has its greatest strengths in the area where improved performance is most important to enjoying music, particularly classical music, female voice, acoustic rock, and naturally recorded jazz. It is particularly impressive in its ability to handle massed strings, woodwinds, and complex choral music. More broadly, it is the kind of unit that is worth auditioning just to see what CD can do. Once you hear it, you won't find it easy to settle for less.

Anthony H. Cordesman

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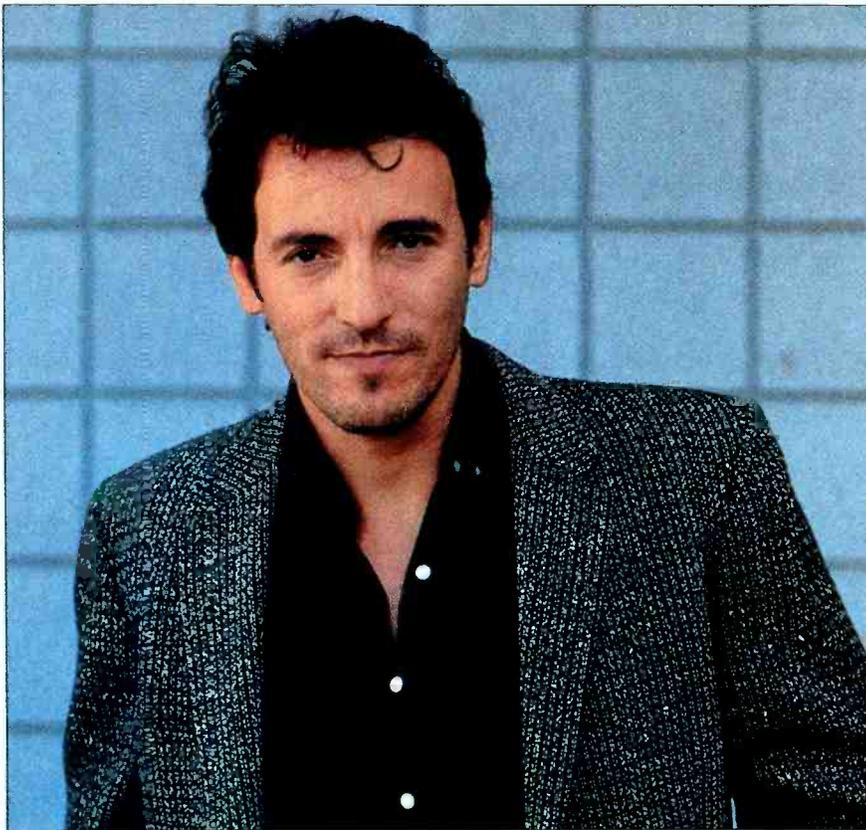
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MICHAEL TEARSON  
JON & SALLY TIVEN

## AFFAIRS OF THE ART



**Tunnel of Love:** Bruce Springsteen  
Columbia OC 40999.

Sound: B+/A- Performance: A

Bruce Springsteen has made a career out of documenting reality, often in larger-than-life productions. Few musicians—regardless of their musical talent—are able to hold listeners spellbound without resorting to theatrics, but Springsteen, a peerless storyteller, succeeds. In making reality his trademark, he carries on in the footsteps of a precious few. Woody Guthrie and Hank Williams were two of the finest; Bob Dylan is another.

Surprisingly, while Springsteen has wrestled with politics, unemployment, and the economy, he has never truly tackled the "real" world of romance. Now, with the release of his latest album, Bruce has traded in his anthemic presentations of blue-collar angst for insightful tales of true romance. And "true" is the operative word here, because *Tunnel of Love* doesn't deal with puppy love or view romance as an elixir to cure all woes. The listener receives a mature view of love, complete

with infidelity, disappointment, abandonment, and compromise.

It is true that certain songs on Springsteen's 1980 release, *The River*, mirror some of the emotions found on *Tunnel of Love*. However, this album takes another step forward in terms of honest emotion and musical conciseness. The songs' characters are more alive, more real; the sparse musical arrangements draw you into the songs. In the past, Springsteen's multi-layered "wall of sound," while certainly surrounding you, had a tendency to keep you at arm's length. You were listening to experiences but not always *sharing* them. *Tunnel of Love* opens the door.

Surely Bruce Springsteen is without rival in his ability to absorb and assimilate musical history and make it his own. *Tunnel of Love* is an amalgam of styles we've all heard before, just not in this way. For example, the album begins with a vocal and finger-snapping intro to a blues-tinged rocker, almost like a fieldhand holler à la Muddy Waters and Bo Diddley. This number, "I Ain't Got You," is a song about a rich man who's got everything—everything

but the woman he needs. (Actually, the sentiment and the song title come from a blues number popularized years ago by The Yardbirds.) Later, in "Two Faces," the '60s-style electronic organ solo brings to mind Del Shannon and Lou Christie. And "Brilliant Disguise" should certainly recall The Drifters and the Latin-inflected arrangements and productions of Jack Nitzsche, Phil Spector, and Leiber/Stoller. Bruce Springsteen is comfortable wherever he chooses to hang his musical hat.

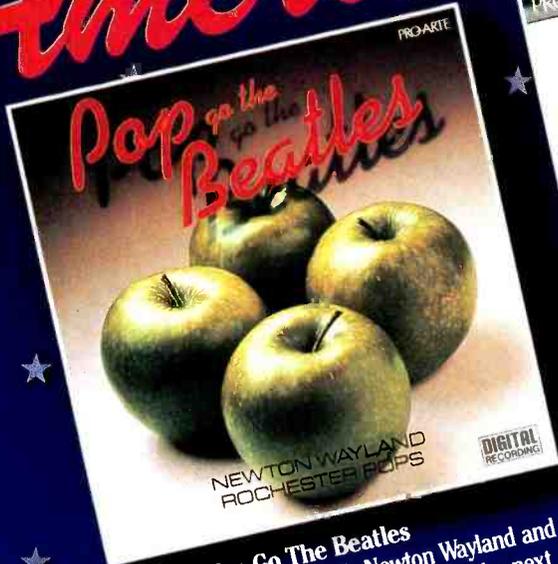
Springsteen fans are going to be surprised that The E Street Band never appears as a whole unit on this album. In addition, never once does Clarence Clemons' signature tenor saxophone show itself. Springsteen has chosen to work principally on his own on *Tunnel of Love*. Although E Street drummer Max Weinberg makes frequent contributions, generally Springsteen is responsible for the guitar parts, some bass parts, keyboards, and sound effects. But this isn't a showy display. The arrangements are sparse—keyboard parts pad the guitars and vocals sympathetically, and vocal harmonies (principally from background singer Patty Scialfa) often also act as backing pads. Springsteen creates arrangements (with a tip of the hat to Spector and Nitzsche, thank you) as if using musical building blocks, adding instruments and melody inversions at the heads of succeeding verses and choruses until he is satisfied. On the title track, after introducing the melody as the most memorable section, he creates several other hooks vocally, permitting the song to build interest even as it fades.

Eleven of the 12 songs on the album were recorded at an unnamed location in New Jersey, most likely at Springsteen's home. Recorded by Toby Scott on digital equipment, the album sounds very clean. The vinyl pressing had minimal surface noise and didn't suffer from any major pressing imperfections which would cause ticks, pops, or skips. Check out "I Ain't Got You" for the unusual stereo treatment. The lead vocal is panned left of center while the vocal echo return is panned to the right. The result is an interesting two-track mono effect which is perfect for the song.

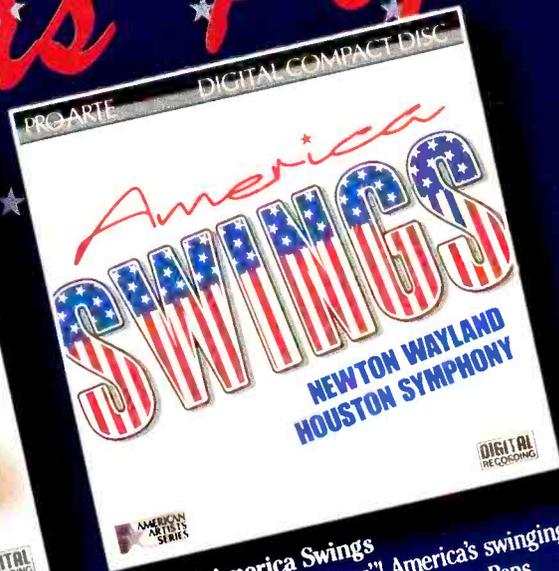
*Tunnel of Love* says little that's new.

Photograph: David Gahr

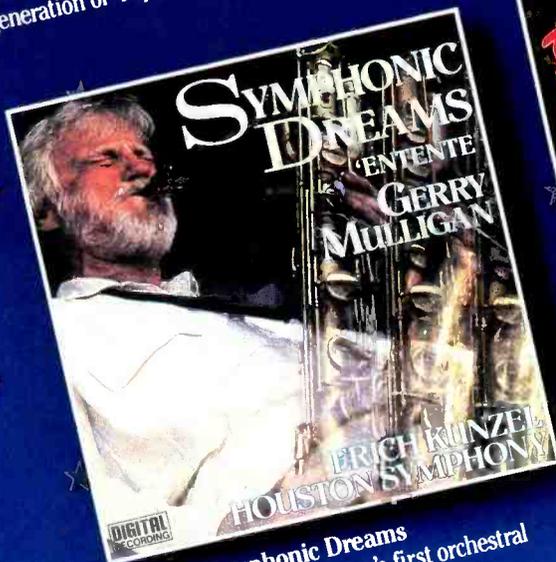
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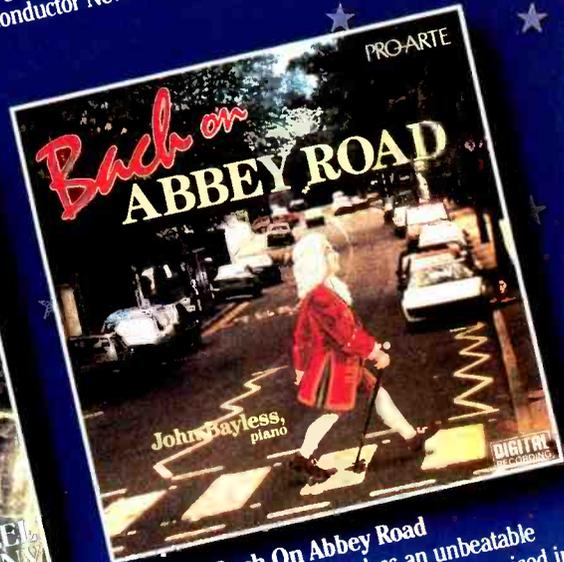
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The Ramones appear to be delighted to play three chords at maximum volume, with maximum distortion, and at high speed.

Still, because Springsteen hasn't previously stripped away the facade of romance as he has with other subjects, the effect is fresh and interesting. With his illuminating lyrics, he has managed to bring romance down to earth where, for better or worse, we can better deal with it. *Hector G. La Torre*

**Halfway to Sanity: The Ramones  
Sire 25641-1.**

Sound: B                      Performance: B

How do you get to be America's most long-lived (and arguably best) punk band? To begin with, every album you put out should sound like it's the first one you've ever made, as if you're barely sure of what you're doing in the studio but desperate to capture what you have in mind. All The Ramones' albums sound like this to me, and none more so than this, their tenth in 13 years.

What is most charming about these "brothers" is that they have never as-



pired to develop their music beyond a primitive level of expression. They appear to be indefatigably delighted to play two or three chords at maximum volume, with maximum distortion, at the rate of a scared rabbit's pulse, and they are still content to mutter, yelp, and growl over it all.

This is not to say that *Halfway to Sanity* lacks diversity. There are distinct shades of difference between the hardest driving songs and what might be called the "ballads": "Bye Bye Baby," which sounds rather like a Ronettes tune recycled through a trash compactor, and "A Real Cool Time."



