Audio

AUGUST 1988 • $2.50

SCENES: SONIC SOLUTIONS' NoNOISE

PIONEER F-91 TUNER SUPERB SOUND

INTERVIEW: TOM JUNG THE DIGITAL MUSIC-MAN

TESTED NAKAMICHI CR-4A CASSETTE DECK GOOD CHOICE

SUMO DELILAH CROSSOVER IMPECCABLE PROBLEM-SOLVER

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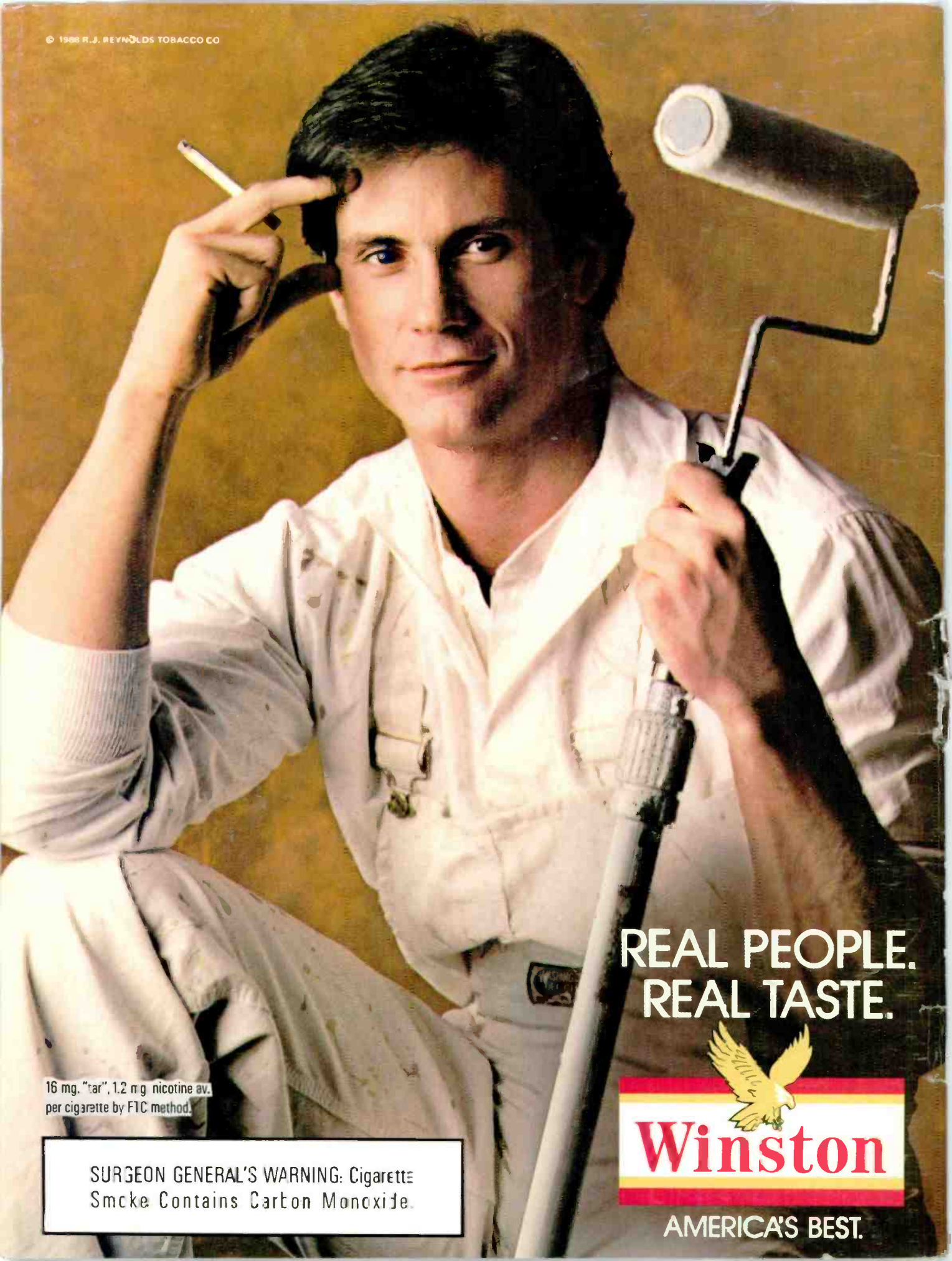
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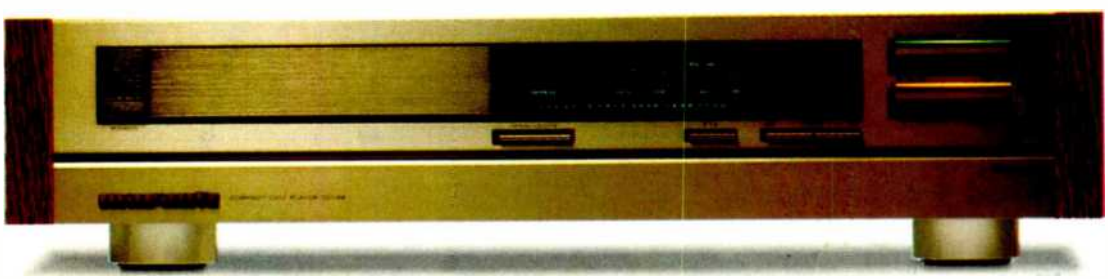

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For more technical information, call or write Marantz for the brochure, "The 94 Series, A Technical Narrative."

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DEPARTMENTS

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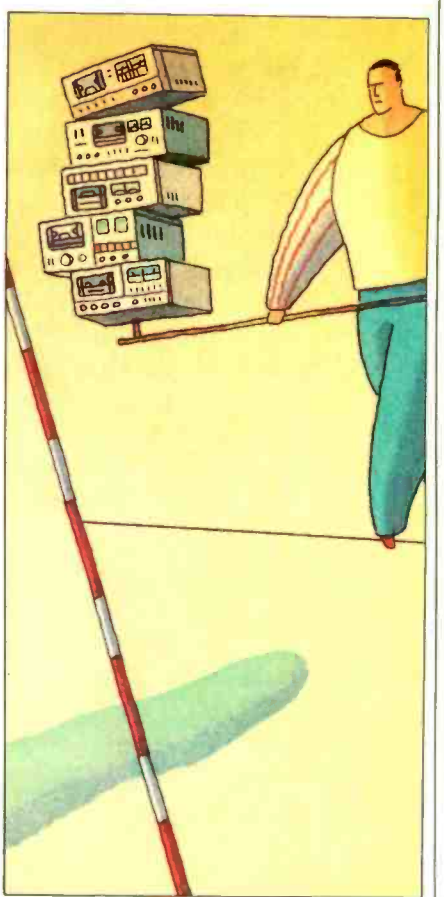

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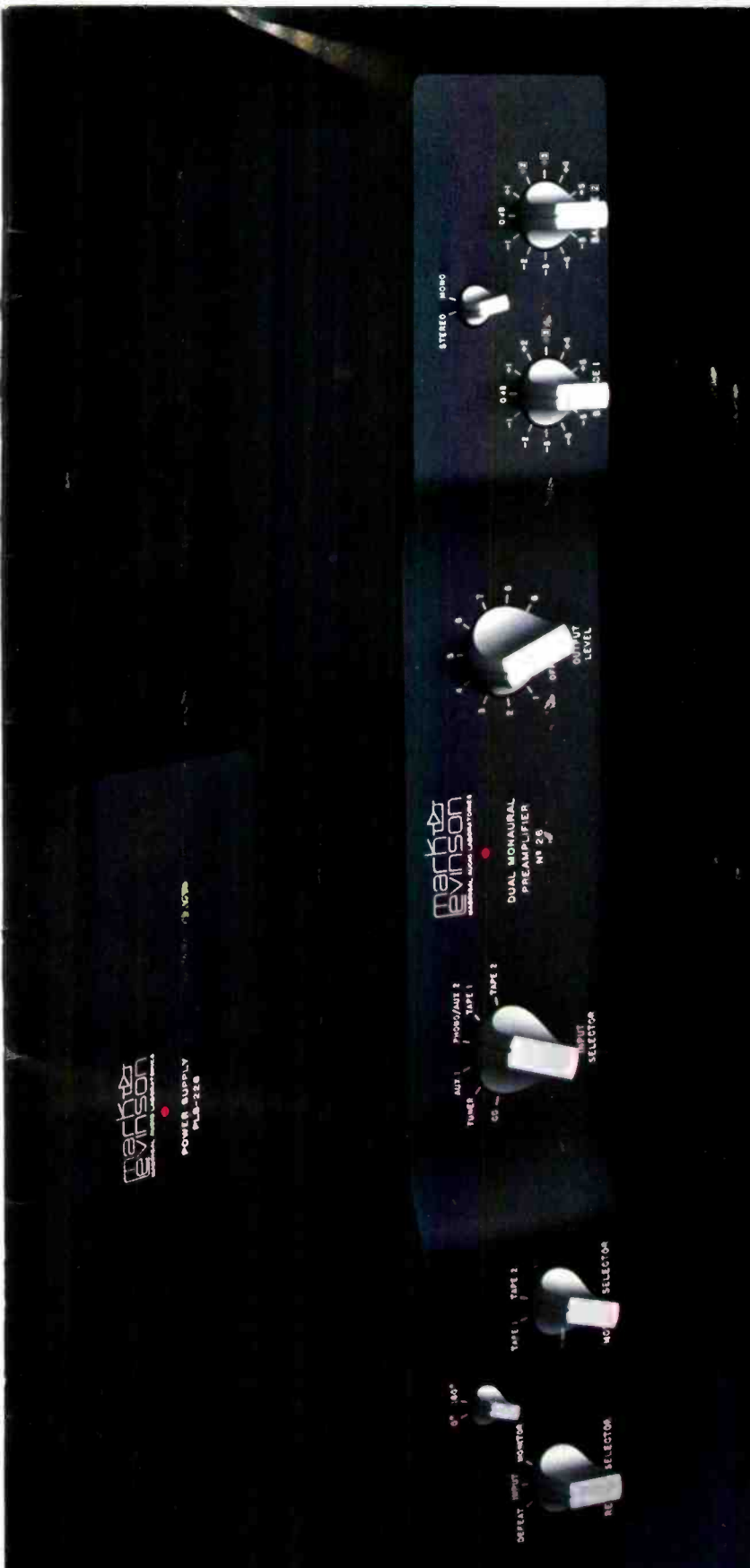

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SIGNALS & NOISE

Sumo Service Summary

Dear Editor:

This is regarding your call for nominations for audio manufacturers who provide state-of-the-art service ("Signals & Noise," August 1987). I would like to make such a nomination: Sumo Products of Chatsworth, Cal.

I own an older Sumo amp which is no longer in production; technically, it is not even a product of the current company. (Sumo was sold by James Bongiorno, the designer of my amp, around 1982 or 1983.) Nevertheless, Sumo still services my unit at a reasonable price, and one of the engineers/technicians is always more than willing to answer questions and give advice whenever I call. Often it's possible to converse directly with Richard Pley, past president and former chief engineer [who now serves as a consultant to the company]. Schematics and manuals for my unit were mailed free of charge. From my experience, I find that Sumo produces a quality product and stands beside it with service many years after the sale.

Thomas Chou
Starkville, Miss.

Bravo, Bryston

Dear Editor:

I recently purchased a second-hand Bryston 1B preamp. When I made the purchase, the salesman couldn't tell me much about the unit, so I wrote to Bryston in Ontario to find out how old the unit was and if any repairs had been done on it. About 10 days later, I received a long-distance phone call from Chris and Brian Russell (Bryston's vice president of engineering and president, respectively). They told me what I wanted to know and said they hoped that I would enjoy the unit. Considering that Bryston made no revenue whatsoever on my purchase, I think this demonstrates what kind of company Bryston is. They really care about their equipment and their clientele.

Kirk LeBlanc
Fredericton, N.B.
Canada

GRP Groupie

Dear Editor:

It was a pleasure to hear from Dave Grusin and Larry Rosen of GRP ("The Audio Interview," March 1988). Their success story is invigorating. Some time ago, I took a chance on the *GRP Live in Session* CD, thinking GRP was a band! (It might as well have been.) Now I buy GRP discs like I would those of a favorite artist. What a showcase disc for a label!

I'd like to pass on a friend's compliment to Dave and Larry, but the best compliment was the gleam in his eye when he reluctantly returned a GRP disc I'd lent him. "That's the music my Polk SDAs were made for!" he said. "The best digital I've ever heard!"

I agree, and I'm off to buy better speakers. Keep it hot, guys!

Mike Gates
Voorhees, N.J.

Rating the Ratings

Dear Editor:

When your magazine reviews recordings, you often include something that is very important for record buyers—you say, for example, "Sound: A, Performance: B." Well, why don't you do the same with your "Equipment Profiles"? For instance, you could rate, on a scale from 1 to 10, a component's construction, control panel, accuracy, price (relative to overall performance), and so on.

I know that in some way you assess these things in your reports, but what does "good" really mean on a scale? Is it a 7, an 8, or maybe a 9? And what's the difference between "excellent" and "superb"? I know it could be dangerous for some manufacturers, but after all, no other audio magazine I know of rates equipment in this manner. And after all, your business is to say the truth.

Anyway, it is a pleasure reading *Audio*, and congratulations for your fine, excellent reports. On a scale from 1 to 10, I would say your magazine rates as follows—Construction: 10, Accuracy: 10, and Content: 10+.

Manuel Torre V
San Luis Potosí, Mexico

Erratum

In the May 1988 "Classical Recordings" column, we misidentified the company which released the Compact Disc of *Milhaud: Le Boeuf sur le Toit; Poulenc: Les Biches; Satie: Parade*; the catalog number for this CD is Denon CO-1519.

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AUDIOCLINIC

JOSEPH GIOVANELLI

Subsidiary Broadcasts

Q. What is "SCA," and why must it be rejected?—Robert Beiswinger, Townbank, N.J.

A. SCA stands for Subsidiary Communications Authorization. Under this authorization, FM stations are permitted to broadcast other programming simultaneously with the programs you hear. Yes, that's right; FM stations often broadcast two or even more programs—the one you can tune into via your regular FM tuner and at least one you cannot.

These SCA broadcasts are transmitted by means of a subcarrier riding on the main carrier. In the same way that an FM station transmits audio frequencies, it can also transmit much higher frequencies. The one most commonly employed for SCA broadcasts is 67 kHz. Like the main carrier, this 67-kHz subcarrier is frequency-modulated. The output of the tuner's detector includes this modulated subcarrier as well as the main-program audio. Tuners designed to "hear" these broadcasts feed the 67-kHz subcarrier to another detector, whose output is the audio signal representing the SCA program To avoid interference with adjacent channels and with the main programming of the FM station, the bandwidth of SCA broadcasts is restricted to an absolute maximum of 7 kHz.

The content of these subsidiary broadcasts varies from restaurant background music to medical conferences. There are special programs for the physically handicapped which feature the reading of daily newspapers and magazines. Specialized foreign-language programs are also often carried. There are even some data transmissions on these subcarriers.

If the main programming of an FM station is stereophonic, then only one subcarrier can be used. If a station is transmitting monophonically, at least one additional subcarrier can be present, though this is rare.

If there are significant nonlinearities in the FM transmitter or in the FM tuner, it is possible for the SCA signal to be heard as a faint background to the main program. Even when such signals are inaudible, if significant 67-kHz leakage is present in the output of a tuner or receiver, that frequency may combine with the bias oscillator during tape recording. The result will be background hash which will probably ruin the recording. This is why SCA subcarriers must be rejected.

Long-Distance AM Reception

Q. I am interested in buying a new tuner with good AM and FM sections. (I need AM because I like to listen to talk shows that are transmitted from considerable distances.) What tuner should I consider?—Wayne Warren, Grants Pass, Ore.

A. My suggestion is that you buy a tuner that has the FM performance you require. As for brands, there are many fine tuners, and, because of the subjective nature of product evaluation, I never enter this area of audio.

As for the AM aspects, buy a good, *general coverage* shortwave receiver. I realize that you might not be interested in shortwave reception, but there are features on these receivers that will enhance your long-distance AM reception in a number of ways:

Often, there are beats between the desired signal and adjacent channel signals. The bandwidth of a good shortwave receiver can be made narrow and selective enough to reject these beats.

If the adjacent-channel signal is strong and the desired one is weak, the average hi-fi AM tuner section will not do a good job of rejecting the strong station; the shortwave set will at least give it a good try, and may be completely successful.

Bandpass tuning is another beneficial feature of some shortwave receivers. It permits a shift of the i.f., which can be extremely useful in eliminating interference from a strong, adjacent-channel station.

An AM phenomenon known as selective fading sometimes results in serious audio distortion and loss of intelligibility. Some shortwave receivers have a synchronous detector, which compensates for this fading by reconstructing the lost carrier.

Sometimes, notch filters are used in shortwave receivers to help eliminate strong beats whose frequency is too low to be eliminated by narrowing i.f. selectivity. Beats of this kind may be produced by nearby TV receivers.

Shortwave sets usually require some sort of outdoor antenna. Don't let this bother you. Good results can usually be had by clipping 10 feet of wire to one of the antenna terminals.

There are some very good portable receivers (some the size of a book) which work well, have most or all of the features mentioned, and are equipped with whip antennas. They also have the means to connect external antennas, but often this only results in serious signal overload.

Editor's Note: The McKay Dymek DR-33 all-wave receiver, which we reviewed in the September 1979 issue, was startlingly good, particularly when used with the company's Model DA-100 all-wave receiving antenna. Unhappily, the manufacturer is now out of business, but the units might be obtained on the used market.—*E.P.*

The Third Dimension

Q. Would a reverb with adjustable depth and delay help to "open up" recorded music and make it "three-dimensional"? Is this possible with two loudspeaker systems?—Richard Garcia, Commerce, Cal.

A. It all depends on the recording. If it already possesses considerable reverb, adding more will not be too noticeable. If the added reverb *is* too noticeable, you may find it overwhelming rather than enjoyable.

Adding reverb to the main stereo channels can enhance a feeling of overall space. But for me, at least, this effect is not truly three-dimensional. It would probably be better to feed the reverb into a rear-channel system, like those used when four-channel sound was popular. This would create a sense of being surrounded by sound. Feeding those rear speakers with two separate channels of reverb/delay is the only way that you can hope for some of the three-dimensional effects in which you are interested.

If you can do so, listen to some reverb/delay units, as a part of either a two- or four-channel system. In this way, you can determine whether the effects produced by these add-on devices will enhance *your* enjoyment.

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

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TAPE GUIDE

HERMAN BURSTEIN

Azimuth Alignment by Ear

Q. I have an azimuth alignment problem in my car deck. Is there any way I can correct the problem myself? The deck has an azimuth alignment screw.—Dominic Ruffolo, Somerdale, N.J.

A. You can probably do a pretty satisfactory job of adjusting azimuth by ear. Play a commercially recorded tape with abundant highs, and gradually adjust azimuth in one direction or the other until you obtain maximum treble response. (You will have to determine which is the correct direction experimentally.) If the majority of tapes you intend to play in your car are those recorded on a home deck, however, use one of your own tapes, instead, for azimuth alignment of the car deck.

In adjusting azimuth, watch out for what is called a "false peak." As you adjust in the correct direction, you may obtain a peak in response followed by a decline. However, if you were to adjust further in the correct direction, you might come to a greater peak, i.e., the true peak in treble response which corresponds to correct alignment.

The best procedure is to adjust azimuth on the basis of a test tape with a high-frequency tone such as 12 or 15 kHz. But such tapes are quite expensive and, further, you'll need an audio voltmeter to measure playback response—unless the deck incorporates a meter that indicates this level. However, as I mentioned, you can usually do a pretty good job by ear. And if you are off just a little from perfect alignment, it probably won't matter in a car.

Longevity

Q. Does the sound of audio cassettes degrade with time? If the tapes are stored properly, will the passage of five or 10 years have any effect on the treble, bass, or overall volume of sound? Do I stand a better chance of escaping such effects by using Type II or Type IV tapes rather than Type I tapes?—Anthony Hudaverdi, Santa Monica, Cal.

A. My understanding is that present-day high-quality tapes are almost impervious to frequency change with time and use. There may be a very slight loss in the extreme high frequencies, but it's usually too slight to be noticeable. The stability of a tape over time depends primarily upon its coercivity, i.e., its resistance to magnetization *and to demagnetization*. Accordingly, Type II and, especially, Type IV tapes would be more stable than Type I. Another factor is the binder that holds the magnetic coating to the polyester base. Advances in binder chemistry have enabled the magnetic coating to achieve high stability over a substantial range of temperatures and humidity levels.

In the past, with repeated playings, there were reported problems of high-frequency losses due to magnetostriction (changes in the tape's magnetic properties with stress and strain). I understand that such losses have been minimized.

VCR Taping

Q. I use my hi-fi VCR as a second audio tape deck, with excellent results. Its specs rival or exceed those of the majority of open-reel decks. Does performance change significantly from one tape speed to another? Also, what are the actual tape speeds for the SP, LP, and EP [standard play, long play, and extended play] modes?—Mark H. Johnson, Cape Cod, Mass.

A. Whether the quality of audio recordings made on a VCR changes audibly with tape speed depends on the particular VCR and videotape you are using. In general, there will be little significant change, often too little to detect by ear. Tape dropouts are apt to be more discernible at the slower speeds, but even so, when using good tape, these tend to be very infrequent. The thing to do, really, is to experiment with your VCR and chosen tape to find out whether you experience a noticeable reduction in audio quality as you go from SP to LP to EP.

In the VHS format, the tape speeds for SP, LP, and EP are, respectively, 1.32, 0.66, and 0.45 ips. In the Beta format, they are 1.54, 0.79, and 0.53 ips. However, the heads rotate several hundred times per minute, so the tape speed relative to the heads is much faster than these figures.

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

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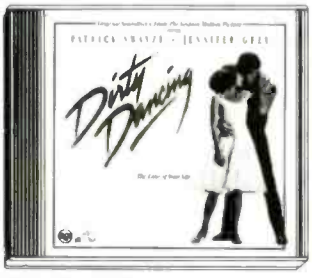

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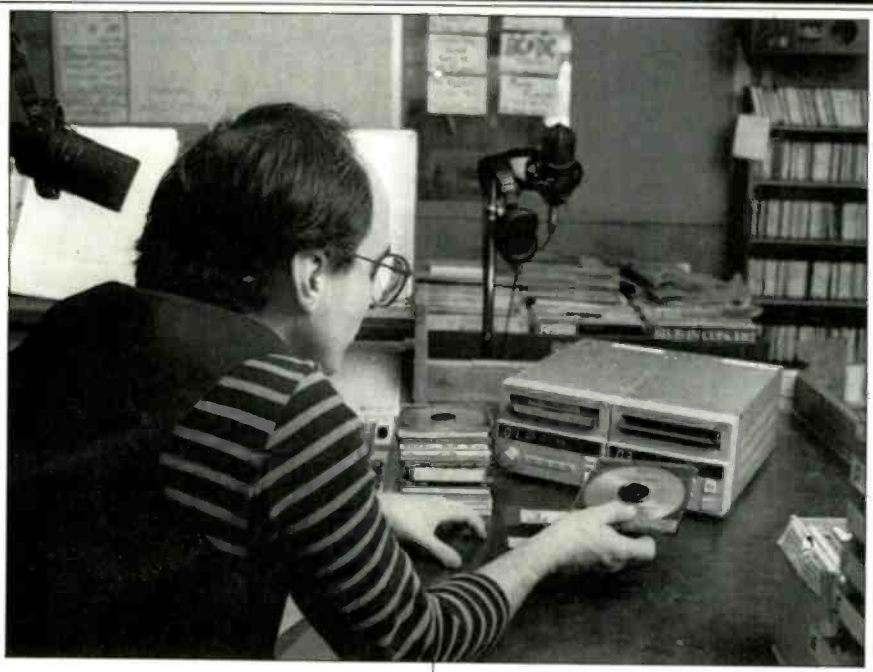

Photograph: Neil Benson

CD on the Air

If you think the Compact Disc has changed the way music is played at home, imagine what it has meant to radio. With more and more recordings released on CD, most stations now play the little discs more than 75% of the time. And they sound great on the air: No clicks, no pops, no hiss—no surface noise, other than what was on the master.

Then again, when something goes wrong, there is hell to pay. With CD, there's no such thing as pushing the needle ahead. The only solution is to get a record up, fast! When such glitches occur, they usually do so because of the less-than-lab conditions at a typical radio station, which includes not only ambient dust but whatever the DJ has managed to get on his fingers—grease, ink, coffee, soda, tobacco, etc. In short, all the enemies of the CD.

Last year, a new sort of Compact Disc player burst into the studio of WMMR in Philadelphia, where I spin rock 'n' roll on weeknights, and it forever changed the way this station plays CDs.

It is a Denon DN-950 "CD Cart Player," so called because it plays CDs only after they have been put into plastic cartridge housings. Instead of putting the bare disc into the machine, you insert a cartridge, which resembles a very skinny 8-track, into a slot. A spring-action door on the bottom of the housing slides open as the disc begins to spin, so the laser can scan the disc.

The DN-950 has several controls and features specifically for studio use. You can select one track while another's playing, and have the machine either play that track next or cue the new track up and await manual starting. You can also audition a disc through the studio's cue channel while another signal goes over the air.

The display reads to 1/75 S, so you can cue with amazing precision, if you take the time. The player's precise cueing capability allows, for the first time, the CD equivalent of a slip cue. While a CD is sitting cued, the display shows the full time of the selection. During play, it counts down the time remaining. This is a marvelous feature, since it tells the DJ exactly how much time he has to prepare the next cut. And the DN-950 can also flash a light and trigger an external signal, 5 to 35 S before the track ends, or signal a studio automation system to start the next selection when the track is finished.

The Denon DN-950 thus is simple and easy to use. It's child's play to take out a disc cartridge, insert another "cart," and cue the desired selection. I've done it lots of times while talking on the air, without missing a beat.

The Denon has proved much more suitable for on-the-air use than any of the fine home-use decks that previously paraded through WMMR's studio. Those units were just not designed for 24-hour, 365-day use, and they simply wore out. Reports Phil Harris, chief engineer and director of engineering at our station, "The only bugaboo that surfaced in our six original Denon machines, as it had in every other CD machine on the market, was skipping. And Denon has recently replaced our old machines with new decks that don't have this problem. Even with skips, the failure rate for our original six players (two of which were in continuous use) was very small, especially on CDs that had been cleaned well before being put into the cartridge."

According to Harris, the DN-950's ability to interface with the studio's console is another huge plus. "The deck will connect easily with any broadcast automation system, including Media Touch and similar computerized systems, because the necessary jacks are on the back panel. The Denon can be remote startable from a button somewhere else, like on a console. Many home or consumer machines didn't have that capability, so engineers like me had to go inside and tear apart the machine to make it work properly with broadcast equipment. The Denon also has balanced-line outputs; that won't be of interest to most consumers, but for us it means there's no interface amplifier necessary between the machine and the console."

At present, the plastic cartridges cost WMMR about $3 each. For home use, this could quickly get into serious money. However, as Harris says, "To a broadcast station, it is a very small price to pay for increasing reliability and keeping dirt off the disc."

Thanks to machines like Denon's CD Cart Player, the era of industrial-strength Compact Disc players is finally upon us. *Michael Tearson*

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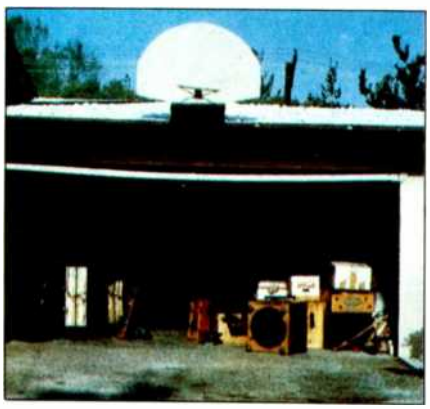
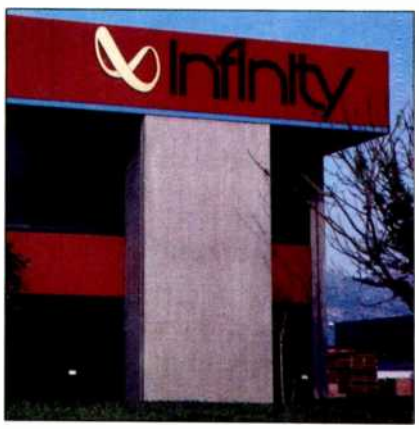
ANNIVERSARY WALTZ

Koss Corporation Turns 30

Whether your local audio store carries Koss headphones or not, it might not be carrying headphones at all if Koss hadn't introduced theirs 30 years ago. There were phones long before that—they antedated speakers, in fact—but the Koss Model SP3 phones of 1958 were probably the first commercial headphones made for stereo. The SP3 was originally produced as a gimmick to draw attention to a new portable phonograph design, but they drew more attention to themselves. "Finally I got the message," says John C. Koss, who quickly went into the stereophone business. Within five years, the field was full of other stereophone makers (few of which survive), but it took longer for headphone jacks to become as universal on stereo components as they are today.





From Here to Infinity

Few presidents have actually been born in log cabins, and not all audio manufacturers started out in backyard garages. One company that did, however, was Infinity, now celebrating its 20th anniversary under founder and president Arnie Nudell. Shown here are Nudell's garage, where it all began, and a corner of the facility Infinity inhabits today.

Disabling the Dialog

I love operetta melodies, but I'm no great fan of operetta dialog: In English (as in Gilbert & Sullivan), it grows tiresome by the nth repetition; in French, it's hard for me to understand; in German, I find it only one-tenth comprehensible.

It would be nice if one of the as-yet-uncommitted subcode bits on operetta records could be used to differentiate music from dialog. Players could then be made which could be set to skip the dialog and get on with the music (or vice versa).

The same one-bit coding could be used whenever a disc includes two types of material. A rock recording, for example, could be coded for fast and slow tunes, or jazz for songs with and without vocals.

Museums Go Musical

Music starts with gadgets—from primitive drums and sticks to sophisticated synthesizers—which illustrate scientific principles. And since making music is fun, learning science through music should be, too. Those were apparently the thoughts behind an exhibit called "What Makes Music?" at Philadelphia's Franklin Institute. The exhibit, which was conceived and designed by the Franklin Institute for the Science Museum Exhibit Collaborative, will be in Philadelphia until September 4th. After that, it will go on tour for two years, visiting science museums in a number of other cities. You'll be able to see the Franklin Institute's brainchild in Charlotte, Fort Worth, Los Angeles, St. Paul, Chicago, Columbus, and Boston.

Yamaha Becomes Yamaha

Century-old Nippon Gakki changed its name, this year, to Yamaha Corporation. They have a perfect right: Founded by Torakusu Yamaha, the company began as the Yamaha Organ Manufacturing Company. As its product line broadened to include other instruments, the company changed its name to Nippon Gakki—Japan Musical Instruments. Now, with the Yamaha brand name gracing instruments, motorcycles, audio equipment, music schools, sporting goods, motorboats, and bathtubs, it's time to change back.

Radio News

Our contributors have been making news in radio. Late in 1987, *Totally Wired*, a National Public Radio show produced by Kimberly Haas and *Audio* music reviewer John Diliberto, celebrated its 100th broadcast. The show also received a $50,000 grant from the National Endowment for the Arts. *Totally Wired* is a documentary series about new music which is broadcast in such cities as Chicago, Houston, New York, Phoenix, and Portland, Oregon.

John Sunier's *Audiophile Audition* also received an award last year—second prize in the Armstrong Awards for Technical Achievement. This year, the show began its fourth season. The hour-long program is syndicated to 200 stations, many of which receive the show in digital form, via satellite. The stations are urged not to use limiters or other processors so as to preserve the wide dynamic range. Some stations even air the show at reduced levels to avoid squashing signal peaks.

Oops!

In the December 1986 "Spectrum," I gave the time for one revolution of an LP as 1.8 S, but a letter from an authoritative-sounding reader temporarily convinced me that the figure should be 1 divided by 1.8, or 0.556 S, so I ran an update in December 1987. The deluge of letters that followed has convinced me I had it right the first time: 1.8 S it is.

True Story

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

He'd put all his furniture in storage, but he brought his KLIPSCH FORTÉs® with him and hooked 'em up next to my speakers. I was ready for the duel and confident my speakers would win.

On the very first CD, the FORTÉs made it clear that I'd been missing a lot in my music. They delivered so much more detail and articulation. So much more dynamic range. The sound was alive. There was no contest.

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

I think the FORTÉs are just great. No component in my system, not even my CD player, ever made such a vivid difference. Music never sounded so good to me.

For your nearest KLIPSCH dealer, look in the Yellow Pages or call toll free, 1-800-223-3527.

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SONIC HOLOGRAPHY:

LIGHT YEARS CLOSER TO REALITY.

SONIC HOLOGRAPHY TRANSFORMS EXCITING NEW PROGRAM SOURCES AS WELL AS FAMILIAR OLD ONES INTO TRULY LIFELIKE EXPERIENCES.

When Bob Carver set out to redefine the stereo listening experience through Sonic Holography, he was really rebelling against the limitations of the stereo phonograph record. At the time his remarkable invention first started astounding audio critics and music lovers, vinyl discs were the musical standard.

If Sonic Holography can breathe life into even your oldest records, imagine what it will do for CD's, VHS Hi-Fi and other exciting new stereo sources.

Now there are at least five major audio/video breakthroughs which further expand Sonic Holography's potential to bring more excitement and realism into your life.

These innovations include the Compact Audio Disc, noise-free stereo FM, AM Stereo, Stereo television broadcasts and stereo Hi-Fi video formats.

Each provides the Sonic Hologram Generator in selected Carver preamplifiers and receivers with a chance to redefine the width, breadth and depth of the traditional stereo sound field – while using your existing speakers.

WHAT SONIC HOLOGRAPHY DOES.

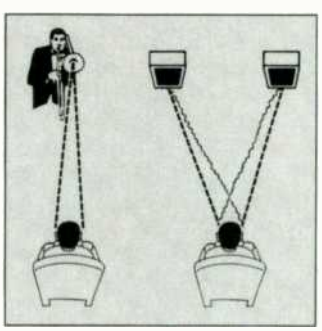
Watch a 13" black and white TV. Now see a movie in 70 millimeter.

Listen to your favorite musicians on a transistor radio. Now sit three rows back from the stage at a live concert.

These are not exaggerations of how much more dimensional and realistic Sonic Holography is than conventional stereo. The most experienced and knowledgeable experts in the audio industry have concurred. Julian Hirsch wrote in **Stereo Review**, "The effect strains credibility—had I not experienced it, I probably would not believe it." **High Fidelity** magazine noted that "...it seems to open a curtain and reveal a deployment of musical forces extending behind, between and beyond the speakers." According to Larry Klein of **Stereo Review**, "It brings the listener substantially closer to that elusive sonic illusion of being in the presence of a live performance."

HOW SONIC HOLOGRAPHY WORKS.

When a musician plays a note, the sound occurrence arrives separately at your left and right ears. Your brain analyzes the difference in these sound arrivals and tells you exactly where the sound is.



L. Real-life sonic event results in two sound arrivals: one at your left ear, one at your right ear.

R. Stereo playback of that sonic event results in four sound arrivals. Two per speaker per ear = four.

Conventional stereo tries to duplicate this process by using two speakers to send a different version of the same sound occurrence to each ear. In theory, this should "trick" your brain's psychoacoustic center into placing the musician on a limited sound stage between your speakers. If – and only if – each speaker can be only heard by one ear.

***Conventional stereo:** The sound is heard, more or less, on a flat curtain of sound between the two speakers. Volume differences only. The timing cues are gone.*

***Sonic Holography:** With SONIC HOLOGRAPHY, the sound is reproduced much like that of a concert performance, complete with timing, phase and amplitude cues. Three dimensional!*

The problem is, these different versions of the same sound also cross in the middle of your listening room, so left and right ears get both left and right sound arrivals a split second apart. Stereo imaging and separation are reduced because both speakers are heard by both ears, confusing your spacial perception.

The Sonic Hologram Generator in the Carver 4000t, C-9, C-1 and Carver Receiver 2000

solve this muddling of sound arrivals by actually creating another "sound." This special impulse cancels the objectionable second sound arrival, leaving only the original sound from each loudspeaker.

The result is a vast sound field extending not only wider than your speakers, but higher than your speakers as well. Sounds will occasionally even seem to come from behind you! It is as if a dense fog has lifted and you suddenly find yourself in the midst of the musical experience. Or, as the Senior Editor of a major electronics magazine put it, "When the lights were turned out, we could almost have sworn we were in the presence of a live orchestra."

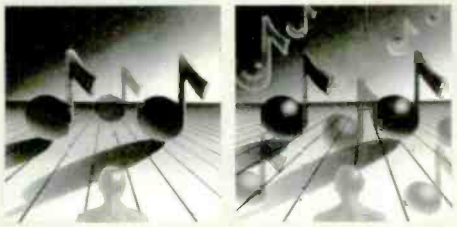
CARVER CD AND TUNER INNOVATIONS EXTEND THE POSSIBILITIES.

Any stereo source can be transformed from monochromatic flatness into vibrant three-dimensional reality with Sonic Holography.

Compact discs afford vastly increased dynamics, frequency response and freedom from background noise. Yet their potential is trapped in the 2-dimensionality of conventional stereo. Sonic Holography can surround you with the drama and impact of digital. (And the Carver Compact Disc Player with Digital Time Lens sound correction circuitry can enhance your listening experience even further).

Thanks to the Carver Asymmetrical Charge-Coupled FM Stereo Detector, FM stereo broadcasts can be received with vastly increased fidelity. Hiss and interference-free, any signal, from chamber music to live rock concerts, can take on an astonishing presence and dimension through Sonic Holography.

The new Carver TX-11a AM/FM tuner delivers AM stereo broadcasts with the same dynamics and fidelity as FM. A perfect source for the Sonic Hologram Generator. Think of it: AM can actually become a three-dimensional phenomenon through Carver Technology!



SONIC HOLOGRAPHY PUTS YOU INSIDE THE VIDEO EXPERIENCE.

More and more people are discovering what theaters discovered some time ago: Audio makes a huge contribution to the realism of video. Still, it has taken the incredible, near-digital quality of VHS and Beta Hi-Fi to make the marriage of audio and video truly rewarding. Now even rental movies fairly explode with wide frequency range, dynamic impact and conventional stereo imaging.

Add the steady emergence of stereo TV broadcasts by all three major networks of prime time programming and special broadcasts, and you have fertile ground for the added realism that only Sonic Holography can deliver.

Unlike so-called "surround sound" a Sonic Hologram Generator puts you into the middle of any stereo soundtrack, (stereo, Hi-Fi stereo, broadcast stereo or even simulcasts). It psychoacoustically expands the visual experience with life-like sound that envelops you in the action.

Once you've heard Sonic Holography with a good video tape or LaserDisc, you'll never go back to mere stereo again.

ENHANCE YOUR SPACIAL AWARENESS WITH FOUR CARVER COMPONENTS.

The patented Carver Sonic Hologram generator circuit is available on two preamplifiers, our largest receiver and as an add-on component. Each can transcend the limits of your listening (and viewing) room. Each can add the breathtaking, spine-tingling excitement that comes from being transported directly into the midst of the musical experience.

Before you purchase any component, consider just how much more Carver can enrich your audio and video enjoyment. And then visit your nearest Carver dealer soon.

The Carver Sonic Holography quartet. Pictured from left to right is the 4000t Preamplifier, the C-9 sonic Hologram Generator, the Receiver 2000 with remote control and the C-1 Preamplifier.

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LEONARD FELDMAN

POP GOES THE PROBLEMS

Illustration: Robert Scott

The first time I walked into a record shop that sold Compact Discs, the salesperson put on quite a performance of his own. Eager to show me how durable the new little discs were, he dramatically threw one of them onto the floor with all his might. The floor, I might add, was nicely carpeted. To add to the effect, he then ground his heel onto the surface of the disc. (The label side was facing up, of course.) He picked up the disc, popped it into a CD player, and punched a few buttons. Miracle of miracles, *the disc still played* without so much as a glitch or a skip.

During the brief ensuing history of Compact Discs, we've all learned to be a little more careful with our collections. That the disc survived the salesperson's demonstration was more a matter of luck than anything else. We now know that even minor scratches on the label side of a CD can potentially wreak havoc when we try to play it on all but the most forgiving (and sophisticated) CD players. But what about the ability of Compact Discs to withstand other forms of environmental stress?

