Audio

MARCH 1985 • $2.00

FOCUS ON FM QUALITY

CARVER CD PLAYER: SUPERB SOUND PLUS THE DIGITAL TIME LENS

HAUTE DECOR: DESIGNS FOR LISTENING

REVIEWED:
TECHNICS RSB-100 CASSETTE DECK

CROWN PZM-180 MICROPHONE

This is Nakamichi

OMS-1000
Optical Memory System

Nakamichi Digital Sound
A product of the *recording* experience

Almost anyone can make a CD player. Only *Nakamichi* could produce the OMS-1000—the first magneto-optical disc recorder! The OMS-1000 is a research tool that took nearly 5 years to develop.
Now *you* reap the benefits!
Introducing the OMS-7 and OMS-5—the first CD *players* with a *recording* heritage—the first CD players with Nakamichi Sound, that ineffable clarity and natural reproduction that must be heard to be believed.
Experience Nakamichi Digital Sound now—at your local Nakamichi dealer.

OMS-7

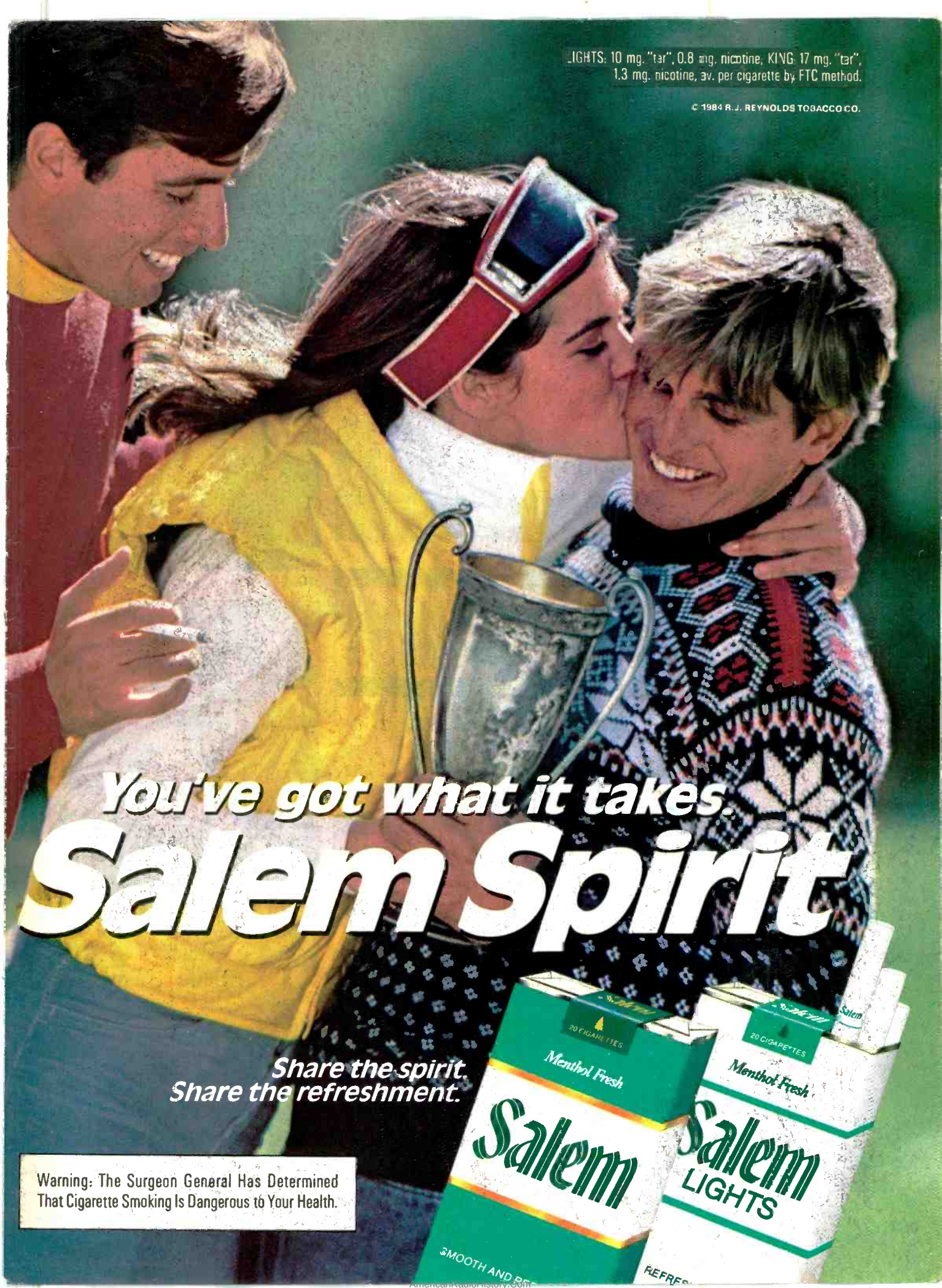
Remote control, 24-command memory, and direct access to any track and index number—advanced features for our most sophisticated CD player.

OMS-5

OMS-7 sound thanks to 4X-Oversampled Digital Filters, Dual D/A Converters, and our exclusive Direct-Coupled Linear-Phase Analog Signal Processor.

Nakamichi

Nakamichi U.S.A. Corporation 19701 South Vermont Ave., Torrance, CA 90502 (213) 538-8150
In Canada: W. Carsen Co., Ltd., 25 Scarsdale Road, Don Mills, Ontario M3B 3G7

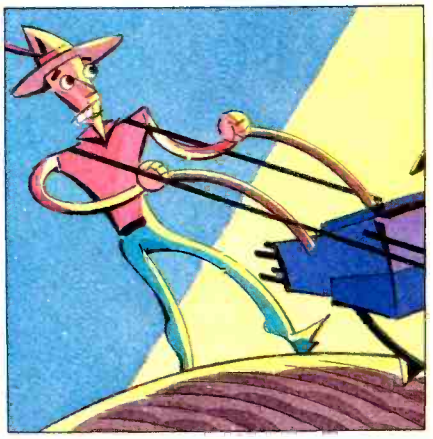


Audio

MARCH 1985 VOL. 69, NO. 3

See page 60

See page 48



See page 26

See page 20

FEATURES

EQUIPMENT PROFILES

MUSIC REVIEWS

DEPARTMENTS

The Cover Equipment: The Carver Compact Disc player.
The Cover Photographer: Robert Lewis.

Audio Publishing, Editorial and Advertising Offices,
1515 Broadway, New York, N.Y. 10036.

Subscription Inquiries, (800) 525-9511; in Colorado (303) 447-9330.

A FACE THAT ONLY AN AUDIO BUFF COULD LOVE.

This isn't just another pretty face. It's a masterpiece of electronic sophistication and technical wizardry.

One look at its dazzling FL display gives you instant verification of station frequency, memory program number, output and input source, Acoustic Memory settings and virtually every other AA-A45 receiver operating function.

You'll find AKAI innovations like Direct Access Volume Control. Just one of many computer-controlled functions, it responds with instantaneous volume settings at the touch of a bar. A special safety circuit automatically prevents abrupt volume increases and resulting performance problems.

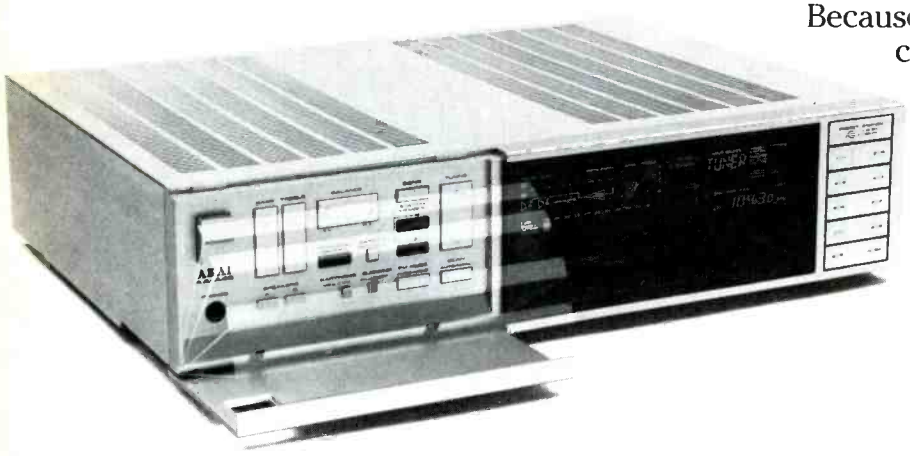
Tuning is also at your fingertips, thanks to 20 Station Random Pre-Set Memory. An advanced tuner section that incorporates quartz frequency synthesis for continuous, drift-free reception.

There's even a Zero-Drive circuit that eliminates distortion and negative feedback. A Dual Pole DC Servo Circuit for greater signal resolution and musical fidelity. And an MC head amp with Moving Coil Cartridge compatibility.

But the thing you'll really love about the AA-A45 is its reasonable price.

Because while a lot of companies can design a receiver that an audio buff would love, AKAI's also designed one that you can afford.

For more information on AKAI's full line of receivers, write to AKAI America, Ltd., P.O. Box 6010, Compton, CA 90024.



AKAI

Enter No. 3 on Reader Service Card

Audio

Eugene Pitts III
Editor

Art Director: Cathy Cacchione

Technical Editor: Ivan Berger
Managing Editor: Kay Blumenthal
Copy Chief: Elise J. Marton
Assistant Art Director: Linda Zerella
Assistant Editor: Andrea Lynne Hecker

Associate Editors:
Edward Tatnall Canby, Bert Whyte, B. V. Pisha
Senior Editors:
Leonard Feldman, Richard C. Heyser, Howard A. Roberson
Editor-At-Large: David Lander
Audio Retailer Section Editor:
Luther Sperberg

Contributing Editors/Artist:
Herman Burstein, David L. Clark, Anthony H. Cordesman, Ted Costa, John M. Eargle, Joseph Giovanelli, Laurence L. Greenhill, Bascom H. King, Edward M. Long, C. G. McProud, Peter W. Mitchell, Jon Sank, Donald Spoto, Len Strazewski, Michael Tearson, Jon & Sally Tiven, Paulette Weiss

General Manager: Mary Anne Holley
Production Manager: Patti Burns
Special Projects Coordinator: Phyllis K. Brady
Ad Coordinator: Ruth M. Linehan

Roman Beyer
V.P./Publisher

ADVERTISING
Advertising Director: Stephen Goldberg (212) 719-6335

Eastern & Audio Retailer
Sales Manager: Stephen W. Witthoft (212) 719-6337
Account Managers: Susan L. Newkirk (212) 719-6346
Lesa Rader Giberson (212) 719-6291

Western Manager: William J. Curtis (213) 827-8655

Classified Manager: Laura J. LoVecchio (212) 719-6338

OPERATIONS
Circulation Director: Leon Rosenfield
Production Director: David Rose
Research Director: Lester Abberbock

CBS MAGAZINES EXECUTIVE STAFF
President: Peter G. Diamandis
Sr. V.P./Adv.: Michael J. O'Neill
V.P., Finance & Admin.: Robert J. Granata
V.P., Circulation: Robert F. Spillane
V.P., Mfg. & Distribution: Murray Romer

AUDIO (ISSN 0004-752X, Dewey Decimal Number 621.381 or 778 5), including **AUDIO RETAILER,** is published monthly by CBS Magazines, A Division of CBS Inc., at 1515 Broadway, New York, N.Y. 10036. Printed in U.S.A. at Nashville, Tenn. Distributed by CBS Magazine Marketing. Second class postage paid at New York, N.Y. 10001 and additional mailing offices. Subscriptions in the U.S., $17.94 for one year, $32.94 for two years, $45.94 for three years; other countries, add $6.00 per year.

Editorial contributions are welcomed but should be accompanied by return postage. Submissions will be handled with reasonable care, but the Editor assumes no responsibility for safety or return of manuscripts, photographs, or artwork. The Publisher, in his sole discretion, reserves the right to reject any ad copy he deems inappropriate.
AUDIO Publishing, Editorial and Advertising Production offices, 1515 Broadway, New York, N.Y. 10036. Subscription offices, P.O. Box 5318, 1255 Portland Place, Boulder, Colo. 80322; (800) 525-9511, (303) 447 9330 in Colorado. Postmaster: Send change of address to P.O. Box 5316, 1255 Portland Place, Boulder, Colo. 80302.

OPEN IT UP.

Most car audio systems can deliver the sound of performance. Enough sound to exceed the human ear's threshold of pain.

But if your taste in music runs the gamut, from the smash of Heavy Metal to the intricate passages of Mozart, volume alone isn't enough. Without sonic excellence, loud sound is just so much musical mush.

PLAY IT GOOD AND LOUD.

Now you can have it both ways with Yamaha car audio. The system that takes some of the world's finest home component performance and puts it on the road.

Yamaha cassette-receivers utilize independent dual microprocessors with over 6K of memory. One precisely controls tape handling. The second fine-tunes signals in difficult reception areas.

Yamaha fully digital power amps provide superior, virtually distortion-free amplification. And easily cope with such road hazards as voltage, impedance and temperature variations.

Yamaha car speaker systems use titanium carbide in the tweeters and carbon fiber in the woofers. Resulting in unrivaled accuracy.

And unequaled performance.

ALL TOGETHER, A GREAT PERFORMANCE.

Just as important, Yamaha car audio is a total system with no weak links. Because every Yamaha component is designed to complement and enhance the performance of the system as a whole.

The result is sound that's clean and natural, reproduced with full clarity and resonance. Sound that makes the music.

No matter how loud it's played.

YAMAHA

Yamaha Electronics Corporation, USA, P.O. Box 6660, Buena Park, CA 90622

Polk's Revolutionary True Stereo SDAs Always Sound Better Than Conventional Speakers

"They truly represent a breakthrough"

Rolling Stone Magazine

"Polk Reinvents the Loudspeaker."

High Fidelity Magazine

Polk's critically acclaimed, Audio Video Grand Prix Award winning SDA (patented) technology has been called the most important fundamental advance in loudspeaker technology since stereo itself. Listener's jaws drop in amazement 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 then conventional loudspeakers. Stereo Review said, "Spectacular... the result is always better then would be achieved by conventional speakers." High Fidelity said, "Astounding... We have yet to hear any stereo program that doesn't benefit." Now the dramatic audible benefits of Polk's exclusive true stereo SDA technology are available in 3 uniquely superb loudspeaker systems, the SDA-1A, the SDA-2 and the SDA Compact Reference System.

The First True Stereo Speakers

Without exaggeration, the design principals embodied in the SDAs could be said to make them the world's first true stereo speakers. When the big switch was made from mono to stereo about 25 years ago, the basic concept of loudspeaker design was never modified to take into account the fundamental difference between a mono and stereo signal.

What is the difference between a mono and stereo loudspeaker? It's quite simple. 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 new dimension in the sound."

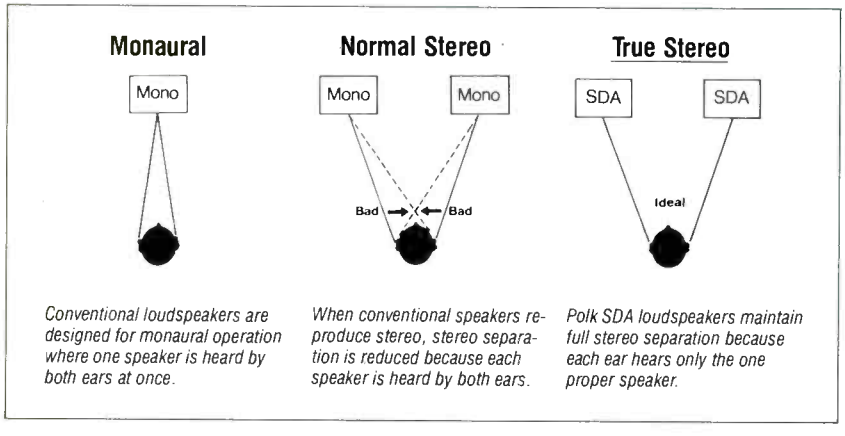
Stereo Review Magazine

Words alone cannot fully describe how much more lifelike true stereo reproduction is. Reviewers, critical listeners and novices alike are usually overwhelmed by the magnitude of the sonic improvement achieved by Polk's Stereo/Dimensional 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, subtle musical nuances and other information, (which is 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, CD's, tapes, video and FM all benefit equally as dramatically. SDAs allow you to experience the spine tingling excitement, majesty and pleasure of live music in your own 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."

The SDA-1A – ($850) is a beautifully styled, full-sized floor-standing system combining Polk state-of-the-art components with our exclusive true stereo technology for the most lifelike sound possible. It has tremendous dynamic range (120 db output), high efficiency and truly awesome bass performance. While efficient enough to be driven by a small receiver, it will handle a 500 watt per channel super amp.

The SDA-2 – ($599.95) is very similar in construction and performance to the top of the line SDA-1A, but is scaled down in size and price. High Fidelity said listening to the SDA-2, is "an amazing experience."

The New SDA Compact Reference System – ($395) is the world's best sounding bookshelf loudspeaker. It combines the exceptionally lifelike sonic performance achieved by Polk's exclusive true stereo technology with a strikingly handsome enclosure of modest proportions, which can be easily and unobtrusively located in any room. A built-in rear mounted 10" subwoofer allows the CRS to achieve remarkably dynamic bass performance, normally impossible for a speaker of its size. They can be placed right up against the back wall, on a stand or on a shelf without compromising the ability of these amazing compact speakers to project a huge sonic image throughout your room.



Conventional loudspeakers are designed for monaural operation where one speaker is heard by both ears at once.

When conventional speakers reproduce stereo, stereo separation is reduced because each speaker is heard by both ears.

Polk SDA loudspeakers maintain full stereo separation because each ear hears only the one proper speaker.

Polk's True Stereo SDAs Maintain Full Stereo Separation

polkaudio®
The Speaker Specialists®

For Dealer Nearest You Call TOLL-FREE 1-800-843-3800
Enter No. 31 on Reader Service Card

Polk's Remarkable Monitors Redefine Incredible Sound/Affordable Price

"Vastly superior to the competition."

Musician Magazine

"At the price, they're simply a steal."
Audiogram Magazine

A new generation of Polk Monitors is now available which incorporate the same high definition polymer tweeter and Optimized Flux Density drivers developed for the SDA s. Polk Monitor Series loudspeakers have always had a well deserved reputation for offering state-of-the-art performance and technology usually found only in systems which sell for many times their modest cost. In fact, many knowledgeable listeners consider that outside of the SDA s, the Polk Monitors are the finest imaging conventional speakers in the world regardless of price. They have been compared in performance with loudspeakers which sell for up to $10,000 a pair and are absolutely the best sounding loudspeakers for the money available on the market. Now they sound even better than ever.

"Open, uncolored, perfectly imaged sound." *Musician Magazine*

All the Polk Monitors regardless of price offer consistently superb construction and sonic performance. They achieve open boxless.three dimensional imaging surpassed only by the SDAs. The Monitor's silky smooth frequency response assures natural, non fatiguing,easy to listen to sound; while their instantaneous transient response results in music that is crisply reproduced with lifelike clarity and detail. In addition, dynamic bass performance, ultra wide dispersion, high efficiency and high power handling are all much appreciated hallmarks of Monitor Series performance.

The consistently superb performance of the Polk Monitors is in large part due to the fact that they all utilize very similar components and design features. However, more importantly, it is the elegant integration of concepts and components which results in the superior sonic performance and value which sets the Monitor Series apart. Audiogram magazine said, "How does Polk do it? We think it is mostly execution. They hear very well and they care." Audiogram is absolutely right. At Polk we take the same care with each and every product we build, whether it is our most or least expensive. We lavish the same lengthy amount of critical listening and tuning on every single Polk speaker because we know that having a limited budget does not necessarily indicate that you have a limited ability to appreciate true musical quality.

"Superior sound at a moderate price." *Stereo Review Magazine*

There are six Polk Monitor Series loudspeakers (Plus the LF 14 Add on Subwoofer). As you move up the Monitor Series, the speakers get larger and more efficient,handle higher power, have greater dynamic range and better bass response. They are designed so that a smaller Polk played in a small room will sound nearly identical to a larger Polk in a large room. And, of course, a larger Polk in a smaller room will play that much louder and have even more bass. The RTA 12C also incorporates unique technology which results in improved imaging and clarity. There is a Polk Monitor which is perfect to fulfill your sonic dreams, at a price you can afford.

The RTA 12C – ($459.95) is the finest conventional (non SDA) speaker system that Polk manufactures. Its extremely high power handling (500 watts) and efficiency (92 db 1 meter 1 watt) result in remarkable dynamic range from large or small amplifiers. It utilizes phase-coherent open air driver mounting in a mirror imaged full-sized floor-standing configuration for superior sonic imaging and clarity. In addition to receiving many rave reviews, the RTA 12C has won the AudioVideo® Grand Prix Speaker of the Year Award and was selected for the prestigious CES Design and Engineering Exhibition was one of the industry's most innovative products!

The Monitor 10B – ($324.95) is considered one of the world's best sounding loudspeakers and in the words of Audiogram Magazine, "At the price,they are simply a steal." The 10B offers sonic performance almost equal to the 12 at a lower cost in a more compact enclosure. Like the 12, the 10 utilizes dual Polk trilaminate-polymer bass midrange drivers coupled to a built-in subwoofer for an outstanding bass response and dynamic range.

The Monitor 7C – ($239.95) is basically a smaller, less expensive version of the Monitor 10, utilizing the same 10" subwoofer and one less bass midrange driver. It can be either shelf or stand mounted with excellent results. How good? Audio Alternatives Magazine said, "It is amazing."

The Monitor 5B – ($179.95)
Similar in design and performance to the Monitor 7, however, it utilizes an 8" subwoofer (rather than 10"). It is more compact, allowing even more placement options.

The Monitor 5jr. – ($124.95) has been called the best sounding speaker of its size in the world (regardless of price). It has also been called the best sounding speaker of its price in the world (regardless of size). It incorporates the same components as the top of the line SDA 1A, and achieves lifelike three dimensional musical imaging which 10 years ago was not available in any bookshelf speaker at any price!

The Monitor 4A – ($79.95 ea.) Even though the 4A is Polk's least expensive home loudspeaker, one quick look and listen will demonstrate that it shares many of the same high technology components and rewarding musical performance of the more expensive Polks. Audio critic, Lawrence Johnson called it, "an all around star of great magnitude." The 4A's uniquely affordable price means that no matter how small your budget, you can afford the incredible sound of Polk!

The experts agree: Polk speakers sound better. Hear them for yourself!

Contact us for full information and the name of your nearest Polk dealer.

Polk Audio, Inc.
1915 Annapolis Road
Baltimore, Maryland 21230
(301) 837-4300

In Baltimore – Soundscape
In Canada – Evolution Audio

polkaudio®
The Speaker Specialists®

For Dealer Nearest You Call TOLL-FREE 1-800-843-3800
Enter No. 31 on Reader Service Card

BASF Chrome.
The world's quietest tape.

When you buy most audio tapes, you get a little something extra whether you like it or not.

It sounds like thisssssss.

Unless the tape is BASF Chrome. Because unlike ferric oxide tapes, BASF Pure Chrome is made of perfectly shaped chromium dioxide particles in an exclusive formulation that delivers the lowest background noise of any tape in the world. It also delivers outstanding sensitivity in the critical high-frequency range. In fact, it's designed especially for the Type II Chrome Bias position on your tape machine. And it's guaranteed for a lifetime.

So, if all you want to hear is the music you record, this little message should be music to your ears. BASF Chrome. The world's quietest tape.

BASF
Chrome Audio & Video Tapes
The quality never fades.

Enter No. 7 on Reader Service Card

TAPE GUIDE

HERMAN BURSTEIN

Tape "Glitches"

Q. When playing prerecorded cassettes, "glitches" or "blurbs" sometimes develop on the tape. The more the tape is played, the more these occur, and they are permanent; they appear thereafter with any deck used to play these tapes. This only happens with a few tapes. Is there something wrong with the tapes or with the deck?—T. P. Johnston, Jr., Pulaski, Va.

A. Inasmuch as the problem occurs only with a few tapes, and the tapes that offend continue to do so in other decks, it is quite likely that the fault is in the tapes rather than in your deck. It may be that the magnetic coating is flaking off in spots or that, perhaps because of static attraction, the tape is picking up foreign particles. If the problem really occurs only with a few tapes, return them. If the brand that has given you trouble continues to do so, you had best avoid this label in the future. Or, it may be that you had the bad luck to get tapes from a bad batch of a normally good company's output, a problem unlikely to recur.

Demagnetization—Again

Q. I have heard conflicting information as to the need to demagnetize tape heads on a fairly frequent basis. I've been told that, in the past, tape heads tended to become magnetized rather quickly, and hence there was a need to demagnetize them frequently. I have read that the heads in recent decks don't need demagnetizing very often. Can you shed some light on this matter?—Freeman Matthews, Columbus, Ohio

A. Opinion remains divided on the subject. The need depends on the material from which the heads are made and on any special circuitry in the deck to demagnetize the heads or to prevent current surges that might magnetize them. Demagnetizing the heads does no harm, so, to be on the safe side, many persons continue to do it. Moreover, not only the heads but the guides and other metal parts contacted by the tape are subject to magnetization, while only the heads benefit from any demagnetization circuits in the deck. It pays, therefore, to demagnetize those other parts—and while doing so, it is only a matter of another few seconds to demagnetize the heads as well. Use a demagnetizer with a plastic- or rubber-covered tip to keep from scratching the heads.

For more on this, I suggest my articles, "Focus on Head Demagnetization" and "Refocus on Demagnetization," which appeared in the April 1981 and September 1982 issues of *Audio*.

Single-Ended Dolby NR

Q. I have a cassette that I recorded without Dolby NR from a phono disc. When played back without Dolby, scratches are heard; when the cassette is played with Dolby C, all scratches are eliminated. Can you explain this phenomenon? Will playing the tape with Dolby C in any way hurt my tape deck?—Stephen A. Leslie, Philadelphia, Pa.

A. Dolby C applies substantial treble cut in playback, which tends to eliminate scratch sounds since they are predominantly in the treble range. If you had recorded with Dolby C, substantial treble boost would have been applied in recording, thus cancelling the playback cut and leaving the scratches audible. (However, the Dolby system would have greatly reduced noise generated *in the tape record-playback process*.) Playing the deck with Dolby C, regardless of how you made your recording, will in no way hurt your deck or tape.

Automatic Level Control

Q. My cassette deck has an automatic level control for recording. Is this reliable? How does it work? Does it perform as well as a conventional system in the hands of an attentive recordist?—Marc Claessens, Toronto, Ont., Canada

A. Automatic level control (ALC) rectifies the audio signal and employs the resulting d.c. voltage to control gain, seeking input to the tape high enough to achieve a good signal-to-noise ratio but not so high as to cause excessive distortion. Generally it works reliably. But it is intended chiefly for speech or other applications where high fidelity is not important, since it compresses the signal's dynamic range too much for high-quality music reproduction. For music, it's better to set gain manually so that signal peaks never drive the recording meter above the maximum permissible level. That level would usually be about 0 or a few dB higher, depending on the individual deck and on the tape used.

When you refer to "an attentive recordist," I hope you do not have in mind the practice of riding gain, that is, changing the record level as signal level changes. This is undesirable if you wish to preserve the original dynamic characteristics of the signal source.

Need for Bias Adjustment

Q. I just bought a new cassette deck and requested the shop where I bought it to adjust the bias for the brand of tapes that I use. When a tape manufacturer upgrades his tapes, as has happened with my brand, is a new bias adjustment needed?—Stan Davis, Buena Park, Cal.

A. Theoretically, bias requirements of upgraded tapes should not change but should conform to standards promulgated by the IEC. As a practical matter, bias requirements may change slightly, but usually not enough to make a large difference in performance. However, the perception of what is "large" may differ from one person to another.

Use FM interstation noise to check how your deck performs with the old and with the upgraded tapes. If the upgraded tapes reproduce this noise about as faithfully as before (or possibly better), do nothing. If there is a noticeable change in pitch, a bias touch-up seems in order.

Multiplex Filter On or Off?

Q. An article that I recently read stated that the multiplex filter in a tape deck should be switched on at all times. But the instruction manual of my tape deck says that the multiplex filter should be used when recording a Dolby FM broadcast to remove the subcarrier signal from a regular FM broadcast. I have a large collection of records on cassettes which have been recorded without the multiplex filter. Am I missing something?—Paul T. Spyrison, Schaumburg, Ill.

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.

A deck's MPX filter should be on when taping off the air or from noisy sources, but off when the source is of high quality.

A. When it comes to taping off the air, I agree that it is safest to keep the multiplex filter of your cassette deck on at all times. The 19-kHz pilot tone and/or the generated 38-kHz subcarrier may interfere with proper operation of your deck's Dolby circuitry when recording with Dolby NR. Also, these tones may beat with the tape deck's bias frequency, causing audible noises. Most FM tuners incorporate multiplex filters which sharply cut off signals beyond about 17 kHz or so, but further attenuating these frequencies can't hurt. It might not be a bad idea to use the filter when taping AM broadcasts too, as anything above 15 kHz will only be noise.

When taping from high-quality LPs, CDs or cassettes, the filter should *not* be switched in, as it can attenuate high frequencies in the music. How audible this will be depends on the steepness of your filter, your own high-frequency hearing ability, and the amount of treble energy in the recording. When taping from noisy recordings, though, the MPX filter may help attenuate some of the noise.

Digital Component Availability

Q. Recently I have been exposed to literature extolling the virtues of digital recordings, specifically the digital audio processors and the digital audio cassette recorders which are presently available. Should I go digital?—Peter F. Tague, Brooklyn, N.Y.

A. There seems to be a misunderstanding. To my knowledge, as this is written there are no digital cassette machines yet available to consumers. The industry is presently working on standards for such a unit, with the expectation that such machines will be available some time in 1986. What is available now in the way of digital equipment for consumers is all based on videocassettes. Most of this takes the form of PCM processors to be used with VCRs, but there are also one or two recorders with built-in VCR transports, which tape in the same format as the PCM-processor/VCR combinations (but do not record video).

In the meantime, if you are looking for top quality, not much behind the capabilities of digital, you might investigate the Beta and VHS Hi-Fi videocassette recorders.

Now You Have a Choice

Four Ways to Get the Best Value in Stereo Imaging

Walsh® Value

If you compare speakers capable of equal sound quality with Ohm Walsh speakers, you'll find that you have to pay much more for sound as good, and that equal quality in stereo imaging is hard to get at any price. One Walsh owner concluded that his Walsh speakers are "head and shoulders above the other higher priced systems I compared them to" and *Audio* magazine judged them a "best buy."

Walsh Stereo Imaging

Walsh speakers create an exceptionally effective stereo image because of the unique patented design. It's an inverted cone with sound radiating from it in a single coherent wavefront designed to cover the entire listening area. This means there are no hot spots from the narrow dispersion common to most speakers, and you get the full sound of both speakers as you move around the room. *The New York Times* described the result as "A spacious acoustic ambiance linked with precise stereo imaging creating a 'reach-out-and-touch-it' realism that this listener has experienced rarely and only with the very best speakers. What's more, the effect is maintained over a broad listening area, so you are not confined to a particular listening position for best results." And since the wavefront is coherent it is devoid of phase distortion so the sound is crisp and clean. This along with an extremely even frequency response is responsible for the sound that Norman Eisenburg said makes "you sense you are listening to a performance rather than to one being reproduced by machinery; this impression which one may get from a few other top quality speakers does not lessen with prolonged listening. The full musical spectrum is easily spanned with authority and fine tonal balance. Detailing of inner instrumental choirs is excellent and so too are the fuller splashes of massed ensemble effects. Titanic dynamic impact comes across when required, yet there is no tonal dropout of the subtler nuances of chamber music."

Walsh Choice

You can choose to put your Ohm Walsh speakers in places where other speakers would sound dreadful because our dispersion is designed to be less sensitive to placement than either omnidirectional or traditional speakers. And our speakers with frequency and perspective controls let you balance the sound to your room's acoustics and choose your position in the audience from the front row to the back of the house. With most of our speakers you have a choice of finishes so you can match their look to your home. And now you have the choices of price, performance and features from a whole family of speakers devoted to value. Get information on Ohm Walsh speakers and details on buying directly from Ohm by calling today, toll free.

(800) 221-6984)

Ohm Acoustics Corp.
241 Taaffe Place
Brooklyn, NY 11205

We make loudspeakers correctly.

Specifications	Ohm Walsh 1	Ohm Walsh 2	Ohm Walsh 3	Ohm Walsh 4
Frequency Response	48Hz to 18kHz ± 4dB	45Hz to 16kHz ± 4dB	39Hz to 16Hz ± 4dB	32Hz to 17kHz ± 4dB
Weight	24 lbs.	29 lbs.	48 lbs.	63 lbs.
Sensitivity	87dB at 1 meter with a 2.83 volt input	87dB at 1 meter with a 2.83 volt input and all controls at maximum	87dB at 1 meter with a 2.83 volt input and all controls at maximum	87dB at 1 meter with a 2.83 volt input and all controls at maximum
Finish	Genuine walnut veneer	Genuine wood veneer, walnut and oak standard. Scandinavian rosewood and black or white lacquer on oak finishes available on special order.	Genuine wood veneer, walnut and oak standard. Scandinavian rosewood and black or white lacquer on oak finishes available on special order.	Genuine wood veneer, walnut and oak standard. Scandinavian rosewood and black or white lacquer on oak finishes available on special order.
Inputs	Press connectors accepting "banana plugs" or bare wire up to 12 gauge	Press connectors accepting "banana plugs" or bare wire up to 12 gauge	Press connectors accepting "banana plugs" or bare wire up to 12 gauge	Press connectors accepting "banana plugs" or bare wire up to 12 gauge
Controls	None	2 — low and high frequency each with 3 positions	3 — low, high and perspective each with 3 positions	3 — low, high and perspective each with 3 positions
Power requirement on Music	20 watts minimum 90 watts maximum	30 watts minimum 120 watts maximum	35 watts minimum 200 watts maximum	50 watts minimum 500 watts maximum
Impedance	8 ohms	4 ohms	8 ohms	8 ohms
Price per Pair	Under $595, depending on finish	Under $995, depending on finish	Under $1395, depending on finish	Under $1895, depending on finish

Enter No. 26 on Reader Service Card

Chrysler creates LeBaron GTS. The American sedan

The design is bold. Sleek, daring aerodynamic lines.

The performance: heart-pounding.

This is GTS. A new kind of LeBaron; a performance LeBaron engineered to outperform Europe's best sedans.*

And it does. When you equip it with turbo, special sport handling suspension and 15" wheels, LeBaron GTS is faster from 0 to 50 than Audi 5000S Turbo, BMW 528e, Mercedes 190E.

And front-wheel drive GTS outperforms the European trio through the twists and turns of a slalom course.

In braking, GTS with dual proportional braking system outperforms them once again.

And yet this disciplined road car is a comfortable sedan

that outperforms BMW 528e and Mercedes 190E.*

for five. LeBaron GTS Premium's cabin is marked by advanced electronics and functional luxury. And supple leathers can be fitted to its ergonomically designed seats.

Even its Protection Plan is outstanding: 5 years or 50,000 miles** on turbo, drivetrain and outer body rust through.

LeBaron GTS would be impressive at any price. At $10,000† less than the least expensive of the three European sedans, it is stunning.

*Results of USAC tests vs. standard equipped 1984 competitive test models. **Whichever comes first. Limited warranties. Deductible applies. Excludes fleet/leases. Dealer has details. †Based on sticker price comparisons of test cars. Standard equipment levels may vary. ††Lowest percent of NHTSA safety recalls for '82 and '83 sales model years for vehicles designed and built in North America. Best backed based on warranty comparison of competitive vehicles.

We engineered it to outperform Europe's best. It does.*

LE BARON GTS

Chrysler
Division of Chrysler Corporation

Chrysler. Best built, best backed American cars.††

You'll know why we're first, the second you hear us.

First it was DC. Then DD/DC and Super Feedforward. Now Sansui astounds the audiophile with the greatest improvement in an amp. X-Balanced circuitry. It cancels out external distortion by eliminating the transformer to chassis ground; and decisively removes IHM.

You'll find X-Balanced circuitry in a wide range of superior Sansui products, like our AU-G99X amp, shown with TU-D99X quartz-PLL synthesizer tuner which incorporates our new Super Linear Digital Decoder for improved rejection of spurious signals and interference. Another version of this tuner even has AM stereo capability.

There's more worth hearing about these great Sansui components. Write: Consumer Service Dept., Sansui Electronics Corp., Lyndhurst, NJ 07071; Carson, CA 90746; Sansui Electric Co., Ltd., Tokyo, Japan.

Sansui

Putting More Pleasure in Sound.

Enter No. 37 on Reader Service Card

AUDIOCLINIC

JOSEPH GIOVANELLI

Bias Is as Bias Does

Q. What is bias?—Tom Wick, Huntington Station, N.Y.

A. Bias usually refers to a voltage or current used to shift or control a device's mode of operation. For example, in tape recording, a high-frequency bias current applied to the tape ensures that audio signals will be recorded in as linear a manner as possible, with minimum distortion. In amplifiers, it controls the operating portion of the input/output curve, again preventing severe distortion. The exact meaning of the word, and how the bias is applied, varies with the type of circuit under consideration; the two definitions given here are, however, the ones most commonly quoted in audio.

Loudspeakers and Video Monitors

Q. I plan to purchase a video monitor and incorporate it into my audio system. I have seen references to "shielded" speakers for use with video equipment. From this, I assume there must be an interference problem. If I use my loudspeakers near a video monitor, what problems will I encounter, if any? If nearness is a problem, is the need for distance between speaker and monitor a linear or exponential function? Is there an economically and sonically feasible way to shield my speaker system?—Rowland M. Hill, Alexandria, Va.

A. Strong magnetic fields can deflect the electron beams in TV picture tubes. This normally causes only slight distortion of the picture details, but on color sets, where a slight mis-deflection moves the beam to a different-colored spot, the result can be disastrous color-smearing.

How far the speaker and the picture tube (CRT) must be separated to avoid this depends mainly on the strength of the speaker's radiated magnetic field. A distance of about 2 feet from the neck of the picture tube is usually about enough; if not, field intensity falls off as the square of the distance (doubling the speaker's distance from the tube neck reduces its field at the neck to one-fourth its original value).

I do not believe it's possible (or, at least, practical) to shield your speakers yourself. On the other hand, try it and see—it may not even be necessary in your case. The only thing to fear is magnetizing your picture tube beyond the ability of your set's built-in degaussing coils to neutralize it when you next turn the set on; if that happens, you can buy more powerful degaussing coils at good TV parts stores, or even build your own.

Audible Sidebands

Q. Let us suppose that we have an AM broadcast system with perfect transmitters, a perfect receiver having square-topped i.f. characteristics but no automatic volume control (AVC), and perfect reception, too. Our perfect receiver has a 9-kHz passband or i.f. selectivity. We tune to an unmodulated carrier at exactly 1,500 kHz, and there is another station at 1,490 kHz, sending a pure, 7-kHz sine-wave signal. The upper sideband of that second station is, therefore, 1,497 kHz, well within our receiver's i.f. passband.

Under these conditions, what will I hear? Will I hear the 7-kHz tone? If I do, and the 1,500-kHz station goes off the air completely, will I stop hearing the 7 kHz transmitted by the station at 1,490?—Russel E. Worthy, North Adams, Mass.

A. You will hear the 7-kHz signal. You will also hear a 3-kHz difference tone. Just how loudly you hear the 3 kHz will depend upon the relative strengths of the two carriers and, of course, the presence of modulation, which would tend to override this beat tone.

If 1,500 goes off the air, the 3-kHz signal will disappear, but the 7-kHz signal will still be heard because it falls within your i.f. passband.

"Rabbit Ear" Antennas

Q. I was originally using the folded dipole which was supplied with my receiver. Not happy with the performance of this device, I next tried a CB antenna. It didn't work well, either. I am now using a pair of "rabbit ears" with 300-ohm connections to the receiver. This works rather well. Why don't more people use these antennas? Are there any drawbacks that I am not seeing or, rather, hearing?—Mark Lemelin, Kensington, Conn.

A. Using a CB antenna did not work well because it was designed for much lower frequencies. A properly designed antenna must resonate within the band it is designed to cover. The CB antenna works for its application because it is tuned to 27 MHz (approximately). The folded dipole works because it is cut to a length which falls within the band of frequencies from 88 to 108 MHz. This is also true of the "rabbit-ear" antenna you now use. Here, however, the antenna can be more critically adjusted for proper length, taking into account changes in resonant frequency resulting from proximity to surrounding objects.

It well may be that many people use rabbit-ear antennas, but there are no statistics to tell us this. These antennas are more expensive to supply than the 300-ohm, folded dipoles supplied with tuners and receivers. The folded dipole can be tucked out of sight, whereas the rabbit-ear antenna cannot be. This is certainly a drawback to its being supplied with FM equipment.

Binaural Recording

Q. What is binaural recording? What are the relative weaknesses and strengths of this recording technique compared to stereo recording?—Eugen Spralja, San Pedro, Cal.

A. Binaural recording employs two microphones *only*. These microphones are placed close together, separated by the distance between a pair of human ears, perhaps even set into a dummy head—ears and all.

Though such recordings can be enjoyed when heard through loudspeakers, they are meant specifically for listening through headphones. With headphones, each ear hears only the sounds picked up by the microphone in the corresponding channel. The mike is placed where those ears would be if the listener took the place of the recording dummy. The result can be exceptionally realistic.

In normal listening, however, the sound produced by one loudspeaker blends to some extent with that produced by the other. Normal stereo recordings, which are meant for speaker listening, have extra separation to partially compensate for this—which is

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.

Binaural recording is simple, but it makes poor internal balance among performers glaringly evident.

why they sound exaggerated when heard through headphones.

The advantages of binaural recording are that the setup of equipment is simple and the recording is made in the same way that a listener would perceive the sound from the location of the microphones. However, there are disadvantages. If the performers do not maintain good internal balance among themselves, the playback of the recording will reflect this. It is interesting to note that, when the listener is present during the recording, he is not seriously troubled nor aware of the poor balance. He will, however, often be annoyed by it when he hears the sound from loudspeakers or, to a lesser extent, through headphones. In addition, the need for headphones can restrict the listener's movements and activities while listening. Binaural recordings also lack the extra clarity that multi-miked recording techniques can produce. Multi-miking's effects are rather clinical, but some people do prefer them.

Biamp Trouble-Shooting

Q. I have a serious problem with my biamplified sound system. Its high end became very faint, starting about a week ago, and I have gone to great lengths to find the answer to this sudden problem. I checked the fuses for all speakers, the connections from my preamplifier to the crossover, the connections from the crossover network to the amplifiers, and the connections from my amplifiers to my speakers. Everything is connected correctly. Please advise me of something else to try.—Ron Truesdale, Greensboro, N.C.

A. First, check the settings of any "level set" controls on either the power amplifier or the crossover network. If their settings have been changed, this could account for all of your difficulties. The balance of more than one sound system has been disturbed by some unsuspected, unsupervised dusting of the equipment cabinet.

Next, disconnect the tweeters from their power amplifier and connect a pair of tweeters known to be working. Operate the system in the normal way and see if any sound is heard from these speakers. If you hear highs in abundance (assuming your experimental speakers are high enough in efficiency), you will know that something is wrong with the tweeters. Perhaps a transient blew them out. If no sound is heard or if the sound is still faint, you should go on to the next experiment.

Disconnect the power amplifier from the high-frequency output of the crossover network and substitute another amplifier, known to be operating correctly. (The amplifier could be the one normally used to drive the woofers. The woofers do not need to operate during these tests.) If sound is now heard from the tweeters, you will then know that there is a problem with your original power amplifier.

If, after all of this, you still do not have enough signal in the tweeters, it is possible that the crossover network is defective. You would then need to have it serviced.

Differences in Speaker Loudness

Q. Why would the loudness be noticeably different between two pairs of speakers? I use two pairs simultaneously and find that Pair A is much louder than Pair B.—Mike Kendall, Gilman, Ill.

A. The reason that one set of loudspeakers produces more volume than another has to do with their relative efficiencies.

The amount of acoustical power output relative to the amount of electrical power input is the measure of a speaker's efficiency. However, even when two pairs of speakers have the same efficiency, one may sound louder than the other. This can be caused by a lack of smoothness, especially in the lower treble; our ears are easily fooled into believing that such peaky sound is louder than smooth sound of equal acoustical power.

Speaker sensitivity ratings don't tell the whole story, either. They measure output on-axis, not total radiated power. A speaker that can produce a given sound output off-axis as well as on-axis will sound louder, in most listening situations, than one producing that output only on-axis.

Eliminating Stereo from Records

Q. The method of connecting speakers between the two "hot" leads of a power amplifier to eliminate the monophonic signal from a stereophonic record has been widely reported. This procedure causes the ambience of a record to be heard.

I'd like to know how to achieve the opposite effect: The elimination of all stereo signals, leaving only the pure mono content. My reason for this is to "clean up" the sound on my old, monophonic 45-rpm records. When listening to these records on my stereo system (in the stereo mode), it appears that all the wear and scratchiness is in one channel or the other but is never in the mono image. If such a connection is possible, it should cancel out all the "wear noise" and leave only a pure mono signal, making the records sound like new.—Thomas E. Dimock, Ventura, Cal.

A. Assuming your preamp does not have a "Mono," "L + R" or "A + B" switch position (which would do exactly what you seek), you can obtain a fully monophonic output from a phono cartridge by strapping its two "hot" terminals together, and also by strapping the two ground terminals together. The cartridge can then be connected to the phono input. There may be some mismatching of load requirements with this arrangement, but the sonic effects won't be significant.

Strain-gauge cartridges cannot be strapped in this manner. If you have such a cartridge, the outputs from its preamplifier must be fed into a mixer and the levels of each mixer input adjusted for proper monophonic balance. Or you could sum the preamp's outputs, using a Y-connector, and feed that sum through another Y-connector into your deck's stereo inputs.

Although it is true that vertical information will be reduced or eliminated by the foregoing arrangements, noisy discs are still likely to sound noisy. You will discover that there is enough horizontal component in the noise that your old discs will never sound brand new; all you can hope for is some improvement.

Sometimes a slightly better result can be obtained by leaving the cartridge wired for stereo and using a mixer as described for the strain-gauge cartridge. Signal can be extracted from the jacks normally assigned to feeding signal into a tape recorder. The mixer can be adjusted for best noise cancellation.

To Find Out Where Audio Is Going, You Should Know Where We've Been.

Over the last ten years, Onkyo has been responsible for many audio innovations that have since become industry standards.

Tuner technology, for example. Onkyo pioneered affordable Quartz digitally synthesized tuning in 1975, and followed it two years later with Quartz & Servo locked tuning. Last year, we developed our Automatic Precision Reception System, an on board microprocessor that automatically controls all critical tuner functions, and introcuced the first receiver, our Integra TX-85, with dbx* and Dynamic Bass Expander.

In cassette decks, Onkyo technology has always been at the forefront. We introduced the first cassette decks with bias adjustments (Accubias) to insure perfect recording with any tape formulation. Subsequently, we were first in the industry with high speed dubbing decks, real time counters, cassette receivers, and a deck with all noise reduction systems—Dolby B-C HX Pro*, dbx*.

Amplification has, in recent years, become another Onkyo hallmark. Our Super Servo, Linear Switching and Delta Power Supply circuitries created the first amplifiers with wide dynamic range and low impedance drive capability. Soon to be introduced in 1985 is our new *Real Phase Amplifier Technology, which utilizes main and secondary power transformers to facilitate distortion-free handling of any speaker impedance load, even down to 2 ohms.*

Onkyo is proud to be celebrating ten years of sound achievements. Experience superb Onkyo performance for yourself by visiting your Onkyo dealer today.

Artistry in Sound

ONKYO®

200 Williams Drive, Ramsey, NJ 07446 (201) 825-7950

*Dolby is a registered trademark of Dolby Laboratories, Inc.
†dbx is a registered trademark of dbx Inc.

Enter No. 27 on Reader Service Card

EDWARD TATNALL CANBY

NON-TRIVIAL PURSUITS

I do what I can to keep up with fashion. This month it's going to be Trivia ETC. Not really unimportant, but since everyone else is talking trivia, why not me?

Such a lot of fads! You get that *déjà vu* feeling. There's chocolate. I've been chomping it since I went to school in Switzerland at age 15, but now it is suddenly "in." You can't pick up a magazine or an ad without finding it full of chocolate. Know what a chocolate chip is? A computer program, just on the market. Detachable ROM. Then there's alphabet soup, so named in 1928 by one Al Smith. Today we're awash in it. If the venerable Nippon Electric Company becomes the snazzy NEC, and Japanese Victor Company JVC, then any day now we'll get GAPTCo. That's the Great Atlantic & Pacific Tea Company. As for audio, you'll have to understand that whereas an audio cassette is technically RAM, the CD is to be understood as modular ROM. More on that in a moment.

Trivium No. 1: Can you name the hierarchy of the dry cell? We use millions in present-day audio. Answer: A is for the A battery, once called a bell battery (used to ring front doorbells, also used for electric trains and the low voltage needed in early radios). It's tall and round, and I haven't seen one for years. B was the B battery, massive and weighty, for high "B" voltage (relatively), or power supply. You always had two or three around and you kept shifting them in and out, to see which would get the strongest signal. Bypassing the 6-V lantern battery, still in use on railroads and for camping trips, we move on to consumer flashlights and, hence, the next letters, the C and the larger D cell. Here things get confusing. Since B was larger than A, and D larger than C, what would they call the little "penlight" cell, now used to power a million audio items and plenty else? Well, they settled on AA, a weasel way out. Worse, the later subminiature cell turned up as an unimaginative AAA. Some day we should try again.

Not earthshaking but of some significance is Trivium No. 2: I finally got a new car, after 12 years and 134,000 miles of unalloyed Superbug. Japanese, of course, like my audio, so now all is harmony. The Bug went lame rather suddenly; its replacement, on very short notice, came with a passel of extras which were not extras at all because they were already there. One was an AM/FM four-speaker stereo cassette player, if you follow my jargon. I said I didn't want it. The people at the dealership said we can't take it out, it's built in. So I got $350 "credit" and they pretended it wasn't there.

The player was a piece of junk. Within a week, the all-mechanical tuning quit. The red dial marker (yes—a dial) just leaned sidewise and wouldn't move. I said, look, that's simple; I've seen it a thousand times. The tuning cord slips. I'll fix the thing myself. *Oh, no! You can't do that!,* they said. It would void the guarantee. We have to send it back to the factory. I said, but you've already given me credit and this thing *doesn't exist*. Remember? It's *not there*. They looked bemused. This was a new and unforeseen situation. They would have to consult Higher Management. I said to heck with it and drove home. End of trivium.

(Sorry, folks, but I do not use the audio in my car. It's strictly personal, you understand, and I know how you-all out there love your car stereos. Don't let me bother you a bit. But when I am in a car it is to drive, period. As I have said before, I am an ear man, but I do not even hear music when I drive. Instead, I strain to hear the actual sounds of traffic and to watch the real sights, like red lights, lane-hopping and people ignoring stop signs. Crazy. But I haven't scratched a moving fender in 50 years and maybe three-quarters of a million miles.)

Trivium No. 3, not at all trivial: I am, of course, pleased that numerous future items over which I have drooled in anticipation now suddenly exist. Non-CRT screens are everywhere (as of my "phase three"), though not yet in commercial TV. Home movies via video—when Kodak gets into it, things are really moving. But one thing that few electronic prophets can really forecast is the curious shift of form and function that can occur en route, as a product is developed for the consumer market.

Who would have guessed, for instance, that the CD, the very essence of a dedicated audio medium and developed straight out of the move to digital audio that has overwhelmed us these last years, would jump the gun

Illustration: Michael Donato

THE EXPERTS SAID THEY HEARD EXCELLENT FREQUENCY RESPONSE, A HIGHER MOL, AND GREATER DYNAMIC RANGE.

BUT NOT IN THOSE WORDS.

Wicked lows. Manic highs. Nasty passages. It all translates the same.

Music sounds better when it's recorded on Maxell XL-S cassettes.

That's because we've improved our crystallization process. So we can now produce magnetic particles that are both smaller in size and more uniform in shape. Which allows us to pack more of these particles on the tape's surface, in turn, making it possible to record more information within a given area of tape.

AC bias noise is reduced by 1dB. And maximum output levels are increased by 1.5dB on XLI-S and 2dB on XLII-S.

As a result, XL-S delivers a significantly expanded dynamic range. A noticeably improved signal to noise ratio. And a fuller impact of dynamic transients.

So if you want to hear your music the way it was meant to be heard, put it on Maxell XL-S.

Because recording tapes just don't get any better.

Or any badder.

IT'S WORTH IT.

Enter No. 24 on Reader Service Card

Few electronic prophets can really forecast the curious shift of form and function that can occur as a product is developed for consumers.

and hop over into the PC? (Here comes the alphabet soup again.) True, the CD has a close first cousin, the LaserDisc, using basically the same system for video. But that one is still in the family, in the entertainment realm, and, like the CD, it's dependent on D/A conversion to get the entertainment back into intelligible form for those of us who listen and look.

Denon, that paragon of recording companies which was the first to put out classical records that were digitally produced, today has some of the finest CDs on the market and a large audio pressing plant to produce them. It is Denon that has taken the CD into PC applications.

Denon's new Compact Disc, technically compatible in all sorts of ways with the audio CD, can be pressed in the same audio plant, perhaps even played (with a couple of switches) on the same players, but instead of audio it stores computer stuff. It is an adjunct to a computer, an attachment or built-in, and it deals entirely with bits and bytes and files and non-files, the sort of material that comes now on floppy disks and the like. Imagine it: On one CD you buy Beethoven and on another maybe WordStar or Lotus 1-2-3.

This goes a lot further than the "TV disc." This one is all computer. The only "analog" it deals with is the display in letters, numbers, or graphics that you see via the screen or the printer. Yes, the audio cassette has also gone this route, but the Denon CD is altogether in another league, enormously higher-tech and right at the forefront of computer development, whereas the tape cassette is at best a low-cost (and relatively clumsy and slow) storage medium useful only in the simpler computer areas.

You will note that the Denon computer CD is—or will be—a ROM device, what I tend to call a modular ROM, part of the permanent and nonerasable computer memory. It could be a direct competitor to the new "chips" or cartridges of ROM (the name doesn't seem to have stabilized yet) which plug into the computer and become a part of it but which can be replaced by a different hunk of ROM, a different program. And here we get into audio analogies galore. The floppy disk and the hard disk are RAMs. In more familiar words, they are erasable. You store material on them, and you can erase that material and put on something else. That, of course, corresponds to tape in audio, and to the cassette in its "blank" selling form. The Denon computer CD, on the other hand, cannot be erased, and is thus a *publication* when pressed in quantity—exactly like the audio CD or, of course, every earlier form of disc record.

Thus—if I may be permitted a bit more non-audio—this astonishing new Compact Disc, like its relative, the computer ROM chip, will not replace the present erasable disks and other such memories. Instead, it will free a lot of room on them for more working capacity. As things are now, you must transfer temporary working instructions to your floppy (or other RAM) before you can even begin, and this can use up plenty of capacity. It also takes up time.

I would not have given so much space to Denon here if it were not for one absolutely startling aspect—the new CD's capacity. Can you believe that one little computer-type CD can store *from 500 to 1,000 times* as much information as a single, somewhat larger, floppy disk? One of these CDs can store information equivalent to literally hundreds of thousands of pages of words, a small library.

Of course, you are not surprised if you understand laser operation in the audio field. It offers enormously greater density than anything magnetic, as is quite obvious in our present audio CDs, which have more storage capacity than we know what to do with. I can only suggest that a computer CD with this capacity is bound to have a reverse impact on our audio world. And the simplest I can think of will likely be the joint Compact Disc player that would take both types of CD using the same laser mechanism—the audio playing into your hi-fi system, the computer disc feeding your PC. How's that for getting cozy? Just another step in our triple marriage of audio, video, and the computer.

What would you hear if you were to "play" a computer CD through your audio? Howls, squeals, bleeps and roars? You'll never know. Because, of course, the player will sense automatically which type of signal is at hand and switch things in the right direction. Why not?

I note that Denon, properly cautious, speaks entirely in the conditional in its press info, using a polite "would" instead of a brazen "will" when describing its new CD. The facts are mighty interesting, just the same.

Notice also that the Nakamichi optical recording/reproduction system I mentioned last month relates to Denon in an outside way. It is a purely professional tool that allows both playback and recording of CD-type audio information (and maybe computer-type info too?); it can do the standard CD things but also offers variables of many sorts—including speeds, sampling rates, and so on—for professional development use. It's a superb tool, I'd say, if you want to tinker with the future in this area.

Finally, three items of trivia from Crown—not at all trivial. That company has mostly taken over an interesting type of mike, one known as the PZM, discussed with enthusiasm in this column a couple of years ago, and is going forward with new applications and models in both directions. The first consumer model (Aha! I knew Crown would do it sooner or later) is highly consumer-oriented, by which I mean it has been given a loud sales handle and bright color. It's called the Sound Grabber. Grab it and enjoy; it should be good. On the other hand, the 12 SP isn't even called PZM, but it has the telltale look and hemisphere pickup pattern. Phantom powered, low impedance and so on, at $249. Very pro.