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Most of The Brandos' debut album is on the mediocre side, and their remarkable resemblance to R.E.M. is more than a bit annoying.

which features a discernible, even catchy, melody line.

Probably the two most successful components in The Ramones' long career are their image as a bunch of Sad Sacks in leather jackets, which hasn't changed a whit since the beginning,

and their lyrics, which have been the prototype for the blatant, often nihilistic, why-bother-to-rhyme school. There is a strange sort of poetic integrity in the suicidal "I Wanna Live"; in "Weasel Face," wherein a desperate man turns to late-night television for solace, and

in "Worm Man," in which a distraught soul compares his life to that of a worm in the most elemental terms. The songs' strength lies in coming across so nakedly and directly that the sentiments, while ostensibly duh-duh-dumb, verge on profundity. *Susan Borey*

**Honor Among Thieves:** The Brandos Relativity 8192.

Sound: B Performance: C+

This power-pop quartet on the relatively small Relativity label is getting a lot of attention due to its remarkable resemblance (particularly vocally) to R.E.M. The track that has garnered the most radio play, "Gettysburg," is fairly good, and the title track has its moments, but the rest of the record is on the mediocre side.

The fact that The Brandos would create a sound so close to another band's is more than a bit annoying. Perhaps they are the thieves of the title, but where's the honor? *Jon & Sally Tiven*

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Pink Floyd's latest LP features the same huge sound and apocalyptic weariness that have long been their trademarks.

**A Momentary Lapse of Reason:** Pink Floyd

Columbia DC 40599.

Sound: A- Performance: B-

The hallmark of *A Momentary Lapse of Reason* is its big, big, bigger-than-arena-sized sound. With the departure

of Roger Waters, guitarist David Gilmour has become Floyd's voice and songwriter. Remarkably, there is a genuine feeling of continuity with the historic Pink Floyd sound: That apocalyptic weariness that has been Floyd's main suit since before *Dark Side of the Moon* inhabits these new tunes too.

What is missing is the instant timelessness. With earlier albums, one knew on first listen that they would not easily be forgotten. The songs on *Lapse* are simply less immediately memorable, though exposure over time might change this impression.

An antiwar theme ties this album together, much like side two of Dire Straits' *Brothers in Arms*, and this continuity strengthens the album. The theme is complemented by an icy sound, crafted by Bob Ezrin (Floyd's producer since *The Wall*), Gilmour, and engineer Andrew Jackson. With totally digital recording used on everything except "acoustic drums" and bass guitar, Ezrin has achieved a vinyl record sound as big and clear as that of most CDs. There are some trademark Floyd subtleties, such as spoken voices mixed into the instrumentals, and the drum sound is monstrously huge. Heck, the whole sound is huge. After all, Pink Floyd sounding small would be a contradiction in terms.

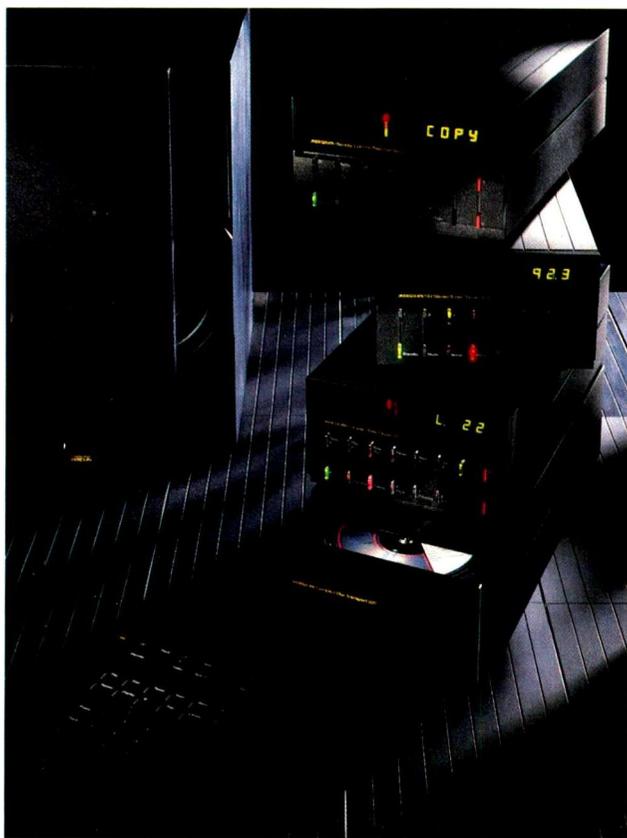
Judging from the album cover, one would think that Pink Floyd is now made up of only Gilmour and Nick Mason; their names are the only ones in large print at the top of the credits. However, listed just below them are keyboardist Richard Wright, a longtime Floyd member, and Ezrin, who plays keys, synth, and percussion. Tony Levin, best known for his work with Peter Gabriel, King Crimson, and Paul Simon, has taken over Waters' bass chair, and there is a large supporting cast of players as well.

*A Momentary Lapse of Reason* is impressive, perhaps more so technically than artistically. The state-of-the-art sound is clearly evident, yet the material breaks little fresh ground. Mercifully, it is not nearly as self-important as Roger Waters' current solo effort, *Radio KAOS*, and therefore emerges as far more engaging. It is also a huge improvement over Waters' last Floyd album, *The Final Cut*. Still, it is a far cry from *Dark Side of the Moon* or *The Wall*.  
Michael Tearson

**A Shout Towards Noon:** Leo Kottke  
**Private Music 2007-1-P**, digital.

Sound: B Performance: B

It has been quite a while between records for Leo Kottke, especially all-



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John Cougar Mellencamp's songs of lonely despair are heartfelt, but that isn't enough to carry an entire album.

instrumental ones like this. Most of the album is solo acoustic guitar, though occasionally producer Buell Neidlinger contributes cello and Randy Kerber adds subtle synthesizer parts.

This is primarily an album of reflective music. Kottke has always been at his best when playing slowly and suspending notes in midair, and that is true here too. Never the flashiest player around, his strengths remain his soulfulness, melody, warmth, and superior musicianship.

Musically, Kottke doesn't explore new territory. Indeed, two of the 12 selections are effective reworkings of older compositions. The point is that what Leo does, he does beautifully and like no one else. His playing and composing remain distinctive, so why should he go through changes merely for the sake of change? Reliable constants on the order of Leo Kottke are rare and precious. *Michael Tearson*

**The Lonesome Jubilee:** John Cougar Mellencamp  
Mercury 832 465-1.

Sound: B- Performance: B

Life stinks, and then you die. So goes *The Lonesome Jubilee*, by an artist who has long since proven himself well acquainted with themes of longing and despair. Life may have its festive moments, John Cougar Mellencamp



seems to be saying, but each of us faces our private fears alone, the same way we take that final journey.

Given these themes, *The Lonesome Jubilee* is ironically up-tempo. "Paper on Fire," the lead-off single, clicks out a quick, precise rhythm line like a train in the night before turning into a guitar rave-up about people who'll never achieve their dreams—those who may be wanted too much and now have to cut their losses and stop dreaming. "Check It Out"—the album's one brilliant song—tells familiar Mellencamp country as it describes with sweet, melodic sadness the way we slowly slide down that predictable path of life, acquiring age and responsibility until we inevitably wither away. A companion piece, "The Real Life," sketches images of those who realize how deadening that path is, who well know what they don't want but not what they do want out of life.

The sound Mellencamp puts to all this is appropriately simple yet not stripped down; he uses acoustic guitar, banjo, mandolin, tambourine, accordion, and haunting gospel background vocals. There's electric guitar too, of course, but pedal steel predominates. The sound quality is fine, except that my copy had several horrendous glitches that sounded like bad

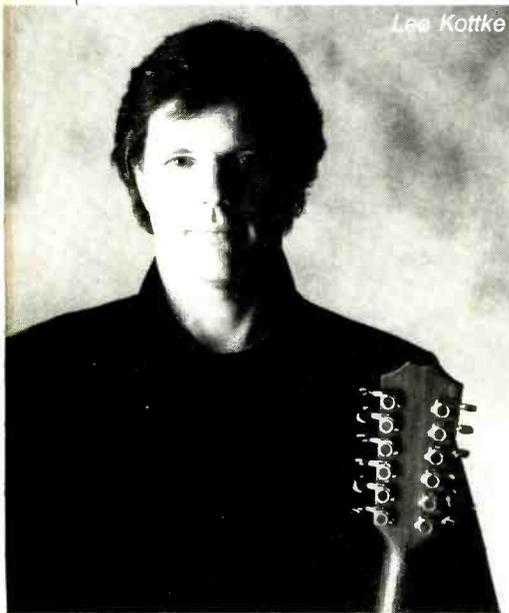
splices. I can't imagine that all copies are equally faulty.

Predictably, given the scope of his theme and his self-imposed restraints on length and form (nothing over 4:49 here), Mellencamp overreaches. "Empty Hands" and "Down and Out in Paradise," for instance, are non-songs, merely recitations backed by full-band noodling. Tom Waits can pull that off; Mellencamp cannot. He also has a tendency, notably on "Down and Out in Paradise" and the ballad "Hotdogs and Hamburgers," to go for knee-jerk imagery—such as a fourth-grader writing to the President about whether the bomb will hurt his family.

No question, however, that *The Lonesome Jubilee* is heartfelt. In one of the album's most striking moments, in the ringing, alarm-like "We Are the People," he shows sympathy and empathy not just for oppressed minorities but for "the fortunate ones." Even rich people have fears, he's saying.

Being heartfelt, however, isn't enough to carry a whole album. I also wish Mellencamp didn't feel constrained to chop off so many songs just when they are starting to sink in. I'll give him this, though: At least he doesn't try to tell us that *The Lonesome Jubilee* is cherries jubilee.

*Frank Lovece*





**The Mercy Seat**  
Slash 25600-1.

Sound: B- Performance: C

If you attempt to lodge The Mercy Seat among the "new music" bands currently topped by R.E.M., you'll either find it very easy to do or well-nigh impossible. Most of the external trappings are appropriate: A specific kind of simplicity; a raw, live feel that's as slick as sandpaper; a few sterling imperfections; bursts of exuberance balanced by ponderous lulls; an independent label. . . . You've even got a transplanted member of the manic/depressive Violent Femmes in Gordon Gano, whose spare, often quirky guitar playing gives The Mercy Seat a boisterous edge. Yet the label "new music" doesn't really fit, because The Mercy Seat's material is, purely and unabashedly, full-tilt gospel.

Husky-voiced lead singer and main writer Zena Von Heppinstall relies solely on the standard catalog of gospel vocal chops and imagery, and the trio that backs her up follows suit. The group hasn't tried to be anything but an exceptionally energetic gospel band whose roots are wrapped around both Mahalia Jackson and The Sex Pistols. Whether their simple offering can be accepted by a wide audience really depends on whether or not listeners thrust the album into the narrow confines of "Christian music."

Susan Borey

**Primitive Cool:** Mick Jagger  
Columbia OC 40919.

Sound: B- Performance: C+

Now that Mick is no longer working with his songwriting partner, Keith Richard, he's falling prey to the Elvis Syndrome, a condition in which a mere singer establishes himself as a cross-media superstar and starts to believe he can sing *anything* and make it a standard.

There are a few moments when Jagger seems on the verge of making an acceptable record here—"Radio Control" and "Say You Will" are musical and personable numbers—but there's nothing else that comes close. "Shoot Off Your Mouth" has a Stones-type verse but a C-grade chorus; the title



track might have been a workable concept, but it comes across as hokey. The rest of the album is a series of cut-and-paste jobs that don't add up to complete songs.