Not too long ago, several new terms crept into the language of optical disc technology. I became fascinated with one of them: "laser rot." It seems that there was a growing number of reports from owners of laser videodiscs that the discs literally began to "fall apart" after being played a number of times. I should point out that laser videodiscs, unlike CDs, are basically made of two slabs of plastic, both of which are coated with the metallic reflecting surface that constitutes the information layer read by a laser pickup. Since laser videodiscs can be played on both sides, much like a vinyl recording, the two slabs are sandwiched together. What has been described in various terms, including "laser rot," turned out to be nothing more than a physical separation of the two "halves." The separation was ultimately attributed to adhesives of poor quality, elements in polluted atmospheres that reacted chemically with the adhesives, unusually severe temperature/humidity conditions, or a combination of these three factors.

Whenever I give a presentation concerning Compact Discs and the state of their technology, one question that always arises is, "How long will a CD last?" Clearly, there is no simple answer to this question. Treat a CD like the salesperson did in 1983, and it may or may not last five minutes. Keep the CD in its jewel box case, at room temperature, at a relative humidity of between 35% and 50%—and play it once a year—and it's likely to outlast your great-grandchildren. As we all know, however, few of us are likely to take this kind of care of CDs. And now, with CD players becoming more popular in automobiles, new questions arise regarding the proper care of these little plastic wonders. Is it safe to leave CDs in the glove compartment of a car in all kinds of weather? Will a CD play immediately after being subjected to winter temperatures in Minnesota—or after sitting inside a car in Arizona in midsummer? How about a Compact Disc's odds for survival in the 100% humidity of someplace like the Florida Everglades in mid-July?

I decided to conduct my own experiment, using a few expendable CDs. Let me state immediately that the environmental variables involved in an experiment such as mine are so numerous that I make no claim for total scientific control or methodology. After all, CDs are manufactured in dozens of plants, and there's no easy way to check whether the plastic compounds and base materials used in each factory are identical. Even within one batch of CDs of the same musical material, there may well be variations in quality and in the number of original digital burst errors (as well as their length or severity). Still, keeping all these variables in mind, I hoped to determine in a very general way just what extremes of temperature and humidity a half-dozen Compact Discs of mixed origin could take.

The CDs I chose ranged in date of manufacture from 1983 to the present—the most recent one having been acquired just weeks before I began my experiment. They were also chosen for diversity of label. As for the experiments themselves, they were quite simple. I started my tests by storing all six discs overnight in my food freezer. The freezer is reputed to bring temperatures down to around 0° F (around −18° C). With the discs at this low temperature, I planned to insert each disc in a state-of-the-art CD player and in an inexpensive, portable CD player known to have a minimum of

Yamaha just solved the industry's biggest problem.

All those little capacitors, resistors and semiconductors?

They make up what's known as a CD player's analog filter.

A necessary evil designed to remove unwanted digital noise. While unfortunately distorting otherwise crystal-clear sound with phase shift.

Yamaha's exclusive hi-bit direct out technology bypasses the analog filter, resulting in pure, crystal-clear sound.

Ahem.

Presenting Yamaha's exclusive hi-bit direct output technology.

A revolutionary technology we've incorporated into our CDX-910U, giving you the option of completely eliminating the analog filter with the touch of a button.

Allowing you, in turn, to enjoy improvement in music you thought couldn't be improved.

You'll also find 8 times oversampling. Giving you incredibly accurate waveform resolution and unbelievably natural sound.

Hi-bit twin D/A converters to improve dynamic resolution and eliminate interchannel phase distortion.

And a host of features that add up to the most pleasurable listening experience yet.

Use the 46-key wireless remote, or use a Yamaha RS integrated amp, preamp or receiver remote.

Stop by your nearest Yamaha dealer today and hear the remarkable new CDX-910U CD player for yourself.

We think you'll come away sharing our philosophy that anything that comes between you and your music is definitely a big problem.

No matter how small it may be.

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"If I Had It To Do All O
This Is Ho

"The technology for a new generation of loudspeaker systems was already here," says Henry Kloss. I was just the first one to put it together right."

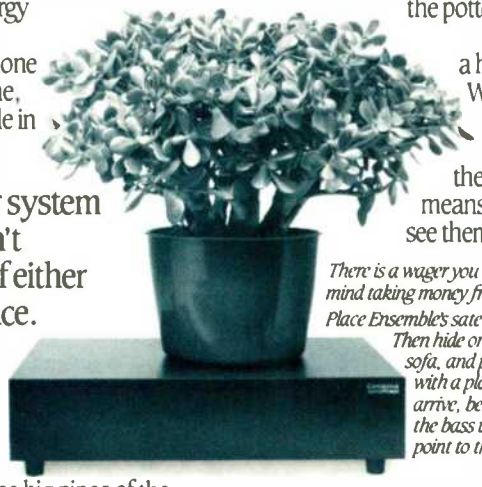
"Right," in this case, meaning a stereo system that allows the integration of speakers into a room in a way that's never before been possible.

Ensemble. The last loudspeaker of Henry Kloss.

Ensemble combines two bass units, two mid- to high-frequency units and something you won't find in any hi-fi store on earth.

Your living room. Which now, because of Ensemble's unique "system" design—becomes a seamlessly integrated part of the sound propagation process.

The result is a system that gives you perfectly balanced energy throughout the full ten octaves of music. And one which, at the same time, can be virtually invisible in your living room.



The first speaker system that doesn't cheat you out of either bass or space.

The fundamental octaves that so much of music is built on...

The almost sub-audible but palpable sounds generated by the big pipes of the organ, the bottom of the acoustic or electric bass, the low notes of the synth...

The frequencies completely ignored in the so-called "mini-speakers" now in vogue...

Ensemble provides them. With two dedicated, acoustic-suspension loudspeakers whose jobs are solely to reproduce the bottom two octaves of musical significance.

It is by design, not afterthought, that Ensemble comes with two, not one, bass units.

Because the human ear can't easily localize bass sound below about 150 Hz, there is no need in a home music system for the bass to emanate from the same source as the higher frequencies. (And many acoustical reasons why it shouldn't.)

So to take advantage of this basic but vastly overlooked fact, the bass units are built small enough to be placed where they'll produce the best sound, without visually overpowering your room.

They are a compact 12" × 21" × 4.5". Yet they generate the low-frequency energy that would ordinarily require either a pair of very large conventional loudspeakers, or adding on a massive "subwoofer." Moreover, using two separate easily placed bass units dramatically reduces the creation of standing waves—the bane of pure hi-fi reproduction.

Without detriment to the sound, Ensemble's bass units can be placed beneath the couch, on top of the bookshelf, or under the potted plant.

And the result is a happy coincidence: Where the units sound the best is likely where they'll look the best. Even if that means not being able to see them at all.

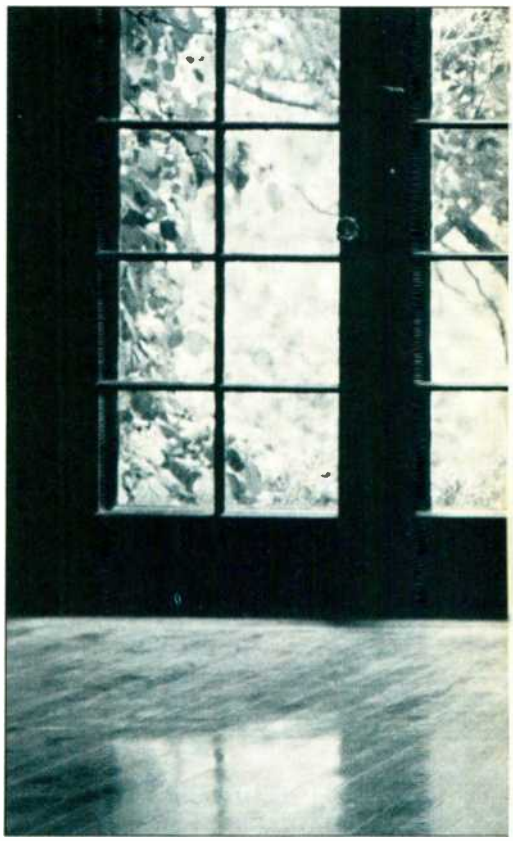
There is a wager you can make, if you don't mind taking money from house guests. Place Ensemble's satellites where they're visible. Then hide one of the bass units under the sofa, and put the other on the floor with a plant on it. When your friends arrive, bet them to point out where the bass is coming from. They'll point to the satellites. Every time.

As for the other 8 octaves of music.

The rest of the sound spectrum, from a nominal crossover of 140 Hz, is reproduced by a stereo pair of two-way satellite units. Each incorporates a low-frequency driver, crossing over at 2,700 Hz to a direct-radiator tweeter that goes beyond audibility.

They are small enough (4" × 5" × 8" high) to set the sound stage (or so-called "imaging") wherever you want it.

Finished in scratch-proof, gunmetal grey Nextel, they will look good for a lifetime.



What Henry Kloss tells his friends:

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

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

Overcoming the fear of paying too little.

This is more difficult than it may sound.

Because the Ensemble System sells for an introductory price of only $499.

And it can be jarring to accept the notion that a product actually outperforms others costing several times more. But think back on Henry Kloss' track record with AR, KLH, and Advent, the best selling high-performance speakers of their decades...Our commercial success will come not from excessive prices

ver Again...And I Do...
w I'd Do It."

Henry Kloss. Member of the Audio Hall of Fame. The creator of Acoustic Research in the 1950's, KLH in the 1960's, and Advent in the 1970's—the dominant speakers of their decades—now brings you Ensemble: the best-sounding speaker system of this era.

on a small number of sales, but from selling a lot of systems to a lot of people. You, perhaps, among them.

The second thing you must overcome is the misdirected notion that you must go to a dealer showroom and listen to the speakers.

Because the fact is, the *only* way to appreciate the astonishing sound reproduction of this unconventional system is to audition it in your own room environment. Therefore, we sell only factory-direct. Either by phone, by mail, or by our front door, to make it as easy as possible to get the speakers to your front door. They come with a straightforward 30-day money-back return policy.

Speaking directly to the people who make the speaker.

To our knowledge, no other hi-fi manufacturer invites you to call and talk about the system. ("Hello, Mr. Sony?" No way.)

We welcome you.

In fact, the easiest way to buy Ensemble is to call us with your credit card in hand, and speak with someone who will be happy to walk you through, talk you through, everything you might ever want to know about the system. From why or why not to buy Ensemble, to questions about installation, room placement and other related audio equipment.

The Ensemble Stereo System: 2 bass units, 2 satellites, 100 feet of wire, mounting units, intelligent documentation, and a warm body. (Your Cambridge SoundWorks audio expert.)

To get literature, to chat—or to order—the toll-free number is 1-800-252-4434. (In Canada, 1-800-525-4434.) Fax # (617) 332-9229.

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Extreme heat seems to pose more of a threat to CDs than does extreme cold or high humidity levels.

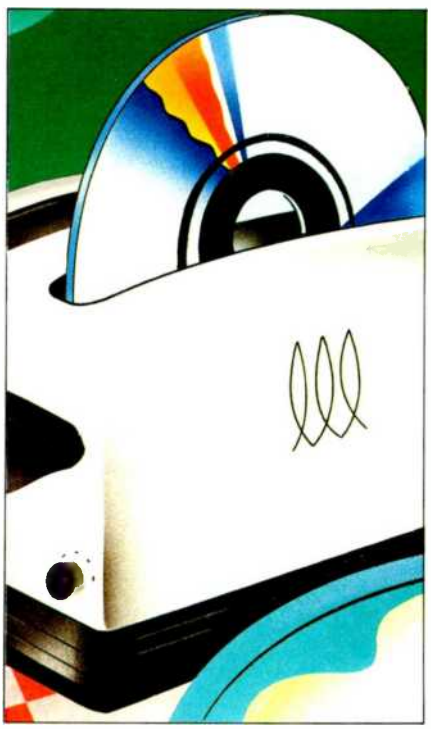
error correction/servo-tracking capabilities. Each track was to be played, in turn, using the track skip feature of the player. Following this test, all surviving discs were to be placed in an oven which was regulated to a temperature of 212° F (100° C), the boiling point of water.

When the disc surfaces were stabilized at the higher temperature, I would play each track of each disc on both CD players—again, requiring the laser pickup to go from track to track by using the next-track feature. Following this test, I would place the discs in an enclosure containing a steam vaporizer, thereby elevating the relative humidity in the vicinity of the discs to as close to 100% as possible. The only concession to the CD players I would make during the test was to wipe surface moisture from the disc before inserting it in the two machines.

Following these three tests, all discs—those that survived, at least—were to be returned to the freezer for another round. My plan was to repeat the entire sequence at least 10 times.

After subjecting all six discs to the deep freeze treatment the first time, I was able to play all tracks on all six discs on both CD players. After the first heat treatment, however, I was able to play only the first four of six tracks of an early, CBS-label CD without any malfunction. Although the laser pickup was able to find tracks 5 and 6, it was unable to stay on course, skipping merrily through them in a matter of a few seconds!

Examining the disc with a magnifying glass, I detected a ¾-inch scratch on the outer edge of the disc. I also found a tiny "bubble" in the plastic near the scratch. It was apparent to me that both defects had been present even before the test began. I also detected warpage on one section of the disc. It was almost as if one section of the plastic had expanded at a nonuniform rate and an entire edge had "lifted upward." Once I found this, it was clear that no servo correcting system could adequately compensate for the severe deformity in the disc. I saw no point in subjecting it to the high-humidity test, which the remaining five discs passed with no difficulty. I did feel, however, that subjecting the now-defective disc to the freezer test for the second go-round might prove instructive. Perhaps the cold temperature could reverse the warpage and make tracks 5 and 6 of the disc playable once more. Unfortunately, such was not the case. Instead, the warpage became more pronounced. When I attempted to access either track 5 or 6, the player was hung up in an endless and unsuccessful search. I finally pressed the "Stop" button.



After one more complete cycle of heating and freezing, the defective disc still could not successfully play track 5 or 6. The laser pickup on the more sophisticated player did locate these tracks, but it could not successfully play through them without skipping randomly.

I saw no point in including this defective disc in my experiments, so the number of discs for the remaining tests was reduced to five. A third cycle through the freezer, oven, and vaporizer yielded no further defective discs. At the end of a day's testing, all discs were kept in the freezer overnight, rather than in the oven. This choice was more practical than scientific: I did not relish the idea of leaving an unattended oven on overnight. The second day's tests were essentially the same as those of the first day. I was able to complete four test cycles for the five remaining discs. By the end of the second day, with seven complete cycles of heat, cold, and high humidity, all five discs were tracked accurately through all their selections by both CD players.

I ran all five discs through three more cycles on the third day. One of the five, a very old Philips sampler given to me in 1983 by the co-inventors of the CD, did develop a slight warp during the next to the last heat cycling. The warpage was enough to cause problems for the portable unit when I played the disc's outer tracks; the other player went through all outer tracks without missing a beat.

On the basis of this admittedly small sample of Compact Discs—and allowing for the somewhat arbitrary number of hot/cold/high-humidity cycles—I can offer these general conclusions:

1. Extreme heat seems to pose more of a threat to CDs than does extreme cold or high levels of humidity.

2. For whatever reasons, older CDs might be more easily damaged by extremes of heat than the more recently pressed discs. Whether an aging process and some change in the chemistry of the plastic is involved here (or whether modern pressing plants are using better grades of plastic) is something these tests were unable to establish with any degree of certainty.

3. Extremes of humidity have no effect upon the longevity or durability of CDs, but moisture can render the surface of a disc temporarily unreadable. It can also cover the tiny laser pickup lens, rendering it somewhat opaque. Neither humidity nor moisture is a permanent condition, however, and normal operation is always restored once the moisture has evaporated or been carefully wiped away.

4. Most important, my tests proved that the occasional "separation" of the two halves of a videodisc is not likely to occur in CDs, which are manufactured in a completely different molding process. Even the one disc that underwent severe warpage retained its integral structure. There was no evidence of any separation of the thick, transparent plastic coating from the aluminized reflecting surface that bears the digital data read by the laser pickup. So much for CD rot!

BRYSTON

Continues to define the state-of-the art...

The Bryston Magic

BRYSTON believes the purpose of an audio system is to create the three dimensional illusion of a live musical event in your own home.

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FORCED COINCIDENCE

Illustration: Lilla Rogers

Since practically everybody is in favor of the popular and highly safeguarded recorded stereo sound we generally call "coincident"—taken down by some combination of two microphones placed, to all intents and purposes, in the same physical spot before the music—I have already (June 1988) set out my own rather surprised reaction as a music listener. Something, to my ear, is *still missing*.

What I miss, very definitely, is the first "real" stereo I heard years back, recorded with *a wide separation*, or spacing, between mikes for the two stereo channels. The distance varied in degree, of course (having been as much as 10 to 20 feet), yet in every case produced a complex of phase differences due to the different distances the sound traveled. (A common balancing and adjusting device has been a third mike at the center, between the other two, which may be blended in various ways into the two main channels.) The human ear notoriously dotes on phase differences! Even if they are a serious problem in a number of aspects of audio reproduction.

This month, after a suitable lapse for mental digestion, yours and mine, I present a corroborating opinion, this from within the active audio profession. I think I was as surprised as he was to find *me* agreeing with *him*. Are we the only two souls who have this odd feeling about current stereo recording? Could be!

If you want, then, I'm fishing around this month to see if I can't pull in a few more operators who might find the idea interesting, worthwhile, and, more important, *possible* in the practical sense. Instead of the coincident arrays we see everywhere recordings are made (and subsequently hear in the sonic product), once again to try the spaced array, discrete separate microphones at sizable distances from each other. And in place of the ubiquitous cardioids (for directionality), the all-around pickup of the omni mike.

Yes, the consequent phase differences, particularly the big-energy bass, must be coped with—in broadcasting, in LP cutting. But as noted in June, things are changing fast; an enterprising recordist who wants to take the risk can surely cope, and the more so as we get into digital and away from the limitations of the LP, the cassette (analog), and present AM/FM safety standards, if I may call them that.

This professional ally of mine goes out into the field in the most business-like way and makes recordings or broadcast pickups, for direct and practical use. All sorts of classical music, and no doubt plenty of other kinds, including musical siblings such as band music.

Somehow or other, this guy got the urge to experiment—sort of risky in such situations, you'll have to admit. Most engineers find it best to stick to the rules, unwritten or no, and get on with the job. Not this one. "I was so bowled over by my first spaced-omnis recording [of concert bands] that it took a couple of years for me to notice that the instruments were a little bit hard to localize precisely." That's quite a whopper of a statement. First, it says that he made a regular practice, for as long as two years, of recording bands with the sort of spaced-out array of mikes I am referring to. More interesting, he was "bowled over" by the sound he got. How's that for corroboration? But in the end, his powers of aural analysis led him to a correct conclusion, as I discussed at length in June: That *stereo directionality* does not primarily come from phase differences in the direct stereo signals, the pair of them, that you hear. The more specific separation, so that you can "point to" this source or that, comes mostly from volume differences, which are the mainstay of the coincident stereo approach and the reason that directional cardioid mikes often play a vital part in the coincident pickup.

My friend goes on to complete his thought: "Contrariwise, I was left so cold by my first coincident mike recording [in the small hall] that I didn't care about the pinpoint left-right imaging; in fact, it rather reminded me of 'multi-mike' techniques." (No surprise since both rely on pure amplitude differences for the stereo effect.)

Now don't get hot under the collar, you proponents of the always-useful coincident systems. There are terrific recordings—right and left, so to speak—made by the enlightened and informed use of coincidence. I am merely saying that something more, very subtle yet powerful, is missing. And my friend agrees.

"In all fairness, I have since learned how to make better single-point recordings. For one thing I always, but *always*, avoid using a pair of cardioids, which I did use on that [first] occasion, because with them there is literally *no* out-of-phase information at all, whereas some [strictly 180°] always sneaks in with the

Brain vs. Bulk.

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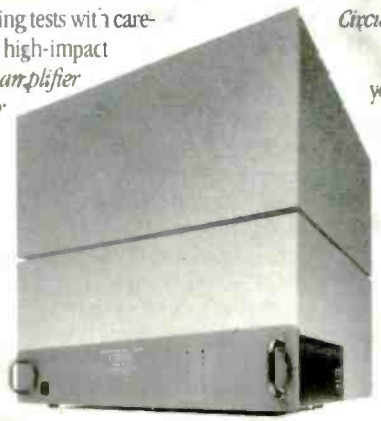

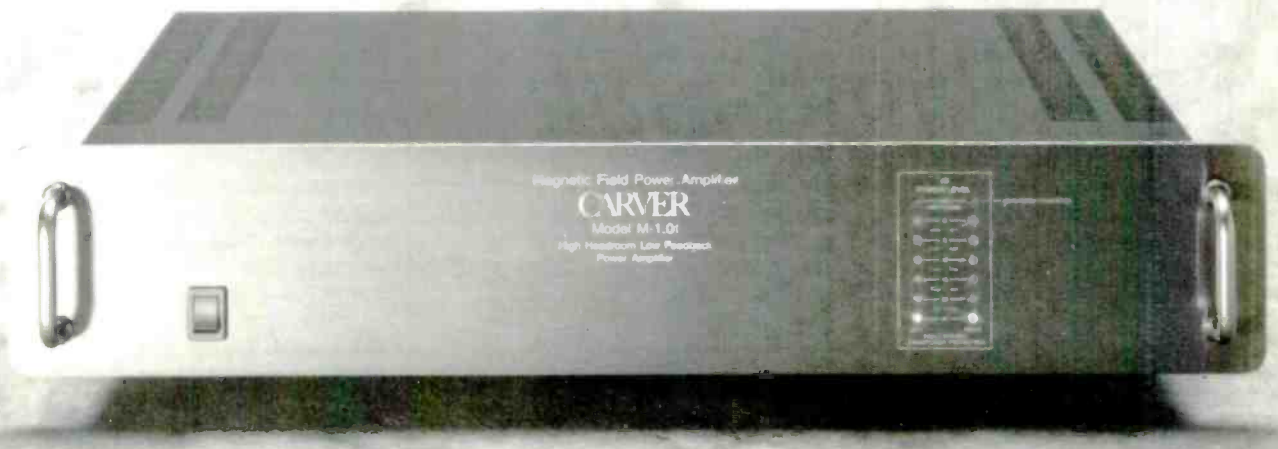

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Coincident miking is responsible for some terrific recordings, but something subtle yet powerful is missing.

other pickup patterns. This gives the recordings at least a little bit of 'warmth' or 'depth' or whatever it is . . . ."

This, I would guess, pretty much reflects the viewpoint of a lot of audio people who use coincident techniques with, shall I say, a small grain of stereo salt. The foot-or-so separation that I seemed to observe in Denon's "one-point" array again seems pertinent.

I should pause here to explain. My friend and ally, the above quoted, works at a Public Radio station. I have so far de-emphasized this because I believe that his thoughts and conclusions largely apply to other areas of recording. Namely, any area where an unhoked and natural all-over sound, with a natural-seeming presence in the consumer playback, is desired.

Now if I am right (out of some personal experience), local Public Radio stations, often sponsored and underwritten in part by a university or other local institution, are allowed considerable autonomy to do what they wish—and dare—with the material they put on the air. This applies not only to programming, as a matter of course, but also to the technical means used. Some readers may remember my discussion, years ago, of the extraordinary mike pickup I saw at the Oregon Bach Festival in Eugene. Large oblongs of transparent plastic hung giddily over the orchestra's heads or were set oddly on the floor below the concert stage, aiming upward at an angle, like so many zany music stands, toward the solo singers at stage edge. PZMs. That was Public Radio, considerably supported by the University of Oregon—station KWAX.

Nevertheless, this suggested a very considerable independence of mind to me, and still does. The PZMs, prototype do-it-yourself models before Crown, have been retired, and all now is coincident. New regime, I assume.

On the other hand, the national PBS, the big network that distributes its recordings to hundreds of PBS outlets at varying times—and not, I gather, always the same network—follows a very different principle. Perhaps necessarily, to avoid (so to speak) mismatches and other local troubles, PBS sets up strict procedures, just as rigid as the network is large. This is inevitable, as all can understand. But in some opinions, it goes too far, for the sake of uniformity and safety, when subnormal intelligence is at work. (It always is.)

On and off for a number of years, my own homemade broadcast tapes were aired on a fair number of individual NPR stations, sent from one to another on an extracurricular basis entirely outside the auspices of the national network. I was told emphatically that these tapes—both the content and the Can-by "engineering"—would never pass muster at the national level. But local enterprise liked them, and indeed a few stations put them on the air via copies, without even bothering to ask my permission nor to tell me when. At that point, I cut off the source in a hurry. The *least* they could do . . .!

Now, every station that originates broadcasts or recordings naturally hopes to get itself onto the big NPR network, with its hundreds of outlets. Who wouldn't? (You've heard the tag lines plenty of times, so-and-so originating in such-and-such a city.) And therefore there is a very heavy pressure, in local operations, to conform to the national standards.

"Last year," writes my friend, "I went to a workshop given by National Public Radio . . . on classical music recording techniques. Overall, it was a really excellent workshop, designed to give producers for local stations the skill to turn out tapes of 'network quality' . . . . My one complaint about it was the hard sell of strictly coincident miking techniques. They had set up a makeshift LEDE monitoring environment, and we made tapes one night on an 8-track machine, which allowed simultaneous recording of the same event with four different stereophonic microphone techniques. The workshop leaders all claimed to hear the most accurate representation with the coincident (particularly M-S) techniques, and did not understand my objection that depth was lacking."

Words, words! What is "depth"? Not easy to say.

He goes on: "To my ears, although it was possible to figure out how far back on the stage an instrument was by its relative amplitude, ambience ratio, etc., the overall effect was still akin to looking at an ordinary photograph (or painting): You can tell that some things are nearer and some farther away, but it is not like a 3-D photograph or hologram [or reality]."

In a word—*mono*. Is not a mono recording much like a flat photograph? Major and satisfying clues as to space and distance are there, but other clues are absent. Are they missed? That depends. Can they be provided? Perhaps—but always at some cost, variably different according to the situation. That is what we are talking about.

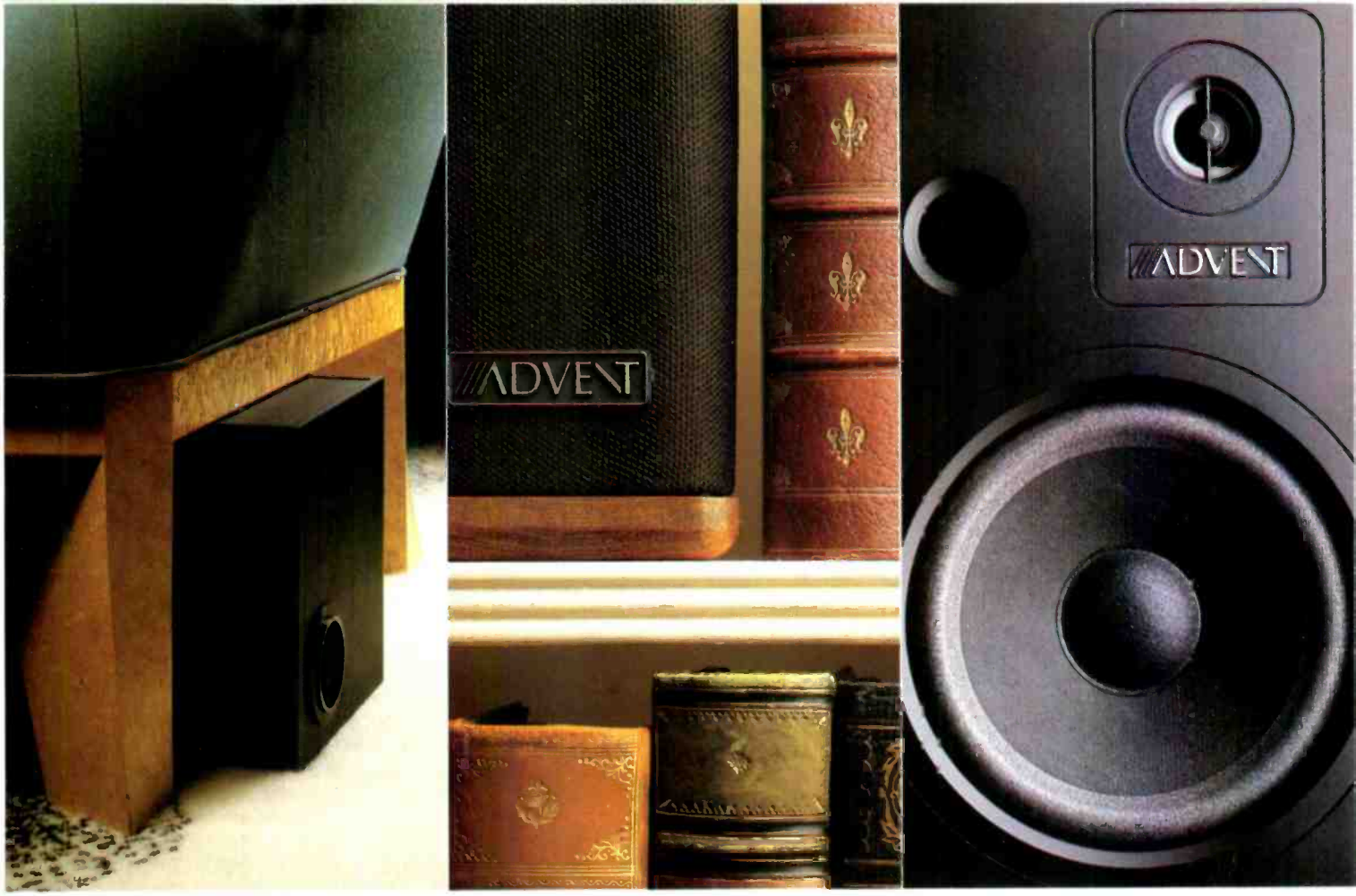
This man's account essentially confirms my thought, that strict coincident stereo is actually *multiple mono*—many different mono sounds in different directions. The real stereo "depth," the living ambience provided by variable and multiple phase differences, is specifically removed by the coincident techniques. There's still much left in sonic effectiveness. Plenty to keep us all going. Yet something more *might* be added, if we will face up to the problems involved.

My friend ends his comments on the NPR workshop with the appearance of an unexpected ally (not myself). Though his workshop leaders did not understand his thinking (and listening), he was reassured, later on, when he found that "They had invited a music professor who did not know much about audio to listen and give his opinion, and *he preferred the spaced technique over all the others* [my italics], saying it sounded the most like listening to music in the hall."

Forget the old concert hall bit—as I've said, this is still the standard phrase to use when you think a recording sounds the way it ought to. But the professor used his good musical ears, and, by golly, I say he was right. Will you, the home (and car?) listener, agree with him? I expect so.

Professionals can be forgiven their wishful thinking, making things as they want them to be. Convenient and all too easy. The consumer ear, when it listens carefully, can be very objective.

I think, finally, you may understand why I have left my PBS friend anonymous. I would prefer to give his name and even address, but the man's life work is involved, and I, for one, do not wish to give him even a hint of trouble. If he wants to promote spaced-out stereo with his own people, he should do so of his own choice, not mine. Good luck, John Doe!



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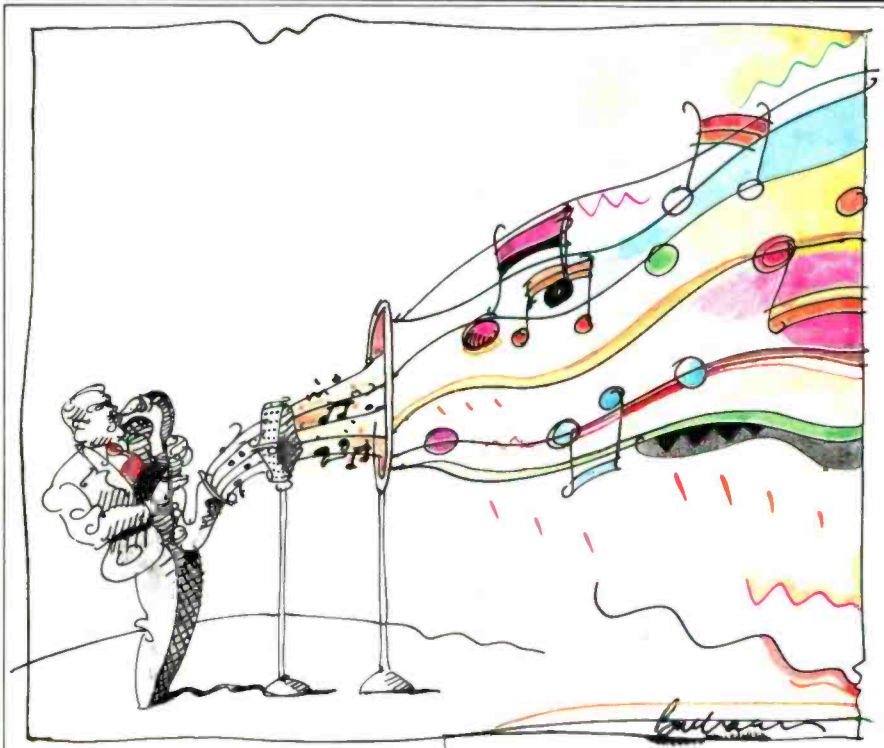


Illustration: Yvonne Buchanan

By now, most people who purchase CDs are aware of the coding designations which indicate whether the CD was processed from digital or analog master recordings. While the codes are in broad use, a number of record companies have resisted this system because they feel many consumers will reject any CD not made from a digital master. Unfortunately, this is indeed a factor, for many people refuse to buy CDs which are not inscribed with the DDD code that indicates a digital pedigree.

I prefer to think of these analog/digital CD codes as an audio sophistication index. The truly knowledgeable audiophile and music lover knows that the digital origin of a recording is no guarantee of high-fidelity sound quality. Yes, Virginia, many superb-sounding, brilliantly engineered recordings were made *before* the advent of digital processing!

Those who insist that their CDs carry the DDD imprimatur are denying themselves access to a vast treasure trove of music. I have pointed out that, prior to the CD's introduction, only a fortunate few had master or first-generation tapes to provide ultra high-fidelity music reproduction far beyond what was available from the very best phonograph systems.

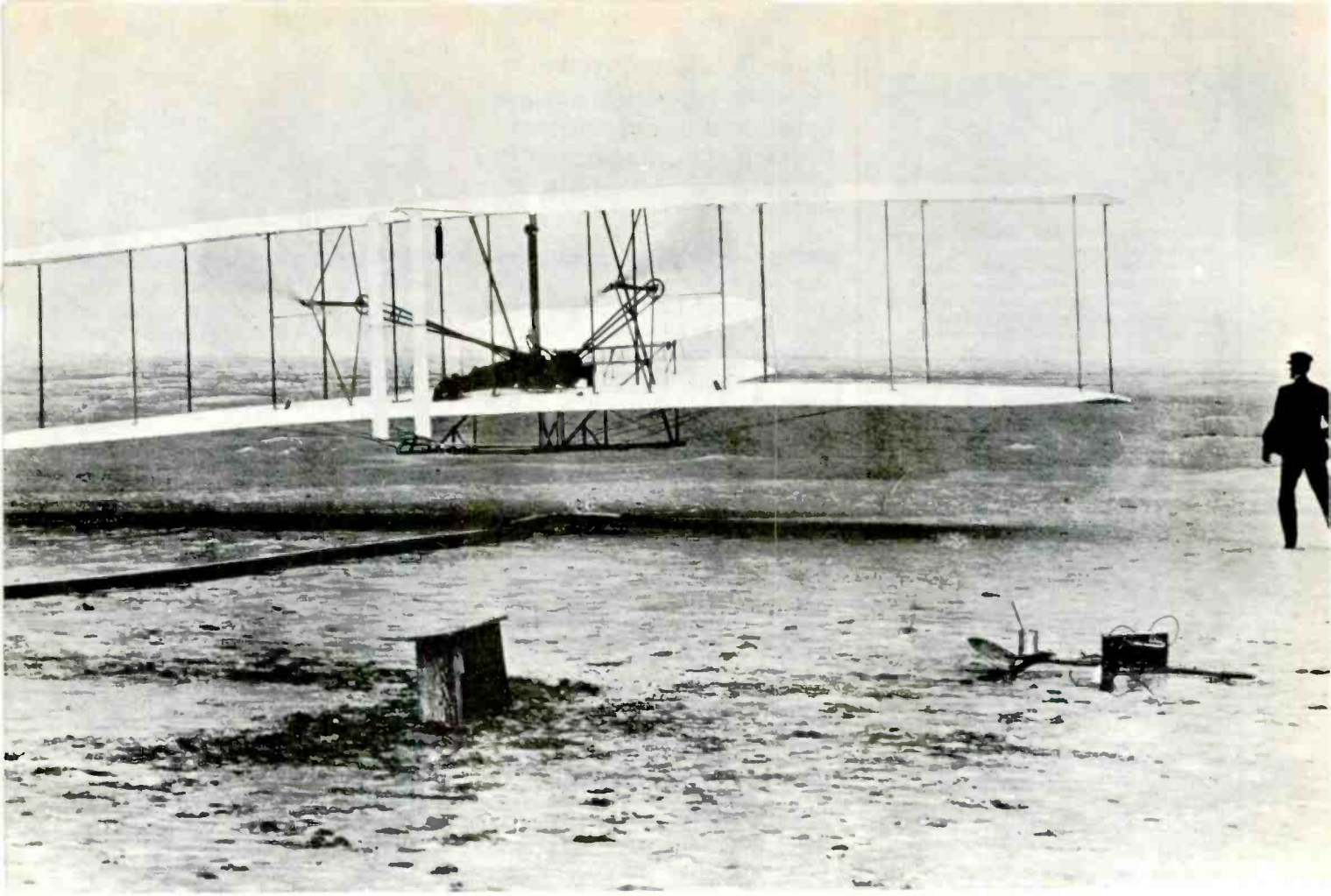
Nowadays, when you buy a CD made from an analog tape recording, you can be fairly certain that the record company has used the original session master tapes, not the so-called "cutting masters," which were several generations removed from the original masters and were subjected to equalization to cope with technical constraints of the vinyl phonograph record. Needless to say, the digitally processed CD glaringly revealed all the sonic artifacts of this "quick and dirty" transfer method. Consumer complaints and competitive motivation forced the record companies to use original session masters in their analog-to-CD transfers. As a consequence, critics and consumers alike noted the improved quality of the sound on the CD, as compared to the sound of the same recording on the vinyl disc. In the transfer of original analog tape masters to CD, no generation losses, incremental increases in tape noise, or other sonic degradations occur. Thus, for all practical purposes, the CD is not a copy of the original analog tape master, but the sonic equivalent of the master itself!

Of course, there is still the matter of the condition and technical quality of the original session masters. Dolby A NR was introduced in 1966 and was quickly adopted for both classical and pop recording. But what about all the recordings made prior to 1966? After all, we had been recording direct to disc for decades, and had been mastering on tape since 1950. To transfer recordings of this vintage to CD, record company engineers have to juggle a lot of factors and decide whether to copy the original recordings "as is"—sonic "warts" and anomalies notwithstanding—or apply some remedial processing to attenuate tape noise, hiss, and impulse noise. If some engineers opted for processing, most of the so-called "single-ended" noise-reduction systems produced modulation effects, which many people found more objectionable than the noise on the recording! Thus, at present, analog transfers to CD from Dolby A masters are generally quite good in respect to background tape hiss, while those made from pre-Dolby tapes and discs range from "tolerable" to distracting and annoying.

A wealth of musical riches exists in the vaults of the record companies. If these recordings could be transferred to CD using some sonically transparent processing that significantly improved their sound quality, this would open up a new world of musical enjoyment for consumers (and extra profits for the record companies).

Enter the giant Philips recording and electronics company of the Netherlands, and an enterprising American company, Sonic Solutions, of San Francisco. Philips has been recording the great artists of the musical world for decades and, of course, is part of the company which co-developed the Compact Disc. Thus, it was to be expected that while currently engaged in an ambitious program of new digital recordings, they would also reissue their enormous analog catalog on CD. And, in fact, they have established a lower priced Silver Line series of CDs, featuring fairly recent analog recordings, a great many of which are encoded with Dolby A NR.

Now, however, Philips is issuing what they call Legendary Classics on CD. The initial 15 discs, in the main,



Lofty ideas can open new frontiers.

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So when we set out to elevate the art of sound reproduction, some people thought we were just dreamers. But by using vacuum tube technology, applying new ideas, then engineering, designing and refining each step, we raised the quality of sonic realism to new heights.