Crown is also developing a new and interesting combination of principles, a PZM-type mike with a miniature supercardioid mike cartridge for a curious "pointed hemisphere" reach forward, probably unlike any mike pattern now in use. It is embodied in the new PCC 160, just now available at $249. Crown lists all sorts of novel uses, but I would propose one they didn't think of, the now-developing "home movie" sound on those new video portables. That sound is unexplored and, indeed, is played down in the ads as though it didn't matter. It does! And it needs a curious sort of reach if the amateur picture is to have a matching and useful audio. This Crown mike could do it, I suspect.

CAN YOU SEE THE MUSIC?

B&W's newest star is in the spotlight.
To celebrate the marriage of Audio and Video, B&W of England commissioned its world renowned research team to design a loudspeaker dedicated to the audio/video environment. A new star was born!

Until recently, TV was meant to capture the eye rather than the ear, a one-experience medium. But now, with the availability of Beta and VHS Hi Fi and the advent of Stereo TV, it has become a two-experience medium. Yes, you can expect theatre quality sound in your own living room. B&W video acoustic monitors reproduce the whole eight octaves of sound, an astounding improvement over the four to five octaves reproduced by ordinary TV speakers.

The television picture tube and associated components are seriously affected by stray magnetic fields. The magnets employed in TV loudspeakers are shielded to prevent magnetic interference but if large magnets required to produce true high fidelity are used, then shielding is only partially effective.

B&W goes one step beyond. B&W has totally redesigned the magnet circuits and motor system by producing nickel-cobalt centre pole magnets. B&W has produced ZMF speakers, giving virtually a Zero Magnetic Field. This revolutionary new approach actually enhances the performance of the loudspeaker system beyond anything achievable with simple screening; B&W ZMF speakers can be placed immediately adjacent to the television monitor without creating any adverse effect.

Behind the successful development of these video acoustic monitors lies B&W's world leadership in loudspeaker technology and design. B&W's Model 801 has been selected by famous recording companies, orchestras and conductors worldwide as their classical music monitor. For both the professional recording artists and the critical music lover, B&W has dedicated itself to the pursuit of perfection in the re-creation of live sound.

More than a contribution to viewing pleasure, B&W ZMF loudspeakers provide all that has been missing from the complete audio video experience. LISTEN AND YOU'LL SEE!

B&W

See dealer listing on page 12E.

Enter No. 71 on Reader Service Card

VIDEO ACOUSTIC MONITORS

SUPERB SOUND WITHOUT PICTURE DISTORTION OR MOVEMENT

Anglo American Audio P.O. Box 653, Buffalo, NY 14240 (416) 237-0595

COLORTRAK VIDEO MONITORS

IT'S NOT JUST A VIDEO MONITOR. IT'S A HIGH-PERFORMANCE TELEVISION RECEIVER.

Video monitors that are just video monitors are less than complete. Introducing the first and only video monitor that is also a Full Spectrum television receiver. Due to remarkable developments in audio and video technology, our high performance monitors for 1985 are the first consumer monitor/receivers to process 100% of the audio/video signal. All the color, all the sound, all the time. Bringing all the magic of life right into your living room. What's more, RCA's Video Monitors come complete with built-in stereo broadcast receiver and speakers for an unsurpassed video experience. (Stereo sound dependent on TV broadcast signal.) Some RCA Monitors, like the one above, actually fit 25 inches of picture (measured diagonally) in about the space of a 19-inch set. And, last but not least, all of RCA's 16 ColorTrak 2000's for 1985 are, in fact, Video Monitors.

A K 2 O O O

JACKS IN THE BACK DELIVER A BETTER PERFORMANCE UP FRONT QUICKLY, EASILY, EFFICIENTLY.

The story behind RCA's Video Monitor helps you get the most from today's video products. As many as 29 rear input-output jacks allow you to bypass the set's antenna circuitry, and plug RCA and other video and audio components directly into the chassis. The result is a cleaner, sharper picture from video components. Sound, too, is dramatically improved because audio jacks* permit direct hookup to stereo systems. Giving you cleaner, easier, more efficient connections than complicated wire hookups. And, with RCA's exclusive Digital Command Center, you can run the whole show from across the room, switching from broadcast to VCR viewing. See the full array of RCA's multi-featured monitors at your RCA dealer. Or, for more information and a free copy of our "Living with Video" book (a $2.50 retail value), write: RCA Consumer Electronics, Dept. 32-312BB, P.O. Box 7036, Indianapolis IN 46207-7035.

RCA

TECHNOLOGY THAT EXCITES THE SENSES.

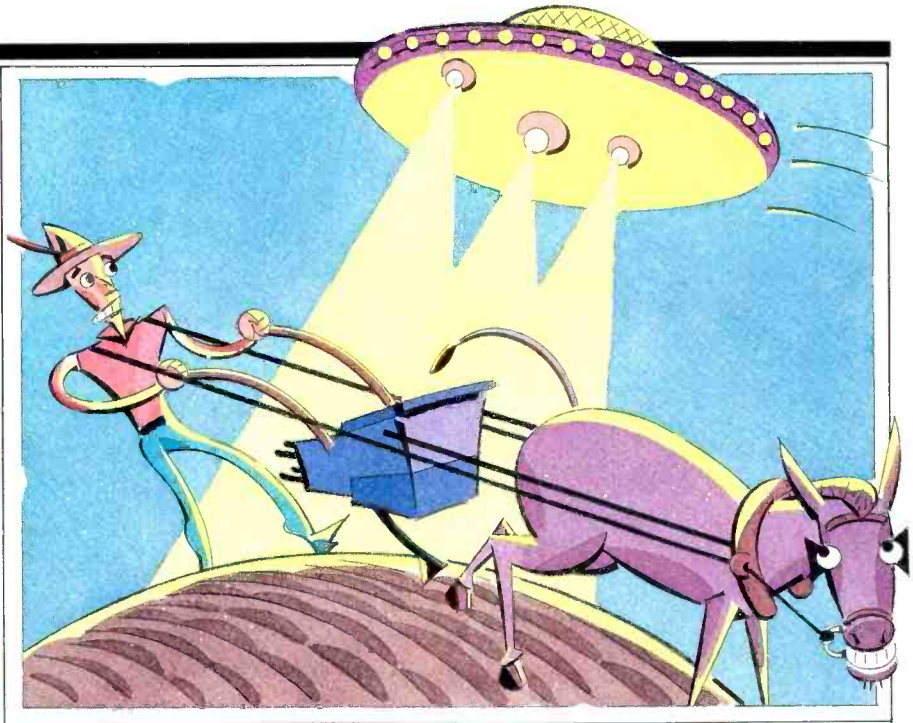
*Selected models.

O N I T O R

Enter No. 34 on Reader Service Card

KEN POHLMANN

KEEPING TRACK



Phono cartridges probably didn't realize how easy they had it, back when tracking was simply a question of staying in the groove. It was as natural as a barge floating down the Mississippi—and about as subtle as a plowshare cutting through black Illinois topsoil. It was a primitive system, and in our Age of Information when spacewalks and supercomputers hardly excite interest anymore, a Stone Age technique of dragging a rock through a ditch could simply no longer be tolerated. Clearly it was time for a new medium and a new reader.

The Compact Disc has responded to the challenge with components from today's high technology. Modulated laser light carries the data, and nothing (except light) touches the medium surface. This poses an interesting engineering challenge: How do we track a spiral pit sequence if there is no groove to guide the pickup? The answer, of course, is the auto-tracking system found in all CD players.

The spiral pit track on a Compact Disc, running from a center circle nearly to the outer edge, makes 60 revolutions within the width of an LP microgroove. An off-center disc might exhibit track eccentricity of as much as 300 μm; in addition, vibration can challenge the pickup's ability to track within a ±0.1-μm tolerance. Hence, it is appropriate that a laser-beam system is used for tracking; it would probably be impossible for any mechanical system to track as well.

Many CD players use a "three spot" method for tracking, whereby the original beam is split by a diffraction grating to create a series of secondary beams of diminishing intensity. The two first-order beams are conveyed to the disc surface along with the central beam. The central beam spot covers the pit track while the two tracking beams are aligned above and below and to either side of the center beam. When the beam is tracking the record properly, part of each tracking beam is focused on the pit circumference; the other part covers the mirrored area between pit tracks. The three beams are reflected back through the quarter-wave plate and polarizing beam splitter; the main beam strikes the four-quadrant photodiode, and the two tracking beams strike two separate photodiodes mounted to either side of the main photodiode.

As the three spots drift to either side of the pit track, the amount of light reflected from the tracking beams varies. There is less average light intensity reflected by the beam which encounters more pit area and greater reflected light intensity from the beam which encounters less (Fig. 1). The relative output voltages from the two tracking photodiodes thus form an error-correction signal.

The electronic system used to convert the photodiode outputs to a meaningful correction signal utilizes current-to-voltage converters, comparators, amplifiers, delay lines, level shifters, and a driver stage. As shown in Fig. 2, the outputs of both tracking photodiodes are applied to operational amplifiers A1 and A2 to convert the current outputs to voltages. The gain of the left error-tracking signal is adjusted by a trimmer in the feedback loop. The right error-tracking signal is not adjustable; however, its output voltage is delayed by 30 μS. This is necessary because the left tracking beam reads a given pit 30 μS after the right beam does, due to the displacement of the two beams on the rotating disc. Delaying the right tracking signal just this amount allows both signals to be compared on the basis of the same pit—as if they were reading the pit simultaneously.

The difference between the tracking signals is determined at the comparator. If tracking is precisely aligned, the difference here is 0 V. If the beams drift, a difference signal is generated, varying positively for a left drift and negatively for a right drift, thus creating an S-curve tracking-error signal. That signal is buffered and amplified by amplifier A3 before being sent to the gain-control and servo-drive circuits.

The gain-control circuits maintain relatively constant tracking-signal voltages, despite differences in disc reflectivity due to such causes as manufacturing differences and soiling of the disc or the player's optics. Keeping these voltages at the proper levels en-

Fig. 1—How the three beams "read" the signal pits while tracking and mistracking.

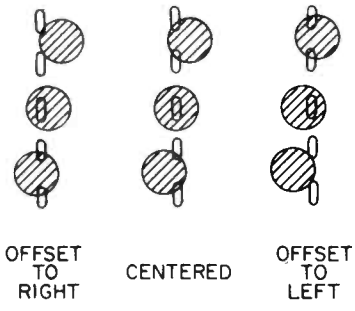


Illustration: Philip Anderson

SUPER DUPER FROM TDK.

Capture all the dynamics of digital performance on your cassette deck. TDK HX-S blasts through the sonic barriers with high powered digital sound!

Its exclusive metal particle formulation reproduces a wider dynamic range and a higher frequency response to handle digitally-enhanced music sources on any cassette deck with a Type II (High-Bias) switch.

With four times the magnetic storage ability of any tape in its class, TDK HX-S virtually eliminates high frequency saturation, while delivering unsurpassed sensitivity throughout the audio spectrum. Additionally, HX-S excels in retention of high frequency MOL, which no other Type I formulation attains.

And to maintain its dynamite performance, TDK HX-S is housed in our specially engineered, trouble-free Laboratory Standard cassette mechanism for durability and reliability—backed by the TDK Lifetime Warranty.

So for optimum results with Type II (High-Bias) and digitally-sourced recordings on your cassette deck, get the only super-duper. TDK HX-S.

TDK®
THE MACHINE FOR YOUR MACHINE.

Enter No. 47 on Reader Service Card

Enter No. 20 on Reader Service Card

Movement of a stylus in the groove of an LP is much like a CD player's operation: In both, the signal "pulls" the pickup across the disc.

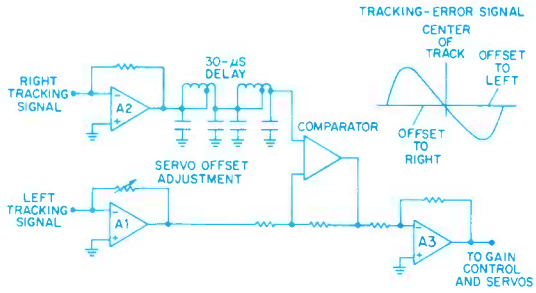


Fig. 2— Generation of the S-curve tracking signal.

sures proper data recovery and minimizes actuator noise during playback.

The gain of the level-control amplifier stage is varied according to the intensity of the laser beam sensed during the initial reading of the disc's "Table of Contents." A microprocessor varies the gain ±10 dB by switching resistors into the amplifier's circuits. The initial gain adjustment for each disc is maintained throughout its playing, but the system reverts to a nominal gain level during searches or jumps.

The error signal is gated by control from the microprocessor and other sources that verify proper tracking. One of these control signals comes from a damage-detection circuit, which alerts the tracking servo system to scratched or defective discs.

If the gating circuit passes it, the tracking circuit is then applied to a push-pull transistor circuit, which drives the actuator coil. The two-axis actuator assembly contains a permanent magnet and the focus/tracking coil. When the driving voltage is applied to the coil, the bobbin swings around a shaft to move the objective lens laterally, so the main laser spot is again centered and the tracking-error signal is again zeroed.

Aside from the tracking accuracy needed to keep the laser beams on track, a motor must properly move the pickup across the disc surface to track the entire pit sequence. Also, the pickup must be able to jump from one place on the disc to another, find the desired place on the spiral, and resume tracking. These functions are handled by separate circuits, primarily using previously generated control signals. A coreless-type slide motor is used to provide constant tracking of the pit circumference. The tracking-error signal used for auto-tracking is sent to other drive transistors by an amplifier for fine control of the slide motor.

It is important to note that the movement of a stylus in the groove of an LP is much like a CD player's operation: With the aid of the auto-tracking system, the signal path "pulls" the pickup across the disc. In the search mode, the microprocessor takes command to provide faster motion than is possible during normal tracking. Control pulses are directed to the drive transistors for accelerated movement in the forward or reverse direction.

For forward or reverse jumps to programmed locations on the disc, the tracking-error signal is disabled by a flip-flop, and signals from the microprocessor drive the slide motor. When the correct location is reached, the S curve generated by the tracking-error signal is referenced to a microprocessor-generated control signal, the flip-flop is switched, and the circuitry is informed that proper track alignment is occurring. Just prior to alignment, a brake pulse is generated to compensate for the pickup's inertia. The actuator comes to rest on the correct track, and normal auto-tracking is resumed.

A Compact Disc player uses a lot more technology than an analog record player to achieve tracking, but most would agree that the result is much more satisfactory. Compact Discs might cost a little more than phonograph records, but the longevity of CD recordings, thanks to the laser-tracking system, makes them a worthwhile investment. The optical pickup, auto-focus, and auto-tracking are certainly some of the niftiest engineering elements in the Compact Disc system. But there are still a number of tricks in the players, and in the discs themselves, to be explored in upcoming columns. A

CLASSICS ON CASSETTES

326983. Bach: Organ Masterpieces—*Toccata & Fugue in D Minor,* etc. A. Newman (Sine Qua Non)

317081. Bach: Goldberg Variations—Glenn Gould *(Digital*—CBS Masterworks)

319434. Bach: Sonatas for Viola De Gamba & Harpsichord—Yo-Yo Ma, cello; Ken. Cooper, harpsichord *(Digital*—CBS Masterworks)

328054. Bach's Tops—*Gavotte; Sleepers Awake;* more. Kapp, Philharmonia Virtuosi of New York (CBS)

329714. Bartok: Concerto for Orchestra; Dance Suite—Solti conducts Chicago Sym. *(Digital*—London)

273409. Beethoven: 3 Piano Sonatas—Moonlight, Appassionata, Pathetique. Horowitz, piano (Columbia)

252874. Beethoven: Symphony No. 9 (Chorale)—Ormandy and the Philadelphia Orch. (Columbia)

325654-395657. Beethoven Piano Concertos Nos. 1 & 5 (Emperor)—Brendel, piano (Counts as 2—Vox)

325274. Berg: Lulu Suite—also Schoenberg, Webern. Ormandy, Phila. Orch. (Masterwarks Portrait)

324780. Bolling: Suite For Cello and Jazz Piano—Yo-Yo Ma, Bolling (CBS)

263293. Bolling: Suite For Flute and Jazz Piano—Rampal, Bolling (Columbia)

330118. Brahms: String Quintets in F and G Major—Boston Sym. Chamber Players *(Digital*—Nonesuch)

328039. Brahms: Symphony No. 3; Haydn Variations—Mehta, New York Phil. (CBS Masterworks)

246843. Chopin: Mazurkas, Etudes, etc.—Vladimir Horowitz, piano (Columbia)

326439. Copland: Rodeo; Dance Symphony; El Salon Mexico; Fanfare for Common Man—Dorati, Detroit Sym. *(Digital*—London)

322826. Debussy: La Mer; Nocturnes—Michael Tilson Thomas, Philharmonia Orch *(Digital*—CBS Masterworks)

328401. Debussy: Sonata for Flute, Viola and Harp; Syrinx for Solo Flute—plus works by Ravel, Faure, etc. Orpheus Trio *(Digital*—Vanguard Audiophile)

321471. Gershwin: Piano Concerto in F; American in Paris; Rhapsody in Blue—Andre Previn and the London Symphony (Angel)

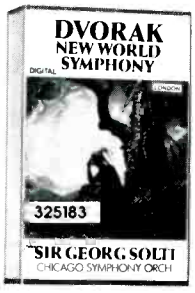
319004. Glass, Philip: The Photographer (CBS)

228684. Grieg: Peer Gynt Suites 1 and 2; Bizet: Carmen Suites—Leonard Bernstein and the New York Phil. (Columbia)

323543. Handel: Royal Fireworks Music; Oboe Concertos 1-3—Karl Munchinger, Stuttgart Chamber Orch. *(Digital*—London)

329615. Handel: Water Music: Malgorie, La Grande Ecurie & la Chambre duRoy *(Digital*—CBS Masterworks)

257956. Haydn: Symphonies No. 101 (Clock) and **No. 103** (Drum Roll)—Bernstein, New York Phil. (Columbia)



326561. Haydn: 3 Favorite Concertos—Cello in D (Yo-Yo Ma); Violin in C (Cho-Liang Lin); Trumpet in E Flat (Wynton Marsalis) (CBS Masterworks)

326272. Holst: The Planets—Bernstein, New York Phil. (CBS Great Performances)

330126. Kodaly: Hary Janos Suite; Alfven: Swedish Rhapsody—Comissiona, Baltimore Symphony *(Digital*—Vox Cum Laude)

321208. Liszt: Hungarian Rhapsodies 2,3,5; Mephisto Waltz—Willi Boskovksy, London Phil. (Angel)

314369. Mahler: Symphony No. 1 (Titan)—Maazel, Orch. Nat'l de France (CBS Masterworks)

305730. Mendelssohn: Symphony No. 4 (Italian); **Overtures**—Andre Previn, London Symphony (Angel)

294264. Mozart: Piano Concerto No. 21 (Elvira Madigan) and **No. 17**—Ashkenazy plays, conducts Philharmonia Or. (London)

325365. Mozart: Eine Kleine Nachtmusik; Symph. No. 40—Casals, Marlboro Festival Orch. (CBS Portrait)

326975. Mozart: Violin Concerto No. 4; Adagio; Rondos—Zukerman plays, conducts St. Paul Chamber Orch. (CBS Masterworks)

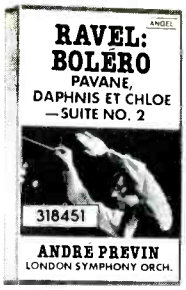
257956. Haydn: Symphonies No. 101 (Clock) and **No. 103** (Drum Roll)—Bernstein, New York Phil. (Columbia)

309492. Mussorgsky: Pictures At An Exhibition; Night On Bald Mountain—Bernstein, New York Phil. (CBS Great Performances)

310698. Offenbach: Gaite Parisienne; Saint-Saens: Danse Macabre; Dukas: Sorcerer's Apprentice—Maazel, Orch. National de France (Columbia)

316406. Pachelbel Canon & Other Baroque Favorites Boyd Neel, Toronto Chamber Orch. *(Digital*—MMG)

318691. Prokofiev: Love For Three Oranges Suite; Lt. Kije Suite—Thomas, L.A. Phil. (CBS Masterworks)



245043. Rachmaninoff: Piano Concertos Nos. 1 & 2—Ashkenazy; Previn, London Sym. (London)

324533. Respighi: Feste Romane; Pines & Fountains Of Rome—Dutoit, Orch. de Montreal *(Digital*—London)

318436. Rimsky-Korsakov: Scheherazade—Svetlanov, London Symphony (Angel)

325100. Saint-Saens: Carnival of the Animals—also works by Debussy, Satie. Philip Jones Brass Ensemble *(Digital*—London)

314260. Salieri: Sinfonia Veneziana; more—Pesko, cond. (CBS Masterworks)

321729. Schubert: The Impromptus, Op. 90 & 142—Murray Perahia, piano *(Digital*—CBS Masterworks)

317677. Schubert: Symphony No. 8 (Unfinished); **Rosamunde Overture and Ballet Music**—von Karajan, Berlin Philharmonic (Angel)

324046. Shostakovich: Cello Concerto No. 1; Kabalevsky: Cello Conc. No. 1—Yo-Yo Ma, cello; Ormandy, Phila. Orch. *(Digital*—CBS Masterworks)

225888. Smetana: Moldau, Bartered Bride Overture, Dances; etc.—Bernstein, N.Y. Phil. (Columbia)

310870-390872. Johann Strauss' Greatest Waltzes Ormandy, Szell, Bernstein (Counts as 2—Columbia)

202796. Richard Strauss: Also Sprach Zarathustra—Bernstein, New York Philharmonic (Columbia)

326405. Stravinsky: The Firebird (complete ballet)—Dohnanyi, Vienna Philharmonic *(Digital*—London)

281493. Stravinsky: Rite Of Spring. Zubin Mehta, N.Y. Phil. (Columbia)

326249. Tchaikovsky: 1812 Overture; Marche Slav; Romeo & Juliet—Bernstein (CBS Great Performances)

329169. Tchaikovsky: Symphony No. 4—Lorin Maazel, Cleveland Orch. (CBS Masterworks)

231563. Tchaikovsky: Swan Lake and **Sleeping Beauty Ballet Suites**—Ormandy, Philadelphia Orchestra (Columbia)

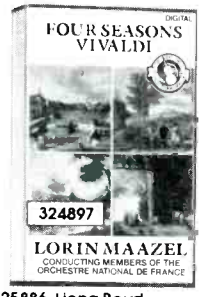
321844-391847. Verdi: La Traviata—Original Motion Picture Soundtrack. Stars Domingo, Stratas (Counts as 2—Elektra)

326447. Verdi: Overtures—*La Forza del Destino, I Vespri Siciliana, Nabucco,* etc. Chailly, National Philharmonic *(Digital*—London)

324525. An Isaac Stern Vivaldi Gala: Concertos For 2 and 3 Violins; etc. Stern, Zukerman, Perlman, others (CBS Masterworks)

323147. Wagner: Orchestral Music from "The Ring"—Sir Georg Solti, Chicago Sym. *(Digital*—London)

310086. Wagner: Overtures—*Flying Dutchman; Rienzi,* etc. Maazel, Philharmonia Orch. (Columbia)



325886. Liona Boyd—Live In Tokyo. Works by Dowland, Soler, Falla, etc. *(Digital*—CBS Masterworks)

292003-392001. Curtain Raisers—World's Favorite Overtures. *Die Fledermaus; Carmen; William Tell;* etc. (Counts as 2—Columbia)

328856. Placido Domingo—Always in My Heart. Spanish songs by Lecuona. *Malaguena,* more (CBS)

326553. Placido Domingo—Great Love Scenes. With Kiri Te Kanawa, Ileana Cotrubas, Renata Scotto (CBS Masterworks)

322347. Marilyn Horne—Live At La Scala. Music by Granados, Handel, Copland, etc. (CBS Masterworks)

326595. Igor Kipnis—Music For The Kings Of France. Harpsichord suites by Marchand and Couperin (Nonesuch Silver Series)

326603. Ivan Moravec plays **Schumann & Brahms.** *Kinderszenen; Intermezzi;* more *(Digital*—Nonesuch)

326108. Mormon Tabernacle Choir—Faith Of Our Fathers. Tradtional hymns *(Digital*—CBS Masterworks)

303453-393454. Pavarotti's Greatest Hits. Works by Bellini, Franck, Puccini, Schubert, Verdi, others (Counts as 2—London)

319582. Jean-Pierre Rampal Plays Scott Joplin. *The Entertainer,* etc. (CBS)

326397. Sutherland/Horne/Pavarotti—Live From Lincoln Center. A truly grand program *(Digital*—London)

320887. Kiri Te Kanawa—Verdi and Puccini Arias. Pritchard, London Phil. *(Digital*—CBS Masterworks)

319848. Andre Watts—Live in Tokyo. Works by Ravel, Brahms, Debussy, Haydn, etc. *(Digital*—CBS Masterworks)

329136. Waverly Consort—Sephardic Songs: songs by Gombert, de Victoria, etc. (CBS Masterworks)

320895. Portrait of John Williams—*Theme from "The Deerhunter", Fool On The Hill,* etc. (CBS Masterworks)

ANY 11 FOR $1.00

plus shipping and handling

if you join now and agree to buy 8 more selections (at regular Club prices) in the coming 3 years

Here's a wonderful opportunity to start or add to your collection of the world's greatest music—on easy-to-play, carefree tape cassettes! As a new member of the Columbia Classical Club, you can get any 11 cassettes for only $1.00, plus shipping and handling. *(Or you may take your 11 selections on stereo records.)* In exchange, you agree to buy just 8 more selections in the next three years, at regular Club prices (which currently are $7.98 to $9.98, plus shipping and handling; multi-unit sets and some digital recordings may be somewhat higher.)

How the Club works: every four weeks (13 times a year) you'll receive our Music Magazine. It describes the "Classical Selection of the Month" *plus* scores of classical releases, as well as selections from other fields of music. In addition, up to six times a year you may receive offers of Special Selections, usually at a discount off regular Club prices, for a total of up to 19 buying opportunities.

There is no obligation to accept the "Selection of the Month"—you order *only* the recordings you want *when you want them!* A special response card will be enclosed with each Magazine—mail it by the date specified to order or reject any selection. And if you want *only* the "Selection of the Month", do nothing—it will be shipped automatically. And you'll have at least ten full days in which to make your decision—if you ever have less time than that, feel free to return the "Selection of the Month" at our expense.

You may cancel membership at any time after you've purchased 8 selections or continue under our money-saving bonus plan. And if not satisfied for any reason, just return your introductory shipment within 10 days—your membership will be canceled and you will owe nothing.

Special Start-Your-Membership-Now Offer: you may *also* choose your first selection now—and we'll send it to you for at least 60% off regular Club prices (only $2.99). This discount purchase reduces your membership obligation immediately—you then need buy just 7 more (instead of 8) in 3 years. Just check box in application and fill in the number of your first selection.

NOTE: selections with two numbers are 2-record sets or double-length tapes. Each of these "double selections" counts as 2—so write in both numbers.

COLUMBIA CLASSICAL CLUB, Columbia House, Terre Haute, IN 47811

Please accept my membership application under the terms outlined in this advertisement. Send me the 11 classical selections listed here for only $1.00, plus shipping and handling. I agree to buy eight more selections (at regular Club prices) in the coming three years—and may cancel membership at any time after doing so.

Send my selections in this type of recording (check one):
☐ TAPE CASSETTES ☐ STEREO RECORDS

☐ Mr.
☐ Mrs.
☐ Miss _____ *Print First Name* _____ *Initial* _____ *Last Name*

Address _____ **Apt.** _____

City _____

State _____ **Zip** _____

Do you have a telephone? (check one) ☐ Yes ☐ No **698/S85**
Do you have a credit card? (check one) ☐ Yes ☐ No
This offer is not available in APO, FPO, Alaska, Hawaii, Puerto Rico, please write for details of alternative offer

☐ **Also send my first selection for at least a 60% discount** for which I will be billed an additional $2.99. I then need buy only 7 more (instead of 8) at regular Club prices, in the coming three years.

All applications subject to review; Columbia House reserves the right to reject any application.

SEND ME THESE 11 SELECTIONS

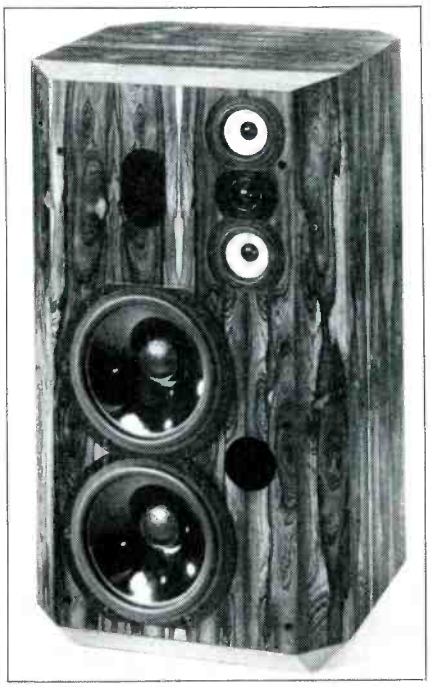
☑ CLASSICAL

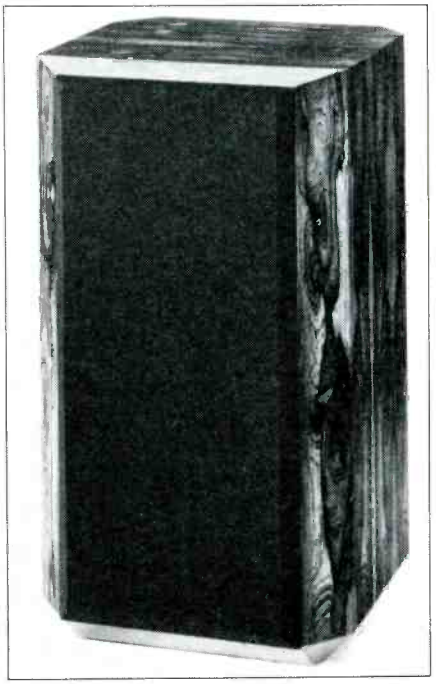
QWW/ME QWX/MD

Enter No. 15 on Reader Service Card

BERT WHYTE

SPEAKER TO SPEC





B & W Model 808

The well-known British loudspeaker manufacturer, B & W, has always had a research-oriented approach to the design and development of transducers. In recent years, B & W has placed even greater emphasis on research, and has expanded their laboratory facilities considerably. They have equipped their laboratories with the most exotic and sophisticated devices of modern audio technology: Fast Fourier Transform analyzers, computer design modeling, and the manufacturer's pride and joy, a laser interferometer.

All this apparatus and many other devices were used in the design of B & W's Model 801 loudspeaker. This transducer aimed to meet record companies' stringent performance requirements for a monitor speaker suitable for classical music recording.

While the Model 801 was well received, ongoing research provided an important refinement to the design. Special fiber-reinforced concrete known as fibercrete, a very inert high-density material, was used to fabricate the midrange and tweeter enclosures. This virtually eliminated panel flexure of the enclosures and the coloration by spurious resonances. Now known as the Model 801F, this speaker has been widely acclaimed for its accuracy of frequency response, very low distortion, smooth spectral balance and, above all, its superlative, almost palpable three-dimensional imaging. The Model 801F is now the "official" classical recording monitor speaker for EMI, London/Decca, Philips, Deutsche Grammophon, CBS, and many others. In fact, I noted that in a recent recording, Telarc too is using the Model 801F. Needless to say, thousands of audiophiles and music lovers all over the world have also acquired the Model 801F.

This sounds like a success story, and it is. However, a new chapter has recently been added. While the Model 801F was widely used to monitor the recording of classical music, there were pop/rock recording engineers who liked the characteristics of the 801F but wanted to monitor at very high levels. Because of the widespread use of synthesizers, with their very high-energy output at extended low-frequency response, these engineers wanted a speaker that could reproduce such huge signals without distress. Hearing about the requirements of their pop-music colleagues, the classical recording engineers declared that, with the wider dynamic range and very low-frequency response of digital recording, such a king-size monitor would be advantageous to them, as well. As I understand it, some EMI recording engineers finally approached B & W, and asked them if they could design a sort of "super 801F" that would afford a very high-quality sound at very high listening levels.

Feeling that with present-day recording technology there was a need for such a no-holds-barred monitor speaker, B & W took up the challenge and, after much research, introduced the Model 808 "super monitor" at the 1984 Summer CES in Chicago. At the show, I asked the ever-genial John Bowers if I might try out a pair of his Model 808s in my home. He graciously consented, but at the time I had no idea what this would eventually entail!

Finally, in early November, a huge truck pulled up in front of my house to deliver the very first pair of Model 808s in the United States. Now, I've had all kinds and sizes of audio gear delivered to me over the years—but I wasn't prepared for what was emerging from the rear of that truck! The Model 808 is shipped in a big wooden case, which (probably by clever foresight) just managed to squeeze through my front doorway. Believe me, B & W is making certain the 808 reaches you intact! Unpacking is a bit of a chore, but once uncrated, the 808 rolls out nicely on its ball casters. Each 808 weighs 185 pounds, so the casters are much appreciated.

The Model 808 is an imposing and beautifully crafted loudspeaker. Available in walnut, black ash, rosewood and natural oak, the 808 is 44¼ in. H × 25¾ in. W × 21¼ in. D. Unlike the 801F with its separate, external midrange and tweeter enclosures, all five drivers are totally within the Model 808 enclosure.

The B & W engineers set three principal design goals for the 808: First, the 808 had to achieve frequency linearity and freedom from coloration and distortion, similar to that of the Model 801F. Second, sensitivity of the 808 was to be 91 dB at 1 watt/meter at 8 ohms, double that of the Model 801F. And third, the 808 had to achieve 120

A few words for those who haven't experienced Sony's new Compact Disc Player.

Listen to it.

Enter No. 41 on Reader Service Card

The Model 808 is an incredibly revealing speaker. Good or bad, it accurately reproduces what you put into it.

dB SPL in typical recording/listening environments.

This was quite a tall order, and it necessitated the design of entirely new driver units. The claimed frequency response of the 808 is ±2 dB from 30 Hz to 20 kHz. Couple the obviously extended bass response with the requirement of a 120-dB output, and the necessity of a large enclosure (220 liters) is apparent. The 808 employs two 300-mm (11⅞-inch) drive units with thermoplastic cones and PVA compound coating. Voice-coils are 2 inches and are wound on special, high-temperature Kapton formers, permitting safe operation up to 250° C (over 480° F)! Each bass driver has a magnet system weighing almost 10 pounds. The drivers feature ultra-long-throw suspensions. Computer predictions indicated that achieving an efficiency of 91 dB at the desired low frequencies would require a fourth-order vented system. This was constructed, and the box has a system resonance of 22 Hz. There is a special design for the internal bracing, and measurement of enclosure panels with laser interferometer and accelerometers gave readouts 60 dB below directionally radiated signals. In other words, resonant coloration from enclosure panels is almost nil. Power handling of the 808 bass section is an enormous 200 *continuous* watts below 400 Hz!

The two midrange drivers are new high-power units, employing the same special Kevlar cones used in the 801F. The voice-coils are once again wound on high-temperature Kapton formers. The specially developed tweeter uses a 32-mm (1¼-inch) polyamide diaphragm, whose contour was determined by laser interferometer studies. High-temperature aluminum formers are used for the voice-coil, and use of Ferrofluid restricts operating temperature to a safe 100° C (212° F). Both midrange drivers and the tweeter are in a vertical in-line configuration, housed in an extremely rigid enclosure completely separate from the bass enclosure. The midrange/tweeter enclosure is a rear-loaded, quarter-wave transmission-line system of tapered construction. It is damped with special fibrous material and tuned to ensure flat impedance and linear absorption.

This three-way speaker uses fourth-order Butterworth-squared configuration crossovers at 400 Hz and 3 kHz, and delay-line correction between midrange and tweeter is provided. The Model 808 can be bi- or triamplified, and there are internal protection circuits to place limits on the power input to midranges and tweeters. Input impedance is 8 ohms nominal. At 100 dB, second-harmonic distortion is only 1% from 100 Hz to 20 kHz, with third-harmonic distortion a mere 0.64% at the same frequencies. Obviously, the 808 is designed and constructed to a new and very high standard.

What you folks probably want to know is what this sophisticated, high-technology loudspeaker sounds like. First off, it must be noted that the Model 808 is an incredibly revealing speaker. Good or bad, it accurately reproduces what you put into it. To really appreciate the fabulous performance of the 808, it should be teamed with the best equipment available. The 808 sounded quite good with a number of high-quality amplifiers and preamplifiers, but the cleanest, most musical, most impressive sound from the 808s was produced by driving them with the new Krell KMA-200 Class-A amplifiers. (Krell's Dan D'Agostino tells me that these mono amplifiers have new "inverse drive" circuit topology, that they are internally wired with Sal DeMicco's Discrete Technology cable, and that they are capable of extremely high-current output.) For the preamplifier I used the new Gamma version of the Spectral DMC-10, a unit I find increasingly impressive for its cleanness, quietness and very musical qualities. I also used the Meridian CD player, and the Sony PCM-F1 and JVC 6400 professional VCR for playback of my own and other digital tape recordings.

With the setup described, listening to the Model 808 is an impressive sonic experience. There simply is no comparison with conventional speakers. Knowing you have 120 dB of output might offer temptations to those who like their music larger than life. Needless to say, some exploratory listening, including forays into ultra-high levels (just to see if the loud levels stay clean), is in order.

It was soon apparent that the 808 has many of the desirable characteristics of the 801F. Spectral balance is extremely smooth unless distortion is present in the source material; I've heard no distortion produced by the 808. Bass response is flat within a few dB to below 30 Hz. Above all, there is utter clarity and cleanness to the sound, no matter what the listening level. Coloration is very low, and the stereo imaging is precise and stable, although it must be said that the 808 doesn't quite match the three-dimensionality of the 801F.

Quite apart from all this is the sheer emotional impact that the 808 uniquely imparts to music. Because it can handle the very wide dynamic range and extended bass response of some digital tapes and Compact Discs, you no longer have to play them with trepidation. There is no longer any fearful "walking on eggshells" feeling that is engendered when playing digital material through loudspeakers that simply are not designed to handle high levels.

On certain uncompressed digital recordings, you can set the pianissimos just above the ambient noise floor of your listening room, and feel secure that, when you reach the triple fortissimos, nothing will blow up. In such situations, the impact of the 808 is startling. Bass response is ultra-clean, awesome and visceral in its unbridled power.

Classical music played on this 808 system becomes a new experience. It is difficult to describe how one gets caught up in the music, how the climaxes of a Mahler symphony, for instance, afford an emotional impact that can truly be described as uplifting.

For devotees of pop and rock music, this is a dream speaker. All the high-level sounds are produced without strain. Transient response and power are shattering. On some Compact Discs with percussion, especially rim shots on drums, you feel someone is in the speaker shooting at you with a .357 magnum.

There is no doubt that the B & W 808 is a major achievement in advanced speaker design. There are other speakers having excellent qualities, but for sheer, gutsy, and emotional musical excitement, the 808 will be hard to beat. There is but one little drawback—you'll need $7,500 for a pair of Model 808s. A

A few words for those who have.

INTRODUCING THE THIRD GENERATION CD PLAYER THAT'S LIGHT YEARS AHEAD OF THE COMPETITION.

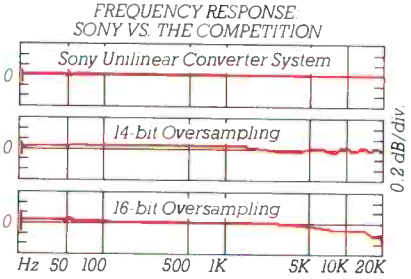
After listening to one of Sony's new third generation component CD players, you begin to realize you're hearing something not possible in any first, or even second generation player.

It's a whole new level of technological achievement not merely designed for those who appreciate great specs, but those who appreciate great music, as well.

A RESPONSE CURVE THAT ISN'T A CURVE.

All CD players are endowed with a much flatter response curve than any turntable or tape deck is capable of reproducing. Unfortunately, most are also endowed with a conventional converter/filter system. Which tends to cause high frequency irregularities.

However, take the response curve of Sony's new CDP-302 (the one that's flat as a board).

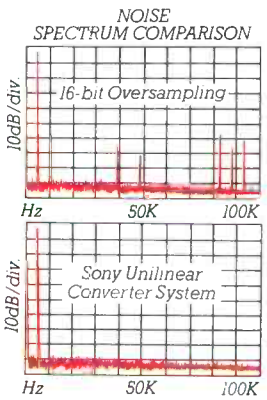


As you can see, it's far more uniform than the one found in conventional models. What this should tell you is that when you listen to even the most intricate piece of music, you'll be hearing precisely what the musicians recorded. Nothing more. And nothing less.

YOU CAN'T BEAT OUR CLOCK.

Perhaps the most interesting "little" feat of engineering is Sony's new Unilinear Converter System. Its high-speed, digital-to-analog converter works by virtue of a "master clock." Using this single clock dramatically reduces intermodulation distortion common to "multiclock" converter systems.

When you combine all this with our new, high-resolution digital filter, it results in something even the most ardent audiophile will find no fault with: incredibly flat response, remarkable phase linearity and the conspicuous absence of spurious noise caused by conventional oversampling.



Of course, you'll need a master's degree in engineering to fully understand all the intricacies of our new Unilinear Converter. But you certainly don't need one to appreciate it.

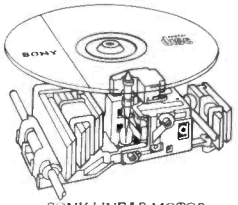
A NEW CHIP OFF THE OLD BLOCK.

The heart of our new CD player is a thing of beauty. This award-winning microchip governs nine different functions usually requiring multiple chips in conventional players. But more importantly, it simplifies the signal path and improves reliability.

CHANGE TRACKS AT THE SPEED OF LIGHT.

Sony has done away with the lumbering gear-driven tracking mechanism, and instead, created a whole new Linear Motor Tracking System. It uses a compact laser optic assembly that's one-third the size of typical units. And its linear, noncogging motor allows the laser to move faster and more precisely.

If you're wondering what speed has to do with these mechanisms, we'd like to remind you of the fact that it takes some CD players up to 15 seconds to go from the first to the last track on a disc. But with ours, you can go from track 1 to 99 in less than a second.



SONY LINEAR MOTOR TRACKING SYSTEM

FEATURES WORTH HEARING MORE ABOUT.

Not all of these advances are audible to the naked ear.

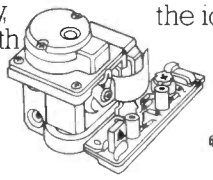
Both of our new CD players come complete with Sony's Remote Commander® unit which provides direct access to up to 99 tracks or subcoded selections. In addition, both have Automatic Music Sensor,™ high-speed search and three-way repeat. (The CDP-302 shown here also allows for programmability of up to 16 of your favorite songs.)

We'd also be remiss in not telling you about our built-in subcode port. Which in the not-too-distant future you can make good use of when CDs are integrated with graphic information.

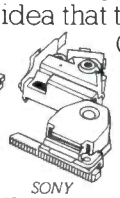
By now, you're beginning to get the idea that the new line of Sony CD players not only sound remarkable, they are.

So having heard and read just about all there is to hear and read about them, we suggest there's only one thing left to do. Go to your Sony hi-fi dealer and purchase one.

Of course, there's no rush. It will take our competition at least one or two generations to catch up.



CONVENTIONAL LASER OPTIC ASSEMBLY



SONY MINIATURIZED LASER OPTIC ASSEMBLY

SONY®
THE LEADER IN DIGITAL AUDIO.™

Enter No. 42 on Reader Service Card

WHAT'S NEW

Danefurn Cabinet

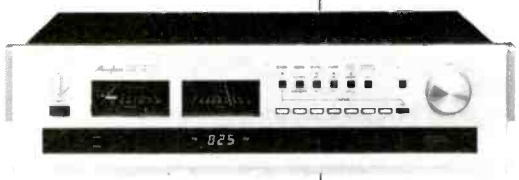
The Danefurn DFAV 8 achieves a look noticeably different from other lowboy audio cabinets, thanks to its vertical cassette-storage drawer. A sliding shelf gives easy access to turntables, and both equipment compartments have glass doors. Price: $579.95.

For literature, circle No. 101

3D Acoustics Speaker

The Legend 403, from 3D Acoustics, is a two-way, floor-standing speaker that features a 6-inch, polypropylene woofer-midrange augmented by an 8-inch passive radiator. The 1-inch cloth dome tweeter is encased in foam to reduce diffraction and early reflections, thus improving phase coherency and imaging. A seven-element crossover is also used. Price: $440 per pair.

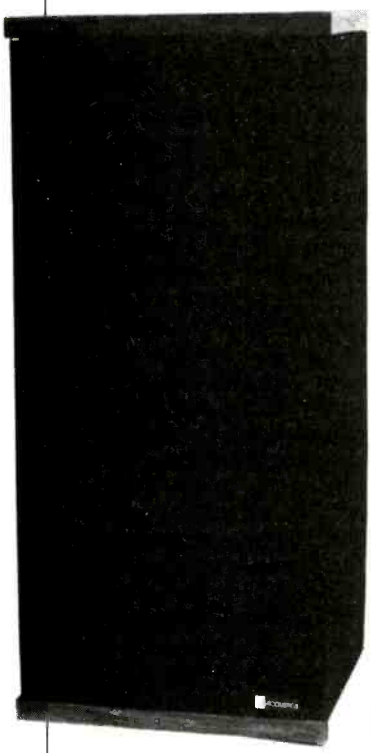
For literature, circle No. 100



Accuphase Tuner

The dial is digital, but the feel is analog on the Accuphase T-106 AM-FM tuner. That's accomplished by an optical pulse generator that senses the motions and positions of the manual tuning knob. The tuner also features a signal-strength meter reading in dBf, and a peak-modulation meter that also serves as a multipath indicator. Specifications include a 37-dBf sensitivity for 50-dB quieting in stereo, 79 dBA of stereo S/N, and 80 dB of AM suppression. Price: $1,100.

For literature, circle No. 102



Revox Preamplifier

Versatility is the key to Revox's B252 preamplifier. Each of its seven inputs (which include two tape loops and both MM and MC phono inputs) has individually programmable sensitivity, adjusted in 0.5-dB steps; the headphone output-level range is adjustable in five steps, and there are main outputs at 2.5 and 12.5 V to match different amplifiers. Each input has its own buffer amplifier to prevent interactions, and the tone controls use a new curve, based on physiological principles. Peak level meters and a separate record-output selector make recording more convenient. Signal-to-noise ratio is 96 dB relative to nominal power output (500 mV) and 80 dB relative to 50-mW out; phono S/N is 75 dB re. 50 mW. The B252 can be operated by the same remote control as Revox's other components. Price: $1,200.

For literature, circle No. 104

Audio-Technica Headphones

Headphone makers have been focusing on ultra-light headphones for several years, since the boom in portables began. But attention is now returning to full-sized phones, as witness Audio-Technica's ATH-V7. These open-back, moving-coil phones weigh just over 6 ounces and are supported on foam-padded rings which surround the ear for comfort and sound isolation. The cord is straight at the headphone end, for easier handling, but coiled at the amplifier end (which bears a ¼-inch phone plug). Price: $74.95.

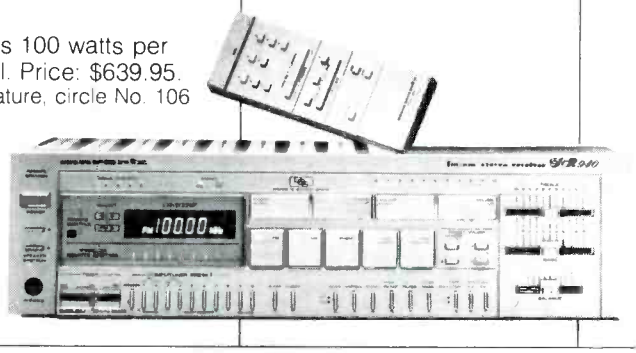
For literature, circle No. 103

Talisman Cartridge

The "intensified-focus" generating system of the Talisman Alchemist IA moving-coil cartridge is said to give it high output (2.0 mV) without adding extra moving mass to the system. The cantilever, of aluminum-magnesium alloy, holds a nude-mounted elliptical stylus. Specifications include frequency response of 20 Hz to 40 kHz, compliance of 15 × 10^{-6} cm/dyne, and a recommended tracking force range of 1.5 to 2.1 grams. Price: $225.
For literature, circle No. 105

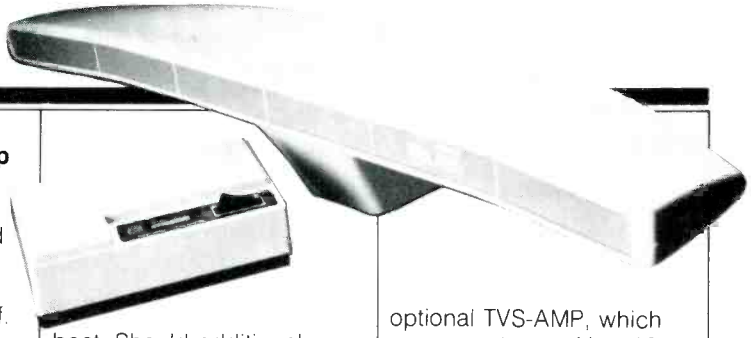
Marantz AM Stereo Receiver

The SR 940 AM/FM receiver is equipped to receive C-Quam (Motorola-system) AM stereo broadcasts without adaptors. The tuner section has its own clock timer, plus presets for eight AM and eight FM stations. Power is 100 watts per channel. Price: $639.95.
For literature, circle No. 106



Regency Electronics FM/TV Antenna and Amp

The Polaris TVS-100 marine antenna receives FM and both the VHF and UHF TV bands. The antenna and a high-performance, low-noise r.f. amplifier are built into a weatherproofed ABS enclosure which has a weather-guard connector boot. Should additional signal amplification be needed, the TVS-100 can be connected to the optional TVS-AMP, which can operate on either 12 or 24 V d.c. Prices: TVS-100, $109; TVS-AMP, $34.
For literature, circle No. 108



Velodyne Subwoofer

The ULD-18 subwoofer system combines an 18-inch driver with a 350-watt servo amplifier and has a built-in electronic crossover with selectable 85-, 120- and 165-Hz frequencies plus provisions for external crossover. Feedback to the amplifier is via an accelerometer, which measures cone motion. The amplifier module is rack-mountable and incorporates an adjustable subsonic filter and a speaker peak-protection circuit with indicator light. Price: $2,500.
For literature, circle No. 107

Zapco Car Equalizer

The controls of the Zapco PEQ graphic equalizer suggest that it's not designed for tone control use, as most car equalizers are, but for use in balancing a system. The nine-band equalizer has individual controls for each stereo channel, for a total of 18 sliders, each with an unusually wide range of ±18 dB. Input gain is adjustable and output level switch-selectable. The circuit features low-noise ICs with a high slew rate of 13 V/μS and distortion less than 0.05%, plus low-impedance output to drive long cables. Price: $313.
For literature, circle No. 109

Soundcraftsmen presents...

MADE IN U.S.A.

BIG POWER FOR YOUR RECEIVER

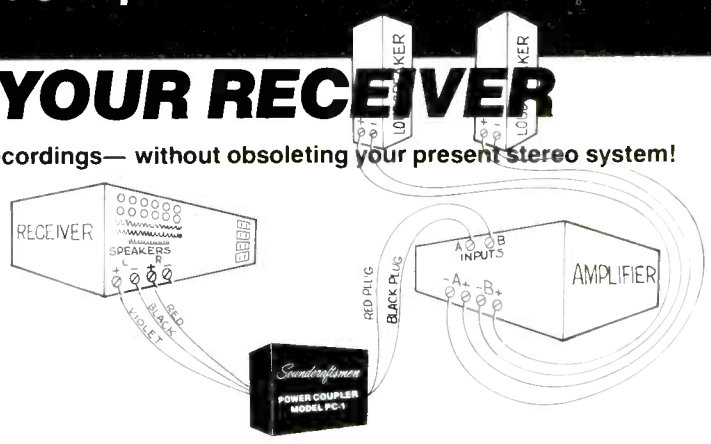
Add the power you need for the new digital, dbx or Dolby recordings— without obsoleting your present stereo system!

PC-1...just $39.00!

Don't sell or trade in your stereo receiver just because you need more power!

The Preamp/Tuner section of your receiver can now be instantly coupled to a Soundcraftsmen high-power amplifier with the amazing new PC-1 Power Coupler.

The PC-1 connects to your receiver (or integrated amplifier) speaker terminals, —perfectly matching the inputs of any Soundcraftsmen amplifier!



THE WORLD'S SMALLEST, LIGHTEST, MOST POWERFUL CONTINUOUS POWER STEREO AMPLIFIER!

410 watts—MOSFET—
205 watts per channel **$449.00**
@ 8 ohms, 20 Hz–20 KHz, less than 0.05% THD...
300 watts per channel @ 4 ohms...

"PHASE–CONTROL–REGULATION"®

Soundcraftsmen's research into **Digital Audio Technology** has resulted in a major advance in amplifier design—**Phase Control Regulation**® The world's first **PCR** amplifier, the **PCR800,** sets continuous performance and reliability standards never before possible in audiophile equipment.

You must HEAR it, to believe it! The improvement is fantastic! You'll love it!

FOR A DEMONSTRATION, VISIT NEAREST DEALER LISTED BELOW

However, many additional Dealers—too numerous to list here—are located throughout the U.S. with many models on display. If no dealer is shown near you, or you encounter any difficulty, please phone us at 714-556-6191, ask for our *"Dealer Locator Operator."*

ALABAMA
Huntsville
SOUND DISTRIBUTORS

ARIZONA
Yuma
WAREHOUSE STEREO

NO. CALIFORNIA
Berkeley
HONKERS SOUND CO.
Concord
SOUND DISTINCTION
Goleta
HOUSE OF AUDIO
Palo Alto
WESTERN AUDIO
Sacramento
NEAL'S SPEAKERS
San Francisco
LISTENING POST
Santa Barbara
HOUSE OF AUDIO

SO. CALIFORNIA
Phone 714-556-6191, ask for "Dealer Locator Operator" (Insufficient space to list all Dealers in this area)

COLORADO
Englewood
GOLD SOUND
Colorado Springs
THE SOUND SHOP

CONNECTICUT
Danbury
CARSTON STUDIOS
Newington
SOUNDS GREAT
Stamford
COUNTY AUDIO

FLORIDA
Fort Walton Beach
AUDIO INTERNATIONAL
Merritt Island
AUDIO MART ELECTRONICS
Miami
AUDIO PLUS
LAS FABRICAS
Orlando
AUDIO MART ELECTRONICS
Tampa
SENSUOUS SOUND

GEORGIA
Atlanta
AUDIO UNLIMITED
STEREO DESIGNS
Augusta
THE STEREO SHOP
Columbus
WORLD-WIDE ELECTRONICS
Dalton
BROCK'S ENTERTAINMENT

HAWAII
Hilo
YAFUSO T.V. APPLIANCE
Honolulu
HARRY'S AUDIO
VIDEO LIFE
Lihue, Kauai
JACK WADA ELECTRONICS
Wailuku, Maui
ADRIAN'S ELECTRONICS

IDAHO
Idaho Falls
PHASE 4 STEREO

ILLINOIS
Dekalb
AUDIO PLUS
Gurnee
OPUS EQUIPMENT
Peoria
ELECTRONICS DIVERSIFIED

INDIANA
Anderson
ANDERSON ELECTRONICS
Indianapolis
SOUND DECISION
New Haven
HJS SOUND
West Lafayette
VON'S ELECTRONICS

KANSAS
Overland Park
AUDIO ELECTRONICS
Salina
DEL'S TV
Wichita
AUDIO PLUS

KENTUCKY
Lexington
THE STEREO SHOPPE
Louisville
HI-FIDELITY, INC

LOUISIANA
Baton Rouge
NEW GENERATION
LaFayette
NEW GENERATION
Metairie
SOUND TREK

MARYLAND
Baltimore
STANSBURY STEREO
Gaithersburg
AUDIO BUYS

MASSACHUSETTS
Brockton
SCORPIO SOUND
Sunderland
SCIENTIFIC STEREO

MICHIGAN
Marquette
AMERICAN TV
Saginaw
LISTENING ROOM

MISSISSIPPI
Gulfport
TIPPIT'S MUSIC
Jackson
HOOPER SOUND
Meridian
HOOPER SOUND

NEBRASKA
Lincoln
LIGHT & SOUNDS FANTASTIC

NEVADA
Las Vegas
UNIVERSITY PRO AUDIO

NEW JERSEY, SO.
Wildwood
SEASHORE STEREO

NEW YORK CITY,

NORTHERN N.J.
Phone 201-947-9300, ask for "Dealer Locator Operator" (Insufficient space to list all Dealers in this area)

NEW YORK—UPSTATE
Albany
SOUNDS GREAT
Newpaltz
NEWPALTZ AUDIO
Plattsburgh
GREAT NORTHERN STEREO WHSE
Poughkeepsie
DUTCHESS AUDIO
Rochester
SOUNDS GREAT
Syracuse
SUPERIOR SOUND

NORTH CAROLINA
Greensboro,
High Point,
Winston-Salem,
AUDIO-VIDEO CONCEPTS
Hickory
MC LAUGHLIN'S TV
Raleigh
CREATIVE ACOUSTICS

NORTH DAKOTA
Fargo
WATTS-MORE

OHIO
Akron
OHIO SOUND
Canton
OHIO SOUND
Cleveland
B&B APPLIANCE
OHIO SOUND
Lima
HART AUDIO
Middleburg Hts.
B&B APPLIANCE
Warren
CUSTOM SOUND CO.
Youngstown
CUSTOM SOUND CO.

