

# Audio

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# Audio

APRIL 1984

VOL. 68, NO. 4



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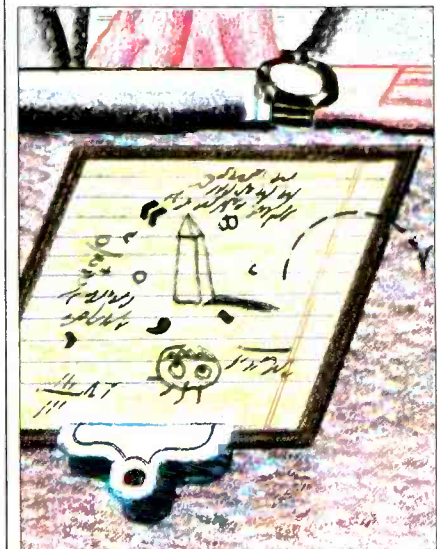
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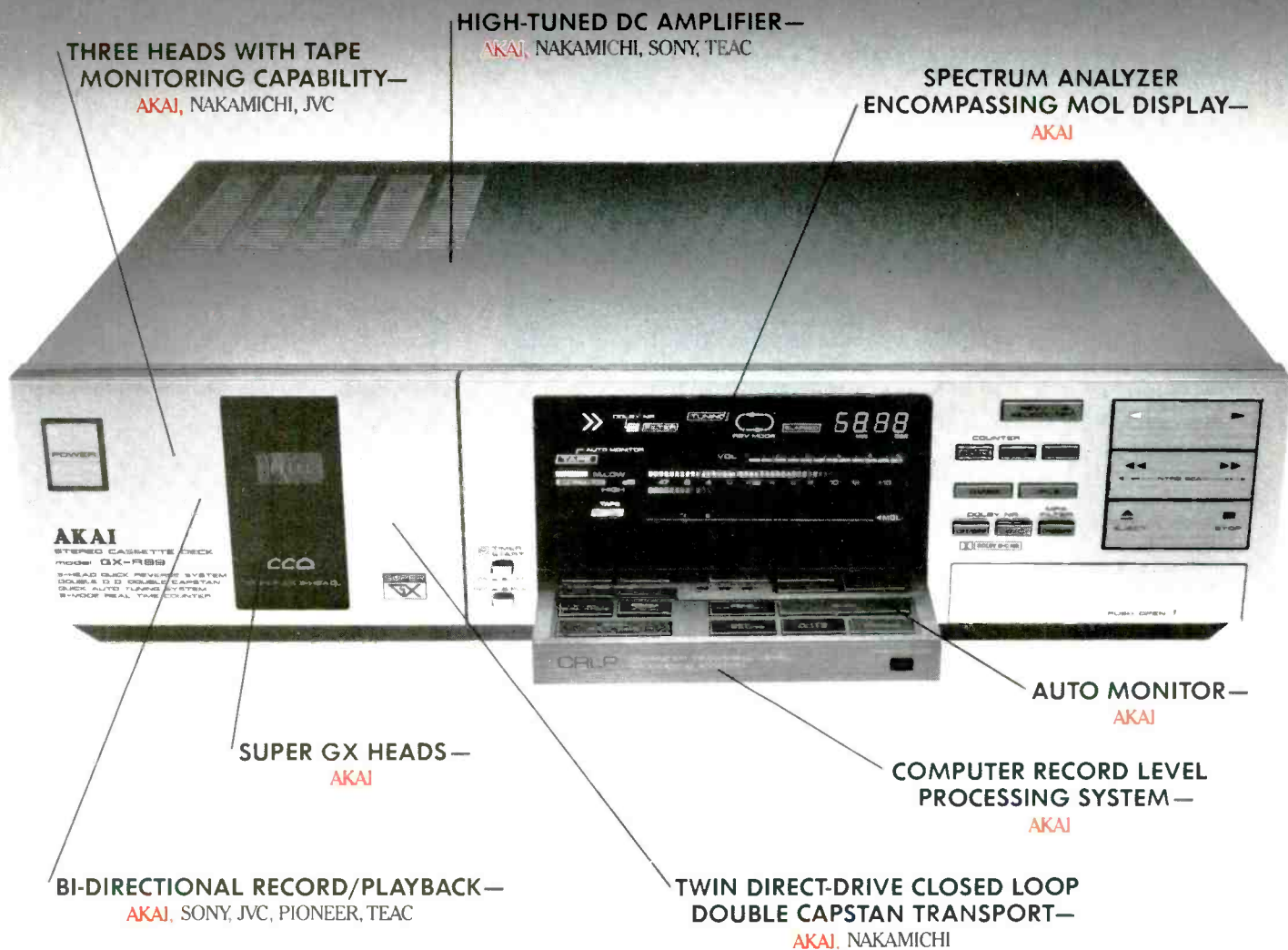
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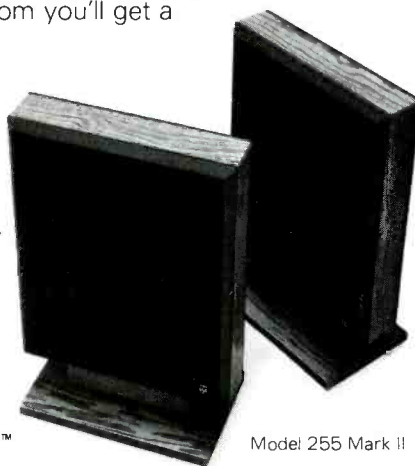
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BERT WHYTE

## WON'T YOU COME BACK, BILL BUYER

**T**he theme song of the Winter Consumer Electronics Show, held in Las Vegas from January 7th through 10th, must have been "Seems Like Old Times." The buyers were back! Throngs of them! The overall attendance of 91,245 made it the largest trade show in the U.S., and that led to extensive TV coverage.

Yes, the WCES, often a barometer of the country's economic climate, was a positive reflection of the recovery in the business world. With comfortably reduced inventories due to recent sales successes, dealers stalked the aisles looking for profit-building products.

Of course, a lot of buying activity centered on computers, telephones, games, and video products. There was, as you might expect, a plethora of new CD players, many of them second-generation models. An easily predictable trend was that almost across the board, in every price category, horizontal drawer loading predominated. As for CD players at reduced price points, Magnavox and Sanyo had bare bones models at \$499. It is widely expected that, at the June CES, some models will be selling at the \$399 level.

All well and good, but those who look to such low-priced CD players to break open the market are likely to be disappointed. Consumers who may have been waiting for a \$399 CD player are still likely to resist paying \$18 to \$20 per disc. Obviously, the key is less expensive Compact Discs. According to industry experts, about the best one can expect in the latter part of 1984 is a reduction in cost of about \$2.00 per disc. As long as mastering costs remain high (anywhere from \$2,000 to \$3,500 each) and production runs remain small (average run on a single title is 1,000 discs), the price of a CD is likely to stay in the \$15 to \$17 range. On the other hand, when people realize CDs will never wear out in normal use, this may cause some rethinking about value for money.

Philips, Mitsubishi and Panasonic showed CD players for car installation. All admitted they were prototypes, with neither price nor delivery quoted for production models. Panasonic hinted their car CD player might be available in 1985. Apparently, the problems of heat and vibration have not yet been completely solved.

The big new high-tech breakthrough at the convention was Kodavision. Kodak launched this "camcorder" (one-piece video camera/recorder) using 8-mm tape, and the rush was on. GE and RCA said they would soon have similar units, as did several Japanese manufacturers. The shame of it all is that the Kodak unit is made by Matsushita and that a company like Kodak, with all of its vast experience in coating technology, will have its tape made by TDK. This 8-mm tape will be available in metal-particle and metal-evaporated formulations, with up to 90 minutes recording time.

All this is great, but our interest is in audio. Now that reasonable profitability has been restored to audio retailing, a bit more attention was paid to audio matters. The daily WCES newspapers gave a bit more coverage than last year, but by and large, audio was still treated like a stepchild. The high-end exhibits at the Riviera Hotel were rarely mentioned. In spite of this, there was plenty of activity, though a number of people felt many audio manufacturers were holding off new product introductions until the June CES. There were, however, several interesting new products shown at the Riviera and even some significant new technology.

Loudspeakers are always in profusion at any CES. In these early days of digital audio, the term digital-ready, as applied to loudspeakers, has already become something of a cliché and, in many cases, a misnomer. As I pointed out last month, the day of the basement tinkerer is over. To compete suc-

cessfully in the overcrowded loudspeaker market, a sound, scientific design approach in a well-instrumented laboratory is absolutely vital. But it must be noted that even with a highly disciplined scientific rationale, there is no guarantee a particular speaker design will provide sonically accurate reproduction and also satisfy the musical sensibilities of the auditor. One hopes that a truly accurate loudspeaker can indeed be equated, with a high degree of similarity, to a live musical event.

An interesting speaker, offered by Rauna, was in the Opus Three exhibit. (Opus Three is a Swedish record manufacturer whose fine-sounding discs may be familiar to audiophiles.) The speaker looks akin to a ship's ventilator. The Njord model employs electrodynamic drivers in a transmission line system and affords a solid, clean bass with no resonant colorations—not too surprising, since the speaker is made of concrete! The weight of the approximately 40-inch-high unit is close to 90 pounds. It can handle 100-watts input, with a sensitivity of 88 dB SPL (1 watt/1 meter). The sound was very smooth and clean, with good imaging and front-to-back depth. Might just be the thing for those who have homes furnished in Scandinavian modern.

Acoustat was on hand with a new electrostatic speaker, the very slim One + One, measuring only 11 inches wide and 93 inches tall, with a depth of 3½ inches. The One + One is a full-range unit, with a claimed frequency response of 30 Hz to 20 kHz, ±2 dB. If you want more bass extension and



Illustration: Dave Shannon



# McINTOSH . . . TIMELESS

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It is the most technically advanced, user-friendly, high performance CD player on the market. It isn't expensive. It is amazing.

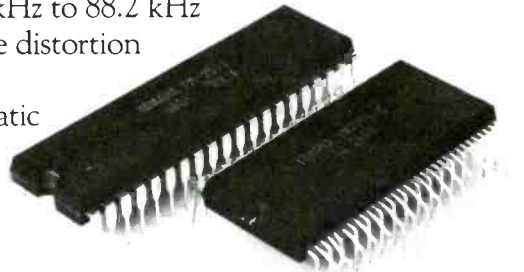
It has a 3-beam laser pickup that is more accurate than any other previous system.

We've also doubled the normal sampling rate from 44.1 kHz to 88.2 kHz and added a new digital filter system to virtually eliminate phase distortion and provide the highest possible playback resolution.

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The user-friendliness also includes a \$599\* price tag.

The CD-X1 from Yamaha. It'll be a long time before anyone closes this second-generation gap.



\*Suggested retail price

The Duntech PCL-3, a wall-mounted loudspeaker, is the most neutral, uncolored speaker I have ever heard.

low-end punch, there is the optional MK-131/B subwoofer. I heard the speaker demonstrated using the soundtrack from the movie *Missouri Breaks*, which is heavily oriented to harmonicas and percussion, and the transient response, imaging and clarity were exceptionally good.

In my rounds at the Riviera, I ran across an exhibit that had a sign reading Tru-Sonic Marketing. Lo and behold, the room was filled with the products of two of the most innovative engineers in the audio field, Sao Win of Win Labs and John Dunlavy of Duntech International.

John Dunlavy developed the remarkable DL-15 loudspeaker some years ago. I learned he has since moved to Australia, where he has a new factory. John was not at the WCES but was represented by Warren Weingrad. A genial chemist and an expert in surfactants (wetting agents) and detergents, Warren formulated the cleaning fluids for the Nitty-Gritty record cleaning machines. The Dunlavy product being demonstrated was, of all things, a planar loudspeaker made for wall-mounting. A wall loudspeaker of true high fidelity and good bass response has been a sort of hi-fi Holy Grail for many years. Although Fisher tried it over 20 years ago and many others have since then, none of these speakers ever truly succeeded.

I don't have to dwell on the sales potential of a really good wall loudspeaker. Now, at last, the legions of ladies who won't permit their husbands to bring "those ugly hi-fi speakers" into their living rooms will have lost the prime reason for their recalcitrance. It is the Duntech PCL-3 planar standard wall loudspeaker, measuring 16¾ in. H x 23½ in. W and only 3½ in. D! It mounts to a wall with a special bracket and Molly bolts. For optimum performance it *must* be flat against the wall. Inside this innocuous looking speaker, with its black (or beige) grille cloth and white oak cabinet, there is much innovative audio technology. John Dunlavy holds over 30 patents in the field of antenna design, and quite a number of his designs are on assorted space hardware. John says there is an acoustic analog to certain aspects of waveguide theory, and he has used some of these analogs in this loudspeaker.

Warren Weingrad explained to me that a U-shaped space, around the periphery of the 6½-inch Bextrene-cone bass/midrange driver, is a series of complex labyrinths filled with variable-density felt, Dacron and polyurethane foam, which afford critical damping in the system. A minimum-phase, first-order Butterworth crossover changes at 6 kHz to a 1-inch dome tweeter using Ferrofluid. Frequency response is claimed to be ±3 dB from 50 Hz to 20 kHz. Efficiency is 83 dB at 1 watt/1 meter.

Warren showed me the speaker's manual, in which Dunlavy has documented, with oscilloscope photos, the performance of his speaker. Would you believe square waves as good as from a moving-coil cartridge? Tone bursts where the output looks like the input? Third-harmonic distortion of 0.09% at 500 Hz and 0.07% at 5 kHz?

Now, quite apart from the obvious advantages of wall-mounting, the sound itself is quite incredible. Irrespective of how big or exotic the design of a speaker may be, this Duntech PCL-3 is the most neutral, uncolored speaker I have ever heard. Its front-to-back depth is amazing (with the proper recordings), and the stereo image is absolutely precise and stable. The delineation of musical textures and the presentation of ambience are uncanny. It plays extremely loudly (fused with a 2-amp fuse) and has dynamic differentials you can't conceive as coming from such a small speaker. The bass response and impact belie its -3 dB response at 50 Hz. If you want more bass extension, and still more overall output, Warren teamed it perfectly with a Janis W-1 subwoofer.

Don't take my word for the foregoing. News about this Duntech speaker has spread rapidly across the country, and Warren says he has signed on many prestigious high-end dealers. The Duntech PCL-3 will sell for \$750 per pair and should be appearing at selected dealers by the time you read this.

There is a lot of new technology at work in the PCL-3, and John Dunlavy's speaker is a stunning achievement. Simply put, it is ruthlessly accurate, and its reproduction is the closest approximation to the live musical event I've ever heard.

audio-talk from  
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Number 2 in a series

## The Simplest Stylus

The cost of a phono cartridge usually varies with the complexity of its stylus design. The more elaborate stylus shapes have audible benefits in terms of high frequency response, improved high frequency tracing, and — in the case of Linear Contact types — extended record and stylus life.

### The Spherical Tip

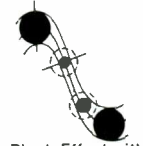
The simplest stylus shape is the Uni-Radial or spherical tip, formed much like the end of a ballpoint pen. Its tip size is determined by the width of the groove, with a typical radius of 0.7 mils so that it normally touches the center of the record groove walls.

### Some Tracing Problems



Spherical tip too large to trace highest frequencies

But a spherical stylus large enough to track at the mid-point of the groove wall is too large to precisely trace the very highest frequencies, especially at the crowded center of the record. Increased distortion and reduced high frequency response results. In addition, spherical tips often exhibit "pinch effect" distortion as they move up and down in an attempt to stay in a groove that is momentarily too narrow. This unwanted vertical motion is almost pure distortion, and results in a "shattering" of high-energy, high frequency sounds like cymbals and horns.



Pinch Effect with Spherical Stylus

### The Design Limit

Simply reducing the radius of a spherical stylus to fit the smallest groove modulation can result in a radius much too small to ride at the center of the groove wall. Instead, the small stylus is often very near the bottom of the groove, picking up noise and wear from accumulated debris and dirt. Its small radius also increases the pressure on the groove wall for a given tracking force, thus accelerating both record and stylus wear.

### Another Answer

While the faults of a spherical stylus tip may be masked by other problems in low-priced record players, they become quite evident in even a modest component system. And the easiest solution to most of the side-effects of a spherical stylus is the elliptical stylus, to be discussed in my next column.

*Jon R. Kelly*

Jon R. Kelly, President  
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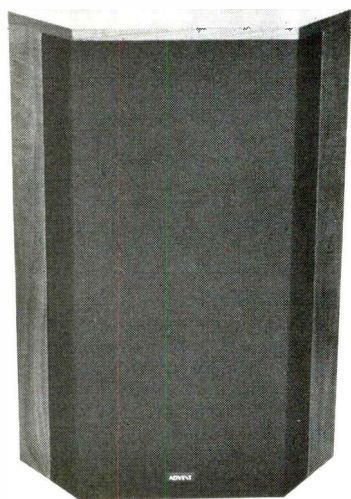
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# ADVENT

## AUDIOCLINIC

JOSEPH GIOVANELLI

### Noise Between Stations

*Q. Most FM tuners with which I am familiar produce lots of noise during the process of tuning from one station to the next. Why?—Name withheld*

A. All electronic equipment has some residual noise. An FM tuner possesses a considerable amount of r.f. and i.f. gain. Under such circumstances, even a small amount of noise can be amplified so much that it can be easily heard.

When a strong signal is received, various circuits within the tuner act to reduce the sensitivity of various stages, thereby lowering the noise in the presence of signal.

If you now tune in a weak signal, more sensitivity will be required to make this signal audible. Thus, some of the background noise, suppressed in the presence of a strong signal, begins to be heard when listening to a weaker signal.

### Stereo from Mono

*Q. How are the "oldie," pre-stereo recordings "electronically processed" for reissue in stereo? Such reissues usually sound artificial and unnatural (perhaps reverberant is the word I am seeking). Playing these "fake" stereo records using the mono mode not only reduces noises such as pops and clicks, but also frequently improves the sound.—Rudi Schmid, Kensington, Cal.*

A. A number of techniques can be used to produce pseudo-stereo from old, monophonic sources. The simplest of these methods is to put more bass in one channel and more treble in the other. The perceived result is that lows will be heard from one speaker and highs from the other. (This is not a favorite technique from the standpoint of the disc mastering engineer because of vertical "pull-up" problems caused by a noncentered low end.)

Another system is to feed the monophonic signal into two stereo channels. Reverberation is then added to each of these channels, with this reverb derived from a different "chamber" for each channel. Differences in reverberation characteristics from one chamber to the next can result in a sense of space surrounding the program.

Still another approach is to send the monophonic signal directly into one stereo channel. Then the same, mono-

phonic signal is delayed just a bit, and sent to the other channel. This, again in conjunction with reverberation, can produce a sense of space around a performance.

Some monophonic performances are so "dry" acoustically that these techniques, when used with care, can sometimes aid in enhancing our enjoyment of a monophonic recording.

All too many of these old recordings are ruined, at least for me, just because of the overuse of one or all of these techniques. (I am certain there are other techniques for producing pseudo-stereo, but these are the ones which immediately come to mind.)

### Lowering Turntable Speed

*Q. I have an old record changer which has no "pitch control." I checked the speed of this unit and found it to be running at 35 rpm rather than 33 1/3 rpm. Is there any way of adjusting the speed?—G. V. V., Omaha, Nebr.*

A. To decrease turntable speed of a typical puck-driven phonograph requires slightly grinding the motor shaft.

Before doing anything, I suggest that you use a strobe card to check for proper speed. (While you are doing this, you may wish to check all speeds.) It is easy to spot speed errors. If you try measuring turntable speed with the aid of a stopwatch, you may not be able to make a correct judgment as to exact speed. Whatever you do, *don't grind any portion of the motor shaft unless you are sure that the phonograph is really running fast, and that the error remains even after replacing the idler puck.*

To do the work, remove the platter. It is probably held in place via a C washer, which must be pried off, hopefully without its flying off into space. Hold the drive puck away from the shaft, perhaps with the aid of a rubber band. Obtain some fine emery cloth. Examine the shaft to be ground down in order to determine the correct "step" to be worked on. Once you have determined this, turn on the motor and grind the shaft by pressing the emery cloth

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against it. Be sure to check the turntable speed periodically so you don't grind off too much material. It's best to be overcautious.