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SUPER NATURAL SOUND

Sonic Solutions' system removes tape hiss, surface noise, and so on, without hurting the integrity of the original music signals.

not only have historical significance, but are drawn from analog recordings considered to be extraordinary performances by some of the world's greatest musicians. Some of the performances go all the way back to direct-to-disc recordings, while others are on analog tape predating Dolby A NR. Obviously, with recordings of this nature, there were both steady-state and impulse-noise problems, and this is where Sonic Solutions stepped in with their unique new digital noise-reduction system. Called NoNoise, this system is claimed to remove tape hiss, hum, surface noise, clicks, pops, and other anomalies without adversely affecting the integrity of the original music signals. Philips engineers transfer the original master tape or disc to a new professional digital audio tape, which is sent to Sonic Solutions. There, the digital data from this tape is transferred to large computer disks, and Sonic Solutions engineers assess noise problems using special analytic programs.

If the recording contains clicks and pops, Sonic Solutions employs a program incorporating techniques developed in artificial intelligence research. It identifies the clicks or pops, and recreates sound to replace the area they occupied. Since this work is reconstruction rather than removal, the precise duration of the original performance is preserved.

To reduce surface noise or tape hiss, Sonic Solutions engineers analyze the spectral composition of the underlying noise floor. Over 2,000 points in the audible spectrum are measured to yield an accurate estimate of the unwanted noise. A special computer program then uses this estimate to perform "microsurgery" on the sound, reducing the noise without affecting any subtlety in the original. Over 53 million separate computations are performed on each second of sound. After processing, the "denoised" version is rerecorded on a new digital tape. This tape is now the master for the usual processing to CD. In a manner somewhat analogous to digital tape editing (in which sections of the signal can be stored in a memory, and edits can be rehearsed until seamless, before committing to the final edit), the Sonic Solutions processor thus can manipulate and operate on the noise artifacts while in the digital domain.

The first CDs of the Legendary Classics live up to their name. How about a pairing of Maurice Ravel, in 1932, conducting the Lamoureux Orchestra on his famous "Bolero" and Sergei Prokofiev conducting the Moscow Philharmonic in a 1938 performance of his "Romeo and Juliet, Suite No. 2"? Compact Disc, of course, and mono, too! What an opportunity to hear their ideas on these famous works! Another CD features Sviatoslav Richter performing Mussorgsky's original version of "Pictures at an Exhibition" and other works, recorded in Sofia in 1959—mono again! Among others on this series, there's Pablo Casals—once more in mono—performing in Beethoven's "Archduke Trio," Bonn, 1958. I recorded Casals' last traversal of the Dvořák cello concerto, in stereo, in 1959, and speaking of that piece, the Legendary Classics line includes the great performance by Emanuel Feuermann (New York, 1940). Another gem is a 1962 recording of Pierre Monteux conducting the Amsterdam Concertgebouw in Beethoven's "Eroica." Yet another is the great George Szell conducting the Concertgebouw on Beethoven's Symphony No. 5 and Sibelius' Symphony No. 2 in 1966 and 1964, respectively. (Here we have stereo recording.) The other Legendary Classics CDs are of equal stature and interest. They will be available in the U.S. soon.

Several British critics have reviewed Legendary Classics—the Mozart Requiem with Karl Böhm conducting the Vienna Symphony Orchestra (recorded in 1956), Stravinsky's "Soldier's Tale" with Igor Markevitch conducting (1962), and Schubert's "Die Schöne Müllerin" with Gérard Souzay (1964). As reported in *Gramophone*, the reviewers were highly impressed by the recording quality and felt the NoNoise process did a particularly effective job of cleaning up these older recordings while leaving the musical values intact.

I am anxiously looking forward to these Legendary Classics CDs. If the NoNoise system lives up to its promise, it will afford all of us the opportunity to savor some great performances, with sound far surpassing that which was available when the recordings were originally issued. A

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"Clearly one of the most important advances in electronic reproduction of music to come along in my lifetime."— *Leonard Feather, Los Angeles Times, Washington Post Jazz Critic*

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"The effect is shattering!"— *Music Technology Magazine*

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"I can't imagine working on another album without BBE."— *Steve Levine, producer of The Beach Boys and BPI Producer of the Year.*

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It's "like the difference between high-fidelity speakers with and without pillows in front of them." — *Radio World Magazine*

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Music Technology Magazine made cassette copies using BBE. It told it's readers: "The cassette sounded better than unprocessed masters!"

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Rather than adding artificial elements, BBE restores natural harmonic balances that are present in live performances.

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THE END OF THE BEGINNING

When "Digital Domain" first appeared, in April 1984, I wanted to start my stint at *Audio* with a splash. So I shocked readers by declaring that analog media had been a mistake. I said that an analog signal is indistinguishable from the noise and distortion inherent in the medium and declared that this "spells failure for an audio information-storage system."

I expected a few letters, and received many. A lot of people were really steamed. They couldn't understand how the high art of analog technology could be so easily dismissed. They argued that analog, whether acoustic or not, was the only true carrier of audio, and that digital could only form a numeric approximation of the original event.

But I also got a lot of letters from readers expressing complete agreement. They immediately accepted the notion that digital technology inherently promised far greater returns. It was that unexpected response which actually made a believer of me. Unsolicited enthusiasm for the new technology made it clear to me that its success was no longer in question. I got down to business, trying to keep track of digital's rapid progress.

Photograph: David Hamsley

It was a tough job because things happened fast and furious, particularly in the pioneering digital audio system—the Compact Disc. Whereas some observers originally predicted that the advent of digital technology would reduce all products to the sameness indigenous to ones and zeros, the exact opposite came true. A real binary renaissance occurred. Technology sprouted in all directions.

We saw laser pickups with one- and three-beam designs. There were players with brickwall analog output filters, and with two-, four-, eight-, and 16-times digital oversampling filters. Compact Disc co-inventor Philips has even devised a chip set with a 256-times oversampling filter; this innovative design doesn't even have a traditional D/A converter, because only one-bit words are output.

Speaking of D/A converters, we saw players with one, two, or even four converters. And their word lengths varied from 14 to 16 to 18. Upstream, we saw all kinds of error-correction algorithms, including players that diagnosed the kind of error they had encountered and selected the appropriate correction method. As the circuitry got more sophisticated, the parts count grew smaller. Early players had masses of chips in their primary sets; that new Philips chip set has two.

Although we heard more than a few tall tales about digital audio, we also encountered unexpected yet bonafide twists and turns in the technology. Data recovery, it turns out, isn't entirely immune to many banes of analog storage, such as vibration. Suddenly CD players appeared with elaborate anti-vibration measures, including isolation feet, floating disc drives, sandwiched cabinet metals, and even fairly exotic transport parts made of composite ceramic and fiberglass materials.

It was soon discovered that all digital data is dirty (due to all that high-frequency clock information spraying around), and countermeasures were introduced. Some players used opto-isolators to block digital noise and to prevent that noise from entering sensitive analog output stages. To prevent spurious beat frequencies, some Compact Disc players used a single master clock to synchronize multiple circuits.

CD players themselves branched out into diverse forms. Single-disc home players were soon joined by portables and changers. Car players were introduced, including trunk-mounted changers. As competition heated up, all kinds of features appeared. Some players flashed a light when there was a disc error, some randomly selected tracks, some had pitch control, and most were programmable and came with remotes. You could buy a CD player for $90 or $9,000, and hear claims that machines at either end of the price spectrum would sound the same.

CD players had subcode jacks for a while, then those faded away. Apparently, the jacks will begin to appear again on some new players, in the guise of graphics outputs. Many players sported digital audio output jacks. These jacks tapped data off before the analog conversion section, to deliver the error-corrected bit stream to an outboard D/A converter (perhaps in a preamplifier). On some players, that digital interface appeared in two forms—electrical coax and optical fiber.

The Compact Disc itself underwent several dramatic transformations. No one could decide on its maximum playing time. At first, as pressing plants ventured into that tricky submicroscopic business, we were lucky to get 60 minutes. Then disc length crept up toward 70 minutes, and reached the announced limit of 74. Now, an 80-minute disc has appeared. And slowly, disc prices have started to relent a bit.

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Soon control circuitry itself will go digital, with digital equalization, gain control, balance, switching, and so on.

it or not) of music lovers. But its incredible storage capacity soon attracted other comers. CD-ROM was introduced for data-storage applications. CD-V was announced as a combination audio/video storage medium. CD-I holds great promise as an interactive, multimedia format. The CD also shrunk to an 8-cm size, called CD-3. Now that graphics appears destined to be reintroduced, there is talk of CD-G. Just to make sure no one gets confused, the original CD has officially been renamed CD-DA, which stands for Compact Disc-Digital Audio.

Hardly a day goes by without yet another flavor of CD. The most recent is THOR-CD, a recordable/erasable disc announced by Tandy Corporation. (THOR stands for Tandy High-intensity Optical Recording.) As "Digital Domain" readers know, recordable CD technology has been around for some time, and includes the MOR (magneto-optical recording) system we examined some time ago.

About the only thing that has remained the same is the sampling rate of 44.1 kHz. That good old number has never varied. (One question we haven't gotten around to is exactly where that decidedly odd amount came from.)

Of course, CD was only part of the fast-paced digital story. R-DAT was announced, but it quickly met opposition from record labels. (These companies apparently were unwilling to suffer the same fate as the software manufacturers that banked zillions of dollars in profits from another recordable medium, videotape.) Still, R-DAT is here. You can walk into your Ford dealer today and buy an R-DAT player and premium sound system for only $1,540. However, the 1988 Lincoln Continental which carries it costs slightly more.

With all the excitement of CD and the notoriety of R-DAT, many people have come to equate digital audio with its storage media. This is only the opening salvo. Just as digital technology has upgraded that weak link in the audio chain, it will upgrade the other links. Many preamplifiers already contain D/A conversion circuitry to permit a digital-to-digital transfer from a digital storage medium. Soon, the control circuitry itself will go digital as well, with digital equalization, gain control, balance, switching, etc. Similarly, the day isn't far off when digital power amplifiers will be introduced. That should really cause a stir in vacuum-tube enclaves!

Most of audio's diehard notions are in flux. In the analog past, the storage medium was all important. The storage accuracy (or lack of it) largely determined the sonic quality of the end result. With digital, storage is relatively unimportant. As long as enough of the data is there to permit the audio signal's reconstruction, the medium is good enough. And why bother with separate components? All you really need is a minicomputer with storage and user interface.

In short, as many readers confidently expected, digital audio is redefining the art and science of audio technology. Moreover, this is just the beginning. Digital technology has taken the first small steps required to upgrade storage. But new kinds of digital signal processing, and even newer kinds of storage, are in the wings. Add entirely new concepts in hardware and software, such as hypermedia—a human, idiosyncratic way of integrating information—and it's hard telling in which direction things might go.

One thing is sure. Digital audio is off to a great start. Most audiophiles are strong supporters (voting with their pocketbooks) of digital audio technology, and look forward to any future advances made possible by the creativity it engenders.

In the first "Digital Domain," the stated objective was to "achieve an understanding of digital audio, in terms both of bits and bytes and of the philosophical nature of this important technological development." Now that we're entirely comfortable discussing things like sampling rate and hypermedia, our goal has been met.

Thus, I hope *Audio* readers have benefited from, or at least enjoyed, this column. Since my goal of introducing digital audio technology has been served, it is time for this author to say goodbye and move on to other professional responsibilities. Thanks for including me in your reading itinerary, and thanks for all those letters.

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EQ & NR: STRIKING A BALANCE

Most recordists stick to standard equalization settings to match the tape type being used: 120 μS for Type I (normal) tapes, and 70 μS for Type II (CrO_2) and Type IV (metal) tapes. In fact, the majority of tape decks set EQ automatically, decoding the holes in the edge of the cassette. Some decks do, however, permit the user to switch-select the EQ, sometimes independently from the bias level. There are possible advantages in being able to do this: Using 120-μS EQ for higher high-frequency MOLs (but higher noise) or using 70-μS EQ for lower noise (but lower high-frequency MOLs). This relationship is based, of course, upon using the same EQ setting for both recording and playback.

You can't necessarily assume that tapes made with noise reduction will always be played back with that same NR mode. Actually, it's rather common for a tape made with NR, especially Dolby B NR, to be played back on another recorder, such as an inexpensive portable, that does not have Dolby B NR. The sound usually will be a bit too bright, but that's not bad, particularly when compared to what happens when tapes encoded with Dolby C or dbx NR are played back without decoding. And if the NR systems are different, what then? And with an EQ change?

120- vs. 70-μS Equalization

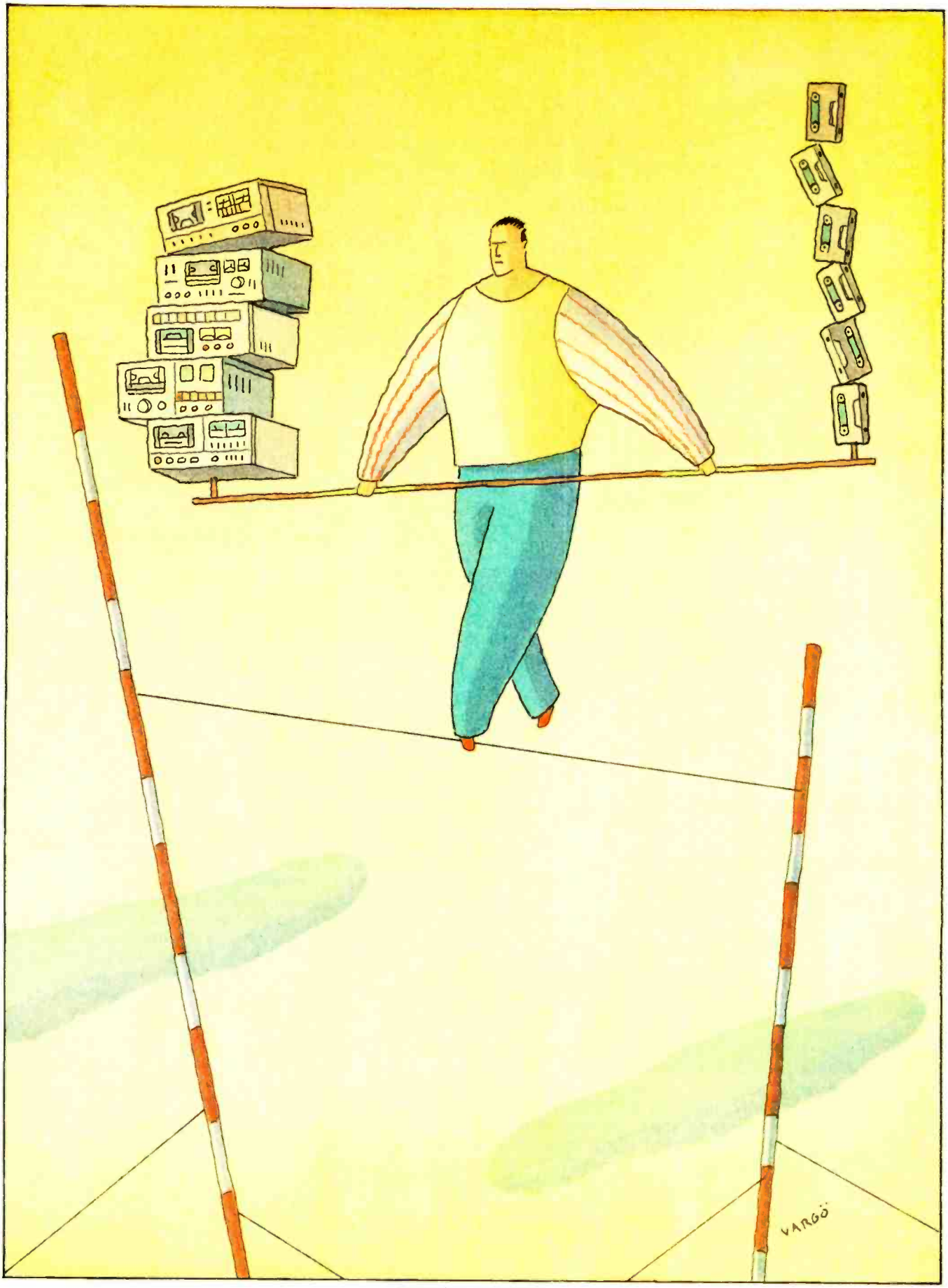
Using the same equalization for recording and playback will yield a flat frequency response, provided the deck is well matched to the tape. This is true for either 120- or 70-μS EQ, as can be seen in Fig. 1. When 70-μS playback equalization is used with a tape made for 120-μS playback EQ, however, there is a large droop in the response above 1 kHz (top trace). From the same relationship, there is a large boost (middle trace) when 120-μS playback EQ is used with a tape needing 70-μS EQ. The addition of Dolby C NR in the first case (bottom trace) causes a doubling of the droop, and the great loss in high-frequency content is very audible.

The conclusion at this point is that the playback EQ might be changed on purpose to bring down excessive brightness (120 to 70) or to bring up a dull high end (70 to 120), *but* if Dolby NR is involved, the effect will be much more exaggerated. The change with Dolby B NR would be less than what is shown in the figure, but the recordist should be aware of the possible effects. The boosts or droops from playback EQ changes would *not* be increased by using dbx NR, however.

Dolby B vs. Dolby C NR

As stated earlier, tapes encoded with Dolby B NR may seem overly bright if not decoded, but will still be acceptable for noncritical playback. Similar statements have been made concerning the playback of Dolby C NR tapes with the use of Dolby B NR decoding. Figure 2 illustrates that there is not a large difference in the playback response when using Dolby B NR decoding on a tape made with Dolby C NR. At meter-zero level (top trace), the response with Dolby C NR decoding is very flat, but response with Dolby B NR decoding falls slowly above 2 kHz, with a rapid roll-off above 10 kHz. This occurs simply because the Dolby B NR

HOWARD A. ROBERSON



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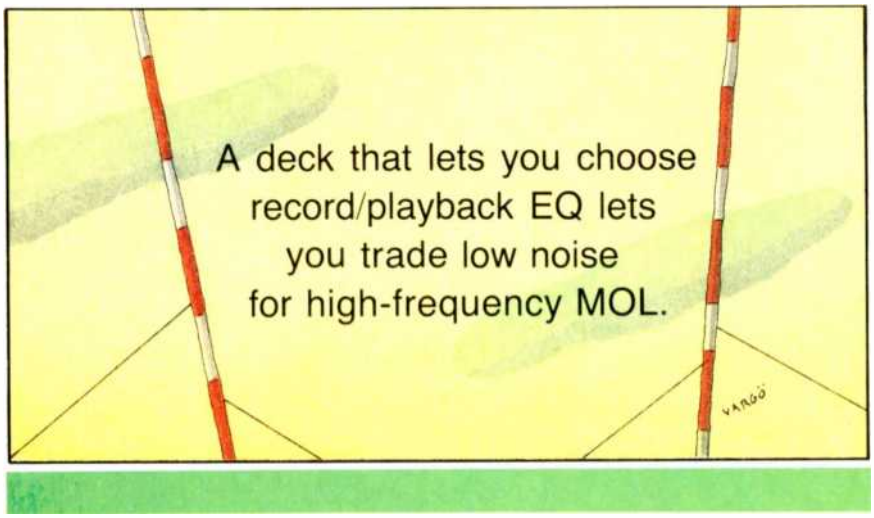


decoder does not compensate for the Dolby C NR anti-saturation and spectral-skewing encoding. At −15 dB (middle trace), there is very close correspondence in the responses over the great majority of the entire band. At −30 dB (bottom trace), there is some elevation in the response above 500 Hz with Dolby B NR decoding. This is to be expected, because Dolby B NR does not have as much encoding boost or decoding cut as Dolby C NR at this low level.

Figure 3 presents the other side of this comparison: Dolby C NR decoding on a tape encoded with Dolby B NR. The reverse of the results in Fig. 2 is shown: A high-frequency boost, especially at meter zero (top trace), and a reduction in level above 500 Hz at −30 dB (bottom trace), except for the peak at 20 kHz.

Figures 2 and 3 demonstrate that, over a range of important levels, relatively small response differences result when using Dolby B NR decoding on tapes made with Dolby C NR, or vice versa. The high-frequency boost with Dolby C NR decoding at meter zero (Fig. 3) was a bit much, however. All this demonstrates that Dolby B NR should be selected for playback of Dolby B NR encoded tapes, as is possible with any cassette deck that has Dolby C NR.

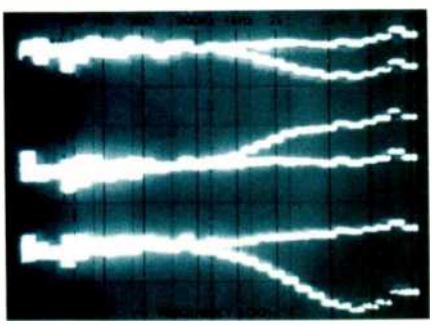


Fig. 1—Wrong equalization in playback. Top traces were recorded with 120-μS EQ and played back with 120- and 70-μS EQ. Middle traces were recorded with 70-μS EQ and played back with 70- and 120-μS EQ. Bottom traces are same as top set but recorded and played back using Dolby C NR. (Vertical scale: 5 dB/div.)

Dolby C vs. dbx NR

Every so often, someone makes a statement or asks a question indicating a belief that the dbx and Dolby NR systems are pretty much alike and that encoding and decoding differences are minor. Figure 4 should help resolve this misunderstanding. Recordings were made at five meter levels, in 10-dB steps from +10 (top trace) to −30 (bottom trace). Dolby C NR was used for the recording, but dbx NR was used in playback. Two basic effects resulted from this combination: Severe response deviations across the band, and nonlinear changes in level at all frequencies.

Three factors contribute to the results shown in Fig. 4. First, dbx decoding includes expansion even at the highest signal levels, but Dolby C NR decoding does not expand when the signal amplitude rises above Dolby level. Second, dbx decoders have high-frequency cut even at very high levels, but Dolby C NR decoders actually boost high frequencies. Finally, the dbx decoder's response is the same at all levels, but the Dolby C decoder applies a broad high-frequency cut that deepens and extends lower in frequency as the level is reduced. Notice how the 10-dB steps in the overall record level are rendered into changes of 4 to 16 dB in playback, depending on the frequency and overall level. The negative results are very obvious and most unsatisfactory with any sort of music.

Next, I recorded with dbx NR and then used Dolby C NR in playback. Record levels ranged from +10 (top trace) to −40 dB (bottom trace), with the zero-meter level set without NR switched in. Figure 5 illustrates the very poor responses from this combination. Because Dolby C NR does not have expansion or high-frequency cut at higher levels, the 10-dB steps have been reduced to 5 dB or even less, and the high end is elevated 10 dB or more. Only at −40 dB (relative record level) does the response become roughly flat. This is another hopeless case of bad sonics that emphasizes the lack of compatibility between dbx and Dolby C NR.

Dolby C with dbx NR

Some time ago, Technical Editor Ivan Berger ("Spectrum," August 1985) commented on using both Dolby and dbx noise-reduction systems. The aim is to get a large reduction in noise with less susceptibility to low-level noise pumping. The combination is set up using the deck's built-in Dolby NR system and an external dbx processor. I tried the combination, using a Nakamichi CR-7A deck with Dolby C NR and an external dbx 224 processor. Figure 6 shows the record/playback responses from +10 (top trace) to −30 dB (bottom trace), relative to meter zero. (The −20 and −30 responses were purposely shifted up to put them in the same figure.) Except for a little roll-off at the high end, the responses are very flat for most levels. To show how little response is affected by adding dbx to Dolby C NR, the traces for the combined NR systems are overlaid on traces made with Dolby C NR alone.

Figure 7 shows what happened with further reductions in level, from −30 to −60 dB, all with Dolby C NR alone and also with dbx NR added. The results remained really quite good, although the Dolby C NR response at −60 dB has a rise in noise at both the low and high ends.

I was pleasantly surprised by how good the responses remained over the 70-dB range shown in Figs. 6 and 7. They emphatically confirm that the two NR systems will not adversely affect

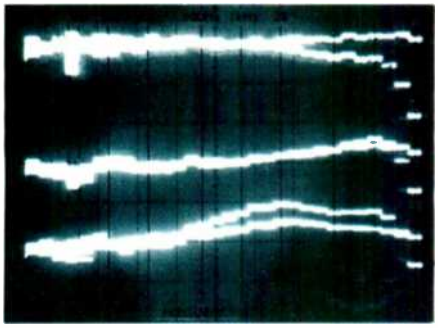


Fig. 2—Recorded with Dolby C NR and played back with Dolby B and C NR. Top pair at zero meter level, middle at −15 dB, and bottom at −30 dB. See text. (Vertical scale: 5 dB/div.)

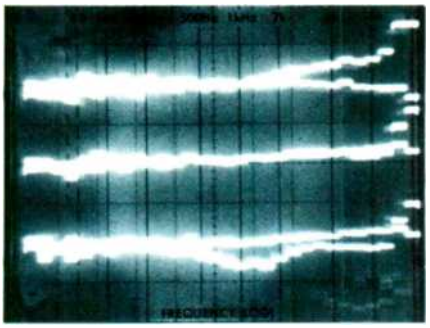


Fig. 3—Same as Fig. 2 but with Dolby B NR during recording. Note the bottom trace's midrange deviation at −30 dB, see text.

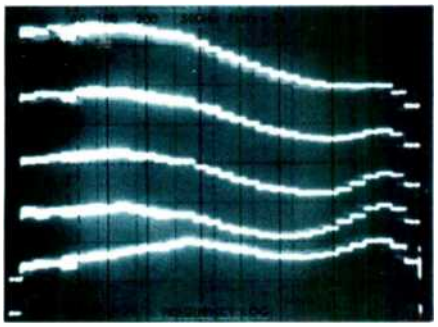


Fig. 4—Effects of recording with Dolby C NR and playing back using dbx NR. Recording levels, from top: +10, 0, −10, −20, and −30 dB. See text. (Vertical scale: 10 dB/div.)

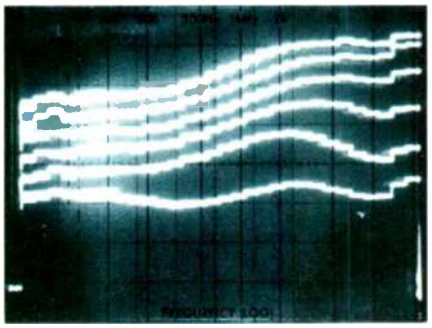


Fig. 5—Reverse procedure of Fig. 4, here using dbx NR during recording and Dolby C NR during playback. See text. (All other test conditions same as Fig. 4.)

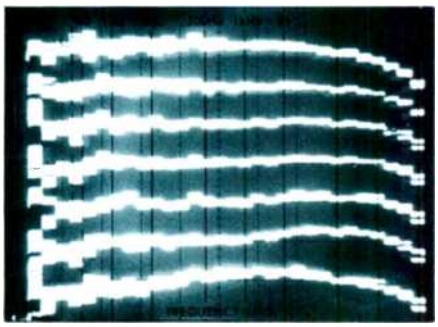


Fig. 6—Effects of using Dolby C NR alone and Dolby C NR in conjunction with dbx NR, in both recording and playback; see text. Traces made using both NR systems are overlaid on traces made with Dolby C NR alone; note the close match at most levels. Recording levels, from top: +10, +5, 0, −5, −10, −20, and −30 dB. (Vertical scale. 5 dB/div, with traces at −20 and −30 dB shifted up for clarity.)

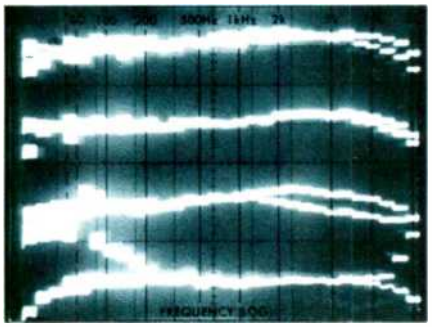


Fig. 7—Same as Fig. 6 but for recording levels of (from top) −30, −40, −50, and −60 dB.

flat recorder response, such as that provided by the Nakamichi CR-7A used in these tests. Adding a bit of equalization after the NR decoders—a boost that increased from 1 dB at 12 kHz to 2 or 3 dB at 20 kHz—would make all the responses fit within ±2 dB from 30 Hz to 20 kHz. To keep the equalizer filter from adding unwanted noise, I prefer to keep the slight roll-off.

Summary

Equalization changes are valid options, when the deck permits, for getting better record/playback high-frequency MOLs (120 μS) or lower noise (70 μS). If the equalization is changed just for playback, a noticeable change will occur in the level of the higher frequencies, which may or may not be desirable. If Dolby NR is used, the change in playback EQ causes exaggerated effects, usually unwanted.

Changes from Dolby B NR encoding to no NR or Dolby C NR in playback will be noticeable, but perhaps acceptable in noncritical listening. Changes from Dolby C NR to Dolby B NR in playback may be similarly acceptable. Adding or taking out Dolby C NR decoding when listening will cause gross and unacceptable sonic effects.

The effects would be most unwanted with dbx NR as well, if the playback does not have the needed decoding or if decoding is added when the recording had no encoding. Using Dolby NR decoding with dbx encoding, or dbx decoding with Dolby NR encoding, produces severe response and level distortions of the original signal, and the combinations have no place in normal listening.

It is possible to use both dbx and Dolby C NR together, by using an external dbx encoder/decoder and a deck with Dolby C NR built in; this will have minimal effects on response and level linearities. It is up to the individual user to decide whether the complexity and cost is worth the possible reduction of low-level noise pumping.

As a generality, I can state that EQ and NR modes should not be switched between recording and playback. This discussion, however, may help the careful user understand the relationships better and choose certain combinations to gain the most satisfactory overall results.

Photograph: Dave King

THE DIGITAL

THE AUDIO INTERVIEW

DAVID LANDER

TOM JUNG

Photograph: Ron Crofoot

Record producers generally feel that they are in the business of marketing talent. While Tom Jung (the "J" is pronounced, as in "jazz") is no exception, the founder and president of Digital Music Products believes in delivering a lot of technology with his music. The entire dmp catalog, which has grown to nearly two dozen titles since the first discs were pressed in 1983, was recorded on a Mitsubishi X-80 digital machine. Jung's newest projects also benefit from his love affair with Class-A electronics and such exotica as hand-built ribbon microphones, high-performance cables, and the Cello Audio Palette. The fact that dmp has never produced an LP is also telling, although early on, its proprietor did make one concession to the marketplace by offering real-time analog cassettes.

Jung's company is now based in a chic condominium complex which stands by Long Island Sound in Stamford, Connecticut. He hails from Minnesota, where he got his start in the record industry, as a disc cutter, 25 years ago. From that spot, Jung moved to field recording and then studio work. During those years, he recorded everything from polka bands to 300-voice choirs—and even a couple of hit rock n' roll songs.

In 1969, Jung and a producer friend got together with outside investors and built a state-of-the-art recording studio called Sound 80. (Its then-futuristic name, Jung confesses, was dreamed up by the ad whiz credited with naming Hormel's Cure 81 ham while drinking Vat 69 scotch.) By 1979, the business had grown substantially, and Jung found himself in management. Hoping to produce his own records, he migrated east and soon became a busy freelancer in the buzzing hive of New York studios. While free-lancing, he made many professional connections and continued to formulate his dream. With the first dmp recordings, mastered in 1982 and transferred to CD in 1983, that dream was realized. *D.L.*

You were involved with the first recordings made on 3M's experimental digital recorder back in the early '70s. How did that come about?

We were doing a direct-to-disc project, so it was a perfect opportunity. At that time, most sessions were multi-track—I think our studio was 16-track—but I always felt that certain aspects of audio quality were actually going backwards as the tracks increased. So I had a keen interest in recording live to 2-track.

And the 3M prototype was a 2-track machine. What was it like?

It was a little R2D2-looking machine. They nicknamed it Herbie. It had an instrumentation transport, used 1-inch instrumentation tape, and went at 45 inches per second. You couldn't cut the tape with a razor blade; you couldn't do anything with the unit but record and play. As long as we were doing a direct-to-disc project, where we were going for a whole side, it didn't matter that editing wasn't avail-

able. Even sequencing, cutting in dead air between movements or between tracks, was a problem. There would more than likely be a click at the splice. The machine was *unbelievably* unreliable. When you made a recording and went to play it back, you just kept your fingers crossed that something was going to be there. But when the 3M prototype worked, it sounded great.

You did a recording of Flim and the BB's, who have since become key dmp artists, on that machine. How did you discover the group?

At the time, Flim and the BB's was kind of a studio band. They were doing the lion's share of the recording work in Minneapolis, working for various producers and artists. We were all friends, and it was an opportunity to do something on the jazz side, which is where my roots are.

That's right, you were a bass player. When did you move east?

In 1979. Sound 80 was 10 years old and had grown to about 28 people, and I was more of a management figurehead than a creative person. Something clicked around the time we tried the digital recorder in the studio with Flim and the BB's, and I really felt that digital was going to be the future of recording music for consumers. At that time, my wife and I started talking about what fun it would be to have a small, high-quality jazz label concentrating on the kinds of things we wanted to do. We also started looking around the country for the best place to do this and, obviously, zeroed in on New York, which is the jazz capital of the world. But 1979 was not a good time to fulfill our dreams because there was a crunch in the record business. On the other hand, I felt we really had to make the move. I figured, well, with my engineering and production background, I could find work on a freelance basis, and I did. It was also a great opportunity to meet a lot of players and, as it turned out, that worked beautifully. I met people like Warren Bernhardt, Joe Beck, and Gerry Niewood in the studio, and I began a casual dialog about starting a label and asked if they would be interested. The response was overwhelming. So in '82, we started doing some recording.

You did an early dmp recording with Flim and the BB's and then three more recordings. Was that your first album on the label? And why are they the dominant dmp group?

Recording with those guys was always real comfortable. From the first album, they zeroed in on the wide dynamic range, the fact that the noise floor was 30-some dB lower than on the typical analog recording. They really used that extra range in terms of the music they composed and played. I've always been in favor of trying to maintain natural dynamics, and these guys thought, wow, with the noise floor down in the −80s to −90s, there's real dynamic potential for some new music. And they came up with it. It was a real natural thing, musically and technically, for us to work together. Actually, the first project we did was a solo piano recording with Billy Barber. The second project was Flim and the BB's.

And what came next?

We did Warren Bernhardt's *Trio '83* album, Joe Beck's be-bop record, and then Jay Leonhart. Those five albums were complete—recorded, edited, and in the can—in '82. It took until the end of '83 before anybody would say, "Yeah, we'll take your master tape and make you a batch of CDs."

Getting CDs pressed back then was an enormous problem, wasn't it?

I had verbal commitments from quite a few plants, but we were too small and unknown. The major labels got the press time.

When you finally got your first discs, how did you go about distributing them?

Our first CDs were probably among a couple of hundred available in the world. When we first got them, I went to MIDEM [a record industry conference] in Cannes, France to look at the worldwide market. Of course, there wasn't any at that time, and that was a bit of a rude awakening. I was probably the only person there walking around with CDs in my bag. When I got back, we really felt that, because of the kind of music and the dynamics, a ripe market for us might be the hi-fi market. So we got to know some manufacturers, went to Consumer Electronics Shows, and basically handed out software. Everyone was very receptive.

Even then, you refused to make LPs. Did people think you were mad?

Jung with Flim and the BB's

Photograph: Richard Laird

Warren Bernhardt

Photograph: Ron Crofoot

> Digital got the noise floor down to the −90s. There was real potential for some new music, and Flim and the BB's came up with it by zeroing in on that wide dynamic range.

Photographs: Buzz Freitag

They did. For a period of time, we did make a real-time duplicated cassette. I didn't want to get into LPs because I felt there weren't any good, high-quality LPs made on this continent. I figured, why should we start a new label with something that was going to be short-lived?

Are you still manufacturing analog cassettes?

No, but we recently started to make digital cassettes.

You've been quoted as saying that these are sonically superior to CDs.

Our DATs *are* better than our CDs. There are two reasons for this, and I'm not sure which has the most significance. We record everything live to 2-track on the Mitsubishi X-80 digital recorder at 48 kHz, and we do a digital conversion to 44.1 kHz for the Compact Disc. So it's a lower sampling frequency, and a conversion takes place. Even though it's a number-crunching digital conversion, there are some sonic differences between it and the master tape. When we make a DAT, we go digital to digital, from X-80 to DAT. There's no conversion involved, and we maintain the higher sampling frequency. The combination of those two things yields better results. I maintain that a higher sampling frequency is better, especially when you're dealing with nuances like the color of the reverberation in a hall or extreme high-frequency detail on percussion and piano harmonics.

The X-80 is only one part of the dmp equipment equation. In terms of the complement of hardware you employ, you're on the leading edge of recording technology. How do you evaluate this stuff? Is it strictly by ear?

About three years ago, we bought what I consider to be a very sophisticated piece of test equipment. It's a Hamburg Steinway grand piano. It provides a reference. You can put your head in that piano and then listen to the results of whatever, however you recorded it, out of a very high-end playback system, and you can really hear the differences. It helped me find weaknesses in the recording chain—the microphones, power supplies, cables, mike preamps, line amps, mix amps, and analog-to-digital conversion techniques in various digital recorders. These things show up quite readily on the piano. I'm sure many of the sonic differences we hear aren't being measured.

Jay Leonhart

Joe Beck

> I was very discouraged by the sound of so-called professional equipment, the consoles and mixers available to the trade. That's why I turned to unconventional equipment.

The harmonics of a piano are incredibly complex. . . .

That's right. Especially the high-frequency harmonics. And the wavefronts that can be established with a strong player are severe. We've found that some of the op-amps used in conventional equipment really can't accurately track these waveforms.

So you turned to unconventional equipment?

I was thoroughly discouraged with the sound of so-called "professional" equipment—the consoles and mixers available to the trade. By the time we started dmp, using op-amps—and not even using them to their full potential—was commonplace in professional audio. With multi-track recording, console design was so feature-oriented that the signal path took a back seat. That's when I started making a departure from conventional recording equipment. I was looking for something that would give me the flexibility to do contemporary recording, but with the purity of passive or virtually no electronics.

You make a point of using Class-A electronics. Why?

I think I looked at and listened to everything, and my background is technical enough to know what happens in Class-A biasing and circuitry. It really makes sense. This amplifier's cooking all the time; it doesn't wait for the signal to come through and then demand that the power supply deliver something it might not be able to. This thing is turned on all the time, so the music doesn't change its characteristics. To my ears, it has the most natural electronics I've ever come across. I started to realize this when we got the Hamburg Steinway. It was real apparent that piano transients and wavefronts were realized through Class-A electronics, whereas they were just squeezed through in more conventional op-amp designs. The 5534 op-amp is used extensively in equipment these days, particularly in pro gear. And as I eliminated 5534s from the signal path, the sound kept getting better.

Tell us about your choice in microphones.

I discovered early on that a lot of the

condenser microphones used in making analog recordings were not well suited for digital. With analog, things happen, like high-frequency saturation, so what you have to do in the recording is pre-emphasize what you want to retrieve. So the industry started making microphones that were purposely hyped on the high end just to maintain sizzle from instruments. Now, a lot of the criticisms of early digital recording can be related to just taking these old techniques and simply replacing the analog recorder with a digital recorder. All of the high-frequency bumps came back overly bright and harsh—all the things that digital got blamed for. Well, early in the game, I said let's reevaluate the microphones and start at the beginning. I sort of rediscovered ribbon mikes, which I had used for years with brass and certain instruments. I found they had a much smoother high end; a lot of the characteristic brightness of condensers was gone.

But are there attendant problems with ribbon microphones?

The problem is that their output is extremely low. Working in big rooms, as I do, with long microphone cable lines, I was losing a lot of high-frequency information in the cable. So I had some pre-preamplifiers built for me, again Class A, discrete. In the studio, I put these as close to the performer, as close to the microphone, as I can, and I use the shortest possible cable (in many cases, only 3 meters). So I get my gain—say, 50 or 60 dB—close to the microphone, which helps preserve some of the detail this poor little ribbon mike is trying to drive down the cable. By bringing the signal up to or near line level, and by balancing it at that point with a good line amplifier, I can drive several hundred feet of cable with virtually no losses. I feed the signal into my rig, which is virtually a line-level mixer. I have the ability to grab up to 30 dB of gain in my mixer, but basically I bring everything in very close to line and then mix at line level. The advantage is that more harmonic accuracy is maintained.

You also use some pretty exotic cables. Do you really find the nature of the cable makes that much difference?

Everything makes a *little* difference. I don't think one thing makes all the difference in the world, but I've found that different cables sound different. Monster Cable sounds different than Cello cable, which sounds different than the new, experimental, linear-crystal cable from Japan, which I'm using right now. Basically, it's an entire copper crystal stretched out to about a meter in length. I end up using different cables for different instruments, depending on the response characteristics.

> Our Steinway grand provides a reference and helps us to find weak links in the recording chain. I'm sure that many of the differences we hear are not being measured.

You try to use these characteristics to your advantage?