Weak material isn't the only problem here; there's also the band. Jeff Beck and G. E. Smith are fine players but not right for this project. Let's face it—Jagger is only as good a singer as his tracks are messy. Clarity and precision only point up the fact that his vocals belong with a garage band, and not mixed too loudly, thank you. He's not singing badly on this record, but his voice sounds best mixed *with* the guitars, not above them.

So why didn't his talented producers save poor Mick from making a record only marginally better than his first solo? One of them, Keith Diamond, is far better at dealing with drum machines and synthesizers than live players; the other, Dave Stewart, works at his optimum when given total autonomy rather than coproducer status. To Diamond's and Stewart's credit, the instruments and the mix sound pretty fine, though our copy of the album has an immense amount of surface noise.

On the basis of Mick's solo work, it seems that a reunion with The Stones is the only way we're going to get more than a couple of good cuts per LP.

Jon & Sally Tiven

**Me and My Girl:** Cast Album  
MCA 6196, digital.

*Me and My Girl* is a lovely addition to the ranks of Broadway show albums in current release. Plot is negligible in this bit of British music-hall fluff, but the performances are not, on stage and on this recording. Robert Lindsay is the freshest, most inventive song-and-dance comic I've ever seen, and Maryann Plunkett, previously a second-stringer for Amanda Plummer and Bernadette Peters, is now proven as a first-rate musical performer. Best known for its infectious "Lambeth Walk," the show has other sprightly tunes—"Thinking of No One but Me" and "You Would if You Could"—and one absolutely lovely love song worthy of Jerome Kern, "Once You Lose Your Heart." This is pellucid singing, and on a shimmeringly produced LP.

Donald Spoto



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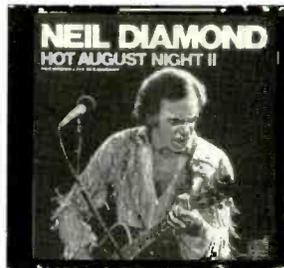
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## POETRY IN NOTION

**Poetic Champions Compose:** Van Morrison

**Mercury 832585-2.**

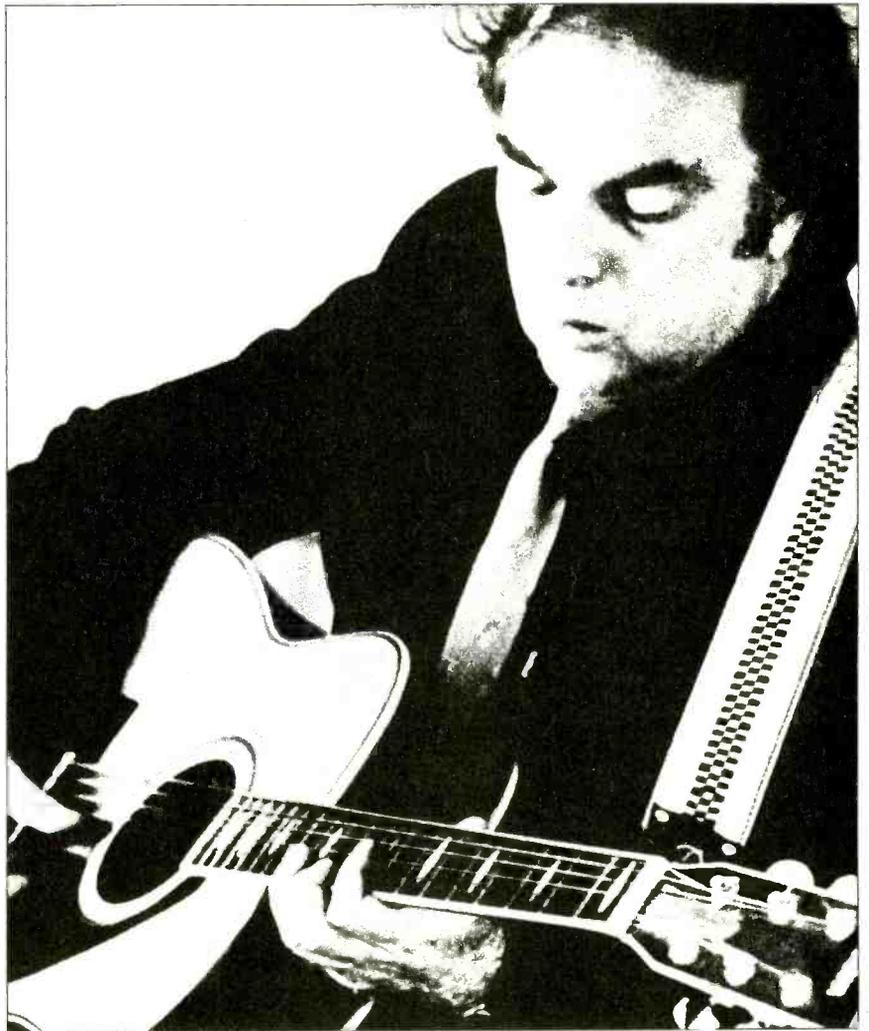
Sound: A                      Performance: A

Many contemporary rock records do not transfer easily to the digital medium. The intentional distortion on guitars, the artificial reverb created for drums, and the general battery of effects can become false-sounding when the product is heard in the full-dynamic-range medium of CD. It can be like watching a TV sitcom in a movie theater.

All of this is intended to preface the fact that Van Morrison's latest record is a brilliant meeting of the rock genre and the CD. *Poetic Champions Compose* is grounded in superb instrumental and vocal performances captured in a way which reflects a sonic reality rather than a fabrication. A lesser performer couldn't face the challenge, but Van is up to it not only as singer but as producer, arranger, songwriter, and even instrumentalist (on sax, which should surprise a lot of people). His time has come.

Van Morrison hasn't made records quite like other artists; after a spate of R&B/pop hit singles in the early '70s, he became a cult favorite, occasionally falling into fashion (*Period of Transition*) but mostly missing (or ignoring) the mass-appeal market. His latest record is not exactly a deliberate attempt to engage those masses, but the majority of songs on *Poetic Champions Compose* are more radio-oriented than previous works. Whether intentional or not, Morrison reaches back to the style of music that brought him the largest audience (circa "Tupelo Honey"), particularly on "Queen of the Slipstream" and "Alan Watts Blues," two of the album's best tracks.

As mentioned, Van has taken up the saxophone and become a featured soloist; he serves up several jazzy instrumentals in addition to handling a chorus break on "I Forgot That Love Existed." His melodic lines are original and exciting, and his tone is pretty good. David Sanborn he's not, but Van makes up in feeling what he lacks in technique. He plays more interesting solos than some session saxmen do, and we look forward to his growth on the instrument.



If you don't already own a CD player, this disc is reason enough to run out and buy one. *Jon & Sally Tiven*

**Light Years:** Chick Corea Elektric Band  
GRP GRD 9546.

Sound: A-                      Performance: D+

There are two Chick Coreas. One puts out graceful, intuitive records of acoustic piano, like last year's *Trios* (with Roy Haynes and Miroslav Vitous) or the propulsive "circle" recordings of the early '70s.

The other Corea puts out electric keyboard albums that have grown increasingly facile and programmatic over the years. It began with the energized pyrotechnics of the original *Return to Forever* and gradually sank into

a miasma of clichés and crowd-pleasing licks. That's the Corea of the Chick Corea Elektric Band and this album, *Light Years*.

This latest Corea group showed some promise on their eponymously titled debut last year. There was a sense of stretching the limits of the fusion genre and getting some real interplay and improvisation going. In concert, the group could cut a groove around Corea's multiple keyboard layers. But that's all light years away from this recording, 12 forgettable funky tunes that are as meticulously crafted as fine-quality formica.

This is jazz for MTV: Perky, jerky rhythms, melodies like machine bursts, and solos like drag races that lead to nowhere. Cut to Corea with a keyboard slung around his neck, cut to Eric Mar-

Dominating Tom Waits' new album is an atmosphere of menace and foreboding that is very well served by the Compact Disc format.

lenthal looking soulful with a saxophone, cut to John Patitucci bopping out those twangy bass lines, and you rediscover the attention span of a 5-year-old.

Corea has mastered his keyboard technology and he's got it all here—Synclavier II, Kurzweil, Yamaha TX816—all of the priciest state-of-the-art synthesizers. His music is full of bright tonal colors that do little to hide a lack of purpose. "Second Sight" would've made a nice ballad with Corea's unison keyboard orchestrations, but David Weckl's electronic drums pummel it to hamburger.

It's music designed for CDs, with immaculate stereo imagery and sharp, dramatic contrasts but little to tease the mind or grace the soul. That's a loss, because Corea is a gifted, sensitive artist who should be able to communicate in any medium, electric or acoustic. Unfortunately, the Elektric Band is more marketing concept than music.

*John Diliberto*

**Frank's Wild Years:** Tom Waits  
Island 90572-2.

Tom Waits has made some darned unusual records before, but none have been as flat-out weird sounding as *Frank's Wild Years*, which contains 17 songs from the theatrical production of the same name.

Now, Waits has always explored the beaten-down, seedy, and desperate, but his subjects have never been quite this odd. His voice has always been scruffy, but here he contorts it into the most bizarre shapes it has ever assumed. He records his voice as the ghost of a scratchy old 78 on several tracks, sings in a goofy, tortured falsetto on another, becomes a sentimental fool for a couple of songs, and sounds like a demented low-rent lounge lizard on two others. Pretty he is not.

Instrumentally, *Frank's Wild Years* is populated by pump organs, glockenspiels, squawking saxophones, occasional accordions, electric and upright basses, assorted guitar sounds, and drums. This is an album in which nothing sounds ordinary; menace and foreboding dominate. Bertolt Brecht and Kurt Weill would feel right at home here, such a long way from Tin Pan Alley.



*Frank's Wild Years* is disconcerting, challenging, even disturbing, as it dares you to explore dark places on its own terms. These songs have conspired to haunt my hours when I least expect them to, most certainly they are not hit-single candidates.

This is one release far better served by the CD format than by vinyl. It is a long album (the playing time is more than 56 minutes); thus, the mastering works much better for CD, allowing the sundry exotic textures of the instruments and voices to come through much more vividly than they would on LP. When an album relies on atmosphere as heavily as this one does, it is important to hear it just as it was intended to be heard. *Michael Tearson*

**Pops in Love.** The Boston Pops Orchestra, John Williams.  
Philips 416 361-2.

Over the years, the Boston Pops has made a series of "theme" recordings, ranging from Westerns and waltzes to

Broadway shows and outer space. The people at Philips must have conceived this Pops recording on St. Valentine's Day, for it speaks of love.