When the work is completed, dismount the motor and disassemble it. Remove all emery dust which may have found its way into it, especially the top and bottom bearings. While the motor is apart, put a drop of oil into each bearing and allow it to soak into the metal. Reassemble the motor and remount it. Apply a drop of oil to the bearing of the drive puck, and to the turntable bearing. Check all other mechanical parts for proper lubrication, and grease where needed.

Replace the platter and C washer, and your changer will be ready for use.

#### Rear-Channel Recovery

*Q I have been using a four-channel receiver with four loudspeakers for a number of years. The front speakers are connected to the front channels in the normal manner. The rear speakers are connected to the rear amplifier in accordance with the hookup suggested by Hafler for recovery of the ambient sound in many stereo recordings.*

*I have found this arrangement useful in that it allows me to control volume and tone separately. This is especially helpful for balancing the system because my front and rear loudspeakers are not matched.*

*Lately I have been wondering whether an alternate hookup might improve the sound even further. My receiver has provisions for "strapping," which will more than double the power-output capacity of the front channels. I could then connect the rear speakers, together with the front-channel speakers, to the front amplifier channels (again using the Hafler circuit for the rear channels), and use a separate L-pad to provide for channel volume balance.*

*What are the advantages and disadvantages of both of these arrangements?—Klaus Hieronymus, Darien, Conn.*

*A. Your present arrangement, using all four amplifier channels, with the rear channels as a Hafler circuit, is a good one. It is simple to achieve good channel balance between the main and derived ambience information. Any added power you might obtain by strapping your amplifier would, in my opin-*

*ion, be insignificant. I do not like to waste power in the form of heat, and that is just what you would be doing if you used an L-pad as you have described.*

*You make a good point about using the separate tone controls in your rear channels. The lack of speaker match-*

*ing is a good reason for the extra set of tone controls; I like that idea and it would be lost with the strapping system.*

*This arrangement can be readily modified to incorporate a time-delay unit, should you decide to add one at a later date*

4

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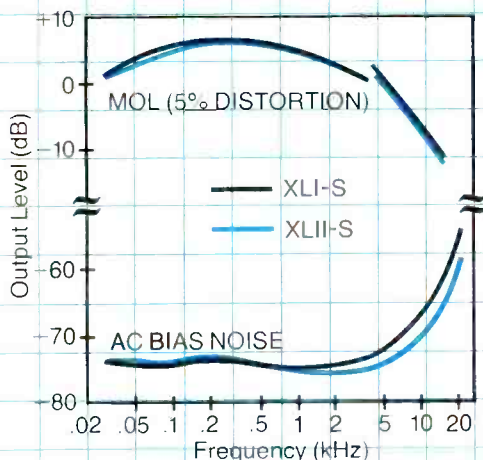
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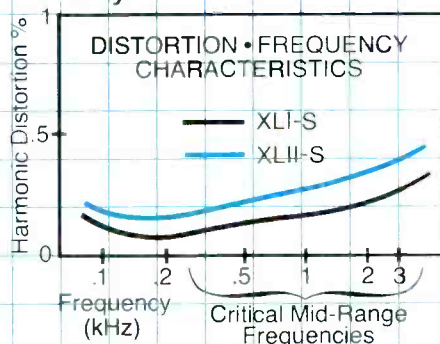


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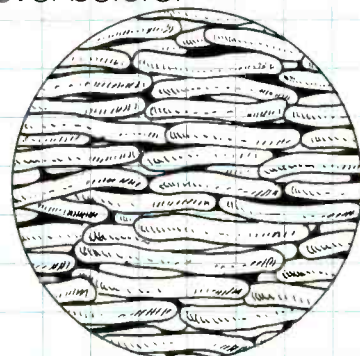
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## CHRISTMAS CARDIOIDS

**D**id I seem to end on a pessimistic note last month? I was talking about loudspeakers in consumerland, and the micro-mouse squeak. Sorry—I just can't take this subliminal background music I hear all over the place these days. All that beautiful, expensively potent hi-fi, so delicately designed for making *big* noises out of small signals, emitting nothing but barely audible chirps, just enough to register on the non-listening ear! Reaction from decades of *loud* volume, the earlier form of hi-fi status? Probably. After all, if one generation wears beards, the next has to be clean shaven, as even the Romans knew, minus electric razors. So did George Washington and Thomas Jefferson. Then there were beards again, and then there weren't, and now there are. Can hi-fi be different? Down with loud volume, up with micro-squeak.

At the other end of the audio chain (see last month), it is good to know that the microphone can *never* be a macrophone. Its rep for useful but totally inaudible sound is permanent. There isn't much scope for status display in any sort of mike, even with chrome and plastic. Much less in TV gray or black or dirt brown. Mikes are not for looking at. Yes, I know, pop stars often sing into a hand mike that is totally dead, using it merely as a required prop—ever notice how they sometimes wave it around in the air (which would produce outlandish results if the thing were really functional)? But mikes in general are sober devices and largely practical, just a means to an end—many remarkable ends. With apologies to the speaker people, I find the mike part of the audio chain much more interesting. Both mikes and speakers are transducers functioning in fields of actual sound, but the range of effects that we can get with our present art of microphoning is absolutely astounding. No lesser word will do.

While loudspeaker designers still work enthusiastically to pare down distortion, flatten peaks and dips, align phases, polish up the TIM (only to launch their marvelous products into the current mouse-squeak void), the mike folks after 60 years are still jubilantly developing whole new kinds of mikes, and new ways of using them—which leads to larger things, such as



Illustration: Philip Anderson

the ever-new recording studios, or those enormous mixing boards you find in every one of them and assembled in booth after booth at the AES shows. To me, those giant boards are blurs of knobs and sliders by the million, as awesome as, maybe, a grand piano 20 feet wide with a thousand keys to play on, but to mike users they are familiar tools. At the shows, high-school students talk over their fine points in the most casual fashion, as though it were all very simple. (It isn't.) Such is the power of the microphone.

As a youth, I never set eyes on a mike, though I had played my own baby records on a wind-up machine long before. Even in the blossoming times of the Orthophonic phonograph, still acoustic but with a folded exponential horn, big volume (relatively) and lots of new bass (I was about to write: Also the Brunswick Panasonic but of course meant the Brunswick Panatropic)—even with these and the electrically recorded Orthophonic records and other equivalents, we had only the vaguest idea as to what a microphone was. The horn was gone; if you had music to record or broadcast, you set up this small square wooden box in front of it, and the music came out of your radio at home. How? We didn't much bother. Or, presumably, it could also go directly onto a shellac

disc; we were foggy as to any necessary steps in between. Somehow, of course, these discs multiplied like the brooms in "The Sorcerer's Apprentice," and we could all play records, but this aspect didn't bother us either.

It was broadcasting that put the mike on the map. There never had been a horn in that area, and the microphone was essential from the beginning for everything but Morse code. Shure Brothers recently sent out a lovely Christmas card with a group of elderly Shure mikes on its cover. If you are my age you will know them all, but the one that instantly stands out is of the type that virtually became a symbol for broadcasting when radio finally went big. It's a sizable metal ring on a stand with a symmetrical set of springs inside holding a round mike suspended in the middle, presumably shock-proof. That was the idea, anyhow. Shure's was a carbon mike, the 33N of 1932, following the well-established transduction system of the telephone, going far back before the turn of the century. For years, every photo of a radio star or broadcasting group would feature a similar mike in the foreground, more as a symbol of the broadcast art than as a practical transducer. If an ordinary citizen were asked to draw a picture of a mike during those years, he would have immediately produced a circle

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Microphones in general are sober devices and largely practical, just a means to an end—many remarkable ends.

with the elegant springs inside, and a blob for the mike itself. That's the way a mike looked.

New shapes, though, were coming in along with new types of transduction. Shure's other mikes of the 1930s are familiar still, in their looks and in principle too—the crystal mike, a small round thing minus springs, and also in the fancier blunt-bullet shape (the 720B) which I remember as the ultimate in elegance. Note that these mikes were generally chromed and nicked, to impress live audiences and to look great in press pictures. All that came to an abrupt end with TV, which could not use any microphone that visibly reflected those huge overhead lights.

What happened to the springs? Dare I surmise that, just maybe, those high-style chromed suspenders created a vast collection of spurious-resonances, right at the mike itself? Think of all the spring-fed reverb units we have used during these later years. In any case, the handsome spring mounts were no longer to be seen on the scene after the mid-'30s. A much better idea for solid protection, though I wonder how the slots were designed, came with the die-cast mike housing, a style that remained good looking and useful even in dun-colored brown, as in the famous Western Electric cardioid, combining dynamic and ribbon elements. Shure's 556B, on that same Christmas card, was long familiar in semi-pro and studio recording. That version dates from 1938, a dynamic. You will note that numerous mike manufacturers made use of these different visual styles, the way the car makers borrowed back and forth in auto shapes, in radiator grilles and fenders. It's not at all a coincidence, I'd say, that the die-cast microphone coincides in date with the equally handsome die-cast automobile grille.

One mike on the Shure picture is really unfamiliar, an early condenser. The 40D of 1935 is an ungainly tall black container with a round mike element mounted rather clumsily on top. In those big-tube days, the necessary extras to polarize the diaphragm and process the signal were hard to devise. A much more familiar, and much later, "early" condenser mike comes immediately to my mind—I bought one

for myself: The wine-bottle Altec, a tall, thin, graceful black shape with a really tiny (for the time) active unit on top. And, alas, an enormous power-supply box plus the most unwieldy thick cable I have ever dealt with. Nevertheless (and in spite of an often cited peak in the high end), it was sensational in its day and I have a story to tell that some will remember. When stereo came in, all resplendent in its two channels, the AES banquet, not to mention everything else in sight, was duly dual-equipped, two of everything. If I am right, then, the human speakers at that banquet faced not one but two mikes, one to each side, with sets of "PA" loudspeakers banked at each end of the hall. The effect was disastrous. Each time the dinner speaker moved his silly head a quarter of an inch (and how many of our fine engineers have yet learned that before the microphone you do *not* move the head?), the sound source jumped 50 feet sidewise. It was a sonic battleground with Presidents, V.P.s, Honored Guests, all flying through the air at terrifying speeds from one end of the room to the other. As I remember, the pairs of mikes in use were "bottle" Altecs.

Not having 50 pages at my disposal, I will gently skip the next quarter-century and more of microphone history in favor of a couple of relevant items from the present, where the furor over mikes and mike techniques is continuing as forcefully as ever in the past. First, a new note on the now-celebrated PZM, which this department touted a couple of years ago as a basically new microphone type in its characteristics and pickup pattern, a half-sphere. Since Crown took up the PZM, its use has spread and so has experimentation, mainly, but, I gather, not exclusively with Crown-made equipment. (The mike originated at Syn-Aud-Con via the work of Ed Long and Ron Wickersham.) It's my impression that for most of this period the PZM has been used in variants of its original configuration, a tiny capsule mounted in the zone of equal pressure within a millimeter or two of a flat surface—that surface being anything from a smallish plate (weak bass) to the lid or "wing" of a piano or harpsichord, even a whole wall, or the floor, or a table top, anything with enough flat space to do the





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After 60 years, the mike folks are still jubilantly developing whole new kinds of microphones, and new ways of using them.

required job, similarly to a flat speaker baffle. Most enterprising usage has been the hanging plastic rectangle with the microphone at its center, giving a horizontal hemisphere of response on one side and virtually none on the other. Not like any other configuration of any common sort.

But the PZM hasn't fitted into the now-common forms of stereo pickup, except in the form of two spaced plastic mounts. Down in Texas, Michael Lamm and John C. Lehmann of the nicely named Dove & Note Recording Co., working largely in classical recording and broadcast, including TV, have devised an ingenious new geometrical complex of plastic mounts and Crown PZMs that can simulate or better, duplicate the conventional pickup patterns for stereo that are now widely in use with standard microphones. Mr. Lamm first phoned me about a Christmas TV *Messiah*, emanating from Texas, that used a specially built array named the L<sup>2</sup> MicArray, and at last fall's AES convention they gave a paper on their system. Unfortunately, I missed it thanks to the Transit Authority—I stood on a 42nd Street subway station waiting for a nonexistent train. But there is a preprint, No. 2025 (C9), which describes this array. It is an adjustable package of clear plastic panes which can be mounted around two PZMs at various positions and angles to produce the typical pickup patterns of an astonishing variety of stereo alternatives—M-S, DIN, X-Y, and many more initials. As usual, I'll keep my non-engineering hands clean and go no further into the details. But the system strikes me as full of interest for classical experimenters and for the latest in pop styles as well, those that are simplified a bit from the usual forest of microphones long standard at pop sessions. No, I assume you will not be able to use 30 PZMs in the L<sup>2</sup> MicArray. For information, you might try Michael Lamm at Dove & Note Recording, 15415 West Antone Circle, Houston, Tex. 77071.

Finally, I mentioned a new type of microphone, mounted like a PZM in plastic rectangles, at the 1983 Bach Festival in Eugene, Ore. It is, rather, a new application of an old principle, using miniature capsules in the PZM manner but in a different way altogether.

er. the flush mount. This capsule is mounted face up, virtually flat against the large Plexiglas rectangle, rather than pointing down towards the flat surface. Messrs. James Swirczynski and Steve Hangebrauk of JES Audio Design (see Dec. 1983) are experimenting with demountable inserts so

that direct comparisons can be made between PZMs and the flush-mount capsules in the same format and I assume, with very nearly identical pickup patterns.

It would be interesting to bring these two operations together—the L<sup>2</sup> MicArray and the flush mounts, perhaps? 



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## TAPE GUIDE

HERMAN BURSTEIN

### What Can \$300 Buy?

*Q. When recording at 0 dB on a cassette deck's meters, what sort of frequency response is necessary at this level in order to faithfully reproduce a top-quality LP? Can such a cassette deck be found in the \$300 price range?—Jim Kincannon, Hammond, La.*

*A.* Top-quality LPs achieve response out to about 15 kHz. However, for most music, particularly classical, the treble frequencies tend to be at substantially lower level than the mid-range frequencies (and than much of the bass). Therefore, despite the treble boost applied in recording, one can record a tape at or close to the 0-dB level without substantially impairing response in the high treble.

However, there are some qualifications. As indicated above, some kinds of music have higher relative treble levels than do other kinds—rock music, for example. If one is using Dolby B instead of Dolby C, there is more chance of saturating the tape and losing highs; with dbx there tends to be still less chance of tape saturation. Then there is the question of what 0-dB level signifies. In some decks it corresponds to Dolby level, while in others it is about 25%—about 2 dB—higher. If 0 dB corresponds to Dolby reference level (200 nanowebers per meter), there is less chance of tape saturation when recording at a level that doesn't exceed 0 dB.

All in all, if frequency response at 10 kHz does not drop more than about 3 dB relative to 1 kHz when recording at 0-dB level, and if one is recording material without unusually strong highs, essentially faithful response out to 15 kHz can be achieved. There are a number of cassette decks today in the \$300 price range that can do this, and thereby faithfully reproduce a high-quality LP record.

### Dolby Level

*Q. What is Dolby level, and what is it supposed to be used for?—Jeff Pagels, Largo, Fla.*

*A.* Dolby level is a recording level which, at 400 Hz, produces a signal level of 200 nanowebers per meter (200 nWb/m) on the tape. When using Dolby noise reduction, there has to be a correspondence (within 2 dB) be-

tween the recording and playback levels going through the Dolby circuitry; this is referred to as proper tracking. In playback, the meter or other indicator shows Dolby level at a specific point, assuming the indicator has been properly adjusted. In recording, level is adjusted (sometimes by the user, if the deck so provides; otherwise, by the manufacturer) so that a 400-Hz tone reads at Dolby level in playback. If there is mistracking—poor correspondence between recording and playback levels going through the Dolby circuitry—high-frequency response tends to suffer. This occurs because the amount of treble boost supplied in recording isn't matched by the same amount of treble cut in playback.

### Channel Dropout

*Q. I would appreciate your advice on the following problem with my open-reel tape deck. Recently I noticed that a taped FM broadcast would have a dropout of one channel for a period of time. I phoned the station and was told that the problem was theirs, not mine. I experienced a similar problem with another station, and it, too, assumed the blame. I would be reassured, except that I seem to experience the same problem in taping phono discs.—Mrs. H. E. Hlad, Bayonne, N.J.*

*A.* If you have the one-channel dropout problem with both phono and FM recordings, but never when listening directly to FM or phono, the problem would most likely lie in your tape deck. You will have to refer it to an authorized service shop. There is a very slight possibility that the tape itself is at fault, owing to excessive oxide shedding. If you re-record on the tape and the dropout shows up in the same region, the tape would be indicated as the culprit. You might also try recording on virgin tape to see if the problem then disappears.

If the problem occurs when listening directly to a sound source, preferably phono, then the fault lies somewhere in your system other than the tape deck. And, as before, you would need the help of a service shop. **A**

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## A BINARY BEGINNING

**F**ranksly, this could turn out to be an unbelievably horrible mistake for me. You have no idea how much trepidation I have undergone since I received the invitation to write a new column for *Audio*. When I accepted, it was on the thin ice of impulse—the question of ego is an enormous one for all writers. Tonight, as I stare into my microcomputer's green screen, I am convinced that the ice has broken, and I have fallen through, into very cold water indeed.

Don't misunderstand me. This should be a piece of cake. My education is solidly electrical engineering, I've spent years designing digital circuits, and I'm a recording engineer and a Music Engineering professor. I've written articles on digital audio, and I'm even secretly working on a digital audio textbook. Qualifications, seemingly, no problem. Yet, I'm in a real jam, because of you, the readers. You see, I can't relate to your interest: I have never cared for recorded music. Yes, that's right. I feel better, having gotten that off my chest. Although this first in a series of articles might be the last, at least I can say I was honest.

Let me explain. My office adjoins a concert hall. My office, or lab, has always adjoined a concert hall. All day or all night long, it's music. Specifically, the creation of music. I am immersed in it, drowned in it. . . . As a result, I don't have much enthusiasm for recorded music. Frankly, it all sounds bad to my ears. Can you blame me? Is there really any comparison between the experience of live music and the pressure wave resulting from the LP on your turntable? No, I, at least, was never remotely seduced by hi-fi. After a day in the concert hall, I could never bring myself to listen to a stereo system and try to believe there wasn't a tragedy being perpetrated.