Absolutely. I like to think of myself as a purist, but I don't throw out the idea that equalization is necessary sometimes to get the right tonal balance, particularly in the area of recording drums. And I've yet to record a piano that doesn't require some equalization. I don't like to use a lot of it, though. I try to use as little as possible because it has its own coloration. On the other hand, to get the tonal balance and the spectrum I like requires a little shaping. I do this with the cable if I can, but if I can't, I insert an equalizer.

You prefer the Cello Audio Palette. Do you do all your equalization on that?

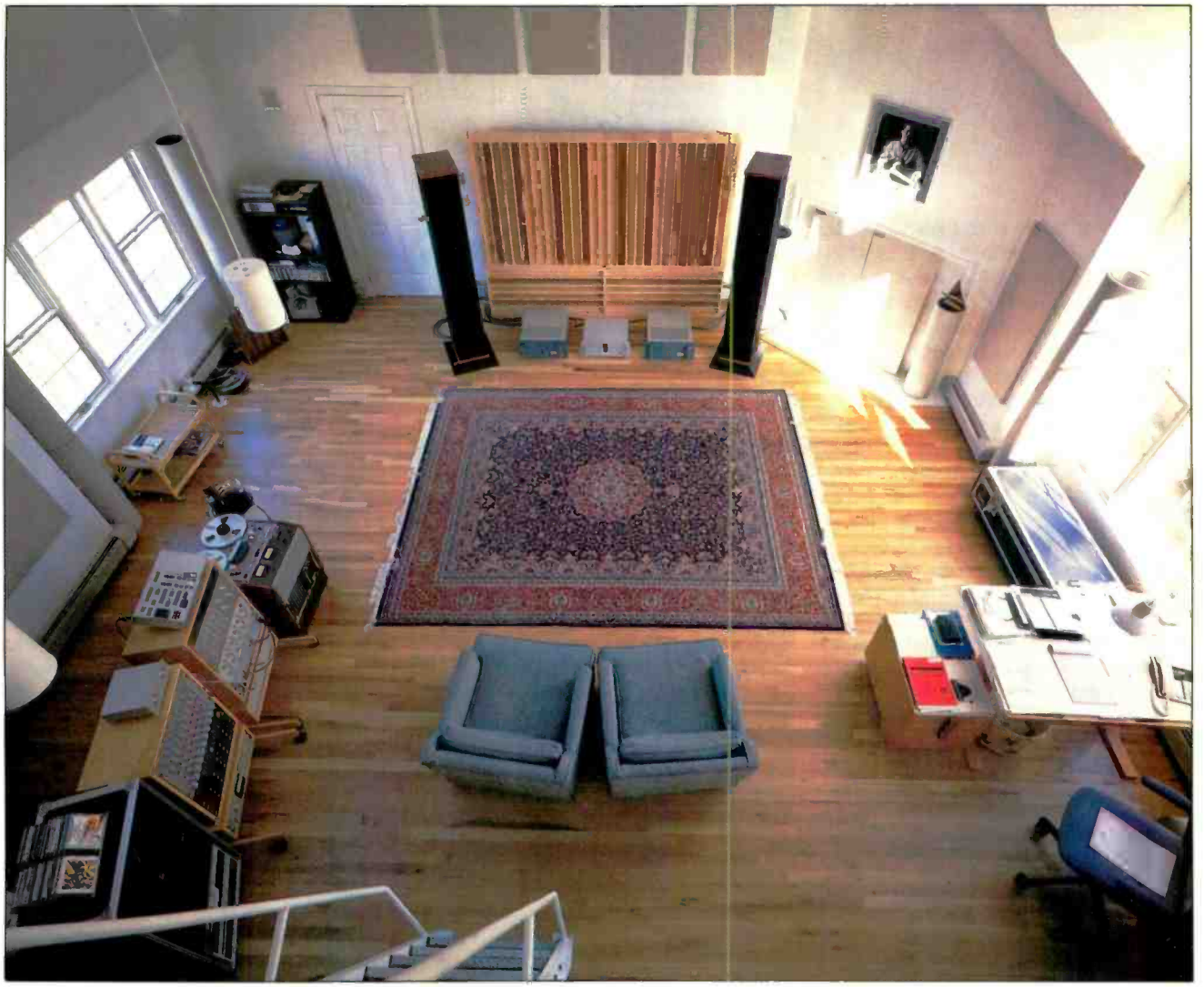
Not all of it, but as much as I can. At 10 grand a pop, I don't have a lot of them standing around. On special projects, [Cello founder] Mark Levinson has been nice enough to loan me a few. We've used three or four of them on several projects. I think the Cellos provide the most musical equalization I've ever heard. In typical professional equalization applications, you have a million frequencies, and you're able to equalize little, narrow bands. But those little, narrow bands, or high-Q equalization curves, also produce more severe phase shift, which really starts to mess with harmonic integrity. That's why I like Cello's broad-Q, wider, spectrum-shaping approach to equalization.

Isn't this the approach Mark Levinson and his designer, Dick Burwen, took with this piece of equipment?

Yes. I had some professional equalizers modified to get broader curves than Cello has, and these professional equalizers sounded better for it. I've just acquired a digital equalizer, and it's part of the DAT mastering stage. It's basically a 24-bit internal equalizer that does some serious number-crunching and mathematics. It's a six-band equalizer. I've had the company in Germany that built it, Harmonia Mundi [not to be confused with the French record company of the same name], design some special curves, which are software changes, to resemble the Audio Palette. Now I have those kinds of curves available to me digitally. So once I get something converted to digital, once I do my original recording, I can still get another crack at doing some spectrum shaping in the mastering process in the digital domain. Basically, the Harmonia Mundi allows me to make level and balance changes—along with equalization changes—while going from one digital format to another. I do the original recording on the X-80, razor-blade edit the master, then transfer it to DAT—all in the digital domain, without going through any converters. Then I build my CD master on DAT. The new Bob Mintzer record was the first project mastered to DAT. The disc plant actually took a DAT and converted it to 44.1 kHz for transfer to Compact Disc. Now, through all these conversions, the signal never comes back to the analog world, it just stays numbers. So it's an endless number-crunching deal until someone actually puts a disc in a player and brings it back to music.

If you think enough of the DAT format to use it as a master tape, do you also see it as the dominant format of the 1990s? Is it going to replace the Compact Disc?

I don't think so. I see DAT and CD coexisting, as LPs and cassettes did for years. They're two different mediums, and I think CDs have certain advantages that DATs will never have



Photograph: Dave King

Jung's Stamford listening room/office

and can never have. DAT is a magnetic medium—it's subject to wear; it doesn't have the track access that CD does; it doesn't have the archival quality. It does have one advantage, though, and that is a higher sampling frequency. The industry itself, I think, will probably stay with the lower sampling frequency because most digital masters are made at 44.1 kHz. There's really nothing to be gained by going from 44.1 up to 48. If the original recording is 44.1, you're not going to capture any more high-frequency detail by going to 48. For a little company like us, trying to carve a niche in high-quality recordings, it makes digital all that much more viable for the audiophiles—the people who are really trying to hang on to the LP. Higher sampling frequency and the lack of conversion actually get you closer to the real thing, and that's what audiophiles are looking for. Ideally, they'd love to see 96-kHz sampling, but it really isn't possible to do that economically at this time.

Cassettes and LPs have coexisted for years. I see DAT and CD doing the same. They're different mediums, and Compact Discs have advantages that analog tapes will never have.

How close are we to that elusive "real thing," to hearing an exact reproduction of your Hamburg Steinway or of a 9-foot Baldwin grand?

We're getting closer, but there's a long way to go. I think it's remarkable, doing it the way we do, that we get *this* close.

You've developed a unique way of recording big bands. Could you explain that process and tell us how it evolved?

I've always been a big band fan. When I was a kid, if Stan Kenton or one of the big bands came through Minnesota or North Dakota or South Dakota on a tour, I'd talk somebody into driving me there. And I'd stand right in front of the stage to get the thrill and sheer energy of this 18- or 19-piece band blowing right in my face. I was forever frustrated with the way records sounded, and, as I got better and better equipment, I found that the big band sound just wasn't on the disc.

What, specifically, wasn't there?

Harmonic detail, I think. You heard this glob of sound that resembled a big

band, but it really didn't have the nuances of a live performance. And, of course, it had things that *weren't* in the live performance, such as distortions, harshness, microphones and mike preamps that were overloading, things like that. This always gnawed at me. And having recorded many big bands myself, I felt that the sound I was getting was as wrong as on any record I'd ever heard. Then I had the idea of getting as pure a signal path as possible from a single-point source pickup, meaning one microphone. By setting up the band around this one microphone, the balance would be achieved acoustically rather than electronically, or artificially, if you will. I used a bidirectional ribbon stereo microphone and then set up the band in two semicircles. We were really dealing with two stereo images—reeds on one side of the mike, brass on the other. One stereo image was the reeds; the other was the brass. It was an X-Y configuration, of course, so the images folded together in a left-right situation. Thirteen horns were recorded with one microphone, and balance changes and corrections were achieved through old-fashioned placement—slide back 3 inches, move up 2 inches. When you soloed, you stood up and walked to the mike, up to a mark on the floor. And that's how we achieved balance. I think we came much closer to the live band sound—even though we were taking this incredibly complex thing, harmonically, and trying to force it out of paper cones.

You prefer recording in large rooms. Why is that?

In a big room, the early reflections are displaced enough in time where I think the direct sound from the instruments really gets a chance to develop. The sound doesn't get colored by a reflection that's too early.

You've also worked on movies—The Cotton Club, Annie, Dressed to Kill. ***How much room for improvement is there in movie sound?***

I think there's a lot that can be done in movies, and I'm amazed that more hasn't been. With videotape and some of the competition that movies have right now, it seems that the theater, other than providing a place to go, could offer a lot more visual and audio quality. Certainly, with digital sound, there are endless ways to improve soundtracks. But it's a very involved process when you think about it, because everything—from dialog to sound effects to music—would have to be recorded digitally.

Jung setting up

Bob Mintzer with Jung

Photographs: Dave King

What improvements do you feel are needed in digital recording?

I think there's a great deal of improvement to be made at this very critical point of converting from analog to digital. Converting something as delicate as music and harmonics, and converting all of the nuances to zeros and ones accurately, is a big, big, important step. That's an area that needs more attention. I also think a greater degree of accuracy can be achieved through more accurate conversions; the analog electronics surrounding the converters and filters have been grossly overlooked. Again, we go to all this trouble to stay Class A up until the time we feed the signal into a digital recorder. In most digital recorders, you go through that same 50¢ 5534 op-amp before you even get to the analog-to-digital converter. These areas really need to be cleaned up.

You said early in this interview that you set out to start a "small, very high-quality jazz label." Yet you're often seen as an audiophile specialty label. How do you feel about that?

I almost resent that a little bit because I think the most important part of what we're doing is the music; the sound is really secondary. If I can bring realism to the music in a recording, I've done my job. But one of the things I'm trying to pay more attention to is finding really great tunes—those killer numbers that could be standards some day. The rest is all a means to an end. The music is what's really important.

Let's talk about that. The fact is, dmp has a distinct musical signature in that you've put together a stable that includes a lot of seasoned studio musicians, largely New York-based. Clearly, these people move in the same circle because they keep showing up on one another's albums.

Some of the finest musicians in the world live in New York City. It's a real kick for me to assemble a roomful of really great players. To have such a great stable of musicians available to choose from and to work with is a great pleasure and an honor.

> Converting delicate music and harmonics to zeros and ones is a very important step. With more accurate conversions, we will get greater authenticity.

Photographs: Richard Laird

They are, in fact, often musicians who've played with some of the top recording stars. Outside the studio world, though, they're generally unknown. Along with a hell of a lot of virtuosity, don't they bring some marketing problems with them?

Well, it's definitely difficult, and it's very challenging. But it's also very rewarding when you can make something happen. All we're trying to do is make as good a record as we possibly can—both musically and technically—and then expose it. We've recently started paying a lot of attention to radio, and with the Thom Rotella Band, we've had some terrific success, even though it's hard to label their music.

In fact, much of the music you record is a little like something or a lot like something else. Your artists perpetually cross stylistic boundaries and tend to elude characterization. Is this because, in their day-to-day studio work, they come in contact with so many styles of music—because they're just so versatile?

Rather than do something that's been done before, the artists we work with—like us—want to do something different, something that hasn't been done before. A group like Flim and the BB's is a good example. I don't think there's anybody that really sounds like Flim and the BB's. The band comes off as four guys having a real good time making music they like to play. And I think our audience is attracted to what we're trying to do. It's different, it's fresh, and it's fun.

There's always more than one producer credited on your albums. Not only do you credit one or more of the performers as producers, but you list your own name last. Is this simply politeness, or do your artists have a lot to say about what their albums contain?

They do. It's definitely a cooperative effort in terms of choosing material. I see us as equals. It's important to me that the artists feel good about the music they're recording. Hopefully, we can do that and accomplish some accessibility at the same time.

You've expressed a distinct preference for acoustic instruments over those that are electronic.

I'm attracted to that real human being playing that acoustic instrument. The nice thing about recording musicians and acoustic instruments, rather than computers and synthesizers, is that more of the artist's personality—or soul, if you will—can come out.

Dave Taylor

Jim Pugh

> I am paying more attention to finding great tunes that could be standards some day. The rest is all a means to an end. The music is what's really important.

Yet there are electric guitars and drum machines and synthesizers on your recordings.

Absolutely. I try to look at the synthesizer as another instrument, not as something replacing instruments. I think synthesizers are overused today, and maybe I overreact a little in trying to downplay them. But I think they do have their place. The synthesizer is an instrument that's no more or less important than any other. But I'm bothered when it starts replacing drums and pianos and many things that should be acoustic.

A few minutes ago, you used the word "accessibility." That seems to me a critical aspect of the dmp musical signature. Yet your Pugh-Taylor album, which showcases a bass trombone, a tenor trombone, and some pretty radical compositions, directly contradicts this philosophy.

I worked with and listened to Dave Taylor and Jim Pugh in the studio, and I loved the way they sound. When we started talking about a project, we addressed the issue of the risks we were willing to take. And in some of the compositions that were written for them, we took great risks, broke a lot of rules, crossed a lot of boundaries. We also learned a lot, and I don't regret doing the project. I believe a lot of people, particularly in the foreign markets, would like to see us do more of that kind of recording. We aren't apt to do it, because the business itself is much more competitive today. Without trying to be commercial, I do get a great sense of accomplishment by recording good music that can reach a lot of people.

There's a Jewish legend in which a rabbi is asked to define Judaism while standing on one leg. If you were asked to recite the dmp philosophy while standing on a single leg, how would you respond?

The direction of the label is definitely jazz-oriented. I hate to say jazz, but I keep coming back to the term "jazz-oriented," because I think the common denominator for these recordings is that all of them are improvisational—at least in part.

1

PIONEER ELITE F-91 TUNER

Manufacturer's Specifications

FM Section

Usable Sensitivity: Mono, 9.8 dBf.
50-dB Quieting Sensitivity: Mono, 12.8 dBf; stereo, 34.8 dBf.
S/N Ratio (at 80 dBf): Mono, 95 dB; stereo, 87 dB.
THD (at 80 dBf): Mono, 0.015% at 100 Hz, 0.009% at 1 kHz, 0.02% at 6 kHz; stereo, 0.02% at 100 Hz, 0.02% at 1 kHz, 0.07% at 6 kHz.
Capture Ratio: 0.8 dB.
Alternate-Channel Selectivity: 85 dB.
Frequency Response: 20 Hz to 15 kHz, +0.2, −0.8 dB.
Image Rejection: 70 dB.
I.f. Rejection: 100 dB.
AM Suppression: 70 dB.
Spurious-Response Rejection: 80 dB.
Subcarrier Rejection: 60 dB.
Muting Threshold: 25.2 dBf.
Stereo Separation: 65 dB at 1 kHz; 55 dB, 20 Hz to 10 kHz.
FM Output Level: 650 mV at 100% modulation.

AM Section

Sensitivity (Loop Antenna): 150 μV/m.
Selectivity: 40 dB.
S/N Ratio: 50 dB.
Image Rejection: 40 dB.
I.f. Rejection: 60 dB.
AM Output Level: 150 mV at 30% modulation.

General Specifications

Output Impedance: 900 ohms.
Power Requirements: 120 V a.c., 60 Hz, 25 watts.
Dimensions: 18 in. W × 3 5/16 in. H × 12 7/16 in. D (45.7 cm × 8.4 cm × 31.6 cm).
Weight: 11 lbs., 7 oz. (5.2 kg).
Price: $600.
Company Address: P.O. Box 1720, Long Beach, Cal. 90801.
For literature, circle No. 90

Rather than design a "me too" tuner, Pioneer's engineers have come up with some innovative circuits in the Elite F-91 that result in measurably better and audibly better FM performance. The first of these is an FM i.f. circuit that has been given the acronym ARTS (for Active Real-time Tracing System). This system eliminates the need for choosing between narrow and wide i.f. bandwidths. Pioneer states that it actively follows the selected signal to provide both the lower distortion normally resulting from wide bandpass and the high selectivity of narrow bandpass. From my station logging and listening tests, I gathered that the system dynamically tailors bandwidth to the instantaneous modulation of the incoming signal. I also saw evidence that the r.f. section has some capability of tracking the signal; even when my FM signal generator was deliberately detuned from the frequency indicated on the F-91's display, minimum distortion and perfect center tuning were maintained.

The second circuit innovation in the F-91 is described as a Digital Direct Decoder, Type III. This stereo demodulation system takes the output of the ARTS i.f. circuitry and converts it into digital form before converting the signals into stereo analog outputs. Pioneer maintains that this digital operation reduces noise, distortion, and signal degradation.

Improvements also have been made in other circuits, such as the r.f. front-end, to provide sensitivity and selectivity that are equivalent to those of a tuner with a four-gang tuning capacitor.

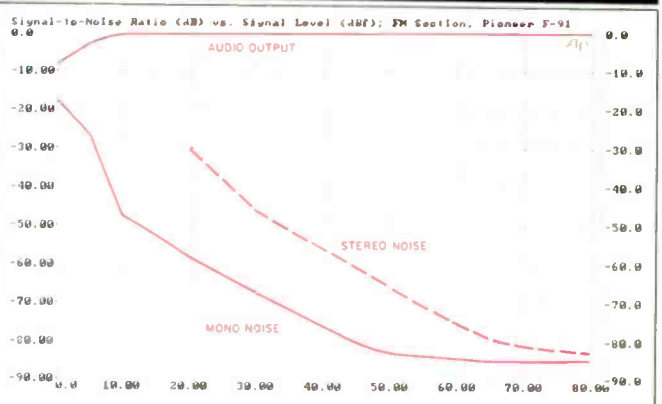


Fig. 1—Mono and stereo quieting characteristics, FM section.

Among the F-91's many convenience features, its 24 station presets memorize not only station frequency, but also such characteristics as the preferred mono/stereo and high-blend settings for each station. The automatic tuning circuit gives you a choice of three signal strengths below which it will ignore incoming signals. For unattended recording in conjunction with an external timer, the F-91 can be set to tune in three different preselected stations as the timer turns it on and off. The F-91 also has a built-in audio signal generator, tuned to around 330 Hz. When switched on, output from the tuner is equivalent to 50% modulation level. This signal can therefore be used to set up recording levels on a tape recorder prior to the beginning of the program you want to record.

Structurally, the F-91 makes extensive use of anti-vibration materials. A "honeycomb" chassis and large insulators are used to achieve high rigidity. Local circuit blocks are built into modules and filled with epoxy resin to damp any resonances.

Control Layout

A power switch and the pushbuttons needed for programming unattended recording are located to the left of the major display area. This fluorescent display indicates AM or FM frequencies, station preset number, program memory mode, auto-tuning threshold level, signal strength, muting, and stereo/mono status. When the high-blend mode has been selected, that fact is also displayed, as is the activation of the record-level check function.

Twelve numbered pushbuttons to the right of the display are used to program and select presets. Presets 13 through 24 are selected by pressing another pushbutton that acts as a shift key. Fairly large "Up" and "Down" tuning buttons are located below the station presets, as are eight smaller buttons. The upper row of these includes the shift key and buttons for memory setting and FM and AM band selection. Below them are buttons for "Tuning Mode," "Muting" on/off, multiplex mode, and, a bit to the right, the record-level

One of the things I liked most about the F-91 was its ability to deliver minimum distortion even when it was slightly detuned.

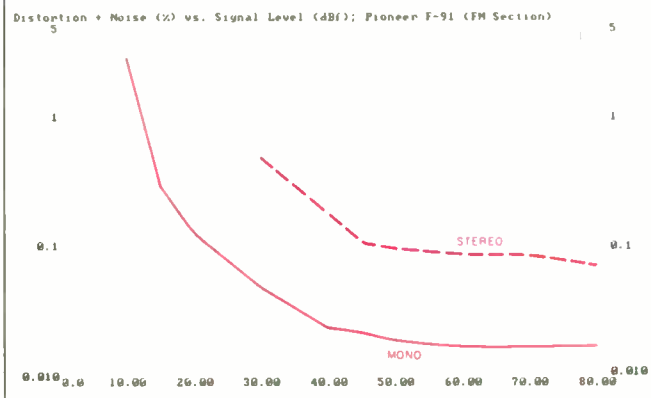


Fig. 2—THD + N vs. signal strength at 1 kHz, FM section.

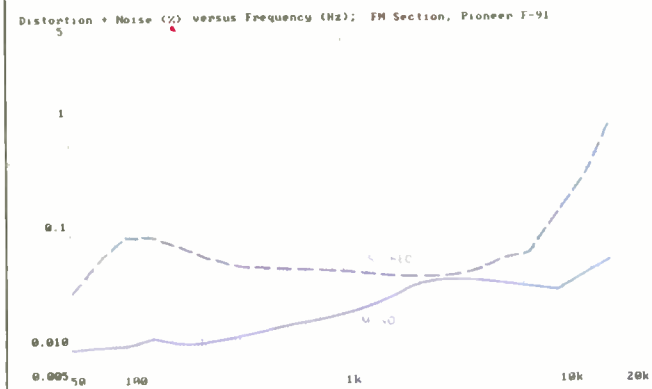


Fig. 3—THD + N vs. modulating frequency, FM section.

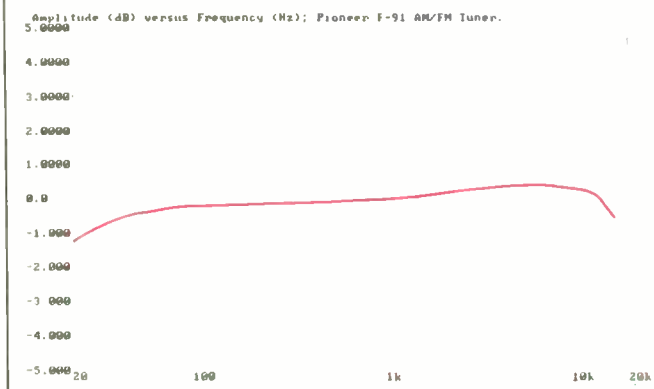


Fig. 4—FM frequency response.

generator switch. The tuning and multiplex mode buttons operate sequentially: Pressing "Tuning Mode" cycles the Elite F-91 through manual and three levels of automatic tuning, each requiring a higher minimum signal strength before it will lock in on a station. Pressing the "MPX Mode" button selects stereo, mono, or high-blend operation.

The rear panel is equipped with a 75-ohm coaxial connector for hooking up the FM antenna transmission line. An accessory transformer is supplied for those who use 300-ohm, twin-lead cable. Spring-loaded terminals are provided for the supplied AM loop antenna, which does not mount on the tuner's rear panel, as is usually the case, but is designed to stand or be mounted wherever it will pick up AM signals best. Two control input terminals are also provided, for interconnection with other Pioneer components bearing the "SR" symbol. (This symbol denotes that these components can be operated via a remote-control module supplied with Pioneer amplifiers bearing that same mark.) The usual left- and right-channel output terminals complete the layout of the rear panel.

Measurements

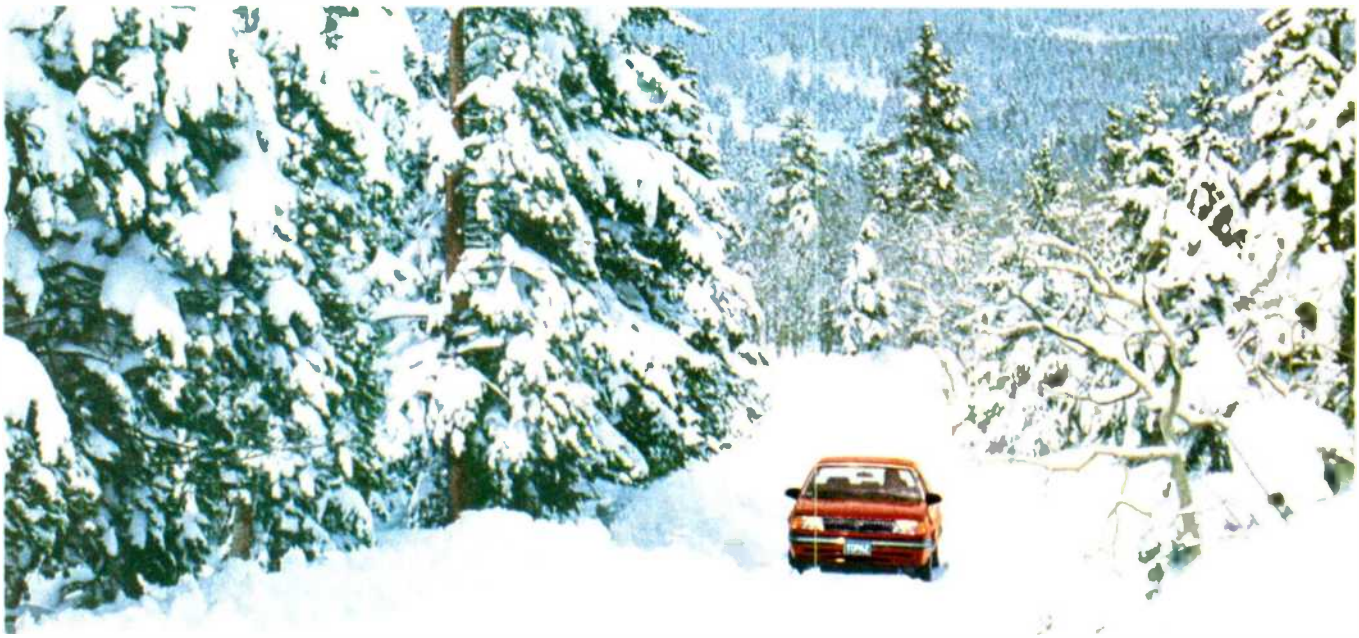
Figure 1 is a plot of mono and stereo residual noise as a function of signal strength for the F-91's FM section. In mono, 50-dB quieting was attained with a signal strength of only 12.5 dBf, a bit lower than the 12.8 dBf claimed by Pioneer. In stereo, 50-dB quieting was reached with an input signal level of only 34 dBf, again slightly below the 34.8 dBf claimed by the manufacturer. While I was unable to confirm Pioneer's specs for ultimate signal-to-noise ratio of 95 dB in mono and 87 dB in stereo (my signal generator's residual noise was a limiting factor here), I did register readings of 85.5 dB in mono and 83 dB in stereo for an input signal level of 80 dBf. The EIA/IEEE Standard for FM tuner evaluation calls for these measurements to be made at the 65-dBf input signal level. At that level, I obtained a reading for signal-to-noise ratio of 85 dB in mono; in stereo, however, S/N decreased somewhat, to 79 dB.

Figure 2 is a plot of THD + N versus input signal level. Usable sensitivity in mono (the signal level at which noise plus distortion equals 3%) measured 10.0 dBf, close to the 9.8 dBf claimed by Pioneer. For strong signal levels, THD + N was an amazingly low 0.018% in mono. For a 1-kHz modulating frequency, stereo THD + N fell short of the claimed 0.02%, though it was certainly low enough: I measured 0.07% at 80 dBf and 0.085% at 65 dBf. Figure 3 shows how THD + N varied with modulating frequency. In mono, it measured 0.0095% at 100 Hz and 0.028% at 6 kHz. In stereo, the results were 0.079% at 100 Hz and 0.056% at 6 kHz.

Figure 4 is a plot of frequency response for the FM section. Referenced to 1 kHz, there was a slight roll-off below 100 Hz, reaching −0.7 dB at 30 Hz. After a slight rise, amounting to no more than about 0.3 dB at 5 kHz, response went down to −0.5 dB at 15 kHz.

In the sample I tested, the subcarrier product output was high. In fact, when I attempted to measure stereo separation, the residual 19-kHz signal that was present made the separation appear to be no more than 32 dB, as indicated by the upper dashed curve of Fig. 5. Since this subcarrier

Reliability:



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Restrictions and deductible apply. Ask your dealer for a copy of this limited warranty. **Buckle up—Together we can save lives.

The AM section was quite sensitive and met or beat spec on selectivity, S/N, and i.f. rejection, although frequency response was poor.

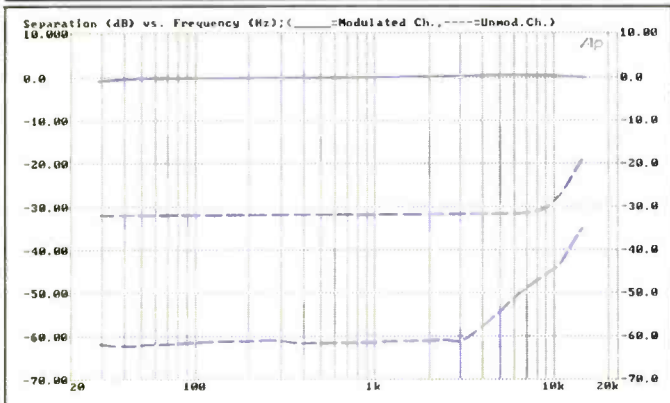


Fig. 5—FM frequency response (top curve; note change of scale from Fig. 4) and separation with subcarrier products included (middle curve) and removed (bottom curve). See text.

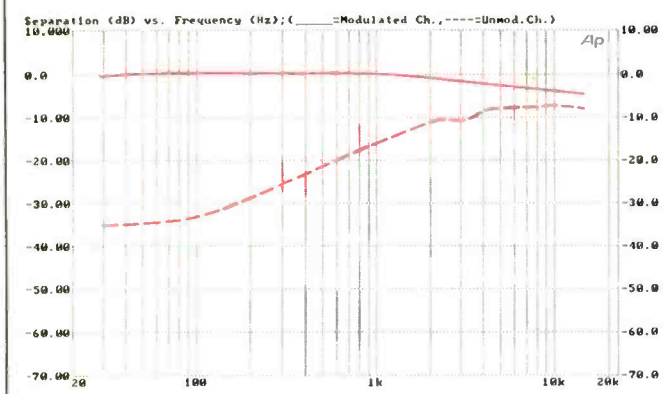


Fig. 6—FM frequency response (top curve) and separation (bottom curve) with high-blend circuit on.

product signal does not represent actual crosstalk, I inserted the filter that I normally use when measuring S/N ratio and THD + N. This filter has a cutoff frequency of 15 kHz, the highest audio frequency normally broadcast by FM stations. Once the filter was inserted in the measurement path, the separation reading increased to better than 61 dB at 1 kHz and 100 Hz, and 46 dB at 10 kHz, as shown in the lower dashed curve of Fig. 5.

Next, I turned on the F-91's high-blend circuit while keeping the filter in the signal-measurement path. Under these conditions, you can see in the dashed curve of Fig. 6 that separation remained well above 30 dB at low frequencies but that it decreased to less than 5 dB at 10 kHz. Note, too, that the frequency response of the modulated channel was affected by the blend. Response, shown by the solid curve in Fig. 6, was down 4 dB at 10 kHz.

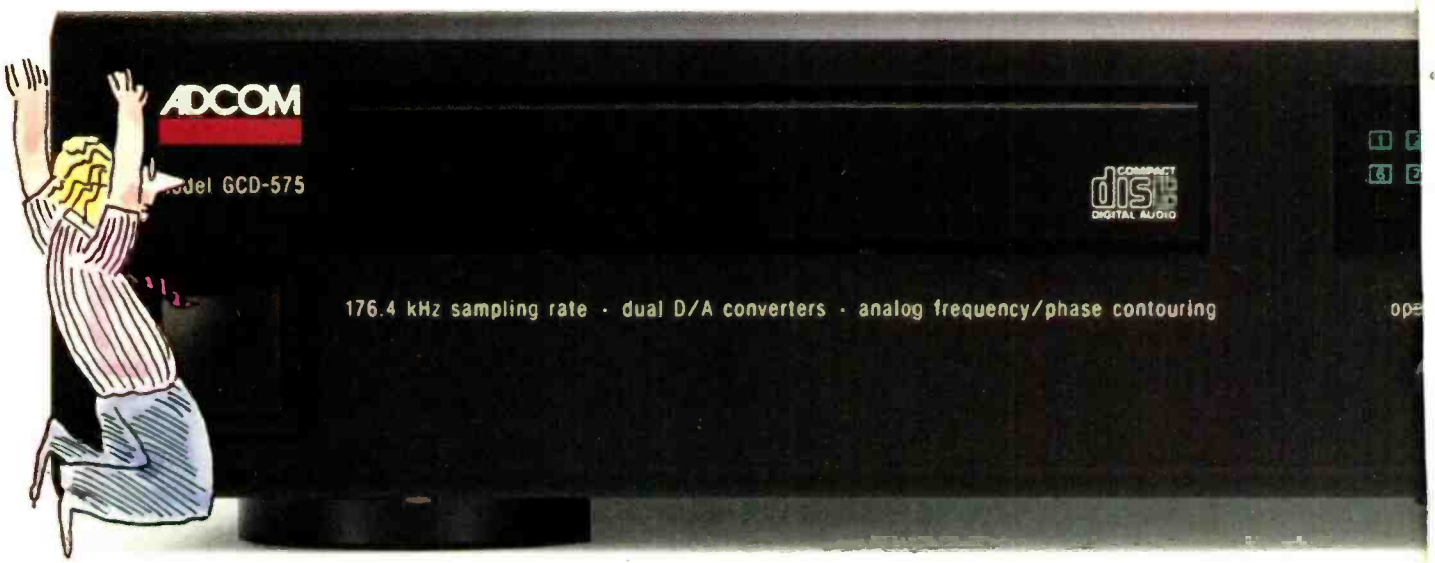
Further evidence of the subcarrier leakage noted earlier was obtained when I made my usual spectrum analysis of the left- and right-channel outputs with a 5-kHz, left-only signal fully modulating the FM carrier. The sweep in Fig. 7 extends from 1 to 100 kHz. At 5 kHz, the modulated channel establishes the 0-dB reference level. Crosstalk at the output of the unmodulated channel is represented by the dashed curve, and, at 5 kHz, the separation is still a very high 58 dB. However, there is also a fairly high-level component at 19 kHz, only about 42 dB below the 5-kHz reference level, as well as a 38-kHz component that is only about 53 dB below the reference.

Capture ratio measured 1.0 dB. Alternate-channel selectivity measured almost exactly the 85 dB claimed. Image rejection was 72 dB, and AM suppression measured a very high 68 dB. Spurious-response rejection measured 85 dB, while i.f. rejection was greater than the 100 dB claimed by Pioneer.

The stereo threshold was set at 20 dBf. The three auto-tune settings (the signal strengths needed for the auto-tune mode to stop when intercepting a signal) measured 35, 45, and 50 dBf. The eight bars which indicate relative signal strength in the main display area were more meaningfully calibrated than usual. The first bar illuminates for signal strengths of about 30 dBf, the fifth bar at around 50 dBf, and all eight with signal strengths of 77 dBf.

All good things come to those who wait.

Finally. A that reproduces not just bits a



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

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

Class "A" Makes A Difference

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

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

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

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

Digital Sound At Its Best

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

(Over please)

The Adcom GCD-575

Details You Can Hear

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

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

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

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

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

Full Function Remote Control

Specifications

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

Signal-to-noise Ratio: 105dB

Dynamic Range: 98dB

THD: 0.0025%

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

Channel Separation (1kHz): 95dB

Interchannel Phase Shift: @ 20kHz Less than 1.8°

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

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

Sampling Rate: 176.4kHz

Quantized Bits: 16-bit linear

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

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

Weight: 12 lbs. (5.5 kg.)

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

Specifications subject to change without notice.

More Features For Better Value

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

The GCD-575's advanced facilities include:

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

Display functions include:

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

Why Should You Listen To Us?

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

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

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

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The F-91 is one of the few tuners that can extract every bit of sound quality that current FM transmission practices permit.

The AM section was quite sensitive, measuring around 20 μV of directly applied signal for a 20-dB S/N ratio with a 30% modulated signal. Other published specs, such as selectivity, S/N, and image and i.f. rejection, were all met or exceeded. On the other hand, frequency response of the AM section (Fig. 8A) was very poor. Without applying the pre-emphasis called for by the new, voluntary National Radio Systems Committee Standard, response was down 6 dB at 80 Hz and 2.3 kHz, referred to 1 kHz. After applying the compensating pre-emphasis, high-frequency response improved somewhat, extending to 3.3 kHz for the −6 dB point (Fig. 8B). It is clear, however, that Pioneer has not tried to conform to the new NRSC de-emphasis recommendations.

Use and Listening Tests

One of the things I liked most about the FM performance of the Pioneer F-91 was that the unit was able to deliver minimum distortion even when it was slightly detuned. This characteristic is associated with the ARTS feature. I logged 55 usable station signals when the tuner was connected to my rotatable outdoor antenna. With the "Tuning Mode" function set to Auto 2, the number of signals at which the tuner stopped was reduced to 43, while in the Auto 3 mode, the number of captured signals was further reduced to 34. Those listeners who would prefer only the most noise-free FM reception possible would do well to select this mode. Even stereo station signals received in the Auto 3 mode will have S/N ratios of around 65 dB, while mono signals will yield ratios of well above 80 dB. Of course, if using Auto 3 results in your missing some of your favorite stations, you can always switch back to Auto 2 or Auto 1. If residual noise during stereo reception is still too great, you have the additional option of switching in the high-blend circuit.

All of this versatility adds up to a tuner that should meet the needs of just about any FM radio enthusiast. Given a good, strong FM signal that is not overmodulated, the sound quality reproduced by the F-91, feeding one of my reference amplifiers and my reference speakers, was superb. Because so many FM stations now use Compact Discs as program source material, it's become almost essential to own a tuner capable of delivering the dynamic range that such discs demand. Of course, most stations use a fair amount of compression when playing discs that have an unusually wide dynamic range. Even so, it is not uncommon to receive signals that have at least 10 dB greater dynamic range than FM audio signals had in the pre-CD era. That makes this Pioneer tuner, with its S/N ratio of more than 80 dB, even in stereo, ideal for the digital audio age. I suspect (but have no proof) that the unusually high level of residual subcarrier product output was peculiar to my sample, since the tuner met, or nearly met, all its other specs. In any case, it shouldn't cause any problems unless you try to record an FM program onto your cassette deck, using Dolby NR and not using the deck's MPX input filter. The Pioneer F-91 must be considered as one of only a few models that can extract every bit of sound quality permitted by current FM transmission practices. Now all we need are more stations sending out signals that are good enough to be taken full advantage of by this and other high-quality FM tuners.

Leonard Feldman

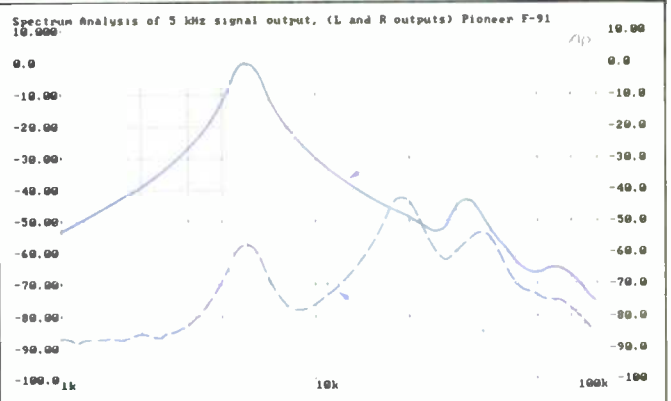

Fig. 7—Separation and crosstalk components for 5-kHz FM modulating signal, plus subcarrier and sideband components (see text).