OKLAHOMA
Oklahoma City
JOHNSON TV & SOUND

OREGON
Klamath Falls
HIGH COUNTRY RECORDS
Medford
SOUNDTRACK ELECTRONIC
Portland
HAWTHORNE STEREO

PENNSYLVANIA
Chambersburg
SUNRISE ELECTRONICS
Hermitage
CUSTOM SOUND CO.
McKeesport
HI FI CENTER
Philadelphia
SOUND SERVICE
Pittsburgh
AUDIO JUNCTION
Reading,
Shillington
PHOENIX HI FI
Willow Grove
SOUNDEX

PUERTO RICO
Puerto Nuevo
LASER SOUND

SOUTH CAROLINA
Columbia
NORTON STEREO
Greenville
DON JONES STEREO
Newberry
THE ELECTRONIC SHOP

TENNESSEE
Chattanooga
COLLEGE HI FI
Nashville
AUDIO SYSTEMS

TEXAS
Arlington
SOUND IDEA
Corpus Christi
SOUND VIBRATIONS
Houston
HOME ENTERTAINMENT
Midland
FOLGER'S ENTERTAINMENT

UTAH
St. George
ARROW AUDIO

VIRGIN ISLANDS
St. Thomas
ELECTRONICS UNLIMITED

VIRGINIA
Falls Church
AUDIO BUYS
Richmond
GARY'S

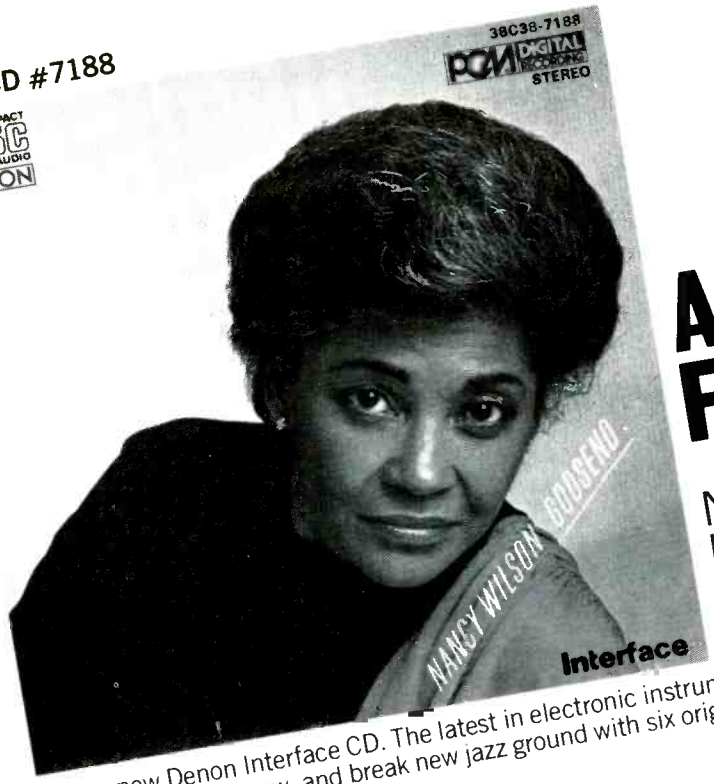
WASHINGTON
Bremerton
EVERGREEN AUDIO
Olympia
DESCO ELECTRONICS

WEST VIRGINIA
Morgantown
THE SOUND POST
Princeton
THE SOUND POST

WISCONSIN
Appleton
AMERICAN TV
Glendale
SOUNDSTAGE
Madison
SPECIALIZED SOUND
AMERICAN TV
Oshkosh
AUDIO PLUS
Sheboygan
GENE'S CAMERA & SOUND
Waukesha
AMERICAN TV

Enter No. 30 on Reader Service Card

CD #7188



A "GODSEND" FOR JAZZ FANS.

NANCY WILSON'S LATEST CD, "GODSEND."

Denon, the Company that invented digital recording, has captured the magic of the legendary Nancy Wilson as never before on this new Denon Interface CD. The latest in electronic instruments and multi-digital recorders bring new life to songs you know, and break new jazz ground with six original selections. A must for CD/Jazz lovers.

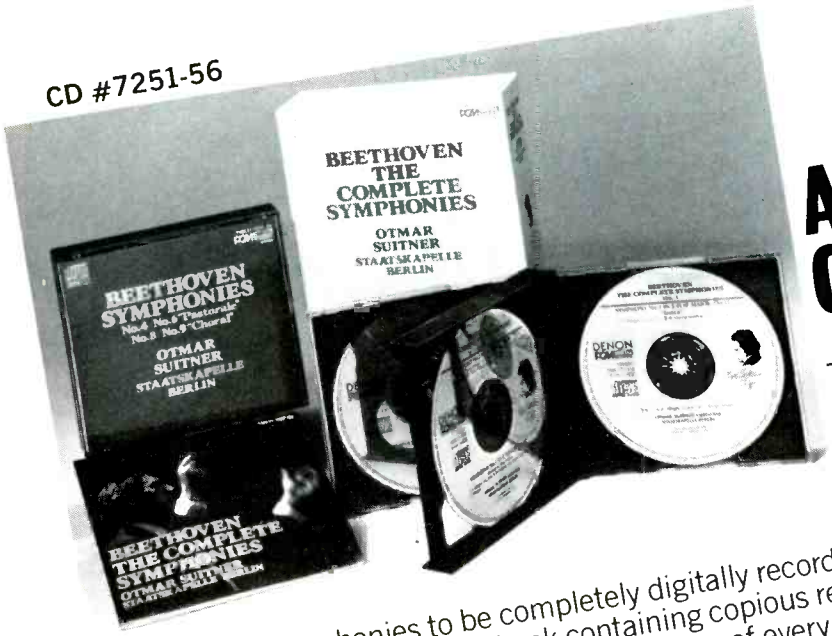
DENON

Nippon Columbia Co., Ltd., 14-14, 4-Chome, Akasaka, Minato-ku, Tokyo, 107 Japan

Denon America, Inc., 27 Law Drive, Fairfield, N.J., 07006
Audio Market Sales, 633 Main St., Milton, Ont. L9T 3J2 Canada

Enter No. 16 on Reader Service Card

CD #7251-56



A MONUMENTAL CD RECORDING!

THE COMPLETE DENON CD COLLECTION OF BEETHOVEN'S SYMPHONIES.

Beethoven's Symphonies to be completely digitally recorded. Packaged in an elegant presentation box with a bound book containing copious recording and musical information, this set will become the foundation of every serious CD collection. Under the direction of Otmar Suitner, the Berlin Staatskapelle brings fresh expression to the scores, while Denon's proprietary digital recording experience captures these outstanding performances with unprecedented sonic quality.

DENON

Nippon Columbia Co., Ltd., 14-14, 4-Chome, Akasaka, Minato-ku, Tokyo, 107 Japan

Denon America, Inc., 27 Law Drive, Fairfield, N.J., 07006
Audio Market Sales, 633 Main St., Milton, Ont. L9T 3J2 Canada

Enter No. 17 on Reader Service Card

IVAN BERGER

OUTSHOUTED SYMPHONY

Virtue and Voice

Back in my year of college-radio announcing (WYBC-FM), I learned a useful rule that some FM stations still seem unaware of—that announcements on music shows should be at lower levels than the music. On talk shows, we let voices peak at meter 0, but on music shows we limited announcer levels to −10 or so. It sounds unnatural to have a speaking voice outshout the Symphony—or Twisted Sister, for that matter.

Beauty Is . . .

Driving up the Pacific Coast Highway a few years back, I tuned into a bank of violins which made me hope, at first, I'd found a classical station. No such luck. The record faded out, and the announcer said this was "Your Beautiful Music Station in Downtown . . ."

I'd heard the phrase a million times before without ever pondering it; this time, I did—concluding that the word "beautiful" did not apply, any more than it would to a woman who'd felt no emotions beyond "Gee! Puppies are cute!" Call it *pretty* music. Maybe.

Super-Juke

The pickup in the picture is an Ortofon, all right—it says so, in two places. But what sort of arm is that? Why does it hold two cartridges? And where's the turntable?

It all becomes clearer when you learn that this pickup system was developed by Ortofon for NSM Apparatebau of Germany, makers of jukeboxes for over 30 years. By clamping the record to a spindle instead of laying it on a platter, and by mounting two cartridges back to

back, the system can play either or both record sides—standard jukebox procedure, *nicht wahr?*

Some of the other technology is a bit less standard, though. The system is designed to withstand the shaking of a crowd of dancers without resorting to high tracking forces, which accelerate record wear. Conductive plastic replaces some wires, and ultrasonic welding replaces the usual glues.

Illustrations: Thomas H. Waters

Timer, Timer . . .

A few readers, so far, have written in with their solutions to the timer shortage I mentioned in December.

The highest-tech solution was suggested by Roy Slovenko, of Chicago, who records off the air with a Beta Hi-Fi VCR, then dubs at his leisure onto audio cassette: "Hardly any loss of fidelity in this two-step process," he writes. "I edit and rearrange to fit the time constraints of the audio cassette. For maximum sound purity and to avoid the 45-minute breaks in longer works, I just keep the VCR Hi-Fi recording."

Mr. Slovenko also has a slightly more prosaic timer system, a Sony PT-77 timer combined with Sony's ST-J75 tuner. The PT-77 is an eight-event, seven-day timer that has settings for particular days of the week, every day, weekdays only, and any six days of your choice. Every time the timer turns the tuner on (take that, Peter Piper!), the ST-J75 tuner advances to the next of its eight preprogrammed station-preselect buttons. Program those buttons in the same order as the programs you want to receive (you can program stations more than once), and the timer effectively changes stations for you.

"And I know almost exactly the time of day that my classical music selection will be played," Mr. Slovenko writes. "You see, I live in Chicago, where the two classical music stations, WFMT and WNIB, publish monthly program guides with day-by-day and hour-by-hour listings." We do have similar listings here in New York, for classical WQXR and WNCN and, I believe, WBAI (listener-supported miscellany), WNYC (Public Radio) and WBGO (Public Radio and jazz, in nearby Newark). However, I don't know which city's listings are the more detailed.

Mr. Slovenko then adds: "WFMT plays CDs extensively, and eschews the compression of broadcast signal used by other stations. Aren't you envious?" Yup.

Back from the Brink

Acoustat, which filed for reorganization under Chapter 11 of the bankruptcy laws last summer, is now being acquired by the David Hafler Co., which has announced that it will keep the company's internal operations and dealer structure intact.

Ivie, makers of handheld real-time analyzers and other test gear, has had a similar salvation, in this case bailed out by recording-equipment company Cetec.

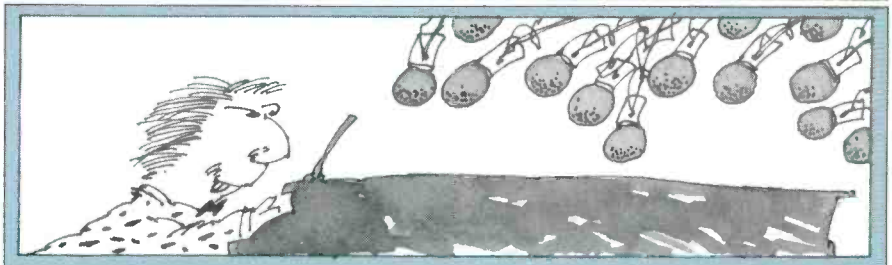
Sound Out of Ultrasound

A few years ago, the English magazine *New Scientist* suggested an interesting use for ultrasound: Modulate an ultrasonic wave with an audio signal, and the inaudible result would become audible when you beamed it at surfaces that could vibrate in response—the glass on your mother-in-law's picture, or the coal scuttle, for instance.

According to one physicist I asked, it would work, though with terrible fidelity—no surprise, since the idea came from Daedalus, the *New Scientist*'s answer to Dr. Lirpa. (And don't ask us what the question was.)

Now, however, someone is actually putting audible ultrasonics to use, although the technology and application are different: Matsushita will use the interference between arrays of 6,600 ultrasonic transducers to generate a narrowly focused audio beam. Its purpose is to convey information from overhead down to listeners in the middle of crowds, without disperson due to sound reflections from walls and other people. Acoustical filters between the arrays and the listeners will reduce the ultrasonic content by 35 dB, while reducing audio by only 6 dB (to 91 dB). As with Daedalus' idea, the fidelity won't be that great (Matsushita's release says 40% second-harmonic distortion, but I hope that's a misprint).

Audio contributor Richard Kaufman says that the same technique could be used to produce a subwoofer which would have very low efficiency but would also have no lower limit to its bass response.



Brubeck, Bruised

About a year ago, I went to hear the Dave Brubeck Quartet accompanying the Murray Louis Dance Company. I was a bit puzzled to see 13 microphones sharing the stage with the four musicians. I was also dismayed to find that most of the sound reaching my balcony seat was from a muddy-sounding speaker box by the proscenium arch. Not all the sound reaching me came from the box, but it would have been better if it had: I'd hear the piano, clear and live, for an instant, only to have its second note drowned by the speaker.

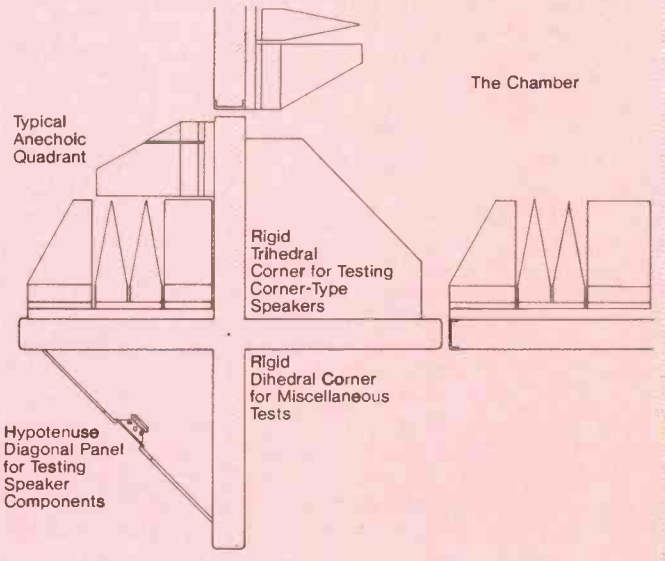
The funny thing is, once upon a time, musicians filled halls with music without electronic assistance. Chamber groups still do—is jazz quieter than Haydn or Debussy nowadays?

Cornering a Problem

Typical anechoic chambers are designed for testing typical speakers—which hardly describes Klipschorns. Those speakers use a room's corner walls and floor as extensions of their bass horn, and the corners of anechoic chambers are filled with the same sound-absorbing wedges as the ceiling, floor and the rest of the wall.

Klipsch considered building an anechoic chamber with one corner left bare. But that would compromise the chamber's use for testing other kinds of speakers, which Klipsch also makes.

The solution was to build a chamber with interchangeable corners, mounted on a four-quadrant, revolving-door-like structure (as shown below). One quadrant is filled with the usual anechoic wedges. A second, used for testing corner speakers, has smooth, rigid walls and a small floor. The third quadrant holds a diagonal panel for testing individual speaker drivers, while the fourth is left bare, but unfloored, for miscellaneous tests.



A plan view of Klipsch's adaptable anechoic chamber.

SONY D-5 PORTABLE COMPACT DISC PLAYER

Company Address: One Sony Dr., Park Ridge, N.J. 07656.
For literature, circle No. 93

When I first encountered this smallest of all CD players, I had to force my way through a crowd of enthusiastic audiophiles who were attending the 1984 Japan Audio Fair. Meanwhile, back in the United States, Sony had elected to introduce this amazing little product at the same time as it was being introduced in Japan. That in itself tells you how important Sony felt this product was going to be.

There are several significant breakthroughs involved in the design of the D-5. First and foremost, it is a very low-cost unit, carrying a suggested retail price of less than $300. Second, this CD player can be plugged into a high-fidelity system or used on the move with an optional battery pack/carrying case (costing $49.95) and optional stereo headphones of your own choosing. Finally, the D-5 is actually smaller in width and depth than the plastic case in which CDs are normally packaged; it measures only 5 inches by 5¼ inches. The height of the player is a mere 1½ inches, and it weighs slightly more than 1¼ pounds.

Despite its low cost and small size, the D-5 performs very much like its heavier and costlier counterparts, though it lacks the programming and random-access features which have constituted the major differences between one CD player and another. Nonetheless, the most important display and access features have been retained, and, of course, the superb performance inherent in the CD format has not been sacrificed in any way. The D-5 incorporates a digital liquid-crystal display which lets you know what track is being played, how much time has elapsed on a given track, and, at the press of a button, the amount of time remaining on the entire disc and the number of tracks remaining. In addition, there is a battery condition indicator and two other LCD indications: One for "AMS" (Automatic Music Sensor) and the other for music "Search" or audible fast-scanning of a disc's contents.

After pressing the "Open" button on the D-5's top surface (in the corner), a disc may be loaded directly onto the turntable. A special safety switch automatically disengages the D-5's mechanism whenever the loading door is open. All other controls and the display are found on the player's front. These include a time remaining button for the display, a "Mode" button (which toggles between the "AMS" and "Search" functions), a toggling play/pause button, a power switch, a stop button, a continuously variable headphone volume control, and a mini stereo-headphone jack. A line-output jack (also a stereo mini type) and a d.c. input terminal are on the rear of the D-5. An a.c. power adaptor which delivers 9 V in the correct polarity is supplied, but the battery contained in the optional case, or an optionally available car-battery cord, could also be connected at the d.c. input terminal.

When the battery case is used, it must be loaded with six C-size alkaline batteries whose life is approximately 5 hours at normal listening levels. Rechargeable nickel-cadmium batteries may also be used with the optional battery case. Charging time for these would be around 15 hours, with fully charged nickel-cadmium batteries supplying around 2½ hours of playing time.

Much of the engineering that made Sony's car CD players possible has also been applied to the D-5. For example, a single-chip, high-density VLSI has been used for primary digital functions and for simplified and stabilized player functions. In addition, the miniaturized laser-optical assembly found in the Sony car CD players has also been used.

Basic performance of the D-5, as might be expected, is very much like that of Sony's car CD units (one of which, the CDX-R7, I measured and reported on for the July 1984 issue). Sony has, so far, continued to use steep, analog, output filters which cut off above 20 kHz, but response up to

André Previn

DG-10107 CD-80107

Louis Lane

DG-10085 CD-80085

Robert Shaw

CD-80105

COMPACT disc DIGITAL AUDIO

TELARC® DIGITAL

Enter No. 48 on Reader Service Card

The D-5 is not a Walkman; it is not intended to be carried on a belt loop. Jogging will cause mistracking.

that frequency is extremely flat. The usual low distortion and high separation figures can be expected from this player. Output via the line-level jack is approximately 1.6 V, not unlike the voltage levels one expects from a larger table-top or shelf-mounted CD player. Use of 32-ohm headphones, such as those recommended by the manufacturer, results in a maximum power output from the phone jack of around 10 mW per channel—enough to drive some of those new high-efficiency stereo headphones to more than adequate sound levels.

In my hands-on tests, I found that the D-5's controls operated reliably and positively and that sound quality was as good as that obtained from any of the larger Sony CD players.

The D-5's optional carrying case

Because of Sony's efforts at creating small, portable music sources such as the famous Walkman, it was inevitable that the D-5 would be greeted in many circles as the "Walkman CD." In fact, Sony emphasizes that this product is *not* in the Walkman category: It is *not* intended as a product to be carried on a belt loop by morning joggers. The elaborate stabilizing techniques used in Sony's car CD players have not been incorporated in the D-5 (nor does Sony claim they have been); therefore, if you bounce the unit around too much when a disc is being played, it *will* mistrack. What Sony did intend for the D-5 was that it be used on a fairly stable surface—at home, walking (not jogging), in the park, on the beach, or wherever else you happen to be when you crave noise-free music reproduction of wide dynamic range. That being the case, Sony seems to have succeeded admirably with its D-5 CD player. *Leonard Feldman*

THE WORLD OF DIGITAL AUDIO IS COMING TO YOUR TOWN. AND YOU'RE INVITED.

It's a new world. And Sony, CBS and Audio Magazine are ready to *show* and *tell* you all about it.

Len Feldman, internationally renowned author, audio critic, lecturer...and Senior Editor of Audio Magazine, will be your guide to this new world.

But there's more.

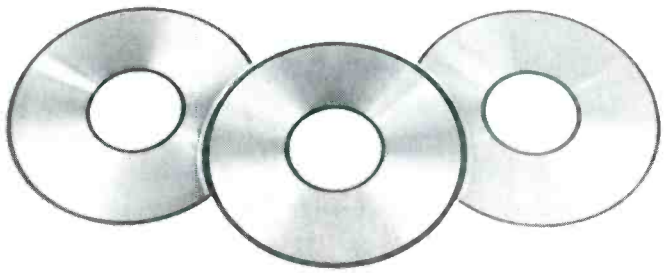
You'll see highlights of the film, *Metropolis**, with its new, digital soundtrack!

There are prizes, too. A Sony CD player and CBS Compact Discs will be given away at each event.

And it's all free! Just contact the sponsoring dealer in your area for the exact time and location.

San Francisco, CA	Feb. 4	PACIFIC
Los Angeles, CA	Feb. 5	ROGERSOUND LABS
Seattle, WA	Feb. 6	MAGNOLIA HI-FI & VIDEO
Denver, CO	Feb. 7	LISTEN UP
Dallas, TX	Feb. 19	SOUND CLIMAX
San Antonio, TX	Feb. 20	STEREO INTERNATIONAL
Houston, TX	Feb. 21	SOUTHWEST RECORD & TAPE
Melbourne, FL	Mar. 4	MARC'S ELECTRONICS
Atlanta, GA	Mar. 5	HIFI BUYS
Nashville, TN	Mar. 6	AUDIO SYSTEMS
New Orleans, LA	Mar. 7	ALTERMAN AUDIO

See additional listings in Audio next month.



A cooperative effort of

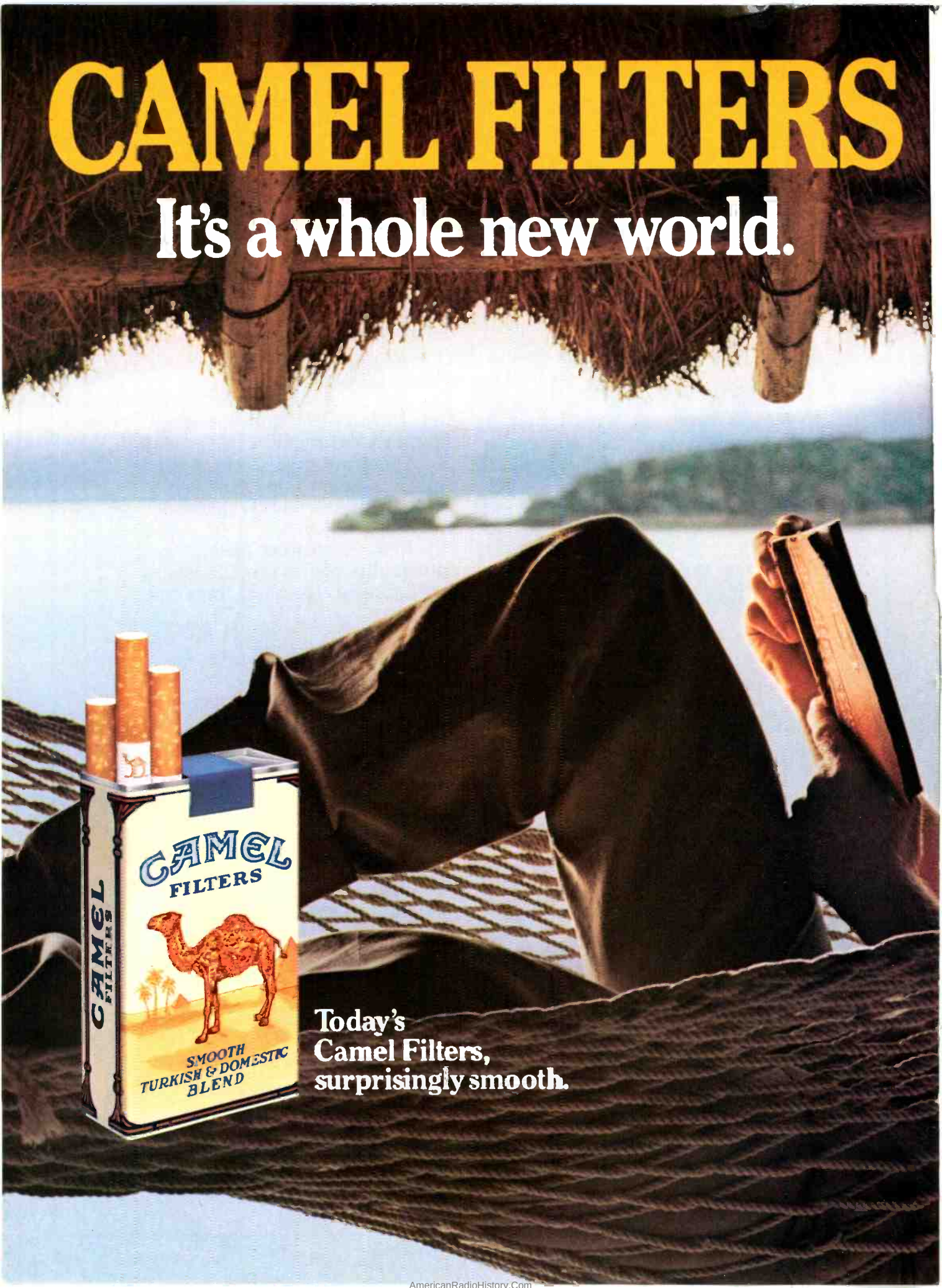
Audio SONY CBS

* © 1984 Giorgio Moroder Productions

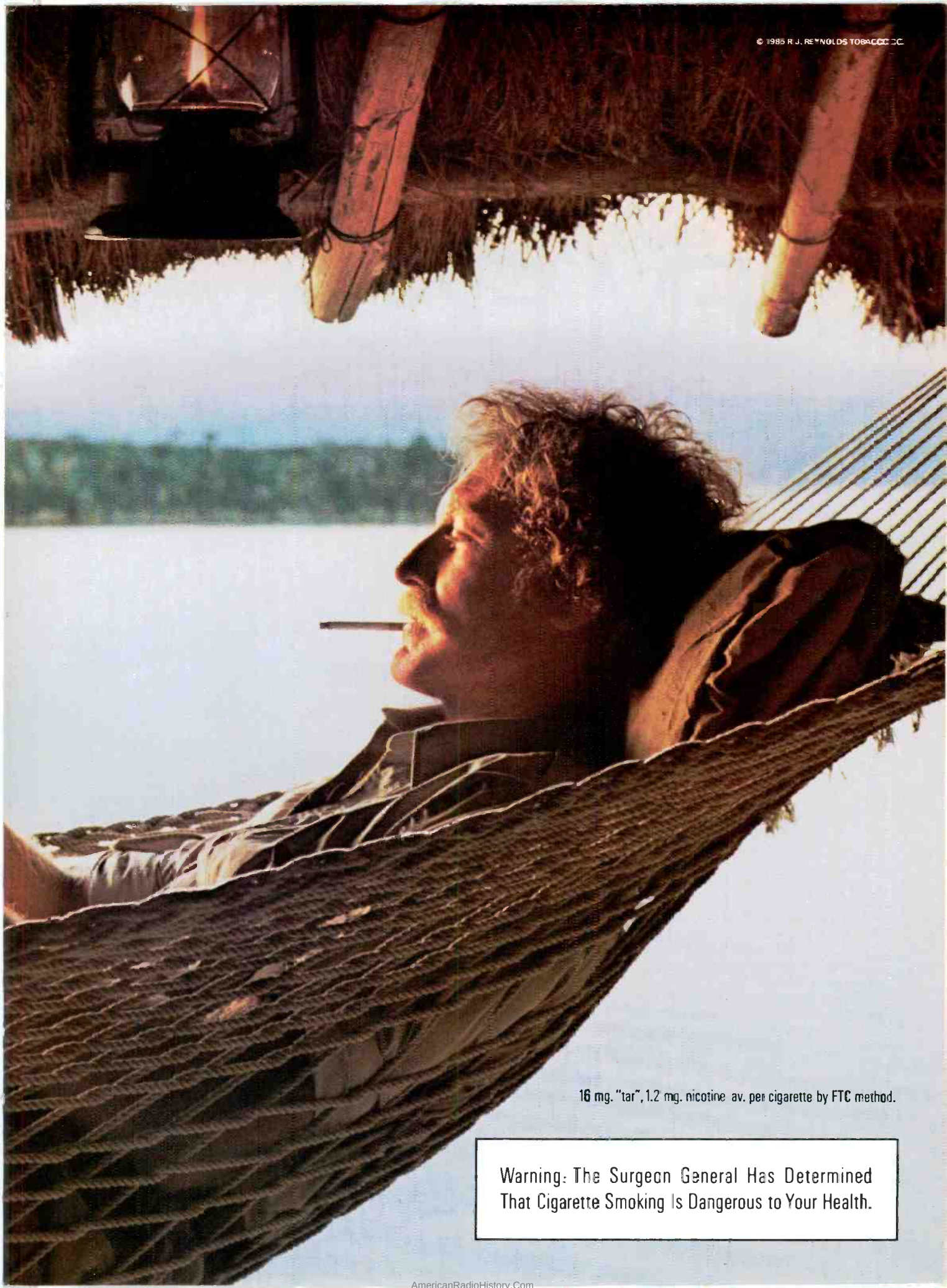
Enter No. 43 on Reader Service Card

CAMEL FILTERS

It's a whole new world.



Today's Camel Filters, surprisingly smooth.



FM Fidelity: Is The Promise Lost?

DENNIS CIAPURA

Now that we broadcasters have spent a full decade making FM loud, perhaps it is time to work on the fidelity side of the success equation.

Even though FM has blossomed into a whopping commercial success, many engineers and programmers have just cause to feel that we have not completely succeeded. Unfortunately, the competitive pressures that are an inevitable byproduct of commercial success have forced many stations to engineer for loudness as a first priority. Although almost everyone goes through the motions of preserving as much audio fidelity as possible, few observers can honestly say that the FM band sounds better today than it did 10 years ago.

Ironically, source and transmission equipment has improved dramatically over the same period, and hardly a home in the United States is without some sort of high-quality FM receiver. What strange road have we taken, then, that has led us so swiftly into the embrace of economic comfort, while leaving behind much that once was of value?

As the FCC continues to withdraw from its role as administrator of technical righteousness, the only hope of reversing the trend lies in the economic pressure that spawned the present situation in the first place. There is good reason to believe that heightened interest in FM fidelity will develop as a competitive factor. The key to understanding this lies in understanding how loudness, at the expense of fidelity, got to be so important.

The proliferation of FM stereo in autos, and the horrendous multipath problems that were generated, resulted in a significant practical requirement for higher average levels and smoother v.f. coverage. FM stations went to tall towers, and competitive processing became the name of the game. During that period, we were rather unsophisticated in our handling of pre-emphasis and filter overshoot problems; therefore, many stations simply overcompressed the audio.

As the number of FM receivers in homes and autos grew rapidly, FM stations began to make a lot of money; the number of well-financed, full-power FMs expanded, thus breeding strong competitive pressures. Programmers demanded "punch," "sock," "dial presence" and other sonic phenomena, all leading to heavier audio processing for higher average levels.

With the advent of the composite clipper, modulation karma was at hand! The peak light could be kept

---

Dennis Ciapura is President of Starnet Corp., a San Diego-based consulting firm. This article is adapted from the August and September 1984 issues of Broadcast Engineering, *with the permission of Intertec Publishing.*

Photo: The Image Bank, © Joe Azzara

aglow at 100% and the modulation monitor needle hung happily around 95. Today, many FM stations are processed far beyond the point of diminishing returns (in terms of coverage optimization). At some stations, FM audio processing has developed into a bizarre art form.

Each time creative audio-processing designers have introduced new products, they have implored their users to swap some additional level gained for better fidelity. However noble the intent of the audio munitions suppliers, though, a processing war is on and nothing short of an industry-wide processing nonproliferation treaty (with verification) can halt it.

Now that there are enough processors in everyone's hands to effect the universal elimination of audio fidelity several times over, perhaps it's time to disarm. Fortunately, the same equipment that now clips, clamps, and compresses in anger can be turned to

Photo: The Image Bank, © Gary Crallé

Above and right: As the number of FM receivers grew, FM stations went to tall towers, and competitive processing became the name of the game.

Now that almost every FM station is incredibly loud, the next new frontier must be the restoration of lost audio fidelity.

peaceful employment without significant loss of level by careful testing and adjustment.

Today, almost everyone on the band is incredibly loud; the next *new* frontier must be the restoration of lost audio fidelity. After all, the only way an FM station can sound different and distinctive these days is to sound better. It is as simple as that, and with various forms of cable radio and other new competitors just around the corner, broadcast FM needs to sound great.

It is much easier to engineer a *loud* station than it is to fashion a *loud and clean* one. Cleaning up the signal without losing level is a much more complicated task than simply turning down the processing. It starts with the cleanest, flattest possible transmission system. In the end, a system design approach, including everything in the chain from tape head or stylus to antenna, will be required.

This process is a sonic adventure requiring both wit and endurance as test instruments become constant companions in the night. Nine-to-five, tweak-by-ear enthusiasts need not apply. The reward for those who persevere, however, is a distinct signature on the air that the station can be proud of. Honestly, there must be engineers out there who are a little tired of rationalizing squashed, clipped audio.

There are a couple of key points that are often missed when stations make their FCC-required proof-of-performance checks. The first is that the proof proves little. A really clean stereo transmission system would maintain all distortion components at 50 dB below operating level (0.3%), which is a far cry from the 2%-and-greater FCC specs. It used to be fun to speculate about how the FCC would bring its 1930s parameters in line with present-day performance capabilities, but those days are gone. Therefore, it is incumbent upon quality-conscious broadcast engineers to be creative and design a meaningful proof routine.

From a technical standpoint, the equipment performance measurements required by the FCC for FM stereo stations are obsolete. For instance, attempting to check high-frequency linearity with harmonic distortion tests at 10 and 15 kHz is pointless. Stereo generators filter the audio above 15 to 17 kHz to protect the 19-kHz pilot, so even the second harmonics of 10- to 15-kHz inputs are also filtered. Under these conditions, the meter is not reading distortion at all, just residual noise. Remove the input signal and you get the same reading. Performing similar measurements at 50% and 25% modulation makes even less sense, because the reference levels are 6 and 12 dB closer to the noise, so the distortion indications get higher as the input level is reduced. Obviously, these rules were pre-stereo and have never been changed.

There are all sorts of little quirks that render the FCC-required equipment performance measurements (EPMs) of limited value except for compliance purposes. The important point, however, is not how inadequate the required tests are, but what additional testing should be done.

To that end, *Broadcast Engineering* is proposing a new set of fidelity-oriented objectives. These objectives are not intended to replace the FCC tests, but to supplement the usual proof to ensure state-of-the-art FM fidelity. (*BE* also plans to expand the program to AM radio, and possibly to television.)

Our performance specifications may look tough, and indeed they do describe superlative FM fidelity. They are, however, achievable. Even though the distortion targets suggested may be tighter than the manufacturer's specs on some of the individual links in a system, it is possible for the overall system performance to be better in some respects than the manufacturer's specifications for one of the component parts. First of all, the factory specs are usually conservative enough to accommodate production variations, so typical performance is generally better than the specification.

Also, distortion figures in a complex system are not usually additive, although they can be, and the weakest link generally sets the overall system performance limit. Frequency response errors can be manipulated to cancel each other, and, fortunately, most FM response deficiencies occur at the extreme high end of the audio band, affecting only a small fraction of an octave. They are, thus, quite inaudible. The point of all this is that station operators should not be discouraged if their stereo generator's distortion spec is equal to or slightly in excess of our system performance target. Even if a unit, when tested by itself, is nudging the factory specification, a call to the manufacturer's engineering department will often produce suggestions for minor adjustments or component swaps to improve performance.

If part of the system is due for replacement, by all means stations should consult the new vendor's engineering department to see what the *typical* performance figures are before making purchasing decisions. This is especially important when it comes to modulation monitors (precision FM demodulators equipped with accurate meters for noise and for L + R, L − R, pilot, SCA and total modulation, plus stereo separation) because some older monitors have rather unimpressive distortion specs. Most broadcast engineers do not have the test equipment necessary to check the modulation monitor independently, so the measured system performance is really the combination of transmission system and demodulator performance. This is an acceptable situation when testing for FCC compliance because the proof limits are so much less stringent than even the worst demodulators.

If we intend to go for all-out fidelity, however, we must know that the monitor demodulator is clean and is not setting the limits of our measurement resolution so loosely that improvements in transmission-system performance cannot be detected. If the old monitor just isn't up to snuff and the factory isn't too optimistic about the unit ever getting down to 0.1% residual distortion and at least a 70-dB S/N ratio, then a new monitor is a must.

It is incredible to see how many stations use FM tuners for audio monitoring at the studio because the signal from the modulation monitor is noisy, and then use the same modulation monitor to make measurements. Alternatively, in some cases, a shiny new high-tech monitor lives in the studio because it's pretty and/or has a smarter peak flasher, while the old monitor does the measuring at the transmitter. If optimizing the station's fidelity means anything at all, stations must get the best possible demodulator out at the transmitter.

TABLE I

General test conditions of Broadcast Engineering*'s proof-of-performance program for FM stations. Note that "superior" performance represents the maximum performance capability of a state-of-the-art FM stereo facility. "Excellent" performance, although tighter than the FCC numbers, is attainable by almost any properly engineered station having typical equipment.*

The following conditions apply to all listed tests:

- System in stereo mode.
- Input signals applied to console line input(s) used for most program sources.
- System output sampled and demodulated at transmitter antenna output.
- All processing and EQ left in line and adjusted as usual.
- Operating level defined as 0 VU or equivalent at console.

The following tests are to be performed under the conditions listed for each:

Frequency Response

Conditions

- Automatic gain-control voltages switched off, not simply bypassed. (Unfortunately, not all processors provide this feature; in such cases, use the bypass mode.)
- Any convenient modulation level between 50% and 100%.
- Input level as required to maintain reference modulation level.
- Response error expressed as deviation of input level required to maintain reference modulation level, compared to the 75-μS characteristic for non-Dolby stations or 25-μS characteristic with Dolby encoding.

Superior Performance

- 30 Hz to 15 kHz, ±1 dB
- 50 Hz to 15 kHz, ±0.5 dB
- 100 Hz to 10 kHz, ±0.2 dB

Excellent Performance

- 30 Hz to 15 kHz, ±2 dB
- 50 Hz to 15 kHz, ±1 dB
- 100 Hz to 10 kHz, ±0.5 dB

Distortion

Condition

- Automatic gain control switched on, input levels as required to produce specific console levels. De-emphasis in.

Superior Performance

At Standard Operating Level:

- THD = 0.3%, 30 Hz to 7.5 kHz
- IMD = 0.3%, 60 Hz and 7 kHz, mixed in a 4-to-1 ratio

At Operating Level Plus 10 dB:

- THD = 0.5%, 30 Hz to 7.5 kHz
- IMD = 0.5%, 60 Hz and 7 kHz, mixed in a 4-to-1 ratio

Excellent Performance

At Standard Operating Level:

- THD = 1%, 50 Hz to 7.5 kHz
- IMD = 1%, 60 Hz and 7 kHz, mixed in a 4-to-1 ratio

At Operating Level Plus 10 dB:

- THD = 1.5%, 50 Hz to 7.5 kHz
- IMD = 2%, 60 Hz and 7 kHz, mixed in a 4-to-1 ratio

Audio Clipping

Conditions

- Same as for distortion tests except that the input level is increased until left/right channel clipping is observed on an oscilloscope at the indicated test frequencies.
- Clipping level is defined as that level above operating level (0 VU) required to produce visible clipping as the input level is increased.

Superior Performance

- +15 dB from 30 Hz to 5 kHz

Excellent Performance

- +10 dB from 50 Hz to 5 kHz

Composite Clipping

"A" Conditions

- Composite output of the monitor demodulator viewed on an oscilloscope with the transmission system in the stereo mode (and 19-kHz pilot tone on).
- Clipping level is defined as that level above operating level required to produce visible clipping of the *total* waveform.

Superior Performance

- +15 dB at 1 kHz

Excellent Performance

- +10 dB at 1 kHz

"B" Condition

- Switch pilot off, view waveform clipping as defined above.

Superior Performance

- +10 dB at 7.5 kHz
- +5 dB at 15 kHz

Excellent Performance

- +10 dB at 7.5 kHz

Noise

Conditions

- Measured at each stereo audio channel's output, with all processing equipment in the line and adjusted for normal operation.
- Noise level is referred to the output level produced by an input signal at 0 VU at the console.

Superior Performance

- −60 dB, 30 Hz to 15 kHz, unweighted, de-emphasis in

Excellent Performance

- −56 dB, 30 Hz to 15 kHz, unweighted, de-emphasis in

Separation

Condition

- Measured at each stereo audio channel's output with all processing equipment in the line and adjusted for normal operation.

Superior Performance

- 40 dB, 400 Hz to 15 kHz
- 30 dB, 30 to 400 Hz

Excellent Performance

- 36 dB, 400 Hz to 15 kHz
- 30 dB, 50 to 400 Hz

Because super-processors are mostly used as heavy artillery in the loudness wars, few realize how beautiful a sonic picture they can paint.

Some of the newer monitors are superb audio test instruments and a real investment in a station's on-air sound. The QEI 691, for instance, features 0.05% THD and IM specs, as well as a 75-dB S/N ratio. It also provides 'scope outputs that generate a spectrum analyzer display for field calibration checks. There are several state-of-the-art monitors, including the new units from TFT which are rated at 0.1% distortion but perform considerably better. These are only two of several models available to broadcasters.

Test Measurements

Before getting into the details of some suggested procedures for optimizing the fidelity of FM systems, a look at our FM broadcast performance targets (Table I) is in order. Comparing the station's last proof results to these specs is probably an irrational act because our tests are geared toward maximum performance in the real world. We propose two sets of specifications. The first and more stringent set of specs, which we label "superior," represents the maximum performance capability of a state-of-the-art FM stereo facility. Although relatively few stations will provide this level of performance, the targets are achievable, yet challenging goals for those in quest of all-out fidelity. The second set of specs will provide "excellent" fidelity, and, although they are considerably tighter than the FCC numbers, almost any properly engineered station with typical equipment can make the grade. (See Table I.) Even stations with older equipment should achieve this level of performance if everything is properly maintained and engineered.

In general, our specifications are based upon a balance between inherent FM performance limitations and a pragmatic approach to audio fidelity requirements for system transparency. A pragmatic approach is necessary because no transmission medium is likely to serve the needs of the super-purist who interconnects his audio components with 3-inch Heliax and runs ½-inch copper tubing to his speakers. Likewise, it would be futile to suggest performance objectives that defy the laws of physics relative to maximum expected system performance. To be realistic from a business standpoint, we also must consider the real-world requirement for effective average levels.

These factors form the triad of objectivity that drives FM broadcast system design:

- Practical fidelity requirements,
- Inherent system limitations, and
- The need for effective average levels.

The practical fidelity requirements are based upon actual experimental results reported by audio industry experts. Detailed references are provided in the bibliography so that you may review the background data and arrive at your own conclusions as to the validity of the assumptions behind the numbers. Like everything else on earth, audio fidelity does reach a point of diminishing returns. Improvement beyond a certain point will be noticed by too few listeners to be of any practical consequence.

Measurement Conditions

The objective here is to simulate as closely as possible the normal operating conditions of the station. Although we suggest sampling the system at the transmitter output, a high-quality, off-air demodulator would be ideal, if available. An off-air demodulator has the advantage of taking transmitter and antenna band-pass irregularities into account. The demodulator must, however, be very flat to avoid invalid results. For stations with a modern, wide-band antenna and near-zero VSWR (voltage standing-wave ratio) indications under static and modulated conditions, an output line tap makes the most sense.

Frequency Response Checks

Absolute frequency response accuracy over the audible band-pass *does* make an audible difference. Researchers exploring subtle differences in audio amplifier designs have found that errors as small as 0.2 dB can be heard [1, 2]. As a matter of fact, if the levels and frequency responses of good-quality amplifiers are made equal, virtually no one can tell them apart in double-blind testing. Therefore, very flat frequency response (strict adherence to the non-Dolby or 25-μS Dolby pre-emphasis) is reflected in our performance objectives.

Because most musical content is in the 100-Hz to 10-kHz range, we call for ±0.2 dB in the "superior" category and ±0.5 dB in the "excellent" classification. There is no reason why an FM broadcast system can't be absolutely flat over this range, and in view of how critical flat response is to overall fidelity, it pays to optimize.

Somewhat looser tolerances are specified at the frequency extremes, in recognition of practical high-pass and low-pass filter considerations relative to subsonic warp components and 19-kHz pilot-filtering requirements. Fortunately, relatively little program material reaches the extremes of the band, so small response variations have less audible impact. As long as frequency-dependent limiting is not excessive, a station meeting the "superior" objectives would do extremely well against program input in a double-blind test comparing subjective frequency response. Most listeners would also have a tough time hearing any difference from the "excellent" parameters.

Although there has been much controversy over whether or not more than 15-kHz response is required for perfect fidelity, many researchers have found little, if any, advantage to extension beyond 15 or 16 kHz, even when the signal source is available for comparison [3, 4]. W. B. Snow's research results of 50 years ago are still valid today [5]. As a matter of fact, I have conducted experiments wherein program material was passed through *two* cascaded 15-kHz, toroidal, low-pass filters and no audible change could be detected, even with direct-to-disc sources and electrostatic headphones. A strong case, based on objective research, can be made for FM broadcast frequency response not being an audible limitation, if the response *within* the pass-band is optimally flat.

This is especially true of stations equipped with late-generation audio processors, which do a superb job of preserving the high end while protecting against overmodulation. Because the super-processors have most frequently been used as heavy artillery in the loudness wars, many users are not aware of how beautiful a psychoacoustic picture these units can paint when used with lower input levels, and a little audio artistry.

A broadcaster's source equipment—turntables and tape recorders—may impair FM fidelity.

Photo: The Image Bank, © Alvis Upitis

ONE STATION'S RESPONSE

The following comments were solicited by Audio *from Gordon S. Carter, Studio Supervisor for Chicago's WFMT, a leading FM broadcaster committed to the highest standards of broadcast quality. (For background on WFMT, see our February 1983 issue.)*

While *Broadcast Engineering*'s proposals for improving broadcast audio quality are long overdue, the standards as proposed leave a few problems. Some of these are intimated in the article but are never really dealt with.

The audio specifications given in the proposal are good. The old FCC requirements were easily passed by all but the very worst broadcasters, and tightening the specifications would tend to separate the men from the boys. *Broadcast Engineering* suggests making these measurements from a high-level console input, but they omit the real problem with many broadcasters, namely, the source itself—tape recorders and/or turntables. Many broadcasters never check their turntables for correct frequency response, wow and flutter, or even channel balance. In fact, many do not even own a good test record. Tape recorders (including cart machines) receive a bit more attention but frequently do not perform up to their intended specifications. Only a regular check of the performance of these items can insure proper operation. It doesn't matter how good the rest of the system is if the sources do not perform well.

While there is no such thing as "correct" or "incorrect" processing, audio processing is the main cause for bad-sounding stations. Usually the decision regarding the amount of processing falls into the hands of one or two people, and their tastes dictate how the station sounds. They may be targeting a certain type of audience and trying to adjust the processing accordingly. If the listeners are happy, the processing is "right." But if you as a listener do not agree, you are "wrong." Unfortunately, it is impossible to put numbers on processing quality.

While the proposed standards call for measurements of frequency response and distortion, no consideration is made for checking the relative phase accuracy of the two channels. Phase errors can cause problems in mono, yet rarely show up in other measurements. Because much of any station's audience listens in mono on inexpensive radios, some sort of phase check should be included in the tests of the system to ensure mono compatibility.

Another problem that broadcasters have is the wide diversity of equipment used by listeners. While some may have expensive sound systems, others use inexpensive portable radios. Somehow the broadcaster has to keep both types of listener happy. He usually tries to do this with audio processing, which requires a delicate balance and a rather good idea of the type of audience the station has. With no standardized listener equipment, some stations will always sound "bad" on some systems and "good" on others. No one station can satisfy everyone, either in musical programming or in "musical fidelity." However, each station must please its own audience.

One of the most disconcerting aspects of FM performance specifications is the lack of adequate monitors to measure current broadcast equipment. The *BE* article suggests a few monitors, but none of these can really measure the performance of a current-generation FM exciter and stereo generator (which produce the composite signal that drives the transmitter). To ensure accurate measurements, the measuring device must have residual specifications considerably better than the equipment being measured. However, there are no monitors currently being manufactured that perform as well in all areas as today's true state-of-the-art FM broadcast systems. As has been the case for a number of years, most measurements of an FM system are not measurements of the system, but of the measuring equipment. Most FM monitors do not perform as well in the areas of distortion, noise and separation as a good FM tuner, though they may cost upwards of 10 times the price of a tuner. A tuner is, however, not a measuring device. All performance standards for FM will be in question until the broadcast manufacturers are able to provide a suitable measuring device whose performance is better than the equipment being measured.

In spite of the efforts of *Broadcast Engineering* to encourage FM broadcasters to do a better job, in reality little will change. Those broadcasters who want to provide good audio quality will do so, as they have done in the past. And those who wish to scream at the listeners will also continue to do so. We are very much in favor of improved quality standards for FM, and have no argument with performance measurements. However, as much as engineers would like to be able to measure the sound quality of a station, the fact still remains that the final test of a station's quality is how it is heard. We are broadcasting music, not test tones, and music remains the final test of our systems.—*Gordon S. Carter*

Achieving these fidelity objectives puts participating stations back in the high-fidelity business, ready for the digital challenge.

Distortion Tests

Our distortion tests are based upon twin objectives:

- Test-tone frequencies must be kept low enough so that at least the second harmonic of the highest audio frequency input will fall within the system's 15-kHz pass-band. Therefore, no test time will be spent making harmonic distortion measurements at frequencies where the harmonics have been filtered out by the stereo generator, and possibly by the test demodulator. Virtually everyone who has done an FM stereo proof is familiar with the phenomenon in which the distortion at 10 and 15 kHz is the same whether the test tone is on or off. The test instruments are reading noise.
- System performance must be probed at two important levels: At operating level, because that is where most of the program energy is most of the time, and at 10 dB above operating level, to be sure that most program peaks are cleanly reproduced.

When distortion measurements are being made, we have specified that the a.g.c. voltages be switched back on. After all, that's the way stations broadcast, and that's what the listener hears. Excessively fast attack-time constants will produce low-frequency and IM distortion (in older limiter designs), and excessive high-frequency clipping will obviously increase high-frequency distortion. The newer limiters, with adjustable limit/clip ratios and low-frequency distortion protection, are an audio engineer's dream.

Although every chief engineer will have his own opinion as to what the optimum processor input level should be, high compression figures will make it more difficult to pass the +10 dB distortion tests. Consider the fact that if 0 VU on the console is right at the threshold of limiting (under these conditions 6 to 10 dB of compression will be indicated with program material), a 7.5-kHz input will be compressed by nearly 12 dB, due to pre-emphasis. If the level is increased to 10 dB above operating level, 22 dB of compression will result. Most systems should still provide fairly low distortion at 22 dB of compression, although the 0.5% "superior" objective might be elusive. If 0 VU at the console is 10 dB *above* the threshold of limiting, the resulting total of 32 dB of compression at 7.5 kHz might let the signal get into the safety clippers.

There is definitely a point of diminishing returns relative to compression versus loudness, until the generation of distortion components provides loudness with a *second breath*. We assume here that the folks who subscribe to that school of thought abandoned us after the first paragraph, and we make no apologies for suggesting that clipping should not be routine.

Although the IM tests are relatively impervious to system noise, the THD tests are limited by the noise floor. If the noise is 60 dB below 100% modulation (mono noise measurement), the S/N ratio of either stereo audio channel is about 54 dB (10% pilot plus 45% for one channel leaves 45% remaining for the other). When most modern modulation monitors make the FM left- or right-channel noise test, 6 dB is added to the actual audio S/N ratio to refer the noise level to 100% modulation, as specified by the FCC rules. Distortion test readings, are, however, susceptible to the noise floor below the recovered left- or right-channel signal, thus producing a 6-dB impairment. Actually, the lower figure measured at the de-emphasized audio output terminals is what the listener hears.

If a station is just meeting present FCC specs, a 54-dB S/N ratio at the audio outputs would amount to a 0.2% residual reading during the distortion tests. Our 0.3% "superior" and 1% "excellent" performance objectives recognize this fact. If a low-frequency spectrum analyzer is available, the distortion components can be picked out of the noise, and readings down to 0.1% are possible.

It is worthwhile to try and get the distortion products down to the noise level, and the noise level down to −56 to −60 dB at the audio outputs. Although THD and IM tests alone do not check dynamic instability problems like TIM, careful selection of high slew-rate components in the audio chain, as well as THD/IM figures down in the noise floor, will leave an audiophile audience impressed.

The Importance of Clipping

The clipping objectives target audio clipping at the audio output, and pilot clipping at the composite output. Either will obviously cause distortion on peaks. The audible consequences of such clipping range from harshness to gross peak distortion. Because peak energy in music falls off rapidly above 5 kHz, and the most irritating distortion components of higher frequencies will fall out of the audible pass-band, the audio clipping tests stop there. At 15 dB above operating level and 8 dB of pre-emphasis at 5 kHz, this is a fairly severe test. The two-tone composite clipping tests are also demanding, but important.

The combination of very low distortion at operating levels and freedom from clipping at high peak levels under actual operating conditions results in audio transmission that is clean and open, with never a trace of harshness. It is the stuff that long listening spans are made of.

Measuring and Controlling Noise

In many cases, system noise is the most frustrating parameter to bring under control. The opportunities for poor results are legion, and the stories about noisy telephone-company or radio links to transmitters are legend. Fortunately, many noise problems are in the transmitter link and not in the rest of the transmission system. Over the years, I have experienced more troubles with interference in these links than noise in transmitters.

Many engineers disconnect the phone-company lines or microwave receiver and, upon finding that the noise goes away, conclude that the line or link is bad. A cavity filter on the microwave-receiver antenna input or careful shielding of telephone-company loops can make a world of difference. If modulation-monitor r.f.i. infiltration is suspected, a quick test with a remote receiver will isolate the problem.

For many years, program-source noise has been so much more audible than even a marginal FM-station S/N that many engineers have become complacent about this area of performance. With digital Compact Disc source material proliferating, it's a whole new ball game. To make matters worse, home audio systems with sizzling highs accentuate any hiss that might be present.

Our "superior" objective reflects

state-of-the-art transmitter performance (about −66 dB) and assumes that the noise contribution from the audio chain and studio-to-transmitter link is minimal. Referenced to 100% modulation, −66 dB noise at the transmitter means −60 dB out of each audio channel. If the audio chain noise is kept down to −70 dB or less, the overall S/N for the system will be close to 60 dB. The "excellent" objective of 56 dB is just 2 dB better than that needed to make the FCC requirement, but every decibel of noise improvement is tough to come by.

Although 56 to 60 dB of dynamic range doesn't look very impressive in this digital age, it's important to bear two facts in mind. First of all, limited dynamic range isn't a limit at all unless the program input exhibits greater dynamic range [6]. Most program material, in most formats, stays within a 20-dB range most of the time, with short peaks outside this range.

Another key factor to remember is that the apparent loudness continues to increase as the threshold of limiting is exceeded and compression begins. The limiter may present a peak-modulation barrier, but loudness forges ahead as density increases. Therefore, a station operating at program levels a few dB under the threshold of limiting can present a somewhat greater *apparent* dynamic range than is electrically possible.

A more important question is whether a 60-dB S/N ratio provides a low enough noise floor at a receiver playing at high levels in the home. This leads to the subjective determination of how high is "high." However, millions of audiophiles have found similar S/N ratios quite acceptable in Dolby-equipped tape decks. In practice, if one monitors a well-engineered FM station during a quiet period between program segments, and adjusts receiver volume so that the residual noise is just perceptible in the listening position (assuming full receiver quieting), a considerable din will be generated when the next segment reaches full volume. The hardest part of arranging this demonstration is finding a period of true silence, devoid of higher noise floors from various sources, especially if the console operator tends to leave pots open.

Stereo Separation Requirements

Our proof separation tests are made in the traditional manner, by feeding tones into one channel while measuring the leakage into the other channel. Our low-end separation objectives are looser than for mid- and high frequencies, in recognition of the nondirectional acoustic properties of long audio wavelengths and the fact that the bass is usually mixed to center for disc production. In large orchestral recordings employing two-microphone techniques, lower frequencies end up in both mikes, even when not intentionally mixed to mono, because of the long wavelengths involved. In view of this, it seems silly to strive for more low-frequency separation than we have recommended. [*Editor's Note:* There is, however, no reason to assume that bass will be blended in CD mastering, so improved bass separation may be necessary in the future.]

In the middle and high ranges, we look for more separation than the FCC specifies, to preserve stereo imaging. Program sources rarely provide greater than 30 dB of separation, so we suggest 6 to 10 dB more than that to ensure that the transmission system is not a limiting factor.