Don't misunderstand. I do a lot of listening at home. My trusty AR turntable has tracked a million miles of vinyl groove, my faithful ReVox A-77 has had untold head transplants; I listen all the time—critically, appreciatively, thankfully. But I was never fooled, not one bit. Those were only recordings, generations and generations removed from their live birthright. There was not even much solace for me in the recording studio: The orchestra on the other

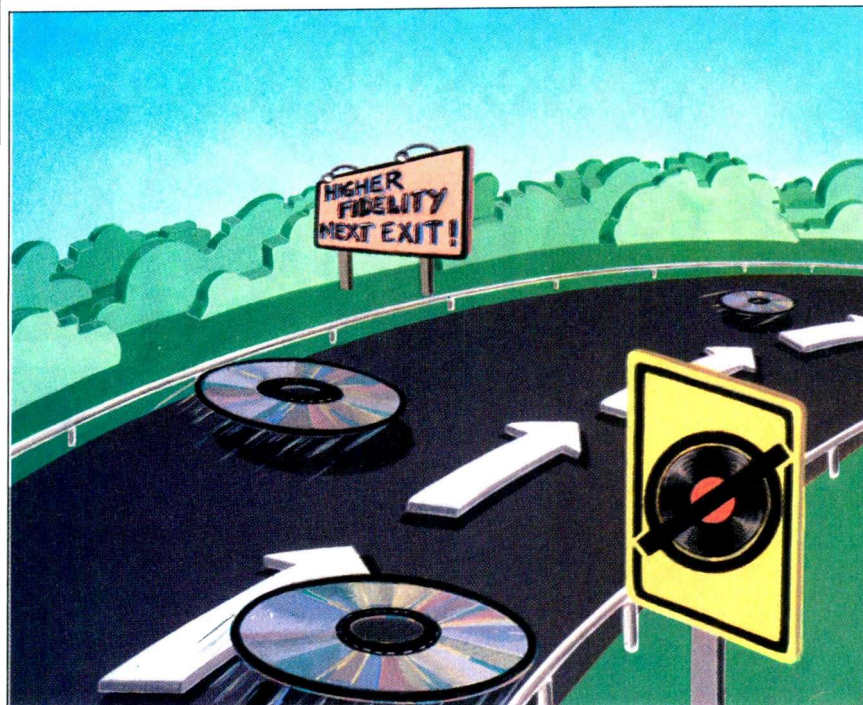


Illustration: George Blume

side of the glass was only a cruel reminder of imperfect reproduction. In my chair behind the console, I could see that none of those controls would help; at the sound of the final chords of a symphony, the sound off the tape would never cause me to jump from my seat and applaud, spontaneously, instinctively. They were only recordings, in an analog medium which was intrinsically disappointing.

Analog was always a mistake, because medium limitations were inherently indistinguishable from signal. Whether magnetic tape and its flux densities or a vinyl groove and its mechanical variations, the medium's method of storing information fused the analog data to the analog medium's noise. Even in the best analog systems, the noise and distortion accompanying the signal were audible—and that spells failure for an audio information-storage technique. If it sounds bad, the stored information is wrong. Thus, for information storage, analog technology was doomed. I think every design engineer can see the reasoning behind that statement. Design is essentially a question of technology, but with music it is ultimately a question of hearing. The limitations of analog storage are simply too audible. In the past

I could never satisfactorily listen to recordings, simply because they were analog.

Then there was digital. With digital, the nature of storage medium and its content have been divorced. Thanks to the digital computer, we can store information as pure data untainted by the fact of its storage. Binary data can be recorded as simple flux reversals on magnetic tape or dimples on a reflective disc, and the noise and distortion from the storage medium—and degradations like the rotational variations of the machinery—will not affect the quality of the data. Suddenly we are afforded the opportunity to record music with much greater accuracy, and thus greater fidelity. Of course, limitations still exist; specifically, the method of conversion from the analog acoustic waveform to the digital storage medium, and back again, presents a formidable engineering challenge. But our advantage is irrefutable—our digital data exist independently of the medium and enjoy all of the efficient methods of computation available only to a digital processor. Moreover, with digital storage our information is irrevocably permanent. Future systems of still higher fidelity will be devised, but our digital data will

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Analog was always a mistake, because the medium's limitations were inherently indistinguishable from the signal.

never be eclipsed—perhaps future players will merely interpolate that data to provide new information from its content, for with digital such things are possible. Analog music recording was time spent in waiting.

Now the wait is over. That is why I can at last write this column: Because digital music exists, because at last I can listen to music playback and hear so much information that I begin to feel as if I am *there*—right there—at the performance. High fidelity will have to be redefined as higher fidelity.

It is a new beginning for the art and science of audio. Just as the wax cylinder gave way to the 78-rpm record, and the 78 rpm gave way to the LP, the LP will give way to the CD. Even if I'm wrong, even if the CD fails, digital will not. It's the first step in a new evolution. Sure, mistakes will be made, and, sure, a complete rethinking of recording technique is required. Our sweeping conversion to digital audio will necessitate this. But the underlying impetus is clear: Because of digital technology, the amount of information is so much more vast and our methods of analyzing and processing it so much more efficient, and because the power of the available music information is much greater, we have begun a new era in the re-creation of acoustic events.

Today's equipment is just the beginning. Eventually the CD will be an antique. That's right—it's not too early to say "CD" and "antique" in the same breath. Sure, the CD has tremendous firepower—a channel bit rate of over 4 million bits per second, and its silvery face might pack 13 billion bits of information—but engineering teams are already working to perfect erasable and recordable CDs. Perhaps in the future, consumer storage formats will disappear entirely, to be supplanted by a commercial library of digital recordings residing in memory—accessed and auditioned at home through your personal computer. Imagine: Any recording ever made, available any time, with a few keystrokes (for a small monthly charge, of course). But even as we attempt to comprehend that, we must try to imagine successive methods of music storage, methods which may someday render digital storage obsolete.

Well, maybe I've said too much. Per-

haps I've insulted the readers of this magazine who have actively supported the slow evolution of analog audio technology and thus implicitly prepared the way for digital audio. Perhaps I've confused people with some of my highly speculative arguments. Well, in my opinion, provocation and

confusion are the early stages of understanding. And our goal now is to achieve an understanding of digital audio, in terms both of bits and bytes and of the philosophical nature of this important technological development. It's an exciting time. I think we're lucky to share in the makings of a revolution. **A**

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# ERROR CORRECTION IN THE COMPACT DISC SYSTEM

**Dr. Toshi T. Doi**

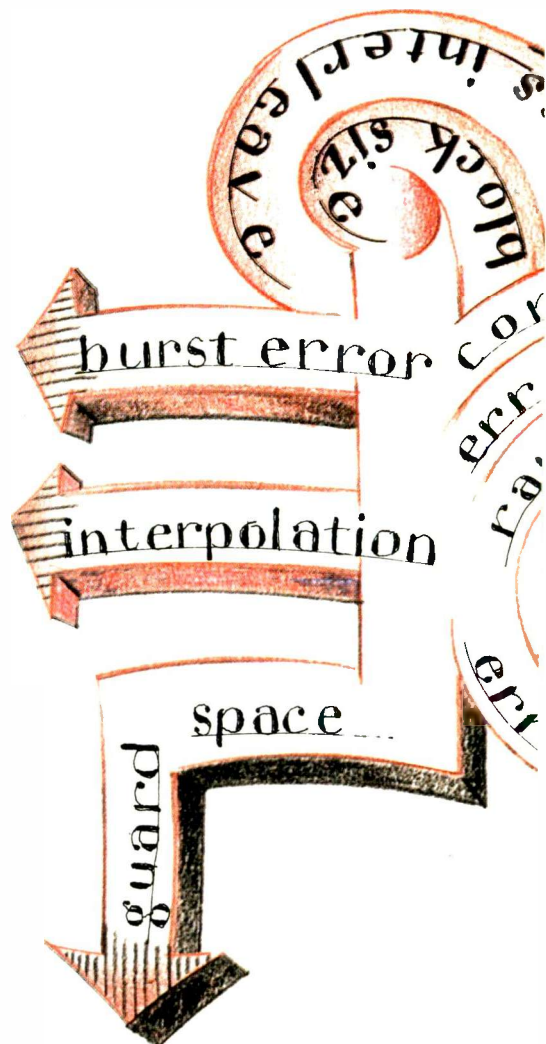
**E**rror correction is one of the key technologies in the field of digital audio, and I believe that the basis for error correction can be plainly explained by use of a "supermarket shopping" model, which I will develop. There are various criteria for any error-correction code which is to be incorporated in a digital audio system, and I will give some details on the various code systems and pay special attention to the Electronic Industries Association of Japan (EIAJ) format for the Compact Disc. This format is called cross interleaving and it is a unique

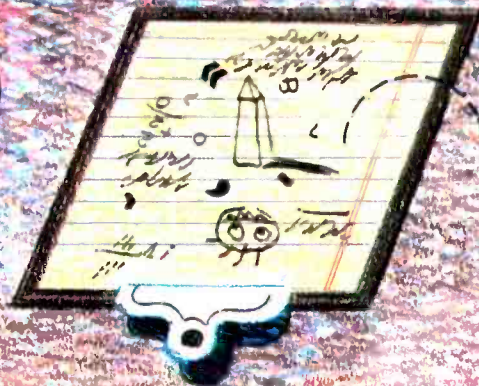
method of combining two codes by interleaving delay. In practice, it has

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*Dr. Toshi T. Doi is Deputy General Manager of Sony Corporation's Digital Audio Division, Communications Products Group, in Tokyo, Japan.*

*This article is excerpted from a paper presented to the 73rd Convention of the Audio Engineering Society, held March 15-18, 1983, in Eindhoven, The Netherlands. Copies of the preprint, No. 1991 (B4), may be obtained from the AES, 60 East 42nd St., New York, N.Y. 10165.*





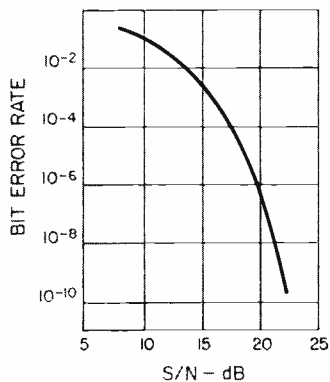


Fig. 1—Bit error rate vs. S/N for peak-to-peak signal and rms noise values.

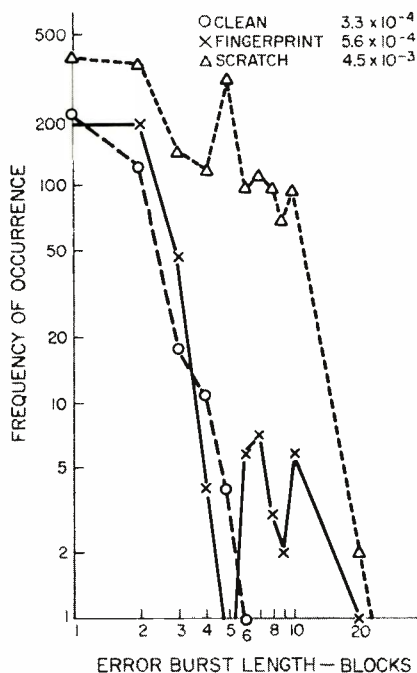


Fig. 2—Typical block-error statistics for an optical disc when clean ( $3.3 \times 10^{-4}$ ), with fingerprints ( $5.6 \times 10^{-4}$ ), and scratched ( $4.5 \times 10^{-3}$ ). Figures shown are for a disc with a linear speed of 1.2 meters per second, bit rate of 2.352 Mb/s, and block length of 160 bits.

proven very efficient in performance as well as highly economical in hardware design. Because of these two qualities, the method has been applied to many other systems beyond the Compact Disc system.

One good way to understand the history of digital audio is to look at the progress of error-correction technology. The error-correction codes themselves have been well studied by the coding theorists, but their application to digital audio recording is not so straightforward. So far, great effort has been paid to the study of the criteria necessary for truly reliable systems in studio or home, the investigation of the causes and the statistics of errors on magnetic tapes and discs, the practical and the theoretical approaches to the design of error-correction codes, achieving a better trade-off between performance and hardware cost, and good, easily implemented hardware designs as well.

Basically, error-correction codes can be categorized as linear versus nonlinear, block versus convolutional, and word-oriented versus bit-oriented.

In digital audio recording, a combination of linear, block, and word-oriented coding methods has generally been adopted. The cross-interleave method, however, is an exception since it uses a block code in a convolutional structure in its application to the Compact Disc. In this way, the higher performance of a convolutional structure can be enjoyed while still keeping within the simple structure of block coding. There are three basic reasons why a word-oriented code is used. First, it has better correction capabilities for burst errors. Second, memory handling is simpler when RAM is used. Last, the digital audio system handles code words of 16 bits per sample, and it is simpler to design error-correction hardware for 8- or 16-bit words.

#### Causes of Digital Coding Errors

There is a large variety of ways in which coding errors can occur, but they can be grouped according to where they occur. Code errors occur during digital recording because of:

1. Defects in the tapes or discs which occur during production;
2. Dust, scratches, and finger-

prints which occur while the media is in use;

3. Fluctuations or irregularities in the recording or reproducing mechanisms;
4. Fluctuation of the level of the reproduced signal;
5. Jitter, wow, and flutter;
6. Noise, and
7. Intersymbol interference.

There are several defects which occur with magnetic tape, and these are:

8. Dust and scratches occurring during production;
9. Defects of scraping of magnetic materials, including traces of dust;
10. Irregularity of tape edge or width, and
11. Trace of a step at the junction between magnetic tape and the tape leader.

Other causes of error are found with the optical disc, and these are:

12. Defects in the photo-resist;
13. Dust and scratches which occur during cutting, developing, plating or pressing;
14. Inappropriate strength of the writing beam or length of the development time, either of which will result in asymmetry of the pits;
15. Error in forming the pits in either plating or pressing of the discs;
16. Bubbles, irregular refraction or other defects in the transparent disc body;
17. Defects in the relative metal coating, and
18. Irregularity of the back surface of the stamper or of the mother.

It should be noted that item 2 also includes damage to the edge of a tape, while item 3 refers to mistracking or misfocusing (in the case of optical discs), an unlocked servo or to fluctuations in the contact between the tape and the head. Items 4 and 5 are mainly caused by item 3, and it should be noted that a small vibration of tape or head causes a great problem because the recorded wavelength is so short. The relationship between error rate and noise, item 6, is shown in Fig. 1. Item 7, the intersymbol interference, is caused by the bandwidth limitation and by the nonlinearity of the recording media.

If a bit error does not have any correlation with other bit errors, it is called a random-bit error. When errors occur in

There exists a trade-off between data redundancy and the safety margin, where the latter depends on the error-correction strategy after detection.

a group of bits, it is called a burst error. Errors can also occur in words or in blocks, and random (word or block) errors and burst (word or block) errors can be defined in a similar way. Among the causes of error described, items 1, 2, 3 and 4 correspond to a long burst error, and 5, 6, and 7 to a random or short burst error. In actual digital audio recordings, all kinds of error are mixed together, and the code should be designed to cope with any combination of random, short burst, or long burst errors.

### Error Measurement

Measuring the meaningful error characteristics of digital audio recording media is not an easy task. In the early days, word errors were directly measured, and optimization of an error-correcting scheme was carried out based on the obtained statistical data. The approach was theoretically reasonable, but a real working system may not always represent the prototype system. Moreover, the complete system may not be available during the process of system design.

Here, the most important point is to be able to recover from such accidents as tape damage, fingerprints, scratches and so on. The system should be designed to obtain a block-

error rate better than, for instance,  $10^{-4}$ , so as to guarantee that the error rate is sufficiently low after the correction in the normal condition.

Defining the tolerable level of accidents is the most important point in designing error-correction schemes, and this greatly depends on the structure of the recording media. Cassette tapes, open-reel tapes, and optical discs must be handled completely differently in this sense. Figure 2 shows one of the typical examples of optical discs measured under the following three conditions:

1. A clean disc, in its normal condition, with a block-error rate of  $3.3 \times 10^{-4}$ ;
2. A fingerprinted disc, where fingerprints are located all over the disc, with a block-error rate of  $5.6 \times 10^{-4}$ , or
3. A scratched disc, where the disc has been rubbed on a wooden table for approximately one minute, with a block-error rate of  $4.5 \times 10^{-3}$ .

In the case of these accidents, long burst errors are observed, and therefore it is recommended that errors be measured by block, rather than by bit.

### Error Detection

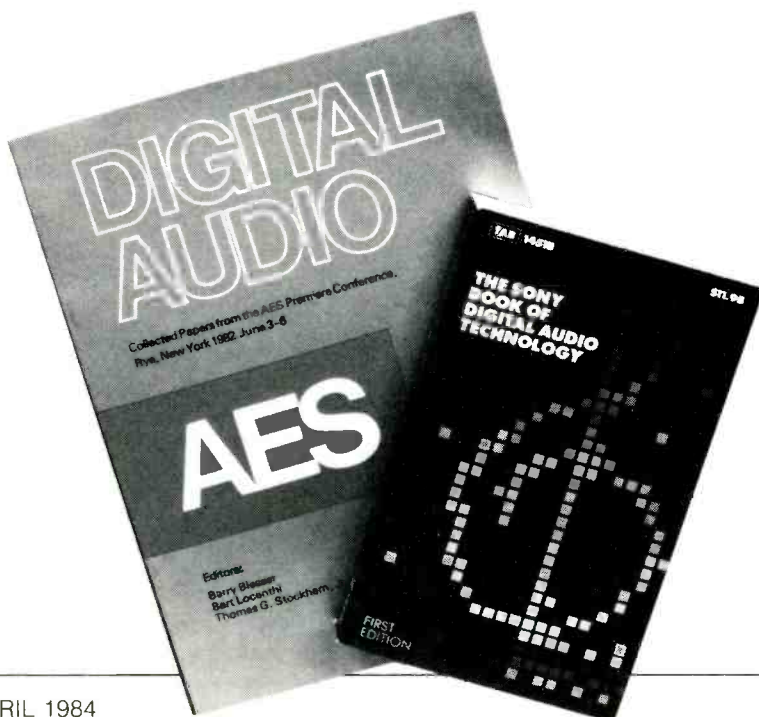
Use of a parity check bit is well known as a simple error-detection scheme, and it detects 100% of even-

numbered errors. This ability is not sufficient for most digital audio recordings, and therefore Cyclic Redundancy Check Code (CRCC) is commonly used for error correction. The basis on which to decide the length of the block always poses a question, and the larger block seems better because it keeps the same detection capability with less redundancy. But if the system tends to encounter random or short burst errors frequently enough, as with optical discs, then the resulting error rate with longer block length may worsen considerably. Moreover, even one bit error in a long block deteriorates the whole block. There also exists a trade-off between redundancy and the safety margin, where the latter depends on the error-correction strategy after detection. CRCC is often used as an "error pointer" in error-correction codes, and the detectability of errors should be analyzed before designing the whole correcting scheme.

### Principles of Error Correction

Figure 3 shows a typical supermarket shopping receipt (Slip A), listing the prices of four items ( $W_1$ ,  $W_2$ ,  $W_3$  and  $W_4$ ) and their total ( $P$ ). The "syndrome" ( $S$ ) is calculated for checking; when there is no error,  $S = 0$ .

In Slip B, the price of  $W_2$  is missing



Two of the best books on digital technology now available are *The Sony Book of Digital Audio Technology*, No. 1451B, Tab Books, Blue Ridge Summit, Pa. 17214, \$11.95, and *Digital Audio* from the Audio Engineering Society, 60 East 42nd St., New York, N.Y. 10165, \$75.00.

Fig. 3—"Supermarket receipts" as examples of single-erasure correction.

SLIP A (Original Slip)		SLIP C (One-Word Error)	
$W_1$	\$ 100.00	$W_1'$	\$ 100.00
$W_2$	\$ 200.00	$W_2'$	\$ 300.00
$W_3$	\$ 300.00	$W_3'$	\$ 300.00
$W_4$	\$ 400.00	$W_4'$	\$ 400.00
<b>P (Total)</b>	<b>\$1,000.00</b>	<b>P' (Total)</b>	<b>\$1,000.00</b>
Syndrome (without error) $S = W_1 + W_2 + W_3 + W_4 - P = 0$		Syndrome $S = W_1 + W_2 + W_3 + W_4 - P = 100$	

SLIP B (One-Word Erasure)		SLIP D (One-Word Error with Pointer)	
$W_1$	\$ 100.00	$W_1$	\$ 100.00
$W_2^*$	•••••	$W_2^*$	→ \$ 300.00
$W_3$	\$ 300.00	Error	\$ 300.00
$W_4$	\$ 400.00	Pointer	\$ 400.00
<b>P (Total)</b>	<b>\$1,000.00</b>	<b>P' (Total)</b>	<b>\$1,000.00</b>
Syndrome (with one erasure) $S = W_1 + W_2^* + W_3 + W_4 - P = -200$		Syndrome $S = 100$	
Erasure Correction $W_2 = W_2^* - S = 200$		Correction $W_2 = W_2^* - S = 200$	

( $W_2^* = 0$ ). The missing data word is called an erasure, and the correction is very simple, as shown. Slip C contains a one-word error in  $W_2$ ; the values of all the words ( $W_1$ ,  $W_2$ ,  $W_3$ , and  $W_4$ ) and the total  $P$  are now uncertain, and they are marked with an accent. As the value of the Syndrome  $S$  is not zero, it is known that an error occurred, but that error cannot be corrected with just the information available.