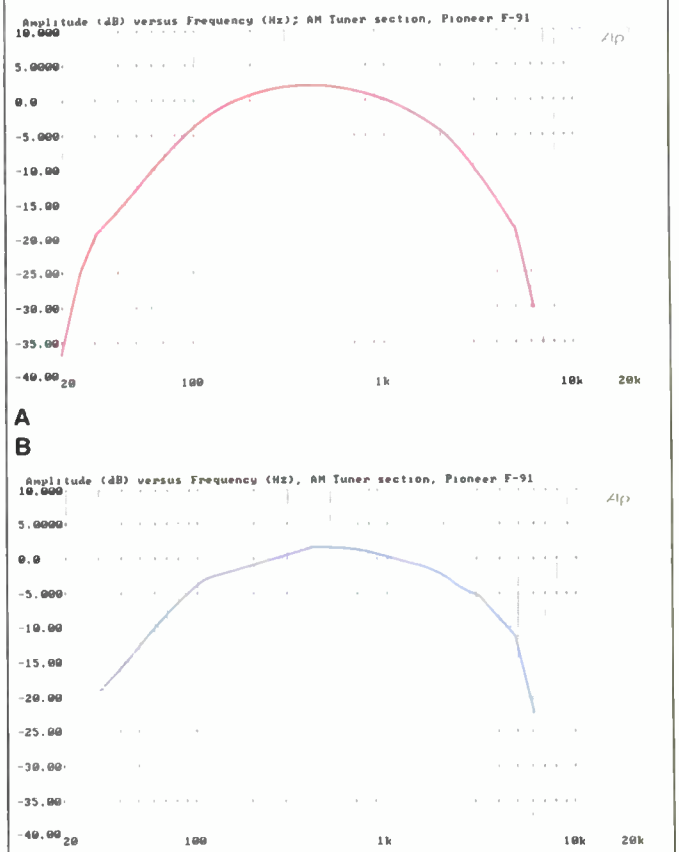

Fig. 8—AM frequency response for signals without (A) and with (B) NRSC pre-emphasis. See text.

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—REVUE DU SON, foremost French stereo magazine.

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2

MARANTZ CD-94 CD PLAYER AND CDA-94 D/A CONVERTER

Manufacturer's Specifications

Compact Disc Player

Frequency Response: 4 Hz to 20 kHz, ±0.5 dB.
Dynamic Range: Greater than 96 dB.
S/N Ratio: 96 dB.
THD + N: 0.003% at 1 kHz.
Wow and Flutter: Below measurable limits.
D/A Conversion: 16-bit, four-times oversampling.
Number of Programmable Selections: 20.
Output Level: 2.0 V rms.
Power Requirements: 120 V a.c., 60 Hz, 30 watts.
Dimensions: 18⅛ in. W × 3½ in. H × 13⅛ in. D (46 cm × 8.9 cm × 33.3 cm).
Weight: 27½ lbs. (12.5 kg).
Price: $1,700.

D/A Converter

Sampling Rates: 32, 44.1, and 48 kHz (automatic selection).
D/A Conversion: 16-bit, four-times oversampling.
S/N Ratio: 101 dB.
Frequency Response (with 44.1-kHz Input): Fixed-level output, 2 Hz to 20 kHz, ±0.1 dB; variable output, 2 Hz to 20 kHz, ±0.1 dB (output level at maximum); balanced outputs, 20 Hz to 20 kHz, ±0.3 dB.
THD: 0.003% at 1 kHz.
Dynamic Range: Greater than 96 dB.
Channel Separation: Greater than 90 dB.
Digital Input Levels: Systems 1 and 2, 0.5 V peak to peak; optical, −15 to −23 dBm; tape, 0.5 V peak to peak.
Digital Tape Output Level: 0.5 V peak to peak.
Analog Output Levels: Fixed, 2.0 V rms; variable, 4.0 V rms; balanced, 2.0 V rms; headphone, 75 mW at 600 ohms, 14 mW at 8 ohms.
Power Requirements: 120 V a.c., 60 Hz, 25 watts.
Dimensions: 18⅛ in. W × 3½ in. H × 13⅛ in. D (46 cm × 8.9 cm × 33.3 cm).
Weight: 25.3 lbs. (11.5 kg).
Price: $1,700.

Company Address: 20525 Nordhoff St., Chatsworth, Cal. 91311.
For literature, circle No. 91

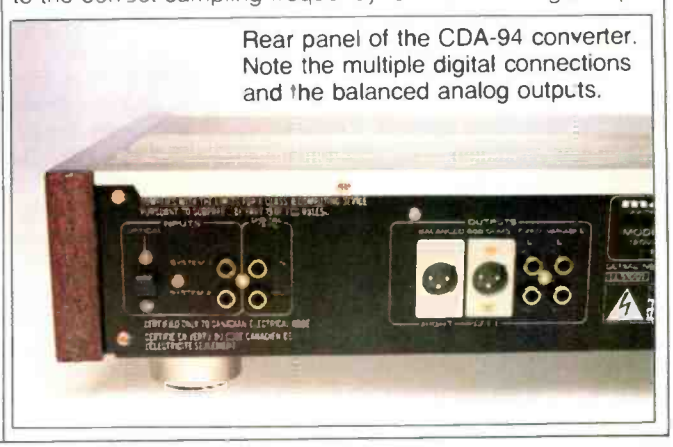
More and more audio equipment manufacturers who offer CD players are also beginning to manufacture and sell separate, stand-alone, digital-to-analog converters. What we are generally told is that, although the company's top CD players deliver excellent sound quality, the use of a separate D/A converter will provide an additional small measure of sonic perfection to a system. A stand-alone converter can be linked to any CD player that has a separate digital output. Most will also respond to digital inputs from DAT players or recorders (at 44.1 or 48 kHz) and from digital broadcast receivers (at 32 kHz) such as those available in Europe and Japan.

The Marantz CD-94 player and CDA-94 D/A converter not only are perfectly matched cosmetically, but are intended to work as a pair to provide the "ultimate" in CD playback performance. I did a comparison study between the CD-94 operated alone and the CD-94 and CDA-94 operated as a system. Essentially, this involved two complete lab testing sessions, using the various test discs available for this purpose. Before I get to the results of this head-to-head contest, let me describe the components themselves.

Both the CD-94 and the CDA-94 can be purchased either in a black-satin anodized finish with oak or rosewood side panels or in a rose-gold finish with rosewood side panels. Up to 20 "blocks" of programming can be memorized by the CD-94, using numeric keys on its front panel or on the supplied remote control. A "block" can be a track number, a track-plus-index number, or a time-into-track number. Shuffle (random) play of all tunes is possible, and Favorite Track Selection, first introduced in Magnavox and Philips CD players, is also featured in the Marantz CD-94. Favorite Track Selection, or FTS, enables you to store track information for a maximum of 226 discs. The number of discs decreases with the number of tracks selected for each disc. For example, if five tracks are memorized per disc, disc capacity of FTS will be 150. If 20 selections per disc are memorized, however, the number of discs that can be handled will drop to 70.

Both optical and coaxial (wired) digital outputs are provided on the CD-94, as well as unbalanced analog outputs.

The CDA-94 D/A converter is equipped with two sets of coaxial wired digital inputs, an optical digital input, digital tape monitoring facilities (for use when listening to a DAT recorder connected to the unit), and a headphone output jack and level control. The converter automatically switches to the correct sampling frequency to match the digital input



Rear panel of the CDA-94 converter. Note the multiple digital connections and the balanced analog outputs.

The promise of stand-alone D/A converters is better sound than one gets from the companion player alone.

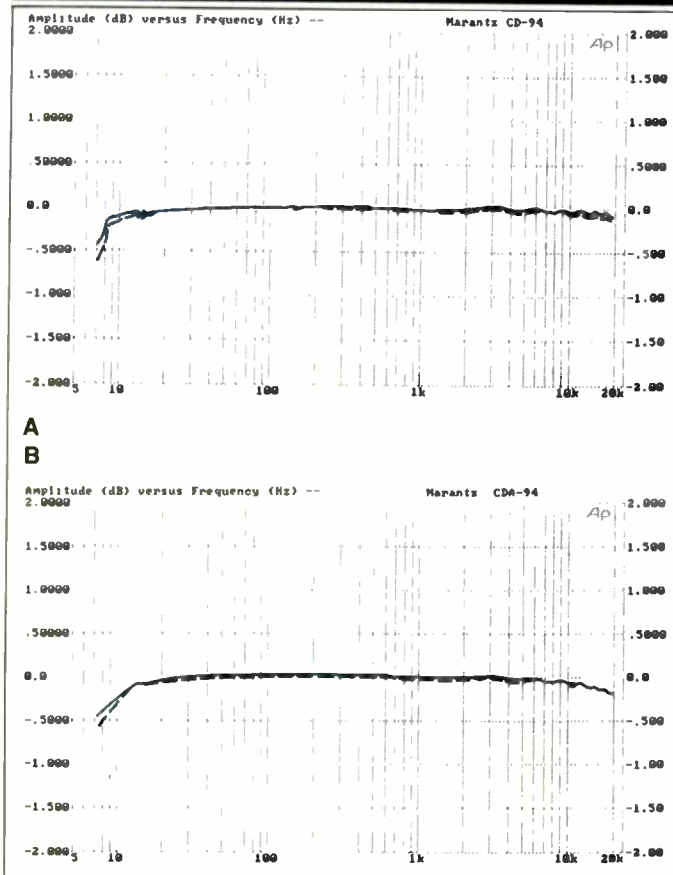


Fig. 1—Frequency response of left and right channels, from 5 Hz to 20 kHz, for the CD-94 player alone (A) and for the combination of the CD-94 player with the CDA-94 converter (B). For this and other figures, solid curve is for the left channel and dashed curve is for the right.

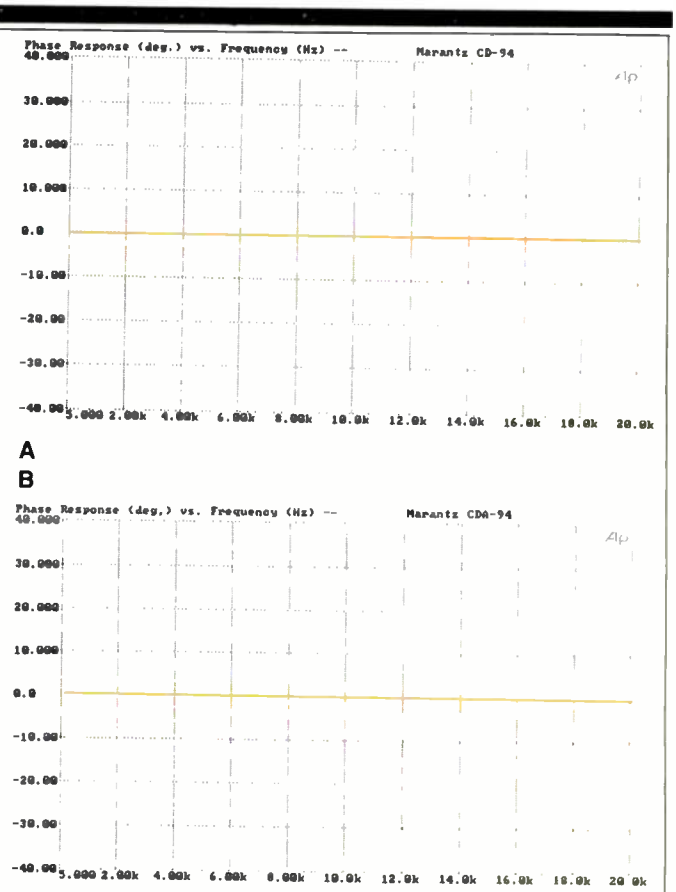


Fig. 2—Phase response for the player alone (A) and for the combination (B).

signal fed to it. The converter has balanced and unbalanced fixed-level output terminals as well as variable-level unbalanced output terminals. Both the CD-94 and the CDA-94 use D/A converters with four-times oversampling and digital filtration. According to Marantz, however, the CDA-94's design further protects signal integrity by using separate circuit boards, power supplies, and power transformers for the digital input-output section, the D/A converters, and the analog amplifiers. This extra care is said to provide a signal-to-noise ratio that is 5 dB better than the CD-94's. The CDA-94 also features an "Absolute Phase" switch that can compensate for phase inversion which took place anywhere in the recording chain.

CD-94 Control Layout

Secondary controls and pushbuttons of the CD-94 are hidden behind a nicely damped swing-down hinged panel along the bottom of the unit's front. The only features and controls visible with the hinged panel closed are the display, the CD drawer, the power switch, and buttons for drawer operation, FTS activation, forward and reverse track advance, play (and replay of the current track), plus a rocker for pause and stop. The display tells you just about everything you would want to know concerning the current status of the player. The time displays can be changed to show total remaining time on the disc as well as remaining time and time elapsed in the current track. Small numerals along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The CD-94's conveniences include shuffle play, Favorite Track Selection, and automatic music scan.

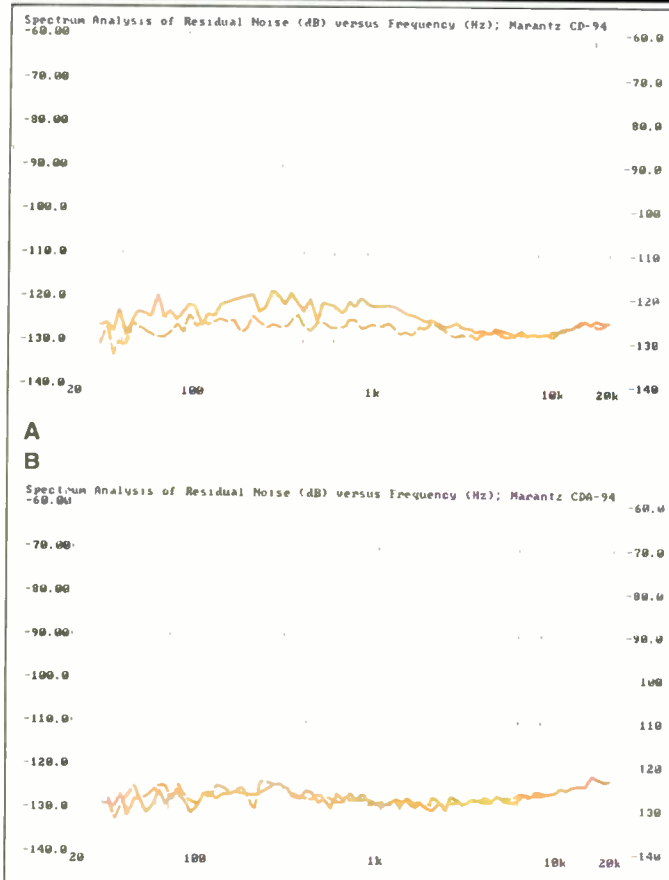


Fig. 3—Spectrum analysis of residual noise vs. frequency for "quiet" track of the CD-1 test disc, using the player alone (A) and the combination (B).

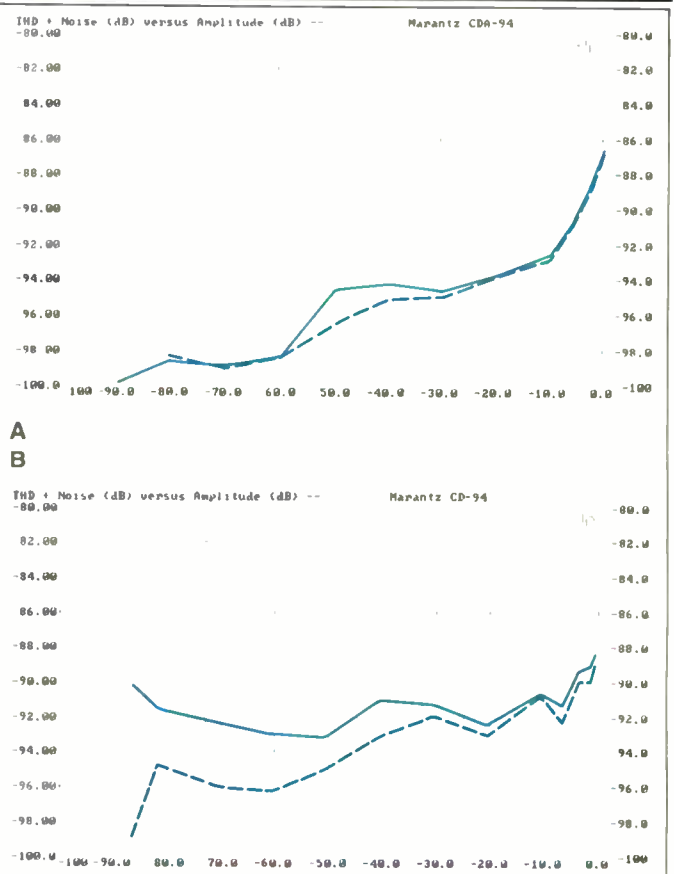


Fig. 4—THD + N vs. signal level for the player alone (A) and for the combination (B).

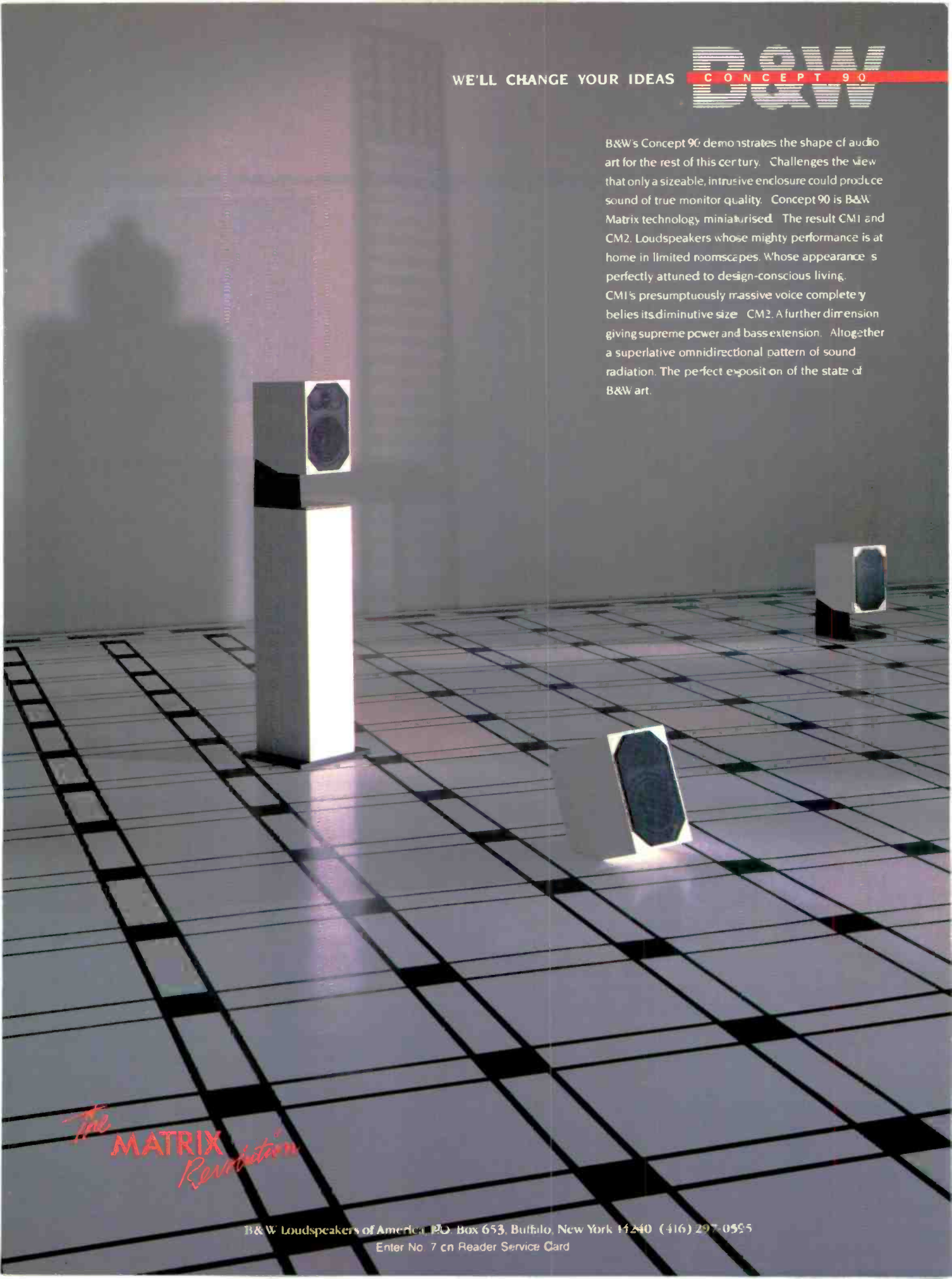
the lower edge of the display show the total number of tracks (up to 24) on the disc.

Ten small numbered buttons behind the hinged panel are used in programming by track, index, or time. Additional buttons determine the type of programming you want to do and the type of time display you want. You can select shuffle play, repeat mode, and automatic scan (to listen to the first 10 S of each track on a disc). Buttons for forward and reverse index, fast-forward, fast-reverse, and a timer on/off switch (for use with external timers) are also behind the hinged section. Most of the features on the front panel of the CD-94 are duplicated on its supplied remote control.

The CD-94's rear panel houses the optical and wired digital outputs in addition to the analog outputs. All signal output jacks, except the optical, are gold-plated. The panel also holds a switch and jack for use with a remote-control bus system used by several Marantz components.

CDA-94 Control Layout

At first glance, the CDA-94 D/A converter's front panel resembles that of the CD-94. It, too, has a display area and a hinged flip-down panel. The only controls visible when the hinged panel is shut are the power switch and a large rotary volume knob for the variable output terminals on the rear panel. The display area shows which input has been selected, whether the monitor switch is on or off, and which sampling frequency (32, 44.1, or 48 kHz) is currently being converted. A stereo headphone jack and level control are behind the hinged panel, as are switches for input selection, tape monitoring, and "Absolute Phase."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While the CDA-94 converter has both unbalanced and balanced analog outputs, the CD-94 player has only the unbalanced kind.

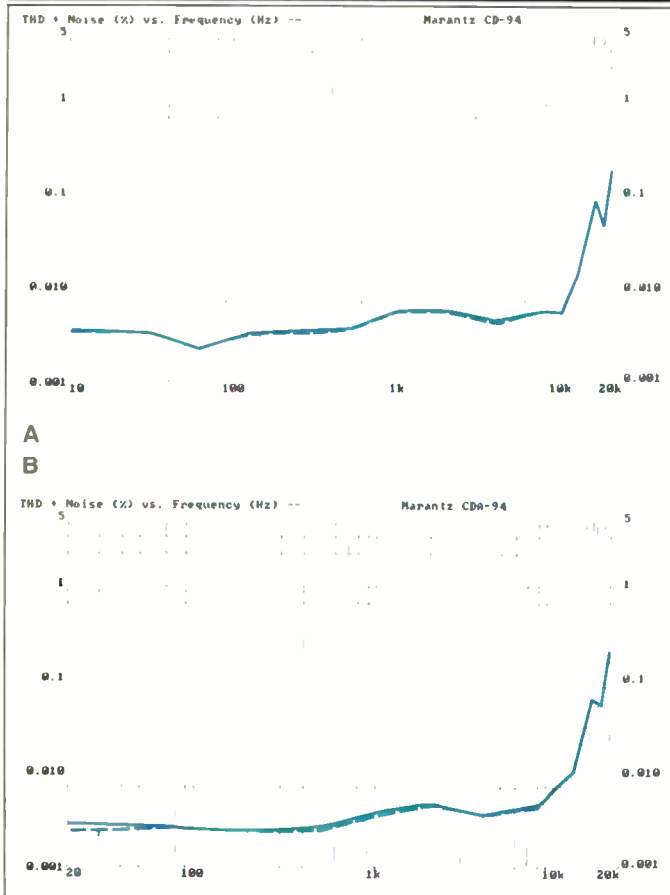


Fig. 5—THD + N vs. frequency, for signals at 0-dB (maximum) level, using the player alone (A) and the combination (B).

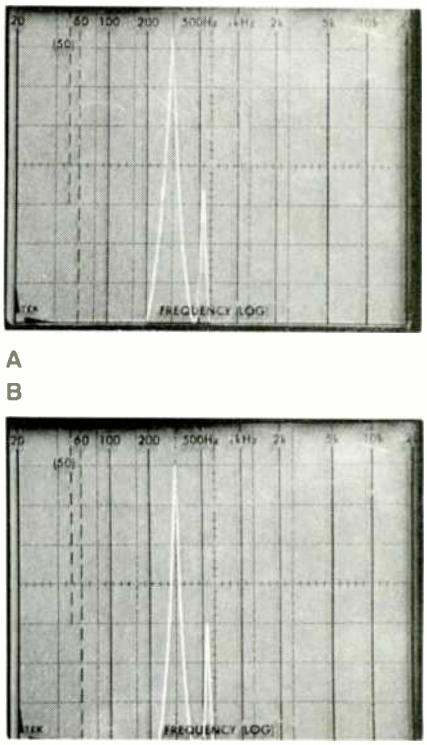


Fig. 6—Spectrum analysis of 20-kHz signal for the player alone (A) and for the combination (B). Note the 24.1-kHz "beat" tone. (Sweep is linear, from 0 Hz to 50 kHz, and vertical scale is 10 dB/div.)

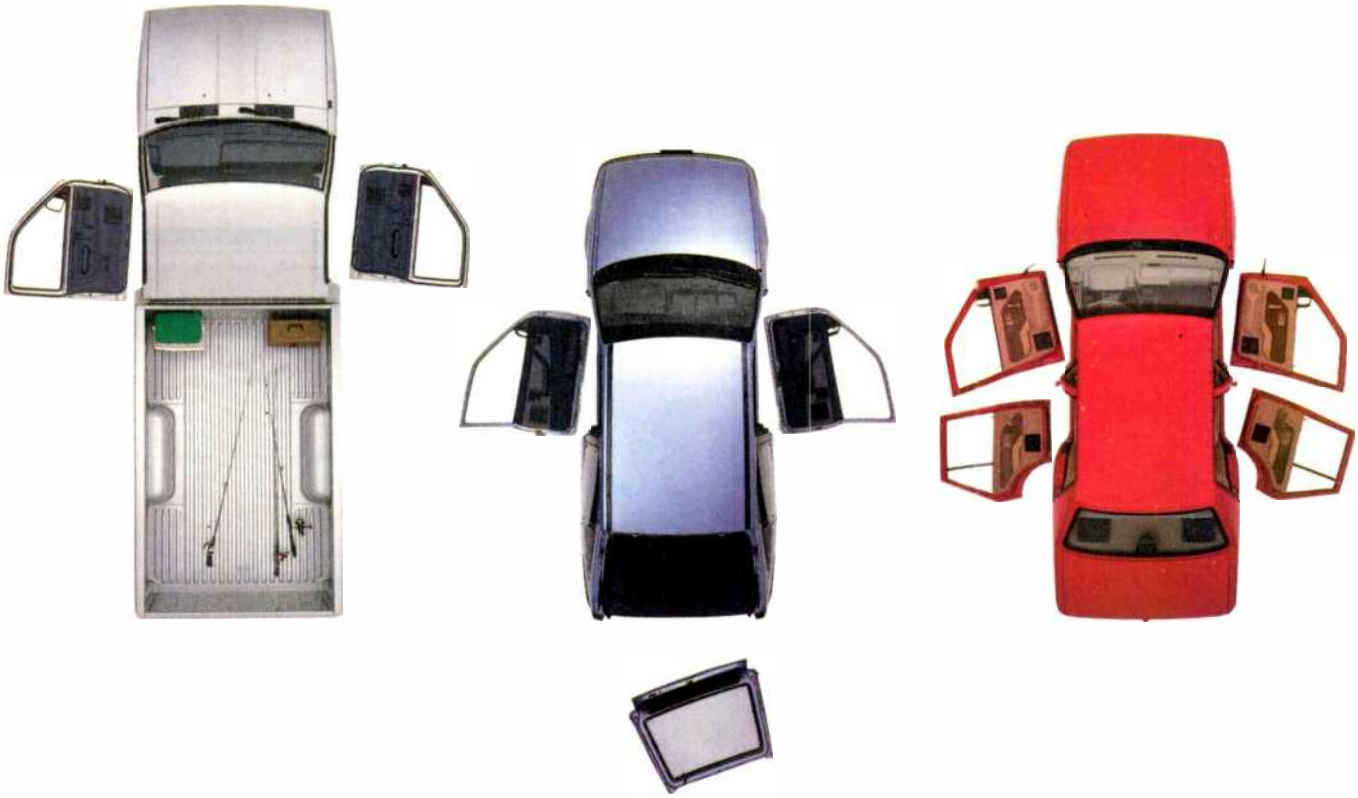
The digital connections on the converter's rear panel include an optical input, two coaxial electronic inputs, and coaxial tape input and output jacks. The analog connections are all outputs, including fixed-level and variable unbalanced outputs and a pair of 600-ohm balanced outputs. A fuse-holder completes the rear-panel layout.

Measurements

Using mainly my EIA Standard test disc (the CD-1, produced by CBS Records) with my Audio Precision System One test setup, I measured most of the significant performance characteristics of the CD-94 and the CDA-94.

Frequency response of the CD player alone is plotted in Fig. 1A, while the results of combining the CD-94 and CDA-94 are shown in Fig. 1B. (In these and all subsequent graphs, figures labelled "A" apply to the CD-94 alone, and figures labelled "B" apply to the CD-94/CDA-94 combination. Where both solid and dashed curves are shown, the solid curve represents results for the left channel, and the dashed curve represents the right channel.) In order to detect any slight differences between the response of the CD player alone and that of the combination, I set the test system to plot all the way down to 5 Hz, instead of my usual 10- or 20-Hz cutoff. If you look very closely at Figs. 1A and 1B, you will notice that response of the CD-94 player alone was actually marginally flatter, down at the low end, than the combination. Both hookups yielded slight and almost identical degrees of ripple at the high frequencies, suggesting that the gentle analog filters following D/A conversion are identical in both components. Response was down only 0.1 dB at 20 kHz for the CD-94 alone and was down 0.2 dB for the tested combination.

Interchannel phase response was perfect when using just the CD player (Fig. 2A) and was equally perfect using the



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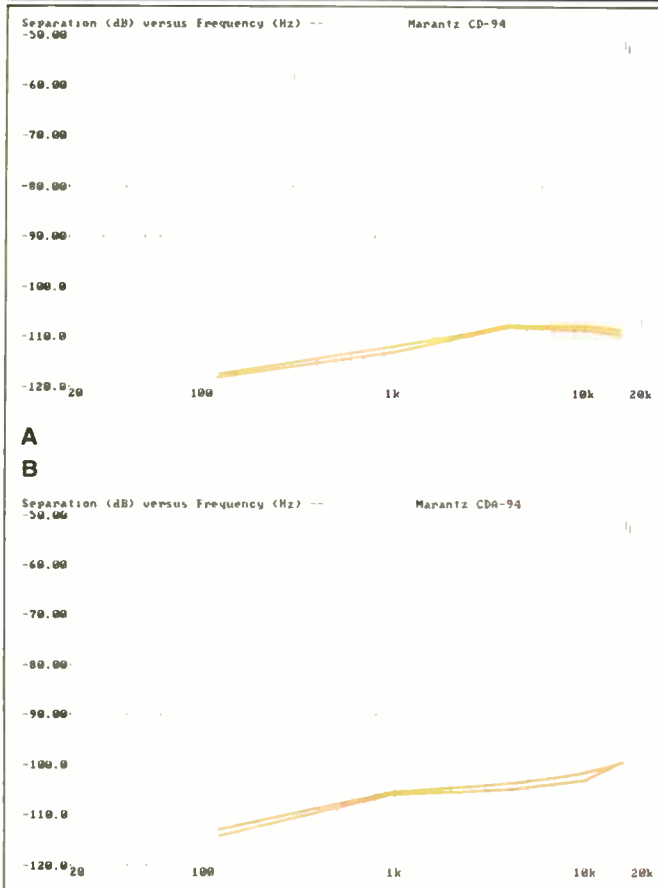


Fig. 7—Interchannel separation for the player alone (A) and for the combination (B). Leakage between channels was almost identical in both directions.

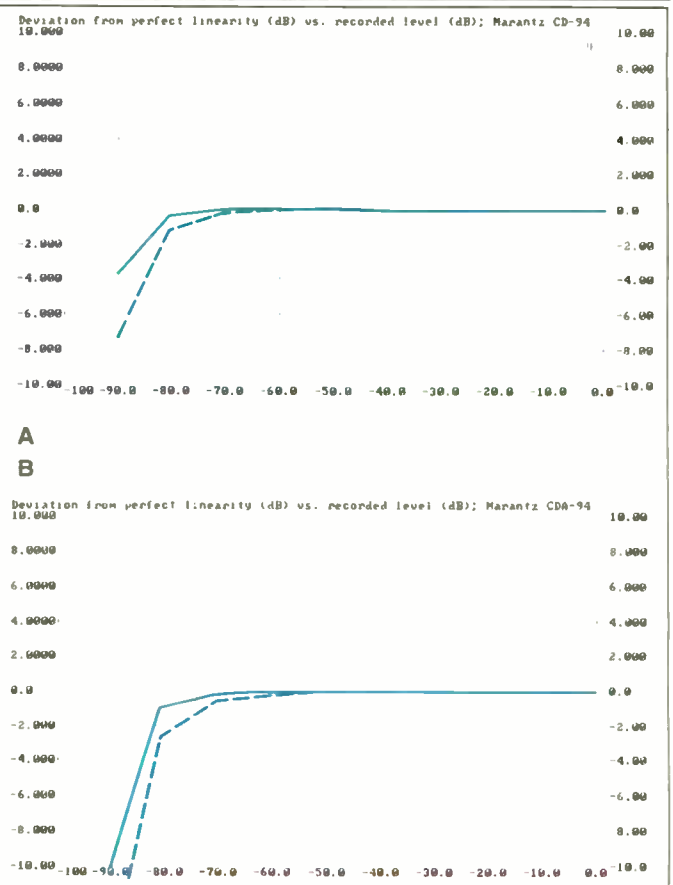
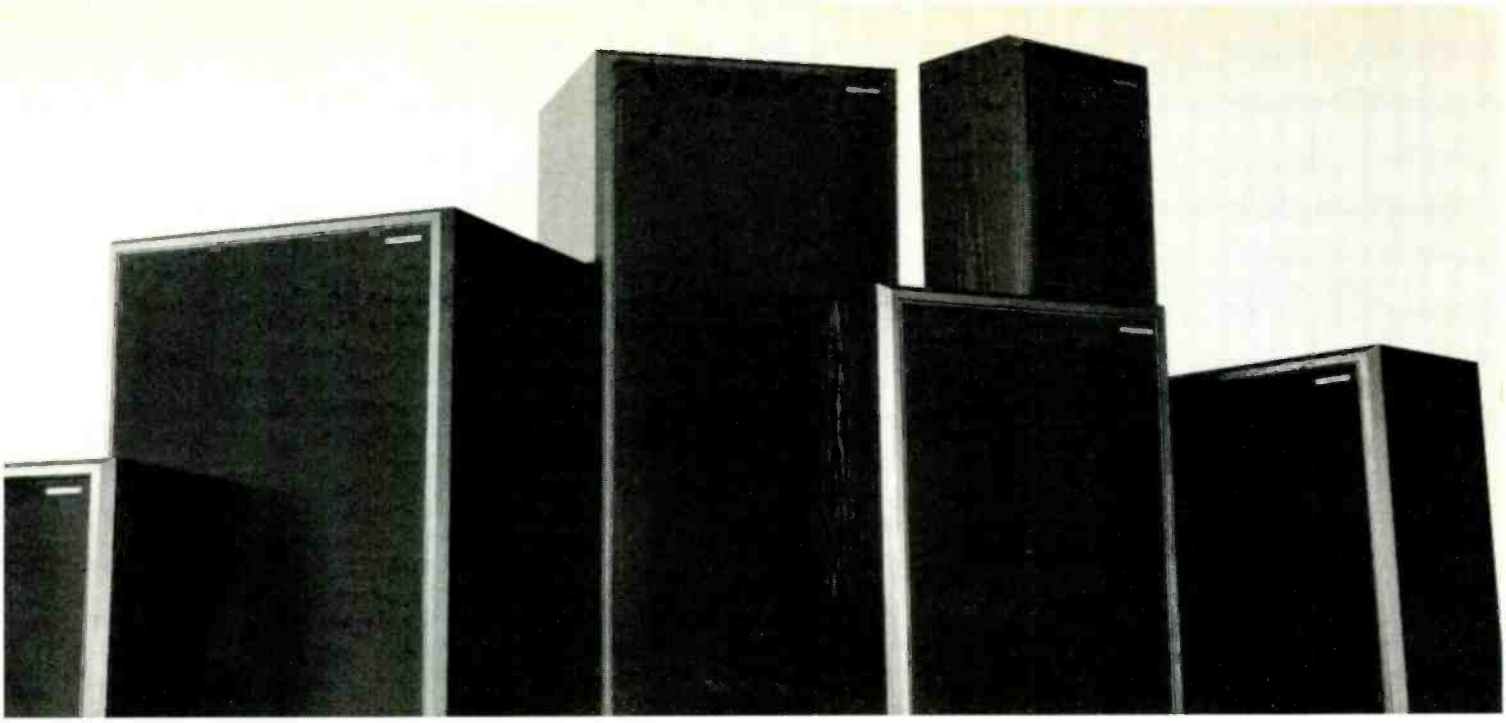


Fig. 8—Deviation from perfect linearity for undithered signal, using the player alone (A) and the combination (B).

CD-94/CDA-94 combination (Fig. 2B). One advantage claimed for the CDA-94 did show up when I measured overall A-weighted S/N ratio for both hookups. The player alone yielded −112.23 dB for the left channel and −114.53 dB for the right. Measuring S/N via the outputs of the CDA-94 yielded marginally higher figures: −115.56 for the left channel and −115.89 dB for the right. As I have pointed out in previous reports, these S/N results are really a measure of the analog output stage's noise characteristics instead of an indication of the effectiveness of the D/A conversion process. Track 4 of the CD-1 test disc is an "infinity zero" track; it does not exercise the D/A converter circuitry of a CD player or of a stand-alone D/A converter. So, what's been shown by this test is that the CDA-94 has a quieter analog stage than the CD-94. If you will recall, that was one of the claims Marantz made for this separate D/A converter. Figures 3A and 3B seek to determine in which section of the audio spectrum the CDA-94's analog stage excels in its low-noise characteristics. Using the ⅓-octave spectrum-analysis function of the Audio Precision test system, I plotted residual noise versus frequency for both setups. In the region between about 100 Hz and 2 kHz, it is clear that the CD-94 operating alone exhibited more residual noise, especially in the left channel.

Figures 4A and 4B show how THD + N varied as a function of recorded level. In these graphs, THD + N is shown as dB below maximum recorded level. Ideally, these curves should be virtually horizontal. In fact, you can see that at recorded levels approaching maximum, the analog section of the CD-94 begins to contribute distortion. At 0 dB, the overall THD + N is only 86.7 dB below maximum recorded level. For the CD-94/CDA-94 combination, the



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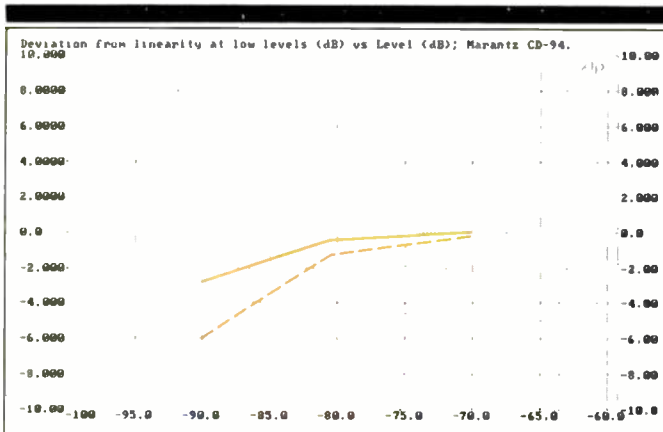
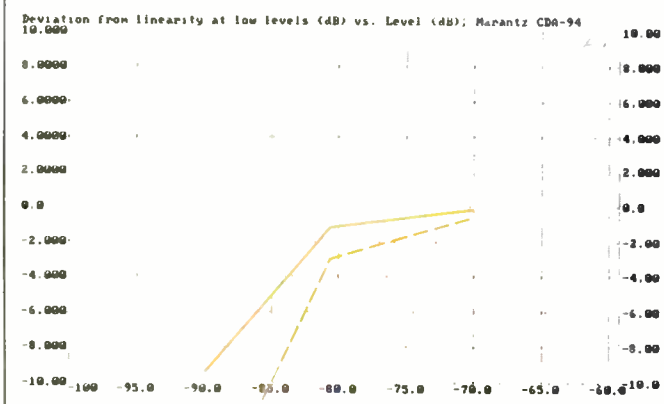
The D/A circuits on the CD-94 player and CDA-94 stand-alone converter are of the same type, but the CDA-94 is more elaborate.