Recommended Processing Levels

Obviously, a station can test quite well under static conditions and yet sound mediocre because of excessive processing. Because it is the intent of the *BE* proof series to propose performance objectives that describe performance in the "excellent" to "superior" strata, completeness requires recommending processing targets. To that end, we suggest specific operating levels *below* the threshold of limiting (400-Hz tone input to one channel) for various station formats: For classical/fine arts stations, levels of −6 to −10 dB; for beautiful music/jazz stations, −3 to −5 dB; for album-oriented rock/adult contemporary stations, −2 to −4 dB, and for rock stations, 0 to −2 dB.

Tweaking time constants and optimizing the performance of the audio chain are areas of individual prerogative that can give a system an extra measure of crispness and openness. One huge benefit of the conservative processing levels and fidelity objectives we recommend is that the transmission system becomes transparent enough to make source and console improvements audible.

Final Thoughts

Achieving the fidelity objectives suggested in the *BE* proof program means more than simply providing outstanding FM audio. It means getting back into the high-fidelity business, ready to meet the challenges of the digital audio world creeping up on us. FM broadcasters will find improved source signals widening the gap between FM quality and home system quality, unless FM can once again establish itself as a high-fidelity medium.

It may well be that a whole generation of broadcast engineers who were reluctant soldiers in the loudness wars will respond to the call to serve under a new and more rewarding banner. For listeners who may be fortunate enough to have these stations in their area, perhaps Dr. Edwin Armstrong's promise of FM fidelity will not be a promise lost after all.

References

1. Lipschitz, Stanley P. and John Vanderkooy, "The Great Debate: Subjective Evaluation," *Journal of the Audio Engineering Society*, Vol. 29, No. 7/8 (July/August 1981), pg. 482.
2. Buecklein, R., "The Audibility of Frequency Response Irregularities," *JAES*, Vol. 29, No. 3 (March 1981), pg. 126.
3. Muraoka, Teruo; Makoto Iwahara and Yasuhiro Yamada, "Examination of Audio-Bandwidth Requirements for Optimum Sound Signal Transmission," *JAES*, Vol. 29, No. 1/2 (January/February 1981), pg. 2.
4. Plenge, G. H., H. Jakubowski and P. Schoene, "Which Bandwidth Is Necessary for Optimal Sound Transmission?," Preprint No. 1449, 62nd Convention of the Audio Engineering Society, Brussels, March 1979.
5. Snow, W. B., "Audible Frequency Ranges of Music, Speech and Noise," *Journal of the Acoustical Society of America*, Vol. 3 (1931), pg. 155.
6. Fielder, Louis D., "Dynamic-Range Requirement for Subjectively Noise-Free Reproduction of Music," *JAES*, Vol. 30, No. 78 (July/August 1982), pg. 504.

THE PROBLEM WITH FM

ERIC SMALL and ROBIN LANIER

Suppose your local FM station announces that it's about to play a recording that you have in your collection. Wondering if you'll hear any difference, you put your record on the turntable and play it, more or less in sync with the broadcast.

As you switch back and forth between the two, the chances are good you will find that, in direct comparison with your LP, the radio version is weak at both the bottom and the top of the frequency range, has a cramped feeling because of serious lack of dynamic range, and is a little more noisy, different in timbre and perhaps a little muddy in the middle.

Is the FM broadcaster simply having a bad day? Probably not. FM radio today typically comes off second best when compared to the best home equipment, and the Compact Disc poses an even tougher challenge to broadcasters.

This comes as no news to the broadcasters themselves, and efforts are now spreading in the FM industry to remedy the situation. These efforts will intensify in coming years, as the competition from alternate program sources of very high fidelity gets hotter. This competition is coming not only from Compact Discs, but also from new hi-fi videocassette recorders with super fidelity, from videodiscs, and even from cable television's recently upgraded stereo programs such as MTV. Too, the movies are giving us an entirely new quality of sound with Dolby Stereo, which is actually a four-channel system with excellent characteristics. And home digital audio tape (DAT) cassettes should be here in a year or two.

FM, of course, has a number of important strengths that look especially good in comparison with AM. The top legal limit on frequency response on AM is 15 kHz, but the noise problem makes the practical limit much lower. The best way to make noise tolerable on weak to moderate-strength AM signals is to limit frequency response, and most readers of this magazine's

Sequerra Model 1 broadcast analyzer/tuner

Photograph: Carl Zapp

"Equipment Profiles" will know that typical AM receivers usually cut off around 3 kHz.

In the past, the most-used route to reasonable fidelity in AM listening was to concentrate on high-powered local stations, whose signals were well above the noise level, so that receiver response could be opened up to 12 kHz or so. Readers whose interest in high-quality sound goes back to the 1940s or '50s will remember TRF (tuned radio frequency) receivers, which had wider band signal amplification than the now-universal superheterodyne circuit. With TRF, frequency response could be wide and distortion low. Strong local stations came in with excellent fidelity. The main problem was an occasional 10-kHz whistle, which occurred when the carriers of strong signals only 10 kHz apart beat together; notch filters were a common solution to this.

The situation on FM is entirely different. Mono FM is a transmission system of basically marvelous fidelity. Noise is not a problem as long as the signal reaches the limiting level, which, in a sense, saturates the residual AM response of the tuner. There is neither a technical nor legal limit on frequency response up to 99 kHz or so, if a subcarrier, or SCA signal, is not used. Even with the extra signals of SCA, the frequency response can go far above the standard 20-kHz top. The maximum legal mid-band distortion is 2.5%, but most FM stations do much better, down to fractions of 1%.

Stereo FM is a bit different. Frequency response is limited to 15 kHz to prevent the signal from "folding over" onto the L – R subcarrier. To reach the no-noise level, a stereo signal must be much stronger than a mono signal—23 dB stronger is the figure usually given, but recent tests by an EIA group studying quadraphonic FM indicated that, with real program material, the difference is more like 26 dB. The broadcasters have accepted this loss, and the resulting reduction in fringe coverage, because it is impossible to be competitive in the FM market without a stereo signal.

However, it's dynamic range that's at the center of FM's present troubles. With first-rate design, FM transmission can have a signal-to-noise ratio of 60 dB or more, including the whole system of transmitter and receiver. This does not mean an FM operator can put a dynamic range of 60 dB on the air. For one thing, the Federal Communications Commission limits the modulation an FM operator can apply to his carrier, in order to reduce the chances that the signal will interfere with others on the air.

Frequency modulation theoretically produces an infinite series of sidebands, new signals that go out with the carrier, at frequencies spaced at multiples of the modulating frequencies. For example, if a 10-kHz signal is applied to an FM transmitter, it will produce sidebands at 10, 20, and 30 kHz (and so on) above and below the carrier frequency. The strength of these sidebands depends on how heavily the station modulates its signal.

Strong sidebands too far from the carrier frequency are likely to interfere with other FM signals. But, luckily for broadcasters, if the carrier is not too heavily modulated, the farther sidebands will be weak and thus no problem to other stations. The FCC must therefore regulate modulation so that stations' signals will be strong, but not so strong that their sidebands will cause trouble.

In AM, maximum modulation is defined by the physical limits of transmitter action as a maximum of 120% above, and 100% below, nominal carrier strength. (The negative limit is lower because, below 100% negative modulation, the transmitter simply cuts off.)

In FM, however, the depth of modulation depends on how far the signal pushes the carrier off its center frequency. Within broad limits, the amount of this frequency deviation is unrelated to the physical limits of the transmitter. A maximum-deviation spec is arbitrary, as far as transmitter capabilities are concerned, and the limit can be raised substantially without causing transmitter distortion from overload.

For this reason, the deviation limit is set by the FCC. To define how much deviation could be allowed without sideband interference, the FCC first defined a characteristic called "occupied bandwidth." This is the spread of frequencies (including all sidebands) that contains 99.5% of the energy in the signal. If this occupied bandwidth is no wider than 240 kHz, interference is likely to be under control. A number

Eric Small, currently Vice President of Engineering for Modulation Sciences in Brooklyn, N.Y., has extensive experience with FM stations and in the development of broadcasting equipment. Robin Lanier, a freelance writer, was formerly Senior Editor of BM/E (Broadcast Management/ Engineering) *magazine.*

Mono FM is essentially a higher fidelity medium than stereo FM, with its 15-kHz frequency limit, lower dynamic range and weaker signal.

of studies have led to a U.S. specification: A maximum deviation of 75 kHz on each side of the carrier frequency will produce an allowable occupied bandwidth.

So far, the story sounds positive. But there is a complication: Nearly all music includes short peaks that are many times as stong as the average level of the music at any given period. If the short peaks are to be kept from going over the 75-kHz deviation limit for stereo, the average strength of the music must be kept very low. In fact, if we define 100% modulation in FM as a 75-kHz deviation, a station turning down the signal level to keep the peaks from going over the limit would typically be modulating at an average level of only 6% to 8%.

This would mean a very weak signal, and a station in a metropolitan area could thus lose a large portion of its natural audience. In today's savagely competitive radio industry, losing a large part of the audience is economic suicide. Advertisers study audience surveys with manic intensity and go where the ratings numbers are highest.

How, then, can a commerical FM operation obey the rules and stay in business? The virtually universal answer has been the use of audio processing to bring the average and peak levels of the music closer together—in effect, to flatten the peaks so they have less tendency to go over the top.

The processing must also do something about pre-emphasis, the large boost of high frequencies at the transmitter to improve the signal-to-noise ratio. Pre-emphasis turns high-frequency peaks into powerful bursts that need special taming if they are not to push modulation over the 75-kHz deviation limit.

The manufacture of audio processors for radio has become a boom industry in the last 5 years, and the units have also moved far ahead technically. The typical processor today has a three-stage action: First, a slow compression circuit somewhat flattens the slower rises in music level; then, moderately fast peaks are compressed, and finally, an extremely fast circuit, usually called a "clipper," catches the very quick peaks that slip through the earlier circuits.

Applying such a device results in a tamed-down audio signal, shorn of troublesome peaks, which the operator can turn up for high overall modulation without having peaks go over the 75-kHz deviation limit. Unfortunately, another obvious result is a reduction in the dynamic range of the music, the amount of reduction depending on how the operator sets his audio processor's controls.

The operator can set those controls for just the amount of enhancement he wants. At one extreme are classical-music stations in large markets. They do less processing than the pop-music stations because classical music is generally understood, at least by its listeners, to have dynamic range as an essential attribute. This is probably not true of popular music or its listeners. Classical station WNCN in New York, for example, uses light processing, producing an average modulation level of around 30%. The management does get complaints of weak or noisy signals from some listeners, but so far the number of listeners who *do* get a usable signal and who appreciate the wide dynamic range has been large enough to keep the station going.

At the other extreme are stations slugging it out on the rock front, where a competitive signal is one that jumps out at the listener tuning past. The signal of a prominent rock station in New York has been measured to have an average modulation level of 70%, and *a dynamic range of 2.5 dB!* The music is very loud, and it maintains nearly the same loudness all the time.

Noncommercial stations have it a little better. They are not forced to compete for big, marketable audiences, although they still need to serve substantial audiences to satisfy their backers. One example is WETA in Washington, D.C., which is said to use very little processing. The management has surveyed listeners to find whether the majority wants the increased dynamic range of a lightly processed signal or a less noisy signal (in suburban areas) with much less dynamic range. The large majority has preferred the maximum dynamic range.

Reducing the amount of processing is a good idea not only because it increases dynamic range but also because it means less coloration. Heavy processing uses program-dependent gain circuits, whose gain varies with signal level, and this adds false coloration to the music.

What can be done to lower the pressure for processing? Because "loudness wars" are an acknowledged part of operating an FM station in many cities today, help must come on the technical front, if it is to come at all.

One thing that some FM operators could do is take advantage of a loophole in the rules. The FCC doesn't say a station may *never* deviate beyond 75 kHz, only that its peak deviation must not exceed 75 kHz more than 10 times a minute. Still, many stations have not allowed themselves even this much overmodulation, in part because of the nonexistence of equipment to automatically restrict such peaks to the allotted 10 per minute. At least one firm, Modulation Sciences, of Brooklyn, N.Y. (of which author E.S. is technical director), plans to produce such equipment. The 10-per-minute rule makes sense because the energy in short peaks, more than a few milliseconds apart, will not "integrate" for a cumulative interference effect, and each separate peak will lack the energy to cause interference trouble.

In the long run, the 75-kHz rule might be modified. Recent studies show that, while peak deviation is directly related to occupied bandwidth in mono, this is not the case in stereo—which is to say, in virtually all FM broadcasting today. Mathematical analyses, some made by Dr. Eric Stoll of Modulation Sciences, have shown that a stereo signal with 75 kHz of deviation does not occupy its full, 240-kHz bandwidth. For example, with a 15-kHz signal modulating a carrier to 75 kHz deviation, one study showed occupied bandwidth to be only 166 kHz.

Measurements of airborne FM signals carried out by the Environmental Protection Agency in Washington, D.C. [1] showed similar relationships. The agency had assembled very elaborate automated equipment for measuring the strength of radio-frequency fields, to determine whether the prevailing fields posed any danger to the health of those exposed to them. As a by-product, the group tested the signals of Washington FM stations to determine occupied bandwidths with typical program material.

If the FCC changed the rules, the stations that used the least signal processing would benefit the most, as would the audiophile listener.

Table I—Summary of data on FM broadcast-station bandwidth (excerpted from Reference 1).

Station	Frequency, MHz	Averaged (25-dB) Bandwidth, kHz
WETA-FM[1]	90.9	47
WGTS-FM	91.9	65
WJMD-FM	94.7	107
WPGC-FM	95.5	160
WASH-FM	97.1	124
WGAY-FM	99.5	80
WFAN-FM[2]	100.3	102
WWDC-FM[1]	101.1	126
WHFS-FM	102.3	120
WGMS-FM	103.5	94
WAVA-FM[3]	105.1	60
WMAL-FM[1]	107.3	87

Notes
[1]Stereo + SCA
[2]Mono
[3]Mono + SCA
All other stations stereo

Table I shows some of the findings. The figures, which are average bandwidths over a period of at least 10 minutes, show how far below the 240-kHz allowance stereo signals typically are. (The differences reflect a number of factors in station operation, including—but not restricted to—the degree of audio processing.) It is notable that nonprofit station WETA, which uses very little processing, was extremely low on occupied bandwidth.

What these studies and tests demonstrate is that the allowable peak deviation could be increased substantially in stereo without causing unacceptable interference on the band, if the FCC would change the rules to allow this. Stations that use the least processing would benefit the most. FM operators who wanted to keep fidelity higher could reduce processing without cutting down average modulation. Stations that still used heavy processing would not gain much from such a change. This question of the peak-deviation limit has been under discussion at the FCC, but there has been no action yet; we hope it will come soon.

Whether that change comes or not, there are a number of ways in which FM operators can raise fidelity within the present FCC rules. Replacing old transmitters with current, top-grade units would be especially effective. Older audio processors, prime causes of below-par fidelity, could be replaced with more recent versions, a number of which—if used lightly—will greatly reduce processing distortion. Experience with FM stations suggests that processing distortion is lowest when the sharp clipper does most of the job and broad gain-control action is eased off as much as possible. But this won't be done unless the operator wants light processing.

Another effective way to raise fidelity is to bring the studio gear—microphones, disc and tape players, and mixing consoles—up to today's best standards. All studio gear has benefited from the last decade's great advances in recording-studio quality. Experience in many FM stations shows that turntables and broadcast tape-cartridge (endless-loop) machines are commonly to blame for low audio quality. The turntables and cart machines used by broadcasters a decade ago had very low quality to start with, often made worse by poor maintenance. Better turntables and cartridge decks have appeared in the last 5 years.

Digital technology is beginning to have an effect on FM quality. A number of FM stations are, of course, occasionally using Compact Discs for programming. As suggested at the beginning of this article, the full quality of the Compact Disc—particularly its dynamic range—cannot get through the FM transmission system. But the CD's recording quality often does give the FM signal a lift that many listeners notice and welcome.

However, the digital disc puts even more pressure on FM radio stations to control the processing function. The CD's frequency response is *really* flat to the top of the range, so bursts of highs, when enlarged by pre-emphasis, are harder to handle than ever. The processor often has to be carefully reset to avoid serious distortion, and some of the older processors won't make it at all.

A number of FM stations are using digital technique to excellent effect in their handling of "remote" pickups—music programs brought in from outside the studio. Nonprofit station WGBH in Boston, which has been particularly venturesome over a number of years in its push for higher signal quality, is among those that have used a digital processor and a VCR to record concerts for later broadcast. WGBH is also using advanced equipment on "live" feeds. A digital audio-transmission system between Symphony Hall in Boston and the station's studios has been especially successful, with listeners expressing strong, unsolicited approval of the results. The station's link from studio to transmitter will also soon be digital, using a video transmission system for the extra bandwidth needed. The existing analog link uses Dolby A noise reduction to improve the signal-to-noise ratio.

On studio broadcasts, WGBH uses very little audio processing. On live music broadcasts, they cut their processing back by another 6 dB, responding to the listener's expectations of especially high quality on such broadcasts, and conscious of the fact that these live events have a large following among listeners close enough to the station to get a strong signal.

A number of other FM stations are making determined efforts to raise signal quality. That is one reason we feel confident, as we said at the beginning, that FM will continue to function as a source of satisfaction for the audiophile and serious music listener. It will also continue to satisfy the average listener, who now approaches FM more as background than as the concentrated listening experience that serious phonograph music so often is. FM's somewhat reduced dynamic range is actually an advantage in a music source that listeners alternately approach and depart.

In any case, we conclude that FM *can* advance to a level close to the best home-play quality, close enough to make the signal thoroughly satisfying. The growing intensity of media competition in the coming decade makes it certain that many FM operators will make the effort needed to reach that high level.

Reference

1. Tell, Richard A. and John C. Nelson, "Broadcast-Signal Bandwidth Measurements Using Real-Time Data Averaging," *IEEE Transactions on Broadcasting*, Vol. BC-22, No. 4, December 1976.

Designs for Listening

DAVID LANDER

Even in a world of few certainties, occasional statements can safely be accepted as truth. One such maxim, beauty is in the eye of the beholder, has been borne out by centuries of changing taste, preferences ranging from the classical elegance of the Parthenon and other monuments of ancient Greece to the curvaceous architectural jewels of Vienna. Just as one generation's collective eye exults in the swirling opulence of Art Nouveau, another era's vision is lured by

Three views of a home set up for sound. Top left: The pedestal under the Grecian urn conceals a floorstanding hi-fi loudspeaker. Lower left: The master bedroom's TV is partially concealed by cabinetry, while the flush-mounted speaker can be fed by either of two separate audio systems. Pictured opposite is the living room, which contains the main audio system's control base, deliberately placed by Cleveland's Audio Craft in the most convenient spot in the house.

Photographs: Northlight Studios/Charles Hudson

Mondrian's linear austerity or the products of the Bauhaus, all based on a firm belief that less is more.

And consider this dictum, no less axiomatic if all too often ignored: A high-fidelity system is seen even more than it is heard. This is why Audio, *which perennially concerns itself with the sound of hi-fi components, makes this brief detour along visual avenues. It is not our purpose here to evaluate the envelopes in which individual pieces of equipment are contained. Rather, in the pages that follow, we present several systems* in situ. *While designers of these rooms took varying directions, some celebrating the hardware while others chose to de-emphasize it, we feel all are exemplary.*

A closet was converted by Sound Plus Wood of Boca Raton, Florida (left), to a cabinet containing both a dry bar and audio componentry. For the room below, speakers were chosen for their sculptural quality as well as sound. The beige cloth trim of the units, from Christopher Hansen Ltd., Los Angeles, integrates elegantly with the surrounding earth tones of the carpet, leather furniture and pre-Columbian art.

Photographs: Dan Lenore

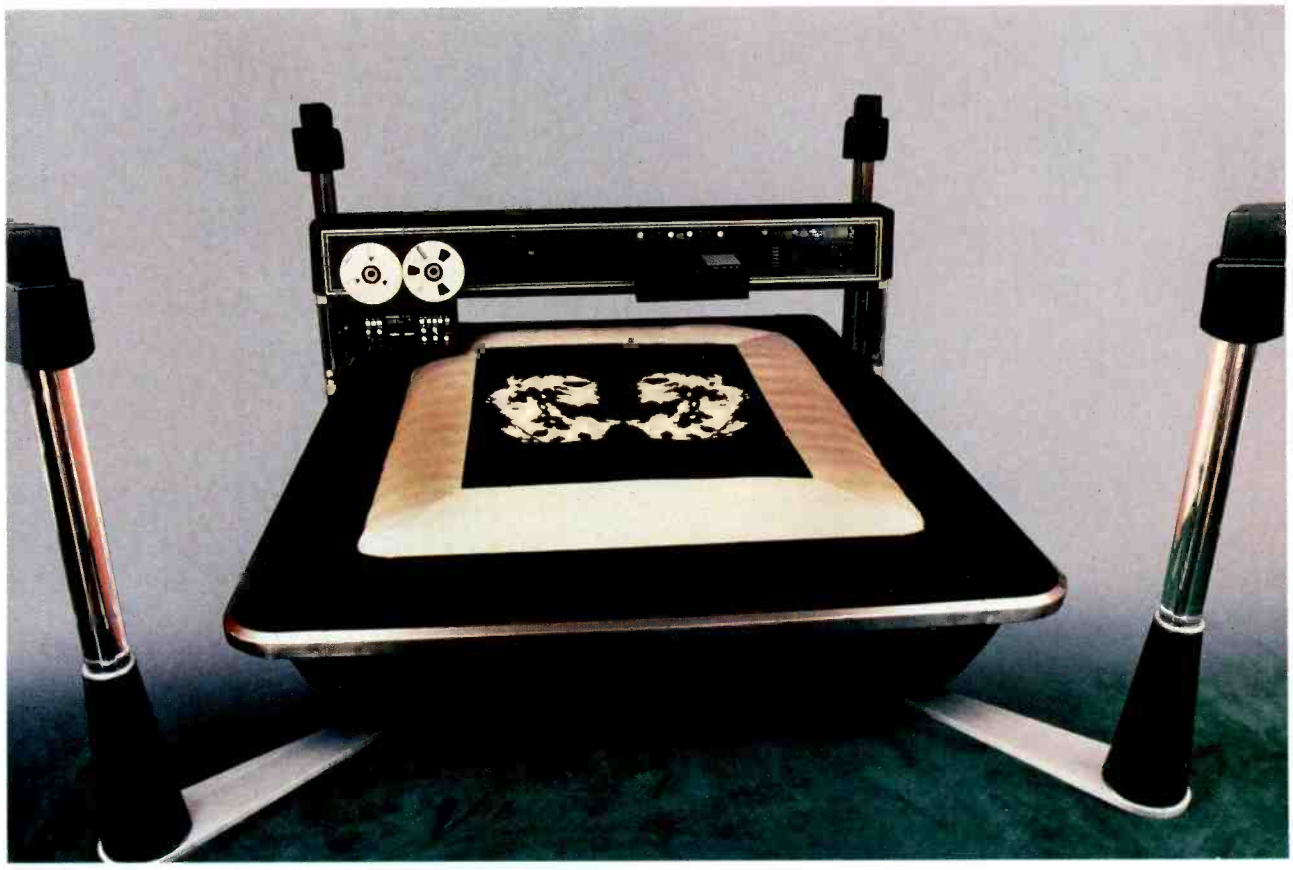
Some years ago, our Senior Editor, Leonard Feldman, supervised the setup of a component system in Jimmy Carter's White House. In the process, he had to convince the Presidential minions presiding over the event that the loudspeakers should not be placed behind drapes.

The installations pictured on the following pages provide clear evidence that neither compacts nor curtains are the answer for people conscious both of what they see and hear. While obviously expensive, some of the visual ideas embodied can be scaled down for a long and happy mating of good looks and fine sound. Such solutions are well worth seeking, even for those who find the merest sight of high tech a low blow. After all, as a poet long ago noted, "Music hath charms that soothe. . . ."

A now-you-see-it, now-you-don't approach to stereo sound was taken in the above installation by Goodwins Music Systems, Cambridge, Massachusetts. Built-in cabinets spell concealment for speakers and subwoofers not in use. For music, one need only open their doors.

Left: For a distinctly different but no less sensuous experience, the opposite wall of the room pictured above contains a fireplace.

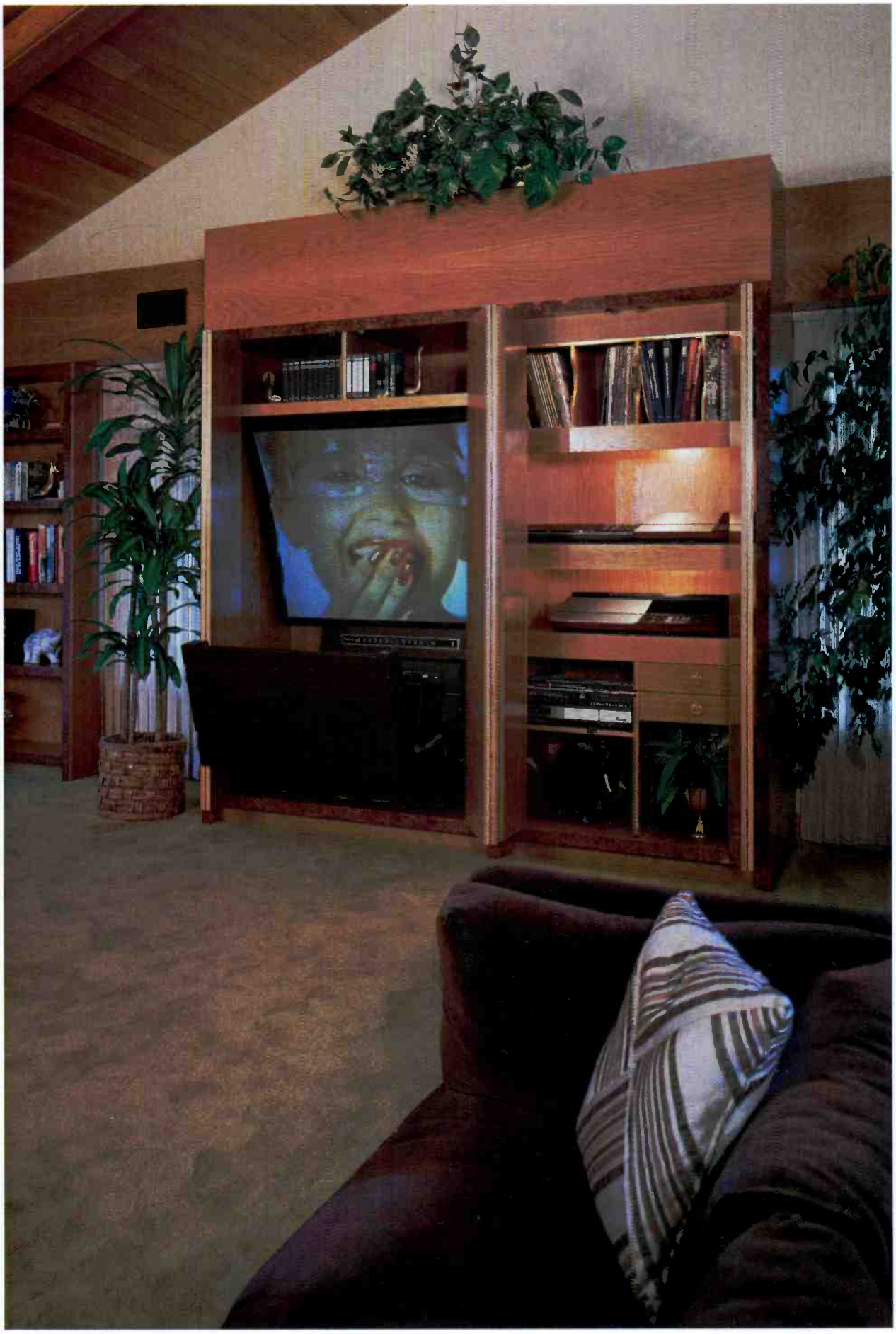
This page and facing gatefold: Created specifically for listening, the room pictured on these pages houses a grand piano flanked by speaker systems painted to make them less obtrusive. The brightly colored Miró tapestry on the far wall serves to lead the eye away from the overly large transducers, while richly grained oak cabinetry contains a portion of the system's extensive electronics (a battery of amplifiers provides power from a basement hiding place). Carefully selected pieces of art and a lush Persian carpet reflect the owners' eclectic taste. Music system by Lyric, New York City.

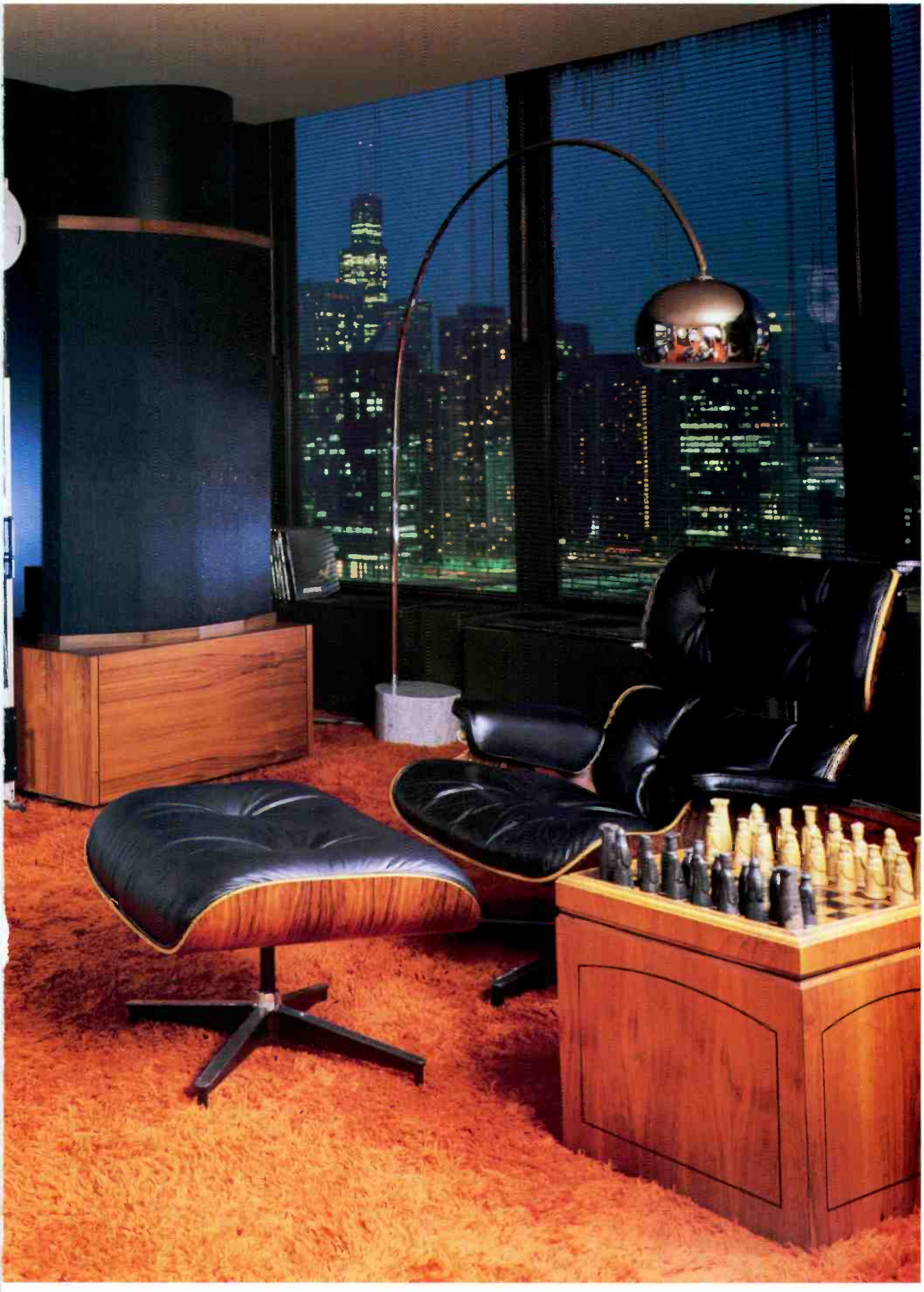


The bed above, a gift from ex-Beatle Paul McCartney to his friend Stevie Wonder, features a mattress head (nearest the viewer) that can be raised to form a backrest; the console holding the audio electronics slides backward to rest conveniently above the occupant's legs. Christopher Hansen, of the Los Angeles hi-fi salon bearing his name, employed a shipwright to fabricate the bed's curved wooden framework and turned to artisans experienced in working with stainless steel and Lucite, and other primary materials, to complete construction.

Along with a media system, the wall-length unit in the room pictured at right contains ample storage space for books, records and tapes. It is a handsome tribute to the high standard of craftsmanship of ex-cabinetmaker Michael Moran, who, with his brother Kevin, operates Boca Raton, Florida's Sound Plus Wood.

Inside gatefold: This elaborate system fulfilled its owner's desire to celebrate a genuine passion for audio equipment. Music is accompanied by a breathtaking view of the Windy City skyline in this Chicago lakefront apartment. The system was installed by Paul Heath Audio, Chicago.





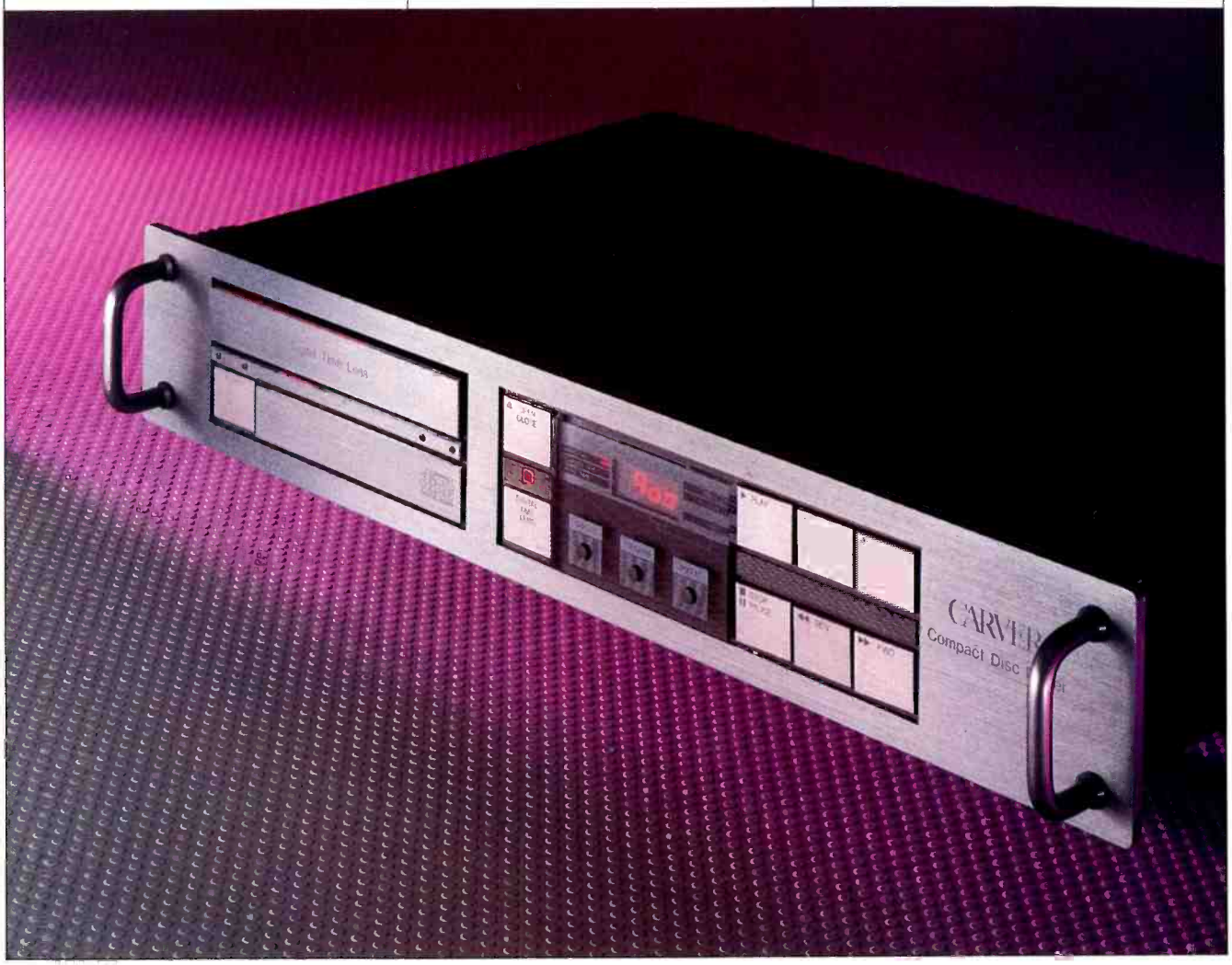
Photograph: Robert Lewis

The wall pictured opposite, top, is constructed of architecturally matched red oak. Control units mounted in the cantilevered central module and adjoining pedestal-mounted modules are flanked by massive horn-loaded speakers. Opposite, bottom: Lighting positioned beneath the lower cabinet (which is mounted 8 inches above floor level) makes this two-tiered wall unit appear to be floating. Below: Built-to-spec cabinetry, in this case made of Formica with stainless-steel accent molding, helps integrate a 40-inch-screen television monitor with its surroundings. The cabinet provides a mounting surface for the audio unit to the screen's right and conceals a videocassette recorder, tapes, and discs. All work on these pages from Sound Plus Wood.

1

THE CARVER COMPACT DISC PLAYER

Manufacturer's Specifications
Frequency Response: 5 Hz to 20 kHz, ±0.5 dB.
S/N Ratio: 96 dB.
Dynamic Range: 96 dB.
Channel Separation: 60 dB.
THD: 0.05% at 1 kHz.
Output Level: 1.9 V at 0 dB.
Number of Programmable Selections: 99.
Power Consumption: 26 watts.
Dimensions: 19 in. (48.3 cm) W × 3 7/16 in. (8.7 cm) H × 11¼ in. (28.6 cm) D.
Weight: 13 lbs. (5.9 kg).
Price: Approximately $649.
Company Address: 19210 33rd Ave. West, Lynnwood, Wash. 98036.
For literature, circle No. 90



Photograph: Robert Lewis

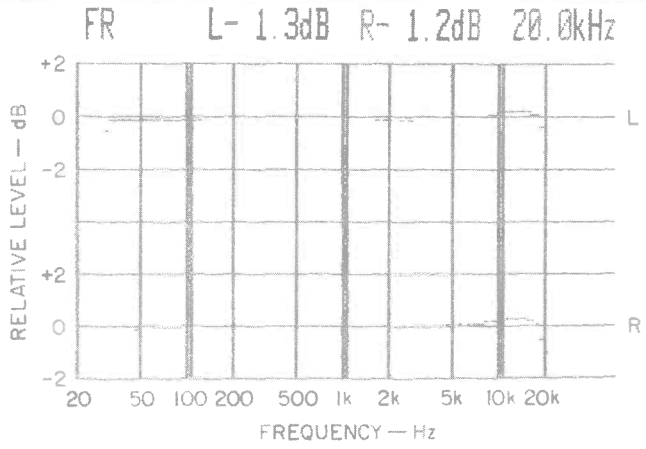


Fig. 1—Frequency response, left (top) and right channels, with Digital Time Lens off.

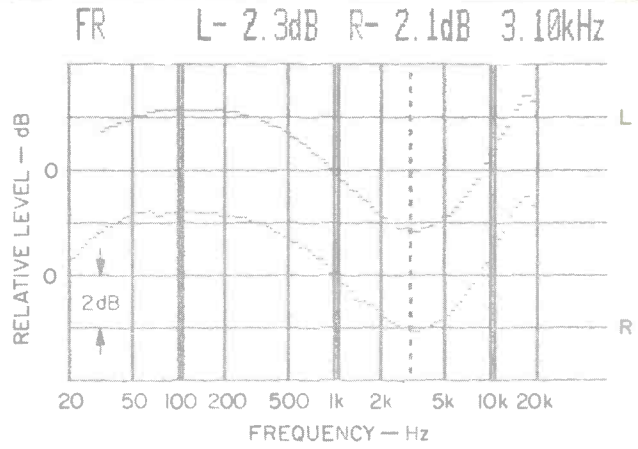
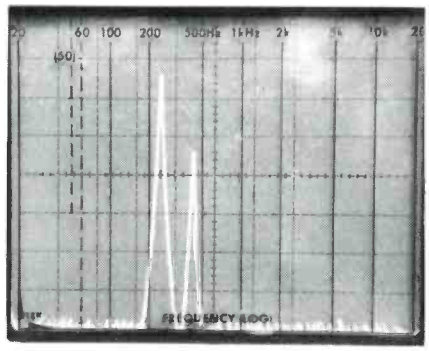


Fig. 2—Same as Fig. 1 but with Time Lens on. Bass peaks shown measure +2.3 to +2.4 dB at 145 Hz, treble dips are −2.1 to −2.3 dB at 3.1 kHz. Note also treble peak just below 20 kHz.

Leave it to Bob Carver to come up with a CD player designed to please both those who love CDs and those who still have reservations about their sound quality. Carver, one of the true innovators in the audio industry, has given us such "magical" signal-processing circuits as the Autocorrelator (a single-ended noise-reduction circuit), Sonic Holography (a space-expanding stereo system), Magnetic Field Amplification, the Asymmetrical Charge-Coupled FM Stereo Detector (for better FM stereo reception), and now, the Carver Digital Time Lens, intended to satisfy those who maintain that LPs sound better than CDs. The names of these audio innovations don't tell you much about what the circuits actually do. The fact is, though, that these circuits *do what Carver intends*, and they do it very well indeed. His newest, the Digital Time Lens, is no exception. But before I get into that unit in detail, let's have a look at the way Carver has put together his first CD player, which, like his receiver, carries no model number—only the appellation *The* Carver CD Player (emphasis mine).

Fig. 3—Spectrum analysis, 0 Hz to 50 kHz, showing 20-kHz tone (tall spike) and spurious beat tone (small spike) at 24.1 kHz.



Control Layout

The player's front panel conforms in size and color to several other Carver products, featuring a 19-inch-wide front panel equipped with handles and finished in a subdued charcoal gray. Carver continues to insist upon using what I call "black on black" printed nomenclature on his front panels. It's almost invisible unless light hits the panel at just the right angle. For a reviewer such as myself, this can be frustrating at times, as I strain to find the right buttons to push. However, for an owner of the equipment, who becomes accustomed to the various controls' positions, it should pose no problem. In fact, it makes for a very subdued-looking panel which fits in with home decor much better than some of the garishly inscribed panels I have seen.

Other than the two handles, there are no protrusions on the front panel whatever. The CD drawer at the left is opened by touching a square touch pad on the right of the

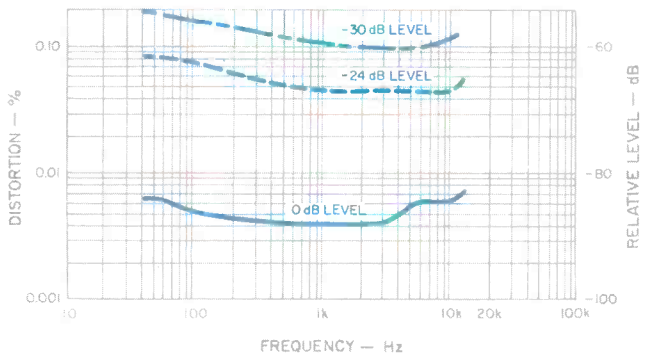
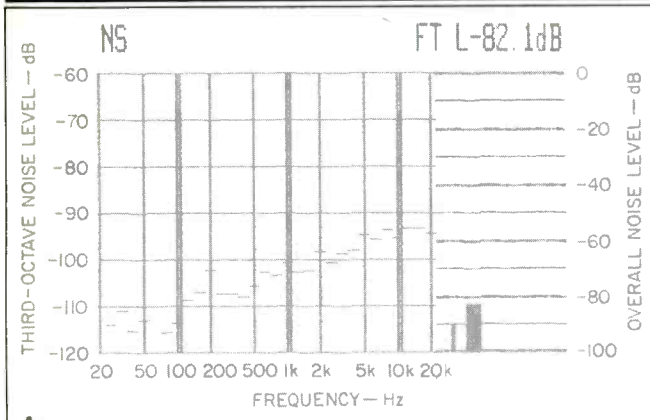


Fig. 4—THD vs. frequency at three signal levels.

Carver is a true innovator. His circuits have strange names, but they do what they're supposed to, and they do it very well.



A

B

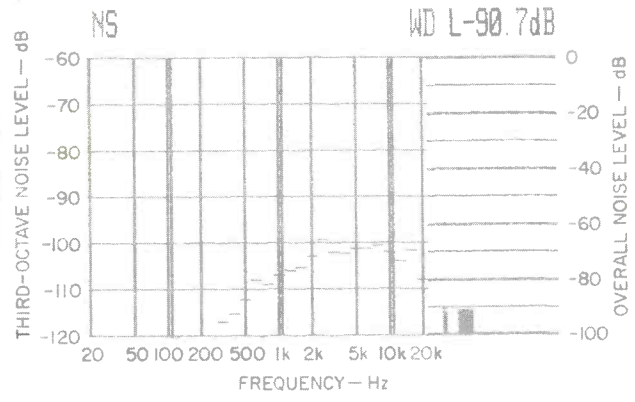


Fig. 5—S/N analysis with Digital Time Lens adding dither, both unweighted (A) and A-weighted (B).

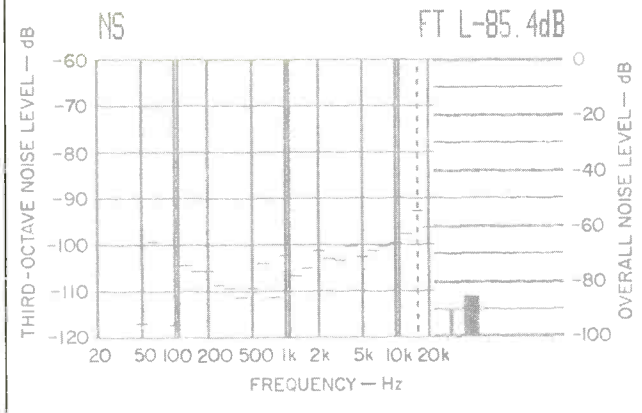


Fig. 6—Unweighted S/N analysis, without added dither.

drawer; it's closed either by touching that button a second time or by touching the drawer itself. The on-off button is located below the disc drawer. A pushbutton below the "Open/Close" button activates Carver's Digital Time Lens (about which I will have much more to say in a few moments). When the "Digital Time Lens" button is depressed, a light above it indicates that this circuit is in use. An LED display near the panel's center alternately displays track number or elapsed time within the track. When a disc is loaded into the disc drawer, the display first shows the total number of tracks on that disc and can then be switched to show total time on the disc. When you're programming, the display shows both the current track or index number and the current program slot—i.e., "16P 3" indicates that you've programmed track 16 as the third of the 99 possible program selections.

Although the display is really a simple numeric one, Carver has managed to program the eight-segment LEDs so that they also provide useful "alpha"-type data. When power is first turned on, the laser pickup does some searching, while the display blinks with a few dashes ("----"). If no disc is located, the word "dISC" begins to flash intermittently. When the door is opened, the word "OPEn" appears. After your programmed selections have been played, or the programming is completed, the word "End" appears. Below the display are three small pushbuttons, labelled "Display" (for switching between elapsed time and track number), "Program" (for initiating program mode and storing each of the track numbers to be played) and "Repeat" (for programming repeat-play of a given disc or group of tracks that have been selected).

Six more touch pads or buttons, to the right of the display, initiate play, track-by-track reverse or advance, stop/pause, fast-reverse and fast-forward (with muted but audible cueing). The track-by-track and cueing buttons are clustered in a square, for convenient shuttling between tracks and locations. These buttons have auto-repeat, so if you wish, for example, to jump ahead by 40 tracks, just hold down the track-advance ("+") button. The display will show track numbers advancing faster and faster until you lift your finger—"warp drive," Carver calls it, though slewing is more usual.

Loading a disc in the drawer and pressing "Play" will close the drawer and start the player. If you press "Open/Close" instead (or simply nudge the drawer itself), the drawer will close and the player will scan the disc to locate its tracks, but play will not begin until you press the "Play" button.

You can begin programming a disc even before the drawer has closed. Press the "Program" button to get into the mode, then press the "+" button to advance to the desired track. If you overshoot, just press the "−" button. (The forward and reverse buttons perform the same functions, but for index points, not tracks.) Pressing the "Program" button once again stores your selection, blanks the left (track/index number) side of the display, and changes the right side from "P 1" to "P 2" for your next selection.

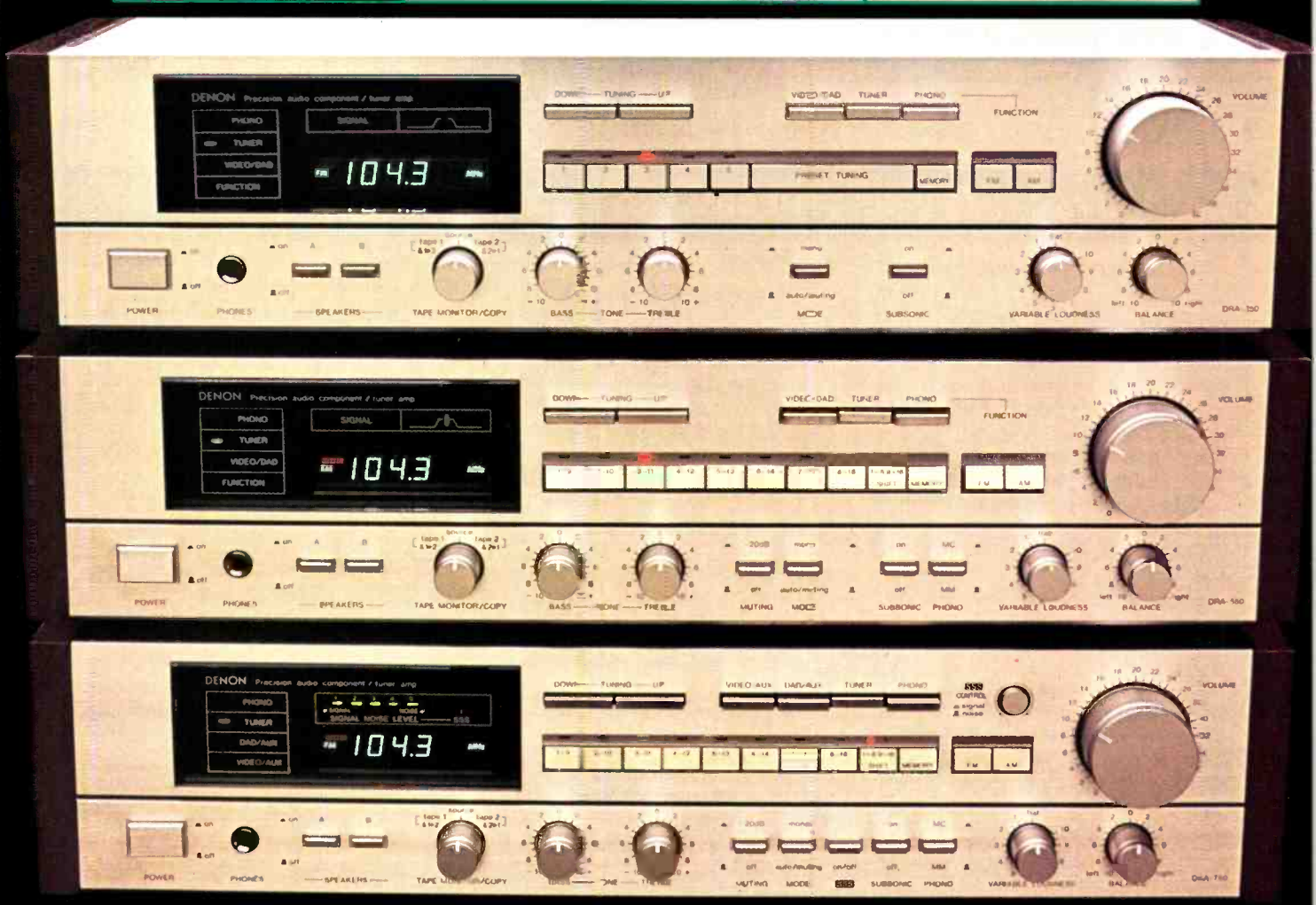
There is no output-level control and no headphone jack. The rear panel carries only the usual pair of output jacks and the power cord.

DENON RECEIVERS DO NOT COMPROMISE FIDELITY FOR CONVENIENCE.

Most receivers are designed as if the person desiring a compact, convenient component obviously cares less about sound quality. The DRA-Series Receivers, like all Denon products, place sonic quality above all. Their power sections incorporate Non-Switching Class-A circuitry (with no negative feedback on the DRA-750) and heavy duty power supplies, temperature-controlled by liquid-cooled heat sinks. Infinitely variable loudness control now ensures full listening pleasure at *all* volume levels.

The tuner section stores up to 16 AM or FM stations or any combination thereof (DRA 350; 5 AM/FM preset memory tuning). The DRA-750 incorporates Denon's exclusive Super Searcher tuning circuitry which eliminates the principle causes of distortion without sacrificing stereo separation.

Whether you choose a 70W/CH DRA-750, a 50W/CH DRA-550 or a 36W/CH DRA-350, its uncompromised performance will convince you that Denon products share more than name alone.



DENON

D E S I G N I N T E G R I T Y

Side panels included on DRA-750 only.

Denon America, Inc., 27 Law Drive, Fairfield, N.J. 07006 (201) 575-7810

Enter No. 13 on Reader Service Card

The Time Lens will add depth and warmth to those CDs that need it. But I wish it could add each of them separately.

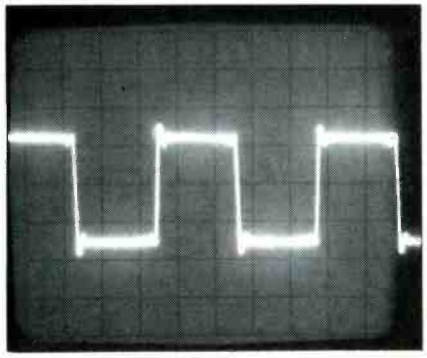


Fig. 7—Square-wave reproduction, 1 kHz.

Measurements

Because of the Digital Time Lens in this CD player, some of my usual measurements had to be taken twice. For example, Fig. 1 shows the normal frequency response of the player without the addition of the special circuit. It is flat to better than ±1.0 dB to 20 kHz. The vertical scale in this graph and in Fig. 2 has been expanded to 2 dB per division, to show even slight deviations from flat response. Figure 2 shows what happens to the response when the Digital Time Lens is switched in. Note that the equalization circuit adds a bit less than 2.5 dB of boost at 145 Hz and just over 2 dB of treble cut at 3.1 kHz.

Harmonic distortion at mid-frequencies, for maximum recorded level, measured 0.0045%, rising insignificantly to around 0.006% at the bass and treble frequency extremes.

THE DIGITAL TIME LENS—THEORY AND PRACTICE

Bob Carver, along with many others, was displeased by the sound of the earliest CDs and decided to find out *why* some didn't sound the same (or, some say, as good) as the LP versions of the same recordings. Unlike many who have complained about poor stereo imaging, lack of depth and strident, harsh treble—and who have blamed the CD digital system itself—Carver was enough of a mathematician and engineering theorist to know that the *system itself* was inherently blameless.

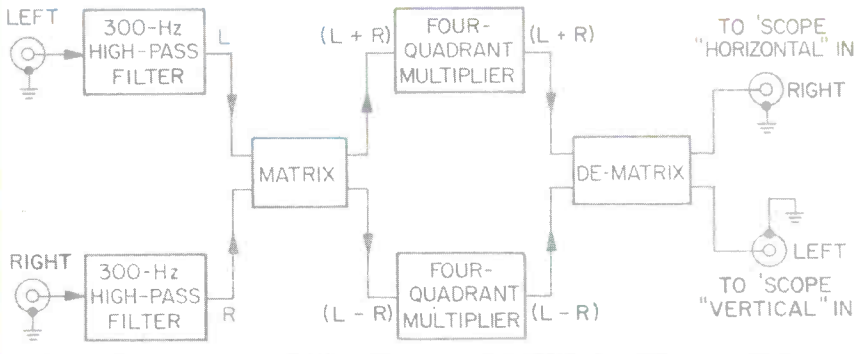
After extensive comparison tests between LPs and their CD versions, which included time-synchronized playings of both types of record while measurements and observations were made, Bob Carver concluded that there were two major differences between certain CDs and their LP equivalents. The first had to do with stereo depth or separation. In any stereo program, the stereo effect is transmitted by the difference between left and right signals (L − R), while the sum of the two signals conveys the mono information. Bob discovered that many CDs have less relative L − R information (compared with the quantity of L + R signal) than do the LPs of the same programs, at the same musical moment.

This difference is not great—often no more than 1 dB or so. In fact, in order to see it on an oscilloscope, Carver had to devise a special test circuit that would amplify the difference. A block diagram of that test circuit is shown in Fig. B1, just in case more ambitious readers want to duplicate Carver's experiments. The four-quadrant multipliers in Fig. B1 expand the output voltages instantaneously so that the Lissajous patterns obtained by connecting the left and right outputs to the vertical and horizontal inputs to an oscilloscope will be easier to interpret. The differences in patterns obtained are, in effect, raised to the second power and become proportional to the output *power* (rather than voltage) or energy into the listening room. (The matrix and dematrix blocks in the diagram represent M-S encoding and decoding matrices.)