In Slip D, we have the same error in  $W_2$ , but the erroneous word is now pointed out by an error pointer. The correction in this case, which is called pointer-erasure correction, is exactly the same as for erasure.

The code in Fig. 3 is a block code with four data words and one check word. The code is capable of one word-error correction and one erasure correction, but error correction is impossible.

In the actual codes used in digital audio recordings, a parity word of modulo-two (exclusive-or) is normally used for erasure correction, instead of the total value  $P$  in Fig. 3, and CRCC is used for the error pointer.

Fig. 4—Encoder for convolutional code.

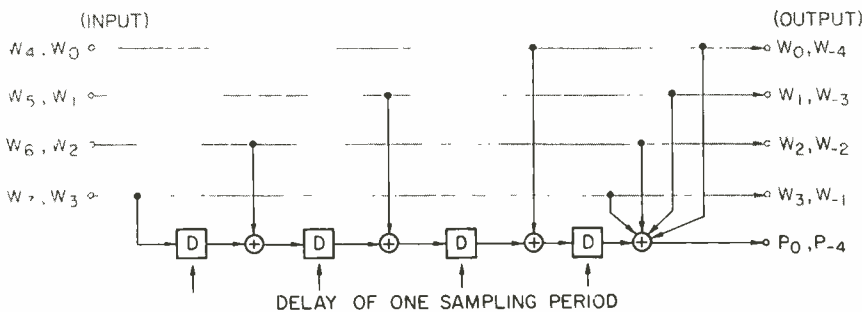
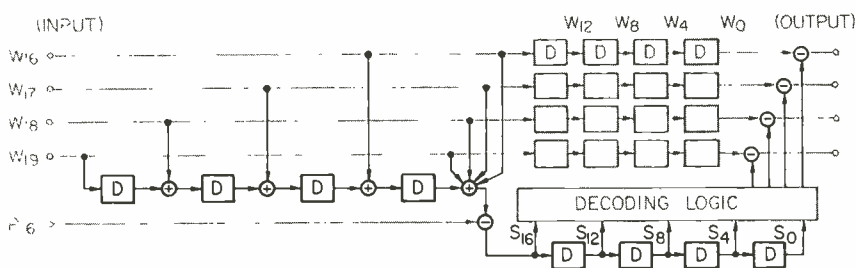


Fig. 5—Decoder for convolutional code.



### Convolutional Code

The examples shown in the previous section are all classified as block codes, where the encoding is completed within the block. Figure 4 shows an example of an encoder of convolutional code, where  $D$  means a delay of one word. (*Editor's Note:*  $D$  can also mean the distance between any two words, though this is not discussed here.) The check words are generated once after every four words of data, and each check word is affected by the previous eight input words. The decoder is shown in Fig. 5.

The redundancy for this code is the same as that of the code in Fig. 3, but the error-correction capability is superior. This is because the number of related syndromes for each error is bigger in the case of convolutional code due to the convolutional structure.

On the other hand, once an uncorrectable error occurs, it would affect the syndromes long after the error passes away, and the number of resulting errors in the decoded sequence becomes longer. This is called error propagation.

Convolutional codes correct errors better than block codes of equal redundancy, but they handle uncorrectable errors less well.

### Interleaving

Interleaving is a way to disperse the original sequence of bits or words into a different sequence; the reverse is called de-interleaving. Figure 6 shows a simple delay interleave. A burst error which might occur during playback is converted into random errors by de-interleaving. Such interleaving is often used with a block code to increase burst-error correctability. If all the words related to the original code block are dispersed to every sixth word, a burst error of up to six words can be corrected if an appropriate error pointer is provided. A combination of double-erasure correction code, interleave, and CRCC for an error pointer was adopted for the Electronic Industries Association of Japan (EIAJ) format for home-use digital tape recorders. (*Editor's Note:* The EIAJ has also just announced agreement on a video format for use on CD).

### Cross-Interleave Method

When two block codes are arranged two-dimensionally so that their rows and columns form a big block, the resulting code is called a "product code." The cross-interleave method falls into the class of product codes, but it is distinguished from the conventional one by its interleaved structure. The cross-interleave method is a combination of two or more block codes which are separated from each other by delay for interleaving. In this case, the final correctability is sometimes better than that of conventional product codes, owing to the convolutional structure. Figure 7 shows the general form of the cross-interleave method. At the decoder, the syndromes of one code can be used as the error pointer for another code, and CRCC for error detection can be omitted in erasure correction. It is also possible to arrange the third block code after another delay interleave.

In Compact Disc format, the two block codes selected are Reed-Solomon codes and are named CIRC (Cross Interleave Reed-Solomon Code). When both codes selected are single-erasure correction codes, the code is called cross-interleave code (CIC). (*Editor's Note:* Reed and Solomon are the inventors of a powerful and widely used class of codes.)

Fig. 6—Interleaving and de-interleaving. Note dispersion of burst error in decoded word sequence.

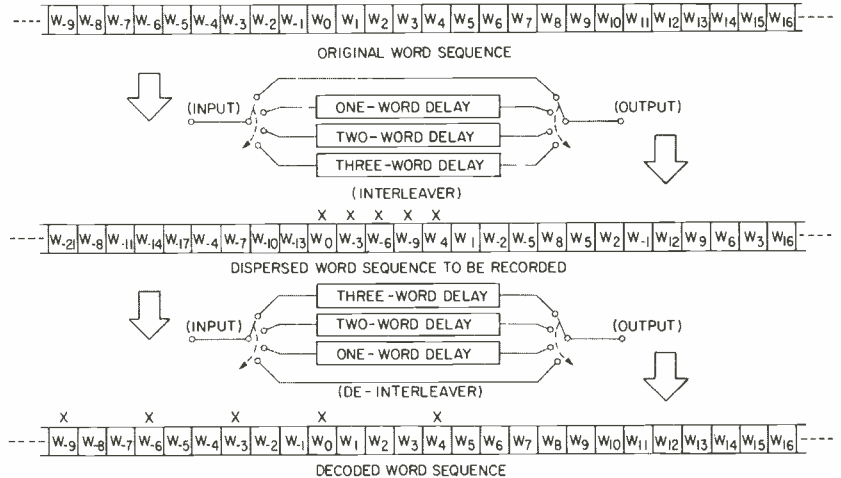


Fig. 7—Encoder for cross-interleave method; original data words =  $k$ ; check words for  $C_1$  and  $C_2 = R_1$  and  $R_2$ ; total check words =  $R_1 + R_2$ ; redundancy =  $(R_1 + R_2) / (k + R_1 + R_2)$ .

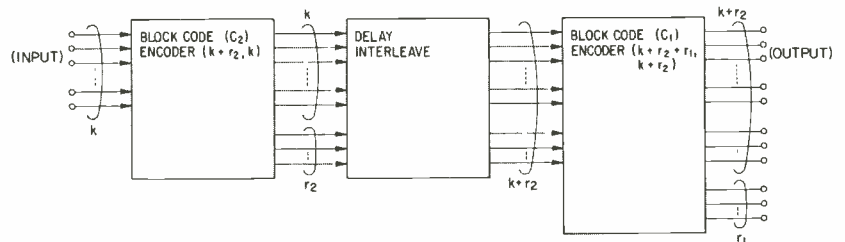
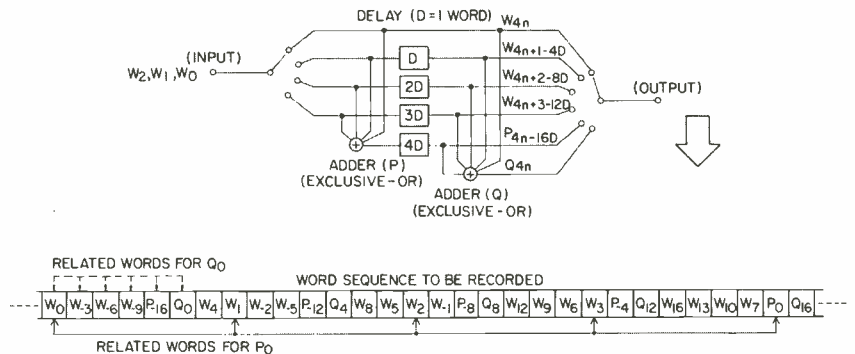


Fig. 8—Encoder for CIC method.



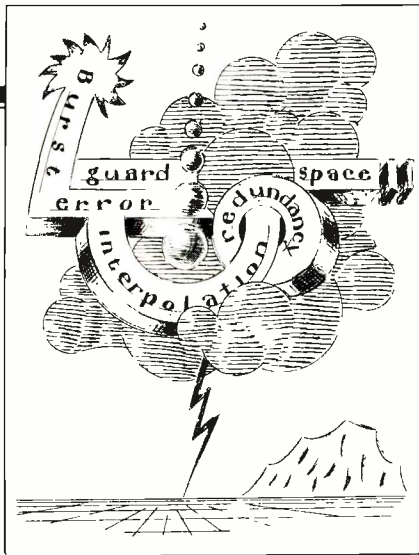


Figure 8 shows a simple example of a CIC encoder where a single-erasure correcting code is added after the delay for interleaving, generating the check words P and Q. The correctability of CIC depends on the number of decoding steps, and one-step decoding is as good as single-erasure correction; thus, the correction capability increases as the number of steps increases. Figure 9 shows the correction capability plotted versus the number of decoding steps.

### Error Concealment

When error exceeds the ability of the code to correct, the uncorrected words should be concealed. Figure 10 shows the noise power induced by various interpolation methods when they are applied to a pure tone signal with uncorrectable errors. The methods of concealment shown here are as follows:

1. Muting is where the value of the erroneous word is always set to zero;
2. Zero-order interpolation is where the previous value is held over;
3. First-order interpolation is where the erroneous word is replaced with the mean value of the previous and the next word, and
4. Nth-order interpolation is where a polynomial is used to generate a replacement for the erroneous word, instead of the first order.

In most systems now in use, a combination of 2 and 3 is used. If all the erroneous words have errorless words as neighbors, then 3 is applied. For consecutive word errors, method 2 would be applied, with the final erroneous word interpolated by method 3. It

is also well known that a better interpolation is possible by use of an appropriate digital filter. Subjective tests show that the length of error does not greatly affect the perception as long as all interpolated words are neighbored by words without error.

### Evaluation of Error-Correcting Schemes

In the application to actual error-correction systems, the above methods are mixed, and the scheme is optimized to suit the particular system either by computer simulation or by trial and error. The most important point in designing the coding scheme is, therefore, to set the criteria for the performance of the code. Some of the criteria are as follows:

1. Probability of misdetection;
2. Maximum burst error to be corrected;
3. Maximum burst error to be concealed;
4. Correctability of random error;
5. Correctability for the mixture of

random, short burst and long burst error;

6. Guard space;
7. Error propagation;
8. Block size or constraint length;
9. Redundancy;
10. Ability for editing;
11. Delay for encoding and decoding, and
12. Cost and complexity of the encoder and decoder.

For most digital audio systems, errors exceeding the correctability of the code are designed to be concealed. Therefore, the most important item is the probability of misdetection (1). The undetected error cannot be concealed and results in an unpleasant click noise from the speakers. This should not occur even in worst-case accidents. Items 2 and 3 taken together represent the strength of the system against burst errors.

Table I gives some examples of the burst-error correction and concealment for CD and other formats. In each case, the length of concealment is de-

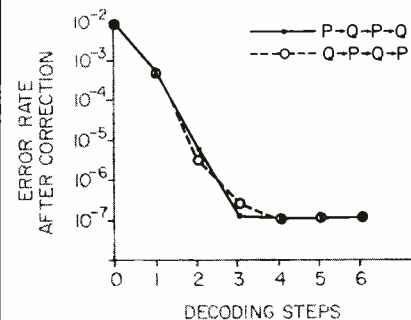


Fig. 9—How the number of decoding steps affects random word-error correctability, using CIC. (One block = 6 data words + 2 check words; word error rate [PW] =  $10^{-2}$ .)

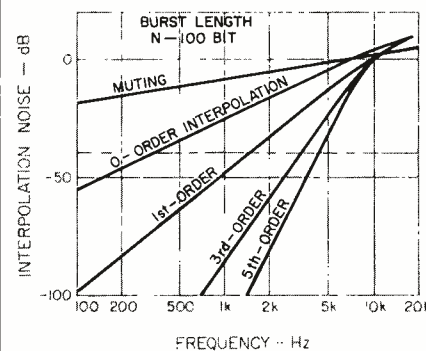


Fig. 10—Noise power for various interpolation methods applied to a pure-tone signal with uncorrectable errors (see text).

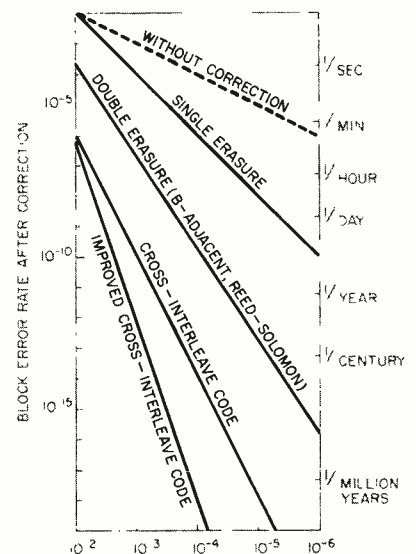


Fig. 11—Random block-error correctability for various codes (1 block = 288 bits).



Interleaving disperses the original data into a different sequence. It is often used with block codes to increase burst-error correctability.

signed considerably longer than that of the correction. CD is strong against fingerprints because the thick transparent layer (1.2 mm) between signal pits and the surface nullifies their effect.

The burst-error correcting capability is mainly determined by delays if interleaving is used with the correcting code. The correction or concealment length should be evaluated as a function of the memory size required.

Figure 11 shows the correctability of various codes against random block error, where one block consists of 288 bits. The block length is supposed to be long enough for even a short burst error to be treated as a random block error. Initially, the evaluation shown in Fig. 11 was considered appropriate, but it was found not to coincide with experience in studio environments. Machines installed in studios showed much more frequent miscorrection than indicated by these values. The reasons were that the tapes were not always new, that dust and fingerprints

were more severe in the studio environment, and that the machines were not always tuned properly. Therefore, evaluations made using a mixture of random, short burst and long burst errors proves to be much more realistic.

#### Error Correction on the CD

Among the causes of error on optical discs, the effects of fingerprints, scratches or dust are not so different from those in magnetic tapes. Therefore, it is sufficient if the error-correction scheme enables correction of a long burst error with reasonably small guard space.

On the other hand, causes 12 through 18, described at the beginning of this article, have the tendency to produce random or short burst errors. In addition, there is a possibility of producing random or short burst errors by misfocusing and tracking offset, which may deteriorate the frequency characteristics and signal-to-noise ratio.

The study started from the comparison between the ICIC (Fig. 12) and a

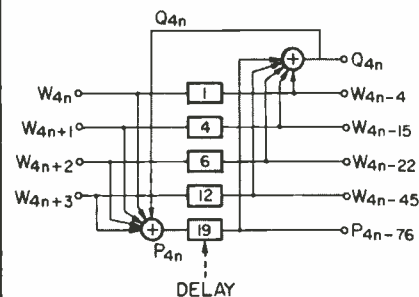


Fig. 12—An ICIC encoder. ("W" codes are data words; "P" and "Q" codes are error-correction words.)

newly developed convolutional code. The ICIC has the ability to correct an arbitrary five-word error, while the convolutional code can correct up to two symbols (words). Both codes are designed with the same redundancy to obtain a bit rate of 2.35 Mb/S. Both performed very well for normal discs with average fingerprints and scratches. It was found that the burst-error correction was better with the ICIC because the correctable length is three times longer than with the convolutional code, and if concealment is considered the goal, it becomes more than seven times (see Fig. 13).

#### Conclusion

The fundamentals of error correction and its application to digital audio recording systems have been described, with the stress of the explanation laid on the practical side, omitting overly detailed theoretical considerations. The cross-interleaving method discussed here is now widely used in the field of digital audio because of its simplicity and efficiency.

Looking back to the short history of error-correction code applied to digital audio recording, remarkable progress has been made with high enough performance and relatively low redundancy. Further progress will be necessary when the packing density increases and high error-rate recording systems are introduced.

One of these applications will be the domestic digital cassette recorder, which is expected to become competitive to the conventional analog cassette in size and playing time, while attaining high performance equivalent to that of the Compact Disc. A

Table I—Burst-error correction and concealment.

Format	Type	Correction, bits	Concealment, Good	Concealment, Marginal
EIAJ	Tape, Rotary Head	4,096	—	8,192
DASH	Tape, Stationary Head	8,640	33,982	83,232
CD	Disc, Optical	3,874	13,282	15,495

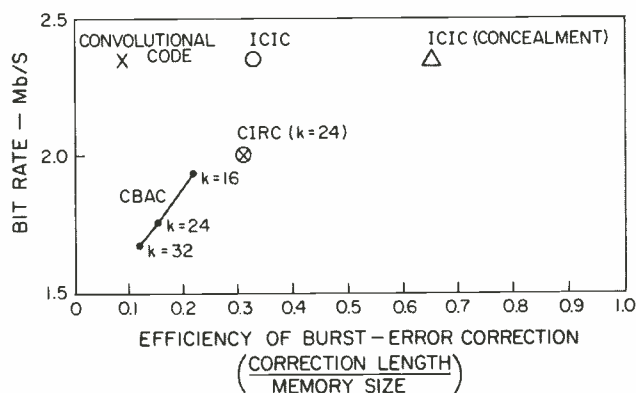
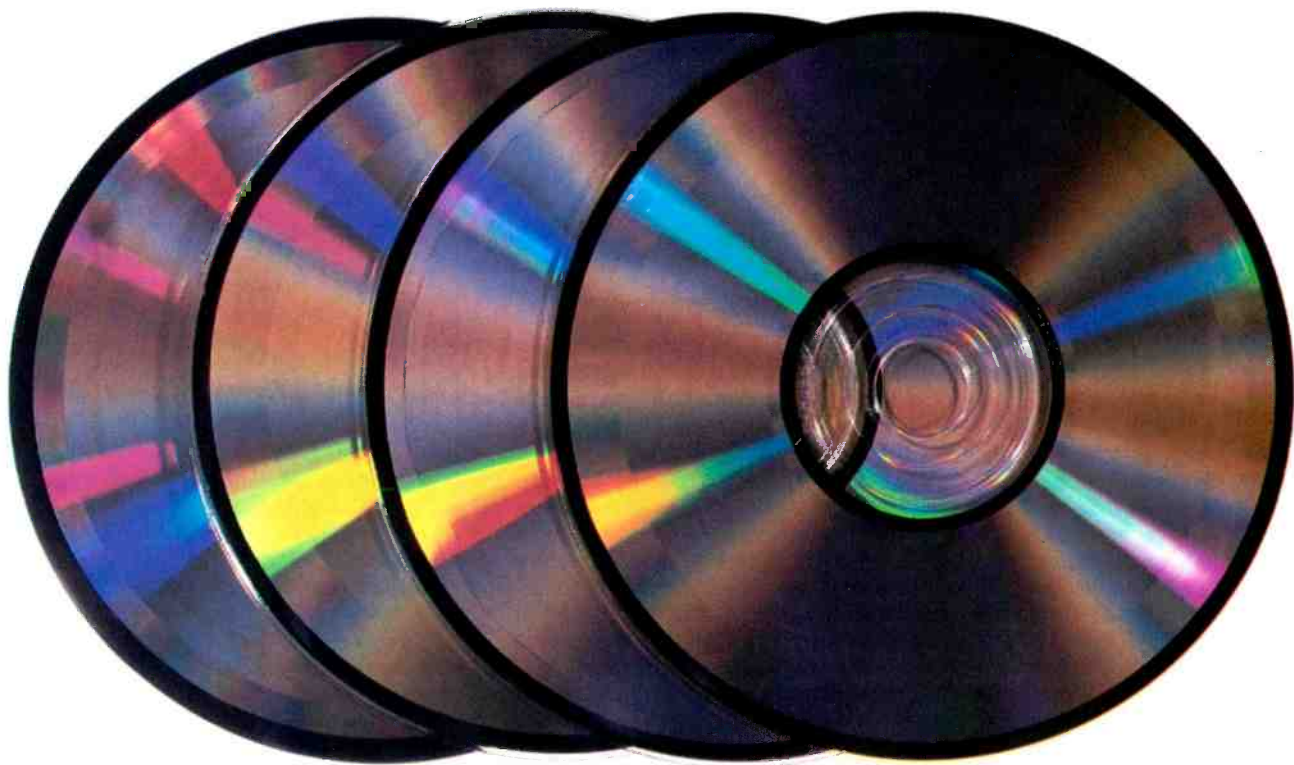


Fig. 13—Burst-error correction vs. bit rate for several codes.