John Williams has the Boston Pops at the top of their form, with lush arrangements of some truly lovely music. The program begins with the haunting strains of the Fauré "Pavane." Debussy's famous "Clair de Lune" is next, followed by the soaring melodies of Albinoni's "Adagio in G Minor," in which the great 32-foot pedals of the Boston Symphony Hall organ provide a sonorous counterpoint. Next, the rich resonance of the cello eloquently portrays "The Swan" so immortalized by Saint-Saëns. Erik Satie's sensuous "Gymnopédie #1" follows, Tchaikovsky contributes his "Andante Cantabile," then Debussy tells us about "The Girl with the Flaxen Hair." Ravel laments with his "Pavane for a Dead Princess"; we then hear Satie's "Gymnopédie #2," with its delicate traceries of softly stroked cymbal and harp. The organ lends its weight again in the Pa-

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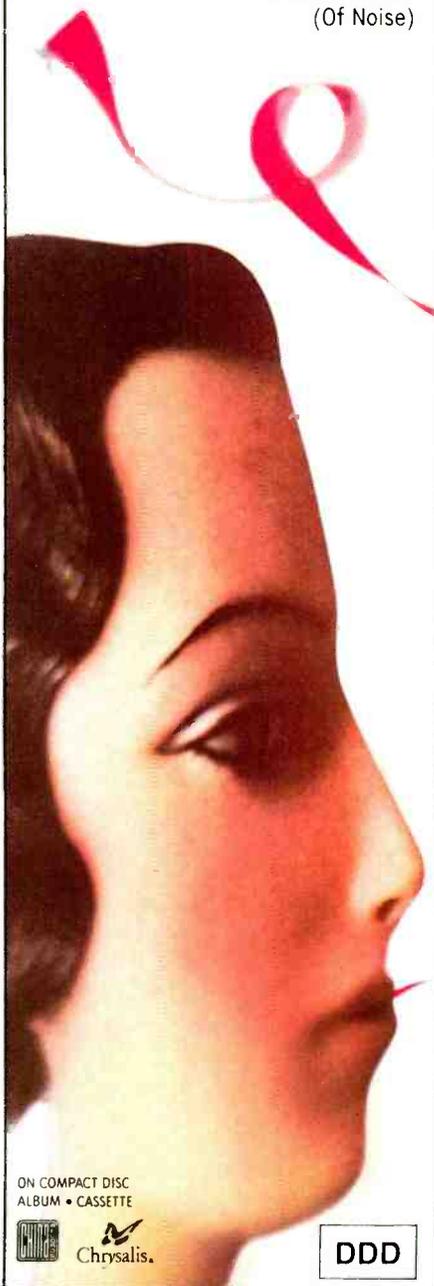


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This release boasts some wonderful playing from The Classical Quartet and the still-unusual feature of period instruments.

chelbel "Canon," and the program ends as Ralph Vaughan Williams provides us with his "Fantasia on Green-sleeves."

The Philips engineers have provided a rich, opulent sound, with string tone as sweet as the music. The orchestral choirs are particularly well balanced, and the overall sound is very clean and well defined.

"If music be the food of love," then the romantically inclined can certainly "play on" with this CD! Bert Whyte

19th century for the larger, less wiry modern sound and increased compass that is standard today. The extended crooked neck and longer fingerboard were major features of this revision and, of course, were also applied to all subsequently built instruments. Thus, most "period" instruments are simply in the earlier configuration, the "original" form of the violin family, including different strings for a different sound. Notably, all four instruments in this recording are actual origi-



**Mozart: String Quartet in G, K.387; String Quartet in B Flat, K.458 ("The Hunt").** The Classical Quartet. Titanic TI-154.

One looks forward to most Titanic releases as models of perfection, both musically and technically—if always modest and mostly unspectacular. They are antidotes to a world of too much hype. This release of two of the most persuasive Mozart quartets is a fine case in point, boasting two special advantages: Wonderfully musical playing and the still-unusual feature of "period" instruments (violins, viola, and cello) as they existed in Mozart's day.

Period? Most of the famous violins, as well as other members of the fiddle family, in fact date from well before Mozart—including the well-known handiwork of Stradivari, Guarneri, and other exalted names. Most of these were extensively rebuilt in the early

nals, dating from 1655 to 1730, a quarter-century before Mozart was born. Unlike the older wind instruments, these are easily played.

Yes, the older instruments are less loud and "carrying." But this, of course, is not evident on recordings, where volume is purely relative. What is very evident on recordings such as this one is the more wiry, sharper sound of the upper tones and the richer, stringier bass sound.

The Classical Quartet, three women and one man, produce wonderfully gracious, easy Mozart, sensitive and not nearly as "high power" as the somewhat over-charged performances by famous-name quartets, past and present. I found this welcome and pleasant. Mozart speaks very well for himself, after all, without portentous interpretation, if the playing is accurate, well shaped, and in good ensemble.

Edward Tatnall Canby

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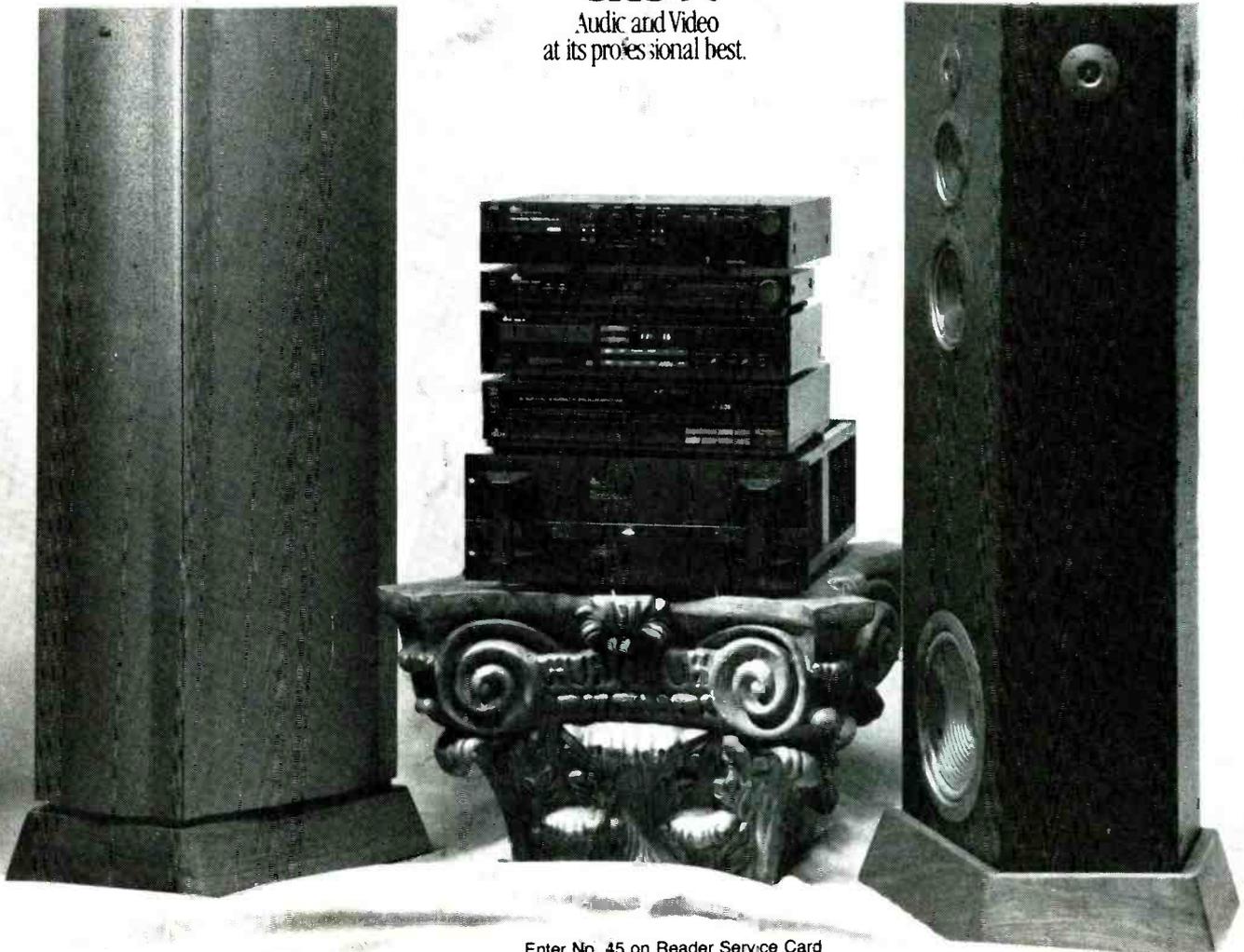
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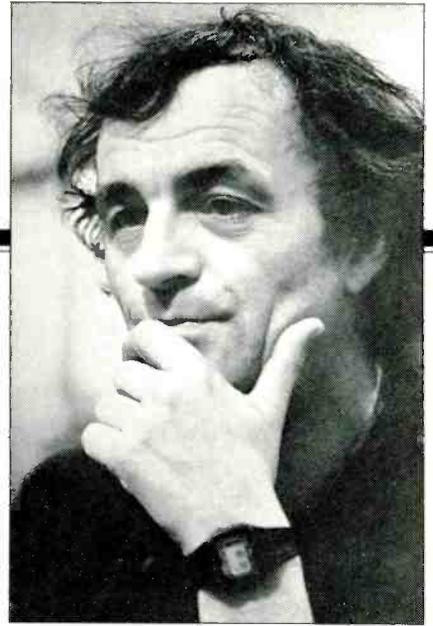
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With its fine ambience and smooth strings, Dutoit's stunning recording of "The Planets" ranks right up there with the best.



**Holst: The Planets.** The Montreal Symphony, Charles Dutoit. London 417553-2.

Just as one might have predicted, by the time my omnibus coverage of 10 recordings of Holst's "Planets" reached the pages of *Audio* ("A Pleth-

ora of Planets," October 1987), there appeared a handful more. Most of these are reissues of earlier performances first heard on LP. One of them, however, is brand-new and deserves special mention: The Charles Dutoit/Montreal Symphony recording on the London label.

This stunning recording ranks right up there with the Previn/Royal Philharmonic version on Telarc and the Davis/Toronto Symphony version on Angel. In the sonics department, we are treated to the fine ambience of St. Eustache, which has been the venue for just about all of the London/Montreal collaborations. String sound is a good bit smoother than usual for London, and the overall texture is quite natural, considering the traditional multi-miking approach used by English Decca recording teams. The organ reaches down to a solid low-G, which is about 25 Hz.

From a musical viewpoint, some of the movements fare better than others. Mercury, who should at least be fleet-footed, seems a little earthbound, and the lugubrious Saturn seems a little agitated. On the other hand, nobody performs Uranus, The Magician, any better than Dutoit. Taking the title literally, he adds some magic of his own, creating a truly splendid account of this difficult movement. As for the rest of the suite, the score is about even with Previn and Davis.

In the final ranking of *The Planets*, there are now three first-rate versions to choose from, and you wouldn't go wrong with any one of them.

*John Eargle*

**Hot Number:** The Fabulous Thunderbirds  
CBS ZK 40818.

Well, I'm not sure about the Fabulous part, but I will say this: The 'Birds are pretty good in the third-generation white-blues category.

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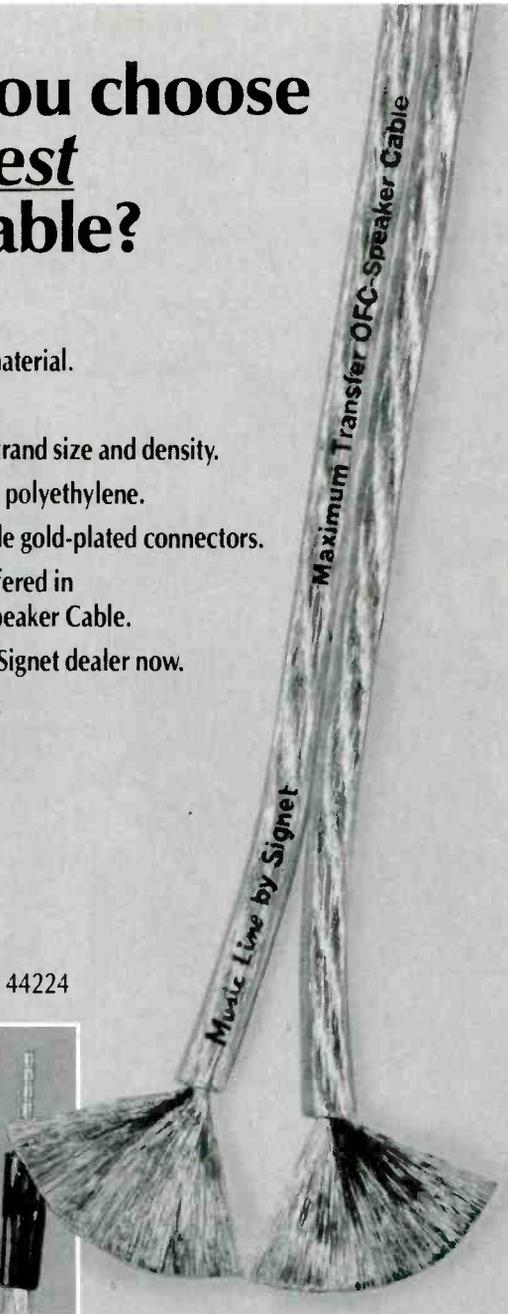
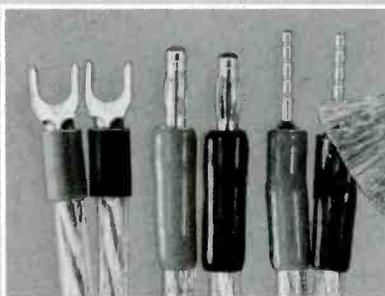
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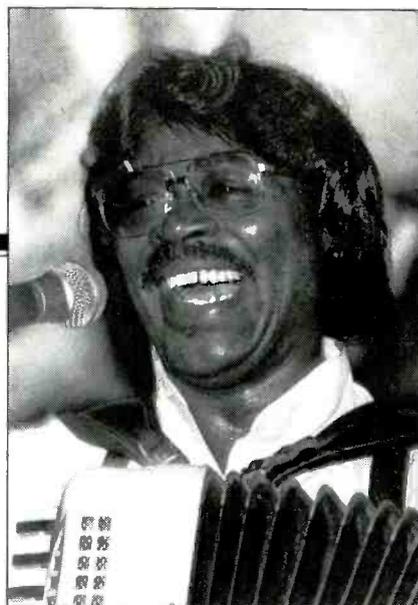
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Buckwheat Zydeco's music, full of sweat, spirit, and fun, is lively enough to get the dead to dance.