The next two figures show the Lissajous patterns obtained from the same instant of musical program in its LP (Fig. B2) and CD (Fig. B3) versions. In this type of Lissajous display, a straight, thin, diagonal line from the lower left to the upper right would represent a purely monophonic signal. The more stereo "difference" information there is, the more the line spreads out into an ellipse. Notice that there is significantly more difference (L − R) signal in the LP version of the music!

The second major difference between some CDs and their LP counterparts noted by Carver during his research was a difference in equalization, or the overall frequency response. Using a fine moving-coil cartridge to play the LP versions of cer-

Fig. B1—Block diagram of circuit used to emphasize and view changes in (L − R)/(L + R) ratios.



FOR THE SHEER LOVE OF MUSIC

There's a big difference between real music and "hi-fi". Unfortunately, as you spend more and more on your stereo system, all you usually end up with is more spectacular "hi-fi". This doesn't have to be the case. With a Linn/Naim system, every additional dollar spent actually results in a musical improvement.

This doesn't mean that a system that can provide *music* in your home must cost a fortune. While the Linn/Naim "Six Pack" system pictured above sells for nearly $20,000, other Linn/Naim systems start at well under $2,000. And, for less than a thousand, substantial improvements can be made to your existing system.

Whether you choose to improve your current system, or start with a complete Linn/Naim system, your Linn dealer, because he fully understands that there is a hierarchy to the system, can see to it that each purchase does indeed bring you more enjoyable music, rather than simply more spectacular "hi-fi".

For additional information on Linn and Naim components and the hierarchy of a hi-fi system, contact your Linn/Naim dealer.

Distributed in the United States and Canada by:
AUDIOPHILE SYSTEMS, LTD., 6842 HAWTHORN PARK DRIVE, INDIANAPOLIS, INDIANA 46220
ALDBURN ELECTRONICS, LTD., 50 ROLARK DRIVE, SCARBOROUGH, ONTARIO M1R 4G2

Enter No. 4 on Reader Service Card

See dealer listing on page 126.

The difference in LP and CD stereo separation isn't great; it takes a special circuit to make it visible on a 'scope.

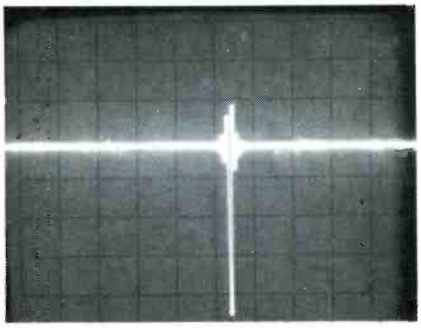


Fig. 8—Single-pulse test.

When I didn't use a band-pass filter for the harmonic distortion measurements, the readings were much higher—caused not by actual harmonic components but by the usual out-of-band component generated by the combination of a high-frequency test signal on my test disc and the 44.1-kHz sampling frequency of the CD system itself. This effect is seen in Fig. 3. The tall spike at left is the desired 20-kHz output, while just to the right is another signal, at 24.1 kHz (the difference between 44.1 and 20 kHz), which is only around 22 dB lower. I suspect that the high (though inaudible) amplitude of this spurious signal is caused by Carver's use of gentle, analog, output filters which roll off slowly above 20 kHz. He is able to use such gentle filtering because, like so many other makers of CD players these days, he has elected to use oversampling and digital filtering before D/A conversion.

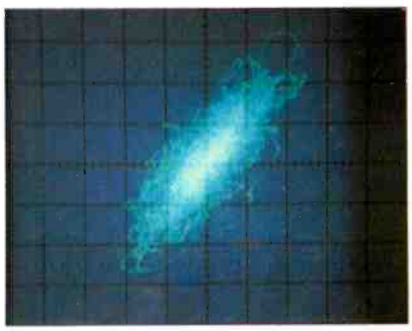


Fig. B2—Lissajous pattern showing (L – R)/ (L + R) ratio from an LP record.

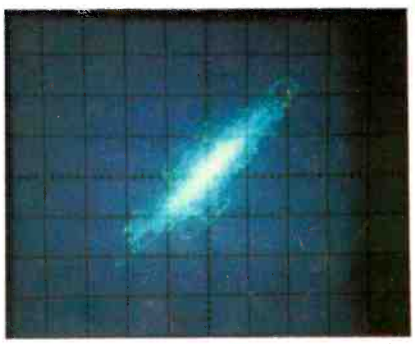


Fig. B3—The same instant of music as in Fig. B2 but taken from the CD version. Note the decreased difference (L – R) content, as shown by the narrowed trace.

tain programs, Carver noted that there was a slight boost in the mid-bass region and a slight cut in the mid-treble region *compared with the response obtained when playing the CD version of the same program*. The average difference is shown in Fig. B4, where the straight-line response is arbitrarily taken as the response of the LP version, while the other curve shows the response of the CD *relative* to that reference response.

Carver's objective in designing the Digital Time Lens was to give the user the ability to introduce the converse of these two effects, at will. That, essentially, is what he has done: If there is a deficiency of L – R signal in some CDs, the user can interpose a form of matrix-dematrix circuitry that will put back some extra L – R signal. If there is overly bright mid-treble and somewhat diminished mid-bass in a CD, the user can add a little mid-bass and attenuate some mid-treble frequencies by means of a switchable circuit. The important thing about the Digital Time Lens, as Carver points out, is that it is switchable. There are some CDs that will not benefit from its use (says Carver) since they are recorded well and are musically pleasing. For those that do require the kind of compensation that the circuit provides, The Carver CD Player lets you introduce it. A block

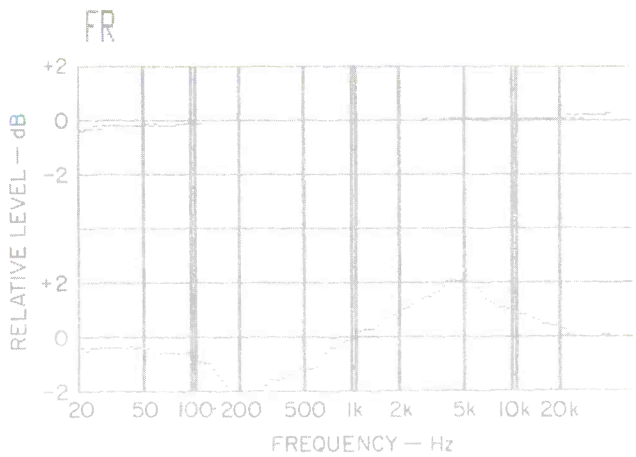


Fig. B4—Relative frequency response of a recording in its CD (lower trace) and LP (upper trace) versions, using the LP as a reference arbitrarily assumed as "flat."

"Sherwood products offer excellent performance at very reasonable prices."

Leonard Feldman, *Audio Magazine*

The occasion of Mr. Feldman's comment was his review of our S2680-CP top-of-the-line receiver. His statement was sparked by the fact that, while quite affordable, the S2680-CP, like all Sherwood receivers, is designed and built with the care, precision and innovation which have become Sherwood trademarks.

A tradition of affordable quality. More than three decades ago Sherwood was founded on this philosophy: Through innovation, make quality audio equipment more affordable. That philosophy has been nurtured throughout Sherwood's history and is the foundation of our newest line of receivers.

We never cut corners on sound. All five Sherwood receivers deliver true high-fidelity performance. Even our budget-priced S2610-CP sounds better than many separate components. And the entire group is laced with features that can make significant differences in your listening enjoyment. Ultra-low-bass EQ, multi-deck dubbing, auto-scan digital tuning and discrete phono preamp circuitry are standard on several Sherwood models, yet missing from many other brands, regardless of price.

Certified Performance. Sherwood is the only manufacturer to test and certify the performance of each individual receiver. On the outside of every carton you will find a certificate showing the measurement details of the power amp, phono preamp and FM tuner sections of each receiver. These are not just the rated specs; these are the actual measured performance data of the individual unit, *so you know exactly what you're buying.*

Find out what the experts say. Get the whole story on why Sherwood receivers—in Mr. Feldman's words—"...offer excellent performance at very reasonable prices."

To get your own copy of his review of the S2680-CP and to find out just how much quality and innovation you can afford, visit your nearest Sherwood audio specialist today. To find him, call (800) 841-1412 during west coast business hours.

Sherwood

Quality and Innovation You Can Afford.

13845 Artesia Blvd., Cerritos, CA 90701 In Canada: The Pringle Group, Don Mills, Ontario

Enter No. 39 on Reader Service Card

Well-recorded CDs, Carver says, won't benefit from the Digital Time Lens. That's why it's switchable.

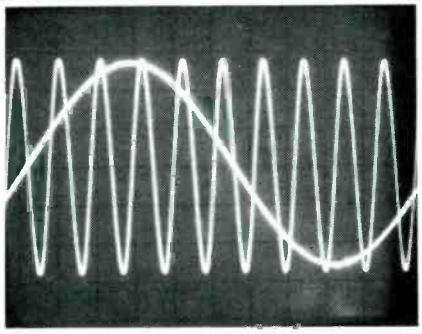


Fig. 9—Two-tone phase-test signal (200 Hz and 2 kHz) with Digital Time Lens off.

Figure 4 is a graph of distortion versus frequency for maximum recorded levels as well as for levels of −24 and −30 dB. At the −30 dB level, turning on the Digital Time Lens circuit resulted in higher distortion meter readings (not shown in the graphs). It was clear from 'scope observations, however, that this was not an increase in actual harmonic distortion, but rather the distortion meter's mistaking the added dither noise (see Sidebar) for new distortion components. The dither is about 82 dB below maximum recorded level, but that's only 52 dB below a −30 dB recorded signal. So, relative to such a lower level signal, the noise represents a level that is 0.25% of the signal level. And, sure enough, that's exactly the level of "distortion" that my distortion meter thought it was reading.

Output linearity was accurate down to −60 dB, within 1.0

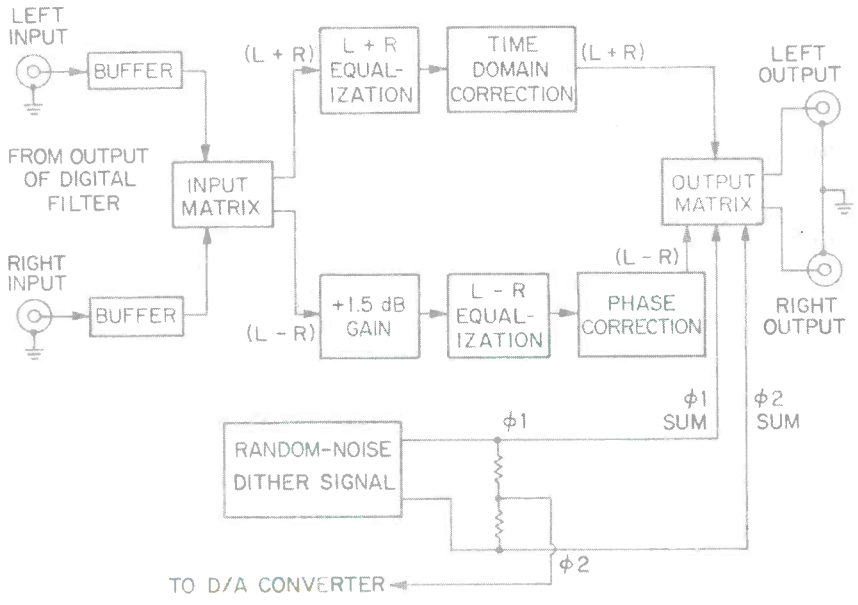


Fig. B5—Block diagram of the Carver Digital Time Lens.

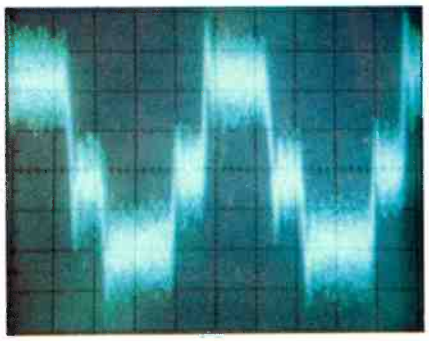


Fig. B6—Ultra-low-level (4-bit), 1-kHz signal, as reproduced by conventional CD players.

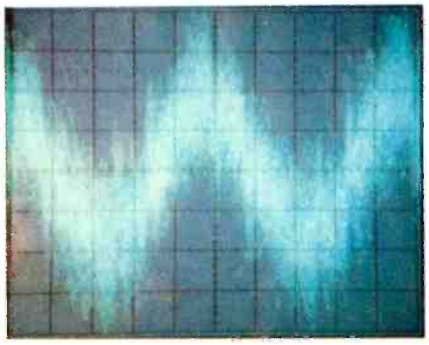


Fig. B7—Same as Fig. B6, with dither added before D/A conversion.

diagram of the Digital Time Lens circuit is shown in Fig. B5.

There is one "block" in Fig. B5 that I haven't talked about yet, the one labelled "Random-Noise Dither Signal." Carver admitted to me that he is not sure whether this feature of his Digital Time Lens really provides an *audible* benefit, but he could easily demonstrate its theoretical desirability. (See also "Digital Domain," *Audio*, November 1984.)

Without dither, very low-level signals are subject to very high distortion. Take, for example, Fig. B6, which shows the output of The Carver CD Player reproducing a 1-kHz signal at 90 dB below maximum recorded level, close to the CD system's noise floor. This waveform is typical of all CD players, and shows clearly the step-like approximation that defines the 1-kHz tone. The "steps" are clearly visible because, in digital

McINTOSH...
POWERFUL PERFECTION

The magnificent music of the mighty organ commands *POWERFUL PERFECTION* from any power amplifier. The 500 watt per channel perfect voice of the McIntosh MC 2500 is *POWERFUL PERFECTION.* Proud craftspeople, here in the United States, assemble carefully selected technologically superior high quality components into a powerfully perfect power amplifier. In the MC 2500 you get performance . . . you get all the power necessary for perfect musical reprocuction . . . you get complete response unaffected by distortion . . . and you get the pleasure of owning the best . . you get *POWERFUL PERFECTION.*

Send for our 76 page catalog for more information.

For Detailed Information on McIntosh Products Write:
McINTOSH LABORATORY INC.
P.O. BOX 96 EAST SIDE STATION, 454
BINGHAMTON, NY 13904-0096

Enter No. 25 on Reader Service Card

Organ pipes photographed at Casadesus Recital Hall State University of New York at Binghamton, N.Y.

The Digital Time Lens misleads meters, showing more distortion where you hear less, and less separation where you hear more.

dB. SMPTE-IM distortion measured 0.0025% at 0 dB (maximum) recorded level and 0.03% at −20 dB. The CCIR-IM (twin-tone) distortion was only 0.0037%; I could not detect any in-band distortion components during this measurement other than the basic, 1-kHz beat which constitutes the CCIR-IM component.

An analysis of signal-to-noise performance, both unweighted and weighted, is shown with the Digital Time Lens engaged in Figs. 5A and 5B. An analysis of unweighted S/N without the Digital Time Lens engaged is shown in Fig. 6. My tester would not plot an A-weighted S/N analysis for this condition, since the S/N was far over 100 dB.

Reproduction of a 1-kHz, digitally generated signal (Fig. 7) was about as close to a true square wave as I have ever seen from a CD player that used digital filtering. The unit-pulse test is shown in Fig. 8. Figure 9 shows a virtual absence of any phase error between a 200-Hz signal on one channel and a 2-kHz signal on the other. When there is zero phase shift between these two signals, the waveforms cross the zero axis in the same direction at the same time, and that is exactly what is happening in Fig. 9.

Figure 10 shows separation between channels with the Digital Time Lens deactivated. At midrange frequencies, separation was around 80 dB, decreasing to just under 60 dB at the extreme high frequencies. If you were to repeat my tests with the Digital Time Lens switched on, you would measure no more than about 15 dB of apparent separation! That's because when Carver increases L − R content with this circuit he does so by adding out-of-phase right signal to the left channel and out-of-phase left signal to the right

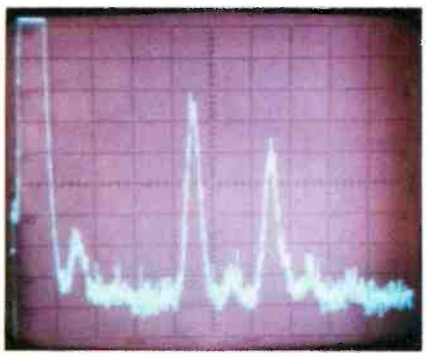


Fig. B8—Spectrum analysis of waveform shown in Fig. B6 shows high level of harmonic distortion components.

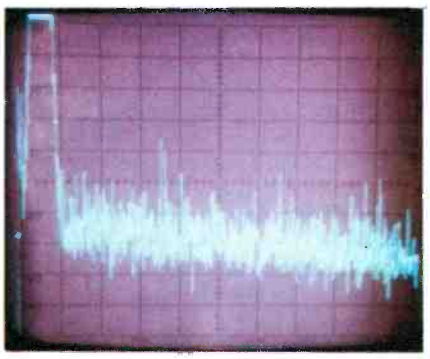


Fig. B9—With dither added, overall noise level increases, but distortion components vanish below the noise floor.

terms, there are only four bits left at this low level with which to describe the waveform.

By adding some random noise to such a signal, it is actually possible to reduce the high levels of distortion that would otherwise be present, by substituting *lower* levels of less-obtrusive, random ("white") noise. Figure B7 shows the same −90 dB, 1-kHz tone, this time with the Digital Time Lens circuit adding some dither noise. The noise is greater, but the step-like nature of the recovered signal has all but disappeared. In practice, the noise dither signal has been set about 12 dB above the system's noise floor.

That this really does represent decreased distortion is shown more clearly by spectrum analyses of the low-level (−90 dB) signals which were shown in Figs. B6 and B7. Without dither (Fig. B8), the fundamental, 1-kHz spike at the far left is joined by large spikes of harmonic distortion products at the right; the total harmonic distortion calculated from this display is 34%! With dither (Fig. B9), the noise has increased significantly, but the distortion (hardly visible, since it is now buried in the noise) has been reduced to a negligible 1% or less!

Though he is not certain that this final element of his three-part Digital Time Lens circuit is essential, Carver related the following story, which dates back to his early days in audio, to explain why he included the dither signal. "A long time ago, when I got my Revox A77 open-reel tape machine, I made a recording of Bruno Walter's rendition of Beethoven's Seventh Symphony. Of course, there was tape hiss (no Dolby NR), and so it sounded clean, but noisy. One evening I had a damp log burning in my fireplace and it was venting steam, making a hissing sound just like the tape recorder. Also, from time to time it would make a faint crackling sound.

"I happened to turn on my A77 and was utterly flabbergasted. Beethoven emerged from a silky, pure silence! I've never heard a tape sound better; the music was so clean, so pure, so uncontaminated by tape noise or record-surface ticks and pops. I wonder what would have happened if I had put an opaque screen in front of my fireplace so no one could see the fire.

"The powerful memory of that experience is why I've put the dither signal in my CD player. It makes me feel safer—and better."

Carver also told me that, while adding the dither may not do much at such low signal levels (the change in octave-to-octave balance and the adjustment of L + R/L − R ratio is much more significant), the dither signal does trade distortion for noise. But it's not an even trade—a little dither noise takes away a lot of distortion! *L.F.*

Perfect bass...Perfect treble... Perfect sound...forever

ROTEL introduces a refreshing new range of audio equipment designed exclusively to appeal to hi fi enthusiasts. Its acceptance in the UK, where Rotel was designed and conceived, is overwhelming.

HI FI TODAY says "Rotel have engineered some outstanding products which offer amazing sound and remarkable value".

NEW HI FI SOUND says "The sound was open, lively, detailed and enjoyable to listen to, and as for the RA820B amplifier, well, it was a real gem".

WHAT HI FI says "The most obvious ability of Rotel is the way it allows music to live and breathe".

HI FI CHOICE says "The Rotel system stands out in its ability to play records properly. The stereo soundstage is well defined, and with a good cartridge there is clarity, precision, and evenness of reproduction that allows the music to sound lively and vivid...Quite clearly, its performance is something special".

Listen to Rotel yourself and let's hear what **YOU** have to say.

ROTEL

P.O. Box 653, Buffalo N.Y. 14240 U.S.A. (416) 297-0599

Enter No. 36 on Reader Service Card

See dealer listing on page 129.

The Time Lens also adds dither, trading a small increase in noise for a large decrease in audible distortion.

channel. Of course, a simple voltmeter can't tell that the opposite-channel content is out of phase, so you get a poor separation *reading*. In fact, when you listen to music with the Digital Time Lens on, separation and depth of imaging actually *increase*—which is one of the objects of this circuit.

Figure 11 (using the phase-check test signals used in Fig. 10) is an interesting 'scope photo in that it shows exactly what I have just described: The left signal with some right mixed into it and the right signal with some left mixed in. Again, the waveforms *appear* to have a fair amount of crosstalk and, hence, poor separation. But careful study of the photo shows, in fact, that the "high-frequency" ripple on the low-frequency waveform is exactly 180° out of phase with the high-frequency signal on the opposite channel, while the low-frequency ripple seen "modulating" the envelope of the high-frequency signal is also 180° out of phase with the low-frequency signal of the alternate channel.

The Carver CD Player was able to track all but the last and widest section of the opaque wedge on my special defects disc. That is, it was able to overlook dropouts as wide as 800 microns. No problems were encountered in tracking the simulated dust spots, the greatest diameter of which was also 800 microns. Neither were there any mutes or skips when the laser pickup traversed the area of the disc that bore simulated fingerprint smudges. So, while The Carver did not do quite as well as some recent players that handled all of the defects on this test disc, it is not likely to give you any tracking problems unless you really mishandle your discs and cover them with scratches too wide for the player to correct. The player's resistance to external shock is very good, too.

Use and Listening Tests

In recent months I have tended to favor the sound of CD players that employ digital filtering, and The Carver CD Player is in this category. It almost goes without saying that the sound quality produced by this player was superb—without the Digital Time Lens. So, what did the Time Lens contribute? I look upon this circuit as an option, one that can and should be used with certain CDs which seem to lack the depth that I feel belongs in a musical performance. You might argue that the equalization afforded by the Time Lens (to provide what some have described as a warmer sound) could just as easily be accomplished by judicious use of bass and treble controls, but that is not true. Look at Fig. 2 and you will agree that no simple bass and treble controls can create this kind of a response curve. A graphic equalizer might, but not everyone has a graphic equalizer or the ability to set it to this empirically derived curve.

As for myself, I almost wish that Carver had chosen to separate the equalization function of the Digital Time Lens from the (L + R)/(L − R) ratio manipulation, since some of my discs seemed to profit from the latter effect but suffer from the change in overall response. I would hasten to add, however, that many of my earliest CDs benefited from both effects (and probably from the dither noise, too, though—like Carver—I can't swear that I could hear improvement from that particular addition).

The important thing about Carver's Digital Time Lens is that you have control over it. You can turn it off if you don't need it, and you can turn it on for those discs that seem to sound better with it. I don't think anyone can fault Carver for giving us this option, and in fact I commend him for the extensive research which must have gone into the development of his latest audio innovation.

Whatever else you do when you audition The Carver CD Player, be sure to listen carefully to the Digital Time Lens for several minutes before you turn it off. Try such a slow A/B test several times; it takes a bit of concentration to really appreciate what's happening. If, after all that, you don't like the feature, just turn it off. But I suspect that many owners of this CD player will use it selectively, putting little coded marks on their CDs that indicate whether they should be played with the Time Lens or not. I find nothing wrong with such an arrangement.

In emphasizing the Digital Time Lens feature, I don't want to overlook the basic CD player itself. It has a well-executed design which fits in nicely with Carver's growing list of fine products, and it is priced at a level that should make it affordable to a great many people who are ready for a good CD player.

Leonard Feldman

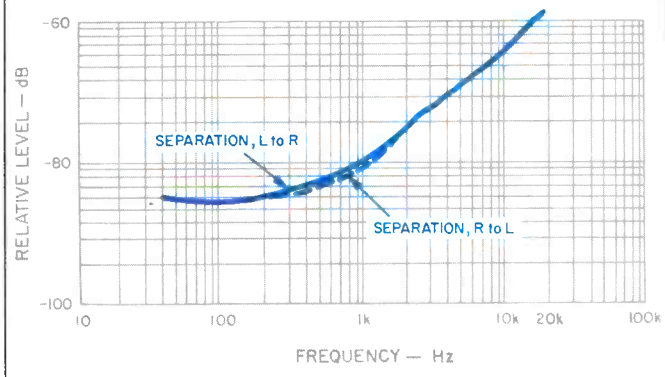


Fig. 10—Separation vs. frequency.

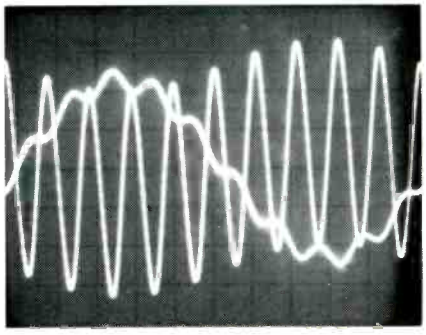


Fig. 11—Two-tone phase-test signal with Digital Time Lens on.

The new
Dual 505-2.
Rated "best buy"
by Britain's
prestigious publication
HI FI CHOICE.
Write for details.
Cheers!

Dual® ADCOM®

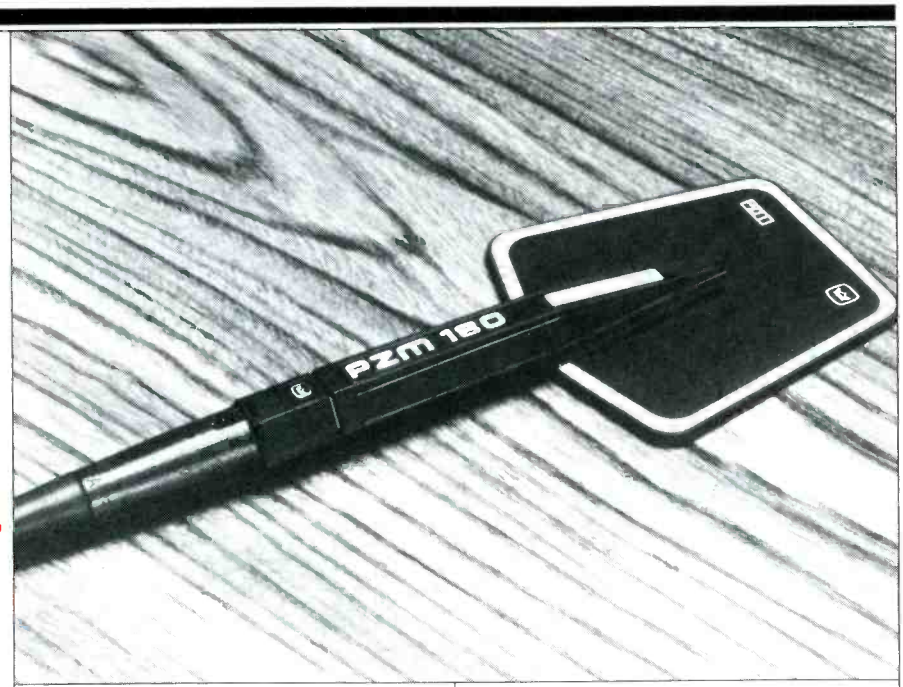
11 Elkins Road
East Brunswick N.J. 08816
U.S.A.

Adcom is exclusive U.S. distribution agency for Dual.

Enter No. 1 on Reader Service Card

2

CROWN PZM-180
PRESSURE ZONE MICROPHONE



Manufacturer's Specifications

Type: Electret condenser (back electret).

Frequency Response: 20 Hz to 20 kHz.

Polar Pattern: Hemispherical when lying on a large, flat surface.

Sensitivity: Battery power, −82 dBV/μbar (−62 dBV/Pa); phantom power, −70 dBV/μbar (−50 dBV/Pa).

Output Impedance: 150 ohms; recommended minimum load impedance, 1 kilohm.

Self-Noise: 21 dBA equivalent SPL.

Maximum Input SPL: 120 dB (battery power).

Polarity: Positive pressure on diaphragm produces positive voltage on pin 2 with respect to pin 3 of output connector.

Power: Battery, 1.5-V size N, E90 Eveready or 6-V A544 Eveready; 12- to 48-V phantom power optional.

Connector: 3-pin professional audio type.

Case: Carbon-filled nylon.

Accessories: Fabric windscreen supplied; PH4 power supply (powers up to four PZMs) optional.

Dimensions: 3-15/16 in. (10 cm) W × 7-3/16 in. (18.2 cm) L × ⅞ in. (2.2 cm) H.

Weight: 2.4 oz. (68 grams) without cable and windscreen.

Prices: Microphone, $169; power supply, $179.

Company Address: 1718 West Mishawaka Rd., Elkhart, Ind. 46514. For literature, circle No. 91

"PZM" is a trade name for several microphone models made by Crown which are part of a growing class known generally as boundary microphones. (A professional model, the Crown PZM-30GP, was reviewed in the March 1983 issue.) A typical boundary microphone transducer is an electret capsule less than 1 cc in volume, with an integral FET amplifier, placed face down about 1 mm from a reflecting plane surface. In actual usage, the "plane" may be a large floor, wall, or ceiling; a free-standing baffle 2 to 4 feet square; a lectern surface; a person's chest, or just the back plate of the microphone (which may be 4 to 6 inches on a side). For stereo pickup, boundary microphones may be spaced many feet apart on boundary surfaces or used in near-coincident arrays with two microphones placed on opposite sides of free-standing baffles (of which Crown manufactures several). These stereo baffles may consist of a single panel about 2 feet in diameter or two rectangular panels joined to form a wedge. The variety of baffles, including carpeting or acoustical foam to modify the hemispherical polar pattern, is limited only by the user's imagination. The *Pressure Zone Microphone Theory and Application Guide*, published by Crown, is an excellent guide to using boundary microphones.

The theoretical advantage of a boundary microphone mounted on the floor (for example), as compared to a conventional microphone on a floor stand, is the elimination of the reflected sound wave from the floor. This delayed reflection interferes with the direct sound wave, resulting in many dips and peaks in the frequency response of the input sound pressure to the microphone—the notorious "comb-filter" effect. An equally important practical advantage is a uniform, hemispherical polar pattern versus frequency, which is related to the small size of the capsule and its proximity to the plane. What all of this means is that the boundary microphone potentially can offer cleaner, more natural sound than a conventional microphone of about 1-inch diameter, mounted on a floor stand 3 or more feet from a musical instrument. The off-axis high-frequency sound, whether direct or reverberant, is not attenuated, as it would be with conventional microphones (except very small conventional models, such as the new Brüel & Kjaer Studio Microphones).

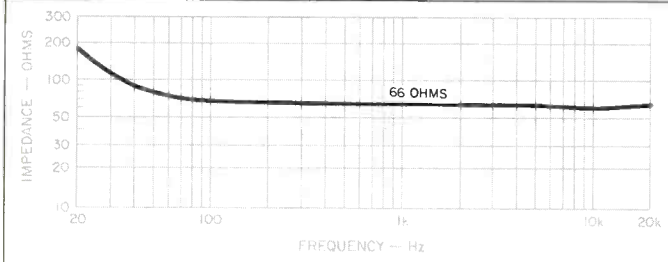


Fig. 1—Impedance vs. frequency was identical for both PZM-180 samples (1.5-V power).

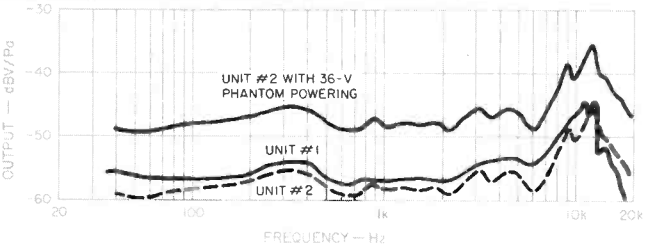


Fig. 2—Frequency response of both PZM-180 microphones, on pseudo-infinite baffles. Top curve: 36-V phantom power; lower two curves, 1.5-V battery power.

Are boundary microphones, and PZMs in particular, the answer to all sound pickup problems? Of course not. The boundary microphone is just another type of omnidirectional microphone. (For those interested in more on the subject, I have covered these types in a lengthy tutorial [1].)

The professional PZM models are priced in the range of $350 each, including the essential power supply. Amateurs having low- to medium-cost cassette recorders might find them beyond their budget. The new PZM-180 was designed for lower cost, with a plastic housing and backing plate, and powered by an internal battery and output transformer instead of the costly power supply included with the pro model. The trade-offs, apparent in the PZM-180's specifications, include reduction of maximum input SPL from 150 to 120 dB, and a 6-dB reduction in sensitivity; the latter deficiency, however, may be corrected by using optional phantom powering. It may seem odd that the PZM-180's frequency response is specified as 20 Hz to 20 kHz while the response of the professional Model PZM-30GP is specified as 50 Hz to 15 kHz, but the lower-priced model's response is specified within looser tolerance limits. Similarly, the self-noise specification for the PZM-180 is 1 dB higher than the self-noise level currently given for the pro model.

A significant advantage of the PZM-180 is its small size and light weight. Thus, it is possible to fit a small stereo cassette recorder plus a pair of PZMs and cables into a briefcase. (Note that cables are not included with the PZM-180.) The small, black-finished PZM-180 placed on floor or stage is less conspicuous than a conventional microphone on a floor stand, and obviously less objectionable to performers. This should encourage more audiophiles to record musical performances.

Measurements

The two units tested were supplied by the manufacturer with frequency response curves; I do not know if the performance of off-the-shelf mikes will be similar.

The specifications indicate that the PZM-180 requires a 1.5-V N cell (a readily available hearing-aid battery) or an Eveready A544, which is a 6-V photo battery that will provide greater sensitivity. Optionally, a 12- or 48-V phantom power source may be used, a feature which professional users will appreciate. Since there is no on/off switch, the battery is being drained constantly; still, Crown states that they expect a 2,500-hour battery life for the N cell. I found that the acoustical sensitivity decreased by 2 dB in one month (about 700 hours) with an alkaline cell, as compared to Crown's claim of a 6-month life. I removed the battery after each usage.

The battery stays in the mike for phantom powering, so in a permanent phantom-powered installation, the power should be permanently "on" to avoid battery drain and eventual corrosion. (It may be possible to replace the cell with a piece of metal, but I did not try this.) Crown indicates that a 6-V battery (Duracell PX-28) may be substituted for the N cell by using a piece of aluminum foil for filler, or by bending the clips. On one mike, a clip broke when bent, so foil is probably a better bet. A metal spacer could be included with the microphone; this might prevent noise due to loose contact.

The impedance versus frequency (Fig. 1) of both PZM-180 samples was identical. The 66-ohm value at 1 kHz is very similar to the values measured on the professional models. The rated 150-ohm value is obtained below 30 Hz, where the impedance rises, perhaps indicating a coupling capacitor. Because of this effect, the recommended minimum load of 1 kilohm should be observed or some attenuation of the region below 50 Hz may occur. Unlike the professional model, the PZM-180's impedance does not rise above 10 kHz; this may indicate that the transformers in the 180s have lower leakage inductance, a desirable improvement. The constant (resistive) impedance above 50 Hz means that loading will not affect frequency response in this region.

The PZM, like most boundary microphones, is not amenable to frequency response testing in strict accordance with EIA standards, which relate to microphones used in free space. My articles in the April 1977 and September 1978 issues detail my test procedures following these standards, which define the frequency response as the open-circuit voltage resulting from a constant sound pressure at the microphone location *before the microphone is introduced*. The microphone, with its integral backplate, is easily tested according to these rules, and Crown calls this the Free-Field Frequency Response. The *ideal* test of the microphone on a boundary would be an infinite baffle. Neither I nor Crown had such a test facility, so we used reasonable substitutes. The 1983 PZM review describes my "pseudo-infinite baffle"

The PZM-180 isn't just affordable. It's also small and light enough to fit, with a small cassette recorder, into a briefcase.

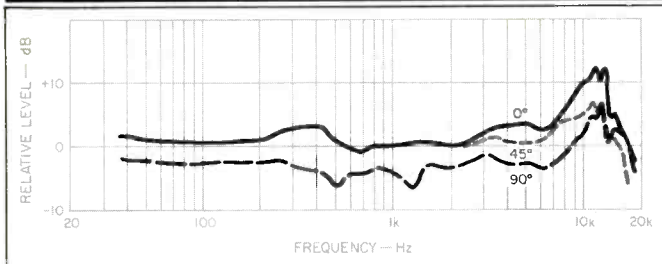


Fig. 3—Frequency response vs. angle of PZM-180 on pseudo-infinite baffle.

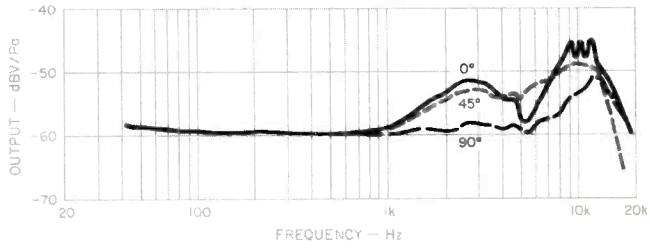


Fig. 4—Frequency response vs. angle of PZM-180 without baffle.

test, for which the PZM is mounted on a 2-foot-square piece of plywood placed 6 inches from a 2-inch-diameter sound source. The SPL is calibrated *before* the baffle is introduced. Bruce Bartlett, a Crown engineer, described their setup: "We measure PZM microphones at 30° vertical incidence on a 4-foot-square plywood/metal boundary, at 2 feet from the sound source. A flush-mounted B & K ¼-inch, pressure-calibrated microphone is used as a reference. Its response, when mounted in the boundary, is subtracted from the response of the microphone on the boundary. This results in a pseudo-infinite plane measurement."

Crown supplied frequency response and sensitivity data with the microphones, obtained on a Crown Tecron TEF-10 acoustical computer by Time Delay Spectrometry (TDS). These curves indicate a false roll-off below 200 Hz because, in a room of moderate size, the time window cannot admit a full cycle of the direct sound wave and still reject reflected waves from the room boundaries.

Crown's TEF-10 printouts are greatly compressed on the frequency axis compared to the figures presented here, but an eyeball check showed generally similar curves, save for the TDS roll-off below 200 Hz. The sensitivity values I obtained are systematically 6 dB higher than Crown's because of the difference in our method of calibration. I think my results show what really happens when a PZM is used in place of a conventional mike, and, in my opinion, more closely conforms to EIA and ANSI standards.

My 1983 review shows frequency response curves at various angles of incidence for the PZM-30GP mounted on 2- and 4-foot-square baffles, measured at 6 feet outdoors. These curves may be presumed to relate to all PZM models, if differences in the pseudo-infinite-baffle response are taken into account.

Figure 2 shows the pseudo-infinite-baffle frequency responses of the PZM-180s, which are generally similar to my data for the pro model but with two differences: First, the low-frequency responses are flat to 40 Hz, whereas the PZM-30GP's response rolled off to −6 dB at that frequency. The response of the 30GP crosses 0 dB at 17 kHz, but the 180s' extend to 20 kHz. The peak at 13 kHz is probably an artifact because, with finite baffles, the 180 is likely to exhibit a flat trend over the entire hemisphere, similar to the 30GP. Both PZM-180s show similar responses, with only 1- to 2-dB differences in output below 4 kHz. The response with phantom power is identical, with 10-dB higher sensitivity. With the 6-V battery, output was up by 4.5 dB. I did not do further testing with this battery.

Figure 3 shows frequency response versus angle of sound incidence, and indicates that the PZM has very uniform response over the entire hemisphere. Observe that the 45° response is within about ±3 dB from 35 Hz to 17 kHz, the best response curve obtained so far from these hard-to-measure microphones.

Figure 4 shows that the PZM-180's response is acceptable even without a baffle, which was not the case with the pro model, probably because of the 180's smaller backplate. The low-frequency response is very flat, and the bright high-frequency response may be desirable for many pop vocal and instrument pickup applications. My 1983 review indicates that the output should fall by 6 dB below the cutoff frequency of this baffle, which is on the order of 1 kHz, but the actual drop is only about 3 dB.

Figure 5 shows the effect of adding the cloth windscreen. (It is to be used with its logo on the bottom side of the mike because the paint blocks the pores, even though logic might dictate that the logo be facing up.) This screen has a far greater attenuation effect than most foam screens, and it can be used with impunity only for speech, vocals, or low-frequency instruments. Since it tends to flatten the peaks in the curves of Fig. 4, the screen may be used to provide high-frequency equalization. All in all, I'd prefer a block of foam, such as that supplied with the pro models.

Figure 6 shows the noise of Unit No. 1. Unit No. 2 was found to have a considerable amount of low-frequency noise, plus impulse spikes. (As my noise tests were conducted long after the response tests, it is uncertain whether Crown shipped a noisy mike.) As you'd expect, the PZM-180's equivalent noise level of 24 dBA is higher than the 19 dBA measured for the 30GP. I find that acceptable, considering the relative price of the mikes, although Crown's specifications for the two mikes show the 180 to have only 1 dB more noise than the 30GP. I found that the equivalent noise SPL was the same with N-cell or 36-V phantom power.

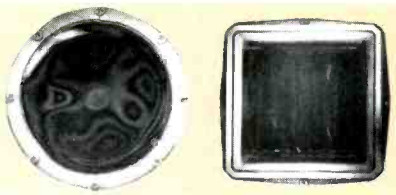
The maximum input SPL for the PZM-180 is rated at 120 dB for N-cell power, but I observed clipping on the 'scope to be 124 dB for speech. This increases only to 127 dB with 36-V power.

The phasing of the PZM-180 as measured on my EMT-160 polarity tester was, as specified, pin 2 positive, in accordance with standards.

WE DEVELOPED A NEW TECHNOLOGY FOR THE DIGITAL AGE.

SFI's Digital 20 loudspeaker system is a culmination of technologies developed by Sawafuji, a brother company established in Japan in 1922.

The SFI Digital 20 loudspeaker system has evolved out of SFI's extensive research, development and experience with high performance, high quality transducers.



Hologram accurately displays cone driver distortion (near right). The uniform diaphragm of the Dynapleats showing no distortion (far right). Tested at 1.5 kHz.

Instead of conventional cone drivers, the SFI Digital 20 employs a completely new transducer technology to accurately reproduce sound. These revolutionary new dynamic drivers, called Dynapleats, allow sound to emit evenly and simultaneously from their entire surface, thereby avoiding the deformation and uneven flexing characteristics of a conventional cone driver.

The sound has improved transient and linear response with a full frequency response, extended bass, wide dynamic range and virtually no distortion.

Because of the unique Dynapleats, sound is radiated equally from both the front and back sides of the SFI Digital 20. Aside from simplifying the problem of placement for proper stereo imaging, the bipolar pattern contributes to an openness of sound, increased definition, localization and realism. And, listening to the SFI Digital 20 over many hours is never fatiguing.

The real benefit of SFI's revolutionary technology is in the listening. The SFI Digital 20's natural spacious sound and superb imaging is unsurpassed. So are the aesthetics of the unique, ultra-thin loudspeaker system which harmonizes with any environment.

The digital age is here. Enjoy it more with a SFI Digital 20. Contact SFI for complete details and information.

SFI
Sawafuji America Corp.

23440 Hawthorne Boulevard, Suite 130,
Torrance, CA 90505, (213) 373-0620, Telex: 756921

I rate the PZM-180 a best buy for audiophiles who have low- or medium-cost cassette recorders and want professional-sounding tapes.

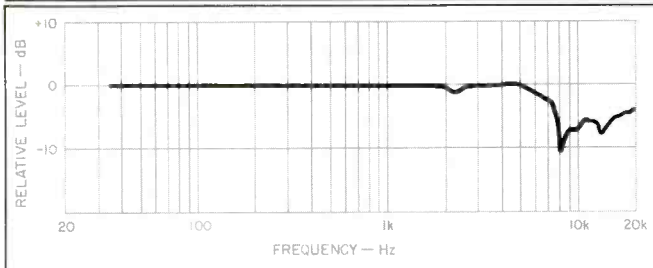


Fig. 5—Effect of windscreen (logo side down) on frequency response, with microphone mounted on pseudo-infinite baffle.

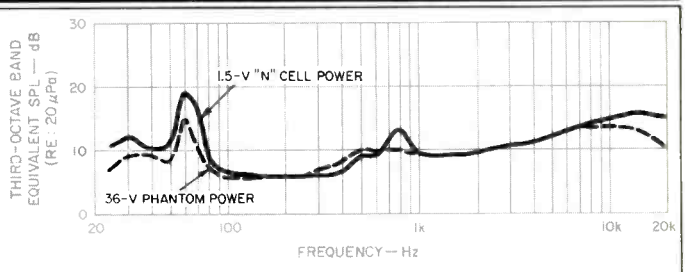


Fig. 6—Noise level vs. frequency (microphone unit No. 1). Overall noise level measured 24 dBA or 28 dB unweighted.

Use and Listening Tests

The first series of tests compared the PZM-180 to a Nakamichi CM-700 condenser microphone with omnidirectional capsule. With their windscreens, both mikes had equal resistance to breath "pops." The PZM-180's 60-Hz magnetic hum was 20 dB lower, which seems remarkable since its transformer is unshielded. Close-up voices sounded identical, at any angle of incidence, and vibration sensitivity was equally low with either mike.

My first recording with the PZM-180 was of a tenor singing and playing the piano in a large church. I used a "bipolar pair"—two PZMs slightly off-center and on opposite sides of a 2-foot-square baffle made of ¼-inch Masonite. I mounted this array on a Shure 14-foot stand (using ½-inch pipe fittings and an Atlas AD-1 adaptor) and placed the stand opposite the keyboard end of a Steinway "B" piano whose lid was open on half stick. The mikes were about 7 feet from the floor, and the baffle edge pointed at the music holder. I used a Sanyo RD S30 cassette deck with Type II Maxell tape and Dolby B NR. Playback in my listening studio showed good imaging, with the vocalist on the left and the piano smoothly spread from left to right. I thought the sound quality was perfectly natural, and there seemed to be no coloration from the measured high-frequency sound peaks (but note that the sound incidence angles were about 45° to 90°).

At this recording session, I also had an opportunity to record a pipe-organ rehearsal. Again, the imaging and sound quality were very realistic. Later on, I recorded the same organ with an AKG C422 stereo microphone used in X-Y stereo with cardioid and figure-8 polar patterns (though it seemed absurd to use a $2,800 mike with a cassette recorder costing less than one-tenth as much). The sonic differences between the C422 and the PZM-180 fall within the 30-Hz to 15-kHz response of the recorder. I was pleased to find that sound quality and imaging were fairly similar with both mikes, the PZM sounding somewhat brighter. The AKG had no bass roll-off, and it captured very deep and fundamental pipe-organ bass sound. The PZM-180 had equally excellent bass sound, which is quite remarkable considering its low cost.

Next, I worked with an associate, Carlton Read, to record a brass quintet in a church having rather dead acoustics. The first half of the concert was recorded using a pair of RCA 77-DX ribbon microphones on floor stands about 4 feet apart, the ensemble being in a tight semicircle. The second half was recorded with the PZM-180s on the carpeted floor, exactly where the 77-DXs had been. A battery-operated Marantz cassette recorder was used. Although the 77-DX is preferred by many recording engineers for recording brass, in this case the PZMs were superior because of improved stereo imaging. Their sound imaging was accurate and smooth from left to right, whereas the 77-DX sound tended to have a "hole in the middle." The sound quality was somewhat brighter and clearer with the PZMs, too.

The PZMs were used unsuccessfully to pick up an orchestra from the edge of the stage. Here, the balance between close and distant instruments was bad; I suspect that a bipolar pair over the conductor's head would have been better. A more successful application was sound reinforcement of downstage action in a school play, with the PZMs at the edge of the stage.

Conclusions

The PZM-180 microphones tested have somewhat better frequency response than the PZM-30GP professional model, but a dynamic range of only 100 dB compared to 141 dB for the pro model. They would probably be excellent for most audiophile recording applications and for professional applications not involving high sound levels. The bipolar pair is a good substitute for a costly stereo microphone. A pair of PZM-180s and a small, battery-operated stereo cassette recorder can make professional-quality, on-location recordings without the size and weight drawbacks associated with conventional mikes and floor stands.

I hope that Crown will provide an adaptor for the 6-V battery, and possibly a dummy battery for permanent phantom-powered installation. The windscreen design needs improvement. Experience with the PZM-30GP shows that a semi-pro model with somewhat flatter high-frequency response may be desirable for classical music recordings.

I rate the PZM-180 a best buy for audiophiles who have low- or medium-cost stereo cassette recorders and want to make professional-sounding tapes. *Jon R. Sank*

Reference

1. Sank, Jon R., "Microphones," Audio Engineering Society, Paper C1000, presented at the 2nd AES International Conference: The Art and Technology of Recording, May 11-14, 1984; Anaheim, Cal.

VCR: stereo or hi-fi?

You can hear the difference.

by Dr. William R. Short
Project Engineer

The first article in this series discussed the importance of audio in your video system. As a fellow videophile, I want to elaborate on that topic, especially since there seems to be much confusion about the difference between stereo VCR and *hi-fi* stereo VCR.

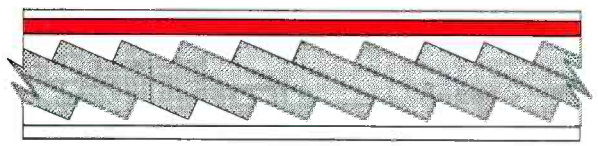
When video tape recorders were first introduced, the engineering emphasis was on picture reproduction quality. After all, there was nothing new about recording audio on magnetic tape. In the first VCR tapes, a very narrow track—about half the width of a track on a standard audio cassette—was allotted for audio. To make matters worse, VCR recording speed was about half the 1⅞ ips used in audio cassette recording. Naturally, the sound quality was not very good.

When VCR's became available for home use, audio quality still was not of major concern. One reason was that people used their VCR's primarily for "time shifting" network programming (frequently broadcast with poor audio quality) for subsequent viewing.

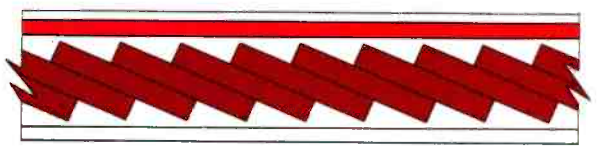
Today, however, VCR audio quality is playing a larger role. The advent of stereo TV, music videos and a wider selection of prerecorded material provides better listening options. And, of course, the sound capabilities of VCR hardware have kept pace with developments in software, in both VHS and Beta formats.

Actually, the first advance in VCR sound came when manufacturers divided the sound track into two channels for stereo recording. While this was an improvement, using the same overall track width to hold twice the amount of program material resulted in a noise level that was twice as high as before. The inherent limitations of the track width demanded further research.

Comparison of VCR and Hi-Fi VCR Tape Formats.



On conventional stereo, or 2-channel, videocassettes, sound is recorded on two narrow tracks located at the edge of the tape.



On new hi-fi stereo videocassettes, sound is recorded across nearly the entire width of the tape, using methods which allow simultaneous recording of video within the same area.

At last, big breakthroughs in VCR sound were realized with the creation of *hi-fi* stereo tapes and decks—first Beta Hi-Fi, then VHS Hi-Fi. Both systems use nearly the entire width of the tape for audio signals, without affecting video signals which are recorded across the same area.

The true significance of these technological advances is the dramatic improvement they can make in your home entertainment experience. But the full potential of the technology cannot be realized unless every component in your system measures up to stringent standards. And, speakers are the components that must meet the highest standards, since they ultimately must reproduce the recorded sound.

Bose® has spent the last 20 years developing unique Direct/Reflecting® speakers—components that are capable of filling your entire listening room, not just a limited section of it, with exciting, lifelike sound. It may be the "widescreen sound" you experience at the movies . . . or the rich sonic ambience that surrounds you in the concert hall . . .

We invite you to experience Bose speaker sound at any of our authorized dealers. They are now playing the Bose Music Video—a hi-fi VCR program which demonstrates the breakthroughs we've discussed. We think you'll enjoy hi-fi VCR. And we think that Bose speakers will help you enjoy it the most.

For more information on Bose products, and a list of authorized dealers, please write: Bose Corporation, Dept. AU, 10 Speen Street, Framingham, MA 01701.

Dr. Short holds an Sc.D. in Electrical Engineering from MIT.

3

TECHNICS RS-B100 CASSETTE DECK

Manufacturer's Specifications
Frequency Response: 20 Hz to 19 kHz; to 21 kHz with CrO_2 tape; to 23 kHz with metal tape.
Signal/Noise Ratio: 60 dBA; 78 dB CCIR/ARM with Dolby C NR; 92 dBA with dbx NR.
Input Sensitivity: 60 mV.
Output Level: Line, 700 mV; headphone, 125 mV into 8 ohms.
Flutter: 0.022% wtd. rms.
Fast-Wind Time: 90 S for C-60.
Dimensions: 16⅞ in. (42.8 cm) W × 3⅞ in. (9.8 cm) H × 10¾ in. (27.3 cm) D.
Weight: 11.3 lbs. (5.1 kg).
Price: $800.
Company Address: One Panasonic Way, Secaucus, N.J. 07094.
For literature, circle No. 92

The RS-B100, Technics' top-of-the-line stereo cassette deck, has a number of performance and convenience features. The closed-loop, double-capstan transport has a direct-drive motor with a built-in frequency generator which is servo-compared to the output of a quartz crystal; any deviations in speed cause an immediate output change from the servo to maintain correct capstan drive speed. Advanced design of the record and playback amplifiers and equalizers improves both amplitude and phase responses and reduces distortion. The RS-B100 is a three-head deck which, of course, allows the optimization of individual recording and playback head designs. The overall results are better than would be possible with a two-head unit.

The Technics deck includes both Dolby B and C NR as well as dbx NR, giving the recordist great flexibility in working for the best results under different conditions. The wide-range fluorescent meters have a three-color readout for speedy and accurate display of record and playback levels. There are front-panel adjustments for record-level sensitivity and bias, and switchable 400-Hz and 12.5-kHz oscillators

for the necessary trimming, using the level meters in an expanded-scale mode for accuracy. This combination permits matching of the deck to the characteristics of most tapes, which can vary quite a bit. Other convenience features include automatic tape-type selection, "Auto Rec Mute," and a three-way digital counter.

Control Layout

The light color of the front-panel designations make them quite legible in normal lighting, contrasting well with the dark brown and black of the panel. The timer slide switch ("Rec/Off/Play") is immediately below the power switch pushbutton at the far left (the best place for it, in my view). Immediately below are the "Eject" button, which gets a smooth and gentle tilt out of the carrier, and the headphone jack.

The light behind the tape compartment is brighter than usual, facilitating fast checks of the tape pack's status. Each time the compartment closes, the supply hub spins backward for about 1 S, taking up any tape slack in the cassette. You need a fairly firm push upwards to remove the tape-carrier door cover, but it's well worth doing when cleaning or demagnetizing because there's excellent access once it's off.

To the right of the tape compartment is the counter, with its controls just below. The "Tape" and "Time" buttons switch the display between the three-digit tape-position mode and the time-remaining mode, but the latter has some limitations. In the time mode, the counter does not actually sense tape position; it merely counts down from a time you select by pressing the "Time" button an appropriate number of times—once for 15:00, twice for 23:00 and so on, through 30:00, 45:00 and 60:00. Because these times correspond to the nominal lengths for one side of standard blank cassettes, this feature is handy if you're starting at the beginning of the tape but not if you start in the middle. Also, this is not a true time-remaining counter: It's a stopwatch function, counting time spent in playback or recording but switching back to "Tape" mode during fast-wind. You cannot, for instance, use this function to find something you remember being 5 minutes back along the tape. A third mode of the counter/timer displays the duration of record mute. If "Auto Rec Mute" is pushed and released while in record mode, the muting will continue for 4 S, counted out in the display, and the deck will go into record/pause mode. If the mute button is held in, muted recording will continue until it is released, with the time duration on display.

To the left of "Auto Rec Mute," along the bottom center of the panel, are the rest of the large, transport-control pushbuttons, which require only a light touch. Changes in mode are direct, in general, but recording can be entered only from "Stop" or "Pause." I do feel that high-end decks should offer punch-in (flying-start) recording during play—anyone who holds in "Play" and pushes "Rec" is not doing so by accident. Fast winding (forward or reverse) to the beginning of a selection and initiation of playback at that point is possible by pushing "MS" (music select), a control just above the "Counter Reset" button, before starting the winding. An "MS" annunciator above the counter display indicates that this mode is operative. "Play" and "Pause" have light-green indicators, and "Rec" has a red one.

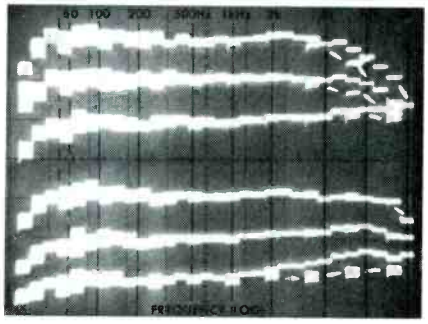


Fig. 1—Record/playback responses with (solid traces) and without (dashed traces) Dolby C NR. Upper three traces: TDK AD (Type I), TDK SA-X (Type II) and PDMagnetics 1100 Metal (Type IV) tapes, all at Dolby level. Lower three traces: AD, SA-X and 1100 Metal, all at −20 dB. (Vertical scale: 5 dB/div.)