# PHILIPS OVERSAMPLING SYSTEM FOR COMPACT DISC DECODING

**Wayne Schott**

The sampling process which converts a digital audio signal from binary numbers back to its original analog form generates spurious frequencies, which must be filtered out

of the final wave form.

Most brands of Compact Disc players

use analog filters for this, usually in a system consisting of a 16-bit D/A converter, a sample-and-hold circuit, and an analog low-pass filter (Fig. 1).

This, however, can be difficult to do accurately. First, the D/A converter must be linear to within one-half the value of the least significant bit (LSB). How-

ever,  $\frac{1}{2}$ -LSB accuracy of the dividing steps becomes more and more difficult to achieve as the number of such steps, or bits, increases. For 16-bit

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*Wayne Schott is Staff Electrical Engineer at N.A.P. Consumer Electronics in Knoxville, Tenn.*



**By oversampling at four times the original sampling frequency, the original noise energy is now spread over a band four times as wide.**

D/A converters, low yield and high cost can easily be obstacles to practical manufacture.

A second problem is caused by analog filtering. A filter steep enough to adequately remove residual components above the audio band must inevitably be a complex one, degrading the signal accuracy and introducing phase distortion. Even an active low-pass filter has a large amount of phase shift near its cutoff frequency. Such a filter also generates noise and requires high-speed operational amplifiers, which have high power dissipation and require tight component tolerances to maintain low ripple in their pass-band. Temperature changes and component aging of such filters also affect performance adversely.

Philips engineers have found a way to carry out most of the essential filtering process digitally. This approach is used in the players sold by Philips under its own name and under its U.S. brand names of Magnavox and Sylvania. It has also been adopted, in whole or in part, by some other manufacturers.

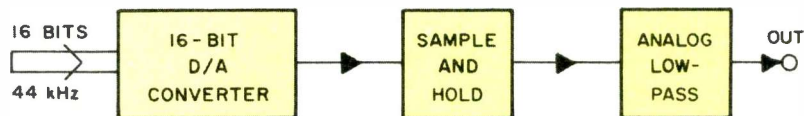


Fig. 1—Analog output section of a CD player using only analog filtration.

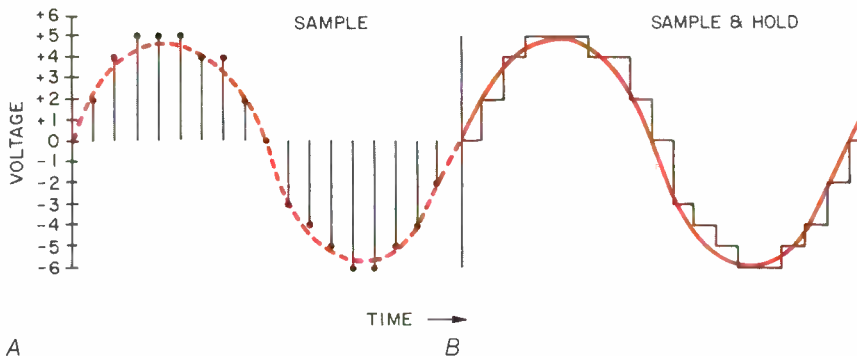


Fig. 2—D/A converter outlines the desired waveform as a series of signal spikes (A), which are then

extended by the sample-and-hold circuit to produce a staircase waveform (B).

Photograph: Robert Lewis

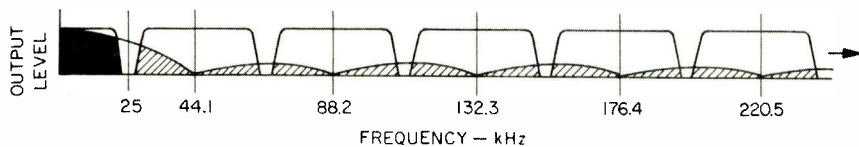


Fig. 3—Spikes of Fig. 2A produce an infinite series of frequency bands centered on multiples of the sampling frequency (shown in outline). Sample-and-hold reduces out-of-band output (shaded portions) but still leaves substantial output between 25 and 44.1 kHz and reduces audio high-frequency response (solid portion).

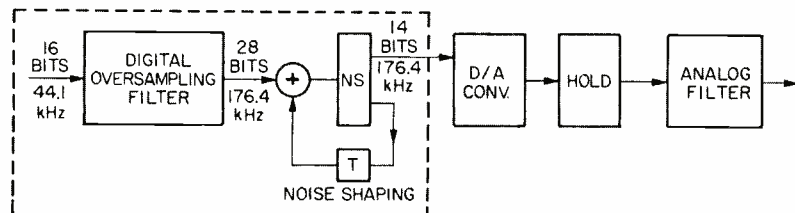


Fig. 4—Analog output section of CD player using Philips system of oversampling, digital filtering, and noise shaping. Some analog filtration is still required.

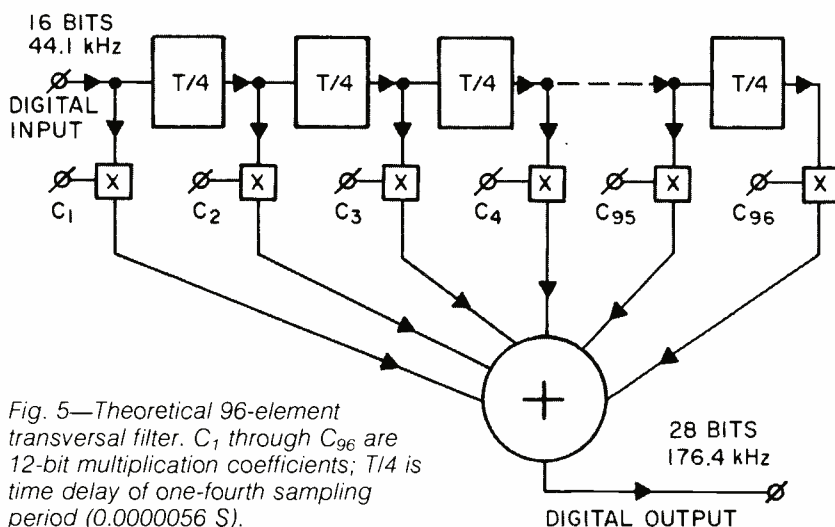


Fig. 5—Theoretical 96-element transversal filter.  $C_1$  through  $C_{96}$  are 12-bit multiplication coefficients;  $T/4$  is time delay of one-fourth sampling period (0.0000056 S).

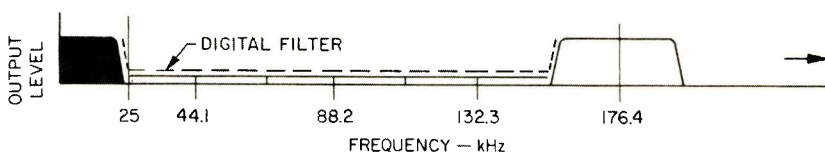


Fig. 6—Digital transversal filter suppresses output between audio band (solid portion) and the band surrounding the oversampling frequency (176.4 kHz).

The spurious frequencies to be removed are functions of the sampling frequency used in the digital process. If the quantized samples of the original audio frequencies are simply converted to analog values, a series of spikes is produced (Fig. 2A). The envelope of this series resembles the audio waveform, but the spikes, in reality, produce an infinite series of frequency bands at multiples of the sampling frequency (in this case, 44.1 kHz), as shown in the unshaded portions of Fig. 3.

In practice, a sample-and-hold circuit holds the output voltage steady after each sampling spike until the next sample is decoded by the D/A converter. This converts the waveform from a series of spikes into a "staircase," as shown in Fig. 2B. This also has the effect of substantially reducing the frequency bands above 20 kHz. However, significant components still remain, particularly in the region between 25 and 44.1 kHz, as shown by the shaded portions of Fig. 3.

Note, too, the cut at the top of the audio band in Fig. 3. This cut occurs because the sample-and-hold process can be represented by a  $\text{Sin } X/X$  function, with the first zero point occurring at the sampling frequency, 44.1 kHz. Response compensation could be employed at the analog stage, but only at the expense of additional phase distortion and noise.

Philips uses a different circuit configuration for D/A conversion (Fig. 4), incorporating oversampling, digital filtering and noise shaping. Each plays a vital role in the filtering and conversion process.

Oversampling is accomplished by increasing the sampling frequency four times, to 176.4 kHz. This results in a frequency spectrum containing multiples of the original 44.1-kHz sampling frequency, at 88.2, 132.3, 176.4 kHz and so on. By oversampling four times, the noise power originally restricted to a band from 0 Hz to 22 kHz is now distributed over a band four times as wide, or 0 Hz to 88 kHz. Only one-quarter of the noise remains within the audio band, and the rest will be eliminated by filtering, giving a 6-dB improvement in performance.

Both the oversampling and much of the filtering take place in a digital transversal filter. The signal enters this

## The full 16-bit information capability of the Compact Disc is retained in this Philips system by transferring information to the 14-bit level.

filter as 16-bit data at the 44.1-kHz sampling rate, and leaves as 28-bit data at a rate of 176.4 kHz.

A transversal filter can be considered as a series of delay lines and multipliers whose outputs are summed. A theoretical transversal filter for CD would have 96 elements, as shown in Fig. 5. In this model, each 16-bit sample is delayed for one-fourth the sampling period, and the output of each delay is multiplied by a 12-bit-accurate coefficient; the product of each multiplication therefore has 28 (16 + 12) bits. After these multiplications and a subsequent addition, the weighted average of a large number of samples is obtained.

However, since new data arrives at the filter input only once per sampling period, three out of four of the numbers multiplied in our theoretical filter would be zero. In practice, therefore, the filter is simplified to include only 24 elements, each with a delay equal to the entire sampling period. Each 16-bit data word is then multiplied four times, with different coefficients for each multiplication, before being passed on to the next delay.

An immediate effect of the digital transversal filter is to suppress all the lower frequency bands, centered at 44.1, 88.2 and 132.3 kHz, as shown in Fig. 6. For the coefficients chosen, the filter has a transition region between 20 and 24.3 kHz (the sloping area in the solid block of Fig. 6) and, due to oversampling, leaves the 20-kHz sidebands on either side of 176.4 kHz.

A further improvement in signal-to-noise ratio is obtained in the noise-shaping circuitry (Fig. 7). This rounds off the 28-bit data from the transversal filter into 14-bit data. The 14 least significant bits, which contain mostly quantization noise and round-off error, are then delayed by one sampling period, reversed in sign and summed with the next sample. This reduces the average quantization error and noise for low-frequency signals (audio) by 7 dB. At high frequencies approaching half the sampling frequency, or 88.2 kHz, the feedback becomes in phase with the input, and its noise increases. But since this out-of-band noise is filtered away, it is no longer relevant. The resulting noise spectrum is shown in Fig. 8.

Much of this filtering is accomplished by the sample-and-hold circuits, which modify the frequency spectrum with the Sin X/X response mentioned earlier (Fig. 10), such that a null occurs at 176.4 kHz and the sidebands on either side of that frequency are attenuated by more than 18 dB. (The hold effect causes no phase distortion in the audio band.)

This attenuation, however, is still not sufficient to attain the desired 50-dB or greater overall reduction of spectral components outside the audio band. A low-pass, third-order Bessel filter is used to remove the remainder of these ultrasonic frequencies. This filter has its -3 dB point at 30 kHz and was chosen because it has a linear phase characteristic. The Bessel filter and the hold function cause a slight attenuation at the high audio frequencies; this is compensated for in the design of the transversal filter, which has a slightly rising characteristic just below cutoff.

The 14-bit output from the noise-shaper circuit allows the use of 14-bit D/A converters. These, unlike current 16-bit converters, can be made very stable, linear to within one-half the value of the least-significant bit, over a wide temperature range of -20° to +70° C.

The full 16-bit information capability of the Compact Disc is retained in this Philips system because the information is transferred into the 14-bit level. This phenomenon is possible because the signal and residual noise of the system combine to produce duty-cycle modulation of the 14th bit. If we look at the average value of four quarter-length 14th-bit samples, three of which are actually null, we find that this average is just as accurate as the full-length, 16th-bit sample for the same period (Fig. 10).

We can thus summarize the advantages of the Philips digital-to-analog conversion system as follows: True 16-bit performance for both signal and noise, linear amplitude response ( $\pm 0.3$  dB, 20 Hz to 20 kHz), linear phase response ( $\pm 0.5^\circ$ , 20 Hz to 20 kHz), signal-to-noise ratio greater than 90 dB, total harmonic distortion less than 0.005% at 0-dB level, and excellent temperature and component-tolerance sensitivity characteristics. A

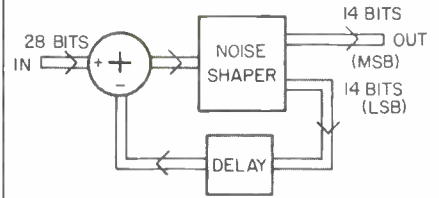


Fig. 7—Noise-shaping circuit (see text).

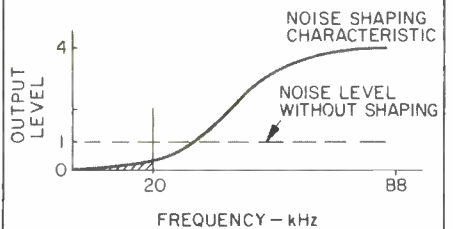


Fig. 8—Noise spectrum after noise shaping.

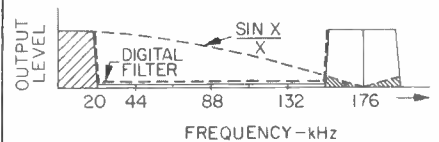


Fig. 9—Output spectrum of oversampling D/A converter before analog filtration.

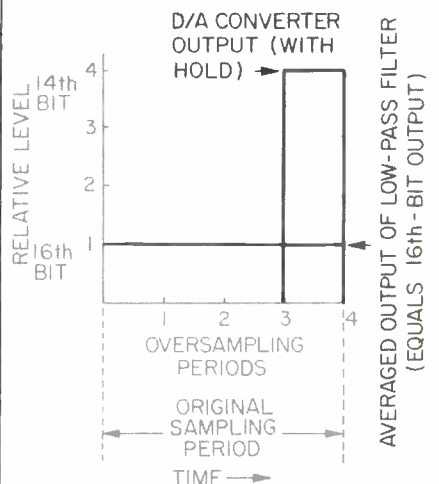


Fig. 10—How average of one 14-bit sample and three null samples match accuracy of a single 16-bit sample over the same period.

# What makes a CD Player Professional?

Leonard Feldman

**W**hen Denon America, Inc. announced that they were producing a "professional" Compact Disc player, those of us who had some experience testing and using CD players wondered what Denon could possibly incorporate into their CD player that would make it "professional" and particularly suited for use in broadcast and recording studios. After all, the 90-dB or more dynamic range offered by any CD player was a good deal more than even the best FM stereo radio stations could transmit using their existing transmitter and studio console equipment. The typical distortion figures of 0.005% or better were far lower than even the finest home FM tuner could boast. And, as for programmability and easy access (a must for the radio DJ in the future CD era), many of the consumer-type CD players I had tested already exhibited sophisticated systems for such convenience features. What, then, would constitute a "professional" CD player?

The answers soon became apparent when a representative of Denon drove up to the lab, hauled out a huge carton, mounted it on a hand truck and wheeled it into my testing room. When the outer trappings were removed, I saw a 100-pound console measuring about 32 inches high, 16½ inches wide and 22 inches deep. Taken aback by the size and weight of this "Compact" Disc player, I posed the big question to the Denon representative, "How does this CD player differ from all other CD players?" He explained that, ideally, such functions as slip-cueing, level metering, fade up, internal monitoring, balanced line output, as well as protection features (which insure against inadvertent line feeds when they are not desired) should all be incorporated in a pro player. In other words, it should have the same access and cueing capabilities as a pro reel-to-reel deck. Denon's



*The Denon DN-3000F Professional CD Player*

DN-3000F is just such a pro unit and, in fact, it incorporates several additional features which arise from the CD disc format itself. They will be much appreciated by the studio engineer who, sooner or later, will have to start using CDs for background music in more complex productions, and for mix-downs as well as for dubbing.

The DN-3000F is, as I already mentioned, supplied as a stand-alone console, with controls and disc compartment located at convenient desk height. Discs are inserted into the player near its rear, via a top-loading mechanism whose door pops open when an eject button is depressed on the console.

Photograph: Robert Lewis

A professional CD player should have the same access and cueing capabilities as a pro reel-to-reel deck, and the DN-3000F is such a unit.

### Control Layout

"Running Address" and "Time" LED displays on a sloped section of the console are located near a pair of standard VU meters. Track number of the disc, index number (if encoded on a given disc to divide longer selections into smaller sections), and time (in minutes, seconds, and frames) are all displayed here. Three different time displays can be accessed, using a "Time Mode" button nearby. These are elapsed time of the track being played, amount of time remaining on the track being played, or absolute time from the beginning of the disc to the current position of the laser pickup. A second display, called "Order Address," is used in conjunction with a 10-key pad to provide elaborate random-access capabilities, including almost instant location of a given point in a disc, down to the very second and frame. After punching in the desired track number, minute, second and frame, touching the "Locate" button brings the pickup to the desired location. Touching the "Play" button then starts disc play, providing that the "Line Out" lever is in its "On" position.

Two more touch buttons near the numeric keypads are labelled "Slow-Fast" and "TOC." The "Slow-Fast" button is used in conjunction with a rotating "Search" dial, which is very much analogous to "slip-cueing" as done on a conventional turntable. The "Search" dial, which works very much like a cueing dial on a video console, allows you to move the pickup in frame-by-frame increments, quickly or slowly (depending upon which end of the "Slow-Fast" switch is touched). The pickup plays a single "frame" over and over again, allowing the operator to zero in on the precise cue location desired. The last button in this area of the panel, labelled "TOC," is a "Table of Contents" button which, when pressed several times in succession, causes the "Order Address" display to show first and last track numbers, total elapsed time, and starting time for each track.