lead vocalist/harmonica player/songwriter Kim Wilson. Wilson's voice and laid-back delivery are reminiscent of the late Paul Butterfield, although the two bluesmen's harmonica techniques are dissimilar. Wilson's vocal texture and delivery lack the grittiness and rough edges characteristic of authen-

tic blues vocals, but hey—the oldest of these songs was written in 1972, so we're not talking historical authenticity here. The band cooks behind Wilson, with some splendid guitar work and some hot horn interludes compliments of The Memphis Horns. A couple of distinctive rocking cuts are led by the



great rockabilly boy himself, Dave Edmunds, who also has done an admirable job of producing.

The technical quality of this disc is excellent. Most cuts explode out of velvety silence. Balances are good, and instrumental presence is outstanding.

*Hot Number* may not be the hottest Compact Disc ever, but odds are good that it will raise the body temperature of any listener within foot-tapping distance.

Paulette Weiss

**On a Night Like This:** Buckwheat Zydeco  
**Island CID 9877.**

The rollicking Louisiana bayou music of Buckwheat Zydeco receives its first major-league release.

Buckwheat Zydeco (born Stanley Duval) apprenticed in the late '70s under one of the fathers of zydeco, Clifton Chenier. Here he takes the style—accordion, rubboard, and all—into fertile, fresh territory. Not only does he do driving versions of some of his own classics ("Ma 'Tit Fille," "Buckwheat's Special"), he does smashing versions of the Booker T & the MG's chestnut "Time Is Tight"; The Blasters' "Marie Marie," making it sound as if it were written with zydeco in mind, and Bob Dylan's "On a Night Like This." Chenier's "Hot Tamale Baby" is served up red hot too.

The sound of the CD is terrific, clean enough to let you hear the slap of the accordion keys opening and closing and lively enough to get the dead to dance.

Buckwheat Zydeco's music is sweat, joy, spirit, and fun. *On a Night Like This* is a super "feel-good" record that can also be a perfect introduction to the wonder of zydeco. Be careful. It could be habit forming.

Michael Tearson

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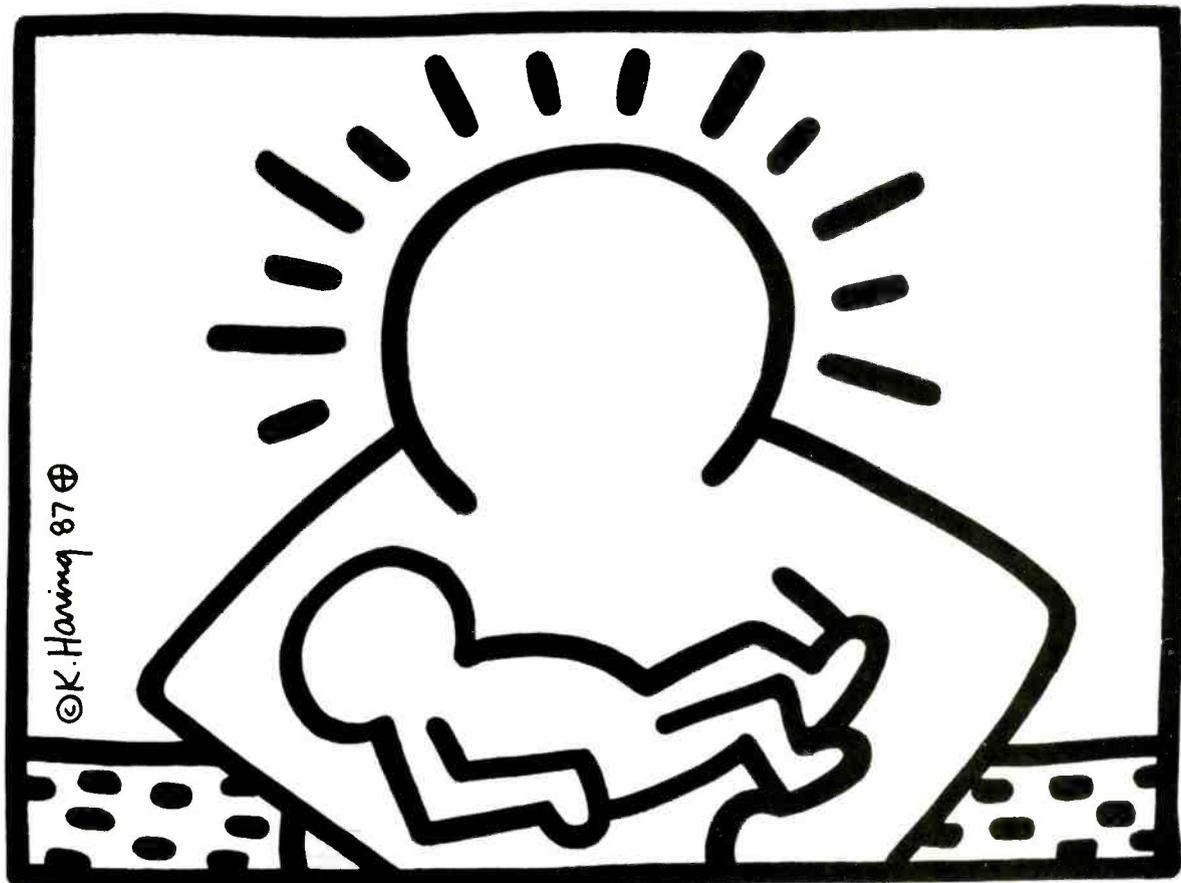
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## SAX IN THE BOX



### The Complete Blue Note Recordings of Sidney Bechet Mosaic MR6-110, 12-record set.

Sound: B+ Performance: A to C

Blue Note Records' founder Alfred Lion recorded clarinetist/soprano saxist Sidney Bechet 13 times between 1939 and 1953. He featured Bechet as a solo artist with rhythm, as an accompanist to folk-and-blues singer Josh White, and as the leader of a variety of traditional small jazz combos. All of it is here on this 12-record set.

Sidney Bechet began playing soprano sax with Will Marion Cook's Southern Syncopated Orchestra in London in 1919 and set the style and method by which the instrument would be played for more than 30 years. The only other major jazzman to use it to any degree during Bechet's lifetime was his star pupil, Johnny Hodges. Late in the 1950s, modernists Steve Lacy, John Coltrane, and then Eric Dolphy added it to their repertoire. Another star Bechet pupil, Bob Wilbur, has played soprano sax in the Bechet style since the late '40s.

Legend says that Bechet dominated every band he worked in and that he hated trumpet players. Many of us believed the legend for a long time, but these Blue Note LPs—superbly packaged and annotated by Mosaic and produced by Michael Cuscuna—prove that he worked easily within the context of each recording unit and that he both supported and shared the lead with the brass players. Admittedly, his huge sax sound and technique were formidable obstacles for the men he recorded with, but they all rose to the task superbly on recording after recording.

Bechet also plays clarinet on 21 cuts here and has some delightful soprano-clarinet duets with fellow New Orleans clarinetist Albert Nicholas. He also plays clarinet with trumpeter Bunk Johnson, who in 1945 was basking in the limelight of lengthy engagements in New York. He was known to dislike the "fishhorn," as he called Bechet's soprano sax, and Bechet accommodated him by playing clarinet on three of their five selections. They also worked in the old New Orleans collective method of improvisation, passing

the lead back and forth and shoring up each other's solo efforts on cuts which also include some splendid trombone playing by Sandy Williams. "Days Beyond Recall" and "Up in Sidney's Flat" are particularly moving.

Bechet's solos on "Summertime" and "Blue Horizon" are simply masterpieces—no other word will do. I particularly like the way Art Hodes, a pianist with limited technique, and bassist Pops Foster work together on the latter. There is a real rapport, as Hodes does very well in the band context and plays fine blues.

It would take too long to describe the fine moments contributed by Sidney DeParis, Wild Bill Davison (whose strong lead equals Bechet's in its forthright drive), and many other wonderful artists. The last date, done in 1953, stands out in my mind for its cohesiveness and swing, even above the others, though it may be the least well known of Bechet's American recordings. This is with trumpeter Jonah Jones, one of the best of Louis Armstrong's followers, who was then working with Earl Hines' small band. The pianist was Harold "Buddy" Weed, an eclectic modernist with ample technique, and the rhythm section comprised Walter Page on bass and Johnny Blowers on drums. They really swing hard, and Jonah is at the top of his very prodigious form. He blows up a storm in a program that includes several tunes which had been major hit recordings for Louis Armstrong. This grouping of jazzmen inspires Bechet even more, if that is possible, and it is a shame that Blue Note did not consider doing more dates with a similar lineup.

Nonetheless, we have a dozen LPs remastered superbly and fine notes by British critic Max Harrison; it is all of a very high order. This is the fully mature genius of one of America's very finest artists.

*Frank Driggs*

### Hubert Sumlin's Blues Party Black Top BT-1036.

Sound: B Performance: A-

Hubert Sumlin distinguished himself as Howlin' Wolf's lead guitarist on a series of recordings for Chess that are, by anyone's standards, legendary. Wolf's versions of the Willie Dixon catalog (as well as his own material) be-

Photograph: Frank Driggs Collection

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Time might have tamed the blood-curdling edge in Ted Hawkins' screams, but he still rages at the world with conviction.

came the textbook from which many contemporary bluesmen learned their lessons. Although Wolf's lower register vocals and sailing harp were the most obvious things about these records, Sumlin's riffing and decidedly eclectic style were highly influential as well. Humble Hubert has finally made a record of his own. Aided by the Roomful of Blues crew and singer Mighty Sam McClain, it definitely establishes a territory Sumlin can call his own.

First off, let's talk a bit about Sumlin's style—he's not a real flash player, nor does he color his tone with effects. In fact, it sounds like he runs a cord straight from his instrument to his amplifier with no sustain devices at all—a rarity in these high-compression times.

On the two cuts on which Sumlin sings, his vocals are delivered with the kind of rawness that you rarely hear nowadays, even on blues records. "How Can You Leave Me Little Girl" is one of the most affecting tracks on the album, marred only by a loud cricket which keeps up quite a racket throughout. (This song was recorded live and features only guitar and vocals.)