Above the transport buttons are five interlocked pushbuttons to select Dolby B or C NR, no NR, dbx encoding/decoding for tape, dbx decoding-only for disc, and the MPX filter for Dolby. The buttons used in tape recording and playback with NR (the two Dolby settings, "dbx Tape" and "MPX Filter") have light-green indicators; the "dbx Disc" setting, which is not used for taping, has a red light.

The "Disc" setting, found on several dbx-equipped tape decks, allows dbx-encoded discs to be played without a separate decoder. In this mode, the monitor switch is automatically set to "Source," so it can be used with no tape running and so that you will not accidentally "decode" a non-dbx tape if you go into play mode. The red indicator warns that this switch position will not encode or decode tapes, and that its accidental use to expand signals not previously compressed by dbx encoding could possibly yield enough volume to damage equipment.

The horizontal, fluorescent bar-graph meters have 18 display segments for each channel, reading from −40 to +18 dB, with meter zero at 2 dB below Dolby level. The segments up to and including zero are light blue, those from +1 to +8 dB are orange, and the segments at +12 and +18 dB (which illuminate only when dbx NR is in use) are red. The above-zero hues not only are colorful but, more important, indicate where caution in controlling recording levels is in order. Momentary (2-S) holds on peaks supply additional clues for the recordist.

Just to the right of the meters are the annunciators for "Auto Tape Select," which indicate "Normal," "CrO_2" or "Metal" tape formulations. Further to the right is the large "Input Level" knob. The RS-100B comes with a silver-colored knob installed, but a second, dark-colored knob is provided to match the dark panel. At the upper right corner is the "Monitor" button, with illuminated "Tape" or "Source" indication. This automatically switches to "Source" mode when the deck is in record-pause mode, so you won't miss any sound cues (announcements, needle scratch, etc.) telling you when to start recording. Unlike most such automatic monitor selectors, however, it does not switch back to

Such features as three NR systems (Dolby B, C and dbx) and manual calibrations suggest this is a deck for serious recording.

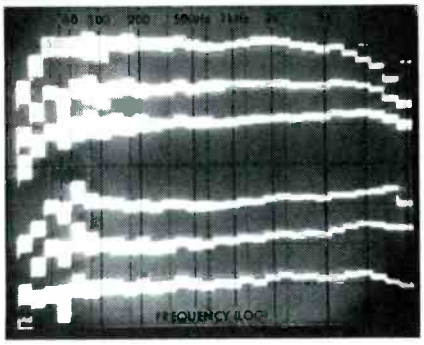


Fig. 2—Record/playback responses with dbx NR. Upper three traces: TDK AD (Type I), TDK SA-X (Type II) and PDMagnetics 1100 Metal (Type IV) tapes, all at Dolby level. Lower three traces: AD, SA-X and 1100 Metal, all at −20 dB. (Vertical scale: 5 dB/div.)

"Tape" when you start recording. I found it a nuisance to have to switch back manually each time.

Below the monitor switch are the small "Balance" and "Output Level" knobs. To the left of the latter are three interlocked switches which select either the normal stereo "Line" input (there are no mike inputs) or the recorder's built-in test tones, used with the unusually prominent calibration-control knobs just below.

The manual calibration procedures are quite simple. For record-level calibration, you first set the monitor to "Source," press the "400-Hz" oscillator-tone button, and adjust the input controls so the signal reads "0" on the meters. Then you start recording, switch the monitor to "Tape," and adjust the "Rec Cal" pots until each meter reads zero again. Bias-setting procedure is similar, except that you press the "400-Hz/12.5-kHz" oscillator button, and adjust the bias for simultaneous zero readings on both the upper meter bar (which reads the 400-Hz tone) and the lower bar (which reads the 12.5-kHz tone). The test signals are all actually recorded at −20 dB, but the meter range is shifted and expanded, for both tests, so the signals will read at zero and so that each meter step near zero will correspond to 1 dB. The center-detented calibration knobs carry numerical scales, so you can quickly return to known adjustments without repeating the calibration tests.

On the back panel are the usual in/out stereo phone jacks as well as a DIN jack for the optional remote control. A look at the internal construction showed a large, almost chassis-sized p.c. board which also serves as a motherboard; it holds some vertical cards, such as the two noise-reduction cards and the power supply. The soldering was excellent, with little flux residue, even at the hand-soldered points. All parts were identified by number. Multi-conductor cabling was used for intercard connections.

The transport was very quiet, particularly in play mode, and its construction appeared to be quite rigid. Although there was a large flywheel, it was difficult to see internal details. The general chassis construction was acceptably rigid, but there was no internal side rail on the right side, making the front panel springy with the cover removed. In my judgment, the unit would be good for rack-mounting (adaptors are supplied) only in stationary installations. The power transformer had good shielding and was not overly warm after a long period of use. I saw no fuses, inside or out, but there may have been other protective devices.

Measurements

The playback responses were very good at both equalizations, with about a 2-dB rise in level at the highest frequencies. The RS-B100 came supplied with samples of TDK AD, SA-X and MA-R tapes, but over 30 formulations were tried, using the deck's calibration scheme to good effect with the great majority of them. Most Type I tapes could be matched very well, but low-bias tapes were marginal, and the hottest tapes (such as TDK AD-X) showed high-end peakiness. The Type II formulations were all matched quite well, although there was a slight high-frequency droop with a couple of minor brands. Most metal tapes showed quite a high-end boost, including TDK MA-R. I decided to use PDMagnetics 1100 Metal for the Type IV tape because it had a smoother response, but I did stick with the TDK-AD (Type I) and SA-X (Type II) because they were judged to be the match of any others tried.

Figure 1 shows the record/playback responses, with and without Dolby C NR, using pink noise and a ⅓-octave RTA. Table I lists the −3 dB points, measured using a sine-wave source. The 0-dB responses are quite good but not outstanding. At both this level and 20 dB below, high-frequency response becomes more extended as you go from Type I tape to Type II and then Type IV tape. The Dolby C NR tracking is excellent with TDK AD and SA-X; although the Type IV results suffered in comparison, the mistracking there was not great. I should also note that other Type IV formulations did not do as well as the PDMagnetics tape. In general, the −20 dB responses have excellent flatness from 30 Hz to 16 kHz.

For all tests with this deck, I recalibrated its recording level and bias for each tape before switching in NR or taking any data. Figure 2 presents the Dolby-level and −20 dB record/playback responses with the three tapes, using dbx NR. The −20 dB responses are quite good (SA-X) to excellent (1100 Metal), but the responses at 0 dB were a puzzle when first run. Having seen a number of decks with flat responses with dbx NR up to +5 dB, I first thought I had made a mistake in level setting. A short test sequence revealed that whereas the other decks had the dbx unity-gain point as much as 8 to 10 dB below Dolby level, the Technics deck was set for dbx unity gain at close to meter zero, or −2 dB re: Dolby level.

Let me clarify what I am referring to here. With the dbx system, there is compression during encoding (before recording), with the highest levels reduced somewhat and the lowest levels increased considerably. In decoding the playback, the highest levels are expanded somewhat and the lowest levels are reduced greatly (downward expansion), returning the signals to their original character with an attendant reduction in noise. The level towards which other levels are compressed in recording—and away from which they

The designers obviously put a premium on legibility, with contrasting panel designations, three-color meters and a bright light behind the tape.

Table I—Record/playback responses (−3 dB limits).

	With Dolby C NR				Without NR			
	Dolby Lvl		−20 dB		Dolby Lvl		−20 dB	
Tape	Hz	kHz	Hz	kHz	Hz	kHz	Hz	kHz
TDK AD	12.2	10.8	13.0	18.0	12.1	9.0	12.0	19.0
TDK SA-X	13.4	12.5	12.8	21.0	13.7	9.9	12.8	22.4
PDMagnetics 1100 Metal	12.5	21.9	12.1	24.4	12.7	17.0	12.0	25.0

Table II—Miscellaneous record/playback characteristics.

NR Type	Erasure At 100 Hz	Sep. At 1 kHz	Crosstalk At 1 kHz	10-kHz A/B Phase Error	10-kHz A/B Phase Jitter	MPX Filter At 19.00 kHz
Dolby C	66 dB	49 dB	−90 dB	80°	20°	−31.0 dB
dbx	>80 dB	51 dB	−95 dB			

Table III—400-Hz HDL_3 (%) vs. output level (0 dB = 200 nWb/m).

		Output Level						HDL_3 =
Tape	NR	−10	−8	−4	0	+4	+8	3%
TDK AD	Dolby C	0.05	0.08	0.16	0.42	1.3		+6.2 dB
	dbx	0.05	0.06	0.10	0.18	0.32	0.56	+16.0 dB
TDK SA-X	Dolby C	0.14	0.18	0.34	0.84	2.7		+4.8 dB
	dbx	0.17	0.20	0.25	0.40	0.63	1.0	+14.2 dB
PDMagnetics 1100 Metal	Dolby C	0.16	0.24	0.45	1.0	2.2		+5.8 dB
	dbx	0.21	0.24	0.32	0.45	0.65	1.1	+16.1 dB

Table IV—Signal/noise ratios with IEC A and CCIR/ARM weightings.

	IEC A Wtd. (dBA)				CCIR/ARM (dB)			
	W/Dolby C NR		W/dbx NR		W/Dolby C NR		W/dbx NR	
Tape	@ DL	HD = 3%	@ DL	HD = 3%	@ DL	HD = 3%	@ DL	HD = 3%
TDK AD	69.8	76.0	78.4	94.4	70.4	76.6	72.5	88.5
TDK SA-X	70.8	75.6	80.1	94.3	70.7	75.5	77.7	91.9
PDMagnetics 1100 Metal	67.2	73.0	80.9	97.0	67.3	73.1	76.2	92.3

Table V—HDL_3 (%) vs. frequency at 10 dB below Dolby level.

		Frequency (Hz)						
Tape	NR	50	100	400	1k	2k	4k	6k
PDMagnetics 1100 Metal	Dolby C	0.32	0.25	0.16	0.24	0.15	0.09	0.22
	dbx	2.8	1.9	0.75	0.21	0.36	0.32	0.20

Table VI—Input and output characteristics at 1 kHz.

Input	Level		Imp.,	Output	Level		Imp.,	Clip (Re:
	Sens.	Overload	Kilohms		Open Ckt.	Loaded	Ohms	Meter 0)
Line	50 mV	>31 V	42	Line	657 mV	609 mV	930	+18.2 dB
				Headphone	696 mV	399 mV	37	

are expanded in playback—is the unity-gain point or unity-gain level. For the dbx system to reduce distortion at the highest levels, and particularly to maintain extended high-frequency response, the unity-gain level in recording must be lower than the point where distortion is already high or the point where tape saturation effects are already detrimental. The 0-dB responses of the RS-B100 do match those for Dolby C NR, but as indicated above, I would prefer a lower unity-gain level for improved high-end performance at high levels.

Table II lists the results of various brief tests of record/playback characteristics. In general, the results are excellent, although the 80° phase error at 10 kHz is somewhat high. Note that dbx NR improves the deck's erasure, separation, and crosstalk. Tape play levels were indicated accurately on the right channel, but one segment low on the left. Tape play speed was as accurate as could be determined by the test tapes available, less than 0.1% off. The record-calibration pots had a range from −10 to +7 dB relative to the center detent using TDK SA-X. The 400-Hz (394-Hz actual) oscillator had about 1.5% distortion, and the 12.5-kHz (12.7-kHz actual) oscillator appeared to be substantially distortionless, though perhaps because the deck's roll-off was filtering out its distortion products.

The level of third-harmonic distortion was measured from −10 dB to the points where it equalled 3% for all three tapes and with both Dolby C and dbx NR. One thing that's most obvious in Table III is that much higher maximum levels are possible with dbx NR using the 3% distortion limit. At low recording levels, as is the normal case, there was generally less measured distortion with Dolby C NR than with dbx NR.

Table IV lists the signal-to-noise ratios with the three tapes for two NR systems, both with IEC A and with CCIR/ARM weightings. The figures are very good: Those for dbx NR are over 94 dBA, and TDK AD had 76.6 dB CCIR/ARM. The results were a little disappointing for the Type II tape, more so for the Type IV.

Table V shows how distortion varies with frequency at 10 dB below Dolby level using PDMagnetics 1100 Metal tape and with Dolby C and dbx NR. At this level there is less distortion with Dolby C NR, especially at the lowest frequencies. The distortion rise at the frequency extremes is moderate, less than with many other decks. However, the mid-band distortion would be lower with TDK AD tape.

Miscellaneous input and output characteristics are listed in Table VI. The attenuation of the two sections of the input-level pot tracked within 1 dB for just over 60 dB, one of the best. The output-level pot sections tracked within 1 dB for 40 dB. The headphone listening levels were very high with all phones tried, but critical listening at lower levels might require choosing a set of higher sensitivity. The polarity of the output was reversed in both "Source" and "Tape."

The bar-graph meters had very fast response, reaching full indication in 30 mS, but they were not fast enough to be classified as true peak-responding meters. They also showed no increase in deflection with positive and negative d.c. offsets added to the tone burst, whereas true peak meters will react to such offsets. The meters' responses were 3 dB down at 30 Hz and 26.2 kHz. The level calibration

The Technics RS-B100 has excellent responses, with a little high-end roll-off, as well as very good noise and distortion performance.

relative to meter zero was very good from −12 to +6, but +8 and above needed lower actual values to turn on, while −40 turned on at −33.3 dB actual. The momentary peak-hold time varied but was more often 1 S than the 2 S claimed. The meter's 20-dB decay time was 320 mS, on the short side for fast-responding meters.

There was no measurable change in tape play speed when line voltage was varied anywhere from 110 to 130 V. Play speed variations were within ±0.01% over a short period of time. Flutter was very low throughout a C-90 cassette: 0.036% weighted rms and ±0.06% weighted peak. At times, the record/playback flutter reached the very low specified figure of 0.022%, but the figures given just above were more typical of the results with a number of cassettes. Fast-wind times for a C-60 were just over 80 S. Changes in transport mode took 1 S, except that it took 2 S for the deck to switch into "Stop" mode after the tape ran out in fast-wind.

Use and Listening Tests

The owner's manual has several large connection and operation diagrams—which is good—but some of the details confused more than they clarified the subject. The text was generally very good, with many helpful notes. The paragraph on dbx NR is in error where it states that, in playback, "Strong signals are greatly expanded and weak signals are expanded in a small way . . . . " An accompanying figure in the manual illustrates the action correctly.

All controls and switches were completely reliable throughout the testing. The calibration scheme worked very well for the tapes tried, with the exception that bias trimming was unavailable for metal tapes, which I felt could have used some. I liked the wide choice of NR systems and the automatic switch to "Source" monitoring in the "dbx Disc" mode. I did not, however, appreciate the monitor's switching itself during "Rec/Pause" without switching itself back when I resumed recording.

I did use the music-selection system ("MS") to good advantage, as I did the tape/time counter in winding back to the start of recording when I had to start over. I was frustrated, however, that this feature was nonoperational after 30 S of recording, and that the deck has no other memory to enable a fast-wind to "000" when desired.

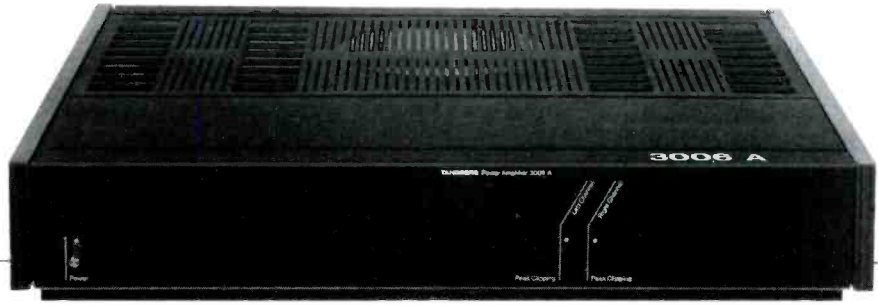
There were no record or pause sounds detected by ear or meter, and a stop caused a soft clunk, just barely out of tape noise, even with Dolby C NR. Although the meter dynamics were not quite what I prefer, the display conveyed level information very well, helping in speedy level-setting. The peak holds were usually about 1 S; a longer time would have helped.

It was possible to hear an increase in the high-frequency energy with Dolby C NR switched in when using metal tape, but with most music the change was pleasant. There were no response shifts noted with the other tapes or with dbx NR. Respighi's *Feste Romane* with Lorin Maazel and the Cleveland Orchestra (Mobile Fidelity MFSL 1-507) copied very well up to fairly high levels with all three tapes, each with two types of noise reduction (Dolby C and dbx). Some low-frequency muddiness prevented recording all the way to full-scale with dbx NR, somthing that *was* possible with less-demanding music.

The Technics RS-B100 cassette deck has excellent responses that exhibit some roll-off at the higher levels. The distortion and noise performance was very good, but the results with metal tape were disappointing. The stability of the tape transport was excellent, and the low flutter probably aided in the clarity of the sound. The RS-B100 is a relatively compact unit with rack-mounting, and that is worth keeping in mind when looking for a deck in its price range.

Howard A. Roberson

Tandberg's advanced engineering offers less.



Tandberg's dedicated staff of audiophile engineers long ago decided that ideally there should be nothing between the listener and the music . . . no IM, no THD, no TID . . . no audible distortion of any kind.

However, in the real world of audio electronics, "nothing" wasn't easy to come by; virtually every aspect of the signal path, and the circuitry that supports it, required reevaluation. Tandberg embarked on a 5-year research project to systematically localize and eliminate *every* source of audible distortion, however subtle.

In Pursuit of Nothing

The practical result of our concentrated research effort is the remarkable TPA 3006A Power Amplifier. Breaking new ground, and old rules, the TPA 3006A employs unique *zero feedback* MOSFET output stages. This is a difficult design topology, but the only one guaranteed to eliminate the audible time domain distortions undetected by conventional test methods. Available power output is 150 watts per channel into 8 ohms and 235 watts per channel into 4 ohms, with less than 0.02% THD/IM.

And, although MOSFETs have been used before, our constant-source impedance driver stage design is specifically engineered, for the first time, to take full advantage of these remarkable output devices.

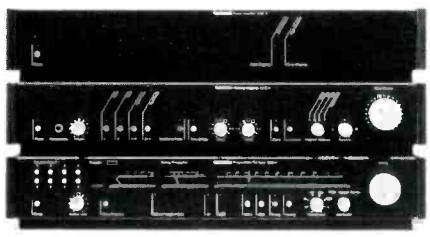
The voltage and current limiting protection circuits of conventional amplifier designs also proved to be major obstacles to full fidelity. Tandberg's MOSFET configuration eliminates the need for all such circuit limitations; the MOSFET stages themselves are maintained at full linearity by a unique Voltage Comparator Circuit. The TPA 3006A, therefore, has an output-current capacity exceeding 25 amperes per channel, supported by a massive, tightly regulated toroidal transformer power supply with over 30,000 microfarads of filter/storage capacitance.

Damaging DC is kept from the output signal path via our (patented) Thermic Servo Loop system that monitors the amplifier's output, automatically and instantaneously rebiasing the amplifier as necessary . . . but, unlike other designs, with no connection whatsoever to the musical signal.

Once the major areas of power amplifier distortion were eliminated, Tandberg engineers were free to pursue the much more subtle, less definable sources of sound degradation.

Further technical nuances

Tandberg's pursuit of absolute fidelity led to the use of carefully chosen, costly high tolerance components: 1% metal-film resistors for their stability and low noise; plus sonically superior polypropylene capacitors (instead of electrolytic and ceramic types) are used in all audio stages. And, all audio stages employ discrete (no ICs!)



TANDBERG

circuitry for maximum headroom and minimum distortion.

Tandberg has even reevaluated circuit board design. The lowest possible noise levels and totally identical performance between channels could be realized only when there is symetrical parts layout and the reverse side of the circuit boards copper-plated to form a shielding ground plane; all housed in an unusually compact, nonmagnetic, anodized extruded-aluminum chassis.

Compact & Cost Effective

Never before has a power amplifier of this degree of performance been compact enough to match our TCA 3002A Preamplifier and the world-famous TPT 3001A Programmable Tuner.

It should be evident that in the TPA 3006A, Tandberg has mounted an all out assault on audible distortion, breaking new ground in those areas that elude conventional measurements . . . and designers.

The final proof, of course, is in the sound. Audition the TPA 3006A at your Tandberg dealer . . . and hear why our engineers feel that they have achieved a quality of music reproduction comparable to the most costly esoteric units, in a compact, cost-effective design that is unobtrusive in any room setting.

For a Technical Paper on the remarkable TPA 3006A Power Amplifier and a beautiful color poster showing the complete Tandberg family of purist audio components, send $2 for postage and handling to: Tandberg of America, Dept. AM, One Labriola Court, P O Box 58, Armonk, N. Y. 10504.

Enter No. 46 on Reader Service Card

EDWARD TATNALL CANBY

ON THE WINDS OF SONG

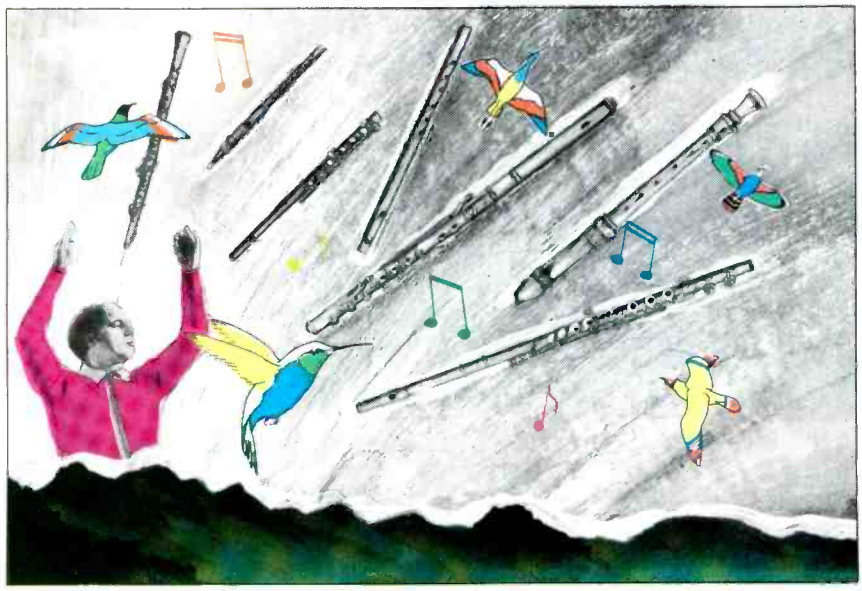


Illustration: Carolyn Brown

Music for Winds, Vol. II. Music of Darius Milhaud, Percy Grainger, and Francis Poulenc. The London Wind Orchestra, Denis Wick.
Nonesuch 78026, $8.98.

Those in the band biz can probably explain to you why a British wind band sounds different from its American counterpart—I can't. But I hear it and so will you in this band disc, featuring all-English music on one side, all-French music on the other.

The first side is all Grainger. That precocious musical dandy of the early part of the century (who was married in the Hollywood Bowl in front of a paying audience of 15,000) is more likely to annoy than to please Americans. He is skillful enough, but his sound is dated (a better man would last longer); his harmonies are by turns cloying, cute, syrupy—why say more? Even a late work, from 1937, merely adds a few stylized dissonances to the same old sound.

If you love Grainger and disagree, it's okay with me. To give credit, he did actually "collect" some of these tunes from the country folk back around the turn of the century, using an Edison cylinder machine to take musical field notes.

Side two has the work of a younger generation of composers, Milhaud and Poulenc. Both came to notice in the snazzy, nose-thumbing '20s, and their music is thus free of cloying sound, more modern and—for our ears—much easier listening. They are as determinedly French, of course, as Grainger is English/Irish—more folk music for you! Both men compose beautifully for band, to better effect on records than Grainger. Those brittle, icy shards of casual dissonance that were Milhaud's genial trademark are plenty audible in his "French Suite" and will try your pickup like the sound of broken glass.

As for Poulenc, *his* "French Suite," somewhat earlier in composition (1937), is spare, where Milhaud tends to be overblown and at times dynamically corpulent, like the man Milhaud himself. The Poulenc winds are beautifully treated, with a casual stroke of genius, a single harpsichord contrasted against the wind forces. The music, originally attached to a stage comedy, evokes 16th-century French dance music, neatly done in modern style with modern instruments. If you have heard any of the Renaissance dance music on old instruments that has recently proliferated on hundreds of recordings, you will appreciate Poulenc's skill, at a time well before that revival had begun.

Interesting note: Poulenc's harpsichord always speaks alone, whether in short passages or quite long ones; its very small tone is thus entirely audible along with the much louder wind sound. The English recording people, thank heavens, have understood this. The harpsichord is unamplified, its sound balanced against the base silence (non-digital, but quiet enough) exactly as it should be. Good job. A twist of a knob could have wholly ruined what is a delicate and pleasing sonic effect.

Calliope Festival: An Italian Renaissance Revel.
Nonesuch 79069, digital, $11.98.

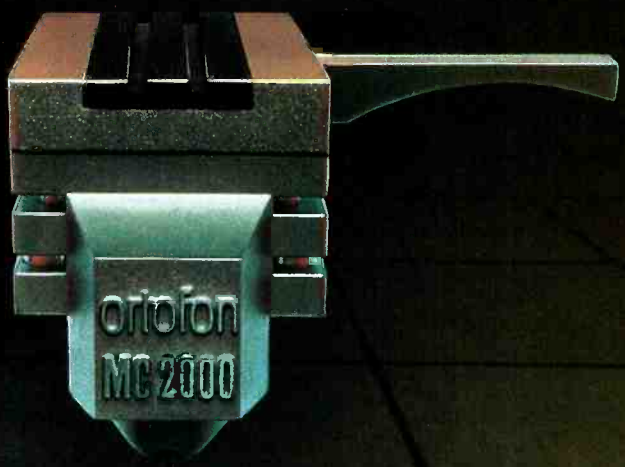
If you have not yet sampled the sonic colorfulness of the old Renaissance instruments, now so expertly revived, this is an excellent recording to start with. Calliope—the group's official name—is extremely professional, its members totally fluent and accurate in all the many instruments they play. (As is the tradition, each member plays a whole series of different instruments, not merely one.) You will not find yourself thinking that, after all, the usual modern instruments at least play in tune! More important, these players, though crisp and no-nonsense in the contemporary manner, still have an excellent sense for phrasing and style. This adds immensely to the impact, even of the little dance pieces that are, inevitably, most of the content of such recordings.

There is lots of good rhythm, plenty of contrast in tonal color (as between the differing families of instruments), and a sprightly sense of humor that makes the recording anything but dull. The span of music runs from the 13th all the way into the 17th century, and it has been nicely recorded in a church in Brooklyn, N.Y.—though you are at liberty to imagine yourself somewhere in Romantic Italy. Who would suppose the Italian Renaissance could blossom on Flatbush Avenue?

ORTOPHASE™

And listening can never be the same again.

"Breathtaking . . .", say the U.S. critics. "Habit forming . . .", say the Swedes. "Heavenly . . .", say the Danes. ". . . Cannot fail to delight . . .", say the British. "Wonderbar . . .", say the Germans. That's how the world responded to the Ortophase™ concept and to the spectacular Ortofon MC2000. Now the Ortophase principle has been incorporated into a full range of moving coil cartridges. This means that every music lover, regardless of budget, can take advantage of this "breathtaking" development. Write for full information.



ortofon

122 Dupont Street, Plainview, New York 11803
Send $1 for beautiful, Ortofon poster.

Enter No. 28 on Reader Service Card

11 mg. "tar", 0.7 mg. nicotine av. per cigarette by FTC method.

Winston. America's Best.

Excellence. The best live up to it.

Warning: The Surgeon General Has Determined That Cigarette Smoking Is Dangerous to Your Health.

David Amos doesn't operate in the mainstream of big-time, music-biz publicity. However, he is a conductor of outstanding sensitivity and intelligence.


David Amos

Photo: Jack Ingber

Spring Night on a Moonlit River: Music of the Chinese Zither (Gu Zhang). Chen Lei-shi.
Nonesuch Explorer 72089, $5.98.

Fascinating but cryptic, here is a Chinese stringed instrument with a 2,000-year-old history, used for nominally popular Chinese entertainment during all these 20 centuries and up to the present. Also, a Chinese professor who plays the instrument with wonderful expertise, song after song for two LP sides, some dating from as recently as 1920, others going casually back to an origin in the Tang or Ming Dynasty. They all sound remarkably alike, at least in their present traditional form, and all make pleasurable listening. But what do we Westerners *hear?* An interesting question.

The zither is somewhat like the Japanese koto, with high-raised individual bridges under each string. The basic tones come from a few open strings; the rest of the highly decorative detail work—a fascinating tissue of little slides and slithers, out-of-tune blues notes, quavers and wobbles, and kitten-like sounds—seems to be played on the other side of the bridges. The instrument's sound is very delicate, and quite mind-bending.

But beware of the liner notes! They are both comprehensive and lucid, with much detail as to the sense and background of every piece; dozens of Chinese characters are interspersed with English, in case you can follow them. I enjoyed these accounts, but, alas, I could not *hear* anything they described. I floundered.

For a moment I thought I heard the playful crow, as described in one song, but it turned out I was in the wrong piece. The fanciful titles, such as "Hungry Horse/Jingling Bells," "Thinking of an Old Friend," "High Mountains and Running Water" and "Autumn Moon . . .," are lovely, but the music doesn't relate to an untrained ear. All the melodies sound the same to me, four or five simple tones, over and over again, in one song after another. Neither horses, crows, old friends, nor running water seemed to have much to do with it.

Knowledgeable scholarly types, of course, will find this a priceless recording, with so much useful information attached. On the other hand, most listeners will just enjoy the music without a worry as to what it may signify to a Chinese listener. That's the best approach.

Paul Creston: Suite for String Orchestra, Op. 109, Chant of 1942, Op. 33; Norman Dello Joio: Air for Strings; Alan Hovhaness: Celestial Fantasy, Op. 44. The Israel Philharmonic Orchestra, David Amos.
Crystal S508, $8.98.

A superb recording of string music, almost: Too bad that one short work, the "Chant of 1942," brings in other sounds such as horns and drums! For a moment, as I listened, these seemed almost a desecration of the purity of strings alone.

It takes many factors of perfection to achieve a really fine string recording. First in order is a top group of string musicians, intelligent, sensitive, not in a rush to get to the next date, not sight-reading the music. Second is a conductor who is outstandingly sensitive and intelligent in his musical direction, as is David Amos. No matter that you have never heard of him; he doesn't operate in the mainstream of big-time, music-biz publicity. He is excellent, nevertheless. You do know of the Israel Philharmonic, of course. It is among the very best, too.

And then we must have intelligent recording, to put the strings, and the music, in the right acoustic space and to set up the microphones where they have to be—not for the "beautiful sound" of supermarket strings, a handful of them blown up and time-delayed into the familiar unctuousness! This is quite something else. I note that it was done in Tel Aviv by Pedro Carin, listed as recording engineer and *Tonmeister*. That means that he has had the modern training that links the art of music and audio engineering into one discipline, equally rigorous in both directions. It is a splendid idea for those who have the talent to follow through. More and more American audio enthusiasts find themselves interested.

Paul Creston has been around since 1906, out of New York. He has done just about everything, though wholly self-taught—like Georg Philipp Telemann or, for that matter, Beethoven. These types, far from showing amateurism, tend to be the most tightly disciplined of all in their music. The major string piece here is the quite recent (1978) "Suite," composed by Creston in his 70s, which I found both very listenable and, as aforesaid, really beautifully played. Creston has ranged as widely as, say, Shostakovich; here he has settled for a kind of gentle "neoclassicism" long after the fact, that somewhat Bach-like, slightly jazzy rhythmic style that was all the rage in the '40s, and persists among the academic composers today. But Creston is not one of those. His sound is unlike anybody else's in that, though the rhythms and counterpoints are "Baroquey," the harmonies are sweet and fruity in a good sense, with echoes of Grieg and Dvořák and others of Creston's contemporaries. A curious and interesting combination.

The "Chant of 1942," written a lifetime earlier in the year of its title, was briefly famous in that dreadful war year; those who are younger and can merely recall Vietnam will not really get its message, the marching sounds of a world war impinging on every side of us.

The remaining two short items are pleasant fillers for strings, with the same lovely playing if not with as much significance. Dello Joio writes a simple ABA song. And that strange mystical product of Somerville, Mass., Alan Hovhaness (the Armenian who found out how to stop Western music in its tracks and make it contemplate its Oriental navel while still going right on like Western music), here presents one of

MASTERWORKS

his earlier minor works. It's all fugue and counterpoint for strings, full of activity and yet standing quite still and going absolutely nowhere. Quite a trick, and to be admired.

Music of Buxtehude, Dandrieu, Zipoli, Mozart and Dubois. Richard Heschke, organ, at the Cathedral of the Holy Trinity, New Ulm, Minn. **Euterpe EAR 39701,** $10. (Available from Euterpe, P.O. Box 29, Briarcliff, N.Y. 10510.)

Here's another brand-new classical label, rather defiantly "analog" by its own account, put together by a group of musicians and engineers. This is its first release.

I'd like to enthuse, being partial to any new enterprise in the small-label area, but in this case it isn't easy. There are deficiencies, as I hear things, in both the engineering and the musical performance.

This is indeed an interesting new baroque-type, all-mechanical organ (there are a number of these in Minnesota already) with some really lovely sounds for an appreciative organist. In its rather large and resonant acoustic space it should be eminently recordable. But this player is the wrong choice and the acoustics do not come through well.

The pair of omni mikes, AKG, are "optimally placed," it says, to capture this organ in its big space. On listening, I find the mike placement much less than optimal. In the opening Buxtehude work, for instance, I was jolted by the loud, acid, edgy sound of the pedal stop—here used in a literal way as a musical "pedal point," a bass tone held down by one toe while the hands play figurations above. It seemed far too close and too loud in relation to the upper work—almost too much for the pickup, in fact. (Is there out-of-phase material, due to the two-mike setup?) I have to doubt that this is the "optimum" sound of the organ's bass department in the live space itself. Moreover, for a big cathedral with a 5-S reverb, the recorded sound is smallish and not expansive, a so-so balance between the direct and reverberant elements.

As for the music, Richard Heschke has all the right qualifications for an

This new, baroque-type organ, in the hands of the right musician, should be eminently recordable. Heschke is not the one.

American, all-purpose traveling recital organist, and that is, somehow, the way he sounds. Most of our professionals in this area tend to distrust the baroque organ and many hate it. I do not sense any affection in these performances, which seem to me to do their best to make the old-type instrument sound the way it "ought" to, rather than the way it does—so sweet, under the right fingers and toes. The Buxtehude is not warm. Where they could be full of jollity, the pair of little 18th-century tidbits, French and Italian, are just so many notes. The man plays all this music in an unphrased, staccato fashion, picking the fingers off the keys as one learns to do in the big Romantic organs in order to penetrate the huge blur of sound. On this sort of instrument, the effect is merely disconnected and ugly.

Side two features the big, very late Mozart "Fantasia in F Minor," K. 608, composed curiously for a mechanical clock but now played on the organ where its astonishing beauty and intensity can be realized. Things are better here—even that gravelly pedal stop sounds better, thanks to louder music in the upper areas. But again, the details of the lovely, quiet interludes are minus subtlety and played in a pedestrian fashion; some organists can make this music ravishingly beautiful. And there are plenty of inaccuracies, too. A new and unfamiliar instrument for the player? His problem, not ours.

By the way, this is a "live recital," straight through in the current fashion, minus editing. Might account for some of the inaccuracies. But oddly enough, editing *was* necessary where there was a change of registration via the mechanical pull stops! Organist could not play and change stops, too. In some recitals on this type of organ, there is a handy assistant who provides the extra hands to do this job; I saw one last summer, a statuesque woman who stood motionless behind the organist throughout the entire evening except when she deftly reached out to pull one knob or push in another. She got deserved applause at the end.

Perhaps one or another of old Bach's 21 children helped him out in this fashion? Better try the idea next time, Euterpe. And better change players, too.

ROCK/POP RECORDINGS

MICHAEL TEARSON
JON & SALLY TIVEN

RONSCADT

Illustration: Rick Tulka

Lush Life: Linda Ronstadt with Nelson Riddle and His Orchestra
Asylum 60381-1, $8.98.

Sound: B+ Performance: A

On *Lush Life*, her second collaboration with Nelson Riddle on an album of Tin Pan Alley standards, Linda Ronstadt sings with much more emotion and technique and pure phrasing than she could muster for their first album, *What's New*. That's what having an album sell several million more copies than expected will do for you.

Here Linda is by turns kittenish and cuddly, coy, coquettish, and downright sexy. Additionally, she is buoyed by real confidence in her ability to carry this demanding material, and so she can bring more commitment to it. Heck, she even sounds like she had much more fun making this record than the last one.

The songs here allow more variety in Riddle's arrangements than those on *What's New*. There are actually a couple of upbeat numbers that allow the big band to get that swing Riddle provided for Sinatra in the '50s, as in "Can We Be Friends." Then Riddle can turn it right around to be sweet and sad for a torch song like "My Old Flame." And then he can throw in a left-field idea like the music box sound of a celeste to open "Falling in Love Again" before the band kicks in to swing the affair again.

The selections have been expertly chosen. From the opening songs, "When I Fall in Love" and Hoagy Carmichael's "Skylark," to a pair of Rodgers and Hart songs, "It Never Entered My Mind" and "You Took Advantage of Me," to a very playful "Mean to Me," all the way through to Billy Strayhorn's "Lush Life," there is not a false moment on this album.

In between the two albums Ronstadt got to do a concert series with Riddle and the orchestra. I'm sure this helped her to loosen up and invest more of herself in *Lush Life* than she could in *What's New*. As a result, Linda has now made the album she set out to make at the time of *What's New*—a truly romantic, sometimes swinging disc of songs her parents love. That she has opened herself up to the best, purely emotional singing I can remember her doing is the reward.

Lush Life is a beautifully recorded and lovingly performed album.

Michael Tearson

Tonight: David Bowie
EMI-America SJ-17138, $9.98.

Sound: B Performance: C+

Tonight is not the sizzling electric affair that *Let's Dance* was. It is a somber, artier collection that maintains Bowie's inclination of not repeating an album's style.

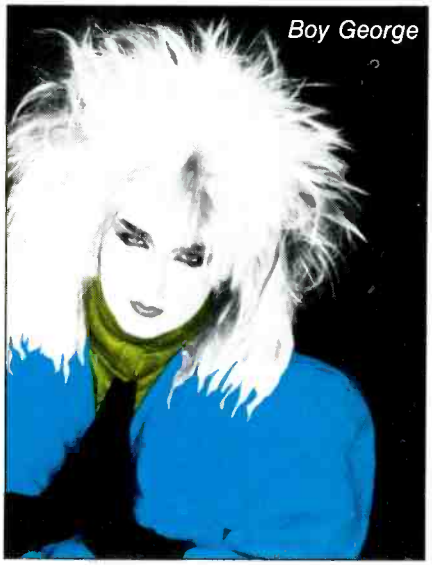
Nile Rodgers' slinky production style has been replaced by a tougher, more angular Germanic style designed by Bowie with his new bassist/guitarist Derek Bramble and ace producer Hugh Padgham (Genesis, The Police, Peter Gabriel, XTC).

The album neatly divides into halves, with the moodier, more diverse material congregated on side one and the more upbeat stuff on side two. Side one's contents include the dark, swirling, ominous "Loving the Alien"; a 1979 Iggy Pop song rendered in reggae, "Don't Look Down"; a rather leaden go at The Beach Boys' "God Only Knows," and a soulful duet with Tina Turner on the ballad that gives the album its name.

Side two attacks you with a '77 vintage Bowie/Pop song, "Neighborhood Threat," that furiously kicks off the side. Next is the obvious hit, "Blue Jean," which is a love song sung by a really confused kid. "Tumble and Twirl" is a travelog of Third World fun-times leading to a bright remake of Chuck Jackson's "I Keep Forgetting." The finale is a new Bowie/Pop/Carlos Alomar thumper, "Dancing with the Big Boys." It has a big, big sound featuring a great horn chart and Iggy Pop as guest vocalist.

Tonight does not coalesce totally. The two divergent sides feel as if they are competing with each other rather than being in sync, as if parts of two separate projects wound up as halves of the same album. Listening to the whole album, from end to end, leaves me feeling disoriented, as if I don't quite know what Bowie was getting at. This unsettling feeling, coupled with the fact that less than half the album is new (that is, 1984-vintage Bowie compositions), leads me to an unescapable conclusion that *Tonight* is only meant to mark time. Clearly this album is not one of David Bowie's major accomplishments; it is just too unsatisfying.

Michael Tearson



Waking Up with the House On Fire: Culture Club
Virgin/Epic OE 39881.

Sound: C+ Performance: B

Boy George is in danger of becoming a crooner. For all his sartorial outrageousness, the Boy's voice and his sensibilities are so conventional here that Culture Club's third album would be no more out of place at a cocktail lounge than at the Peppermint Lounge.

Waking Up is certainly not a bad bit of craft, but it sounds, in spots, like a Holiday Inn International Night: Pop tunes colored by everything from calypso to be-bop, delivered with harmless, singsong phrasing. This album is as mannered, and occasionally as quaint, as a Victorian bedtime story. Even the horn blasts are polite.

Boy George O'Dowd does try to assume all manner of vocal identities here—Smokey Robinson's, Michael Jackson's, operatic castrati's—but he tends to smooth them all out. Thus, bereft of his past vocals' intimations of passion, *Waking Up* finds him "whitening" black and other idioms in the manner of white, pre-Elvis cover bands. I mean, I love the sentiment, but it takes something deeper than George's nursery-rhyme cadence to pull off a line like "War, war is stupid."

The backing band—which isn't really the rest of Culture Club—falls in step with George's lack of dynamism, although that may be primarily a product of the mix, which plants the vocals firmly out in front. You'd think such material wouldn't present much of a challenge in terms of record pressing, but not so. Quite audible pops afflicted at least two songs on my copy, and low-frequency noises bristled underneath other passages. Before B. G. starts playing Vegas, he ought to have a word with Liberace's label.

Frank Lovece

Tropico: Pat Benatar
Chrysalis FV 41471, $8.98.

Sound: B+ Performance: C

It would be all too easy to call the latest Pat Benatar album a load of rotting swill dropped off the end of an assembly line. This dreary recording act not only lacks the fire and passion of Motley Crue, they sing every word of their quasi-anthems as if they really mean it. Perhaps Benatar and crew exist solely for the purpose of giving critics someone to sling their arrows at; certainly no one could make self-conscious parodies of "Rock at Its Worst" quite so convincingly.

This is Dee Snider and Twisted Sister with tongue firmly out of cheek, taking themselves very seriously, and revering predecessors such as Led Zeppelin not just as influences but as rock gods. There are kids on Long Island who worship what they hear on the radio, but only a few of them grow up to be Neil Geraldo.

This is not to downgrade Geraldo's musicianship, as he is a good guitar player and not a bad harmonicist. He has gone and married Pat (who has adopted the surname of Geraldo for publishing purposes), and this is the latest album by the two of them and their backing unit. It is what one could refer to as theatrically shaded hard rock, although at times this album borders on being lightweight. The first single, "We Belong" (not written by the band, as is the case with most of their hits), sounds like Eurythmics, and there's a definite Spanish/Caribbean flavor to some of the other tracks. The band is also becoming more dance oriented these days, not surprising considering it is more of a weathervane for popular taste than a stylistic element unto itself. No surprises. No thrills. Just high-gloss dross. After consuming, floss.

Jon & Sally Tiven

Pat Benatar

Los Lobos' music ranges wildly. All in all, there are enough styles to leave you breathless.


Los Lobos

How Will the Wolf Survive?: Los Lobos
Slash/Warner Bros. 25177, $8.98.

Sound: B Performance: A

There is something invigorating and real about Los Lobos. It is more than just their dazzling versatility; it's the sincerity and virtuosity behind it. Los Lobos' music ranges wildly. There is a John Lee Hooker-style boogie with "Don't Worry Baby," the Freddy Fender-ish balladry of "A Matter of Time," and the pure C&W of "Our Last Night." There's the Spanish-styled, accordion-driven, English-language "Corrida #1" and the traditional, Spanish-language "Serenata Norteña." Then there's the old-fashioned, swinging rockabilly of "I Got Loaded" and "Evangeline" and the full-throttle rock 'n' roll of "I Got to Let You Know." All in all, there are enough different styles to leave you breathless.

Album production is in the hands of T-Bone Burnett and Steve Berlin, who were responsible for 1983's mini album, . . . *and a time to dance*. In between the two records, Berlin joined the group to add the saxophone wizardry he also adds to labelmates The Blasters. Berlin and Burnett have kept the band's performances pure and as simple as possible, without gimmickery, to keep their eclecticism from overpowering the music.

I've got to tell you how excited I've been about Los Lobos. I've been turning on friends, strangers, people off the street, anyone I can, to the special pleasures of this band. They are a fresh breeze of authenticity in a prefabricated scene. *Michael Tearson*

Who's Last: The Who
MCA MCA2-8018, two-record set, $10.98.

Sound: C– Performance: D

The final Who album is a two-record set of performances from their 1982 farewell tour. There's nothing new here unless you count the raggedy "Twist and Shout" that closes the set. Sure, there's plenty of bombast and thunder, but not much fire or lightning. Just the old troupers giving the fans what they expect.

As hard as it has been for The Who in recent years, it really is just as well that Daltrey, Entwistle, Townshend, and Keith Moon's replacement Kenney Jones are hanging it up.

After all, this was the band whose first anthem (of the many that were to come) said, "Hope I die before I get old." *Michael Tearson*

Fee Waybill's solo effort feels no different from recent Tubes albums: Pure, anonymous, gray-flannel rock 'n' roll.

Read My Lips: Fee Waybill
Capitol ST-12369, $8.98.

Sound: B– Performance: D

Considering the consummate corporate rockers (à la Journey) that The Tubes have become, the first thing I did on receiving the solo album of Tubes leader/singer Fee Waybill was to check the "courtesy credits" (you know, "appears courtesy of . . . "). There they were: Three members of Toto, just as I expected.

Indeed, *Read My Lips* feels no different from recent Tubes albums: All calculation, all pose, all image, no heart. Pure, anonymous, gray-flannel rock.

Michael Tearson

Knife: Aztec Camera
Sire 25183, $8.98.

Sound: B+ Peformance: B+

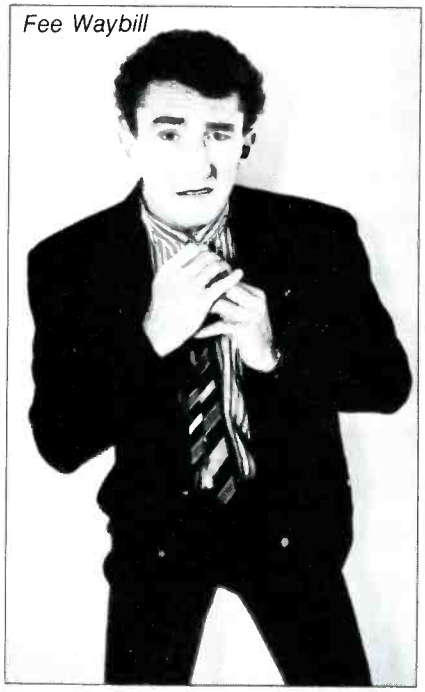
Knife is Aztec Camera's second album. Several friends, whose opinions I respect a lot, were more enchanted by their first album than I was. Roddy Frame and his songs just didn't strike that emotional chord in me that they seemed to for others. Even a fresh relisten hasn't changed my opinion of that album very much.

Knife largely dispels my reservations. The big difference is the infusion of Dire Straits' Mark Knopfler as producer. Under his aegis, the sound of Aztec Camera has blossomed into a beefier, more substantial entity, and Roddy's singing doesn't sound as precious as before. What the songs are about still escapes me much of the time, but the soundscape has become so attractive with warmth and luster that I really don't mind the difficulty of the songs. In any case, *Knife* has been inordinately hogging the turntable at my place.

I am now convinced that Aztec Camera and its central figure, Roddy Frame, are genuine comers.

Michael Tearson

Fee Waybill



KEITHBOARD ARTISTRY

Illustration: Rick Tulka

The Köln Concert: Keith Jarrett
ECM 1064-2.

When's the last time a piece of popular music brought tears to your eyes with its breathtaking splendor? Well, be prepared and get your hanky out when you put Keith Jarrett's *The Köln Concert* on your Compact Disc player. In truth, you won't be weeping throughout, for in between its moments of sheer majesty and introspective beauty, this recording swings, rocks, drifts and soothes.

Jarrett is nominally a jazz musician, although his work defies true categorization. (*The New Schwann*, that venerable reference guide to recordings, has listed him in its classical category.) This concert recording of a 1975 performance at the Opera in Köln, Germany catches Jarrett in one of his most accessible modes, weaving beautiful melodies throughout a typical free-form performance. There is a wonderful ebb and flow to this material, as Jarrett drifts along in the wash of a lovely introspective pattern, then builds subtly and slowly to a swelling crescendo from which he smoothly descends to the next melodic well.

Although this is a solo piano concert, Jarrett's music has moments of such density and richness that the memory retains the impression of an orchestrated piece. In contrast, there are also passages of such shimmering delicacy that they seem to have been created in the listener's mind and not by a musical instrument at all. Such a moment occurs about a third of the way into the first piece, when a last, deep piano note reverberates and fades, leaving a hazy cloud of sound into which a quick, light arpeggio is tossed like a glittering handful of silvery fairy dust.

The recording is ECM splendid. It is crystal-clear, with an impeccable sense of space; just the sound of the audience applauding conveys an accurate aural impression of the size of the hall. Hats off to the producer, once again ECM's brilliant Manfred Eicher, and to the engineer, Martin Wieland. Surfaces are, of course, pristine, and those all-important stretches between distant, thoughtful notes are blessedly silent.

One problem here has nothing to do with the technical handling of this CD. Keith Jarrett, like a few other instrumentalists who become totally engrossed with their work (the late Glenn Gould comes to mind), has a habit of accompanying himself vocally. His subdued but audible whoops, howls, and groans of delight may prove distracting to some listeners. Personally, I enjoy hearing the artist get so lost in his own performance.

Although this CD offers more than 59 minutes of Jarrett at Köln, it is missing the fourth side of the original two-disc vinyl album. For faultless, durable sound, stick with the CD. For seven more minutes of Keith Jarrett's exquisite pianism, get the double vinyl set as well. *Paulette Weiss*

Max Steiner: Film Score for King Kong. The National Philharmonic Orchestra, Fred Steiner.
Southern Cross SCCD 901.

Max Steiner was unquestionably one of the finest composers of film scores from the '30s through the '50s. The hallmark of a fine composer for the film medium is, of course, the knack for integrating the score into the action of the film itself. Not much film music can stand on its own in an expanded concert presentation, and the very attributes that make it good for the film may militate against it in the concert hall.

The exception, of course, is the symphonic synthesis, often done by someone other than the composer, which presents highlights of the score in a condensed form 8 or 10 minutes in length. If you recall the immensely successful film music series on RCA conducted by Charles Gerhardt, you know what I have in mind.

For anyone except the real film buff or Steiner devotee, there is simply too much *King Kong* here. Otherwise, the music is beautifully played, and the recording engineering and production are excellent. *John M. Eargle*

Mountain Dance: Dave Grusin
GRP D-9507.

Have a drink. Grab a handful of nuts or pretzels. Chat with a friend. Put Dave Grusin's *Mountain Dance* on your CD player. Listen, sip, talk, listen, nibble. Get the picture?

Mountain Dance will not exactly command your full attention. The tunes are attractive, the recording—another

rare pop original digital master—is excellent, but, depite the obvious technical competence, both in musicianship and studio-to-disc processing, there's little here of real substance.

The cuts are uniformly pretty, varying in tempo and intensity from the introspective Grusin acoustic piano solo, "Thanksong," to more uptempo boppers like "Captain Caribé." With the exception of the somehow thin "Rag Bag," with its skinny, whining synthesizer accents, the recording is technically excellent throughout; the CD captures delicate textures and textural contrasts, lovingly reproduces the wide variety of sounds the keyboards and synthesizers whip up, and gives real definition to aural space and instrumental placement.

Grusin and company dared to record live, direct to a two-track digital format. This meant forgoing the remixing step on which most pop records depend for final balancing, diminishing and/or eliminating mistakes, and generally perfecting the final product. Give Grusin a pat on the back for his bravery. Then have another drink. Have a pretzel. . . .

Paulette Weiss

Ravel: Gaspard de la nuit; Prokofiev: Sonata No. 6. Ivo Pogorelich, piano. **Deutsche Grammophon 413 363-2.**

The sensational young Yugoslavian, Ivo Pogorelich, has been raising eyebrows for a few years. His unorthodox interpretations at the prestigious Chopin Competition a few years ago split the panel of judges down the middle and resulted in his failure to qualify.

While there may be certain norms for performing Chopin, Ravel and Prokofiev allow for a bit more experimentation. In the case of the three poems for the piano in "Gaspard," the unorthodox approach brings out more detail than I had thought possible.

"Ondine" starts out at what many would call a practice tempo; however, the musical line remains pliant. As things build in complexity, the tempo gradually increases. By the time the cascades in thirds arrive, Pogorelich is well up to speed, and the figurations ripple as you may have rarely heard them.

"Le Gibet" is given a more usual treatment, but Pogorelich's skill in half-pedalling makes the performance a special one. In "Scarbo," Pogorelich knows no technical limits; he plays it faster—and better—than anyone else.

It is a mistake to follow "Gaspard" with Prokofiev, or anything else, for that matter. The program would have been better planned with Ravel all the way, ending with "Gaspard." Pogorelich handles the asperities of Prokofiev's writing without any unusual insights, and I found the performance less than convincing.

Ivo Pogorelich

The piano is given a big hall sound, which fits the music perfectly.

Recommended for the Ravel.

John M. Eargle

Mendelssohn: Concerto in E; Saint-Saëns: Violin Concerto No. 3. The Philharmonia Orchestra, Michael Tilson Thomas; Cho-Liang Lin, violin. **CBS Masterworks MK-39007.**

Cho-Liang Lin is one of the new generation of Oriental *Wunderkind* of the violin. On this CD, he offers fine performances of the Mendelssohn "Concerto in E" and the Saint-Saëns "Concerto No. 3." He certainly has a big, impressive tone, is very secure technically and maintains a fine rapport with the ever-maturing, ever-improving Michael Tilson Thomas. Thomas conducts the Philharmonia Orchestra, an ensemble he has conducted fairly regularly in past months. No stones thrown at CBS, but this is

Cho-Liang Lin

an English recording, with an EMI balance engineer at the controls, and, frankly, it is of much better quality than most domestic CBS recordings. The solo violin is moderately forward in its projection, but it is never obtrusive. Balances are generally good, and the sound is very clean and in a fairly spacious ambience. *Bert Whyte*

Girls with Guns: Tommy Shaw
A&M CD 5020 DIDX 138.

I never much cared for Styx as either a river or a band, but I really do like Tommy Shaw's solo debut, *Girls with Guns*. Mr. Shaw, Styx's ex-lead singer and songwriter, proves himself an intelligent, talented rocker. He has created a balanced albumful of slam-bang cuts and softer rock ballads, all with memorable melodies and arrangements, as well as lyrics that actually communicate coherent thought. I'm very much taken by the passionate tenderness that underlies the intensity of his vocals. I never noticed this quality when he was a member of Styx; maybe it was always there, maybe going solo set it free. Maybe I'm just in love. In any case, this 1984 album is high on my short list of discs to listen to again, in between the flood of new albums I'm supposed to review.

The hit title song is an exciting opener that crashes out of the gate at breakneck speed and doesn't stop until it slams to an abrupt end at the finish line. Shaw's got a way with guitars as well as girls, and lots of both is how he likes it. His work with acoustic guitar, six- and twelve-string electric guitars, and mandolin shines through with searing power on "Come in and Explain," with firm elegance on "Kiss Me Hello," and with simple folksy sweetness on "Little Girl World."

The arrangements and subtle special effects are inventive. I'm particularly fond of the use of overdubbing and echo on Shaw's expressive voice, which is applied and removed both to place his vocals tangibly in aural space and to emphasize the meaning of a lyric (the reverberated stretch added to the word "shout" in "Kiss Me Hello," for instance). Synthesizers buzz thinly against massed instrumentals, and tubby bass drums thump in marvelously restrained punctuation.

Brad Miller has recorded some of the most demanding sound sources that exist, steam locomotives.

Brad Miller

There is a tendency on the part of producer Mike Stone to bunch instruments up into his own version of Phil Spector's famous "wall of sound." This makes for an interesting CD transference problem, once again involving an analog recording that seems to have been made unclear deliberately for rock 'n' roll effect. The instrumental masses are quite blurred and muddy, with little of the crispness that usually comes across so well on a Compact Disc. Sibilants, in particular, are smeary and distorted, as is the extended hiss of a cymbal. True, the A&M Compact Disc version of this recording has wonderful silences between cuts, from which each song emerges with explosive power. However, the songs themselves are so chockful of sound that there are very few silent spots to admire within them. (The brilliant and effective dead pause on "Kiss Me Hello" is one notable exception.)

Whether a slight added clarity and a guaranteed extended playing life are worth the higher price tag of CD over LP is ultimately your decision, one rock fans rarely get to make with new recordings like this. *Girls with Guns* is one of the few pop CDs released at approximately the same time as the original LP, a move major record companies make only when they're absolutely certain that they're dealing with a hot artist. According to all reports, Shaw is heading up his own personal rock 'n' roll heatwave here in the chill of early winter. As for me, I'll take the CD and send Tommy Shaw a big box of chocolates and a mash note.