Close to the front of the console desk, and handy to the operator's fingers, are a master output attenuator control, "Play" and "Pause" buttons, a "Monitor" on-off switch (which lights up when on), a separate level attenuator for the small built-in monitor speaker

(which plays a "sum" program of L + R), and a button labelled "Attenuator Start." This last-named pushbutton enables the operator to introduce start delays of from 0.1 to 0.3 seconds, or no delay at all. The operation of this function is somewhat similar to that found on professional turntables. The amount of delay for this function, as well as the length of play for the slip-cue function using the "Search" mode, is an internal adjustment normally performed once during installation of the console player. "Standby" and "Line Out" lights above the VU meters tell the operator the status of the line output signal. A cue light, just above the left-hand VU meter, lights when an external remote control is used with the player. Protection against possible operator error is built into the unit. For example, when the "Line Out" key is "On," the "Eject," "Locate," and "Search" controls have no effect if they are depressed or rotated.

XLR 3-pin connectors are located at the rear of the pedestal or stand which supports the player console. Cables connect to these connectors for balanced line outputs (separate left and right) and for a "Mix" input, which can be a signal from other equipment that can then be mixed with the CD signals and fed to the line output.

### Measurements

Though the purpose of this investigation was not to treat the Denon DN-3000F as the subject of a full-length test report, I could not resist measuring the basic performance of this pro unit. In terms of lab measurements, the unit performed about as well as a consumer or home-type CD player, which was no great surprise. Frequency response was virtually flat from 20 Hz to 20 kHz, with a slight rise of around 0.7 dB showing up at the high end before response dropped off sharply above 20 kHz.

Harmonic distortion at maximum recording level (0 dB in terms of the digital recording, +4 dBm on the output meters of the unit) was 0.004% at 1 kHz, rising to around 0.018% at the treble end of the spectrum, and 0.006% at bass frequencies. As is true of all digital disc players, at lower levels, distortion rises. At -24 dB levels, it measured 0.04% at mid-frequencies

and around 0.06% at the ends of the spectrum. Linearity was accurate to within 0.5 dB from 0 dB down to below -80 dB, while unweighted signal-to-noise ratio (band-limited to 20 kHz) was 93 dB below maximum output levels. SMPTE-IM distortion measured a low 0.01% at maximum output, increasing to 0.08% relative to a -20 dB IM test signal.

Square waves and unit pulses, contained in the special Philips test disc that I now use to test all CD players, looked just about the same as they did when I tested all the home players that utilize sharp "brick-wall" analog low-pass filters following D/A conversion. There was the usual ringing at a super-audible frequency apparent in the reproduced 1-kHz square wave, as well as the usual overshoot in both polarity directions for the unit-pulse waveform. As for phase error, I calculated a time delay of about 25  $\mu$ S introduced by the low-pass filters, or about one-half cycle of a 20-kHz signal.

As for the Denon DN-3000F's ability in the area of error correction, I used another test disc supplied by Philips which contains the defects likely to exist on a typical, improperly cared for disc. The defects consist of a wedge, which widens from track to track of the musical selections contained beneath it, a series of opaque black dots of increasing diameter, and, near the outer rim of the test disc, a semi-opaque smudge. The wedge is meant to represent a severe scratch on the surface of a disc, the dots to simulate dust specks (of varying size), while the "smudge" approximates a fingerprint on the surface of a disc.

The Denon DN-3000F was able to "track" the wedge until its width had increased to 600 microns. This is not particularly outstanding, since I have tested consumer-type players which can successfully play through that wedge at its widest point of 900 microns. The player did much better with the simulated dust particles, coasting right through the largest of them without so much as a millisecond's worth of sound muting or mistracking. It wasn't at all bothered by the fingerprint simulation either. This suggests that professional users of this type of player should exercise the same care with respect to the surfaces of Compact

An important aspect of a player's performance is its ability to withstand shock. Although I pounded on the console's top, this unit did not mistrack.


Discs as they do (or should) with conventional LPs. They should be handled by their outer edges, and care should be taken not to allow their surfaces to become scratched. Given such care, the life of a Compact Disc will be as long as its promoters are claiming for it. Without this care, discs can mistrack

just as surely as poorly treated LP records can.

#### Use and Listening Tests

What makes the Denon DN-3000F unique is its superb solutions to problems that will face the professional studio engineer when he or she begins to

use CDs in the course of normal broadcasting and mixing activities. The very unit I tested, incidentally, was shipped from my lab to FM radio station WNCN, where it replaces an earlier consumer-oriented player made by Denon as well. In my own auditioning of the DN-3000F, I was especially delighted by one feature of the unit which wasn't even described in the temporary owner's manual. When you insert a disc into the player's turntable area and close the door, the disc is automatically scanned so that track count, time counts, etc. all are stored in its computer memory. So far, that's not unlike some consumer players I've worked with. But the DN-3000F, instead of coming to rest at the 00:00 starting point of the first track, actually cues up at the instant the music starts. Thus, if the music on track 1 starts 1 second and 3 frames past the actual start of track 1, that's where the laser pickup will focus. Then, when you shift the "Line Out" lever to "On," music starts instantly—with absolutely no waiting. That, and the other remarkable cueing and random access features of this player, make it worthy of the designation "professional"—a term that Denon never uses lightly.

Another important aspect of the player's performance, which is difficult to measure in quantitative terms, is its ability to withstand physical shock and vibration. Unlike some consumer CD players which I've tested, that mistrack even if their cabinets are tapped lightly with a finger tip, the Denon DN-3000F continued to track flawlessly even when I pounded my fist on the console's surface, right near the "turntable" itself. Such refined and stable tracking capabilities must involve mechanics and servo mechanisms that are far costlier than those used in home CD players. The special random access and display features also add to the final cost of the unit, as do the real VU meters (not found on any home players), balanced line outputs, and all the other features which distinguish this player from consumer versions. Clearly, radio station WNCN in New York must have thought that the difference in features and performance was worth the extra \$7,500 or so, or they wouldn't have traded their consumer player for this expensive model. 



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For example, the DP-103 employs a three-beam optical pickup in place of the conventional single beam. These two insurance beams constantly correct for imperfections in the disc, ensuring stable, error-free tracking.

The retaining springs for the laser optics pickup, which are susceptible to vibration, have been replaced by Mitsubishi's exclusive linear-sliding cylinder—in effect eliminating a problem before you've had one.

These second-generation refinements also allow simplified servo circuitry which results in fewer parts, less to go wrong.

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1

## LIRPA Si-O<sub>2</sub> COMPACT DISH PLAYER

### Manufacturer's Specifications

**Frequency of Response:** As often as you like.

**Dynamite Range:** Percussive sounds, 2 to 3 miles, on-axis; fluid noise, somewhat less.

**S/N (Suds/Noise) Ratio:** 90 Lux.

**Channel Separation:** Two-sided dishes, 3/32 in. (0.238 cm); single-sided dishes, unmeasurable.

**Wow and Flutter:** Dependent upon detergent used; little or none with liquid, somewhat more with powders.

**Audio Output Level:** During rinse cycle, 80 dB; during spin cycle, 95 dB.

**Number of Programmable Selections:** 41 (permits programming the "top 40" with one program left over for music *you* like).

**Power Consumption:** 2,000 British Thermal Units.

**Dimensions:** 3 ft. (91.44 cm) W × 3.5 ft. (106.68 cm) H × 2.5 ft. (76.2 cm) D.

**Weight:** 180 lbs. (81.81818182 kg), loaded.

**Price:** \$300.00.

**Options:** Electronics, \$2,500.00; interconnecting cable, \$250.00 per foot; necessary plumbing, \$500.00; Compact Dishes, five-piece set, \$150.00 (special order) or \$39.95 each (open stock).

**Company Address:** 102054 Noritake Dr., Silicon Valley, Cal. 99999-8765. (Distribution and showroom office in Bone, China.)





It has been, alas, only a full year since I last checked out a product designed and produced by the world-famous Lirpa Laboratories. During that time, Professor I. Lirpa, the company's peripatetic founder and chief executive officer, has once again moved his entire operation to a new location. I found the professor on the beach in a remote town in Southern California, sifting through the sand in search of just the right kind of silicon. Refusing to comment concerning his sudden departure from Moscow, where his last factory had been established, Prof. Lirpa did explain that he needed just the right sand to mix the concrete needed as a stable base on which to mount his latest creation, the Lirpa Si-O<sub>2</sub> Compact Dish player.

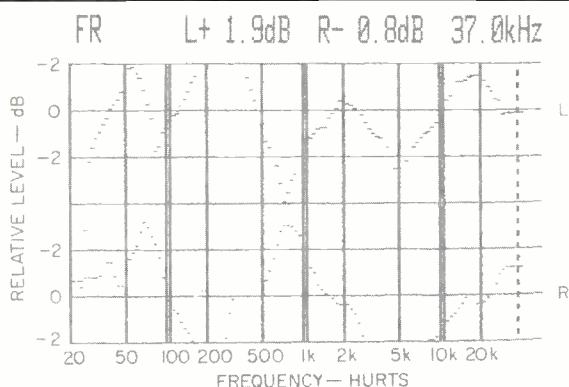
I wondered why Lirpa had decided to complicate matters by introducing a different digital music storage format. After all, the rest of the world has settled for the laser CD (Compact Disc), which has been well accepted in most audio circles. "Simple!" replied the good doctor in his usual forthright manner, "I was concerned with some of the negative opinions about CDs and CD players expressed in that respected publication, *Positive Noise*, and I decided to do something about it. Since I didn't want to confuse the audio fraternity unduly, I kept the same acronym for my player—CD—Compact Dish." Needless to say, I was eager to get a prototype of the new player for an evaluation. After determining that my lab was equipped with hot and cold running water (needed for installing the Si-O<sub>2</sub>), Dr. Lirpa agreed to ship me one of the first models to come off his assembly lines. It arrived a few weeks ago and was installed in a matter of no more than three days.

The Lirpa Si-O<sub>2</sub> comes in two large crates. One contains the player mechanism itself, which stands some 3 feet wide × 3½ feet tall × 2½ feet deep. Lirpa has chosen to make this player in a top-loading configuration, with a hinged lid that opens to the left. (Left-handed listeners may obtain a lid-switching kit which allows opening from the right.) Since it is well known that serious listeners are intrigued not only by the sounds of their program sources but by watching the program source revolve, Lirpa wisely incorporated a fully transparent front window on the player section so that you can, at all times, see what's happening inside. We'll get to what's inside the player presently, but first let's discuss the contents of the other crate.

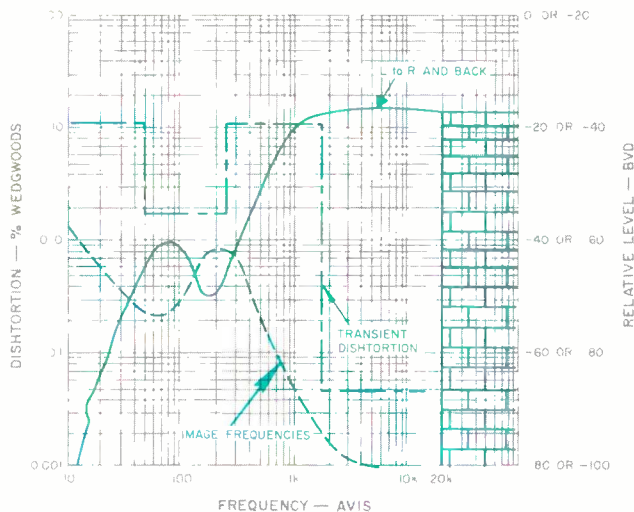
Inside I found a rack, divided into five sections. The upper section stores as many as 200 digital Compact Dishes. The second section contains several illuminated pushbuttons. In addition to the "Play" button, which starts things moving in the companion player itself, there are buttons labelled "Repeat," "Scrub" (a term used in space exploration meaning to abandon the current project; used here, I assume, when you've changed your mind about listening to a given dish), "Skip," "Wash," "Rinse" and "Dry." Also emanating from this second shelf on the rack is a gloved robot hand which reaches up into the dish storage compartment to select the particular dish you want played. Here is true instant access! Imagine being able to choose the desired dish in less than three seconds—but only after you've looked up what it is you want to play, using a short computer data-base program which takes only two minutes to sort through 100 dishes and tells you lots of things about each one of them

Illustration: Roger Meicall

The Lirpa CD player is the world's first trinary digital system, translating "yes," "no," and "maybe" symbols into acoustical output.



**Fig. 1—Frequency response, Lirpa Si-O<sub>2</sub> Compact Dish player.**



**Fig. 2—Dishtorted separation vs. separated frequencies and frequency dishtortions.**

that you probably would never have asked had you not had the accompanying computer program. But I digress.

Getting back to the rack layout, the third level (from the top) features a "Mixture" control. This knob determines the intensity of the "beams" which are directed at the dish being played. The functions of the six pushbuttons adjacent to this control are self-explanatory: "Hot," "Warm," "Cool," "Tepid," "AUX" and "AUX." The first four buttons are non-interactive; you can push one or more of them at once, depending upon the kind of music you like. I asked Prof. Lirpa why there are two AUX settings, and he explained that, in the audio business, you've always got to be ready for another outboard device or two, and his player was not about to be caught short.

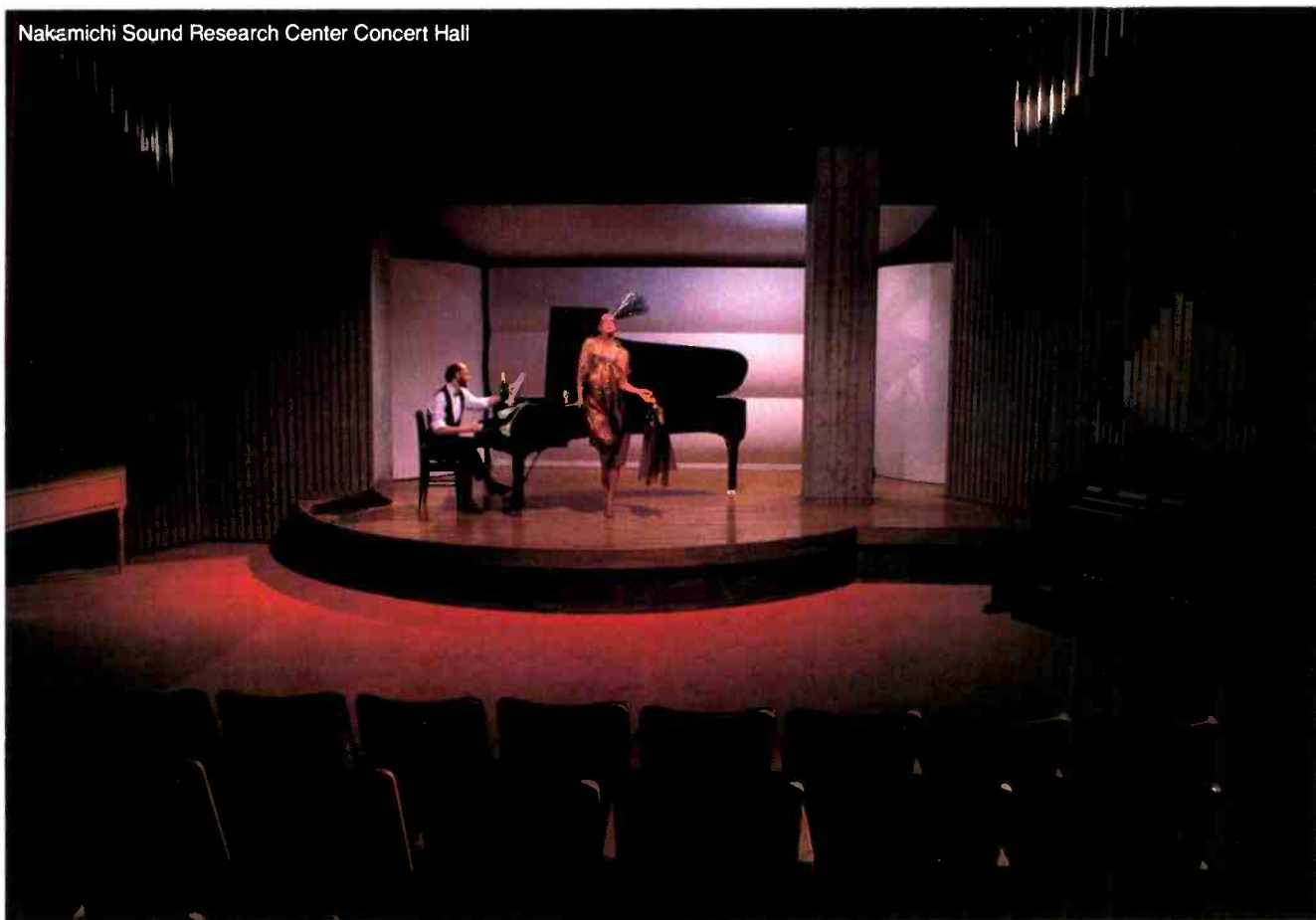
As you can see by examining the next shelf of the electronics rack, Dr. Lirpa, like so many audiophiles, prefers

tubes to transistors, transistors to ICs, and ICs to LSIs. Since the Si-O<sub>2</sub> was designed from scratch, Lirpa decided it was time to go back to the warm sound of tubes, especially for a digital unit. Another suitable acronym for the active devices used in the electronics section is "DDT" (Digital Dish Tube). Not all of the tubes built into the system can be readily viewed. There are actually the equivalent of 4,294,967,296 of them, since each acts as a simple binary switch and this is a 32-bit system. Lirpa, as well as the experts at *Positive Noise* and other subterranean publications, long ago concluded that 16 bits just aren't enough to fully describe the nuances of musical sounds. So, by doubling the number of bits per digital dish sample, Lirpa was able to effectively reduce the distortion levels from 0.00152% to 0.000000002328%. As for sampling rate, Lirpa and other researchers also concluded that a sampling rate of 88.2 kHz is needed, and that's the sampling rate used here. Asked what he would do about the complete absence of any software for use with the player, Lirpa responded, "Now that my machine is here, the rest of the industry can switch over to making records in dish form." For the moment, Lirpa intends to supply both hardware and ceramicware (Lirpa's name for what was formerly called software but was not really all that soft to begin with). But I digress again.

We have now reached the lowest level—of the rack, that is. Here we find a 5-horsepower blower motor which drives a gust of air up into the tube compartment. Ice cubes (crystallized [H<sub>2</sub>O]<sup>3</sup>) are fed through an inlet to the blower motor when the unit is first turned on (or "powered up," as they say in the Compact Dish Player Group), and a servo system turns on adjacent heater coils in the event that the air surrounding the tubes gets too cold. Such frigid air, after all, might crack the glass from which the tubes and other parts are made.

We turn now to the more important section of the Lirpa Si-O<sub>2</sub>, the player itself. At the beginning of this report, we can see that the top-loading lid is in the open position. After the dishes are loaded into the dish racks within the unit, the lid is gently lowered and bricks are used to create a brick-wall filter. This filter insures against any possibility of leakage of the super-audible 82.2-kHz spikes (or water, or detergent) from leaking out of the system.

Individual nozzles, located at the bottom of the player compartment, spray proper amounts of water lubricant and detergent to keep the sounds clean and to prevent dish breakage or "smeared" sound. After turning on the hot and cold valves and touching the "Play" button on the nearby rack, 32 individually calibrated digital hammers strike the dish or dishes being played (up to three dishes can play at once, creating a sort of three-part harmony which is both cacophonous and atonal). The digital hammers are arranged so that the first hammer has one striking element, the next two, the one after that four, then eight, etc. According to Dr. Lirpa, this is the first direct-to-sound trinary digital system in the world. It translates digital "yes," "no" and "maybe" symbols directly into acoustical output, via a diaphragm which picks up the hammer blows directly and feeds them to the listener via the built-in horn. An output jack on the right side panel allows you to feed the sound to your existing stereo system, if you insist, although Prof. Lirpa



## Nakamichi—Commitment to Innovation

Innovation—not a word to use lightly! Innovation demands a fresh look—a break with the past—a new solution to an existing problem. Innovation begins with an idea born of free thought, unfettered by tradition, unshackled by preconceived notions of what is possible. Technological innovation is akin to artistic inspiration. An idea originates in the creative soul of one person; the R&D lab—technology's "orchestra"—converts that idea into reality.