Small problems like these aside, *Blues Party* brims with the kind of spontaneity and spark that is most often associated with the Chess records of 20 or 30 years ago. There are few bluesmen continuing in this tradition. One can only hope that Sumlin will continue to make records like this one for some time, if only to show the young'uns how it's done.

Jon & Sally Tiven

**Happy Hour: Ted Hawkins  
Rounder 2033.**

Sound: B Performance: B+

Ted Hawkins' music isn't the sort that's ordinarily preserved on vinyl. At first hearing his intensely personal work, you get the embarrassing sensation that you're eavesdropping on the intimate details of Hawkins' life. His 1972 debut, *Watch Your Step*, was a testament to a flame burning so brightly that you might expect the artist to self-destruct long before making a follow-up. The reward for singing as if you're chased by the devil rarely includes a long career.

It's no surprise that *Happy Hour* doesn't quite measure up to its prede-

cessor; lightning rarely strikes twice in the same place. Time might have tamed the blood-curdling edge in Hawkins' screams, but he still rants and rages at the world with conviction. Hawkins learned from his idol, Sam Cooke, that shouts are best framed by softer crooning. Such contrasts in his work are one of the sources of its power.

*Happy Hour's* material is not as strong as on Hawkins' debut, although once again it's firmly rooted in soul and R&B. The best track is "Bad Dog," a witty, half-sung, half-spoken appeal to a lover to explain, after a lengthy separation, why her evil-tempered pet doesn't bite "one special man." Most tracks are propelled by the singer's own fiercely strummed acoustic guitar. On others, he provides only minimal backing.

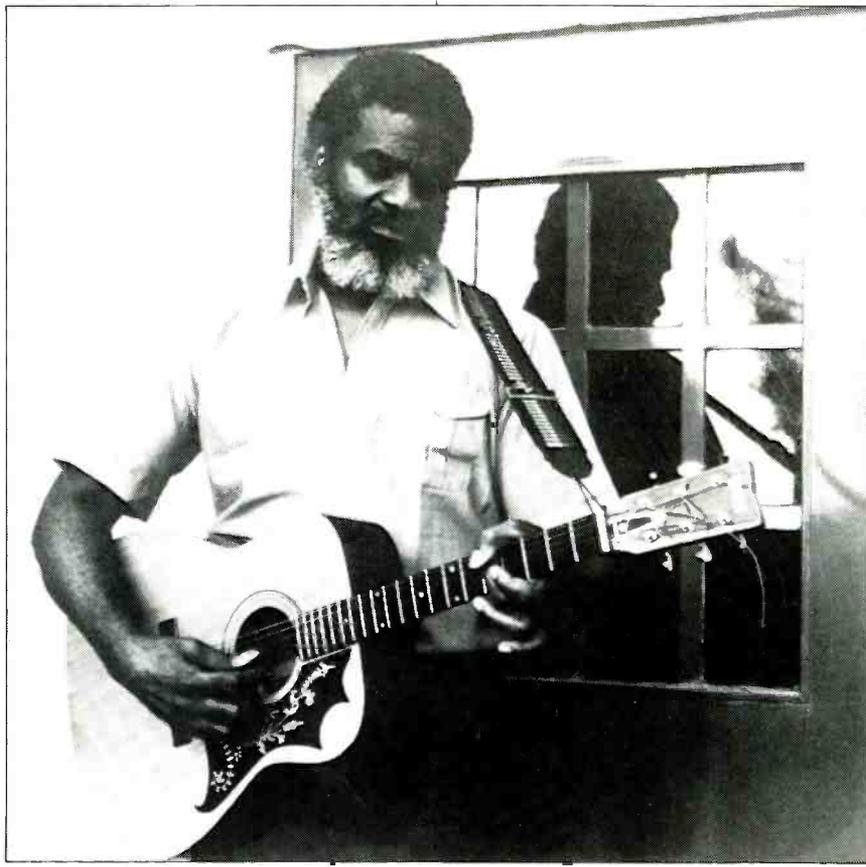
Ted Hawkins is the perfect antidote to "music as product." Buy *Watch Your Step* for an eloquent reaffirmation of the power of music to heal both singer and listener, and then consider purchasing *Happy Hour*. Roy Greenberg

**Blue and Sentimental: Ike Quebec  
Blue Note BST 84098.**

Sound: B+ Performance: A

Blue Note, now part of Capitol Records, has been reissuing a lot of its 1960s product, using digital transfers and the original covers and liner notes. They have done well to reissue *Blue and Sentimental*.

The making of this album, featuring the gifted tenor saxist Ike Quebec, was a particularly felicitous occasion. Quebec was one of the last of the big-toned tenor men who were influenced and shaped by the work of Coleman Hawkins and Ben Webster. Blue Note founder and producer Alfred Lion had lost interest in Quebec's kind of music but had retained his friendship with the saxist, who had had personal problems throughout the '50s. Reintroduced on LP on a Sonny Clark date, Quebec soon had his first Blue Note LP, *Heavy Soul*, which was followed by this album, a further demonstration that despite his difficulties, Quebec had



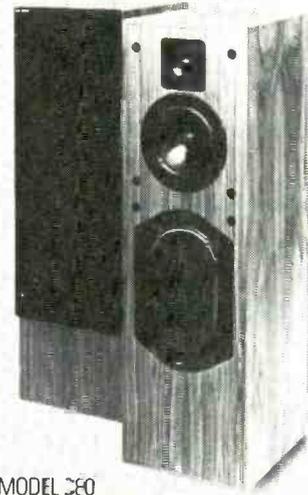
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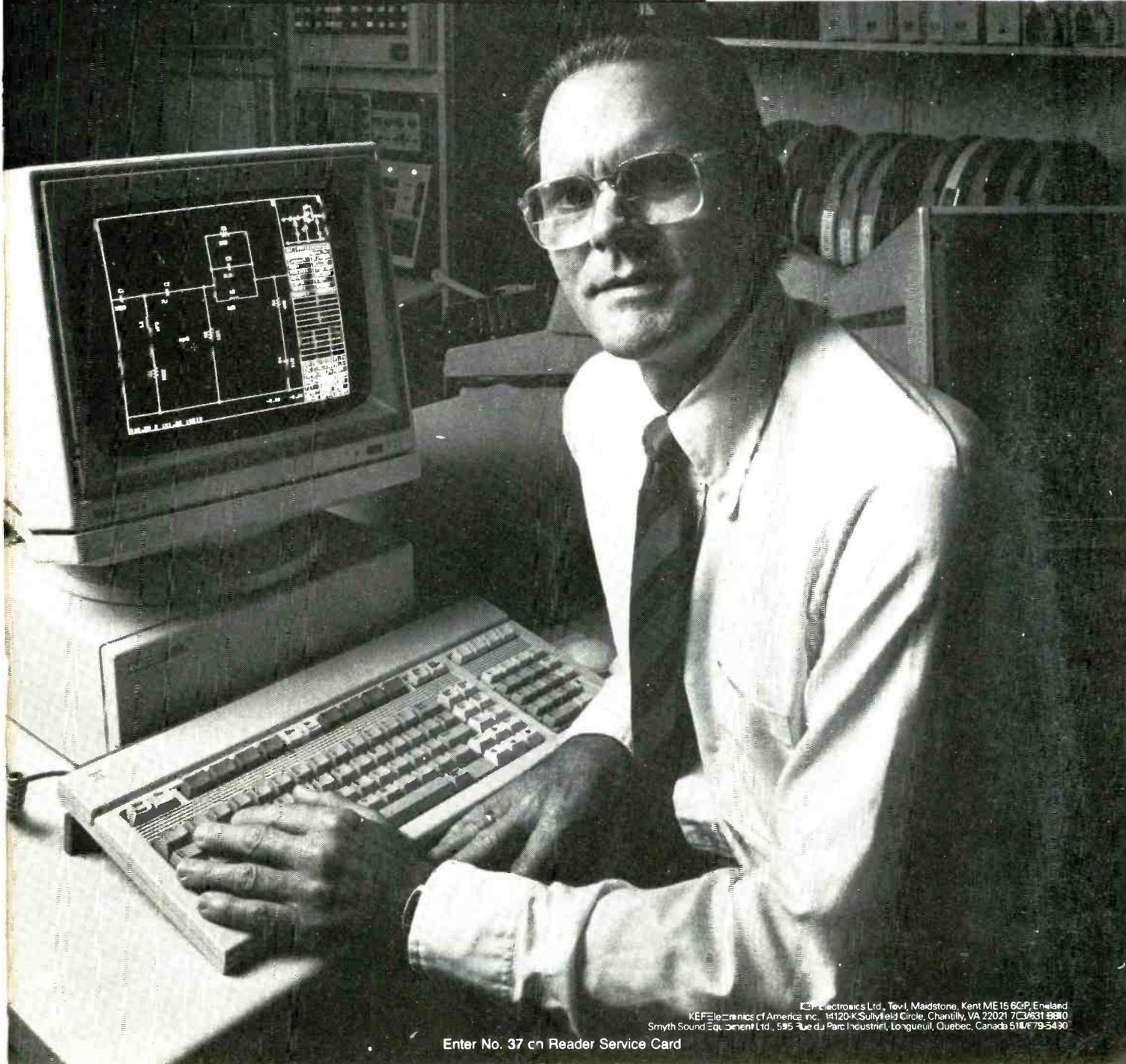


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Benny Morton's trombone style is warm and forceful, but Jimmy Hamilton's work on clarinet seems to lack a certain spark.

lost none of his gifts for melody, swing, and passion.

Quebec's main foils here are guitarist Grant Green and a rhythm section of Paul Chambers or Sam Jones on bass, and Philly Joe Jones or Sam Hays on drums. As Ira Gitler's good notes state, Quebec's forte was ballads. The title track and "Don't Take Your Love from Me" are balanced by the swinging "Minor Impulse" and "Like." Green's "Blues for Charlie," a tribute to the late Charlie Christian, has superb work by Green and Quebec.

This is an exceptional recording.

Frank Driggs

## The Benny Morton and Jimmy Hamilton Blue Note Swingtets Mosaic MR1-115.

Sound: B+ Performance: A to B

This is the final Mosaic reissue of Blue Note's catalog of swing-style jazz. Alfred Lion made nothing else in this style after an Ike Quebec date in September 1946, although, after turning to be-bop, Lion did occasionally record some New Orleans-style music.

Trombonist Benny Morton was one of the real giants of an era in which there were a dozen or more superb trombonists. A New York native, he started with Fletcher Henderson, Chick Webb, Don Redman, Count Basie, and Teddy Wilson before leading his own combo and freelancing mainly in



Jimmy Hamilton

Broadway pit bands before Bell's palsy and other illnesses caught up with him; he died in 1985, as Stanley Dance's excellent notes tell us. Dance's notes remind us that although Morton (like most of his generation) was not an academically trained musician, he formed one of the most individualistic, forceful, and warm styles heard on trombone.

On the Morton dates included here, Barney Bigard and Ben Webster fill out the front line, which has two fine takes, "Sheik of Araby" and the masterpiece "My Old Flame." This recording also introduces pianist Sammy Benskin, backed by bassist Billy Taylor and drummer Specs Powell. Benskin does admirably, particularly on "The World Is Waiting for the Sunrise."

Clarinetist Jimmy Hamilton, a South Carolina native, was raised in Philadelphia and became influenced by Benny Goodman. After establishing his worth with Lucky Millinder, Teddy Wilson, Benny Carter, and Eddie Heywood, Hamilton joined Duke Ellington in 1942 for a stay of nearly 25 years.