Paulette Weiss

The Power and the Majesty, Vol. II: Brad Miller
Mobile Fidelity Sound Lab MFCD 812.

Mobile Fidelity got its name from the remote environmental recording activities which Brad Miller presided over in the '60s and '70s. More recently, it has become known for prestige reissues of best-selling product licensed from other record companies.

In this second volume of *The Power and the Majesty,* Miller has gone back into the field, this time armed with the latest gear, to record some of the most demanding sound sources that exist—steam locomotives. He made four-channel, original recordings which were then mixed down to two-channel format for LP and CD purposes. (One suspects that he has in mind a quadraphonic release at some date in the future.)

The dynamic range is stupendous, and you had better start off at low volume until you have taken the real measure of your system and its capability of handling extremely low frequencies at high levels.

About the program itself, unless you are a train devotee, you will find it hard to sit straight through the disc's full playing time. There are many long and arid stretches, but when the locomotives *do* roar by, stand back!

John M. Eargle

Bartók: Bluebeard's Castle. The Hungarian State Opera, Janos Ferencsik.
Hungaroton HCD 12254-2.

I looked forward to this CD with much anticipation. Bartók's early opera has a particular kind of magic that can only be described as Magyar, which is inherent in the music as well as the Hungarian language itself. (The old Walter Berry/Christa Ludwig collaboration with Istvan Kertesz on English Decca captured this magic so well.) "Bluebeard" seemed such a natural for Hungaroton, but, alas, it is not the case here.

The problem is the two soloists. Instead of real Hungarians, we are presented with Russians. Not Russian voices of the Boris Goduonov sort—but voices of the Soviet type! The dialog between Bluebeard and his latest wife, Judith, comprises the entire opera, and to hear it carried out in rough,

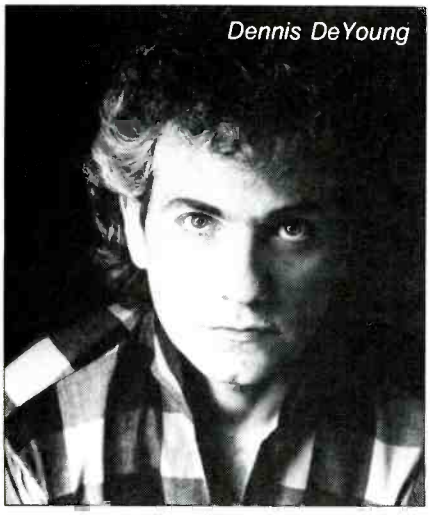
declamatory style is simply not right. Even the Hungarian language doesn't help; it might as well be Russian.

In purely recording terms, the production is excellent, but I really can't recommend this CD on musical grounds. *John M. Eargle*

Desert Moon: Dennis DeYoung
A&M CD-5006 DIDX 82.

1984 was the year Styx shot soloists out onto the pop charts, and the bullets were flying fast and furious. The big hit for ex-Styx keyboardist and vocalist Dennis DeYoung was "Desert Moon," the title song of his first solo album. This poignant ballad of innocence and first love was accompanied by a video remarkable for its romantic restraint, considering its potentially sappy, sentimental subject. Restraint may be the key descriptive term for this entire recording as well, as becomes apparent in the Compact Disc version released at approximately the same time as the analog LP.

This is a nicely eclectic gallery of songs. The energetic opener, "Don't Wait for Heroes," rocks along with some neat keyboard action on an attractive tune from DeYoung's own hand. With its tongue-in-cheek, male, doo-wop vocal chorus; precious, all-girl backup vocals, and white-boy street rap from DeYoung, "Boys Will Be Boys" pokes fun at the "forever young in the summertime" rock genre. The basic rock line on "Suspicious" is shot through with jazz inflections, from its


Dennis DeYoung

The clarity of the CD version of *Desert Moon* exposes a production job just a shade too staid for the material.

lightly swinging chorus backup to DeYoung's bluesy but bogus synthesized harmonica. DeYoung has a dead-center sense of humor that appears throughout the album; it comes through wonderfully in both the musical arrangements and lyrics of "Gravity." Against the celestial "bom bom bom" of a heavenly chorus, DeYoung rocks out with a line about wanting to climb Mount Everest but "... that mountain's so steep/I know my nose will bleed, 'cause gravity don't sleep/It don't sleep."

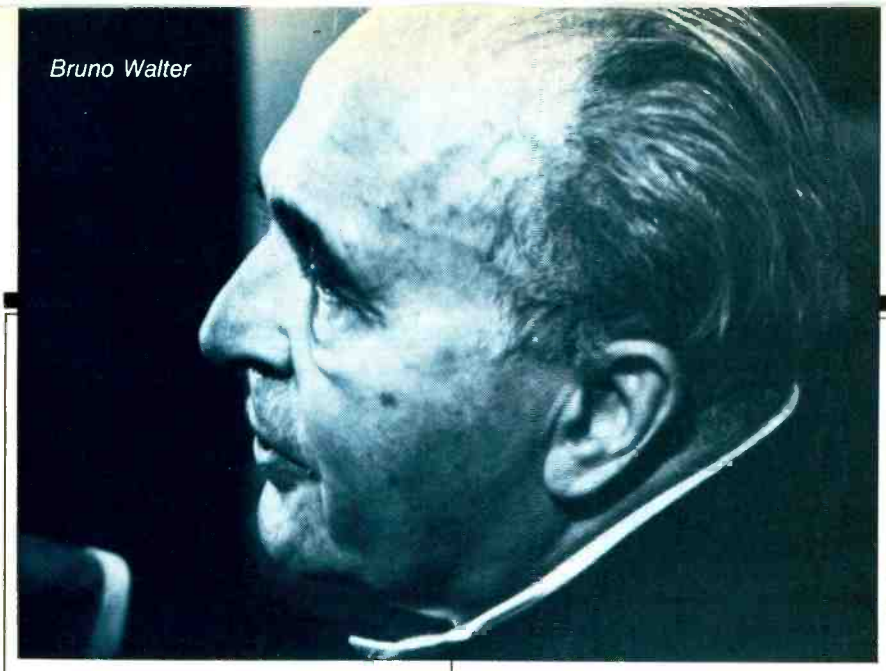
Where the aforementioned restraint becomes obvious is in the production and execution of some of these intelligently arranged and attractively melodic tunes. The clarity of the Compact Disc version exposes a production job just a shade too staid for the material. There is an adequate sense of aural space but little imagination used in spatial presentation. Most vocals and instrumentals cluster at mid-center. There are, indeed, forays into split-channel effects; instruments do not necessarily occupy the same aural location through all eight cuts, and a peppering of electronics—like the stretching of the vocal chorus on "Fire" and the very subtle secondary delayed echo on DeYoung's vocal in "Boys Will Be Boys"—do add extra interest. However, there's a general lack of power here, a subdued quality to DeYoung's vocals and to many otherwise fine instrumental passages that may speak of his inexperience as a producer.

The CD's sparkling-clear sound is evident from the rock-solid opening drum that rolls out on the disc's first cut, to the last fading note of the saxophone that closes out the final cut, "Dear Darling (I'll Be There)." This is one of those borderline CDs. Whether you shoot the works on the more expensive digital package or set your sights on the less costly analog disc, you'll wind up with a satisfying solo first from Dennis DeYoung. *Paulette Weiss*

Mahler: Das Lied von der Erde. The New York Philharmonic Orchestra, Bruno Walter; Mildred Miller, mezzo-soprano; Ernst Haefliger, tenor.
CBS/Sony 35DC 115.

Mozart: Symphonies Nos. 36 and 38. The Columbia Symphony Orchestra, Bruno Walter.
CBS/Sony 35DC 74.

CBS/Sony is embarking on a noble project, the reissuing on CD of the vast bulk of Bruno Walter's stereo catalog. Whenever possible, they are going back to the original half-inch, multitrack master and mixing directly to a new digital two-track format. By multitrack, of course, I mean the original three- or possibly four-track source tape. Furthermore, the remixes are taking place under the supervision of John McClure, the producer of the original sessions.


Bruno Walter

What is amazing here is just how clean and quiet some of these 24-year-old master tapes can be! I suspect that source tapes of similar quality exist in the vaults of RCA, EMI and Decca, among others, and I hope that they follow this important precedent.

The Mahler was recorded in Hollywood in April 1960, presumably while the orchestra was on tour. The recording venue, again presumably, was the American Legion Hall on Highland Avenue, where so many of Columbia's West Coast classical recordings were made.

Walter pioneered the music of Gustav Mahler, long before the great Mahler rebirth of the mid-'60s, and it would probably sadden him to hear today's typically overblown performances. Walter was such an even hand with these rich and easily overstated scores that his recordings stand today as the models of how this music should be conducted.

Only when the music is played back at elevated levels does the tape hiss of a quarter-century ago become apparent. There are occasional traffic rumbles which serve to tell us how little things have changed over the years. The production is very simple by today's multi-mike standards—and that is all to the good. Some of the older microphone designs were a bit brighter at the high end than today's models, and that can often be noticed. Otherwise, the recording beats most of what is typically done today.

The Mozart symphonies were also recorded in Hollywood, during late 1959 and early 1960. The Columbia Symphony Orchestra was the name given to a group of freelance musicians assembled for Columbia's West Coast classical recordings. The sound is clean and the production technique simple. Would that more of today's recordings had the natural sheen to the strings that these recordings exhibit. Heartily recommended!

John M. Eargle

CLASSIFIED ADVERTISING

CLASSIFIED ADVERTISING RATES

BUSINESS ADS—$1.40 per word, MINIMUM charge PER AD, PER INSERTION $33. All centered or spaced lines $11.

NON BUSINESS ADS—95¢ per word, MINIMUM charge PER AD, PER INSERTION $17. All centered or spaced lines at $9.

ALL LINE ADS—First line set in bold face type at no extra charge. Additional words set in bold face at $1.65 *extra* per word. One point ruled box is $12.

CLASSIFIED LINE ADS ARE PAYABLE IN ADVANCE BY CHECK OR MONEY ORDER ONLY. (Sorry, we cannot accept credit cards or bill for line advertising.) **ALL LINE ORDERS** should be mailed to:

AUDIO/CBS Magazines
P.O. Box 9125
Dept. 346V
Stamford, CT 06925

ORDERS WILL NOT BE PROCESSED WITHOUT ACCOMPANYING CHECK OR MONEY ORDER FOR FULL AMOUNT.

CLOSING DATE—First of month two months preceding the cover date. If the first of the month falls on a weekend or holiday, the closing date is the last business day preceding the first. ADS RECEIVED AFTER THE CLOSING DATE WILL BE HELD FOR THE NEXT ISSUE UNLESS OTHERWISE STATED.

FREQUENCY DISCOUNTS—3 times less 5%, 6 times less 15%, 12 times less 20%. These discounts apply to line ads only. Ads submitted for a three-time frequency are unchangeable. Frequency discounts not fulfilled will be short-rated accordingly. Agency discounts do not apply to line advertising.

BLIND ADS—Audio box numbers may be used at $6 extra for handling and postage.

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.

CLASSIFIED DISPLAY RATES

1 col × 1 inch	$275
1 col × 2 inches	$435
1 col × 3 inches	$622
2 cols. × 1 inch	$495
2 cols. × 2 inches	$836

One column width is 2⅛". Two columns wide is 4¼". For larger display ad rates and 6, 12, 18 and 24 times frequency rates call (212) 719-6338.

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

FOR ANY ADDITIONAL INFORMATION, contact Laura directly at (212) 719-6338.

ATTENTION READERS:

Please note that only retailers who are authorized by manufacturers to sell their product lines are listed under the heading **"AUTHORIZED DEALERS."** This particular category is further subdivided into the geographic areas which these dealers serve.

Ads placed by private individuals, manufacturers and retailers can be found in specific categories, i.e., AMPS, PREAMPS. (The letters **AD** in bold face type at the end of an ad means **AUTHORIZED DEALER.**) We hope this will allow you to easily locate a specific product or service.

AUTHORIZED DEALERS

NATIONAL

ABBIE'S AUDIO NOW OFFERS ACOUSTAT, Berning, B&K, Klyne, Lazarus, Nova, Tandberg, VSP, Superphon, Robertson, Precision Fidelity, Creek, Goetz Systems, Watkins, JSE, Spica, M&K, VPI, AR Tables, Heybrook, Pink Triangle, Souther, MMT Premier, Zeta, Alphason, Sumiko, Audioquest, Koetsu, Accuphase, Talisman, Monster Cable, Promethean Green, Discrete Technology, and others. Good used equipment, newsletter. 302 E. High St., Waynesburg, PA 15370. (412) 852-1134.

AUTHORIZED DEALERS

NATIONAL

ACOUSTAT AND PS AUDIO—SUPERB!
Free shipping! Fast service! Also Nakamichi, Thorens, Talisman, Audire, Hafler, Klipsch, Adcom, Mitsubishi, SAE, compact digital players. READ BROTHERS STEREO, 593 King Street, Charleston, South Carolina 29403. (803) 723-7276.

APPALLING? ISN'T IT?

How many esoteric audio products look and feel as if they were made by orangutans with screwdrivers. If you are fed up with sacrificing reliability, aesthetics and quality of construction to obtain purer sound, don't despair!

There are many high end audio components built by small yet solid professional companies which not only express the utmost in musicality but also reflect the high level of design integrity, craftsmanship and quality control. At Sound By Singer we select and blend only such components into systems designed to extract the most music from your audio dollars.

ACOUSTAT • ADCOM • AKROYD • APOGEE • AUDIOQUEST • AUDIO NOTE • AUDIO INTERFACE • AUDIO VOIS • B&K • BERNING • BEVERIDGE • COUNTERPOINT • CWD • DYNAVECTOR • FUSELIER • GRACE • GRADO • KISEIKI • KLOSS • KOETSU • KRELL • LINN SONDEK • LIVEWIRE • MC LAREN • MONSTER CABLE • NAIM AUDIO • NITTY GRITTY • NOVAK • NYAL (MOSCODE) • PRECISION FIDELITY • PROAC • PROTON • RANDALL RESEARCH • RAUNA • REGA • ROBERTSON • SNELL ACOUSTICS • STAX • SYMDEX • SYRINX • TALISMAN

SOUND BY SINGER

165 E. 33RD STREET
New York, NY 10016
(212) 683-0925
WE SHIP ANYWHERE

BEST DARN TRADES OFFERED. Dealer for Accuphase, Acoustat, Alpha-1, Audioquest, Audio Research, AR turntables, Beard, Bedini, Belles, Berning, Classé, Counterpoint, Creek, Dual, Duntech, Dynavector, Electrocompaniet, Electro Research, ESB, Goetz, Goldbug, Grace, Grado, Gyro-dec, Hafler, Helius, JSE, Koetsu, MAS, Monster Cable, Music-Link, Oracle, Perreaux, Pentagram, Pink Triangle, Premier, Precision Fidelity, PS AUDIO, Pyramid, Rauna, Robertson, Rogers, Snell, SOTA, Spendor, Spica, Souther, STAX, Sumiko, Symdex, Syrinx, VPI, Win-Labs, Nitty Gritty, and more. In the beautiful OZARKS. Audio Doctor. 1518 West Commercial, Box 390, Buffalo, Missouri 65622. 417-345-7245 Newsletters.

BEST TRADES OFFERED—Acoustat, Audio Research, Beard, Berning, Belles, Classé, Counterpoint, Creek, Dual Electro Research, ESB, Goetz, Hafler, Helius, KEF, Koetsu, Oracle, Perreaux, Pink Triangle, PS Audio, ProAC, Robertson, Rogers, Snell, SOTA, Spendor, Spica, Souther, STAX, Sumiko, Syrinx, UPI, Premier, AR turntables, and more. Audio Doctor, P.O. Box 390, Buffalo, Missouri 65622, (417) 345-7245. Free newsletters.

DALLAS

AR	Nitty Gritty
Acoustat	Onkyo
Audible Illusions	PS Audio
Audio Source	ProAc
Audioquest	Randall Research
Belles	Reference Recordings
CJ Walker	Robertson
Conrad-Johnson	Sheffield
Electrocompaniet	SOTA
Grace	Sonographe
Grado	Souther
Harman-Kardon	Spica
Kimber Kable	Sumiko Products
Live Wire	Talisman
Magnepan	Thiel
MAS	Threshold
Monster Cable	VPI

Omni Sound
4833 Keller Springs Rd.
Dallas, Texas 75248
(214) 931-6664

AUTHORIZED DEALERS

NATIONAL

ATTENTION DYNA, HAFLER, CROWN OWNERS
Frank Van Alstine and Associates engineer complete new Transcendence power mos-fet amplifier and precision fet preamp designs to interface with your existing chassis. Original circuits, and their problems, are discarded. Obtain superior performance without buying expensive new hardware. Learn why "underground" magazines claim our rebuilt Dyna 150 is a best buy, our MOS-FET 120B sounds like 150 watts, our FM-5 circuits sound best, and our preamps play music. Call or write for free catalogue and sample Audio Basics monthly newsletter. We ship worldwide. Jensens Stereo Shop, 2202 River Hills Drive, Burnsville, Minnesota 55337 (612) 890-3517.

AUDIO CONCEPTS—HOUSTON

Linn Sondek	Naim Audio	Isobariks
Rega	Mark Levinson	Spectral
Magnepan	Nakamichi	NAD
Kinergetics	Thorens	Energy
Apt	Hafler	PS Audio

Shipped prepaid. Closed Mondays. (713) 527-0774.

CALL TOLL FREE 1-800-826-0520 FOR ACOUSTAT, DAHLQUIST, NAD, HAFLER, DENON, dbx, 3D, PROTON, TANDBERG, BELLES, ORACLE, M&K, GRADO, NITTY GRITTY, AUDIOQUEST, DUNTEC, MONSTER, CWD, B&W, DCM, THORENS, VSP, STAX, SOTA, GRACE, ASTATIC, PROAC, DYNAVECTOR, TALISMAN. THE SOUND SELLER, 1706 MAIN ST., MARINETTE, WI 54143. (715) 735-9002.

Quality Tapes

THIS MONTH'S SUPER SPECIALS

TDK		MA 90	4.19	MAXELL	
SA 90	1.75	MA 60	3.89	UDXL II 90	1.89
SA 60	1.69	HX-S 90 New	4.15	UDXL II 60	1.75
SAX 90	2.69	HX-S 60 New	3.89	XL II S 90	2.65
SAX 60	2.49	MAR 90	5.85	MX 90	4.59
ADX 90	2.55	MAR 60	4.79	UD 90	1.85
AD 90	1.85	LX 35-90	4.79	UD 60	1.65
AD 60	1.45	LX 35-90B	5.85	LN 90	1.15
D 90	1.15	T-120	5.25	LN 60	1.05
D 60	1.05	T-120 H S	6.49	UD 35-90	4.89
HD-01 D'mag	12.49	FUJI		XL I 35-90B	6.39
SONY		FR METAL 90	3.49	T-120	5.25
UCXS 90	1.95	FR II 90	1.99	T-120 HGX	6.99
UCXS 60	1.85	T-120	5.35	DISCWASHER	
LNX 90	1.05	T-120, SHG	6.75	DISCKIT	32.49
LNX 60	.85	TEAC		SYSTEM	9.49
L-750	4.99	Reels in Casset.		Tape Care Set	9.49
L-750 HG	7.49	CDC 90	2.89	16 oz. Fluid	9.99
T-120	4.99	CRC 90	3.19	D'mag	12.49
				DISCSET	14.49

CALL NOW 718-434-3417 OR ORDER BY MAIL
In Continental USA add $3.50 for shipping on orders up to $70. Over $70 add 5% of total order. Elsewhere in USA add $7 on orders up to $70. Over $70 add 10%. Outside USA write. MC/VISA additional 3%.

QUALITY TAPES
864 East 7th Street, Dept. A 3, Brooklyn, NY 11230

AUTHORIZED DEALERS

NATIONAL

EXCEPTIONAL AUDIO REPRODUCTION SYSTEMS
Authorized dealer for: AR, ADCOM, AUDIRE, CREEK, DUAL, FRIED, GRACE, GRADO, HEYBROOK, KENWOOD BASIC, KYOCERA, LOGIC, MORDAUNT-SHORT, NITTY GRITTY, PREMIER, REGA, ROTEL, VSP, ZETA and many accessories. EARS, P.O. BOX 658-U, W. COVINA, CA 91790. 818/961-6158 EVENINGS, WEEKENDS. MC/VISA. MONTHLY SPECIALS (SEND STAMP).

Monster speaker cable with its new winding for better sound.

Monster Cable never fails to impress. Great bass, extended highs, and increased dynamic range. It's rightfully become the standard of the audio industry, providing big sonic improvements for little money. Just ask a friend who has a pair. **Now introducing the New Monster . . .**

Higher performance, same low cost.
Our latest research into the electromagnetic behavior of audio signals has led to an updated design of the original Monster. The results are impressive. Improved clarity, even better bass, and superb imaging that cannot be matched by any competitor . . . at many times the price. If you currently own Monster Cable, we invite you to audition the New Monster. And if you do not yet have the Monster in your system, old or new . . . then you're in for a very pleasant sonic experience.

MONSTER CABLE® Call or write for the Monster dealer nearest you.

Monster Cable® Products, Inc.
101 Townsend, San Francisco, CA 94107
415 777-1355 Telex: 470584 MCSYUI

MUSIC TO YOUR EARS

PREAMP AMP	Audio Research • Sony Esprit • SAE-X
SPEAKERS	Infinity RS-1B • B&W 808
TURNTABLE	Oracle Adelphi • Micro-Seiki BL-111
CARTRIDGE	Black Koetsu • Accuphase AC-2 • Alpha 2
CASSETTE DECK	Tandberg TCD-3014 • Nakamichi Dragon
TUNER	Tandberg TPT-3001A
VIDEO	Mitsubishi Monitors • Kloss Novabeam

Park Avenue Audio

425 Park Avenue South at 29th Street New York, N.Y. 10016 212 685-8101/3102

For accuracy, quality and reliability, we carry and demonstrate:
AUDIO RESEARCH • SONY ESPRIT • SONY ES SERIES • MCINTOSH • NAKAMICHI • SAE X • BLACK KOETSU • ACCUPHASE AC-2 • ORACLE • B&W • QUAD • MERIDIAN • ESB • BANG & OLUFSEN • TANDBERG • KIRKSAETER • SHAHINIAN ACOUSTICS • PIONEER LASER-VISION • DENON • INFINITY • MITSUBISHI • LUXMAN • SIGNET • KLOSS NOVABEAM • ADS • PROTON • MONSTER CABLE

AUTHORIZED DEALERS

NATIONAL

CAUTION, YAMAHA BUYERS! Some dealers are offering Yamaha products for sale that are not designed for use or sale in the U.S.A. These units may not carry the UL approval for safety nor are they designed for usage on 110 Volt U.S. current. YAMAHA ELECTRONICS CORPORATION, USA, CANNOT BE HELD RESPONSIBLE FOR THESE UNITS MEETING U.S. PERFORMANCE SPECIFICATIONS NOR ARE WE RESPONSIBLE FOR WARRANTY SERVICING. For the name and location of your nearest authorized Yamaha dealer, call 1-800-854-3264. Or write Yamaha Electronics Corporation, USA, P.O. Box 6660, Buena Park, CA 90622.

MUSIC LOVERS: Exciting new advances in system design. Goetz, MCM, Spica, Berning, Lazarus, Sumo, The Rock, AR, MAS Mark II/MAS 282, Audioquest Shadow and AQ 407, Alphason, Grado, Shinon, Alpha, Koetsu, Music Link, LiveWire, Monster, Mobile Fidelity, Opus and select used/demo equipment. Newsletter. Musical Images of Kentucky, 11027 Buckeye Trace, Goshen, KY 40026, (502) 228-3200

AUTHORIZED DEALERS

NATIONAL

HAFLER—NEW AMPLIFIER

We stock all of the following components: DH-100K $175.00, DH-100A $225.00, DH-110K $360.00, DH-110A $440.00, DH-112 $75.00, NEW DH-120 AMPLIFIER: DH-120K $260.00, DH-120A $340.00, DH-160K $275.00, DH-160A $375.00, DH-220K $400.00, DH-220KE $410.00, DH-220A $500.00, DH-220AE $510.00, DH-330K $385.00, DH-330A $460.00, DH-500K $675.00, DH-500KE $695.00, DH-500A $850.00, DH-500AE $870.00. Accessories too! Three year warranty on assembled units. FREE SHIPPING to all fifty states, PR and APO/FPO. WORLDWIDE EXPORTING. Visa and Master-Card honored. OXFORD AUDIO CONSULTANTS, INC., Box 145, Oxford, OH 45056-0145, 513-523-3333, TLX427791.

MICROPHONES—For professional recording, musicians or home use, Electro-Voice has your microphone - high performance, rugged, lifetime quality. In stock, low prices. Catalogs $1.40 (stamps). Rick Marder (E-V Dealer), (201) 561-8123.

AUTHORIZED DEALERS

NATIONAL

NOTICE TO REVOX BUYERS: Unauthorized dealers are selling Revox products not designated for sale in the USA. STUDER REVOX AMERICA CANNOT BE RESPONSIBLE FOR ANY WARRANTY SERVICING OF PRODUCTS SOLD BY THESE DEALERS. For the location of your nearest authorized Revox dealer, call or write: Studer Revox America, 1425 Elm Hill Pike, Nashville, TN 37210; (615) 254-5651.

OXFORD AUDIO CONSULTANTS, INC.

For nearly ten years, we have been serving the audio cognoscenti, from our pastoral setting here in Oxford, Ohio, with excellent services, superb products and succinct, expert advice. We reach customers not only in Ohio, Kentucky and Indiana but throughout the United States, Puerto Rico and in countries all over the world. OAC specializes in accurate high quality audio components. Our product lines include AKG, Audionics, Dennesen, Hafler, Janis, Linn, Naim, Spendor, Vandersteen and Walker. Demonstrations are given by appointment in our single speaker demonstration room. Most orders are shipped by the next business day. We pay for shipping and insurance on orders shipped to the fifty states, Puerto Rico and APO/FPO. Our extensive export facility ships worldwide. OXFORD AUDIO CONSULTANTS, INC., Box 145, Oxford, OH 45056-0145, 513-523-3333, TLX427791.

SOUND SERVICE CO.

We proudly represent:

AR Turntable	Futterman OTL	Naim Audio
Accuphase	Genesis	Nitty Gritty
Akroyd	Goldring	Proton
Ampliwire	Grace-Supex	PS Audio
Audioquest	Grado	Rega Planar
Beyer	Infinite Slope	RH Labs
Bryston	JSE	Robertson
Burwen	Kenwood Basic	Rogers
Celestion	Kimber Kable	Sonographe
Creek Audio	Koetsu	Soundcraftsman
CJ Walker	Linn Isobarik	Spectrum
Dynavector	Linn Sondek	Spica
Electrocompaniet	Livewire	Stax
ESB	Micro Seiki	Talisman
Fuselier	NAD	Thiel

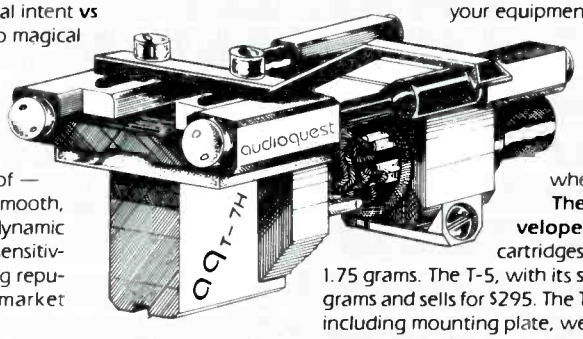
Sound Service Company
8010 Bustleton Ave. Philadelphia, PA 19152
(215) 725-1177-78 Bank Cards Accepted

SPICA SPEAKERS & ARCICI STANDS—SIMPLY THE BEST. Authorized dealer, personalized service, free shipping. Call for audition/prices. Mobile Recording Company, Carmel, IN. (317)-846-5308, 5-10 PM.

MUSIC OR MAGIC . . . ?

When developing a new product many decisions must be made and many different parameters must be balanced. The **best** audio equipment is the result of someone listening very carefully and being very sensitive to the notion of musical intent **vs** information processing. There are no magical solutions, alchemy isn't the answer. If we wanted to sound trendy we would call our approach "holistic".

The new AQ T-5 and AQ T-7 moving coil cartridges have a musical balance we are very proud of — a combination of superior tracking, smooth, clean, fast, neutral sound, high dynamic contrast and a minimum of tone arm sensitivity. AudioQuest has earned its strong reputation in the quality cartridge market with its high output moving coils. Almost single-handedly, AQ has made most prepreamps and transformers obsolete. The AQ T-5 and T-7 are available in 3 output levels so you can choose the best one for your equipment. The T-5H and T-7H have an output of 2.2mV for all normal phono inputs. The T-5M and T-7M are 1.1mV and are perfect for "high gain" preamps (which includes almost all current tube units). The T-5L and T-7L are .22mV and should be used when a top quality MC input is available.



The AQ T-5 and T-7 use a specially developed tapered titanium cantilever. Both cartridges have a compliance of 12 and track at 1.75 grams. The T-5, with its solid brass mounting plate, weighs 8.8 grams and sells for $295. The T-7 has a solid sapphire support system including mounting plate, weighs 6.9 grams and sells for $495. The AQ M-1 induced magnet cartridge at $95 and the AQ MC-3 high output MC at $145 also set value standards that can't be matched.

aq audioquest

AudioQuest brings your system to life!

412 N. Coast Highway, #B-360, Laguna Beach, California 92651 714/720-1995

AUTHORIZED DEALERS

MIDDLE ATLANTIC

Visit a Showcase of AudioVideo Values in N.Y.C.-L.I.-Metro Area

ADS-BES-DCM-STAX-GRADO-ALPINE-GRACE-AMBER-ADCOM-SIGNET-FOSTEX-DENON-LUXMAN-ALLISON-PYRAMID KLOSS-TALISMAN-PROTON-AUDIO-PRO-3D ACOUSTICS-AUDIOCONTROL-UNGO BOX-BANG & OLUFSEN-BOSTON ACOUSTICS

Call for hours: (718) 961-9888 No mail orders

173 Broadway, New York City, NY 10007
(N.W. corner of Flower & Cortlandt. One flight up, entrance on Cortlandt.)
184-10 Horace Harding Expwy. Fresh Meadows, NY 11365
Exit 25 L.I.E., Utopia Pkwy (Three blocks from Bloomingdale's)

SOUND STAGE AUDIO-VIDEO

DBX SOUNDFIELD

AUDIO CONNECTION
in Northern New Jersey

TURNTABLES: Goldmund—Merrill—Heybrook—VPI Industries—Systemdek IIX

TONEARMS: Eminent Technology—Goldmund/Lurné Grado Signature LSTA—Souther

CARTRIDGES: Alpha—Audioquest—Decca vdHul—Garrott Decca—Grado—Promethean

ELECTRONICS: (tube) Audible Illusions—Berning—Eidolon—Jadis—Melos—Quicksilver
(solid state) Electrocompaniet—Leach LSR&D—FM Acoustics—Magnum—PS Audio—Klyne

SPEAKERS: Fuselier—Goetz—Heybrook—Kindel—Rauna—Spendor—Spica—3D—Vandersteen

ACCESSORIES: Goldmund mat/clamp—LiveWire—Last—Randall—Kinergetics—Kimber Kable—Sims Vibration Eng.—Tiptoes—Tweek—VPI

1-201-239-1799
615 Bloomfield Ave, Verona NJ 07044

AUDIO CONNECTION also has for sale: occasional close-outs, used equipment and display pieces. Single speaker demonstration; record cleaning; audiophile discs. Hours: Mo, Tues, Fri 12-7, Thurs 12-9, Sat 11-6. Please, call for an appointment!

ORPHEUS AUDIO—LONG ISLAND, NY
Lowest Prices! AR (turntable), Grace, Hafler, Kyocera, Orpheus, Sumiko, Vandersteen. **(516) 676-5082.**

SOUTHWEST

GENE RUBIN AUDIO—LOS ANGELES

Linn Sondek	Naim Audio	Isobariks
Thorens	Conrad-Johnson	Acoustat
C.J. Walker	Creek	Spendor
Acoustic Research	NAD	Celestion
Dual	Precision Fidelity	PS Audio

Pre-paid shipping, (818) 571-1299, (Pac. time)

REMOVES VOCALS FROM RECORDS!

Our VOCAL ELIMINATOR can remove most or virtually all of a lead vocal from a standard stereo record and leave most of the background untouched! Record with your voice or perform live with the backgrounds. Used in Professional Performance yet connects easily to a home component stereo system. Not an equalizer! We can prove it works over the phone. Write or call for a free brochure and demo record.

Write to: LT Sound, Dept. AU, PO Box 338 Stone Mountain, GA 30086
In Georgia Call (404)493-1258
TOLL FREE: 1-800-241-3005 — Ext. 43

PS AUDIO BULLETIN

***THE SOURCE** is now available! Full function, mc-ready, this incredible sounding budget preamplifier will offer more musical pleasure per dollar than any other unit on the market. $329, solderless kit; $419 assembled.*

***IIC+ DM** modification kits are now available. Easy in-home installation. Convert your IIC+ to the DM standard for just $50.*

***IVH's** are now in better supply. This sought-after preamplifier is now easier to get; please see your local dealer for details.*

***REFERENCE B** audio cables will let you hear what your equipment has to offer ... and they're just $20!*

PS AUDIO • 3130 SKYWAY DRIVE • SANTA MARIA, CA 93455 • (805) 928-2631

MUSIC, NOT JUST SOUND.

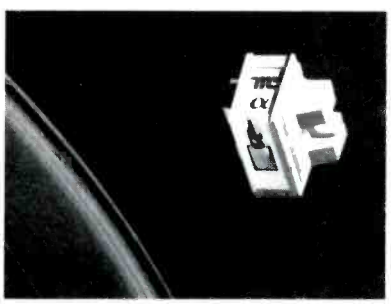
Our equipment is designed to reveal the full range of music. Hear it all at Chestnut Hill Audio: Accuphase, Acoustic Electronics, Amber, Apature, Apogee, Audio Pro, Audioquest, B&K Components, Berning, CWD, Counterpoint, DB, Denon, Duntech, Dynavector, EMT, Entec, Euphonic, Fourier, Grace, Hafler, Janis, Koetsu, Kiseki, Krell, LAST, Linn Sondek, Live Wire, Mark Levinson, J.A. Michell, Monster Cable, Music Reference, NAD, Naim, Oracle, Origin, Pioneer Video, Proton, Pyramid, Quad, RGR, Rogers, Signet, Sony, Souther, Spectral, Spendor, Symdex, Syrinx, Talisman, Tandberg, Thorens, 3D Acoustics, VPI, VSP Labs, Vandersteen, Zeta
We are located at 311 Cherry Street, Philadelphia, Pa., 19106 (215) 923-3035.

CHESTNUT HILL AUDIO LTD.

"A Revelation"
Sound News Journal

"Flawless Reproduction"
Audio Magazine

"Absolutely Superb Sound"
High Fidelity



The Alpha 1™ moving coil by Monster Cable

Finally, A moving coil cartridge that all the experts agree on! It's no surprise that critics, manufacturers, and audiophiles alike have given unanimous critical acclaim to the Alpha 1. Our unique "magnetic feedback control™" circuit reduces phase and intermodulation distortion for dramatically improved music reproduction that will keep you up nights re-listening to your entire record collection.

The Alpha 1 recreates the original musical event with unprecedented realism. Hear every instrument clearly placed across the concert hall soundstage in the finale of Berlioz's "Symphonie Fantastique", feel the gut shaking bass of the Sheffield "Tracks" album, or listen to just how delicate and natural an instrument can sound in any of the Windham Hill recordings. You will agree with the experts. The Alpha 1 is an exceptional sounding cartridge with few peers.

So meet the digital challenge. Put new life into your analog records by adding the Monster Alpha 1 to your sound system.

alpha 1™

Call us for the Monster Cable Alpha 1 dealer nearest you. Suggested retail $475.

Monster Cable® Products, Inc.
101 Townsend, San Francisco, CA 94107
415 777-1355 Telex: 470584 MCSYUI

AUTHORIZED DEALERS

SOUTHWEST

CROSBY'S IN NEW MEXICO, Quicksilver, N.Y. Audio Labs (Futterman), Counterpoint, Audire, PS Audio, Classé, Spica, ProAc, Vandersteen, Sota, VPI, Sonagraphe, Randall, Eminent Tech, ECT, "Good trades" "Satisfaction Guaranteed" Hobbs, NM (505) 393-3992, 392-8448 (Eve).

MIDWEST

COHERENCY & TRANSPARENCY: Delivered by Spica at Esoteric Audio of Farmington Hills.

AUTHORIZED DEALERS

MIDWEST

CONRAD-JOHNSON PREMIER 3 & 4 AT Esoteric Audio of Farmington Hills.

HEAR THE ELECTROCOMPANIET
Preampliwire I and II at Esoteric Audio of Farmington Hills.

NEW ENGLAND

BOSTON, BURLINGTON & HARTFORD
Scientific Stereo will demonstrate and precisely install Spica, CJ Walker (has earned three BEST BUY ratings), Soundcraftsmen, Tiptoes, Scott and Grado within this geographic triangle. Why settle for brown boxes? 11 Garage Rd., Sunderland, Mass. 413-665-3980 VISA/MC. **AD**

GOODWIN'S MUSIC SYSTEMS

In New England, Goodwin's is recognized as the leader in high performance audio. Along with the finest in components, we can provide the most sophisticated custom installation tailored to your individual needs. We offer:

Mark Levinson, Magneplanar, Apogee, Soundlab, Quad, Entec, Goldmund, Linn, Oracle, Tandberg, Nakamichi, Bryston, Hafler, Adcom, Celestion SL, Eminent Technology, Nitty Gritty, Walker, AR, Thorens, Infinity, H-K, NAD, Proton, B & W, Rega, Camber, Essence, Janis, Velodyne, Van den Hul, AudioQuest, Monster, Favorite, Kyocera, Stax, Astatic & Grace.

Goodwin's Music Systems, 16 Eliot St., Harvard Square, Cambridge, MA 02138 Tel. 617-492-1140

AUTHORIZED DEALERS

WEST

GOETZ SYSTEMS DENVER—For the love of music! Hear the Goetz Speakers and amplifier, now, in Denver. By appointment 303-422-1674.

HITACHI LINEAR CRYSTAL WIRE now in stock. Phenomenally superior to any other wire. Hear the true sound your system is capable of. LC/OFC INTERCONNECTING CABLE pairs w/plugs—.5 meter $28, 1 meter $38, 1.5 meter $45, 2 meter $50, unterminated twinaxial cable $5.50 ft. LC/OFC SPEAKER WIRE—2 conductor $2.50 ft., 4 conductor $3.50 ft., 8 ga. coaxial LC/OFC $4.50 ft., 8 ga. coaxial OFC $2.10 ft. WE SHIP. Also discount prices on MICRO SEIKI turntables, SAEC tonearms, Moving Flux cartridges $60. We remanufacture and modify tube equipment. **CHRISTIAN FILMS, AUDIO DEPARTMENT.** 415 W. Imperial, LaHabra, CA 90631. Phones (213) 691-0967 (714) 871-5670.

AMPS/PREAMPS

BIG TEN SYSTEM
(ABOUT $10,000)

Turntable:	Linn Sondek Lp-12
Tonearm:	Syrinx PU-3
Cartridge:	Koetsu Black
Tuner:	Adcom GFT-1A
Preamp:	Krell PAM 3
Amp:	Krell KSA-100
Speakers:	Apogee Scintilla's

SOUND BY SINGER
165 E. 33rd Street
New York, NY 10016
(212) 683-0925

COUNTERPOINT—Tube & tube hybrid amps & preamps of the first order of magnitude. One of the first preamps to allow the listener to appreciate the nuances of multiple melodic lines. The SA-7—$600. LANDES AUDIO, Rt. 24, Chester, N.J. 201-879-6889 **AD**

DB SYTEMS DB-6 (6M) POWER AMPLIFIER MODIFICATION—Triples power supply capacitance to 42,000 μF. 1 dB more Dynamic Headroom. DB SYSTEMS, Main St., Rindge, NH 03461 (603) 899-5121.

ESOTERIC AUDIO RESEARCH 100 watt mono tube amps $1000/pr. Michaelson and Austin 100 watt monoblok tube amps $1000/pr. Mike Sanders 818-989-3329.

AMPS/PREAMPS

EXPERIENCE THE ALL NEW NOVA ELECTRO-ACOUSTIC CPA-100 J-FET preamp. The best solid state preamp under $1700. Presto Audio, 3125 Williamsburg Dr., S.J., CA 95117 408-378-8283.

HAFLER IN THE SOUTH!
In stock, the superb Hafler pre-amps, amplifiers, tuner and equalizer. Immediate FREE shipping. Also Acoustat, Adcom, Audire, Conrad-Johnson, Dynavector, Fried, Klipsch, Mirage, Nakamichi, PS, SAE, Talisman, Thorens, compact digital players. READ BROTHERS STEREO, 593 King Street, Charleston, South Carolina 29403. (803) 723-7276. **AD**

HARMAN/KARDON, NAKAMICHI, TANDBERG, CROWN, REVOX, HAFLER, CARVER, NAD, DBX, ELECTRO-VOICE AND OTHER QUALITY COMPONENTS. BEST PRICES—PROFESSIONAL CONSULTATION. **ALL PRODUCTS COVERED BY USA MANUFACTURER'S WARRANTY.** AMERISOUND SALES, INC.; P.O. BOX 24009, JACKSONVILLE, FL 32241. EAST: (904) 262-4000; WEST: (818) 840-0878.

MARK 9 POWER AMPLIFIERS, 300 watt amp using six 6550A outputs tubes and a regulated power supply. $950 kit–$1,200 wired. Write for brochure. AUDIO CLASSICS/ ATLANTA, PO BOX 690, ROSWELL GA 30077.

MCINTOSH AUDIO EQUIPMENT—All types—tubes & transistor—electronics & speakers—bought—sold—traded. S.D.R. P.O. Box 176, Walton, NY 13856, 607-865-7200.

PERHAPS THE EAST COAST'S LARGEST dealer in **HIGH END** used stereo. BOUGHT • SOLD • TRADED— **STEREO EXCHANGE,** 687 Broadway between 3rd & 4th Streets (opposite Tower Records) NYC 10012 (212) 505-1111 or 1-800-833-0071.

PS AUDIO'S INCREDIBLE PSIV CHALLENGES every preamplifier. Audio Nexus, NJ (201) 464-8238, (201) 730-2409.

QUICKSILVER AUDIO AMPLIFIERS—don't buy any amplifier until you have auditioned this fine line of amplifiers. Audio by A.J. Conti, 35 minutes from Boston. (603) 883-4504.

ROBERTSON'S RENOWNED 4010 AMPLIFIER IS AMAZING! Their incredible, new 6010 defies description. You must hear them! Audio Nexus, NJ (201) 464-8238, (201) 730-2409.

RECEIVERS

HARMAN/KARDON, NAKAMICHI, TANDBERG, CROWN, REVOX, HAFLER, CARVER, NAD, DBX, ELECTRO-VOICE AND OTHER QUALITY COMPONENTS. BEST PRICES—PROFESSIONAL CONSULTATION. **ALL PRODUCTS COVERED BY USA MANUFACTURER'S WARRANTY.** AMERISOUND SALES, INC.; P.O. BOX 24009, JACKSONVILLE, FL 32241. EAST: (904) 262-4000; WEST: (818) 840-0878.

TUNERS

YAMAHA T-2 TUNER, MINT $450. (918) 582-8944 after 6 p.m. Central.

TUNERS

HARMAN/KARDON, NAKAMICHI, TANDBERG, CROWN, REVOX, HAFLER, CARVER, NAD, DBX, ELECTRO-VOICE AND OTHER QUALITY COMPONENTS. BEST PRICES—PROFESSIONAL CONSULTATION. **ALL PRODUCTS COVERED BY USA MANUFACTURER'S WARRANTY.** AMERISOUND SALES, INC.; P.O. BOX 24009, JACKSONVILLE, FL 32241. EAST: (904) 262-4000; WEST: (818) 840-0878.

LOUDSPEAKERS

ABBIE'S AUDIO OFFERS THE FINEST in loudspeakers, Goetz Systems for people who care about the reproduction of music. 302 E. High St., Waynesburg, PA 15370. (412) 852-1134.

EXCEPTIONAL
loudspeakers from
EUPHONIC AUDIO
RR1 Box 266 New Egypt, NJ. 08533 201-929-2613

ALTEC-LANSING QUALITY SPEAKERS—Models 14 and 19 available quickly, models 4, 6, 8 and others usually in stock. Literature available. Electro-Voice speakers, components and microphones. Low prices. Rick Marder (201) 561-8123.

ARE THE BEST LOUDSPEAKERS really available only by mail? Send one dollar for our 60 page color catalog. Acoustic Interface, POB 6632, Santa Barbara, CA 93160.

ARE YOUR ADVENT WOOFERS FALLING APART? We rebuild Advent "12 inch" woofers to like-new condition for $40 each plus shipping. UNIVERSAL SOUND, 2253 Ringling Blvd., Sarasota, FL 33577 (813) 953-5363.

Hi-Fi, Video, TV:
Most Brands—CALL!

COMPACT DISC:
SONY D-5 portable compact "DISCMAN" ... $218
TECHNICS SL-P1 programmable ... $239
TECHNICS SL-P2 programmable, wireless remote ... $299
TEAC PD-11 3 beam laser, 88.2 KHz, sampling programmable ... $329

HI-FI VIDEO:
SANYO VCR-7200 BETA HI-FI wireless remote, 105 ch ... $428
TOSHIBA V-S46 BETA HI-FI, wireless remote, 4 head, 117 ch., bilingual ... $658
JVC HRD-725 VHS HI-FI, 4 head, wireless remote, random access quartz tuner ... $838
PANASONIC PV-9600 VHS HI-FI PORTABLE, 4 head, wireless remote ... CALL

TAPE:
SONY UCX-S90 ... $1.98
SONY L750/T120 ... $4.28 after $1.00 mfr. rebate
SONY L750 UHG/T-20 UHG ... $6.48
MAXELL T120 HGX ... CALL
MAXELL T120 GOLD ... CALL
MAXELL REEL TAPE ... CALL

WORLD WIDE ELECTRONICS DISTRIBUTORS
240 Ivory Street, Braintree, MA 02184
800-225-8656 ORDERS ONLY 10am-6pm EST M-F
MAIL ORDER: For rapid service, send certified check or money order. All prices reflect cash discount. MC/VISA add 3% for handling. PERSONAL CHECKS REQUIRE APPROX. 14 DAYS FOR CLEARING. Add $7 shipping & handling charge for orders under $100. 7% for orders over $100. No COD! Mass. residents add 5% sales tax. MASS ORDERS (617) 843-7350

MOREL INTEGRA

MOREL'S "INTEGRA" AUTO FIDELITY loudspeakers provide the perfect solution to high-quality sound reproduction in the car. Morel's system differs from conventional coaxial systems which use two separate drivers that have to be mounted mechanically together. The "Integra" concept is based on a two-way coaxial system consisting of two magnets - one for the dome tweeter and one for the woofer - integrated on a single axis. Similar in their high power-handling and excellent sound to the Morel driver units for home loudspeakers, the Morel Integra auto fidelity loudspeakers are durable and rugged enough for use in any type of vehicle.

INTEGRA – 1 MkII
Integrated 2-way 6" / Dome Tweeter (Adapted for bi-amp)

Power Handling Capacity	100 Watts RMS
Frequency Response	45-25000 Hz
Woofer Type	6" Dia., 3" Aluminum voice coil
Tweeter Type	Soft dome, Aluminum voice coil
Ferrofluid Cooling/Damping	Yes
Impedance	4 ohms
Sensitivity 1W/1M	91 db.
Magnetic Structure Weight	2.3 lbs./1.05 Kgs.
Dimensions	160mm/6¼" Dia., 67mm/2⅝" Depth
Mounting Depth	53mm/2⅛"
Net Weight	2.85 lbs./1.3 Kgs.
Front Grill	Integral metal grill

INTEGRA – 2 MkII
Integrated 2-way 8" / Dome Tweeter (Adapted for bi-amp)

Power Handling Capacity	120 Watts RMS
Frequency Response	35-25000 Hz
Woofer Type	8" Dia., 3" Aluminum voice coil
Tweeter Type	Soft dome, Aluminum voice coil
Ferrofluid Cooling/Damping	Yes
Impedance	4 ohms
Sensitivity 1W/1M	92 db.
Magnetic Structure Weight	2.3 lbs./1.05 Kgs.
Dimensions	220mm/8⅝" Dia., 75mm/3" Depth
Mounting Depth	57mm/2¼"
Net Weight	3.3 lbs./1.5 Kgs.
Front Grill	Integral metal grill

Please write for details:

morel

morel acoustic usa
414 harvard street, brookline, mass. 02146
u.s.a. tel. (617) 277-6663

morel acoustic ltd
industrial area b, p.o.b. 140, ness ziona
70 451 israel. tel. 054-70796, telex 361951

stereophile
SAVVY EQUIPMENT REPORTS AND SPIRITED EDITORIAL CONTENT
Send $20 for 10 issues. Stereophile 1107c Early Street Santa Fe NM 87501 or
Call toll-free 800/821-3528

LOUDSPEAKERS

AR9LS MATCHED PAIR, removed from factory boxes November 10th. Used 2 weeks. $1,375. Call anytime 1-304-843-1761.

LOUDSPEAKERS

MAGNEPAN IIB OWNERS TAKE NOTE

Now your Magnepan sound can be everything you've ever wished for. Unique new plug-in crossovers deliver the benefits of bi-amplification at significantly lower cost. Improved bass definition is only the start. Lower distortion and better dynamics combine to give you the detail and increased image depth you've been wanting . . . Try it for 20 days. Installs in seconds. Money back guarantee. $229.00. Visa or Mastercard accepted. DSA Marketing, 4448 W. Howard St., Skokie, IL 60076. (312) 673-7003.

LOUDSPEAKERS

ATTENTION AUDIOPHILES: JSE INFINITE SLOPE LOUDSPEAKERS Models 1 and 2 with a Lifetime Transferrable Warranty are now available. Inquire about our 7 day auditioning program. Sound Unlimited, est 1959, 178 Main St., Bristol, Conn. 06010. (203) 584-0131.

BRITISH LOUDSPEAKERS—From Cambridge, England, a highly regarded small monitor speaker with an unusually boxless sound. A quality wood finish with fine English craftsmanship. $250.00 a pair. Dealer inquiries welcomed. LANDES AUDIO, Rt. 24. Chester, N.J. 07930, 201-879-6889 AD

A&S OFFERS THE WIDEST SELECTION of European and American speaker kits and raw drivers including Dynaudio, Fried, Audax, Falcon-Acoustics, SEAS, Peerless, Morel, Dalesford/Cambridge, Jordan, Philips, Becker, Pyle, JVC. Featuring custom auto speaker systems, Morel Intergras and the "Avery Dark 10". Free catalog. A&S SPEAKERS, Box 7462A, Denver, CO 80207. (303) 399-8609.

FOCAL LOUDSPEAKERS AND KITS FROM FRANCE Featuring: Neoflex cones, Fiberglass domes, Flatwound wire, Active or passive crossovers, Compound woofer systems, Extensive design parameters. Available in the US from **MADISOUND SPEAKER COMPONENTS** 8982 Tablebluff, Box 4283, Madison, Wisconsin 53711, 608-767-2673.

FRIED SPEAKERS & KITS
State-of-the-art sound. Try our prices! Free shipping. Also Nakamichi, Hafler, SAE, Audire, Mitsubishi, Adcom, Dynavector, compact digital players. READ BROTHERS STEREO, 593 King Street, Charleston, South Carolina 29403. (803) 723-7276. AD

GOETZ SPEAKERS
The new Grand Master Series. Precise image and focus, extremely dynamic 'big sound', tonally accurate and speakers that completely vanish! Closest to a live performance yet! Musical Images of Kentucky, (502) 228-3200 AD

HARMAN/KARDON, NAKAMICHI, TANDBERG, CROWN, REVOX, HAFLER, CARVER, NAD, DBX, ELECTRO-VOICE AND OTHER QUALITY COMPONENTS. BEST PRICES—PROFESSIONAL CONSULTATION. **ALL PRODUCTS COVERED BY USA MANUFACTURER'S WARRANTY.** AMERISOUND SALES, INC.; P.O. BOX 24009, JACKSONVILLE, FL 32241. EAST: (904) 262-4000; WEST: (818) 840-0878.

HIGH-END SPEAKERS! SAVE 40% on esoteric speaker systems. Fast service. Visa/MC. RTRD, 2105 Claremont, Springfield, IL 62703.

DIMENSIONS UNHEARD NC-1 LOUDSPEAKER images so vividly it's almost unsettling. Time aligned. Phase coherent. Transient perfect. Hand-built polypropylene woofers coupled to European dome drivers by a FFT optimized crossover. Ten year warranty! RTRD, 2105 Claremont, Springfield, IL 62703 (217) 529-8793.

LOUDSPEAKERS

JBL PARAGON CLASSIC STEREO SPEAKER system, oiled walnut, mint, $5,500.00. Call 203-929-0212 or write Box 2009, Huntington, Conn. 06484.

J.B.L. PARAGON FOR SALE $2500. A classic stereo speaker in very good condition. Call 415-531-8725

J.B.L. USED SPEAKERS, COMPONENTS, LITERATURE, and blueprints. Bought, Sold, and Traded. 313-229-5191. Aft. 7 PM EST.

JSE INFINITE SLOPE LOUDSPEAKERS Hear your music at last! Now, unique and technologically advanced crossovers deliver unparalleled clarity, smoothness, dynamics. Call AUDIO NEXUS, NJ, (201) 464-8238, (201) 730-2409 for copies of Sensible Sound's rave reviews.

KEF 105.2 LOUDSPEAKERS. New. Sacrifice $1375.00. Goetz GMS-3 loudspeakers. List $2500.00. Sell for $1595.00. (603) 883-4504.

E.M. LONG REFERENCE MONITORS. I have an extra pair of TIME ALIGN(R) Reference monitors to sell for $4500. Please. Only serious inquiries. 415-531-8725

LANDES AUDIO—Offering speaker modification, utilizing metallized polyprop capacitors, superior wire, and specialized cabinet modifications. Landes Audio, Rt 24, Chester, N.J. 201-879-6889 **AD**

LOUDSPEAKER COMPONENTS—KITS, Audax, Dynaudio, Eclipse, Focal, Foster, Peerless, Morel, Vifa, SIARE, and more! New catalog, 50¢. Meniscus Systems, 3275W Gladiola, Wyoming, Michigan 49509

MAGNEPAN TYMPANI IV, excellent, $1950 VMPS Super Tower IIa/R, all updates. $1450 pair (813) 526-3678 evenings

PERHAPS THE EAST COAST'S LARGEST dealer in **HIGH END** used stereo. BOUGHT • SOLD • TRADED—**STEREO EXCHANGE,** 687 Broadway between 3rd & 4th Streets (opposite Tower Records) NYC 10012 (212) 505-1111 or 1-800-833-0071.

SL6 AND 600 MUSICALITY in a small box using lasers: Esoteric Audio of Farmington Hills.

SPICA TC-50
Audition these truly remarkable speakers at Alternative Audio, Massapequa, NY. (516) 541-1413. Authorized Dealer, free shipping. **AD**

TANGENT ACOUSTICS—The RS-4, long considered one of the finest full range British speakers, originally $760.00 in 1976. Available in 1984 for $795.00. One of the few true bargains. The PS range offers no holds barred performance in exquisite cabinetry. Current technology upgrades available on all Tangent models. LANDES AUDIO, Rt. 24, Chester, N.J. 07930. 201-879-6889 **AD**

LOUDSPEAKERS

THIEL CS3 SPEAKERS AT Esoteric Audio of Farmington Hills.

TURNTABLES

DRAMATICALLY IMPROVE YOUR "NEW" AR TURNTABLE.
1) AudioQuest Sorbothane Mat ..... $35.00.
2) Predrilled Aluminum Armboards
MMT or Linn Arms ..... $25.00.
All others (provide template) ..... $25.00.
We guarantee these products to improve the AR's transparency, detail and smoothness or we will refund purchase price. The Audio Advisor, Inc., Box 6202, Grand Rapids, MI 49506 (616) 451-3868. Shipping: $3.00/item. **AD**

Authorized Linn/Naim Dealers

Here is a list of a few good dealers that won't try to TALK you into believing that they are "experts". They can, and will, actually demonstrate the differences in components under conditions that will allow you to make a sensible decision.