A



B

Fig. 9—Deviation from perfect linearity for low-level, dithered signal, using the player alone (A) and the combination (B).

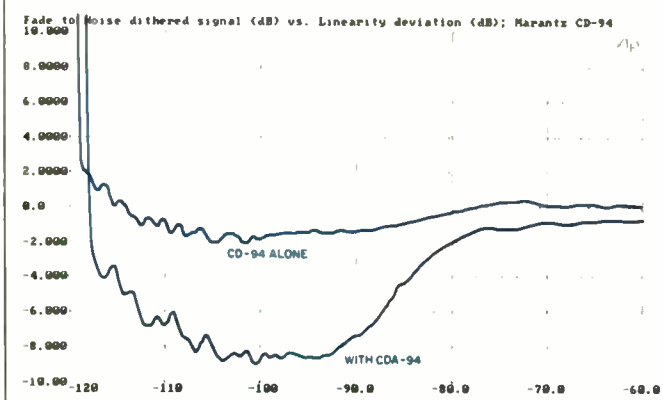


Fig. 10—Linearity deviation for EIA "fade-to-noise" test of dynamic range, using dithered signal.

results at maximum recorded level are −88.5 dB for the left channel and −89 dB for the right channel. These figures show that although the CDA-94 D/A converter has higher noise and distortion at all levels below about −18 dB, its analog output section has a bit more headroom than does the CD-94 Compact Disc player's.

For a signal recorded at 0-dB (maximum) level, THD + N at 1 kHz measured 0.006% for the player alone (Fig. 5A). Using the combination, THD + N for the same test tone was slightly lower for the left channel, 0.004%, and even a bit lower for the right (Fig. 5B). I was disappointed, though, in the fact that at 20 kHz, the "beats" associated with most (but not all) CD players were present, regardless of whether I measured the CD-94 alone or with the D/A converter. In either case, apparent THD + N was 0.2% at 20 kHz. Of course, this higher figure does not represent actual harmonic distortion. It is a measure of the beat-frequency component that shows up when a 20-kHz test signal combines with the CD's sampling rate of 44.1 kHz to create a spurious out-of-band component at 24.1 kHz (Figs. 6A and 6B). For both hookups, the 24.1-kHz beat was exactly 40 dB below the desired 20-kHz signal. Using the CDA-94 offered no advantage here.

Figures 7A and 7B show how separation varied with frequency for both test setups. In these figures, both channels are represented by solid curves, and there is virtually no difference between left and right. For the CD-94 alone, separation at 1 kHz was 112 or 113 dB, depending on the channel measured. At 16 kHz, this player offered 108 or 109 dB. Surprisingly, separation for the combination was somewhat less than that of the CD-94 by itself, although the results were still more than adequate for excellent stereo, by anyone's criteria. Despite the extra care taken in the construction and layout of the CDA-94 as described by Marantz, it is nonetheless interesting to note that separation for the combined setup was around 105 dB at 1 kHz and just under 100 dB at 16 kHz.

Figures 8 through 11 are all concerned with the characteristics of the digital-to-analog converters used in the CD-94 and the CDA-94. In particular, these figures give us some idea about the linearity (or lack of it) of the D/A converter components in these two units.

For Figs. 8A and 8B, I first measured the linearity of the systems from 0 dB (maximum recorded level) to −90 dB, using a track of the CD-1 test disc that contains undithered signals at gradually decreasing discrete recorded levels. Then, rather than plot the results as input versus output, I let the Audio Precision test system translate the results into deviation from linearity, which is much easier to interpret. Using these undithered signals, linearity of the CD-94 was excellent down to −80 dB. However, as expected, the player departed from linearity for the −90 dB recorded level by a modest 3.8 dB in the left channel and 6.5 dB in the right. In the case of the CDA-94, deviation from perfect linearity was greater at −80 dB than it was for the CD-94, and was off the graph at −90 dB. I am forced to use the test disc's entire undithered sweep, from 0 to −90 dB, even though undithered signals do not give very meaningful results below −80 dB for this test. Therefore, I didn't draw any final conclusions about the CDA-94's performance. Yet con-

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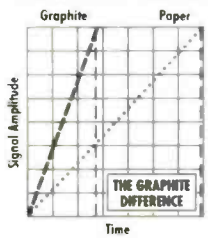

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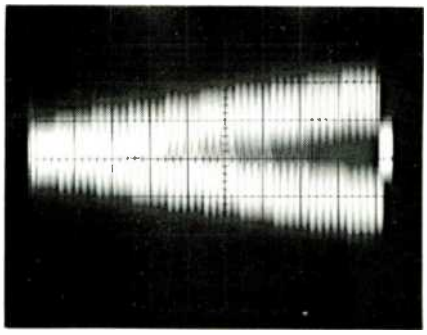

A
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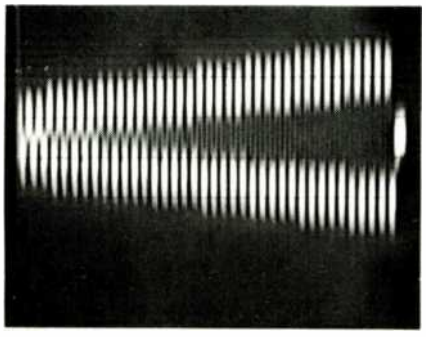
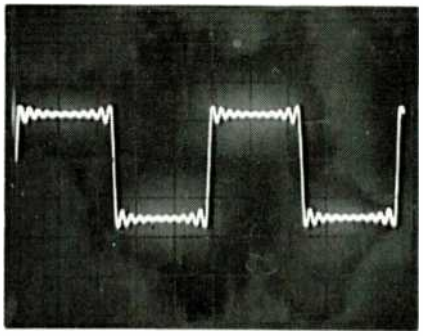


Fig. 11—Monotonicity test for the player alone (A) and for the combination (B).



A
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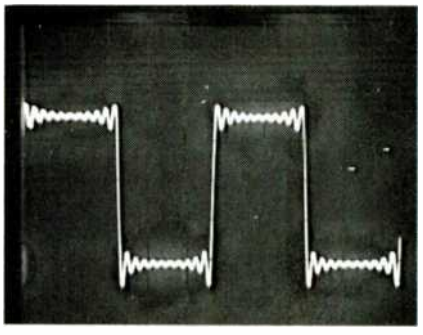

Fig. 12—Reproduction of 1-kHz square wave by the player alone (A) and by the combination (B).

sider what happened when I used dithered signals to check low-level linearity. For the player, the deviation was less than 3 dB at the −90 dB level for the left channel and nearly 6 dB for the right (Fig. 9A). Now take a look at Fig. 9B. These results were obtained using the CDA-94 as the D/A converter and applying the same low-level, dithered signals from the test disc. Once again, the CDA-94 curves fall off the graph.

On the "fade-to-noise" signals of the test disc, the signal starts out at −60 dB and fades linearly into the noise level, or down to −120 dB, in less than 30 S. A special procedure of the Audio Precision test gear translates this changing signal into a plot of deviation from linearity, and, as you can see in Fig. 10, the CD-94 operating by itself is far and away the winner in this case, too!

The last test track of the CD-1 is called a monotonicity test. Ideally, in Figs. 11A and 11B, you should see the signals rising in equal steps, with the negative-going signals having the same amplitude steps as the positive-going signals. For the player alone, this was essentially true. In Fig. 11B, using the separate converter, you can see that the second, third, and fourth steps from the left exhibit an asymmetry between their top and bottom edges. This suggests less than perfectly linear operation of the CDA-94's D/A converter components.

Theory tells us that the maximum dynamic range that one can obtain using the EIA's proposed method of measurement (assuming "perfect" D/A converter chips) is just over 98 dB. Readings of more than 98 dB actually indicate nonlinearities in the D/A chips. Based on the fade-to-noise test discussed earlier, I would have come up with a much higher dynamic range figure. This suggests again that the D/A chips in both the CD-94 and the CDA-94 are less than perfect, with the chips in the CD-94 the better of the two. Using the simpler EIAJ method of computing dynamic range, I came up with readings of 87.1 dB for the CD-94 and an even better figure of 92.7 dB for the left channel and 95.9 dB for the right with the CDA-94. The player, as might be expected, exhibited no measurable level of wow and flutter, and clock accuracy was within 0.0139% of being perfect.

....remarkable!

par.a.digm (par'adim) *noun: serving as an example or model of how something should be done.*

Every once in a great while a product comes along that offers performance which rises above the current variety of clever designs and marketing hype. When this occurs the new level of performance achieved can be readily heard by both the ardent audiophile and the novice listener.

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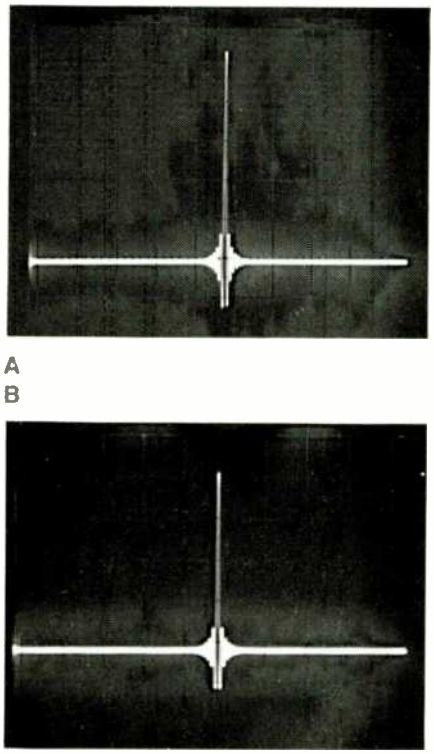
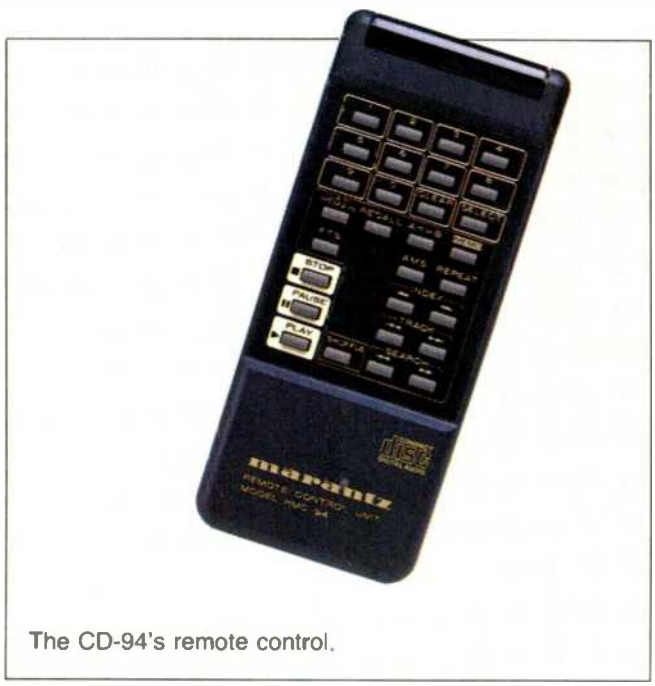
The performance differences between the player and the player/converter combo are more visible in the graphs than they were audible.



A
B

Fig. 13—Single-pulse test for the player alone (A) and for the combination (B).



The CD-94's remote control.

Figures 12A and 12B show how a 1-kHz square-wave test signal was reproduced by the CD-94 alone and by the combination. The vertical scales on my oscilloscope were set a bit differently for the two photographs, but I could detect no significant difference between the two resulting waveforms. The same held true for Figs. 13A and 13B, which show how a unit pulse was reproduced in both test setups. In testing the CDA-94, it was gratifying to note that the polarity of the unit pulse was correct when the unit's phase-reverse switch was in its normal position.

Use and Listening Tests

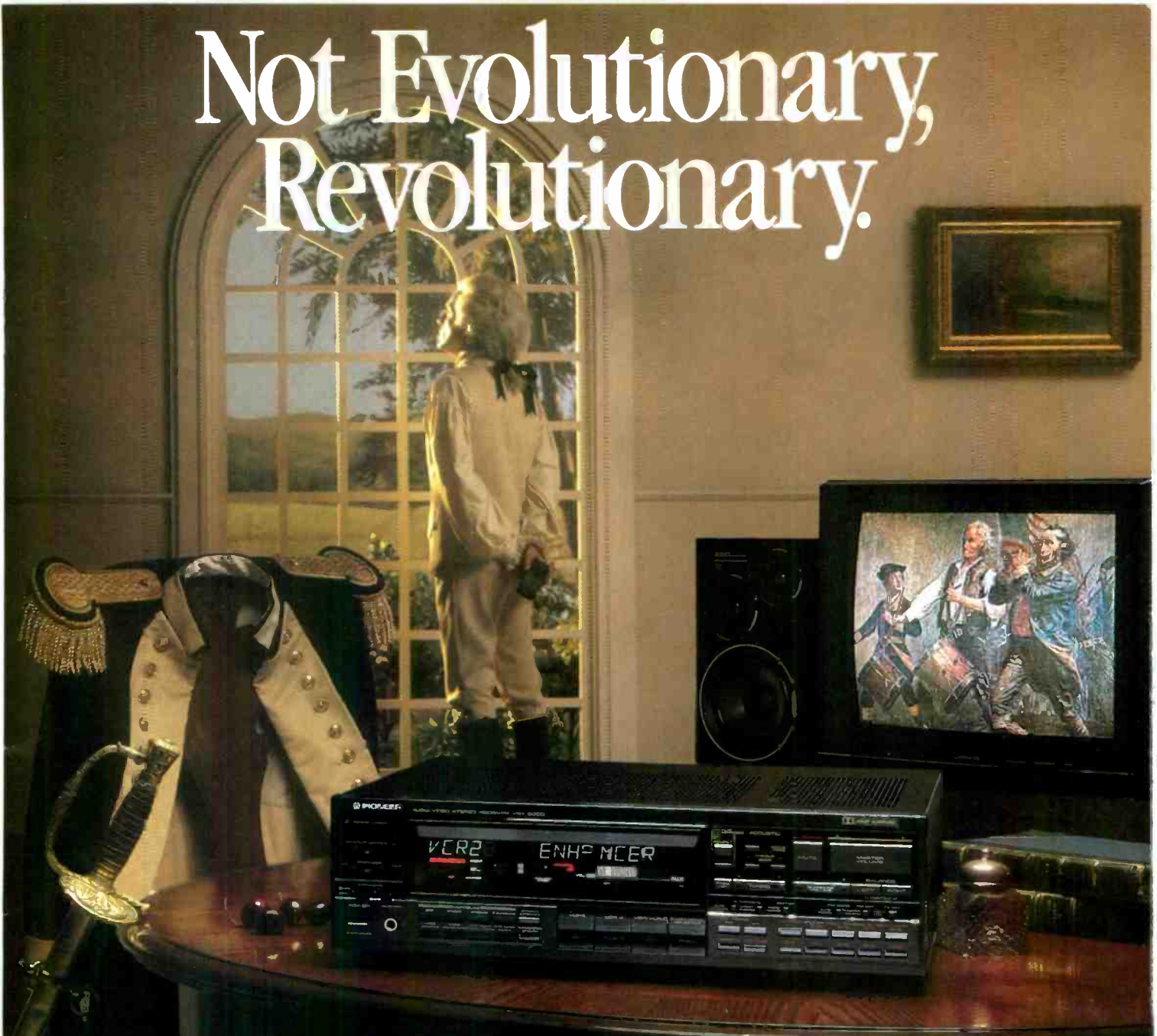
I listened extensively to the CD-94, operating alone, and was very pleased with what I heard. I have recently acquired a new set of reference loudspeakers, the Infinity RS 9 Kappa units, and I must say that it has taken me awhile to get used to their awesome bass response and somewhat more brilliant high end. All of us tend to get used to our loudspeakers, and when we finally change (and we surely must from time to time, as the state of the art improves), it takes a period of adjustment to become familiar with their "new" sounds. Nevertheless, given some of the most recent CDs in my collection, such as a Telarc recording of Mozart's Symphonies Nos. 25, 28, and 29 (CD-80165) and a Delos recording of Rachmaninoff's Symphony No. 2 (DCD-3071), it was obvious that I was dealing with a good-sounding CD player. Moreover, its many conveniences—such as Favorite Track Selection, shuffle play, and extensive programming facilities—make it one of the more full-featured players that have passed through my lab and listening room recently.

The real evaluation started when I hooked up the CD-94/CDA-94 combination. All listening tests for this pairing were done using optical coupling between the two units. I selected this method because Marantz and others claim that it will provide audibly better results than a wired digital-to-digital connection. (The same hookup mode had been used for the bench measurements.)

During normal listening, I could not detect any difference in sound quality between the two setups. Oh, every once in awhile, I seemed to think that one or the other sounded better on certain passages of music, but with careful level matching, I found it almost impossible to favor one hookup over the other in an overall sense. There were moments, in the quieter passages of the Rachmaninoff recording, when I felt that the CD-94 alone provided a cleaner, more transparent sound. Switching to the combination, during those same quiet passages, seemed to add a bit of sheen to the string sounds. Though not unpleasant, the string sound did not seem totally lifelike to my ears.

The CD-94 does not boast the linearity of some other high-end players I have tested recently, yet it certainly has many compensating features that may justify its high price. I'm afraid the same cannot be said of the CDA-94 converter. If the sample I tested is representative of the full production run, I can see only one reason for spending as much money to own this component as for the player alone: The need for D/A conversion of sampling rates other than the CD's 44.1 kHz. Even so, there are other D/A converters that cost less and do a better overall job. Marantz seems to have batted .500 with this pair. *Leonard Feldman*

Not Evolutionary, Revolutionary.



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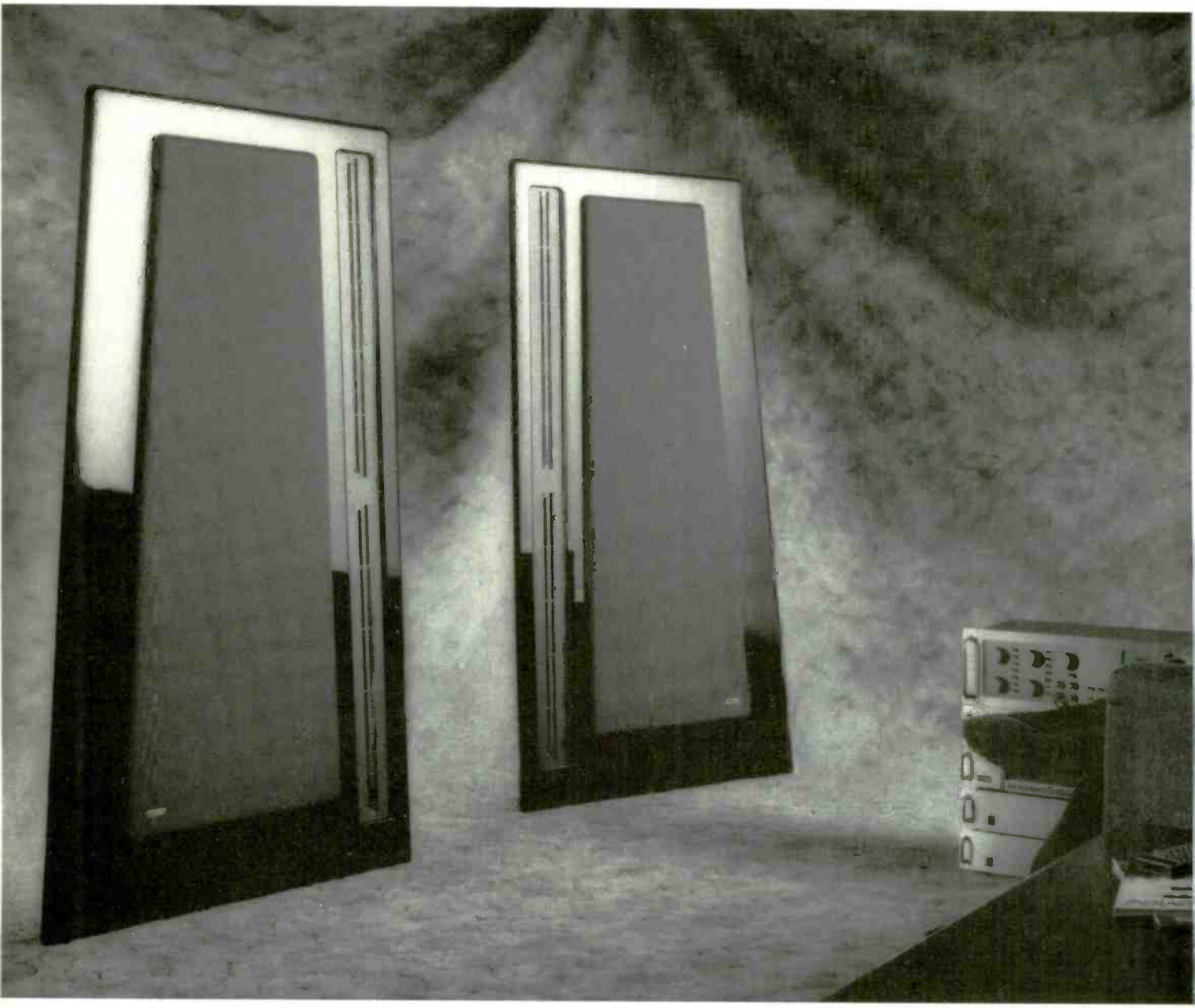

How it works. A brief conversation with Bob Carver.

Q. How can The Amazing Loudspeaker put out so much powerful, extended bass?

A. Brute force. A total of 8 subwoofers, each with 4 times the excursion of regular bass drivers for a total displacement (area times excursion) of almost 2000 cubic inches. The low frequency 3dB point is 18Hz!

Q. Why use a ribbon driver?

A. Because the sound of a ribbon is nothing short of glorious! Free of individual driver anomalies and crossover problems, the Amazing Loudspeaker's extended line source driver delivers a majestic sonic image that literally floats in 3-dimensional acoustic space. Simultaneously, it reproduces an amazing amount of musical detail that's simply unmatched by any point source driver.

POWERFUL

Distributed in Canada by: evolution technology

This is not a typical speaker ad. Because The Amazing Loudspeaker is anything but a typical speaker.

This isn't even a typical *Carver* ad.

True, the Amazing Loudspeaker breaks so many conventional speaker rules — and succeeds so spectacularly at it — that we're tempted to fill this ad with a litany of hertz, watts and exotic buzz words the way our competitors' ads do.

"Its overall sound is spectacular, its bass performance surpasses that of almost any other speaker one might name."
STEREO REVIEW

Because there's bound to be quite a story behind a speaker that's 5½ feet tall and yet just 1½ *inches* thick. Especially when Bob Carver has a hand (or rather two hands, both feet and a year or so of lab time) in its creation.

But ingenious design is only our means to an end. The beginning of a dramatic awakening that will re-define for you the very essence of music.

"The image is as wide, deep and multi-layered as I have ever heard. Only Infinity's $35,000 Reference Standard impressed me more."
Henry Hunt
Hi Fidelity Editor
HOUSTON POST

The Amazing Loudspeaker can etch a sonic image so detailed you can almost see rosin drift from a bow onto the polished surface of a violin.

It can brighten your listening room with the sheen of a #4A drumstick on a Zildjian hi-hat cymbal. Or darken it with the smokey midnight growl of a battered baritone sax.

It can stun your senses and rearrange your furniture with thunderous salvos of tight, perfectly controlled low bass.

"It solves certain design problems and achieves certain sonic results with a simplicity and flair that can only be called, well, amazing."
Peter Aczel
THE AUDIO CRITIC

It can meticulously separate every instrument and vocal on a dense, multi-track mix and project each in sharp relief at precise points across the sound field.

In short, the Carver Amazing Loudspeaker restores what time and reading too many speaker ads often takes away.

Sheer wonder.

"It's price is ridiculously low for what it does and... what comparable products cost."
Julian Hirsch
STEREO REVIEW

We have merely touched on the highlights of this truly amazing loudspeaker. We'd be happy to send you more information including reprints of several great reviews.

However, if your immediate interest is the sensation of a listening room melting away to reveal the crystalline clarity of pure music, you need only visit your nearest Carver dealer.

Your amazement will begin when you discover just how affordable the Carver Amazing Loudspeaker really is.

Q. But aren't ribbon drivers inefficient?

A. Not when designed with enough magnetic field strength. Each Amazing Loudspeaker ribbon uses 30 feet of high energy magnets in a special focused field gap. At 82dB efficiency, that's almost twice as efficient as any other ribbon that goes down to 100Hz. Our M.100 power amplifier yields peak SPLs exceeding 106dB, up to 110dB with an M.1.5t. More than ample to deliver a symphonic orchestra's sonic power, fifth row center.

CARVER

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3

NAKAMICHI CR-4A CASSETTE DECK

Manufacturer's Specifications
Frequency Response: 20 Hz to 21 kHz, ±3 dB.
THD: Type IV tape, 0.8%; Types I and II tape, 1%.
S/N Ratio: 66 dBA with Dolby B NR, 72 dBA with Dolby C NR.
Separation: 37 dB at 1 kHz.
Crosstalk: 60 dB at 1 kHz.
Erasure: 60 dB at 100 Hz.
Input Sensitivity: 50 mV.
Output Level: Line, 500 mV; headphone, 5 mW into 8 ohms.
Wow & Flutter: 0.027% wtd. rms, ±0.048% wtd. peak.
Fast-Wind Time: 80 S for C-60 cassette.
Dimensions: 16 15/16 in. W × 3 15/16 in. H × 10 7/16 in. D (430 mm × 100 mm × 265 mm).
Weight: 13 lbs. (5.9 kg).
Price: $995.
Company Address: 19701 South Vermont Ave., Torrance, Cal. 90502.
For literature, circle No. 92

Nakamichi's CR-4A deck features their discrete three-head recording system. The manufacturer emphasizes that this configuration—with physically separate record and playback heads—offers a number of advantages. Among them are the ability to align each head gap individually for the best magnetic performance, and superior isolation between record and playback. Nakamichi also states the design gets more accurate results from the deck's manual bias and calibration system. The transport is an asymmetrical dual-capstan design for minimum wow and flutter.

Both Dolby B and C NR are included, with an MPX filter that can be defeated for more extended high-frequency response. The CR-4A provides a manual change of equalization; use of 70-μS EQ with Type I tapes will reduce noise, while using 120-μS EQ with Types II and IV will increase high-frequency headroom.

Control Layout

The front panel has the typical Nakamichi look, light-gold lettering on a black background. The combination of colors gives good legibility over a wide range of lighting levels. The eject button is at the upper left of the panel, with the power on/off button and the gold-plated headphone jack below. The cassette compartment door opens smoothly with a push of "Eject." Access for cleaning and demagnetization is fair, becoming excellent with the removal of the cover. A push of the play button will move the head assembly up and start the dual capstans driving the pinch rollers even if no tape is in place. This can be helpful in cleaning the tape path, but caution is needed to ensure that nothing gets caught between a capstan and a pinch roller.

The cassette carrier is not as rugged as it might be, but its metal and plastic frame is more rigid and more accurate than the typical all-plastic ones. When the door is pushed closed, the supply hub spins in the rewind direction to remove any tape slack. If the tape is already snug, there is substantially no motion to affect cueing. A light in the compartment makes it easy to see the status of the tape pack.

The head assembly is well constructed, and there are some eye-catchers in the tape compartment, too: Nakamichi tape guides, the pressure-pad lifter, and the matte finish of the capstans for better tape gripping. I would be remiss if I didn't mention the accessibility and extent of the head assembly adjustments, although I'm not encouraging users to fool with them. Too many decks cannot be adjusted easily for best performance, even by service technicians.

To the right of the tape compartment, along the top, is the display panel. On the left is the green-LED, four-digit counter, and to its right, the green-LED horizontal peak-responding meters, with 13 segments for each channel. The normal scale, which is between the channel-level displays, extends from −40 to +10 dB, a fairly broad range. I found the gold-colored numbers easy to read up to −5, but the red numbers for 0 and above were a bit obscure.

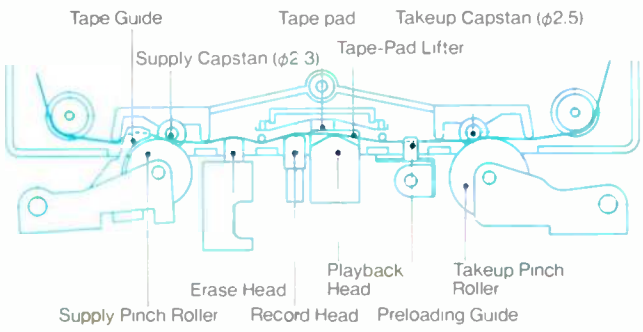
In "Calibration" mode, the meter scales are expanded, as indicated by small numbers reading from −10 to +5, with "Cal" at meter zero. The top LED display, normally for the left channel, is used for "Bias"; the bottom one, normally for the right, indicates "Level." (A discussion of calibration procedure will follow.) To the right of the meter display are four small, green status indicators for "Monitor" ("Source" and "Tape") and "Dolby NR" ("B-Type" and "C-Type").

Below the display panel, from left to right, are the counter reset button and three-position switches for the tape-counter memory and for operation with an external timer. The "Memory" switch selects "Memory Stop" at 0000, "Off," or "Auto Repeat" (which rewinds from the tape's end to counter zero and then replays until the function is turned off). The "Timer" switch selects "Play," "Off," or "Rec."

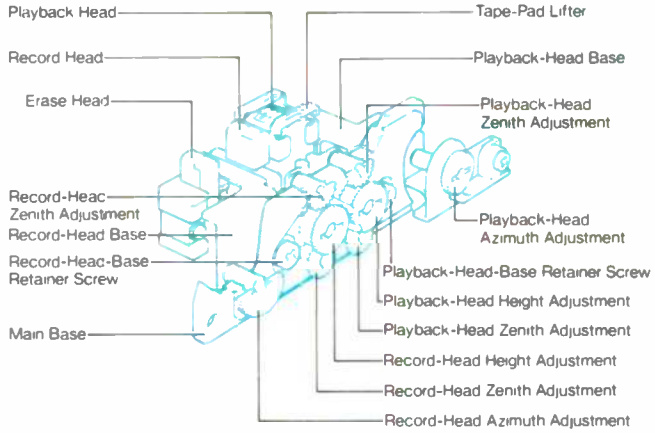
Next on the right is the "Monitor" ("Tape/Source") pushbutton and the momentary-contact "Rec Mute" button with its red-LED indicator. This button must be held in as long as muting is desired; the CR-4A does not automatically mute for a period of 4 S, then stop the tape, as many other decks do. It is true that this Nakamichi deck does not have a search mode to stop fast-winding when it detects such 4-S spaces, but its automatically timed muting is very helpful for spacing a series of selections as well as for making tapes to play on decks which do have search modes.

Below the buttons and switches are the large, angled transport buttons. From the left are rewind, stop, play, fast forward, pause, and record, each of which has a large function symbol on its face. Stop, play, and pause also have good-size green LEDs inset into their top edges, and record has a similar indicator in red. It is possible to switch directly between play and the fast-wind modes without pressing the stop button, but the deck will stop itself very briefly for the transport cam to do its work. Record mode, however, can only be entered from stop mode; it is not possible to go into record from either pause or play, though that would certainly be helpful to some users. A push of the record button puts the CR-4A into record-pause mode; pushing the play button then initiates recording.

Below the transport buttons are eight pushbutton switches and two knobs. To the left are the interlocked "Tape Selector" (bias) buttons for "EX(I)," "SX(II)," and "ZX(IV)." I'm a little surprised to see that manual bias selection is



The transport features dual capstans, three discrete heads, and a tape-pad lifter.



Multiple adjustments allow service technicians to tweak the CR-4A's head alignment with extreme precision.

The transport was fairly quiet in fast wind and outstandingly quiet during playback or recording.

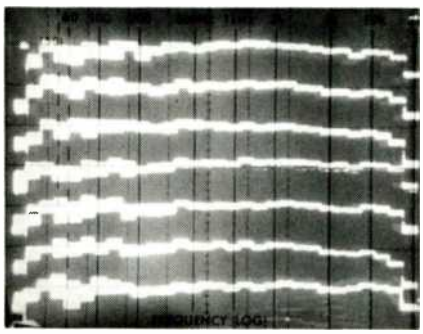


Fig. 1—Record/playback response to "PN/Music" test signal (see text), recorded with Dolby C NR. Top three traces recorded at rms levels of +5 dB (+10 on CR-4A's meter), using Nakamichi EXII, SX, and ZX tapes, respectively, and with bias- and level-calibration pots at center detents. Next three traces recorded at rms levels of 0 dB (+7 on the meter), using the same tapes and calibration settings. Bottom trace is for ZX tape, at an rms level of 0 dB, after slight bias trim. (Vertical scale: 5 dB/div.)

required, but the inclusion of the "EQ(μSec)" switch (next on the right), with its choice of "120/70," is consistent with the manual bias switching. There are advantages in being able to select equalization for the best overall results with the music being recorded. I would have liked, however, to have a red indicator go on whenever the EQ choice was not the normal one for the tape type in use.

To the right of the EQ switch are the "Calibration" pots—"Bias" to the left, "Level" to the right, and an "Off/On" button in the center. (A small red LED indicates "On," which is very important since it is impossible to record while in calibration mode.) The pots have definite center detents, perhaps slightly too stiff. The knobs are somewhat small and have smooth surfaces; a larger size or some light knurling would make them easier to turn.

Calibration is started by going into record-pause mode, resetting the counter to zero, and turning on "Calibration." (Dolby NR should be off.) Pushing the play button starts the actual recording of the deck's two test signals. The average 15-kHz level for the two channels is shown on the top ("Bias") meter, and 400-Hz on the bottom ("Level") meter. As mentioned earlier, these meter scales are expanded to facilitate making accurate adjustments. The position of the "Monitor" switch has no effect on the display: In calibration mode, playback is always shown. First, bias is adjusted to make indications for the upper and lower meters the same. Then, level is adjusted so the lower display matches "Cal." If necessary, bias is readjusted to get the upper indication exactly to the "Cal" mark. Finally, turning off "Calibration" triggers an automatic rewind to counter zero in preparation for actual recording.

To the right of the calibration controls are pushbutton switches for "Dolby NR" ("Off/On" and "B/C") and "MPX Filter." All front-panel button switches have a good feel, but their status is a bit hard to see in dim light because the controls are the same color as the panel.

Furthest to the right along the bottom is the "Output" level control—always a good thing to include, in my view. Above it are concentric, large-knobbed "Master" and "Balance" recording-level controls. The "Balance" ring, which is larger and to the rear, has a nice, soft center detent. This control functions by attenuating the channel opposite the direction in which it is turned: Turning the knob to the left, for example, lowers the level in the right channel. I expect that its use would become quite natural after awhile.

The back panel has the expected stereo in/out phono jacks, which have nice gold-plating. Also on this panel is a system-remote DIN-type socket which can be connected to either the RM-5 wired remote or to other Nakamichi components equipped for system remote operation.

I got a look inside the CR-4A by removing its top and side cover. One large p.c. board covered about three-quarters of the chassis area. Two other boards were at a higher level: One held most of the power-supply components, and the other carried the meter and calibration circuits. A vertical board was behind the meters and controls, and several small boards were placed at various points.

Parts quality was high, and all were identified clearly with white lettering. Some of the boards were a bit springy, but in general they were well supported. The soldering was excellent, with substantially no flux—except at the hand-soldered points. Interconnections were made with multi-pin plugs and sockets, using either ribbon cable or bundled single wires.

The transport was fairly quiet in fast-wind and outstandingly quiet in play or record. The two flywheels, each driving a capstan, are of good size, which should aid smooth tape movement. The cam action appeared to be quick and efficient, and it certainly was quiet. I judged the general construction of the rotating elements and support structure to be rigid and reliable.

The power transformer, which was mounted on a side rail near the back panel, had a surrounding shield. After a period of use, the shield was just warm to the touch. A p.c. board on the rail next to the transformer provided clip-mounting for three fuses. The two side rails greatly helped to make the overall construction rigid. With the cover in place, it was even better.

Prism Effect

What has prism effect, a refractive phenomenon, to do with audio equipment?

Nothing, except that it is the simplest analogy to describe what our sophisticated XM-3* Mobile Electronic Crossover does to audio signals.

When an ordinary ray of white light passes through a prism, it is systematically separated into the primary colors of the spectrum—optically much more aesthetic than the original light.

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*Patent pending

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The CR-4A's response goes low enough for organ music, which reduces distortion at higher frequencies, too.

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
Nakamichi EXII	9.9	21.5	9.9	24.9	9.9	12.0	9.7	26.0
Nakamichi SX	9.9	13.9	9.6	23.5	10.0	9.6	9.5	24.6
Nakamichi ZX	9.8	25.3	9.6	26.0	9.7	17.0	9.5	27.1

Table II—Miscellaneous record/playback characteristics.

Erasure At 100 Hz	Sep. At 1 kHz	Crosstalk At 1 kHz	10-kHz A B Phase		MPX Filter At 19.00 kHz
			Error	Jitter	
68 dB	42 dB	−90 dB	15°	±10°	−29.6 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%
Nakamichi EXII	Dolby C	0.11	0.17	0.32	0.58	1.3		+6.0
Nakamichi SX	Dolby C	0.13	0.19	0.40	1.12	3.0		+4.0
Nakamichi ZX	Dolby C	0.07	0.11	0.22	0.56	1.15	3.0	+8.0

Measurements

The playback responses with TDK (120-μS) and BASF (70-μS) calibration tapes were within ±1.0 dB, relative to the level at 315 Hz, from 63 Hz to 12.5 kHz. There was some rise in responses at the lowest frequencies because of fringing from the full-width test tapes. There also was a rise in level at the highest frequencies with the Type II and IV tapes, reaching +2.7 dB at 18 kHz. The tape play speed was as accurate as I could measure, closer than ±0.1%. Dolby play level indicated zero on the meter, as it was supposed to for the Nakamichi deck.

Quick checks in calibration mode showed that the level pot had a range from −3.4 to +2.6 dB at 400 Hz, and the bias-level control could adjust the 15-kHz level from −4 to +3 dB, both relative to the center-detent position with Nakamichi ZX (Type IV) tape. I needed a little calibration myself, as I had expected that rotating the bias pot to the right would increase bias and drop the 15-kHz level. Actually, rotating the pot to the right *decreases* the bias, which *increases* the 15-kHz level. Thus, the bias meter indication changes in the same direction as the pot is turned, just as the level indication does with its pot.

Nakamichi supplied samples of their EXII, SX, and ZX tapes, but I really wanted to see how well the manual-bias and level-calibration process would work with a wide variety of formulations. I made my tests using pink noise as the source, and switched on the deck's Dolby C NR, which emphasizes any response and level deviations. I had to roll-off the pink noise at 25 kHz to prevent in-band modulation; in the real world, there would be no energy this high, except perhaps with some wild synthesizer setting.

Calibrating the deck to each tape was a speedy process requiring just a few seconds—unless the tape was near the extremes of the deck's bias and/or sensitivity ranges. The CR-4A provided substantially exact matches, with very flat record/playback responses for 75 out of the 78 tapes I tried. The minimum bias setting was too high for a Fuji ER (Type I) tape I had on hand, and there was a 3-dB peak at 20 kHz with the Type II Memorex CDX and Triad EM-X formulations. This peak seemed to correspond to the one at 18 kHz which I measured in my playback-response tests, but these were the only two tapes which produced such obvious peaks.

Record/playback responses were measured with my latest version of "PN/Music," which is flat on a third-octave basis from 25 Hz to 2 kHz. It then rolls off to a shelf of −8 dB from 5 kHz to 16 kHz, with a further roll-off at 20 kHz. This frequency envelope is very close to that for the most challenging music. Compensating equalization was used on the deck's output, so my analyzer would show a flat display when response was flat, except for the drop at 20 kHz. Tests were made at rms levels of 0 dB (which made the peak-reading meter's +7 LED flash) and 5 dB (which made the +10 LED glow steadily). At the higher level, the results showed some occasional clipping of the highest peaks in the deck's output.

Figure 1 shows the record/playback responses; the traces for +5 dB are at the top (EXII, SX, and ZX, from the top down), followed by the three 0-dB responses in the same order. These traces all show response with the deck's calibration pots at their zero detents. The bottom trace shows response for ZX after I turned the bias pot slightly to the right to get exact calibration. All these responses are admirably flat, and the higher level responses demonstrate the value of Dolby C NR at the highest frequencies. Table I lists the −3 dB limits with a sine-wave test tone for the three tapes, with and without Dolby C NR, at Dolby level and at −20 dB. The value of Dolby C NR at higher levels is further demonstrated, and the reduction in the roll-off points at −20 dB with NR is minor indeed.