Consider the Nakamichi Dragon—an innovative cassette deck in the true sense of the word! Why? Not because Dragon plays both sides of a cassette automatically, but because it is the first to do it *perfectly*—the first to solve the "bi-directional playback problem" that has plagued every auto-reverse cassette deck ever made!

The "bi-directional playback problem" is caused by cassette tolerances which allow tape to follow a different path when played in reverse than it did when recorded. This produces "azimuth error" which results in lost overtones. Instruments no longer sound true to life and the music is dead!

This is not acceptable to Nakamichi! A decade ago, we solved the "azimuth-alignment problem" of conventional re-

orders by using special test tones on each cassette. This technique cannot be used when *playing* tapes that were recorded *without* the tones. A practical *playback* azimuth-alignment system must utilize *music itself* as a test signal, but how can an electronic circuit know what music should sound like?

Can *music* be used to check itself? Yes! We've invented a way to measure phase error between signals on a single track. To the non-technical music lover, this sounds like gobbledygook, but your ears will tell you that it works! It won't make good music out of bad, but it does reproduce absolutely everything that was recorded without loss of overtones, clarity, or life. And, it works on every tape—recorded commercially or at home—and in both playback directions!

The system is NAAC—Nakamichi Auto Azimuth Correction. Dragon is the first deck to have it—which makes Dragon the world's first "perfect" auto-reverse cassette deck! Nakamichi—where commitment to innovation creates the products of the future—today!



For a 22"x30" full-color poster of the Nakamichi Concert Hall, send \$2.00 check or money order payable to Nakamichi U.S.A. Dept. M-1 1101 Colorado Ave. Santa Monica, CA 90401. Allow 4-6 weeks. Offer expires March 31, 1984. Void where prohibited.

DRAGON Auto Reverse Cassette Deck



KING: 17 mg. "tar", 1.3 mg. nicotine, 100's: 17 mg. "tar",  
1.4 mg. nicotine, av. per cigarette by FTC method.

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*You've got what it takes.*

# Salem Spirit

*Share the spirit.  
Share the refreshment.*

Warning: The Surgeon General Has Determined  
That Cigarette Smoking Is Dangerous to Your Health.



A unique filtering system permits sounds to reach the listener not only from left and right, but from behind, in front, above and below.

maintains that the direct-to-horn approach will yield far better results. Alternatively, provision has been made for mounting a microphone on the concrete base, just in front of the output horn. The output from this microphone may then be fed to a low-level input on your existing system, should you prefer that arrangement. In case you are wondering about stereo, it should be pointed out that a special holographic time-division filtering system, located within the horn itself, permits sounds to reach the listener not only from the left and right, but from behind, in front, above and below. This is only true, however, if you listen via the horn. Should you insist on using your existing system, you will need to purchase a second player section which can be readily interfaced with the first one and with the rack for stereo applications.

The unit I tested was equipped with an extra option. At the upper left of the player you may be able to just make out a tiny turntable system, complete with a tonearm, a high-quality quartz crystal pickup, a cactus stylus, and a 45-rpm record (sometimes referred to as a hard disc). The entire assembly, available for only an additional \$99.95, is enclosed in a vacuum-sealed box and is called a surface-noise simulator. As its name suggests, its purpose is to introduce controlled amounts of surface noise for those who miss this artifact while listening to CDs. In the Si-O<sub>2</sub>, Lirpa uses a record with a closed groove which is repeatedly tracked by the stylus. This seemingly crude version has the advantage of becoming more and more effective the more you use it. Nevertheless, Lirpa intends to synthesize the surface noise digitally in second-generation models.

### Measurements

Contrary to popular opinion, the gently waving shape of the response curve (Fig. 1) is not to be thought of as a defect in the Lirpa unit. This type of response has been known to have a calming effect upon listeners, especially those who become very tense (and whose arms stiffen noticeably) when listening to conventional CDs on ordinary CD players employing those dangerous microwatt lasers as pickups!

Harmonic distortion at maximum recorded level was noted, but Dr. Lirpa (who was present during my tests) absconded with the figures. Still, subsequent listening tests suggested that THD as well as IM distortion were both about equal—to each other.

Output linearity seemed to vary with water temperature and diameter of the dish being played. Twelve-inch platters did best here, with dessert plates and coffee cup saucers not faring quite as well. I suspect that this variation has to do with the non-flat nature of the latter dishes. The hammers probably slide down while striking the surface, thereby upsetting the delicate balance between the digits and the lubricant (in this case, water). Plots of distortion versus frequency (recovered at a later date) are superimposed upon plots of channel separation (to conserve graph paper) in Fig. 2.

Figure 3 is a 'scope photo of square waves reproduced from a special test dish supplied by Prof. Lirpa. Note, for the first time ever, that I was able to obtain a *complete* square wave series—not your usual three-sided squares which

conventional CD players deliver from conventional CDs. Eat your hearts out, Philips and Sony!

Lirpa's engineers were good enough to supply me with a full complement of Compact Dishes for my tests. Included were a few paper plates, which contain digital music that most people would not want to listen to more than a few times. On one of the test dishes, Dr. Lirpa incorporated 72 pulses, rather than illustrate a single unit-pulse waveform. His reasoning here was that 72 pulses are much closer to the human pulse rate. He also figured such a test signal might be looked upon more favorably by audio critics, who would empathize with the higher pulse rate which is so much closer to their own. The reproduced results are shown in Fig. 4: Count 'em, 72 complete pulses—one exactly like the next. How about *that*?

As for S/N (suds-to-noise) ratio, I found that this, too, was highly dish-dependent. Lead-weighted glass dishes offered far less noise than earthenware dishes, and noise from both types was also dependent upon the condition of the surface-noise simulator. After some experimenting, I found the ideal setting for the noise simulator when playing most musical dishes was at that level which was just loud enough to mask the inferior mixing job and microphone placement errors of the engineers who recorded the original performance. An analysis of suds-to-noise ratio is shown in Fig. 5. Both "flat" (abbreviated "FT" in Fig. 5A) and "wide" (abbreviated "WD" in Fig. 5B) test dishes were used for this measurement.

When I broached the subject of error correction to Dr. Lirpa, he quickly informed me that he didn't make any errors. I explained I was referring to the Compact Dish player, at which point he extracted from a locked desk drawer a special recording of the original cast of *A Chorus Line*. "Play this dish," he shouted, "and observe the pattern

Fig. 3—  
The first truly square waves ever seen in a 'scope photo were produced by the Lirpa player.

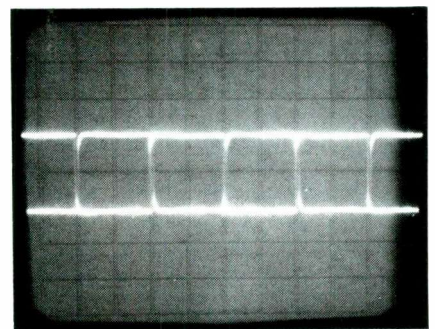
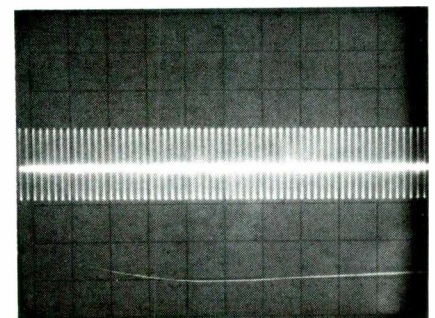
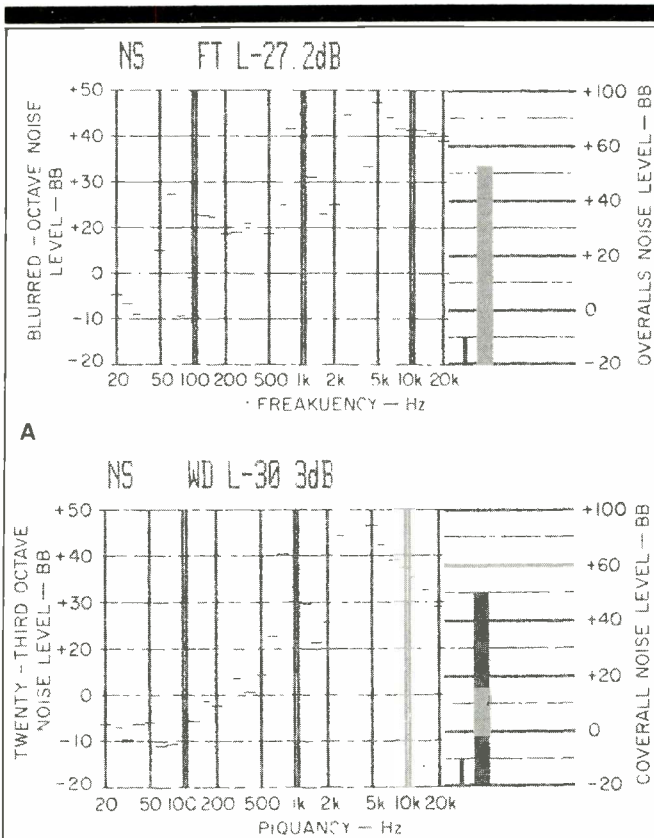


Fig. 4—  
The more human pulse rate of 72, as reproduced by the Si-O<sub>2</sub>.

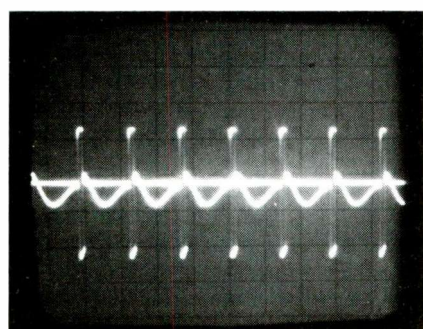


The Compact Dish is not indestructible; it should be handled with rubber gloves to keep it from falling on the player's concrete base.



**Fig. 5—To counter the high noise level of "FT" (flat) and "WD" (wide)**

**Compact Dishes, Prof. Lirpa suggests listening in another room.**



**Fig. 6—Oscilloscope pattern produced by Lirpa unit during play of special test dish containing music from *A Chorus Line*.**

you get on the 'scope. If you use your imagination a bit, and if the dish player is doing its thing without any errors, you will be able to fantasize a complete chorus line, in lock-stepped formation, arm-in-arm, prancing across the stage." I was skeptical, but, sure enough, when I played this dish, a pattern appeared on my 'scope, accompanying the music (see Fig. 6). You have to squint and use your imagination a bit, but, by Heavens, Lirpa was right—again!

I performed further error-correction tests by using a special test dish containing artificially induced problems intended to determine how well the player could handle them.

Around the dish perimeter are stains which seemed to be caused by the remains of some cooked eggs. The Si-O<sub>2</sub> could not handle them well at all; the digital signals sounded "scrambled," possibly relating to the method of the preparation of the eggs themselves. After further scrutiny, I noted that the test dish also included some baked-on pasta, which increased in width from the center of the dish outward. This player negotiated the thinner spaghetti strands quite admirably, particularly those coated in an olive-oil-based pesto sauce, but it utterly failed with the wider fettuccine noodles.

### Use and Listening Tests

The Lirpa Si-O<sub>2</sub> Compact Dish player was easy to use, once I hooked up its plumbing and cables. A far greater problem was finding available dishes themselves. There isn't much open stock, though the plants at Noritake and CBS/Imari should be up to full steam by the time you read this. I am told that there will be many recordings having sets of service for 12 available by mid-1985. At the present time, there are no plans for production of digital dishes in the U.S., though rumors have it that Dr. Lirpa has been negotiating with several manufacturers of glassware, such as Owens-Corning. The fear in involving these firms is that their products may produce the annoying, glassy sound so often criticized by *Positive Noise* and other subsurface, astrologically oriented publications. Coating of glass dishes with buttermilk or Pepto Bismol is a potential remedy.

With the help of Dr. Lirpa himself, I was able to acquire a sufficient collection of Compact Dishes to fulfill my listening requirements. My favorite was a performance of Raoul Dukes' "The Saucer's Apprentice," which offered a veritable feast of sounds. I found white dishes were best; others tended to color the sound. I even tried a few silver platters, only to find that these definitely yielded a highly metallic sound. I have yet to play a golden platter, but I'm sure as this new medium gains in popularity we will see them.

As for the dishes themselves, don't let anyone tell you they are indestructible. You are advised to handle them (especially when unloading the player) with rubber gloves to prevent their slipping out of your hands and falling onto the player's concrete base. Frankly, I think the concrete base was a needless addition—put there to make sure a dish will break if you drop it. Let's face it: Hardware and ceramicware makers tend to stick together, don't they?

Without a doubt, Dr. Lirpa has come up with a real *first* with the introduction of his Si-O<sub>2</sub> player. Already, however, the industry is buzzing with rumors that Kitchen Aid, Maytag and Sears are not far behind. Until the competition catches up, though, Dr. Lirpa has the Compact Dish player field all to himself. I'll be watching the progress of this remarkable music system, as I'm sure you will, too. How long will it take for the Compact Dish player to render the Compact Disc player obsolete? That depends upon how willing you, the listening public, are to start eating on plastic plates so that production facilities of the glass and china makers of the world can be diverted to producing enough Compact Dishes for all to enjoy. My own estimate is that not all music listeners are as dedicated to audio as you and I, so we may have to suffer for a few years more with the already antiquated Compact Discs we know today.

*Nel Namdief*



# THE ONLY WAY YOU WILL BUILD A BETTER DIGITAL AUDIO PLAYER IS IF YOU KNOW MORE ABOUT DIGITAL AUDIO.

While other manufacturers talk of "second generation" CD Players, Denon has already produced 5th generation PCM Digital Recorders (having first developed the process of digital recording in 1972).

While CD software makers are just now experimenting with microphone placement to improve digital sound, Denon has already recorded over 650 digital titles and pressed many of the finest-sounding CD's.

In the process Denon discovered that the key to musicality in a CD player is the reduction of distortion in the digital-to-analog (D/A) conversion process. Therefore, Denon uses two D/A

converters in the DN-3000FC Professional CD Player and Direct Digital-to-Analog Circuitry (DDAC) in the new DCD-1800.

The DCD-1800 also adopts the DN-3000FC's single-pivot transport system for greater shock resistance, and fastest access time. This speed makes possible unprecedented CD operational convenience (ex., 10-key Direct Program Access, Block Repeat, Program Sampling and Index Location Cueing).

While other manufacturers are trying to build cheap CD players that sound like a good deal, Denon builds one that sounds a good deal better.



# DENON

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

## 2

## TECHNICS SL-P8 COMPACT DISC PLAYER

### Manufacturer's Specifications

**Frequency Response:** 4 Hz to 20 kHz,  $\pm 0.5$  dB.

**S/N Ratio:** Greater than 96 dB.

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

**Channel Separation:** Greater than 90 dB.

**Harmonic Distortion:** Less than 0.003% at 1 kHz, 0 dB.

**Output Level:** 2.0 V for 0 dB.

**Number of Programmable Selections:** 32.

**Power Consumption:** 35 watts.

**Dimensions:** 16-9/16 in. (43 cm) W x 3 1/2 in. (8.8 cm) H x 12-13/16 in. (32.5 cm) D.

**Weight:** 13.4 lbs. (6.1 kg).

**Price:** \$700.00.

**Company Address:** One Panasonic Way, Secaucus, N.J. 07094.

For literature, circle No. 90



The new Technics SL-P8 is, without a doubt, the most feature-laden Compact Disc player I have tested to date. It is also one of the best in terms of error-correction capabilities, control layout, and styling. Though Technics continues to offer its "first-generation" model SL-P10 for a suggested retail price that is \$300 higher than the SL-P8's, I frankly cannot see any reason to select the costlier unit, since the SL-P8 offers superior performance and a great many more operating features, not the least of which is a full-function wireless remote control. Technics also introduced an even less expensive (\$600) CD player, the SL-P7, at the same time that they announced availability of the SL-P8. I have

had an opportunity to check out both models, and, although the lower priced unit's basic performance is essentially equal to that of the SL-P8, it lacks many of the latter's features (see accompanying sidebar).

Even a quick summary of the SL-P8's outstanding features is enough to impress the most seasoned user of other late-model CD players. It offers a search function at two speeds, with audible cueing (you hear samplings of audio content even at the faster search speed). You can program up to 32 different selections by track or index point within a track, and play them in any order you choose. You can skip (advance) to the next track or to the next index point pro-



grammed, or, if no program is in memory, to the next sequential track or index. You can program the system to begin play at any point on a CD, either by track, by index, or by time (minutes and seconds). You can program the end-point of play in the same ways. There's even a "Music Scan" feature that will send the laser pickup to the beginning of each track, at which point it plays the first few seconds of that track. If you do nothing, it proceeds to the next track and plays its opening few seconds. If you like what you hear at any given point, pressing the "Play" button stops the scanning function and allows you to continue playing the track just auditioned.

Many of these features have been found in other CD players, but I can't remember a single unit that incorporated all of them at a price this low. There are also at least two features in the Technics SL-P8 that I have not seen on any CD player before. The first of these is a pitch control. Yes, you can actually change the pitch of music contained on any CD by as much as  $\pm 6\%$ —much as you would on conventional turntables equipped with this feature. How is it possible to change the pitch of a digital recording which, after all, consists of sampled "number values" taken at a fixed rate of 44.1 kHz? Well, if you think about it, it's really not that difficult in principle. The samples read by the laser pickup are first stored in solid-state memory before being fed out at a uniform rate (controlled by a quartz clock) to the D/A converter. If you change the clock rate to something other than the standard 44.1-kHz sampling rate, you change the musical pitch of the recovered analog audio signals. In order to insure perfect pitch when the feature is not wanted, Technics tied the pitch control slider to an on/off pushbutton. When you want perfect pitch, this button is released and the slider control is completely bypassed.

The second unique feature is "Synchro Record," which synchronizes certain Technics tape decks to start recording when the SL-P8 starts to play, a feature I'd previously only seen on automatic turntables.

### Control Layout

A power on/off pushbutton is at the extreme upper left of the control panel. Just below it are a stereo headphone jack and a headphone output-level control. Disc loading is via a slide-out drawer, to the right of the power switch. Further to the right is an "Open/Close" touch button to operate the drawer motor. A large display area to the right of this control button offers a variety of visual indications. These include a ruler-like scale, calibrated from 1 to 20, showing the total number of tracks on a disc after it has been inserted in the drawer. During play, a flashing fluorescent bar along the length of this scale shows which track is being played, and, in addition, other bars show which programmed tracks remain to be played. To the right are LED numeric displays which show total playing time (when the disc is first inserted), elapsed track time, track playing time, remaining playing time, track number or index number. Controls to the right of the display area include a "Pause/Stop" button (touch it for "Pause," hold it down for a couple of seconds for "Stop"), a "Play" button, forward and reverse search touch bars, and forward and reverse "Skip" buttons for advancing to the beginning or next track or programmed selection.