ALABAMA
Audition, Homewood
Campbell Audio & Video, Huntsville

ARIZONA
Listening Post, Tempe

CALIFORNIA
Audio Basics, Claremont
Classic Audio, Encinitas
Musical Images, Fresno
Havens & Hardesty, Huntington Beach
Christopher Hansen, Los Angeles
Gene Rubin Audio, Monterey Park
Audible Difference, Palo Alto
Keith Yates Audio, Sacramento
Stereo Design, San Diego
House of Music, San Francisco

COLORADO
Audio Alternative, Fort Collins

FLORIDA
Sound Components, Coral Gables
Sound Components, Fort Lauderdale
Sound Source, Marathon
Audio Gallery, Miami
Audio Gallery, Sarasota
Audio Visions, Tampa

HAWAII
Audio Shoppe, Honolulu

ILLINOIS
Pro Musica, Chicago
Victor's Stereo, Chicago
Victor's Stereo, Morton Grove
Sound Choice, Lisle
Absolute Audio Systems, Rockford

INDIANA
Audiotrend, Evansville
Hi-Fi Gallery, Indianapolis

MASSACHUSETTS
Matrix Audio & Video, West Hatfield

MICHIGAN
Absolute Sound, Ann Arbor
Sound Room, Grand Rapids

MISSOURI
Audio Rennaissance, Kansas City
Music Systems, St. Louis

NORTH CAROLINA
Audio Salon, Charlotte
Stereo Sound, Chapel Hill
Stereo Sound, Greensboro
Stereo Sound, Raleigh

NEBRASKA
Sound Environment, Lincoln
Sound Environment, Omaha

NEW JERSEY
CSA Audio Design, Upper Montclair

NEW YORK
Ears Nova, Great Neck
Innovative Audio, Brooklyn
Sound by Singer, New York
Stereo One, East Rochester

OHIO
Stereo Showcase, Dayton
Oxford Audio, Oxford

OKLAHOMA
Audio Dimensions, Oklahoma City

PUERTO RICO
Precision Audio, Rio Piedras

SOUTH CAROLINA
British American Sound, Charleston

TEXAS
High Bias, Austin
Audio Distinctions, Corpus Christi
Audio Concepts, Houston
Concerf Sound, San Antonio

VIRGINIA
High-C Stereo, Leesburg
Listener's Shop, McLean

WASHINGTON
Definitive Audio, Seattle

audiophile systems LTD.

6842 Hawthorn Park Drive
Indianapolis, Indiana 46220

TURNTABLES

HARMAN/KARDON, NAKAMICHI, TANDBERG, CROWN, REVOX, HAFLER, CARVER, NAD, DBX, ELECTRO-VOICE AND OTHER QUALITY COMPONENTS. BEST PRICES—PROFESSIONAL CONSULTATION. **ALL PRODUCTS COVERED BY USA MANUFACTURER'S WARRANTY.** AMERISOUND SALES, INC.; P.O. BOX 24009, JACKSONVILLE, FL 32241. EAST: (904) 262-4000; WEST: (818) 840-0878.

LINN SONDEK LP-12 WITH VALHALLA and Nirvana mods, and 45 rpm adaptor, $425. (201) 429-7898.

MERRILL AR MODIFICATIONS
Tonearm Replacement Subchassis Kit for old AR $85.00—Subchassis for sonic improvement of AR-XE with adjustable feet $95. Following modifications are for all models: Platter Coating $10. Replacement Spindle $25. Spring Kit $8. High Torque Motor $45. Platter Balancing Service $10. Replacement inner and outer platters $135 for all AR-XA, AR-XB, and AR-XE turntables. UNDERGROUND SOUND, 2125 Central Ave., Memphis, TN 38104 (901) 272-1275.

MERRILL TURNTABLE
Features: Beautiful solid oak base. A tunable, three-point Constant Resonance Suspension System. A subchassis designed to absorb tonearm release energy. Supplied with an inner gravity clamp and outer periphery record clamp. For more information contact UNDERGROUND SOUND, 2125 Central Ave., Memphis, TN 38104. (901) 272-1275.

PERHAPS THE EAST COAST'S LARGEST dealer in **HIGH END** used stereo. BOUGHT • SOLD • TRADED—**STEREO EXCHANGE,** 687 Broadway between 3rd & 4th Streets (opposite Tower Records) NYC 10012 (212) 505-1111 or 1-800-833-0071.

SOTA SAPPHIRE AND STAR SAPPHIRE: EXQUISITE SOUND from the crown jewels of turntables. Audio Nexus, NJ, (201) 464-8238, (201) 730-2409.

SOTA SAPPHIRE IN KOA WOOD with Grace 747 arm & Talisman S-M.C. cartridge, mint $900. (918) 582-8944 after 6 p.m. Central.

VPI ACRYLIC TABLE—STATE OF THE ART of Farmington Hills. **AD**

MULTI COMPONENTS

AUDIO HOUSE—FLINT MICHIGAN: ROGERS, SOTA, CONRAD JOHNSON, ROBERTSON, NEC VIDEO, ONKYO, REVOX, AUDIO PRO, SPECTRUM, SOUTHER, GRADO, BELLES, GONZA Speaker wire 12 gauge 100ft. $49. 4304 Brayan, Swartz Creek, Michigan, 313-655-8639 by appointment.

MULTI COMPONENTS

ACCURATE AFFORDABLE AUDIOPHILE EQUIPMENT AT GREAT PRICES! WE CONCENTRATE ON COST-EFFECTIVE AUDIOPHILE PRODUCTS AND HOW TO GET THE MOST OUT OF THEM. GREAT SELECTION INCLUDING ACCESSORIES, CABLES, AND RECORD CARE PRODUCTS. SPECIALISTS IN TURNTABLES, TONEARMS, CARTRIDGES. GOOD HONEST ADVICE AVAILABLE. CALL OR WRITE FOR OUR FREE NEWSLETTER. HCM AUDIO, 1600BB MANGROVE, CHICO, CA 95926, (916) 345-1341

AT RM HIGH-FIDELITY—LONG ISLAND, hear the musicality of RAUNA loudspeakers, the esoteric PROMETHEAN GREEN, outstanding electronics by PSE and more. Demonstrations by appointment (516) 420-9092, Farmingdale, N.Y.

AUDIO EQUIPMENT NEW AND USED AUDIONICS PZ3 poweramp; ET1 headamp; BEVERIDGE Tube preamp; BRYSTON 2Bpoweramp; CELESTION DT250—$400/pr; GRACE 9E Ruby—$200 new; F9E—$130 new; LEVINSON ML6A, ML3, ML11, ML12; LUXMAN 110 FM tuner; MCINTOSH C28 preamp; C32 preamp; 2120—$600; 2205 poweramp; ORACLE Alexandria w/arm; ORACLE/Magnepan/Dynavector Ruby; PERREAUX SM2 preamp; REVOX B77 Reel-to-Reel; SONOGRAPH SG3 turntable New/without arm—$250; TANDBERG TD20A; THIEL O31—$880/pr; Call Terry #402-391-3842.

CARVER 1.5 AMP; Infinite Slope model 2 speakers; Tech. SLP2 player. 215-567-4626.

COMPONENTS FOR THE CONNOISSEUR . . . Audio Research, Audire, Apt Holman, Audible Illusion, Meitner Audio, Streets Electronics, B&K, Thiel, Perkins, Vandersteen, Raven Ribbons, Transducteurs Acoustiques Apogee, Duntech, Rauna, MCM, VPI, Elite Rock, Rega, Souther, MMT, Maplenoll, Eminent Technology, Peterson, Grado SACRIFICE B&O 8000, Acoustat 2+2, Magnepan IIB, Daybreak, SKS Intaglio, Sequerra Pyramids, Sumo Amps, preamps, tuners, Robertson 4010, MacC26, 300 new Dynaudio drivers, Pioneer & Teknika Monitors, Satellite Equipment, much more. PAUL HEATH AUDIO, 217 Alexander Rochester, NY (716) 262-4310 evening 346-5630

CROWN 724SX. CROWN DC300A. Crown 1C150. Thorens TD125 with SME arm. All with walnut enclosures. Near perfect condition. Bozaks with custom walnut cabinets. $1,800. (313) 543-8025.

DENON DRM4 NEW—$395 ($600 list), Denon DRM3 new—$315 ($500 list), Yamaha M70 new—$535 ($950 list), Sansui D77OR new—$325 ($600 list), Denon DP57L demo—$375 ($600 list), Denon PMA770 demo—$325 ($600 list), Denon PMA750 demo—$250 ($450 list), Alpine 3502 new—$265, Alpine 3506 new—$145, Alpine 3000 new—$155, Revox B780 new—$1750 ($2200 list), Revox B795 new—$425 ($580 list), Revox B791 new—$525 ($725 list). 609-466-2021, 6-9 pm M-S Gary (NJ).

LOW LOW PRICES on most audio products, including many esoteric brands. Write for full catalog. E&F Industrial Co., 10944 Aztec Ct., Cincinnati, OH 45241.

THE UNSPEAKER

- No artificial sweeteners, artificial flavors or colorants added.
- The First Minimum Periodicity Loudspeaker System.
- Minimum Periodicity is a new measurement and design technique from Dayton Wright Research.

LCM I

DAYTON WRIGHT

THE DAYTON WRIGHT GROUP LIMITED
97 NewKirk Road North, Richmond Hill, Ont. M4C 3G4 (416) 884-8586

MULTI COMPONENTS

ELECTRONIC REPRESENTATIVES NEEDED!! UNLIMITED PROFIT POTENTIAL! LOWEST POSSIBLE PRICES!! OVER 100 BRANDS! AUDIO - VIDEO - CAR STEREO - COMPUTERS ELECTRONIC EXPERTS 1000 ORANGE AVE., WEST HAVEN, CT 06516

HARMAN/KARDON, NAKAMICHI, TANDBERG, CROWN, REVOX, HAFLER, CARVER, NAD, DBX, ELECTRO-VOICE AND OTHER QUALITY COMPONENTS. BEST PRICES—PROFESSIONAL CONSULTATION. **ALL PRODUCTS COVERED BY USA MANUFACTURER'S WARRANTY.** AMERISOUND SALES, INC.; P.O. BOX 24009, JACKSONVILLE, FL 32241. EAST: (904) 262-4000; WEST: (818) 840-0878.

HCM AUDIO 1-916-345-1341 "VALUE LIVES" AUDIOQUEST ★ B & W ★ GRACE ★ GRADO ★ HAFLER ★ LIVEWIRE ★ MONSTER CABLE ★ NITTY GRITTY ★ PREMIER ★ PYRAMID ★ SOTA ★ STAX ★ TALISMAN ★ THORENS ★ SUMIKO ★ AND MUCH MORE ALL AT REASONABLE PRICES! FREE NEWSLETTER & EXPERT ADVICE. HCM AUDIO, 1600BB MANGROVE, CHICO, CA 95926

HIGH END SYSTEM—Audio Research Corp. SP-6B preamp $795, ARC D-79 pwr-amp $1895, ARC D-110B pwr-amp $1595, Oracle Delphi TT $700, Magnepan tone-arm $225, Nakamichi ZXL-1000 cassette deck $2600, Infinity/Magnepan QRS/1D Hybred speaker system with ARC x/over (a la TAS) $3500. Call 1-503-254-9802

MCINTOSH, MARANTZ, BEVERIDGE, AUDIO RESEARCH, old J.B.L., Tannoy, Sequerra FM, Spectral, Counterpoint, Conrad Johnson and many other hi-end and collectables bought for really decent prices. Some remaining pieces now selling at surprising prices including: Coloney AB-1; Beveridge; Cosmostatics, R.E.L.; Tandberg 3004; KLH 9's; Breuerarm; Vandersteen pre-preamp and other rare birds! Everything used but perfect. N.Y. Sound Investments (718) 377-7282. Noon to 3pm ONLY!!

MORE WITH FOUR SYSTEM

(UNDER $4300)

Turntable:	Linn Sondek Lp-12
Tonearm:	Linn Basik LV-X-Plus
Cartridge:	Talisman 1A
Tuner:	Adcom GFT1-A
Preamp:	Counterpoint SA-7
Amplifier:	Robertson 4010
Speakers:	Fuselier 3.3

SOUND BY SINGER

165 E. 33rd Street
New York, NY 10016
(212) 683-0925 **AD**

MULTI COMPONENTS

MCINTOSH SOLID STATE COMPONENTS. Bought, Sold, and Traded. Also wanted Mac 3500 or MI 350 for personal use. 313-229-5191 Aft. 7PM EST.

MOUNTAIN AUDIO TAKES TRADES. Berning, VSP, Rauna, Goetz. Demo Goetz Speakers at substantial savings. Used equipment. 30 Columbia Ave., Cranford, NJ 07016. 201-276-2217.

PERHAPS THE EAST COAST'S LARGEST dealer in **HIGH END** used stereo. BOUGHT • SOLD • TRADED—**STEREO EXCHANGE,** 687 Broadway between 3rd & 4th Streets (opposite Tower Records) NYC 10012 (212) 505-1111 or 1-800-833-0071.

PRESTO AUDIO OFFERS CONRAD-JOHNSON, BEL, Nova, Belles, Vsplabs, Adcom, ProAc, Chapman, AR, Monster Cable and more. Best pricing. Free Shipping. 3125 Williamsburg Dr., S.J., CA 95117 408-378-8283.

START WITH SEPARATES SYSTEM 1

(UNDER $2700)

Turntable:	Rega Planar 3
Cartridge:	Adcom XC/LT II
Preamp:	Adcom GFP-1A
Tuner:	Adcom GFT1-A
Amplifier:	Adcom GFA-2
Speakers:	Snell Type E II

SOUND BY SINGER

165 E. 33rd Street
New York, NY 10016
(212) 683-0925 **AD**

TRADE-INS WELCOME

Carver, conrad johnson, Nakamichi, harman/kardon, Gold Aero tubes, Sonographe, AR turntable, Clements ribbon spkrs., VSP amplifiers, VPI turntable, NEC video and lots more! ADS spkr. sale now! Used specials—Macintosh MR-78 mint, $699; conrad johnson PV-3, $169. THRESHOLD AUDIO 409 S. 22nd St., Heath, Ohio 43056. 614-522-3520

YAMAHA C-70 PREAMP $350.00, Yamaha M-50 power amp. 120 watts RMS $250.00, Denon M-44 cassette deck $300.00. All mint Condition. JVC QL-Y66F turntable, new—in box $250.00 (904) 575-6645.

21ST CENTURY AUDIO LTD For all of your high end audio needs at reasonable prices. Top brands such as Argent, Belles, C-J, DCM, Eagle, Grado, Pentagram, Perreaux, Pyramid, SOTA, Spica, Stax, VPI and much more. Plus Computer and video items too many to mention. Call or write to 5041-Rising Sun Ave, Phila., Pa. 19120. (215) 324-4457. MC, VISA, Diners Club, & Carte Blanche welcomed.

TRANSISTOR SUPERIORITY

Quality and Value

Quality in Design
"...unique distortion cancelling circuitry..."

Quality in Construction
"...greater resistance to overload..."

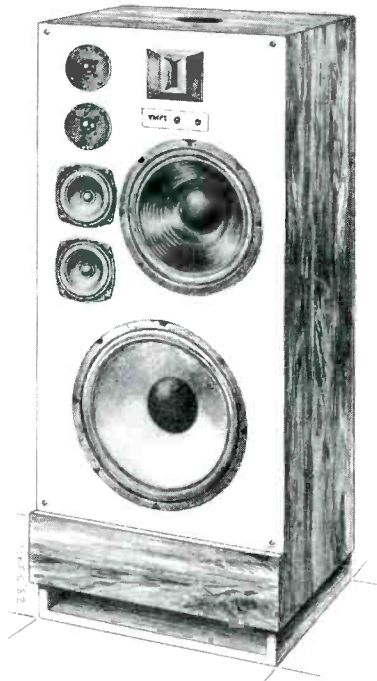
Quality in Sound
"...compares to reference equipment..."

KBA-200
200 Watt High Power Amplifier $1495.00

For information — UNDER LICENSE BY ASR

KINERGETICS INCORPORATED
6029 Reseda Blvd. • Tarzana, CA 91356 • (818) 345-2851

ANNOUNCING QSO HOLOSONICS FROM VMPS



The VMPS Super Tower/R QSO Series, 49 x 21 x 17", 140 lbs, shown with grillframe removed

VMPS introduces a new system of loudspeaker image enhancement (i.e. a three-dimensional soundstage from a single stereo pair) which matches the best of the recent phase-matrix and omnidirectional systems for boxlessness, spaciousness and depth, but without the artificial "everywhere and nowhere" image and poor instrument localization that plagues many of these speakers.

QSO Holosonics utilizes the inherently linear-phase Quasi-Second-Order filter network, plus driver level staggering and small amounts of linear time delay, to generate a breathtaking stereo image which is true to the phase and ambient information of the program source. Our new system is currently available in the VMPS **QSO Tower II** ($419ea kit, $599ea assem), **Super Tower/R** ($679ea kit, $969ea assem), **Super Tower IIa/R** ($999-1199ea kit, $1499-1699ea assem) and **Widerange Ribbon** ($5995-7500).

Write us for brochures, test reports, and information on QSO Holosonics and hear these systems, our famous **Subwoofer** ($250ea kit, $375 assem), and John Curl-designed **Electronic Crossovers** ($250 & $449) at the dealers listed below. Kits supplied with fully assembled cabinets and all prices include **free shipping** in USA.

VMPS AUDIO PRODUCTS

div. Itone Audio
1016 Contra Costa Dr El Cerrito CA 94530
415-526-7084

Hear VMPS at: The Listening Studio, Boston; Cuomo's, Salem NH; C&S Audio, Colorado Springs Co; Stereo Unlimited, San Diego Ca; Efficient Stereo, Torrance Ca; Sounds Unique, San Jose Ca; Itone Audio, El Cerrito Ca; Stereotown, Brookings SD; Missoula Trumpet Sales, Missoula Mt; North American Sound, San Angelo Tx; The Long Ear, Big Bear Lake Ca; Arthur Morgan (rep), Altamonte Springs, Fl; Eclectic Audio, Livermore Ca.

MULTI COMPONENTS

YOUR CHOICE—$175.00 EACH: Heath AA1640 super-amp or Revox B790 linear-drive turntable. (206)-746-9686.

TAPE RECORDERS

HARMAN/KARDON, NAKAMICHI, TANDBERG, CROWN, REVOX, HAFLER, CARVER, NAD, DBX, ELECTRO-VOICE AND OTHER QUALITY COMPONENTS. BEST PRICES—PROFESSIONAL CONSULTATION. **ALL PRODUCTS COVERED BY USA MANUFACTURER'S WARRANTY.** AMERISOUND SALES, INC.; P.O. BOX 24009, JACKSONVILLE, FL 32241. EAST: (904) 262-4000; WEST: (818) 840-0878.

PERHAPS THE EAST COAST'S LARGEST dealer in **HIGH END** used stereo. BOUGHT • SOLD • TRADED—**STEREO EXCHANGE,** 687 Broadway between 3rd & 4th Streets (opposite Tower Records) NYC 10012 (212) 505-1111 or 1-800-833-0071.

TUBE EQUIPMENT

FUTTERMAN OTL AMPLIFIERS—The ultimate tube amplifier with no reservations. No output transformer, no transformer coloration. The purest sound we have yet experienced. LANDES AUDIO, Rt. 24, Chester, N.J. 07930, 201-879-6889 **AD**

GOLD LION, "INDIA," TELEFUNKEN TUBES. Cramolin, Furman Sound, Hartley, Kimber Kable, LAST, Precision Fidelity, PS Audio, Sheffield, SONEX, VPI. VECTOR ELECTRONICS, 2030 NW Marshall #104, Portland, OR 97209. VISA, MASTERCARD, AMERICAN EXPRESS. 503-227-5641.

MOSCODE TUBE AMPLIFIER I - A synthesis of tubes and MOSFETS in order to create cost effective tube electronics. One of the true marvels of this time. Tube liquidity, **better** than transistor punch in the bass. 150 per channel with **8db** headroom!!! Only $900.00. LANDES AUDIO, Rt. 24, Chester, N.J. 07930, 201-879-6889 **AD**

PARTS/ACCESSORIES

ELECTRONIC CROSSOVERS: 6, 12, 18dB/octave. Kits from $116. Transient-Perfect Crossover, $175. Subsonic Filters, Bandpass Filters from $25. Free Folder w/reviews. ACE AUDIO CO., 532-5th Street, East Northport, NY 11731-2399. (516) 757-8990.

EXTRAORDINARY PRODUCTS

Triplanar Tonearm, Phoenix Preamplifier, Klyne, Oracle & SOTA Regulated Power Supplies, Tiptoes, Tonearm Termination Box, MacMod Tonearm & Interconnect Cables, MacMod Crossover, MacMod Subwoofer

EXCEPTIONAL MODIFICATIONS

QUAD 405 amplifiers, Ittok, Mission, SME & Technics EPA-100 tonearms, Bedini, Belles & Spatial preamplifiers, QUAD 63, Rogers Studio I & LS3/5A speakers

Request a complete catalog from The Mod Squad, 542 Coast Highway 101, Leucadia, CA 92024.

(619) 436-7666

The Mod Squad

PARTS/ACCESSORIES

AMPLIWIRE SIGNATURE "LIMITED EDITION," Ampliwire III, and Ampliwire IIA: Coming soon to Esoteric Audio of Farmington Hills. **AD**

LOW DCR AIR CORE INDUCTORS ARE OUR ONLY PRODUCT! Wide selection of coils wound with twelve and sixteen gauge wire! Custom orders welcome! Lowest prices! Rush C.O.D. orders accommodated! Free Information! Wilsonics, 2111-M 30th Street, Suite 1138, Boulder, Colorado 80301. (303) 530-1067 evenings

NEED MORE INPUTS? Revised DBP-2J(5) switches up to five. Quality construction, five year warranty. $59.95 w/ nickel jacks, $69.95 gold. DB SYSTEMS, Main St., Rindge, NH 03461 (603) 899-5121.

THE BEST ESOTERIC CABLE? We sell Randall Research, Straight Wire and Discrete Technology. We have studied each cable and know the differences. Call for details. Audio Advisor, Inc. 616-451-3868. Box 6202, Grand Rapids, MI 49506.

TOPLESS!!! (also means unsurpassed). SWL, Inc. offers Quicksilver cable (our Teflon & silver coated copper combination) and our highest quality gold RCA plugs. We also offer discount pricing on many cartridges, tonearms, tape decks, personal/business computers. Please send SASE for catalog or call 409-763-6061. Stephen Worsham Labs, Inc., P.O. Box 959, Galveston, TX 77553. TELEX 383390.

BLANK TAPE

TAPE WORLD TOLL FREE 1-800-245-6000

TDK		MAXELL					
MAR-90	6.05	MX-90	4.59	TDK T120/L750	5.39	SCOTCH T120/L750	5.99
MA-90	4.25	XLII-S90	2.69	TDK T120/L750HG	7.29	SONY T120/L750	5.99
SAX-90	2.79	UDXLII90	1.99	MAXELL T120/L750	5.39	SONY L750UHG	7.99
ADX-90	2.59	UDXLII60	1.89	MAXELL T120/L750HGX	7.29	PANASONIC T120	5.49
SA-90	1.85	UD90	1.79	KODAK T120/L750	5.89	BASF T120	5.99
SA-60	1.79	UD60	1.69	FUJI T120/L750	5.69	TDK HXS-90	4.19
AD-90	1.89	LN90	1.19	FUJI T120/L750HG	7.39	FUJI METAL-90	3.49
AD-60	1.49	LN60	1.05	SONY UCX-S90	2.29	SCOTCH XS II C90	2.29
D-90	1.07	XL-S90BB	6.49	SONY HF90	1.09	BASF PRO II 90	2.29
D-60	.99	UD3590	4.99	FUJI FR1190	1.99	MEMOREX HIBIAS90	2.29

WE WILL BEAT ANY COMPETITOR'S PRICE OF THE TOTAL ORDER, INCLUDING ALL SHIPPING AND HANDLING CHARGES BY 1%. 3.75 SHIPPING ANY SIZE ORDER
VISA, MC No extra charge COD add 1.95 PA add sales tax. Schools and Govt. on PO.
Orders shipped in 48 hours. Give us a try. M-F 8:30-5:00.
220 Spring St. Box 361 Butler, PA 16001 412-283-8621

AMPEX PROFESSIONAL SERIES AUDIO TAPE SALE. High quality open reel 1800' or 2400' on 7" reels, used once. Case of 40, $45.00. 10½ X 3600' and Cassettes. MC/Visa. Valtech Electronics, Box 6A, Richboro, PA 18954 (215) 322-4866.

CARTRIDGES/TONEARMS

DIAMOND NEEDLES and STEREO CARTRIDGES at DISCOUNT PRICES for SHURE, PICKERING, STANTON, EMPIRE, GRADO, AUDIO TECHNICA, ORTOFON, MICRO-ACOUSTICS, SONUS, ADC and LAST, send S.A.S.E free catalog. LYLE CARTRIDGES, Dept. A., Box 69, Brooklyn, NY 11218. For fast COD service Toll Free 800-221-0906. N.Y. State (718) 871-3303. 9AM - 8PM except Sunday. VISA/MC **AD**

KOETSU—THEIR MAGIC IS HEARD at Esoteric Audio at Farmington Hills.

SYRINX PU-3 TONEARM, $395.—Monster Cable Alpha-1 cartridge, $275.—Talisman S cartridge, $150. (201) 429-7898.

Get It Free!

Luxman
Harmon Kardon
Tandberg
Boston Acoustics
Audio Control
Sherwood
Hitachi
Denon
Revox
Onkyo
Ortofon
Hafler
Thorens
ADS
AIWA
Grace
M&K
B&O
SME
& Many More

We Deliver FREE Anywhere in the Continental USA!

the SOUND Approach
6067 Jericho Tpke., Commack, NY 11725
Charge it...Call 516-499-7680

CARTRIDGES/TONEARMS

THE ALCHEMIST/TALISMAN TOUCH—only at Esoteric Audio of Farmington Hills.

PRERECORDED TAPE

DIRECT-TO-TAPE RECORDINGS: REAL TIME DUPLICATED REELS (2/4 track, Dolby B/C, TypeX), CASSETTES, PCM DIGITAL CASSETTES, and BETA HIFI AUDIO from MASTER TAPES. We also sell CD's. SEND $1.00 for CATALOG and NEWSLETTER. Direct-to-Tape Recording, 14-R Station Avenue, Haddon Heights, NJ 08035.

CD PLAYERS

AUDIO DISCOUNTS OFFERS A LARGE selection of CD players at discount prices. For more information Mon. thru Sat. Please call 301-593-8833. Audio Discounts, 1026 McCeney Avenue, Silver Spring, MD 20901. We honor Visa & M/C. **AD**

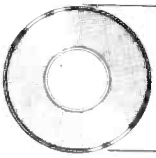
HARMAN/KARDON, NAKAMICHI, TANDBERG, CROWN, REVOX, HAFLER, CARVER, NAD, DBX, ELECTRO-VOICE AND OTHER QUALITY COMPONENTS. BEST PRICES—PROFESSIONAL CONSULTATION. **ALL PRODUCTS COVERED BY USA MANUFACTURER'S WARRANTY.** AMERISOUND SALES, INC.; P.O. BOX 24009, JACKSONVILLE, FL 32241. EAST: (904) 262-4000; WEST: (818) 840-0878.

SONY PCM UNITS: PCMF1 $1599; PCM701ES $969. Catalog of over 50 PCM recordings (Beta/VHS) $1.00. Send check/money order: DIRECT-TO-TAPE RECORDING COMPANY, 14 Station, Haddon Heights, NJ 08035 609-547-6890.

CD PLAYERS

SONY CDP-701ES PLAYER, with remote control, $895.—Dennesen PRD, Phase Restoration Filter, see Audio July '84, $150. (201) 429-7898.

COMPACT DISCS



New England Compact Disc Headquarters
Acoustat • AR • Boston Acoustics • B&W • Carver
Celestion • Denon • Dual • Fried • Hafler
harmon/kardon • Onkyo Integra • Ortofon
Pyramid • Shure • Sony ES Stanton • Thorens
Sound & Music
92 King St., Northampton, MA 413 584-9547

COMPACT DIGITAL DISCS AND PLAYERS! In stock! Fast, FREE shipping. Also: Mitsubishi, Klipsch, Nakamichi, Telarc, more (see our Hafler ad). READ BROTHERS STEREO 593 King Street, Charleston, South Carolina 29403. (803) 723-7276. **AD**

COMPACT DISCS, EXCLUSIVELY—FROM STOCK. Detailed Catalog $1, refundable with purchase. Ethel Enterprises, Box 3301, Falls Church, VA 22043.

COMPACT DISCS AND ACCESSORIES
7 DAYS A WEEK — FREE CATALOG
CALL TOLL FREE
1-800-ALL DISC
IN CONN CALL 1-452-0203
ALL DISC MUSIC, INC.
133 WHEELER RD., MONROE, CT 06468
COMPACT disc DIGITAL AUDIO

Listen...

Before You Buy!
- **Time Delay**
- **Reverberation**
- **Crossovers**
- **Noise Reduction**
- **Compressor/Limiters**
- **Expanders**
- **Spectrum Analyzers**
- **Parametric EQ**

Don't have regrets about paying too much for a lesser product. In demos and comparisons, we'll show you why we're Better! Our Factory Direct sales allow us to produce a Superior product and offer it to you at a Lower price... Call or write for a free full length Demo Album and 24 page brochure.
Write to: **LT Sound,** Dept. A-3, P O Box 338
Stone Mountain, GA 30086
In Georgia Call (404)493-1258
TOLL FREE: 1-800-241-3005 — Ext. 18

COMPACT DISCS

COMPACT DISCS—MOST TITLES $11.99—$13.99. 2,000 plus titles in stock. Free catalog plus monthly updates. Oz Records, 5246A Memorial Drive, Stone Mountain, GA 30083, (404) 292-5452.

ROTEL *hi fi*

Authorized Dealers

CALIFORNIA
Audio Basic, Claremont, CA
Havens & Hardesty, Huntington Beach, CA
Absolute Audio, Orange, CA
Century Stereo, San Jose, CA

CONNECTICUT
Audio Etc., New Haven, CT

MARYLAND
Myer Emco Inc., Rockville, MD

MICHIGAN
Steketees Audio, Grand Rapids, MI

NEW YORK
New Paltz Audio, New Paltz, NY

OHIO
Stereo Showcase, Centerville, OH

SOUTH CAROLINA
Don Jones Stereo, Greenville, SC

VIRGINIA
Myer Emco Inc., Falls Church, VA

WASHINGTON D.C.
Myer Emco, Washington D.C.

WASHINGTON
Audisar, Bellvue, WA

WISCONSIN
Audio Video Exchange, Menesha, WI

CANADA

BRITISH COLUMBIA
Absolute Stereo, Coquitlam, B.C.
British Sound Ltd., Vancouver, B.C.

British Columbia (cnt'd)
Epic Audio Ltd., Vancouver, B.C.
The Sound Room, Vancouver, B.C.

MANITOBA
Sound Lovers, St. Boniface, Man.

ONTARIO
Audio Centre, London, Ontario
Brack Electronics Ltd., Toronto, Ontario
Dewar's Hi Tech Home Entertainment, Nepean, Ontario
Dimension Stereo, Kingston, Ontario
Sounds Superior, Sault Ste Marie, Ontario

QUEBEC
Audio Club, Montreal, Quebec
Beaudry Electronique, Joliette, Quebec
Bourget Stereo Cabinet, Sherbrooke, Quebec
Filtronique, Montreal, Quebec
Wm. Layton Audio Inc., Montreal, Quebec
Opus Audio, Montreal, Quebec
Perigny Haute-Fidelite, Shawinigan Sud, Quebec
Rotac Electronique Inc., Ste-Foy, Quebec

MARITIMES
Stereoasis, Antigonish, Nova Scotia
Music Stop Ltd., Halifax, Nova Scotia
Music Stop Ltd., Dartmouth, Nova Scotia

For More Information Contact:
Anglo-American Audio, PO Box 653, Buffalo, NY 14240 USA

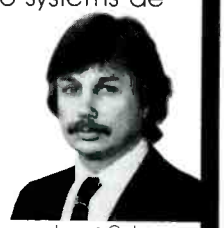
THE MOST TRUSTED AUDIO DEALERSHIP

Located in Rochester, New York and established by pianist James Gala, **GALA SOUND** sells musically accurate and correctly engineered audio components.

Audiophiles, musical institutions, and recording studios interested in achieving the highest level of sound reproduction rely on GALA SOUND for definitive audio systems designed for their specific needs and listening environments.

We deliver and install state-of-the-art audio systems anywhere in the Continental U.S. with a minimum purchase of $7,000. For lesser amounts, we ship you the audio components of your choice the day you order.

Phone — please do not write — Mr. Gala at (716) 461-3000. If Music is significant in your life, you deserve an audio system from GALA SOUND.



James Gala

MARK LEVINSON • THRESHOLD • McINTOSH
KEF • B & W • QUAD • MAGNEPLANAR • ACOUSTAT • POLK
ORACLE • THORENS • NAKAMICHI • KYOCERA • NAD
BANG & OLUFSEN • LUXMAN • BRYSTON • GRACE

GALA SOUND

650 Monroe Avenue, Rochester, N.Y. 14607
(716) 461-3000

COMPACT DISCS

FRANK SINATRA CONDUCTS THE MUSIC OF ALEC WILDER. EXTREMELY RARE INSTRUMENTAL COLUMBIA DISC. MINT CONDITION. $5000. 601-649-8369.

GOING PORTABLE? New **COMPACT DISC CARRIER** offers you safe, durable, compact protection for six discs. Hand made of top quality nylon with velour lining and velcro closure. Money back guarantee. Available in black, blue and red. Send $12.95 plus $1.50 postage and handling to: Shore Brothers Ltd., Box A, 2323 Corinth Ave. Los Angeles, CA 90064

IBM PC/XT PROGRAM TO TRACK RECORDS/TAPES. Store up to 32,000 records. Requires 128K or more Memory, DOS 2.10, BASICA. $79.95. Information: MICROWARE ASSOCIATES-A, 763 Taft Drive, Suite G, Arlington, Texas 76011

JAZZ CDs

RECORDED TOTALLY DIGITAL. Free catalog **DMP**, Box 2317, NY, NY 10185.

★**WE SPECIALIZE** in audiophile and imported compact discs.
★We will **BEAT** any catalog price by one dollar per CD.
★We give **CREDIT** for used CD's in good condition.

Send $1 for 50 page catalog to SUPERSOUND, P.O. Box 7082, Forest Park, IL 60130. Phone (312) 366-1300 12-5 pm

In New England...

The knowledge, creativity and dependability you expect from a dealer who represents these and other major manufacturers.

Alpha	Oracle
Astatic	Plexus
Audio-Interface	Robertson
Audio Pro	Signet
Audioquest	Snell
Belles Research	Sonographe
Boston Acoustics	SOTA
Bryston	Souther
Carver	Spica
Counterpoint	Stax
Denon	Sumiko
Dynavector	Talisman
ESB	Tandberg
Grace	Threshold
Keith Monks	Vandersteen
Magnepan	VPI
Martin Logan	and more...
Mission	**VIDEO**
Mod Squad	NEC
Morel	Pioneer
Niles	Proton

5 listening rooms...New England's largest audiophile record dealer... Keith Monks record cleaning... Custom cabinetry...In-store service... All shipments pre-paid and insured in the continental U.S... MC/VISA/AMEX/Take 5 Charge

TAKE 5 AUDIO

105 Whitney Ave., New Haven, CT 06510
(203) 777-1750
Mon., Tue., Wed., Fri. 10-6, Thurs. 10-8, Sat. 10-5

TEST RECORDS

SEVEN STEPS TO BETTER LISTENING, FROM CBS TECHNOLOGY CENTER, is a high-precision test record for the novice. Set up your hi-fi system and tune it to the specific acoustics of your listening room. Make certain your equipment functions properly. Includes 16-page booklet by AUDIO's Edward Tatnall Canby which shows you how to perform the following "ears only" tests: Proper identification of left and right channels, phasing, loudspeaker balance, tone control settings, elimination of buzzes and rattles, proper adjustment of vertical and lateral-tracking forces, and much more. Send $6.98 in check or money order in U.S. funds only; payment must accompany order. Allow four to six weeks for delivery. **AUDIO TEST RECORD,** P.O. Box 182101, Dept. 406, Cincinnati, OH 45218

TEST RECORDS FROM CBS TECHNOLOGY CENTER

STR 100 PHONO CARTRIDGE TEST RECORD, includes sweep frequency with sync for recorder; spot frequency; separation; compliance; vertical- and lateral-tracking; tonearm resonance, and more. $10.00 each.

STR 112 PHONO CARTRIDGE TEST RECORD, includes square wave, graduated-tracking, and IM bands. $15.00 each.

STR 120 PHONO CARTRIDGE TEST RECORD, includes ultra-sonic test tones, high-level low-frequency glide tones, standard-level and silent bands, and can be used with a graphic level recorder. $15.00 each.

STR 130 RIAA FREQUENCY RESPONSE TEST RECORD, provides accurate means of calibrating professional recording equipment. Can be used with a graphic level recorder or, without automatic equipment, with the spot frequency bands. $15.00 each.

STR 140 PINK NOISE ACOUSTICAL TEST RECORD, is designed for acoustical testing of loudspeakers in ordinary rooms and whole systems, and for psychoacoustic tests. Includes spot frequency tones with voice announcements and glide-tones in 1/3 octave bands from 30 Hz to 15 kHz synced for a graphic recorder. $15.00

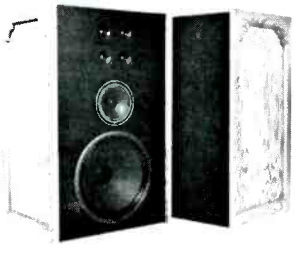
SQT 1100 QUADRAPHONIC TEST RECORD, the standard test disc for SQ decoding adjustment, has test bands for pickup measurements, setup of decoders, channel identification and balance. $15.00 each.

Payment must accompany order and be either a check or money order in U.S. funds. Allow four to six weeks for delivery.

STR 100 Stereo Frequency Record $10.00
STR 112 Square Wave, Tracking and IM Disc $15.00
STR 120 Wide-Range Cartridge Disc $15.00
STR 130 RIAA Frequency Response Disc $15.00
STR 140 Pink Noise Disc $15.00
SQT 1100 Quadraphonic Test Disc $15.00

AUDIO TEST RECORDS, P.O. Box 182101, Dept. 406, Cincinnati, OH 45218

ECHELON



ECHELON AUDIO is proud to introduce the **Eclipse** series loudspeaker. A digital ready, state of the art system that overshadows the rest. High power handling - yet highly efficient. Computer designed and tested for extremely accurate performance. Come up to our level of listening pleasure, write:

ECHELON AUDIO
P.O. Box 8086
Gadsden, AL 35902-8086
Priced at $1750 per pair

VIDEO EQUIPMENT

CONVERT VIDEOTAPES PAL—SECAM—NTSC (OVERSEAS). 110-220 AUDIO, VIDEORECORDERS, TELEVISIONS, CANON COPYING MACHINES, DISCOUNTED. Apple Audio, 74-18 37th Avenue, Jackson Heights, New York 11372 (718) 507-5800.

RECORDS

FREE ISSUE OF GOLDMINE, world's largest record collector's publication! Thousands of records of all types, eras for sale. Plus articles on recording stars, past and present. Rock 'n' roll, jazz, country, folk, blues. Every two weeks! 13 issues, $22. GOLDMINE, Circulation Department AJY, 700 E. State St., Iola, WI 54990.

PROTECT YOUR LPS. Poly sleeves 13¢. Polyline paper 16¢. Cardboard jackets 40¢. We buy and sell like new lp's, prerecorded reel tapes and cassettes. Catalog $3.00. House of Records, Box 323, Hillburn, NY 10931.

RECORD CLEANER—A+ Generic Anti-Static Record Cleaner Fluid offered by a major supplier of record cleaner products. Guaranteed. 8 oz. bottle only $4.95 Post Paid. D-MAG Inc., 6746 White Dr., West Palm Beach, Fla 33407

VINYL DUST BUSTERS!
Resealable album jacket covers—Safeguards valuable albums from dust and dirt. Easy open, easy close zipper provides the ultimate protection for all 12" records! $4.25 + $1.50 P&H per twenty (Ca. residents add 6% tax). GE Kent, P. O. Box 1073, Santa Ynez, Ca. 93460

AUDIOPHILE RECORDS

★**ALL THE AUDIOPHILE** labels: Sheffield, Reference, Proprius, Meridian etc.
★We will **BEAT** any catalog price by $1 per LP.
★**LARGEST** stock of Japanese import Jazz in North America
★Fantastic **SAVINGS** on all Japanese import titles, Mobile Fidelity, and Fresh Aire.

Get our newsletter and on our mailing list now. Send $1 to SUPERSOUND, P.O. BOX 7082-A, FOREST PARK IL. 60130. Phone (312) 366-1300 12-5 pm.

BEATLES MOBILE FIDELITY COLLECTION. Unplayed. Already a collector's item. A steal at $425 U.S. 416-665-4196.

MFSL STONES COLLECTION $200. Low priced audiophile, collector albums/CD's. Complete price list $2.00, refunded first order. Visa/Mastercard accepted. M.F.Y.E., P.O. Box 668585-C, Charlotte, N.C. 28266-8585.

OUT-OF-PRINT MOBILE FIDELITY
Fromer **MFSL** employee selling **FACTORY SEALED SINGLE** disc, **DOUBLE** disc, **UHQRs, COLLECTIONS.** Call **BOB (818) 845-9236** Evenings PST.

REFERENCE RECORDINGS
The long wait is over! It's been thirty years since Mercury Records, in the golden days of Living Presence mono, introduced to an astonished audio community Respighi's orchestral spectacular, "CHURCH WINDOWS." Now at last this monumental work for large orchestra, organ and tam-tam has been given the Prof. Johnson super-analogue audiophile treatment on RR-15. Keith Clark conducts The Pacific Symphony in this first recording to do the work full sonic and musical justice. Also new, on RR-16, the CHICAGO PRO MUSICA, principal players from the renowned Chicago Symphony Orchestra, bring you William Walton's whimsical music from "FACADE"—the first recording of an instrumental suite in the composer's original scoring, along with Strauss' "Till Eulenspiegel" in a chamber version, and more. The Chicago recordings were made in the magical acoustics of Medinah Temple, and, we think, are Keith Johnson's best work to date. RR-15 and RR-16 are 45 rpm premium-quality pressings in deluxe, double-fold jackets, available now at your local RR dealer or directly from us at $16.98 each, postpaid in US, Visa/MC welcome. Reference Recordings, Box 77225X, San Francisco, CA 94107. Call free: 800-621-0854 ext. 107, or 408-745-7159. Dealer inquiries invited!

U.H.Q.R.'S! PINK FLOYD: s/s $500, #113 best offer. SGT. Peppers: s/s $200, #650 and #642 unplayed $125 each. Supertramp #18 best offer. Eric Anderson, 714 N. Nowlan #4, Glendive, Mt. 59330. (406)-365-8779.

AUDIOPHILE RECORDS

M.F.S.L. OUT OF PRINT BEATLES collection $897. Hurry! STONES and SINATRA collections also. U.H.Q.R. Bizet's Carmen, Puccini's La Boheme. BEATLES MMT and White album. Some imports. Call Sound Advice (816) 361-2713.

WANTED TO BUY

MCINTOSH, MARANTZ TUBE, MCINTOSH S.S. EQUIPMENT, Thorens TD-124, Western Electric, Altec/JBL/EV/Tannoy/Stephens raw speakers, Tubes, etc. Top cash. Scott Dowling, 9908 Daines Dr., Temple City, CA 91780 (818) 286-9122. Weekends and after 6PM M-F

MCINTOSH, MARANTZ TUBE COMPONENTS, Western Electric, Hartsfields, Patricians. John Conrad, 1178 Blackbird, El Cajon, Ca. 92020 (619) 449-9155

QUADRAPHONIC OPEN REEL TAPES, RECORDS (whole collections), select equipment. Michael Robin, 120 Atlanta Place, Pittsburgh, Pennsylvania 15228. (412) 341-1686.

WANTED: EARLY RCA VICTOR prerecorded 7.5 ips 2-track stereo tapes: Also Sprach Zarathustra, Ein Heldenleben, Beethoven's Fifth, Tchaikovsky's Sixth, other titles. Contact Carleton Sarver, 256 West 88th Street, New York, NY 10024

WANTED: JBL PARAGON. Tel. (312) 645-1056. Marc Boukerche. Business hours Chicago University (312) 996-2141.

WANTED: MCINTOSH, MARANTZ, QUAD, TUBE AMPS. Old Tannoy/Jensen/JBL speakers. Garrard 301. Thorens TD-124. JHL Raw Drivers. Hartsfields, Patricians. Western Electric Equipment. Tel: 818/576-2642, David Yo, POBx 832, Monterey Park, Ca. 91754

WANTED TO BUY: Nakamichi 620 amp. Excellent condition. H- 919-847-8566, W- 919-781-4139.

SERVICES

AUDIO PULSE SERVICE. Factory trained technicians. Write us about Model One update kits. White Labs, 10528 Lower Azusa Rd., Suite 192A, El Monte, CA 91731. (818) 446-5346.

AUDIO PULSE SPECIALISTS. Repairs—Modifications—Updates—Sales. WALT'S AUDIO SERVICE, 111 East Rialto Ave., Rialto, Calif. 92376. (714) 875-0776.

BUSINESS OPPORTUNITIES

DEALER AND STUDENT REPRESENTATIVES NEEDED For Denon And Nakamichi Cassette Decks And Turntables. Serious Inquires Only. AudioWorkShop, Box 18009, Seattle, WA 98118, 1-206-323-4987, Established 1967

PUBLICATIONS

ARE YOU INTERESTED IN QUALITY, USED STEREO EQUIPMENT? Send for the **PLAY IT AGAIN SAM** newsletter—hundreds of listings—items for sale—items sought—published 6 times per year. $8. 1-year subscription. Send today to **PLAY IT AGAIN SAM,** 12611 Madison Avenue, Lakewood, Ohio 44107. (216) 228-0040. Master Charge and Visa accepted.

QUALITY, USED STEREO EQUIPMENT INCLUDING THE ESOTERICS. Shop the convenient way with our up-to-date list featuring premium equipment from all over the country. Buy direct from owner—no middle man. Hundreds of listings. Send $2.95 to: Tradin' Times, Inc., P.O. Box 1445, Norcross, GA 30091.

MISCELLANEOUS

ABARGAIN: Stax Sigma $199. LAMBDA $162, SRX/MK3 $129. SRD-7 $68, SRE15 $25, SRM1/MK2 $275, PROF LAMBDA/amp $519; Grace F9EMK2 $99, F9E Stylus $55, Ruby Stylus $109, F9E Ruby $155, 707 II (B) $129, 747 $145; Accuphase AC-2 $255, AC-3 $229; LINN ITTOK $385; Technics Stylus Gauge $49, 205CMK3 $85. 205CMK4 $155, Denon 103C $135, 103D $165, DL303 $199; Dynavector 23RS $169, 17DS $359, 10X $85, 20BII $145; Koetsu Black $445; FR64FX $299, 64S $375; Orsonic $22; Interconnect: Hitachi 3' $35, 4.5" $45; CD $10.95 pp; all unused; full MFG warranty; Box 6312, L.I.C., NY 11106. (718) 784-2939; (305) 487-1048.

AUDIO DISCOUNTS OFFERS THE FINEST lines of audio components **(INCLUDING THE ESOTERICS)** at **DISCOUNT PRICES.** If you're in the market for speakers, receivers, cassette decks, to the best in separate components including amps, pre-amps, turntables, cartridges etc. or a new **CAR STEREO,** our knowledgeable sales staff will be glad to assist you. For more information Monday thru Saturday **PLEASE CALL** 301-593-8833 or write to **AUDIO DISCOUNTS,** 1026 McCeney Avenue, Silver Spring, MD 20901. We honor VISA-MC and COD for your convenience. **AD**

HARMAN/KARDON, NAKAMICHI, TANDBERG, CROWN, REVOX, HAFLER, CARVER, NAD, DBX, ELECTRO-VOICE AND OTHER QUALITY COMPONENTS. BEST PRICES—PROFESSIONAL CONSULTATION. **ALL PRODUCTS COVERED BY USA MANUFACTURER'S WARRANTY.** AMERISOUND SALES, INC.; P.O. BOX 24009, JACKSONVILLE, FL 32241. EAST: (904) 262-4000; WEST: (818) 840-0878.

J.S. BACH TRICENTENNIAL T-SHIRTS: 10.95ea. A true classic of a design for Bach's 300th Birthday. Screen printed on your choice of silver, tan, black or sky blue. Specify size: S,M,L,XL. Visa/MC orders call 1(800) 334-8987, or order by mail from: Gemini Shirts, PO Box 2707, Rocky Mount, NC 27801

MISCELLANEOUS

A BETTER SYSTEM? People who know stereo buy their sound direct. Now you can buy the finest in high fidelity components, including esoterics and autosound, at unheard of prices. DIRECT SOUND MARKETING provides sensible expert advice, in-house service facilities, and factory fresh components on an in-stock basis. Discover America's best kept audio secret. Send $1.00 for our informative catalogue to DIRECT SOUND MARKETING, Dept. A, 3095 Bolling Way N.E., Atlanta, GA 30305 or call 404-233-9500. MC/VISA and AMEX accepted.

THEY DON'T DISCOUNT IT? WE DO! Get **LOW PRICES** on **ALL** types of audio equipment—including high-end and even esoteric products not normally discounted! Now we can save you money on the equipment you REALLY WANT. Extensive selection—no need to settle for second choice. Thousands of satisfied customers nationwide. Call us for price quotes or friendly, expert advice. Catalog $1. 616-451-3868. VISA/MC/AMEX. THE AUDIO ADVISOR INC., BOX 6202, GRAND RAPIDS, MI 49506.

20% TO 40% SAVINGS: NAKAMICHI, B&W, KOETSU, Denon, Tascam, NAD, Etc. VISA/MC, COD. AudioWorkShop 1-206-323-4987.

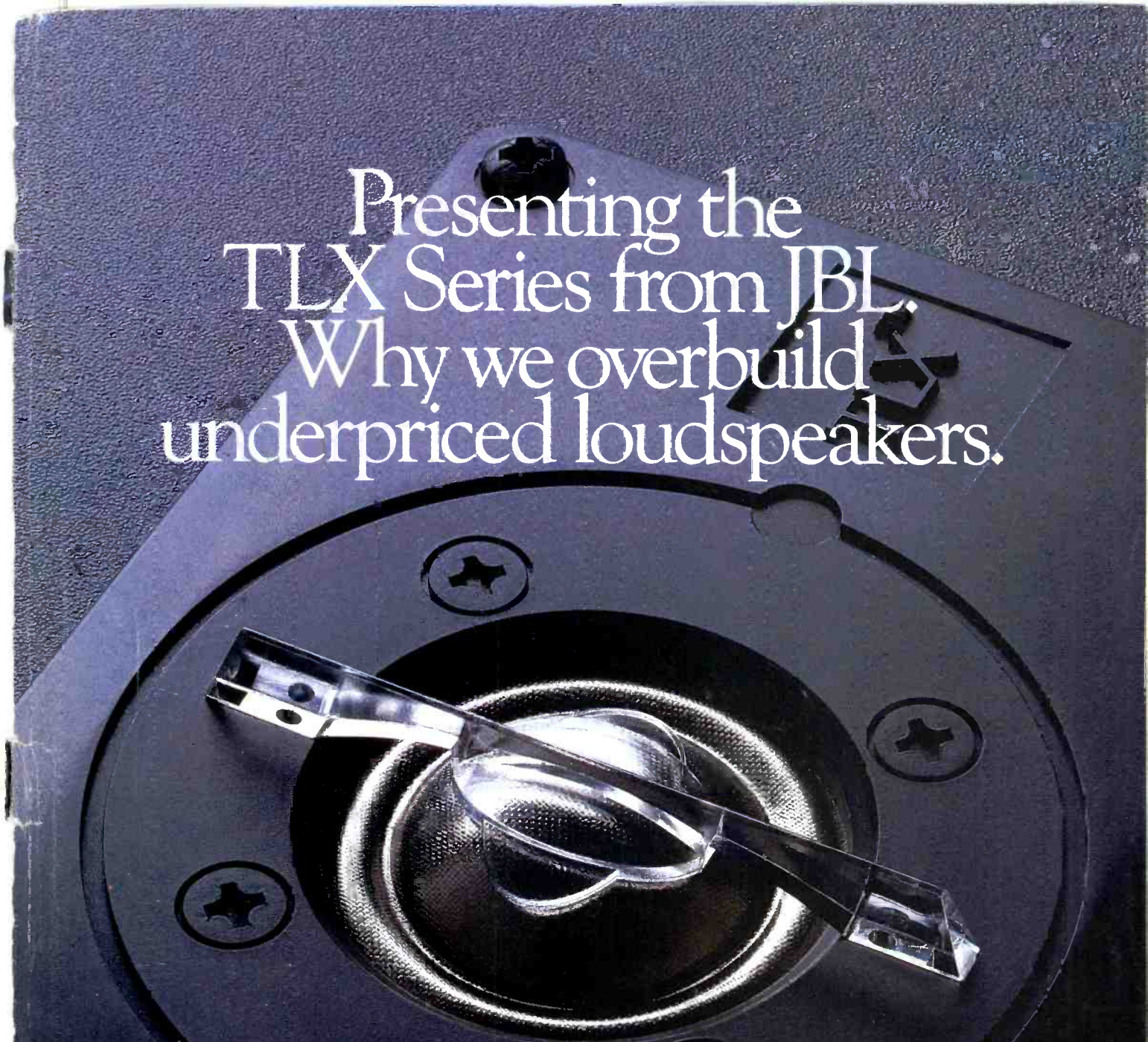
MISCELLANEOUS

MCINTOSH MC-75's $1,000, MI-3 audioscope $700, MC-240 $425, MC-225 $350. MI-75 $500, MR-71 w/cabinet $350, MR-67 w/cabinet $225, 1700 w/cabinet $375, 1900 w/cabinet $600, MX-110 w/cabinet $500. Allison 6 white sealed $200, 7's sealed $270. Onkyo TX35 sealed $200, TX-25 $150. Kenwood KA-6060A $200, Pioneer SD1100 $600. Marantz 7T preamp $165. 2 pair KLH-9 electrostatics w/original cartons $850 each pair. KLH-1 pristine w/original cartons $1,000. JBL-300 $1,500. Scott 4310 Broadcast Monitor tuner $1,000, 272 amplifier $175. Braun PS-500 table $135. Hitachi DA-1000 $400. Sony Ferrichrome elcaset tape $11 Teac AL-700 elcaset machines factory sealed originally $1,100 now $299, mint Sony EL-7 $299, EL-4 mint $139. RX10 DBX for elcaset factory sealed $225, 234 Syncaset new $750, demo $700. MB-20 meter bridge $100. Mitsubishi LT-30 sealed $370, DA-M30 meter (demo) $150, DA-F30 (demo) $250, DA-R8 (demo) $150, mini system: MT-04, MA-04, MF-04, MP-04 $666. Acoustic Research 2AX $125. Advent 500 SoundSpace delay $375. Lux L-110 integrated amp $550. Sansui QSD-1 $500. EV 7445 quad encoder $500. Revox B77 $825, B790 turntable $450. Phase Linear 3000MK2 preamp $175. Sound Concepts SD550 $500. Pioneer RTU22 perfect $1,000, laser video players: LD700 $650 demo, VP1000 $350, new video discs 40-60%. DBX 224 $225, 400X $225. Burwen TNE7000 $275. Many Scott, Fisher, Dual tubed preamps, poweramps, tuners, tables, receivers must liquidate. Ortofon STM72 transformer $25. 250 prerecorded r/t/r $6, 1/2track $20. 5,000 original service manuals. Want collections pre-recorded r/t/r, Pioneer TAU-11, JT-2044T, McIntosh, Marantz (tube) units, Quad r/t/r tapes, Sansui QS units, Sony, Teac, Dolby units many oddball pieces, accessories. Everything money back guaranty. Shipping worldwide Martin Gasman, 779 Worcester St., Wellesley MA 02181, phone: 617-CEL-TICS, 617-235-8427.

NAKAMICHI NAKAMICHI SHAMEFULLY LOW PRICES: Products Designed Especially For USA And Overseas Use. The More Information You Have The Better You Can Make Your Decision. Extremely Long Insured USA Warranties. Service Available Nationwide. Thousands of Satisfied Customers Worldwide. AudioWorkShop 1-206-323-4987.

AD INDEX

Presenting the TLX Series from JBL. Why we overbuild underpriced loudspeakers.



The titanium laminate tweeter, abbreviated TLX,™ is the most significant innovation yet afforded to budget-minded audiophiles. Borrowing lessons learned with our no-holds-barred Titanium Series, we vapor-deposited titanium onto a phenolic dome high frequency driver, enabling us to combine the best characteristics of both a soft and a hard dome: good internal damping to control unwanted resonances, fast response to capture the musical transients and extreme dynamics of digital recordings.

Then we added a unique acoustic contact lens above the dome, to insure phase coherence and further reduce distortion.

That commitment to every detail affecting sonic accuracy has made JBL the reference standard of the music industry for more than 35 years. So if the TLX Series seems overbuilt, you'll understand why. It's a habit with us. One you'll appreciate no matter how little you pay.

Pictured above: JBL's new titanium laminate tweeter with unique acoustic contact lens.

JBL

harman international
8500 Balboa Blvd., P.O. Box 2200
Northridge, California 91329
Telephone: (818) 893-8411

Enter No. 21 on Reader Service Card

Fly First Class.

Wild Turkey. It's not the best because it's expensive. It's expensive because it's the best.

Now you can send a gift of Wild Turkey® /101 Proof anywhere* by phone through Nationwide Gift Liquor. Call Toll Free 1-800-CHEER-UP (Arizona 602-957-4923). *Except where prohibited. Major credit cards accepted. Austin, Nichols Distilling Co., Lawrenceburg, KY © 1985.