Except for the roll-offs at the frequency extremes, the record/playback responses at −20 dB for EXII and SX were flat within ±0.5 dB. The ZX response met the same limits, except for a sharp 2-dB peak at 22 kHz. The 10-Hz low-frequency limits are typical for a Nakamichi deck but quite unusual in general. The lowest frequencies of most music, of course, are octaves higher than this, but the CR-4A's 10-Hz response allows recording the lowest organ tones and reduces distortion at higher frequencies as well.

Bias in the output during recording was very low. Table II lists some miscellaneous record/playback test results. The 68-dB erasure of ZX metal tape at 100 Hz is excellent, one of the best I have ever measured. The 42-dB separation is good, and the crosstalk was at least 90 dB down. The interchannel phase error and jitter were also excellent. The attenuation of the MPX filter was a very good 33.9 dB at 19.16 kHz, but it was a bit less effective at 19.00 kHz, where I measured 29.6 dB. The frequencies of the calibration tones for level setting and bias adjustment were very close to 400 Hz and 15 kHz, respectively.

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There were few audible clues as to whether I was listening to the tape or the source, even when I switched back and forth.

Table IV—MOL vs. frequency.

Tape	NR	Frequency (Hz) 40	100	400	1k	2k	4k	6k
Nakamichi EXII	Dolby C	+4.7	+6.8	+6.0	+5.3	+4.6	+3.6	+0.6
Nakamichi SX	Dolby C	+2.1	+4.2	+4.0	+2.9	+2.0	+0.1	−2.6
Nakamichi ZX	Dolby C	+5.5	+8.1	+8.0	+7.2	+6.0	+3.4	+0.4

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

	IEC A Wtd. (dBA)				CCIR/ARM (dB)			
	W/Dolby C NR		Without NR		W/Dolby C NR		Without NR	
Tape	@ DL	HD=3%	@ DL	HD=3%	@ DL	HD=3%	@ DL	HD=3%
Nakamichi EXII	66.4	72.4	51.7	57.3	68.4	74.4	49.4	55.0
Nakamichi SX	69.8	73.8	57.2	60.6	71.7	75.7	55.9	59.5
Nakamichi ZX	68.7	76.7	55.0	62.6	71.1	79.1	53.3	60.9

Table VI—Input and output characteristics at 1 kHz.

Input	Level Sens.	Overload	Imp., Kilohms	Output	Level Open Ckt.	Loaded	Imp., Ohms	Clip (Re: Meter 0)
Line	49 mV	>31 V	36	Line	490 mV	415 mV	2.1k	+19.3 dB
				Hdphn.	500 mV	398 mV	13	

Table III shows the third-harmonic distortion (HDL_3) for the three tapes at 400 Hz with Dolby C NR. The lowest amplitude was 10 dB below Dolby level and was increased in each case until the output showed HDL_3 had reached 3%. Distortion was lowest with Nakamichi ZX tape, highest with SX tape.

In the past, I have measured HDL_3 across a frequency band from 50 Hz to 4 kHz or above, at a level 10 dB below Dolby, for one of the three tape types. Such results indicate how distortion increases at the frequency extremes, but I decided to change how I present this information (Table IV). First, I reduced the lowest frequency to 40 Hz, because recent tests have shown that a fair percentage of music has considerable energy down to this point. Then I measured the 3%-distortion MOLs for all three tapes, to give a better picture of the actual maximum recording levels with the various tapes.

The superiority of the ZX metal tape in the lower frequencies is quite apparent in Table IV, but notice that EXII is slightly better at 4 and 6 kHz. With music that has much high-frequency energy, it might not be possible to take full advantage of the ZX's *low-frequency* MOLs. All of the results are at least very good. Without Dolby C NR, distortion was generally about 10% higher.

Signal-to-noise ratios of the three tapes were measured with and without Dolby C NR, using both IEC A and CCIR/ARM weightings (Table V). The results are very good—and better than the specs—although they are lower than those for a few other decks, including some higher priced Nakamichi models. Some lower cost decks also have attained higher S/N ratios by restricting their high-frequency responses.

The input and output characteristics (Table VI) are basically right to specification. I would, however, prefer a lower output impedance to minimize loading when the CR-4A is feeding some professional equipment having 10-kilohm input impedances. The clipping level, relative to meter zero, is higher than for most decks—a desirable feature. With an 8-ohm load, the headphone output was 4.2 mW for each channel. High to very high levels were obtained on all of the headphones tried.

The two sections of the input pot tracked within 1 dB over an attenuation range of 60 dB down from the maximum-level setting—excellent performance. The sections of the output pot met the same criterion for a 50-dB range, which is quite good. Turning the balance control left reduced the level of the right channel—up to 56 dB at its maximum left setting. The control had a very good nonlinear effect: It reduced the level just 2 dB in the first 30° of rotation, and 10 dB at 90°. Balance controls which have a linear effect can be too touchy for fine adjustment of relative channel levels.

The CR-4A peak-responding meters have 13 light-green segments for each channel. Only 12 of these are effective level indicators, as the −40 segment is always on. Because of the inconsistent relative positions of the LEDs and the level numbers, I couldn't be certain what the turn-on thresholds should be for a number of the segments. Those that seemed obvious were all within ±0.5 dB of the calibrations. The steps below zero were somewhat coarse, but those above were each about 2 dB. This resolution is actually quite good, particularly as the meters are peak-responding and the maximum recording levels are above meter zero for the three tapes. I did, however, conclude that accurate level setting would be easier if the LEDs changed color above zero.

The frequency response of the meters was 3 dB down at 39 Hz and 16.5 kHz, which is a bit restricted, especially with the extended record/playback response of the deck itself. The meters actually responded faster than called for in the IEC Standard, if the continuous reference level was any more than a small fraction of a dB above the meter-zero threshold. The 20-dB decay time was 1.2 S—slightly shorter than the Standard. Overall, I judged that peak levels should be easy to read. The meters read higher with the tone-burst test signal offset in the negative direction, which is good. However, they were *not* higher with a positive offset, which means they are not fully peak detecting.

I had commented earlier that the tape play speed was very accurate. I also found that the deck was very resistant to changes in line voltage. Over a range from 110 to 130 V, the *greatest* change relative to 120 V *appeared* to be about +0.003% at 130 V. Tape-speed cyclic variations were ±0.01% at most, with a 0.7-S period. Flutter was 0.033% weighted rms and ±0.048% weighted peak; these results are both very good, even if the rms figure is slightly above specification. Fast-wind times were 64 and 99 S for C-60 and C-90 cassettes, respectively. Run-out to stop was less

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Users who want the best performance, rather than automated features, will find that the CR-4A offers good value.

than 2 S in fast wind, about 1 S in play. Changes in fast-wind direction, or going from wind to play, took 1 S or less.

Use and Listening Tests

The owner's manual is trilingual (English, French, and German), with illustrations correctly placed for each language. The material presented is succinct and lucid. Many users, however, would probably benefit from more discussion on how to tell when an equalization change would be in order. Additional details on setting record levels would also be helpful.

All of the switches and controls were completely reliable throughout the test cycle. I did have to remind myself occasionally to switch EQ after making a change in tape type. It would have been helpful if the positions of the pushbutton switches were more obvious. Timer start in play or record had about a 3-S delay before the transport started. Record mute worked as intended and the status LED was helpful, but I missed not having automatic mute timing and stop. The clicks from record, pause, and stop were muted in nature—hard to hear even with Dolby C NR in use and the output amplified greatly.

Calibration was very easy to do and took but a few seconds. I always remembered to switch it off because I always wanted to rewind to where I started. It did, however, take me a few times before I consistently remembered to set the counter to zero before starting calibration to ensure getting rewind to the right point. The dynamic responses of the meters were very good for setting levels with music, but a change in LED color at or above zero would have been helpful.

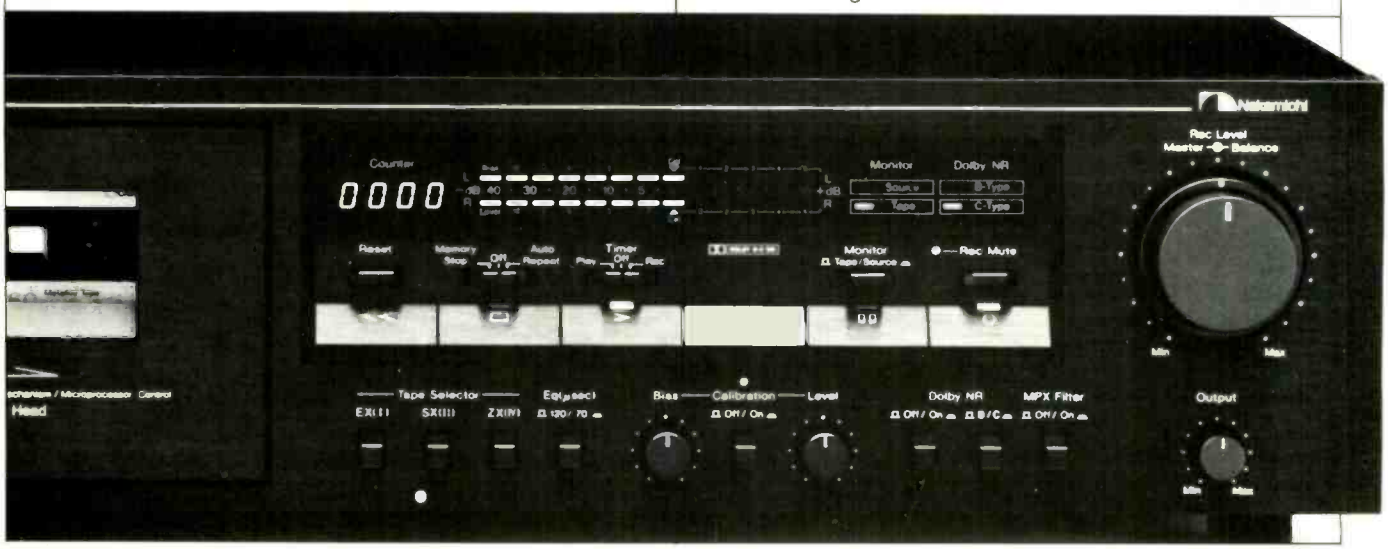
The record playback with pink noise covering the range from 20 Hz to 20 kHz was very close in sound character on all three Nakamichi tapes, with and without Dolby B and C NR. When switching back and forth between NR modes, or between tape and source, there were few audible clues as to which signal I was hearing. At higher levels, where the meters reached +7 and above, the roll-off with Dolby B NR and the improvement with Dolby C NR both became quite apparent.

Among the CDs used for sources were *Bach: The Organs at First Congregational Church, Los Angeles* with Michael Murray (Telarc CD-80088), André Previn and the Vienna Wind Soloists playing Beethoven and Mozart piano and wind quintets (Telarc CD-80114), and *Star Tracks* with Erich Kunzel and the Cincinnati Pops Orchestra (Telarc CD-80094). Bach's "Toccata and Fugue in D Minor" was a good track to demonstrate that the lowest frequencies in some music are what limit the recording level. Meter indications for the three tapes had to be made somewhat lower than Nakamichi's recommendations to ensure clean bass.

Because of their somewhat restricted spectral energy at both low- and high-frequency ends, the piano and wind quintets could be recorded up to the limits of all tapes. The best results did require keeping the peak levels measurably below the MOL figures given in the measurements section. By listening very intently and switching back and forth, I thought I might get indications of tape flutter. I didn't really hear anything that I could label as flutter, but there was greater clarity when listening to the CD directly. *Star Tracks* has a lot of treble energy, which I expected to be the limiting factor in setting record levels. Instead, the actual limiting factor turned out to be the bass drum in "The Imperial March" from *The Empire Strikes Back*. This required a reduction of about 3 dB in the record level, but with a typical deck, the reduction would have been much greater.

I got a lot of really good listening from the CR-4A. I would credit its flat, extended responses, very good MOLs, and low distortion, noise, and flutter. This deck certainly has one of the best sounds at any price. Its price is not low, and Nakamichi has included few conveniences for the recordist. The manual calibration process takes but a few seconds, however, and the results are certainly not bettered by any other approach I have seen.

For those who want many automated features and different counter modes, the CR-4A could be rather frustrating. For the user who doesn't need scans and searches and will use just a little effort to get the best magnetic performance from a tape, this Nakamichi deck is worth its dollars and would make a good choice. *Howard A. Roberson*

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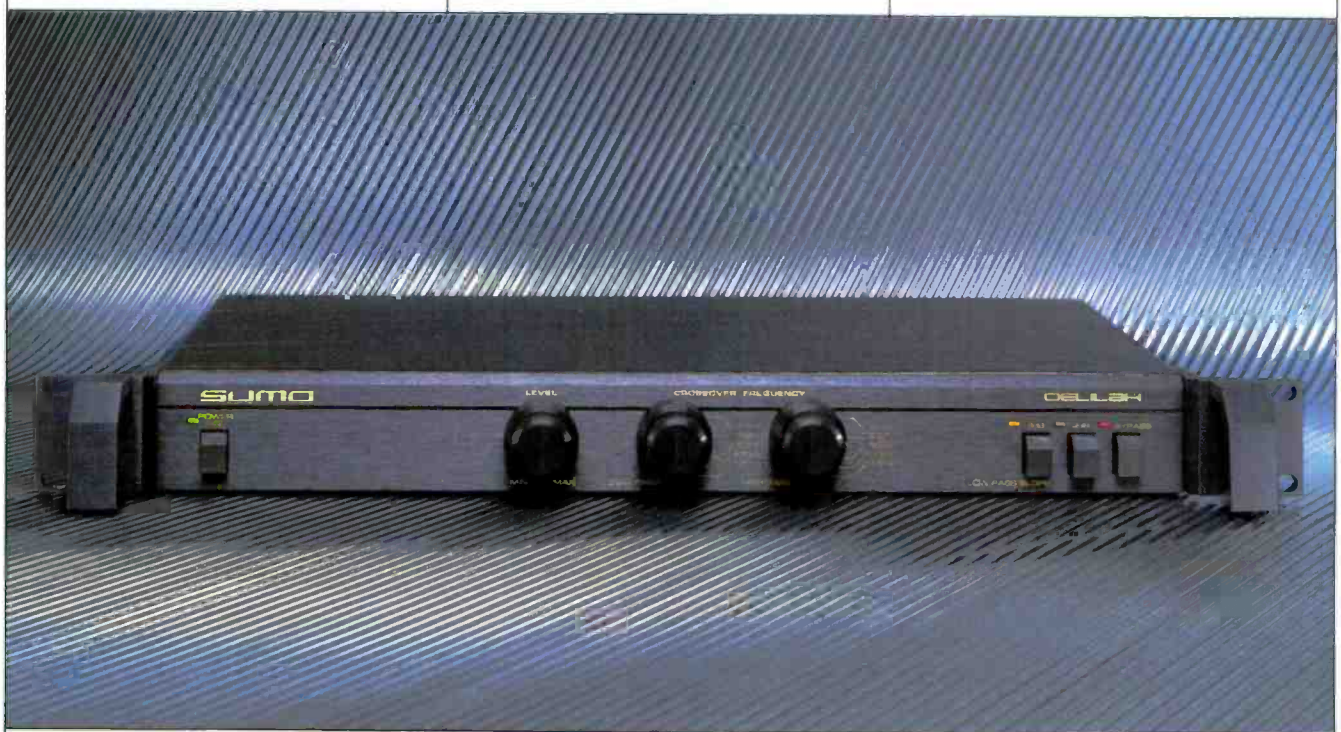
Before I buy a car, Maggie always does the test driving.

4

SUMO DELILAH CROSSOVER

Manufacturer's Specifications
Crossover Frequencies: 50, 63, 80, 100, and 125 Hz.
High-Pass Filter Slope: 12 dB/octave.
Low-Pass Filter Slopes: 12 or 18 dB/octave.
Hum and Noise: −95 dB.
Total Harmonic Distortion: Less than 0.007%.
IM Distortion: Less than 0.007%.
Dimensions: 19 in. W × 1¾ in. H × 8¾ in. D (48.3 cm × 4.5 cm × 22.2 cm).
Weight: 12 lbs. (5.5 kg).
Price: $499.
Company Address: 21300 Superior St., Chatsworth, Cal. 91311.
For literature, circle No. 93



The Sumo Delilah crossover offers substantial flexibility in its outputs and crossover frequencies. In addition to the expected high-frequency stereo outputs, it has low-frequency outputs that include both same-polarity and reversed-polarity stereo pairs. Being able to make polarity changes at the crossover is a worthwhile advantage. Otherwise, such changes would have to be made at the loudspeaker or amplifier output and could be much less convenient. The low-frequency outputs can also be used for feeding a stereo subwoofer, with two stereo amplifiers operating together in bridged mode for higher power output. Sumo makes a strong pitch for the desirability of having plenty of power for the two bottom octaves.

With most stereo amplifiers, bridging is possible by feeding the "+" and "−" outputs of the crossover to the left and right inputs of the amplifier. The "hot" terminals of the amplifier's left and right outputs are then used to drive the subwoofer. In this way, both channels of the amplifier contribute to the subwoofer drive. (Some stereo amplifiers will not work well with this hookup. Check with your amplifier's manufacturer to make sure there are no potential problems.)

The connections for a mono subwoofer also include both normal- and reversed-polarity jacks. This makes it easy to reverse a mono subwoofer's polarity at the crossover—if such a change is needed—and to drive a stereo amplifier in bridged mode for greater power output.

The low- and high-pass sections can be set individually to 50, 63, 80, 100, or 125 Hz. The high-pass section has a 12 dB/octave slope. The low-pass section has a gain control, and its slope can be set for 12 or 18 dB/octave.

Control Layout

The Delilah crossover is just 1¾ inches high but, with its solid rack ears and handles, conveys a sense of ruggedness immediately. The mounting-hole spacing and standard EIA height make for easy and exact placement in all 19-inch racks. The weight is hefty enough, however, that the rear of the unit should be supported in any portable installations.

The "Power On" switch, at the left end of the front panel, clearly shows by its position (in or out) whether the unit is on, as does its green LED, which is easily seen at a distance. In the center of the panel, from left to right, are the low-pass "Level" control and the "Low Pass" and "High Pass" crossover frequency rotary switches. Each has a large round knob which makes for easy turning (although the switch knobs might benefit from some knurling). The "Level" control has "Min" and "Max" labels at the extremes of rotation, but an indication of the 0-dB gain point would be much more useful. The crossover frequencies (50, 63, 80, 100, and 125 Hz) are the same for both low pass and high pass. The range and the third-octave spacing of these frequencies are good, as they allow matching the great majority of subwoofers. The detents for these two switches are excellent, but setting them and the level control to particular positions would be aided by indices more obvious than grooves in the black knobs. At the right end are three pushbutton switches. The first two are interlocked and are for "Low Pass Slope," "18 dB," and "12 dB." Each has a yellow LED to show which has been selected. The third switch is for on/off "Bypass"; bypass is indicated by a red LED. All control labels are gold and, on the black panel, are relatively easy to see with medium-level room lighting.

The gold-plated input/output jacks on the back panel have easy-to-read white labels on a black background. From left to right are stereo pairs of jacks for "Input," "H.F. Out," "L.F. Out" (two pairs, one "+" and one "–"), as well as the single "+" and "–" jacks for "Mono Out."

Removing the top and side cover revealed a close-to-full-chassis p.c. board of the highest grade. The layout of the high-quality components was very neat, and each was labelled. There were many discrete transistors and just five ICs soldered in place. (And what soldering could be seen was excellent.) The power supply was mounted separately from the board and covered by a close-fitting shield. The toroidal transformer could just be seen from the front-panel end. After long use, the power supply cover was barely warm. There may have been a fuse under the shield, but I did not remove it to check.

Crossovers and Sound Fields

I suspect that most audiophiles who have two- or three-way loudspeakers never give much thought to the crossovers included in their speaker systems. Most of us prefer to believe that the manufacturer did whatever was necessary to make things come out right. Subwoofers are available with and without built-in amplifiers and with and without low-pass filters. The accessory crossover provides both low- and high-pass sections to control what goes to the subwoofer (keeping out the high frequencies) and what goes to the main speaker (keeping out the lowest frequencies).

One design approach is to make the subwoofer responsive to bass transients so that, in the crossover region, the bass pressure wave adds in phase to the pressure wave from the main speaker. A second approach considers the subwoofer output to be nondirectional because of the long bass wavelengths; thus, the addition of sound within the listening room from the subwoofer and the main speaker will be on an acoustical power basis. For the first approach, the

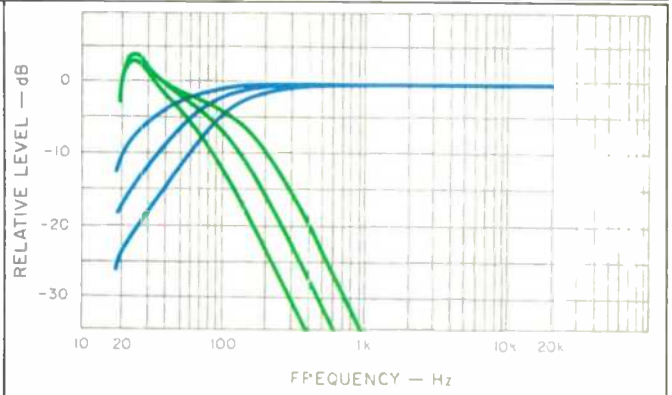


Fig. 1—Swept-frequency responses for low- and high-pass settings of 50, 80, and 125 Hz, and 12-dB/octave slopes, with internal equalization set for use with Sumo Samson subwoofer (see text).

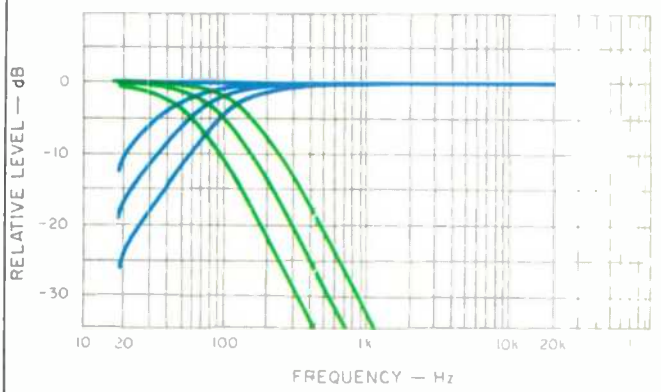


Fig. 2—Swept-frequency responses for filter settings of 50, 80, and 125 Hz, and with crossover bypassed after switching equalization out.

The range and spacing of the crossover frequencies is good, allowing a good match for most subwoofers.

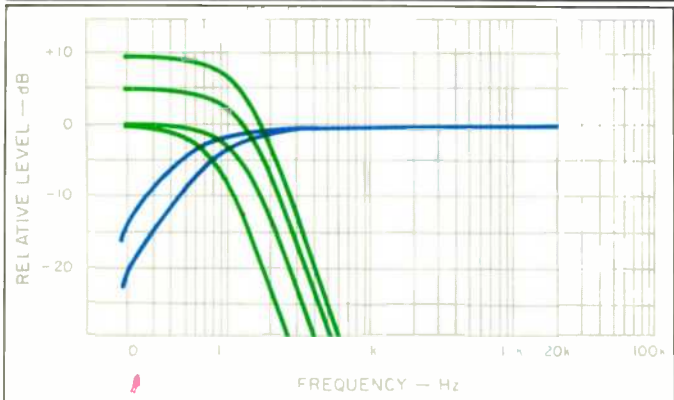


Fig. 3—Swept responses at 63 and 100 Hz, with low-pass slope switched to 18 dB/octave. Additional sweeps (beginning top left) show effect of raising low-frequency level by 5 and 10 dB.

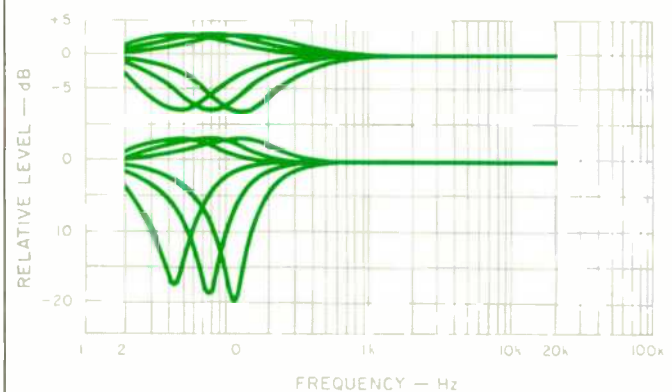


Fig. 4—Responses resulting from voltage addition of low- and high-pass outputs. Top group is with 12-dB/octave slope, bottom group with 18-dB/octave slope.

subwoofer can be relatively compact, which permits positioning in the same plane as the main speakers. Power addition is the goal with the second approach, where subwoofers can be quite large, usually requiring floor placement. Such units may offer high power and more extended bass response than the typical, shelf-mountable, fast-response subwoofers.

With the fast-response subwoofer, addition of the pressure waves would be desired for the best perception of the direct sound wave from the speakers. A crossover that has both low- and high-pass outputs down 6 dB and in phase at the crossover frequency would meet these basic needs. The amplifier and subwoofer, of course, would need to have the correct polarities for the desired acoustical addition.

The Sumo Delilah has low- and high-pass outputs down 3 dB at the crossover point, and flat response would result from power addition of the two outputs. This makes the Delilah more applicable to the second type of subwoofer. Sumo uses Bessel filters, which have the flattest response in the time domain with less-sharp frequency roll-off in comparison to other designs. There is no common agreement on this; some feel that Bessel-filter crossovers sound better than Butterworth-filter devices with the same slopes.

Measurements

In the measurements that follow, keep in mind that electrical testing of a crossover cannot prove exactly what will happen with various loudspeakers and their placement in particular rooms.

I first checked the frequency response at the high-pass output, with the crossover in bypass mode. Relative to 1 kHz, the level was down 0.4 dB at 20 Hz but was flat (±0.0 dB) at 20 kHz. The −3 dB points were at 3.4 Hz and 644 kHz. The high-frequency response seemed unnecessarily extended, though the 20-kHz response was certainly outstanding and later tests showed that the noise output was low. With the Delilah set for normal crossover operation, the high-pass output was the same (within 0.04 dB) as it had been in bypass mode, while the low-frequency levels were controlled by the crossover settings.

When I first tried measuring the frequency response of the low-pass section, I got confusing results. At first, as shown in Fig. 1, substantial peaking occurred around 25 Hz, with response dropping sharply below that point (to −21 dB at 10 Hz). A check of the owner's manual showed me that this was probably due to a switchable equalization circuit, which is designed to get flat response down to 25 Hz (from Sumo's Samson nonpowered subwoofer) while rejecting subsonic energy. Following the instructions for other subwoofers, I removed the top cover and switched this EQ out.

Figure 2 shows the responses after turning off the equalization and matching the low- and high-pass levels by switching the frequency back and forth and adjusting the low-pass level control. For clarity, plots were made only for the 50-, 80-, and 125-Hz settings and for the bypass. The filter slopes were accurate for 12 dB/octave, most obviously so with the low-pass responses. With the 125-Hz setting, the low-pass response (relative to 30 Hz) was +0.06 dB at 20 Hz, −1.0 dB at 2.6 Hz, and −3 dB at 1.5 Hz.

Figure 3 shows the response for the 63- and 100-Hz settings with the low-pass slope switched to 18 dB/octave. Also shown is the effect of increasing the low-pass level in two 5-dB steps. The range of the control was from total attenuation to 1* dB above matched level. (The matched-level point was at about one o'clock. The control has no marker, so I put a little label on it to aid in my own evaluation.) Note that in both Figs. 2 and 3, the crossover points are very consistent in their displacement below zero. A check of this specific property showed that *all* of the points for all five crossover frequencies and the two slopes were 3

Crossover points are *very* consistent, within 0.3 dB for ten frequency/slope combinations I measured.

dB down (±0.3 dB) at the crossover frequency. This held true, provided both the high- and low-pass filters were set to the same slope. (That ±0.3 dB variation, incidentally, includes any error I might have made when matching levels.)

The outputs from the Delilah can be combined in a number of ways. If the low-pass stereo outputs are selected, then you can use the same-polarity ("+") or the reversed-polarity ("−") jacks to feed a stereo amplifier. In adding the outputs of the low- and high-pass sections by summing their voltages, we can get some indication of how the sound pressure waves from the subwoofer and main speakers would add acoustically. What is shown in Figs. 4 and 5 (discussed below) only applies, however, if the listener is equidistant from the acoustic centers of both speakers, so as to maintain this time/phase relationship. The relative phase in the crossover region changes in such a way that the reversed-polarity low-pass output adds positively to the high-pass output. The same-polarity output, however, causes a subtraction.

Figure 4 shows the summed responses for both low-pass slopes for 50-, 80-, and 125-Hz settings. With the shifted phase of the reversed-polarity output matching the shifted phase of the high-pass output at the crossover point, the responses actually increase to a maximum of +3.0 dB relative to reference level. Remember that the crossover points were at −3.0 dB and that there is a 6-dB increase with voltage addition of the same signal:

−3.0 + 6.0 dB = +3.0 dB.

For the low-pass same-polarity condition, the phases are close to 180° out at the crossover. There also is noticeable cancellation—about 8 dB with the 12 dB/octave slope and 17 dB or more with 18 dB/octave. These numbers demonstrate why it is so important to get polarity relationships correct when using a subwoofer. However, keep in mind that, for a particular pairing of an amplifier and subwoofer, *including their location*, the same-polarity connection might be the one to use.

If the sound powers from the subwoofer and the main speaker are considered to be adding, the total of the two powers at −3 dB results in flat power response. I thought of a test to prove that this was so: I fed one pink-noise source into the left input and another into the right. Then, I added the left low-pass output to the right high-pass output and fed the summation to a third-octave RTA. The response was flat throughout the crossover region, showing good results from power summing.

Figure 5 shows how it might or might not be possible to use the Delilah's controls to flatten voltage/pressure added responses. The uppermost group of curves shows the effect of shifting the 12-dB/octave low-pass crossover frequency down while leaving the high-pass setting at 125 Hz. Appreciable flattening takes place, and the overall response with a low-pass setting of 63 Hz is really quite good. The second set of curves, for the 18-dB/octave case, indicates less success. The third and fourth groups show that reducing the low-pass level for the 12- and 18-dB/octave slopes, respectively, is not a good idea for this purpose.

Harmonic distortion was very low in the high-pass output—just 0.002% in the left channel and 0.003% in the right channel over most of the range. At the highest frequencies, the distortion reached 0.003% and 0.004% for left and right channels, respectively. It was difficult to make any meaningful measurements of the low-pass output, but over this output's limited frequency range, noise and distortion was less than 0.015%.

Relative to 1 V, the noise was down 92 to 97 dBA, with −95 dBA typical for most control settings. The maximum input and output level was a very high 10.2 to 10.5 V at any frequency from 20 Hz to 20 kHz. The input impedance was 46 kilohms, and all of the output impedances were very

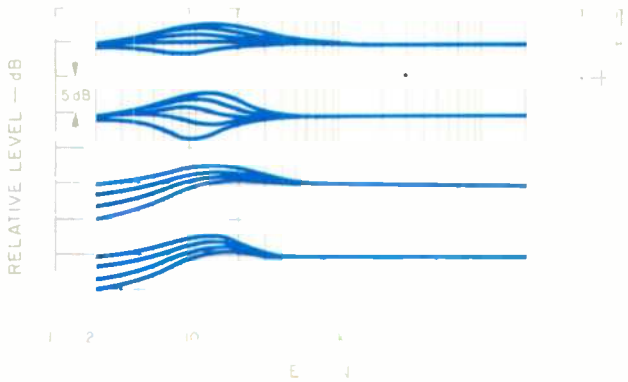


Fig. 5—Attempts to flatten responses by shifting low-pass frequency down (top two groups) and by reducing low-frequency level (bottom two groups). Filter slopes are 12 dB/octave for the first and third groups, 18 dB/octave for the second and fourth.

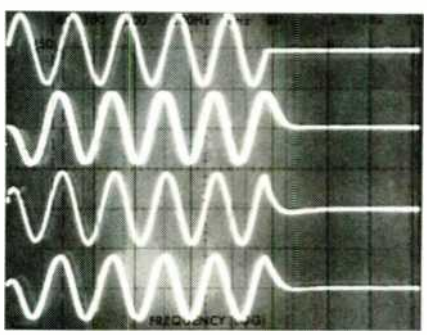


Fig. 6—Phase comparisons for 80-Hz, five-cycle tone burst. From top to bottom: Test signal, low-pass output, high-pass output, and voltage-summed results. Note the relatively small phase difference between the low- and high-pass outputs, and the good damping at the termination of the burst (see text).

Electronically, the Delilah is impeccable, with low noise and distortion and very flat response outside the crossover region.

low—close to 100 ohms (120 ohms was the highest figure obtained). These are all excellent results.

I set both sections of the Delilah to 80 Hz, with the low-pass gain set for matched level. Then, I fed in a five-cycle 80-Hz tone burst. Figure 6 shows (from top to bottom) the test signal, the low-pass output, the high-pass output, and the voltage-summed result. Oscilloscope gains were adjusted to facilitate making waveform comparisons. The broadening of the second and fourth traces is the result of storing the waveforms from tests with both 12- and 18-dB/octave slopes and the fact that there was a difference in phase shift for the two slopes. The phase difference between the low- and high-pass outputs is relatively small, so these two waveforms are lined up quite closely, as is the summed signal. These waveforms are really quite good, and the low- and high-pass signals remaining at the termination of the burst are quickly and smoothly damped.

Use and Listening Tests

The owner's manual has the feel of a personal communication, with its stapled pages and typewritten (but well reproduced) text. There are very good comments on the requirements for associated amplifiers and how they might be used. No illustrations or connection diagrams are included, but the text is explicit on which jacks to use and why. Sumo makes the important point that, for each configuration, the polarity needed cannot be proven when making the initial hookup. The manufacturer also provides good guidance on selecting crossover frequencies and does a fine job of explaining how a reduction of the low-pass frequency setting can reduce unwanted bass heaviness. Sumo's position appears to be that the sound from the main speakers and the subwoofer will add on a power basis, in which case exact subwoofer location would not be as important as it would be if the goal was to have the two sound waves add and be in phase. A comment or two on subwoofer placement, however, would have been in order.

The Delilah was tried with a Triad Design HSW-300 subwoofer, which has a built-in stereo amp. I found a combination that seemed best to me: High-pass and low-pass frequencies at 80 and 63 Hz, respectively, and the reversed-polarity left and right outputs. It was quite easy to adjust the low-pass gain for good balance, but I did change the setting occasionally for better results with particular music.

Electronically, the Sumo crossover is impeccable; it has low distortion and noise and very flat response outside the crossover region. With the many choices for crossover frequencies and low-pass output connections the Delilah offers, it can be a problem-solver for many audiophiles who are adding subwoofers. The price is a bit on the high side, perhaps, but the Delilah is of the highest quality—in all respects.

Howard A. Roberson

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MOD SQUAD PRISM COMPACT DISC PLAYER

Company Address: 542 North Highway, 101, Leucadia, Cal. 92024.
For literature, circle No. 94

By and large, I have not been impressed with the sound quality in many recent CD players. These new players have appeared with claims about the benefits of technologies like higher sampling rates and optical interstage coupling. Nevertheless, their sound has seemed to plateau out or even to degenerate in quality.

Although other reviewers disagree, I have been disappointed in particular with most of the machines using the new Philips 16-bit, four-times oversampling system. For all the hoopla from the various manufacturers who convert Philips-based electronics, most of these models have not sonically outperformed the earlier 14-bit Philips-based machines, and many have fallen behind the latest generation of Sony and Yamaha machines. While the various Philips 16-bit players I have heard have differed in the details of their sound character (as well as front-panel features and brand names), they all have been characterized by a slight hardness and low-level grittiness in the upper midrange. This increases the artificiality of most music and contributes to listening fatigue.

This brings us to the Mod Squad Prism, a $1,300 player intended to be representative of the current state of the art. Like many high-end players, it is a conversion of a machine supplied by another manufacturer. In this case, the Prism is a converted Philips CD473 that uses the same Philips 16-bit D/A circuitry I have just complained about. Nonetheless, it is the first real advance in CD sound that I have heard recently. It also demonstrates that an engineer who emphasizes sound as well as technical quality can make a tremendous improvement in audible performance.

Steve McCormack, the chief "Mod" of the "Squad," is understandably reluctant to explain all the details of the changes he has made in the Philips CD473. He does believe, however, that the Prism differs fundamentally from most other high-end conversions in that the company has made significant changes in the digital circuitry as well as in the analog circuitry. He feels that this allows the Prism to get the maximum possible lucidity and transparency out of a CD with minimal loss of musical information.

It is clear that the Mod Squad has done far more than change a few minor components. There are major changes in the D/A section of the motherboard as well as a totally new board with a new audio gain stage, power-supply regulation, current-summing amplifier, and filter circuitry. The Mod Squad has added an inboard power supply for all of the new analog circuitry but has left the Philips 473's original power supply to handle the digital and motor circuitry. They have damped the 473's transport mechanism and the chassis, developed a damping disc to match the transport's characteristics, and completely removed the headphone amp circuit.

Whatever the actual details of the technology, the sonic results are striking. The Prism is significantly more open and dynamic than any other player I have heard to date. It delivers the dynamic range that CD has promised since it first appeared.

It is interesting to compare the Prism to a top-quality conversion of a Philips 14-bit player like the Sonographe. If you listen to a high-quality disc like *Jazz at the Pawn Shop* (Proprius CD7778/9) on each player and set the volume to provide the same measured output levels on a medium-intensity passage of music, the Prism will provide substantially more dynamic energy in the loud passages and substantially more resolution of harmonics and low-level sound. The same is true of a comparison with the older Cambridge CD player, the recent Sony top-of-the-line machines, and several others.

It is important to note that the Mod Squad Prism does more than simply make CDs sound more dynamic and improve the musicality of the upper octaves. Given at least a 24-hour warmup and using the supplied damping disc, the Prism consistently provides more musically convincing detail with percussion, strings, and woodwinds than any other player I've heard to date. It also does a better job of resolving complex organ passages and choral music. In fact, for anyone who loves choral music or opera, the

Prism should, perhaps, be compulsory. Vocal details that smear into the background on other machines are significantly clearer on this player.

As for frequency response or timbre, the Prism has the merit of being remarkably flat and neutral. If you like popular music or jazz, you will be very pleasantly surprised by the quality of the bass line. The Mod Squad player restores a lot of bass power without exaggerating bass output. Its superior dynamic performance is comparable to, or better than, that of the best moving-coil cartridges.

The Prism has superior upper midrange and treble. Most high-end players soften the upper octaves, particularly the upper midrange. The Prism takes a very different approach. It removes most of the hardness and "grunge" in CD sound without losing upper-octave speed and energy, and it offers the most musically realistic reproduction of low-level treble "air" and detail I have yet heard in a CD player.

I should, however, stress that this is not a "forgiving" player. While other players—all in very different ways—reduce some of the sonic shock effect of poor or mediocre CDs, the Prism gives you all the data on the disc. To give some specific examples, The Mod Squad player's superior resolution can be a real blessing with CDs that are good remasterings of older recordings, or where the producer really knows what he or she is doing. Anyone who admires the Chesky remasterings of classic records is going to love this unit. The same will be true of anyone who admires the string sound of Reference Recordings, or jazz and voice on the better Opus and Proprius CDs. If you like the way Harmonia Mundi treats its vocal recordings and Bach, you are going to want the Prism. At the same time, it is merciless in revealing the essentially nonmusical results of close miking. You clearly hear the fact that the mike is too close or that the instruments are spotlighted in ways you will *never* hear in a live performance. The strange fascination many producers now have with the sound of a violin as heard at the violinist's chin is all too clear.

Some of the same advantages and disadvantages occur in terms of soundstage. The Mod Squad Prism can overcome the slight two-dimensional sound character of CD, and it is more revealing of soundstage detail than any other player I've heard. This superior soundstage performance comes through quite clearly even on a popular-music disc like Willie Nelson's *Stardust* (Columbia CK-35305). You will get better definition of imaging and soundstage width than with any other player yet developed. The Prism has a deeper apparent soundstage than any other player I've heard except the conrad-johnson—and the Prism puts more musical detail in that depth. Just sit back and listen to any given instrument

On good recordings, the Prism provides amazing realism. On bad recordings, the extra resolving power can be jarring.

on *Jazz at the Pawn Shop*. Not only do you get a musically convincing placement, you get more apparent focus without any artificial "etching" or exaggeration of imaging effects.