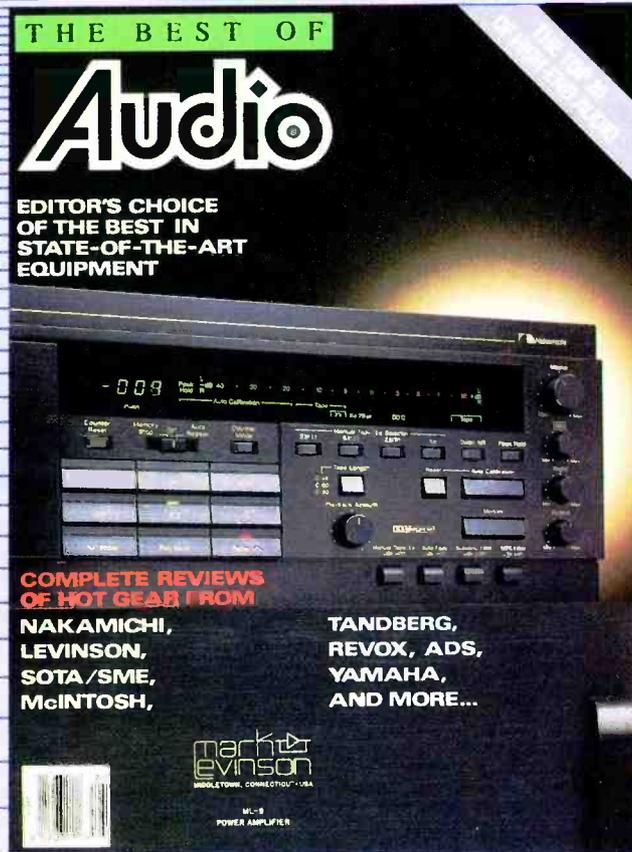
For the cuts on this recording, Hamilton surrounded himself with fellow Ellingtonians Ray Nance, Otto Hardwick, and Harry Carney plus trombonist Henderson Chambers and a rhythm section of Oscar Pettiford and Big Sid Catlett. Although Hamilton composed and arranged three of the four titles on his date, Nance, Carney, and, most particularly, Chambers (a very underrated trombonist) took the spotlight away from him with their forceful and



Benny Morton

Photographs: Frank Driggs Collection

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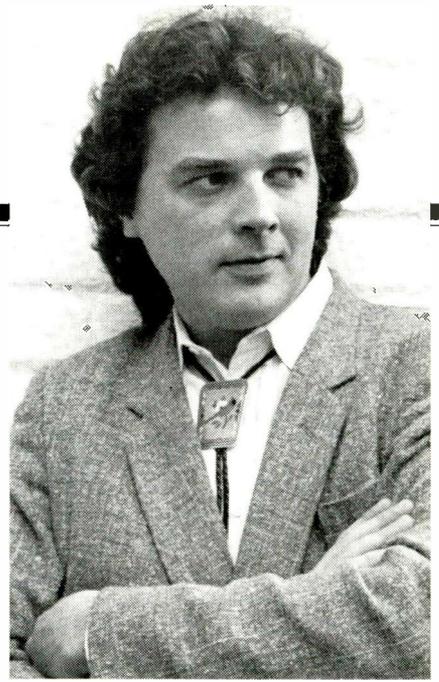
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*Ron Levy's Wild Kingdom* is energetic and at times inspired, but the music is rarely indispensable.

imaginative solo work. "Blues for Clarinets" and "Blues in My Music Room" show how well Chambers could play. Hamilton's own work is always polished but always seems—to me—to lack a certain spark.

In the late '40s, as R&B and be-bop came into their own, the search for the

new and fashionable froze out the swing men; the tide of public opinion kept many superb players from having their most mature work heard at a critical time in jazz history. This rerelease is a fine example of Mosaic's continuing effort to document the ever-changing panorama of jazz. *Frank Driggs*



**Ron Levy's Wild Kingdom  
Black Top BT-1034.**

Sound: B— Performance: B

With Roomful of Blues bursting at the seams with talent, solo space has always been at a premium for individual members of the group. Roomful's guitarist Ronnie Earl has cut some exciting solo albums on Black Top, and now pianist Ron Levy has released his own record—sort of. *Ron Levy's Wild Kingdom* features Levy backed at various times by half of Roomful, most of The Fabulous Thunderbirds, Bobby Bland's former ace guitarist Wayne Bennett, and other players.

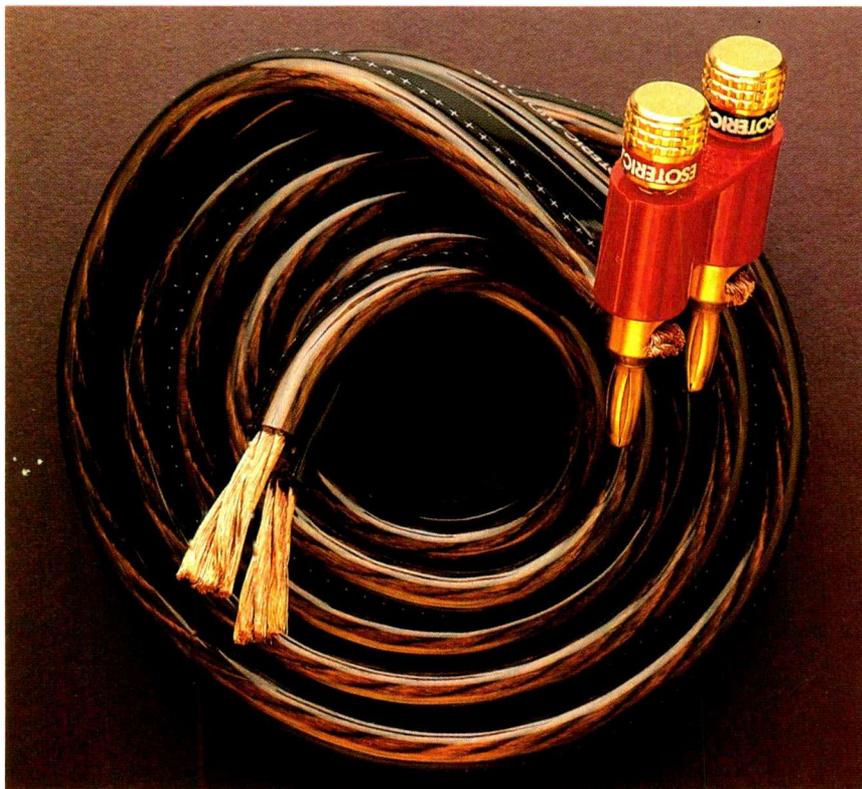
Levy's credentials are impeccable (seven years with B. B. King), but as with too many sidemen, he has nothing unique to say and lacks the commanding personality to dominate these sessions. The results are pretty much what you'd expect from a group of talented friends who've gotten together to jam: Energetic, fleetingly inspired, but rarely indispensable. Recommended to fans of Roomful and the T-Birds only.

*Roy Greenberg*

**In the Condon Tradition:** Ed Polcer **Jazzology J-150.** (Available from Jazzology Records, 3008 Wadsworth Mills Pl., Atlanta, Ga. 30032.)

Sound: C Performance: B/C

Cornetist Ed Polcer became known around New York as a playing manager of Eddie Condon's club on West 54th Street. This is a live concert performance from the 1982 Manassas Jazz Festival put on annually in Manassas, Va. by Johnson McRee.



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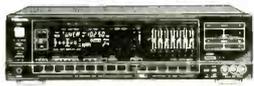
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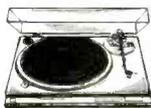
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**CRUTCHFIELD**

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Tom Pletcher captures perhaps better than any other young cornetist the sound and unique style of Bix Beiderbecke.

The band, hand-picked by George H. Buck, Jr., features clarinetist Tommy Gwaltney, one of the leading lights of traditional jazz in the Washington, D.C. area for more than 30 years, and trombonist Bill Allred, a standout player who currently leads a traditional jazz band in Orlando, Fla. The rhythm section includes pianist John Eaton, well known in the D.C. area; veteran guitarist Steve Jordan, also a long-time D.C. legend; bassist Van Perry, and drummer Barrett Deems, late of Louis Armstrong's All Stars.

This is the kind of recording that plays best to those who were in attendance at the Manassas Festival, because the engineering leaves a great deal to be desired, pushing Van Perry's strong bass way too far to the front.

The tunes are good ones, including "September in the Rain," which is not the usual Dixieland fare. Mr. Polcer has improved a great deal in the past 10 years, and Bill Allred seems on the mark. However, while there is an awful lot of drive and energy here, there is not, to my ears, an awful lot of creativity. I'm sure everyone concerned has had better moments. I'm also sure that much better music could have been produced with better planning.

*Frank Driggs*

**A Portrait of Bix Beiderbecke:** Bob Haggart with Tom Pletcher  
**Jazzology J-149.** (Available from Jazzology Records, 3008 Wadsworth Mill Pl., Atlanta, Ga. 30032.)

Sound: B+ Performance: B+

Bassist/arranger Bob Haggart has enjoyed great success as a player since 1935, when he was with the original Bob Crosby big band. He has had great acceptance as an arranger, composer, studio musician, and leader of many fine jazz groups over the past 30 years and longer. His collaborator here is cornetist Tom Pletcher, who captures perhaps better than any other young player the sound and unique style of the late Bix Beiderbecke. He is also president of a Midwestern steel company, making his musical achievement all the more remarkable.

Haggart and Pletcher are joined by the superb bass saxist Spencer Clark, whose career has included stands with The California Ramblers, Lud Gluskin,



Bix Beiderbecke

and Ozzie Nelson; and Jack Howe, who played saxophone at Princeton University and jammed there with Bix on houseparty weekends in the late '20s. The younger bandsmen include Mike Katz on clarinet and sax and Doug James on drums; both acquit themselves very well.

The program is made up of songs that Beiderbecke played and recorded, including "Clementine," "Peg o' My Heart," "Blue River," "Davenport Blues," "Dardanella," and "You Took Advantage of Me." This *Portrait*, the third such collaboration between Haggart and Pletcher, is recommended.

*Frank Driggs*

Photograph: Frank Driggs Collection

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**GENERAL INFORMATION**—Ad copy must be typewritten or printed legibly. The publisher in his sole discretion reserves the right to reject any ad copy he deems inappropriate. **ALL ADVERTISERS MUST SUPPLY:** Complete name, Company name, Full street address (P.O. Box numbers are insufficient) and telephone number. Classified LINE ADS are not acknowledged and do not carry Reader Service Card Numbers. **AGENCY DISCOUNTS** do not apply to line advertising. **FREQUENCY DISCOUNTS** not fulfilled will be short rated accordingly. Only those advertisers who have prepaid for their entire contract time will be **RATE PROTECTED** for the duration of that contract, in the event of a rate increase.

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**DISPLAY ADVERTISERS** should make space reservation on or before the closing date. Ad material (film or velox) may follow by the tenth. **DISPLAY ADVERTISERS MUST SUPPLY COMPLETE FILM NEGATIVE READY FOR PRINTING OR VELOX. PRODUCTION CHARGES WILL BE ASSESSED ON ANY AD REQUIRING ADDITIONAL PREPARATION.**

**ALL DISPLAY CORRESPONDENCE** should be sent to:

Laura J. Lo Vecchio, AUDIO MAGAZINE,  
1515 Broadway, New York, NY 10036

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## ANNOUNCEMENTS

**STEREO EXCHANGE . . . AMERICA'S LARGEST** hi-end used inventory . . . Now we **BUY & SELL** by **PHONE ALL OVER THE WORLD!** Here's a **SMALL SAMPLE** of our kind of items...and prices. **TURNTABLES:** B&O 4002 \$200, Denon DP75/DA401/VPI Base \$500, Goldmund Studietto T5 \$2350, Kenwood KD500 \$100, Logic DM101 \$225, Luxman PD300/SME III \$600, Pink Triangle \$350, STD 3055 (new) \$260, Thorens TD 125 II \$140. **TONE-ARMS:** Alphason Xenon \$275, Fidelity Research FR 645 \$300, Helius Orion \$400, Magnepan Unitrac I \$99, Technics EPA 501 (tubes) \$65, Triplanar \$1000. **CARTRIDGES:** Koetsu Blackgold \$425, Koetsu Onyx Sapphire \$695, Monster Alpha II \$350. **PRE-AMPS:** Accuphase C240 \$1300, Audio Research SP8II \$1250, Audio Research SP10II \$2350, Berning TF10AH \$1075, Bozak 919 \$475, Citation eleven \$110, Citation X-II \$1100, Conrad Johnson Premiere 3 \$2150, Krell KRS-1 \$3700, Levinson ML12A \$1275, McIntosh C29 \$850, Perreux SM 2 (new) \$650, RGR IV \$300, Spectral DMC5 \$1000. **POWER AMPS:** Accuphase P400 \$1275, Acoustat TNT 200 \$695, Audio Research D250-II \$3700, Belles A \$750, Classe DR-2 \$1150, Dynaco 416A \$395, Eagle 7a \$2000, FM Acoustics 600A \$850, Krell KSA50 \$1500, Sumo Gold \$800, Threshold SA-1 \$5700. **SPEAKERS:** Acoustat 2 - 2 \$1300, Apogee Scintilla \$2300, Beveridge 3 \$1250, Beveridge 5 \$1200, Bosc 901 IV \$500, Dahlquist DQ-10 \$550, Duntech Sovereign \$10,000, Magnepan Timpani ID \$750, McIntosh XRT-20 \$2975, Polk SDASRS \$1900, Quad ESL \$700, Quad ESL63 \$1900. **TUNERS:** Accuphase T105 \$525, Crown FM1 \$400, McIntosh MR80 \$1700, Phaseliner 5000II \$250, Tandberg 3001A \$1175, Yamaha CT7000 \$550. **TAPE DECKS:** Nakamichi Dragon \$1200, Tandberg TCD3014 \$775, Revox A77 IV \$550, Revox A700 \$1700, Teac A73-2T \$1000, Teac 3340 \$650. **SIGNAL PROCESSORS:** ADS Model 10 \$350, Audio Pulse Model I \$150, DBX 128 \$170, Sound Concepts SD550 \$200. **PHONE OR WRITE:** STEREO EXCHANGE, 687A BROADWAY, NYC, NY 10012. 1-800-833-0071. 1-212-505-1111

## ANNOUNCEMENTS

**ANNOUNCING MODIFICATIONS TO B&K AMPS AND PREAMPS:** Most sonic improvement for \$\$ invested!! Improved detailing, depth of soundstage, increased transparency, deeper & tighter bass! State-of-the-art Technology!!! We pay shipping. **SOUND UNLIMITED**, 169 Church St., Bristol, CT 06010. Est. 1959. (203) 584-0131.

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The amplifier, a "Limited Edition," is a dual mono design rated at 60 Watts per channel utilizing McIntosh output transformers. A unique feature is FET Tube driver circuits that achieve very low noise and distortion with only 8 db of negative feedback. Massive power supply with two stage regulation provide superior definition and imaging. The amplifier is rack mountable, has gold input connectors, turn on surge & line transient protection and runs cool for a long life.

Hand & Machine Crafted in the USA. Projected Retail: \$1660. For details contact Steve Rowell at Audio Classics, POB 176, Walton, N.Y. 13856. 607-865-7200 8AM-5PM Mon.-Fri.

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**"... the Sonographe is, to my ears, the best CD player to hit the market."**  
 —Anthony H. Cordesman

**T**he Sonographe SD-1 is a Conrad Johnson product which has been put on the market with remarkably little hype about its features or special technology. Its analog stages have, however, been very extensively modified, with the goal of making the player sound as musically realistic as possible. C] exerts very high quality control over the players it converts, improves their damping, and perform a number of other tweaks, but the key issue here is the analog circuitry.

In spite of this lack of corporate techno-babble, the Sonographe is, to my ears, the best CD player to hit the market. There is a slight loss of transient detail and resolution compared to the best competition, but the Sonographe is consistently musical. The depth and imaging is superior to that of any other player to date, and the timbre is exceptionally convincing. The soundstage is a bit wide, but just a hair. The bass and deep bass are very convincing and

dynamics are excellent. It is forgiving, not in the sense of masking CD problems, but in that its overall sound balance is so clearly aimed at musical realism rather than to conform to some technical theory or design concept.

All in all, the Sonographe is a clear "best buy." I am not going to wax at length over the sound of this unit; it is simply musically right. It equals any other CD player I have heard in overall sound quality regardless of price, and outperforms any analog front end you can hope to buy for under \$1000. Only the very best analog front ends, and semiprofessional open-reel and digital tape machines, will be consistently superior.

—Anthony H. Cordesman

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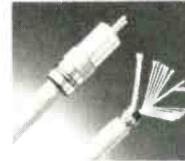
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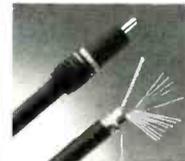
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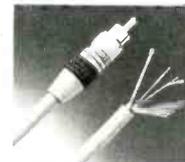
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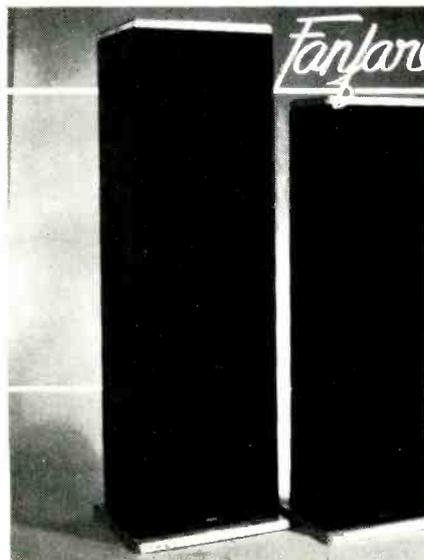
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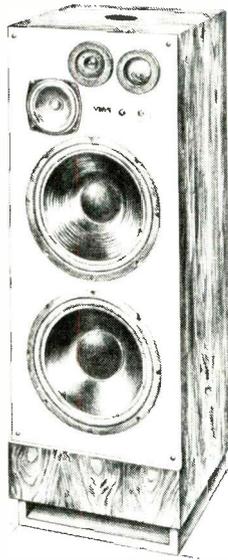
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## FOR SALE

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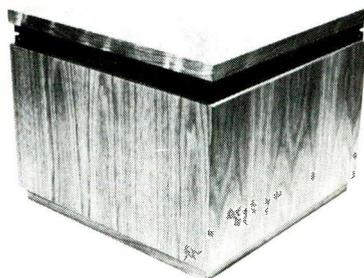
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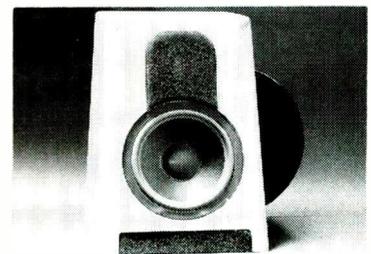
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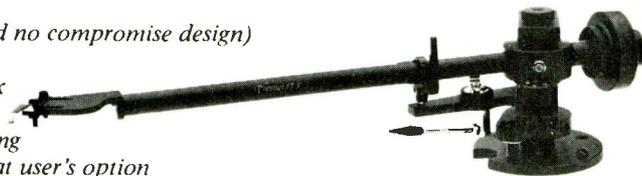
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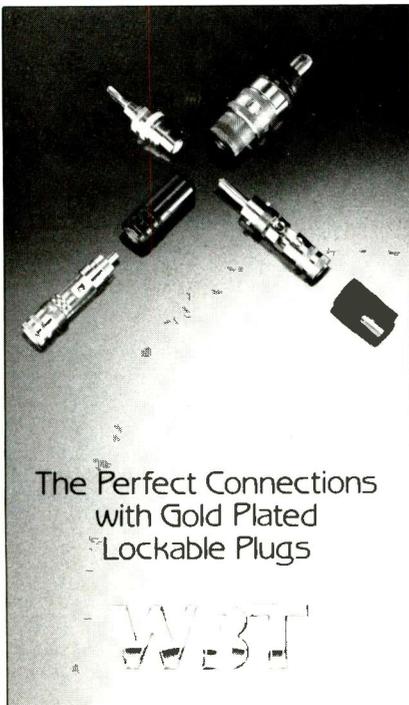
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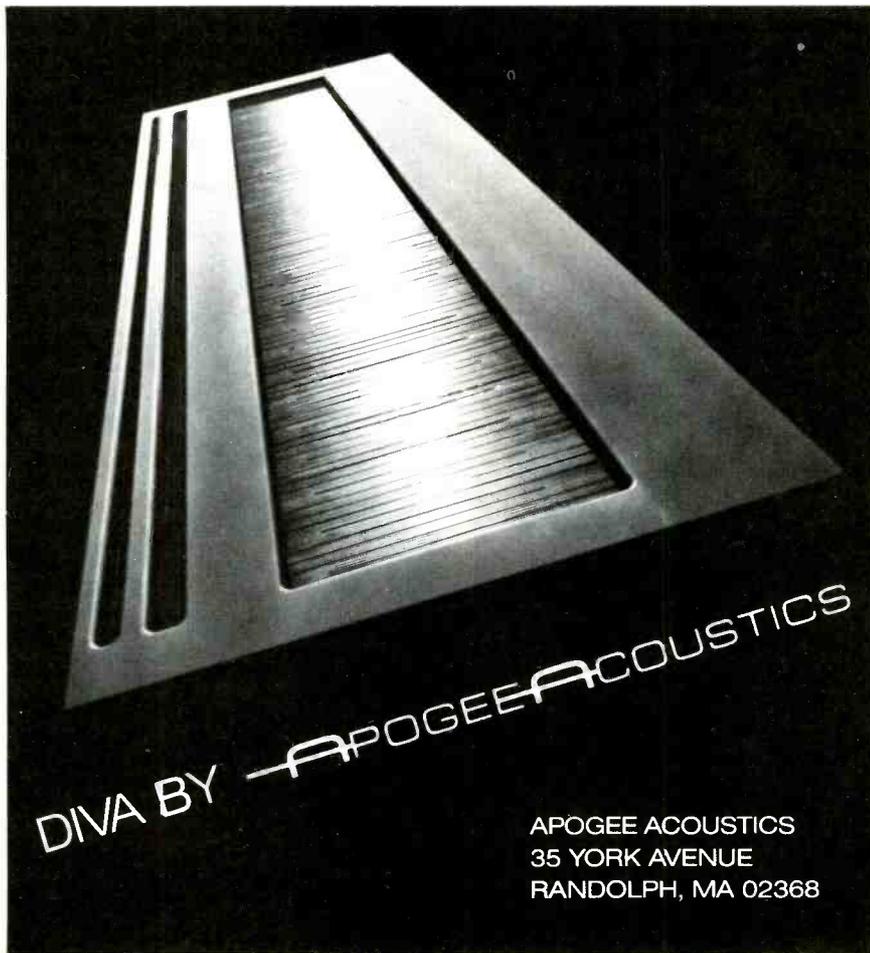
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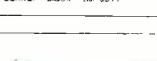
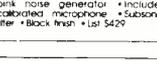
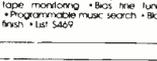
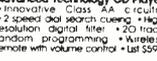
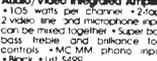
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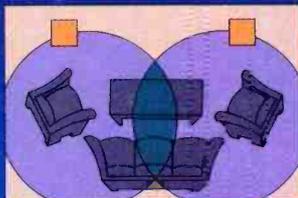
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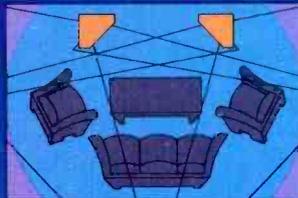
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