You may, however, feel differently if you put on something like Linda Ronstadt's *Greatest Hits, Volume I* (Elektra 1062). While Rontstadt scarcely turns into a 15-foot wandering violin, the overall effect on about half the tracks makes one wonder what the producer thought he was doing with the soundstage. One of my sons occasionally listens to Abba, a group that was cursed, during its early and middle career, by some of the worst recording efforts in the history of the business. The Mod Squad Prism clearly reveals that Abba's backup on its *Greatest Hits* (Atlantic 19114-2) is often recorded in a way that I can only describe as stage-wide, mono, time smear; it seems to have been filtered to remove the deep bass and any localizing information above 2 kHz.

The Prism presents the producer of a recording with the same challenge posed by many of the best new moving-coil cartridges. There is no forgiveness in terms of errors in the soundstage. With good chamber music and jazz recordings, the Prism will provide a far better illusion of realism. With bad recordings, the extra resolving power can be jarring.

You really do need to set your balance control to provide the best soundstage with a given recording. As is the case with all other top-quality players, the Prism is very revealing of the minor imbalances in right-left signal information in CDs.

If I had to go out and buy a player today, I'd buy the Mod Squad Prism. I have to stress, however, that I am talking about the nuances you hear with top, high-end equipment. There is a long list of other new high-end players coming onto the market, and a number of other firms have their own high-end conversions of the Philips 16-bit machines. If you buy this player, do so because it produces excellent musical sound, not because it comes with any guarantee of being top of the heap.

If a competing designer is to make a major advance over the Prism, that designer will have to combine the best of digital sound with the best of analog. The Prism has solved the problems of lucidity and apparent dynamic range in CD to a degree where depth, air, and transparency are the remaining barriers. Further, I should remind you that while the Prism does cost $1,300, no one ever said good sound should cost only pocket change. (While earlier there was an upgrade service for the CD650 and 472 models, the Mod Squad no longer converts other models.) In a world where high-end tonearms can cost over $2,000, the Mod Squad Prism CD player offers a hell of a lot of sound quality for the money.

Anthony H. Cordesman

The AR Expert

Name: Alex Barsotti
Occupation: Teledyne Acoustic Research's National Service Manager
Years with Teledyne Acoustic Research: 21
Objective: To service the customer

(Editor's note: We interviewed Alex to find out how Teledyne Acoustic Research excels at serving their customers)

Q. Alex, what is your position at AR really about?

A. Customer satisfaction. I do everything I can to keep dealers and customers satisfied with AR products.

Q. You mean repairing speakers, electronics?

A. Yes, but there's more. It goes beyond the typical Service Department framework.

Q. Explain "goes beyond".

A. Actually, my day encompasses much more than the "fix-it" problems. I usually spend most of my time answering questions.

Q. Questions — what kind?

A. I think the most common questions asked by consumers are what amplifier should I use or how much power do I need or what speaker is best suited for my own listening.

Q. So what do you tell them?

A. What we try to do is to get a feel from the customer as to what kind of music he or she prefers, what kind of room environment the product will be used in, what kind of listening habits. And from that we try to give a guideline on how to choose an amplifier, what to look for in an amplifier according to what the listening habits are. Often they will call and ask which speaker should I buy. That's not an easy question to answer because there are so many different factors involved in choosing a loudspeaker.

Q. So you help the customer think about the things he has to consider before he can make a decision?

A. That's correct. We really try not to suggest a specific amp or a specific loudspeaker, but give them options so that when they go into a store they know what they should look at. For instance, a floor model versus a bookshelf. Most customers have no idea that a loudspeaker designed to be on a bookshelf might not be suited to being on the floor and vice versa. We try to find out their listening habits — do they like mellow sound or more contemporary music? Do they listen at high volumes or background levels? From this information we can give accurate advice. Other questions asked are what the difference is between loudspeakers, not only within our own current line of loudspeakers, but also the difference between AR and some other company. You can look at specs and you can detail features of a product, but I think the bottom line is that you have to *listen* to it. We try to advise the customer to listen to a few types — two or three models. A loudspeaker is like anything else: you have to choose the one suited for your own listening criteria. We recommend how they should listen. If they have a favorite recording, to take it with them, something they are familiar with and use that to audition the different models of loudspeakers with the same recording.

Q. Aside from answering these questions, what is the most important thing you think you do for your customers?

A. Provide service — fast and easy. When you own a product and something goes wrong with it, you want it repaired not only quickly, but easily. No hassles. No long waits. That's what part of my job is all about.

Q. How would you describe Acoustic Research's philosophy toward its customers?

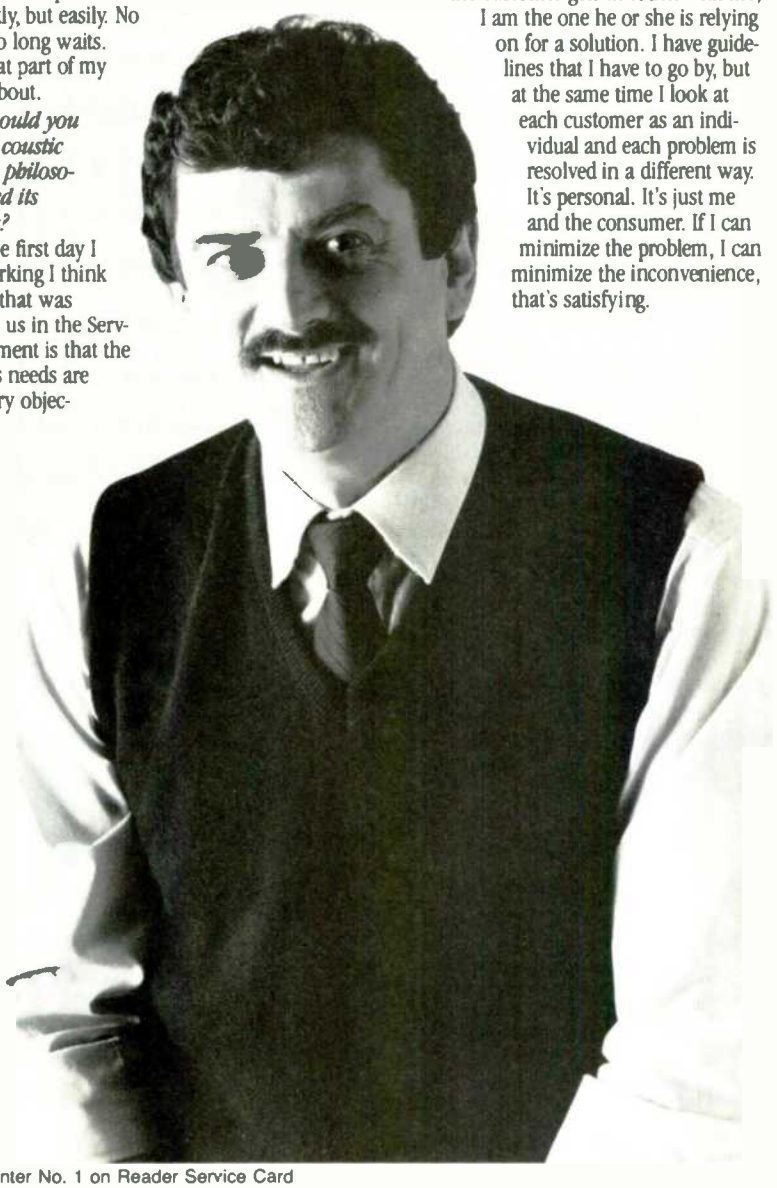
A. From the first day I started working I think one thing that was stressed to us in the Service Department is that the customer's needs are our primary objectives In fact, Acoustic Research was the first company to give a 5-year "full" warranty on performance.

Q. What does the AR warranty cover?

A. The AR warranty for loudspeakers is a 5-year full warranty. Full warranty means that for 5 years from date of purchase, we not only guarantee our product will not fail, but will perform within ± 1 dB of the original specs.

Q. Alex, would you summarize what are the most satisfying parts of being Service Manager for Teledyne Acoustic Research?

A. In the morning, when I arrive at work, I never know what to expect. I have to deal with different problems; I have to deal with different situations. I think the most gratifying thing is when someone comes to me with a problem, I am able to solve that problem. Because when the customer gets in touch with me, I am the one he or she is relying on for a solution. I have guidelines that I have to go by, but at the same time I look at each customer as an individual and each problem is resolved in a different way. It's personal. It's just me and the consumer. If I can minimize the problem, I can minimize the inconvenience, that's satisfying.



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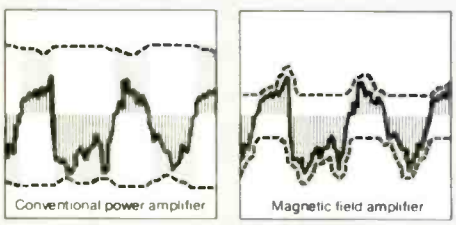
ESSENTIAL POWER. Even before the exciting advent of car Compact Disc players, an abundance of power has been necessary to reproduce, without distortion, the frequency and dynamic range produced by modern decks.

Unfortunately, conventional amplifier technology is particularly unsuited to delivering this needed power to the specialized car interior environment. Like their home stereo counterparts, traditional car designs produce a constant high voltage level at all times, irrespective of the demands of the ever-changing audio signal – even those times when there is no audio signal at all! Because automotive amplifiers must, obviously, derive their power from the host vehicle, such an approach results in substantial drain to delicately balanced automobile electrical systems.



Solid line: audio output signal. Broken line: power supply voltage. Shaded area: wasted power. Vertical lines: power to speakers.

The Carver Magnetic Field Car Amplifier is signal responsive. Highly efficient, it produces only the exact amount of power needed to deliver each musical impulse with complete accuracy and fidelity. Thus the Carver Car Amplifier not only reduces overall long-term power demands, but produces the large amount of power necessary for reproduction of music at realistic listening levels without the need for oversize power supply components: Important considerations in the minuscule spaces which quality car design allocates to add-on electronics.

INTELLIGENT POWER. A hallmark of all Carver amplifiers is the careful integration of sophisticated speaker and amplifier protection circuitry. The Carver Car Amplifier is no exception.

Speakers are protected with a DC offset internal fault protection design which turns off the power supply at first hint of overload. An overcurrent detector mutes audio within microseconds of a short circuit, as does an output short circuit monitoring circuit. Together, these three circuits eliminate the potential need to replace fuses, revisit your autosound installer, or worse yet, replace expensive speakers due to a moment's indiscretion with your deck's volume control.

ASSIGNABLE POWER. Integrated bi-amplification and bridging circuits, along with The Carver Car Amplifier's compact configuration make it ideal for multiple-amplifier installations.

The built-in 18dB/octave electronic crossover allows use of two amplifiers in a pure bi-amplification mode without addition of extra electronics. Or, at the touch of a button, one Carver Car Amplifier can become a mono amplifier for subwoofers while the other Carver Amplifier handles full range. Or, for astonishing dynamic and frequency response, two Carver Car Amplifiers may be operated in mono mode into 8 ohms for a 240 watt per channel car system which will truly do justice to digital without taxing your car's electrical generation system.

INNOVATIVE POWER. Can 1/10th of a cubic foot of space hold yet more innovations? Yes.

Carver has addressed the ongoing problem of head-end/power amplifier level matching: Output of current car decks varies widely from brand to brand and model to model. The result can be a less than perfect match. The Carver Car Amplifier incorporates circuitry which compensates for variations in head-end output, reducing noise and optimizing signal-to-noise ratio. In addition, Carver has added a subsonic filter which removes inaudible power-robbing infrasonics before they can tax the amplifier and speakers. Finally, a delayed turn-on circuit activates the Carver Car Amplifier after your head-end unit has powered up, to eliminate starting pops and thumps.

ACCURATE POWER. It goes almost without saying that a product Bob Carver designs for the road carries the same superb electronic specifications that his home audio products are known for.

The Carver Car Amplifier is flat from 20Hz to 20kHz, down -3dB at 16Hz and 30kHz. Not coincidentally, the usual specifications given for Compact Discs. A signal-to-noise ratio of over 100dB means that, in even the most quiet luxury sedan, you will never be annoyed by hiss. The other specifications are equally as impeccable. You may peruse them in our literature or in independent reviews soon to appear.

ACQUIRABLE POWER. The remarkable Carver Car Amplifier is currently available for audition at Carver dealers across the country.

It is worth the journey. Whether you have a car system in need of the sonic excitement possible with abundant power, or are in search of the perfect complement to a new high-performance automobile, you owe it to yourself to experience the logical extension of Carver technology – The Carver Car Amplifier M-240.

Power Output Stereo Mode: (continuous RMS power output per channel, both channels driven, at 13.8 VDC input). 120 W into 4 ohms, 20 Hz to 20 kHz with no more than 0.15% THD.

Power Output Bridged Mono Mode: (Referenced to 13.8 VDC input) 240 W into 8 ohms, 20 Hz to 20kHz with no more than .15% THD.

Input Sensitivity: Variable 250mV to 4V

Signal to Noise Ratio: (Referenced to 120 W. A weighted into 4 ohms) Greater than 100 db

Crossover: 115 Hz, 18 dB/octave

Weight: 4.7 lb.

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VOICE OF CHANGE

Tracy Chapman
Elektra 60774-2, CD; **60774-1,** LP.

CD Sound: A–	Performance: A
LP Sound: C+	Performance: A

Photograph: ©1988, Janette Beckman

When you first sit down and listen to Tracy Chapman's self-titled debut album, the immediate temptation is to make comparisons between Chapman and other female singer/songwriters. Avoid that temptation! While it's certainly true that Chapman brings to mind artists such as Joan Armatrading, Odetta, and even Miriam Makeba (plus a taste of Joni Mitchell), to dwell on such comparisons would be to miss the issue at hand. And the issue is that the music industry has finally brought us a young black woman who writes, sings, and thoroughly addresses serious political, social, and, yes, emotional matters. This is new ground, and it is being broken by a very talented individual.

Tracy Chapman is one of those uncommon musicians capable of drawing listeners into her songs. Whether writing in the first or third person, all she says can be shared and understood. You may empathize or sympathize, but either way you are captured. Great musicians, of course, can only be measured over the long haul; tagging Chapman with a "great" label at this time would certainly be unfair and premature. However, one thing all great songwriters share—from Berlin to Springsteen—is the ability to allow us to bear witness to the proceedings, to be drawn into the song, and thus become part of it. Tracy Chapman has that ability.

The material on her debut album is varied, lyrically conveying feelings which can be simultaneously construed as naively hopeful and painfully realistic. In the lead track, "Talkin' 'Bout a Revolution," Chapman writes: "Poor people gonna rise up and get their share/Poor people gonna rise up and take what's theirs . . . Don't you know they're talking 'bout a revolution/ It sounds like a whisper. . . ."

Chapman writes of societal and personal changes equally well. There are songs here about domestic violence, sacrifices for love, and an expertly rendered first-person telling of a young woman desperately searching for a way out of poverty ("Fast Car"). After her mother leaves home, she drops out of school to care for her alcoholic father. The only time she feels free from her problems is when she's with a young man driving in his fast car. However, the thought which remains throughout the song is: "You got a fast car, but is it fast enough so we can fly away/We gotta make a decision, we leave tonight or live and die this way." Add that to such lyrics as "Why do babies starve when there's enough food to feed the world" (from the cut "Why"), and you've got a tough, emotionally deep album. Chapman does provide more tender moments in this collection, but it's the tougher tunes that make *Tracy Chapman* an album of some musical/historical significance. Perhaps other record labels will now realize that there are other Tracy Chapmans with stories to tell.

Producer David Kershenbaum, who spent time at A&M Records (once known as *the* singer/songwriter label), did an expert job, on this digital recording, of gathering the right players to back Chapman. These musicians clearly understood that they were there to support, not to lead. Kershenbaum also structured the instrumentation and arrangements to support Chapman's songs in a simple manner. Her original acoustic guitar and vocal arrangements are enhanced by the extra instrumentation; only rarely does the snare drum compete with, rather than complement, the vocal.

One problem, though: On the front cover of the LP, a sticker reads, "Pressed on high-quality audiophile vinyl." Well, this may be so, but I have heard countless LPs pressed on less esoteric vinyl that presented fewer extraneous sounds. Overall surface noise was about equal to regular offerings. If labels are truly trying to improve vinyl quality, they need to stiffen quality control and provide nonstatic-collecting inner sleeves. So bypass the LP and go directly to the CD bin when you buy this collection.

Tracy Chapman is certainly having her day in the sun. The album is boom-

Joni Mitchell overreaches, but it's a small price to pay for all the places, public and private, that she lets us enter.

ing on the *Billboard* charts and getting a fair amount of radio airplay. All the raves are warranted; this woman is a very talented musician. But beyond the accolades remains the fact that someone like Tracy Chapman has been given a chance to sing what she's written. We could be talking 'bout a musical revolution here, but this one sounds like more than a whisper.

Hector G. La Torre

The Bitter and the Sweet: Pete Seeger
Mobile Fidelity MFCD 873, CD.

Sound: B Performance: A

Mobile Fidelity's reissue of *The Bitter and the Sweet* on CD returns to the public one of Pete Seeger's very best albums, one that was a key to the folk music revival of the early '60s. Recorded in 1962 at New York City's The Bitter End, it captures a solo performance of Seeger in top form. Selections include "We Shall Overcome" (remember, this was recorded when the Civil Rights movement was just hitting its stride), "Turn! Turn! Turn!" (which years later became a huge hit for The Byrds), an a cappella version of "Where Have All the Flowers Gone," a particularly lovely "Barbara Allen," Leadbelly's "Mister Tom Hughes's Town," and Seeger's banjo and whistling gem "Living in the Country." This cross-section of traditional songs and social concerns illustrates just how remarkable Pete Seeger is.

The sound of this CD is quite clear, but it is somewhat hissy at times—due, no doubt, to the primitive recording techniques then available. Still, there is a marked improvement over the LP.

I've always regarded *The Bitter and the Sweet* as one of Pete Seeger's very best albums. It is a celebration of humanity, and on CD, the performance is extraordinary. Time has not diminished it one iota.

Michael Tearson

Chalk Mark in a Rain Storm: Joni Mitchell
Geffen GHS 24172, LP.

Sound: A– Performance: B+

Joni Mitchell is a special case. You don't expect hit singles to come flying off her albums, and with her latest, she doesn't surprise.

Not that she's anybody's fool. To indulge her much-loved talent for writing musical poetry, as opposed to pop songs, Mitchell's included a plethora of background-vocal ringers to help move some records here. Among them are Willie Nelson, Peter Gabriel, Tom Petty, Billy Idol . . . I'm surprised we didn't get Don Johnson and Barbra Streisand. Yet, what could have been—hell, what *is*—a gimmick manages to work. Maybe the songs have something to do with it.

On "Dancin' Clown," for instance, a witty spin through the old game where men make fools of themselves for every "last-word Suzie . . . lookin' top nice," we have Billy Idol growling a few lines as one Rowdy Yates, with Tom Petty as the upright young Jesse. Idol, in particular, is hilarious with his little self-referential yowps and yelps. Willie Nelson is distinctive in a slightly revised version of the old Roy Rogers tune "Cool Water" (you know—"cooool, clee-earr, waterrrr"). And on the haunting ballad "The Tea Leaf Prophecy (Lay Down Your Arms)," Wendy Melvoin and Lisa Coleman (Wendy & Lisa, once of Prince's band) serve as essentially co-lead counterpoint. The duo form an insistent Greek chorus snaking in and out of Mitchell's tale about a woman's adequate, empty life, from a wartime marriage through dull years of watching Johnny Carson on late-night television.

Mitchell's music is more folk-inspired than jazz this time around, and though it's skilled integration of drum machines and keyboard synthesizers sound just as apt as Dylan's when he turned electric, the effect is much less jarring. Lyrically, Mitchell picks and chooses her images with the care of a mother trying to find just the right formula for her infant. But sometimes she goes overboard. In the leathery-tough "The Beat of Black Wings," she takes on the guise of a soldier, Killer Kyle, whose girlfriend had an abortion at a clinic after "I put my hand on her belly/ To feel the kickin'." Take it from an expectant father—kicks are *real* unlikely through the first trimester, the limit for a legal abortion. And you have to think twice about the lyrics of "My Secret Place," which talk about a special place "that you, like no one else I know, might appreciate . . . you're a

special case." Gee, Joni, you mean all of us?

Whatever. Let Joni Mitchell overreach. It's a small price to pay for all the places, public and private, she lets us enter. *Frank Lovece*

ooh yeah!: Daryl Hall and John Oates
Arista ARCD-8539, CD; **AL-8539,** LP.

ooh yeah!, Daryl Hall and John Oates' first joint studio album in three years, is the peak of this duo's career. They have picked the fruits of their considerable experience, and, by whipping together the right proportions of rock, doo wop, African rhythms and instrumentation, soul, and sheer studio savvy, they have produced another sinfully delicious serving of their personal blend of rock and R&B.

Throughout this record, Hall and Oates again prove themselves to be splendid songwriters. With the occasional aid of Rick Iantosca, Holly Knight, and frequent collaborators Sara and Janna Allen, they have brought forth material that is intense but never harsh. For instance, "downtown life" opens with a brief scream cutting the silence. As it speeds along at a smart pace, its caustic lyrics are offset by sweet, gentle chimes in the background. The result is a revealing song about an ongoing, but sometimes turbulent, love affair with New York City's nightlife. Cut after cut offers beautiful melodic lines ("everything your heart desires"), sexy, soul-stirring horns ("i'm in pieces"), intriguing synthesizer effects (the blend of "soul love" into "realove"), and breathtaking use of percussion.

The production and arrangements—by Hall and Oates, with bass player Tom "T-Bone" Wolk—deserve mention in their own right. They are simply a knockout. The shifting planes of instrumentation, the superb balances in texture and volume, and the superior spatial presencing—this is the work of recording studio masters.

In comparing the CD to the LP, few gross sonic differences are apparent. The shining sound quality of the master recording is only slightly marred by surface noise on the LP. Served up on vinyl or laser-read Compact Disc, *ooh yeah!* is one delectable dish.

Paulette Weiss

Daryl Hall and John Oates offer a sinfully delicious blend of rock and R&B.

Conscious Party: Ziggy Marley and The Melody Makers
Virgin 90878-2, CD; **90878-1,** LP.

Sound: A Performance: A

Although Ziggy Marley and The Melody Makers made two not-very-exciting albums for EMI, their debut for Virgin is a smash. Here, the children of Bob Marley do their father proud.

An all-digital recording, the CD sound of *Conscious Party* is spectacular with its full-blooded, in-your-face presence. Exotic percussive effects, always a big part of the charm of the best reggae, whip from side to side and bubble underneath. The rhythm section is as sturdy as Gibraltar, without the bass being obnoxiously overbearing as in some reggae.

Producers Chris Frantz and Tina Weymouth (both of Talking Heads) have wisely stayed pretty much out of the way of Ziggy, his siblings, and the band. The sound they have designed is ingenious, as it delivers strength on the reggae backbeat and on the rock downbeat. The producers also vary textures from song to song to avoid the bear trap of sameness.

The spice elements work just as they are meant to: Lenny Pickett adding assorted reeds to four cuts, Jerry Harrison (also of Talking Heads) adding keys to two others, and Keith Richards playing lead guitar on "Lee and Molly." It's a dense sound, and the CD delivers it in a fashion that the LP can't match. Even though the LP has really good sound, in order to really hear and appreciate this one, you've got to get the Compact Disc.

Besides, there's a bonus track on the CD, and the music is sequenced differently than on the LP and cassette. Obviously, the order of songs was completely rethought for a medium in which there is one long program instead of two short ones. I'm surprised this isn't done more often. The CD medium cries out for it!

In the end, it all comes down to Ziggy Marley. Here, his charisma blooms. He sounds eerily like Father Bob, but Ziggy's songs are so strong that they blunt any sound-alike criticism. "Tumblin' Down" crackles with the sinew of a "Get Up, Stand Up" or a "Trenchtown Rock." "New Love" is melodically reminiscent of "I Shot the Sheriff," and "Tomorrow People" has a grace like "No Woman No Cry."

End-to-end, *Conscious Party* is upbeat and uplifting, and it will please even those who aren't wild about reggae music. Its ebullience and insinuating good nature are simply impossible to resist.

I haven't liked a reggae album this much in a decade. Mark my words, Ziggy Marley is about to become a huge international star. He's got it all, and so does *Conscious Party*. Get it or get left behind. *Michael Tearson*

PASSIONATE BACH

Illustration: Rick Tulka

Bach: Johannes Passion. Collegium Vocale, Gent; Orchestre de la Chapelle Royale, Paris; Philippe Herreweghe.
Harmonia Mundi 901264.65, two CDs; **1264.65,** two LPs.

Yes, there is an LP of this splendid recording as well as a CD, and I received both, though I got the two versions at different times. Significantly, the LP set enclosed, instead of the usual lavish spread of foot-wide notes and illustrations, a tiny CD booklet, almost lost in the vast spaces of the unadorned box.

I did make a brief comparison of the sound, but not to any useful conclusion. Both sets are quality products, and if J. S. Bach gets your interest as he is supposed to, the differences will be very minor—mainly the inevitable turning rhythm of the LP version, which is audible in quiet moments.

Ah, but the fringe differences! The band separations on the LP are almost invisible, if numerous, and you will resort to the ancient try-and-try-again method of locating a specific musical item. Okay if you play straight through, of course, but like an opera, this work consists of dozens of short segments, each flowing on into the next. It is indeed often desirable to pick out one or another passage or to start somewhere in midstream.

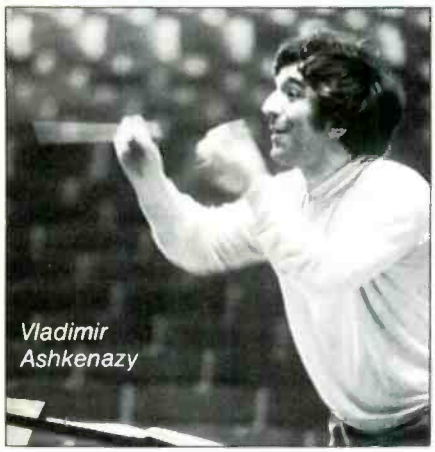
On the CD version, there are 19 or 20 precise index positions on each disc, plus a good number of subindex items at useful points, adding up to half a hundred exact locations which you can reach virtually instantly and without extraneous music, not to mention squawks and scrapes. It is in this kind of music that the CD automation soars triumphant to bring us a really new dimension in home listening! It makes superbly easy what used to be a pain in the neck: A detailed study or listening to specific parts of the work. And remember, the numerical readout also tells you exactly where you are in the continuity and, of course, where in the actual words of the text.

Dare I make a radical statement?—that the CD, in this respect, will at last reverse the long-time trend toward "background" listening which has developed implacably ever since audio began. This has not been good for music that was definitely intended for direct listening with full attention. Now we have the means whereby we can put that sort of attention to highly efficient use, perhaps even more so than in the concert hall.

The recording? This is a first-class "St. John," done in a contemporary but not fussy manner, reasonably "authentic" but claiming no exactitude since none really is possible. The Bach passions are very close to opera, as opera was known in the 18th century. The dramatic and often grisly story of Christ's death, surrounded by the mob at every point, is a better plot than 99% of all operas, and Bach makes the most of it. No longer do we do these works in the heavy-handed, solemn fashion we inherited from the 19th century. Things move along rapidly and lightly here, and the climactic moments are almost terrifying in their intensity—"*Crucify him! Crucify him!*" shouts (or sings) the mob. And such moments as Peter's agony of remorse or Christ's resigned words on the cross, "It is finished," will make your flesh creep. All in all, I myself have always felt that the St. John Passion—much leaner, more concentrated, more youthful than the exalted St. Matthew—is really the finer work of the two.

A Bach passion performance is "made," first of all, by its "Evangelist"—the narrator, a high tenor whose job it is to tell most of the story in quick recitative (words spoken to musical lines). This one, Howard Crook, is a bit light but musically and dramatically excellent, rising to the high points in superb fashion, always in pitch whatever happens. Christ comes next, with far less to say—he is traditionally grave and reserved, a bass. In this role, Peter Lika is a bit operatic but essentially good. The other, briefer soloists (notably the alto, Catherine Patriasz) are in proportion. The chorus is small, only 15 singers, but it is accurate, especially in the fast and difficult "mob" scenes, the bane of every amateur Bach chorus. (I should know, for I've sung in a number of performances as a member of the "mob.")

Though nominally this is a French recording, the performers predominantly seem to come from the polyglot regions to the north and east of France—namely Belgium, Luxembourg, and perhaps even Holland—where musical ties to Germany are bound to be strong thanks to simple geography. It is not, therefore, a defiantly French production but, rather, interestingly different from German Bach or Bach from England or America. I liked it. *Edward Tatnall Canby*



Rimsky-Korsakov: Scheherazade, Op. 35; Tsar Saltan: Suite, Op. 57. Philharmonia Orchestra, Vladimir Ashkenazy.
London 417301-2 LH, CD.

If this CD doesn't sell, there is no justice! This is an outstanding recording in every respect. Engineering whiz John Dunkerley furnishes a sensational recording of demonstration quality in the fabled acoustics of Walthamstow Town Hall.

Ashkenazy is in his element with a wonderfully Slavic, very romantic reading of the richly orchestrated "Scheherazade." The portrayal of "The Young Prince and the Young Princess" section is especially sensuous, and the hall accentuates the dazzling brass and explosive percussion in the "Sea and Shipwreck" finale.

Ashkenazy's conductorial skills grow more impressive with every recording. The superbly disciplined string playing he elicits from the Philharmonia shows how far he has progressed. Fine idiomatic performances of the "Tsar Saltan" suite and the ubiquitous "Flight of the Bumblebee" make appropriate fillers on this exceptional Compact Disc.

Bert Whyte

Mozart: Piano Concerto No. 13; Overture to "Lucia Silla." Midsummer Mozart Festival Orchestra; Jeremy Menuhin, piano; George Cleve.
Bainbridge BCD-6273, CD.

There's much besides Mozart in this recording. For one thing, it is the first CD in this Sonic Arts series, and the first to use the four-channel (folded into two for stereo) Colossus digital surround recording system. It is also the first Colossus I've heard. Good! Very good, folded or no, with a large, open sound and excellent balance in spite of live-audience acoustics. Colossus? Or just the circumstances? Give Colossus the credit on faith.

Second, this formerly shaky, small Mozart orchestra is now healthy and full-blooded, doing good things to the music. Nothing precious here, no overdelicacy, but no ponderosity either. Can't help but enjoy it. As for Jeremy Menuhin, son of *the* Menuhin (Yehudi), I heard him "live" in New York doing

In this rendering, Mozart's Piano Concerto No. 13 is neither precious nor ponderous. You can't help but enjoy it.

Beethoven and was not impressed. (Sounded as if Papa had made him do his homework.) But here—perhaps because we listen on disc?—he is more persuasive, an accurate and expressive Mozart player, if on the gentle side. Maybe he catches some of the orchestra's new vitality? Whatever the circumstance, he fills the bill nicely as a concerto player.

Finally, this is a live performance with audience. Like the rest of the Mozart series out of Sonic Arts in Berkeley, it was made under that somewhat flamboyant, lower-California engineer and producer, Leo de Gar Kulka. Not long ago, when Mr. Kulka first sailed into classical recording with audience, he managed to produce some real dillies of sheer ineptitude—the classics are not *that* easy to barge into right out of that other big stuff! His "live" recordings were *ultra*-live—minutes of coughs and conversation before the music began and long, noisy pauses between movements.


George Cleve

Well, live and learn. Kulka is not dumb. I am, myself, still against "live" audience recording in principle, because 90% of the time you substitute the most glaringly unpleasant aspects of a live concert for the much safer *illusion* of concert reality. Who wants audience coughs and rustles, too-long pauses, noisy background sounds, and, worst, assorted mistakes, whether tiny or large, to be repeated at every playing? A recording is *not* a live concert and shouldn't be.

So, at last, though this is another such concert with very evident audience, things are under control. The opening coughs are momentary, the pauses are relatively quiet and brief, and only the loud burst of applause at the end seriously intrudes.

So Leo de Gar Kulka and Sonic Arts, with the aid of Colossus and a much improved orchestral ensemble (1987), do a very creditable job. Mozart is happily served this time around.

Edward Tatnall Canby

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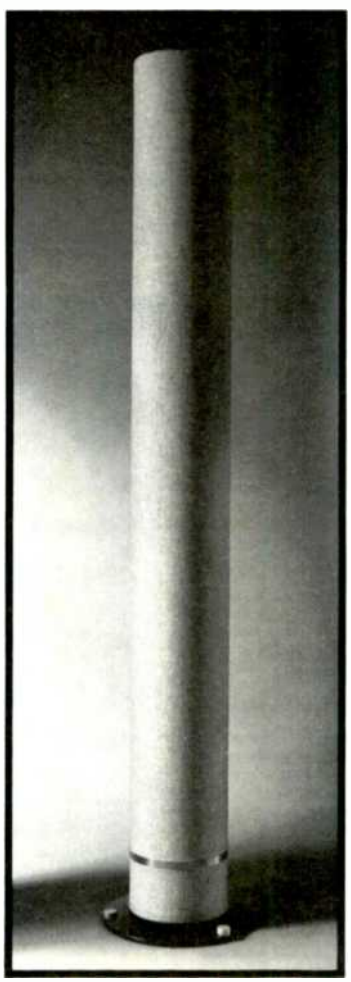

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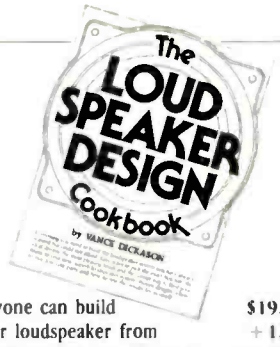

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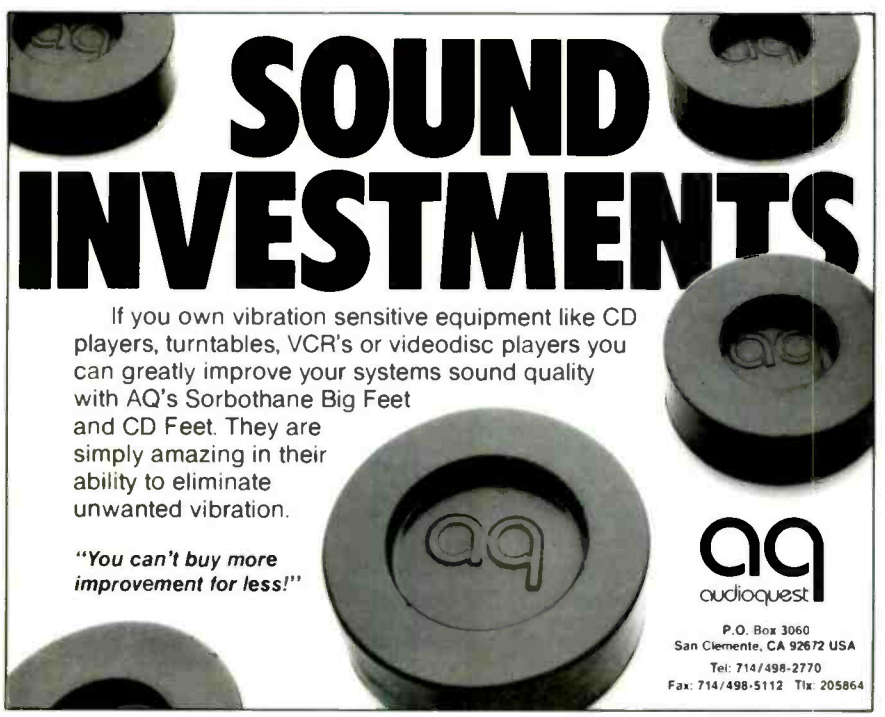

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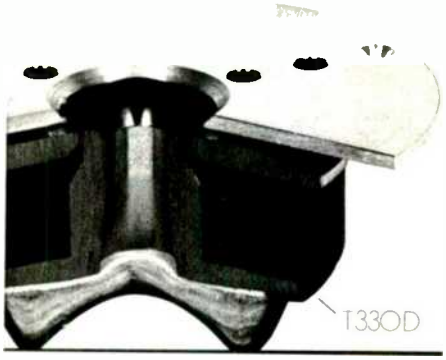

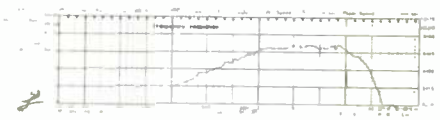

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PRESS COMMENT ON VMPS

The updated Special Edition of the VMPS Super Tower IIa/R speaker system was shown for the first time at the 1988 Winter CES. The **International Audio Review** (J. Peter Moncrieff) reports:

"VMPS continues to improve the sound of its speakers year after year. This year saw a change to Focal tweeters (the same unit used in the highly praised WATT). They certainly benefit the STIIa/R, which sounded more transparent and less colored than ever, in addition to its usual virtues of superb dynamics and wide spectral response, plus the very good imaging achieved with last year's introduction of QSO Holosonics (which helps spread the image and enrich ambient clues from the recording). There's little doubt that the VMPS Super Tower IIa/R is now a great dynamic cone speaker system, and a bargain at $3876 the pair." (**Hotline 50,** Ap 88).

VMPS manufactures three Subwoofers (**Smaller,** $229ea kit, $299ea assem; **Original,** $329ea kit, $399ea assem; **Larger,** $439ea kit, $549ea assem), four floorstanding (including the new **Mini-Tower IIa,** $369ea kit, $479ea assem), and two QSO bookshelf speakers (model 404, $139ea kit, $199ea assem; model 808, $225ea kit, $345ea assem). We also distribute John Curl's **Vendetta Research TPC 1** electronic crossover ($449), the **SCP1** MC prepreamp ($949), and the new, ultra low noise **SCP 2** MC to line phono preamp ($1895), praised by the **IAR** as "...the finest phono front end (we) have ever heard, trouncing previous references." (Hotline 50)

Write for brochures and test reports, or hear VMPS at the dealers listed below. Kits include fully assembled cabinets and all prices (except bookshelf) include free shipping in 48 US states.

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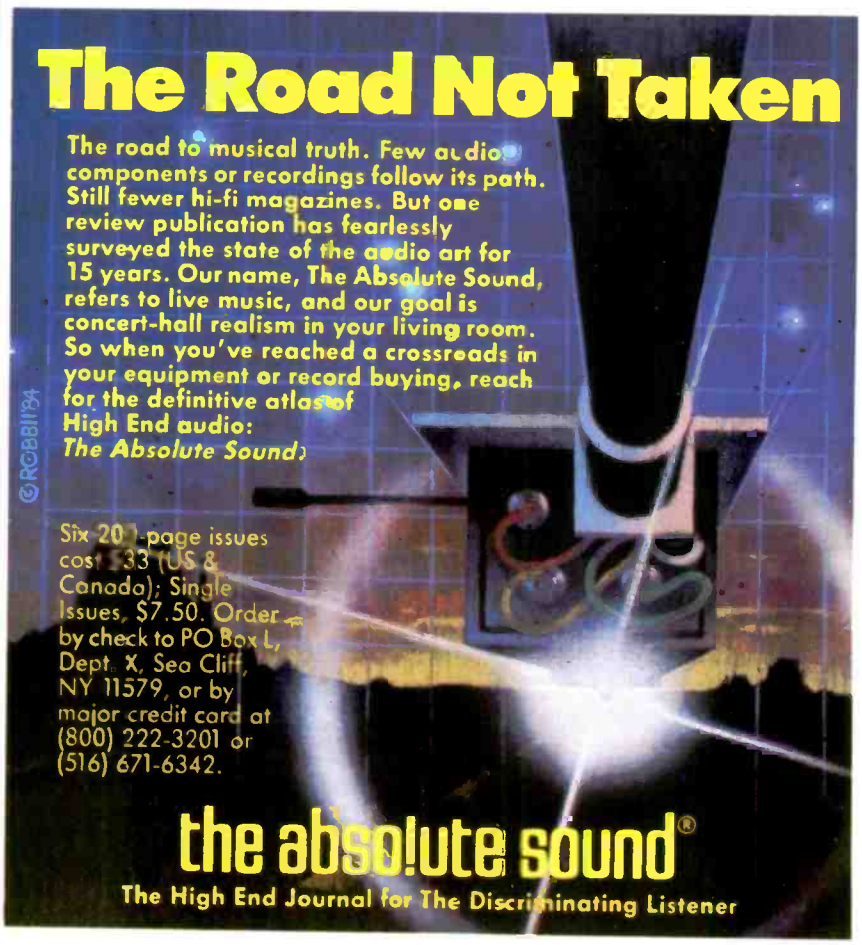

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