All of the remaining front-panel controls are found logically arranged below the large display area. They include the "Music Scan" button, 10 numeric buttons for entering desired track and index numbers for programming, the pitch-change on/off button, the slider control for altering pitch, a "Memory" button (for entering programming data), and "Index," "Time," "Clear" and "Repeat" buttons. All of these controls are also found on the wireless remote control, so the user can program the player from across a room in addition to simply starting, stopping and pausing the machine's turntable and pickup system. A three-position switch on the main panel selects the "Auto Pause" feature (which

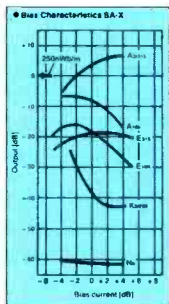
\*\*\* TDK AUDIO (MOL) TEST  
MODE \*\*\*

# Sonic Tonic from TDK



What comes out of your audio cassette deck is only as good as what goes in. And if you want unmatched dynamic performance, you need the highest performance audio cassette you can get. You need a TDK Pro Reference Series cassette. Each is designed to maximize the untapped potential of your cassette deck by generating clear, crisp, full-bodied sound.

Take our SA-X high-bias cassette. It offers you a degree of



sound clarity, quality and fidelity virtually unmatched by any other cassette on the market. Its exclusive dual coating of Super Avilyn particles provides optimum performance for all frequency ranges. And SA-X's super-wide dynamic range and higher MOL handle high signal levels without distortion or saturation.

You also get high-powered performance from TDK's famous MA-R metal and AD-X Avilyn-based normal-bias cassettes. And to make

sure the energy never fluctuates, each TDK cassette is protected by our specially engineered cassette mechanisms for reliable, trouble-free performance. Plus a Full Lifetime Warranty.

Before you waste energy on any other brand, put more life back into your cassette deck with TDK's Pro Reference Series cassettes. They're pure Sonic Tonic.

**TDK**  
THE MACHINE FOR YOUR MACHINE®

I can't remember a single CD player incorporating so many features at so low a price—including two features I haven't seen on any CD player before.

stops play at the end of each track, resuming when you press "Play"), as well as "Timer Play" (if the player is powered through an optional clock-timer).

The rear panel of the SL-P8 is equipped with the usual left and right output jacks, the "Synchro Record" terminal, and an accessory terminal for easy connection to external components that Technics plans to make available some time in the future.

### Measurements

Figure 1 shows a plot of frequency response for both left and right channels of this CD player. As in previous reports, the vertical scale has been expanded to 2 dB per division, and the plot is from 20 Hz to 20 kHz. At 18.5 kHz, response was up by 0.1 dB for the left channel and down by 0.1 dB for the right. You could hardly ask for flatter response from any audio component.

Harmonic distortion at mid-frequencies, for maximum recorded level, measured only 0.003%, rising to 0.0065% at 16 kHz. Above that frequency, I did note what appeared to be a rapid rise in THD—reaching nearly 0.1% at 20 kHz. While such a level of distortion is clearly not an audible problem, I was curious about the sudden rise in the reading. A spectral analysis of the situation disclosed that the supposed "harmonic distortion" was not harmonic, but rather a "beat" frequency at 24.1 kHz, outside the range of human hearing. In Fig. 2, a linear sweep from 0 Hz to 50 kHz was used (5 kHz per division). The tall spike is the desired 20-kHz output signal; just to its right, about 4 kHz higher in frequency, is the spurious beat component which was responsible for the higher distortion reading.

Figure 3 presents plots of distortion versus frequency for 0-dB record level as well as for a -24 dB level, and the expected relationship (higher distortion at the lower output level) holds true here, as in previously tested CD players.

Output linearity was accurate to within  $\pm 0.2$  dB from 0-dB output down to -60 dB, and within 0.4 dB from -60 to -80

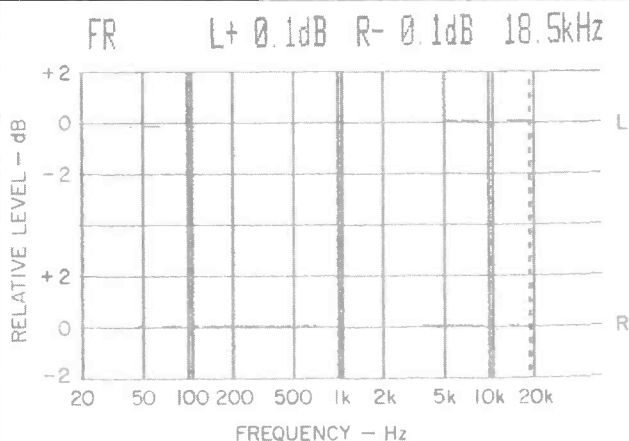
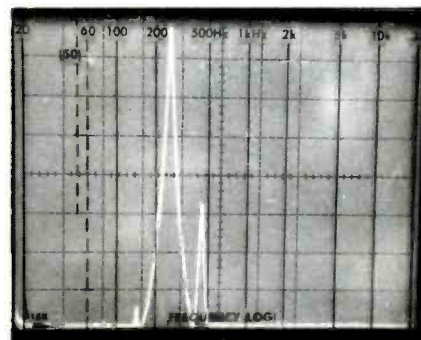


Fig. 1—Frequency response, left (top) and right channels, at 0-dB level.

Fig. 2—Spectrum analysis of reproduced 20-kHz test signal revealed presence of beat tone at inaudible frequency of 24.1 kHz (small spike at right of the desired, tall spike).



### WHAT THE TECHNICS SL-P7 OMITTS

Laboratory measurements made on a sample of Technics' SL-P7 CD player revealed that its basic performance was virtually identical to that of the more expensive SL-P8. If you don't require any of the refined programming features and the wireless remote control offered by the SL-P8, you may very well want to consider this more basic player.

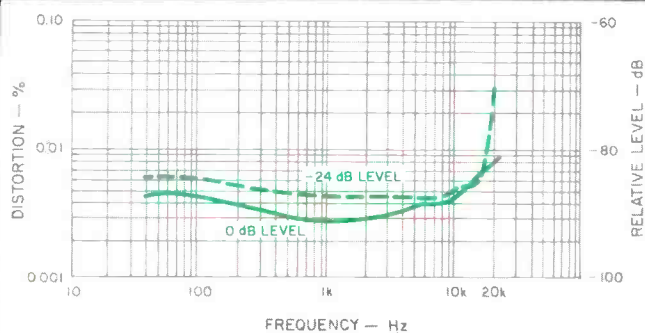
The SL-P7 measures nearly 4½ inches less in width and weighs nearly 3½ pounds less than its more expensive "big brother." The smaller unit's display area has been compressed so that it displays track, index and time. Like the SL-P8, however, it does display total time and total number of tracks when a disc is first inserted into the disc drawer and that drawer is closed. The major controls, such as "Pause/Stop," "Play," forward and backward "Search/Index" and forward and backward "Skip" buttons all perform the same functions as they do on the SL-P8. Although all controls and buttons relating to programming (such as the number keys, the "Memo-

ry" key, and "Index," "Time" and "Clear" keys) found on the SL-P8 have been omitted on the SL-P7, it does offer repeat-play capabilities of either the track in progress or the entire disc. The pitch control is omitted, as are the auto-pause feature and the headphone jack. The synchro-record terminal and the accessory connection socket are, however, retained on the SL-P7.

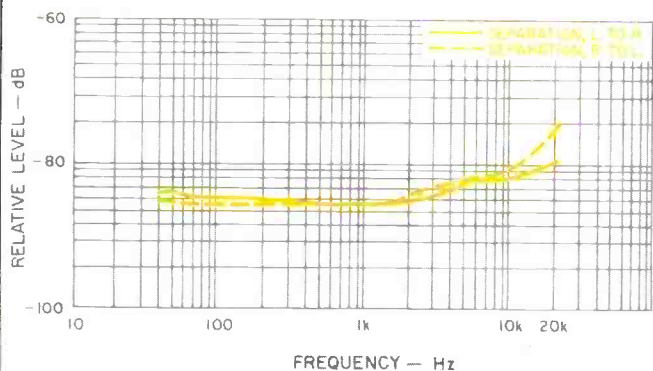
### Equal Basic Performance

What differences I noted in the measured performance characteristics of the SL-P7 compared with those of the SL-P8 are, more than likely, the minor differences that one might find between any two samples employing the same circuitry. Specifically, the SL-P7 had mid-frequency harmonic distortion readings of 0.004% and exhibited the same sort of super-audible "beat" phenomenon that I observed in the SL-P8. Signal-to-noise ratios on the SL-P7 were actually a shade better than the SL-P8's: 95.3 dB unweighted and an even 100 dB, A-weighted. Linear-

At 18.5 kHz, response was up by 0.1 dB for the left channel and down by 0.1 dB for the right one. You could hardly ask for flatter response than that.



**Fig. 3—THD vs. frequency, at levels of -24 (top) and 0 dB.**



**Fig. 4—Separation vs. frequency.**

dB. Stereo channel separation is plotted for left and right channels in the graph of Fig. 4. I measured separations of approximately 85 dB at mid-frequencies and between 75 and 78 dB at the high end of the spectrum. Left-to-right separation at the treble end was somewhat better than right-to-left separation.

SMPTE-IM distortion measured 0.0037% at 0-dB recording level, increasing to 0.036% at a -20 dB signal level. Signal-to-noise analysis was conducted with and without an A-weighting network. Unweighted S/N measured 93.6 dB (as displayed in Fig. 5A), while weighted S/N was 99.1 dB (as shown in Fig. 5B).

Reproduction of a 1-kHz, digitally generated square-wave test signal, shown in Fig. 6, was typical of that encountered with CD players which utilize multi-pole, steep-analog post-D/A filters. The same held true for reproduction of the digitally generated unit-pulse test signal, shown in the 'scope photo of Fig. 7. The usual slight phase displacement between a left-channel, 2-kHz test signal and a right-channel, 20-kHz test signal is evident in the 'scope photo of Fig. 8. Had phase linearity been perfect, positive crossing of the zero axis would occur at the same time for both signal frequencies. Though phase displacement at 20 kHz looks to be 25° or 30°, actual displacement might be higher by a multiple of 360°. (See Sears review, this issue.)

I repeated the usual tracking and error-correction tests using the specially prepared Philips test disc, which contains a wedge of opaque material, several black dots of specified diameters and a semi-transparent, simulated fingerprint smudge. The Technics SL-P8 is one of a very few CD players I have tested that successfully completed this "obstacle course" without missing a beat of music encoded beneath the deliberate defects. In other words, the laser tracking system, in combination with the built-in error-correction circuitry, was able to overlook disc "scratches" having a linear thickness of 900 microns, "dust" particles of 800-micron diameter, and a rather nasty "smudge" that

ity, stereo separation, and IM distortion readings were identical for both units and, best of all, the SL-P7 performed very nearly as well as the more expensive model in tracking my test "defects" disc. It almost played through the 900-micron-width wedge without any audible problems. I heard just one tiny pop, towards the end of the band, which wouldn't even qualify as a real mute, although the player did exhibit one or two moments of muting when playing through the test disc's 800-micron simulated dust speck. As for square-wave and unit-pulse reproduction, these appeared to be identical, when viewed on a 'scope, with the results obtained for the Technics SL-P8.

While the SL-P7 has no multiple-selection programming capability, I should stress the fact that access to any point on the disc (including index points, if they are present on any CD) is as rapid as in the SL-P8. Only access by *time* has been omitted.

To summarize, if you are the type of listener who needs

the programming versatility and the remote-control facilities of the SL-P8, by all means audition this model, and, if you're as pleased with it as I was, select it. If, on the other hand, you are looking for superior basic playback performance in an up-to-date CD player design and are willing to expend a little more effort in accessing desired programs on a disc, the SL-P7 could well be what you're looking for—and it will save you enough money for at least five or six extra Compact Discs. L.F.

#### Technics SL-P7 CD player



# Virtuoso

## THE NEW AIWA AD-F990 3-HEAD CASSETTE DECK: PERFORMANCE READY FOR THE DIGITAL AGE.

At Aiwa, we believe being the best means taking the lead, not following. That's why our engineers developed the AD-F990: the first fully automated cassette deck designed to meet the demands of the compact digital disc.

### 20-21000Hz FLAT FREQUENCY RESPONSE!

Listen to the AD-F990 and you'll be stunned. Dolby HX Professional and Aiwa's exclusive amorphous combination head have extended performance parameters so far that the AD-F990 can faithfully reproduce digitally recorded programs without compromise...or effort.

### A TRIUMPH IN HUMAN ENGINEERING

To perfectly integrate man and machine, the Aiwa AD-F990 presents its controls on a unique "keyboard." That's new! So is our Auto Record Level Control, Auto NR Detector, Auto Demagnetizing, Auto Tape Selector, Digital Time Remaining Display that shows all tape operation modes, and a fluorescent display for all functions.

The Aiwa AD-F990: the top of our new line of "digital-ready" cassette decks. The sound of the future, today.



**AIWA**<sup>®</sup>  
SIMPLY ADVANCED

AIWA CORPORATION, 35 Trafford Drive, Moonachie, New Jersey 07074. In Canada, Shiro (Canada) Ltd.

---

It took a touch of  
genius to fill this  
house with music.

---

As you might expect, the curators of Mozart's residence in Salzburg, Austria, attach considerable importance to the quality of music reproduction in the museum. Their overriding concern is the faithful re-creation of Mozart's works.

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They chose JBL loudspeakers.

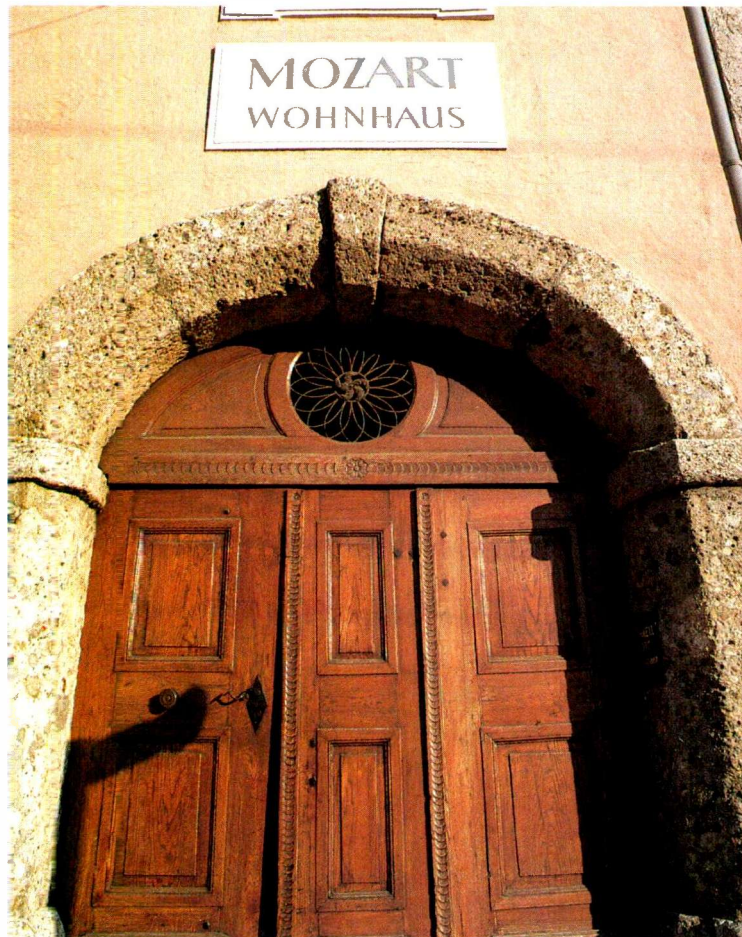
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JBL engineers share the concerns of the curators. JBL loudspeakers deliver not only the notes but the spirit of great musical performances. From wax cylinders to the latest digital and advanced analog recordings, JBL loudspeakers will help you appreciate musical genius.

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For a demonstration, visit the audio specialists at your nearest JBL dealer. Or the Mozart museum in Salzburg.

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JBL incorporated, 8500 Balboa Boulevard,  
P.O. Box 2200, Northridge, California 91329 U.S.A.

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JBL/harman international





With players this good, I'll need a "defects" disc that makes even greater demands on their tracking and error-correction systems.

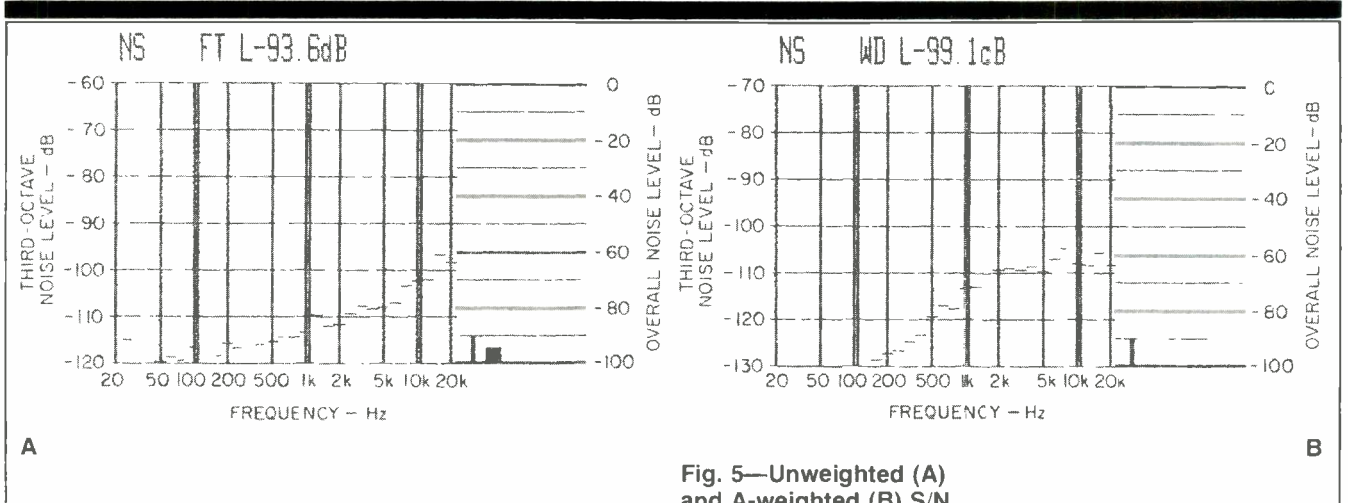


Fig. 5—Unweighted (A) and A-weighted (B) S/N.

occupies nearly an inch of linear distance near the outer diameter of the test disc. I can't tell you what it would take to make the SL-P8 mute or fail in its tracking ability, simply because these were the worst defects available on my test disc. With players such as this, I'm going to need a test disc that makes even greater demands upon a unit's tracking and error-correction system.

As for mechanical stability and shock resistance, I was half tempted to mount the SL-P8 in an automobile, so resistant was it to the thumps and whacks that I gave its top surface and side while playing CDs. It really took a rather violent pounding on the surface to cause mistracking, and that, to me, is an important characteristic of any machine.

### Use and Listening Tests

The Technics SL-P8 is, quite simply, a pleasure to use. I have maintained right along that the biggest differences between CD players are not so much the quality of sound they produce (though, in recent tests, I have heard some differences) but in the features they offer and in their ease of use. It is in this latter area that the Technics SL-P8 truly excels.

As for sound quality, I now have some excellent Telarc discs which confirm what I've been saying: There's nothing wrong with the standardized CD system itself; we've simply got to learn how to make discs that take best advantage of the system. Telarc seems to have mastered the technique well ahead of others, though in all fairness, I must say that I own several other CDs that are beyond reproach musically and technically. In any case, playing the Telarc version of the Berlioz *Symphonie Fantastique* or their recording of Rudolf Serkin as soloist in the Beethoven Third Piano Concerto, or their recording of Stravinsky's *Firebird Suite*, one begins to appreciate the true potential of the CD format. These and other discs were played during my evaluation of the Technics SL-P8, and while I did not compare sounds heard with the same material played on other CD players, I can tell you that I truly liked the sounds delivered via the Technics unit. I hope Technics is nearly out of stock of the older SL-P10; if they aren't, they're likely to have a hard time selling it when it's compared with this newer, finer and less expensive player.

Leonard Feldman

Fig. 6—Response to 1-kHz square wave.

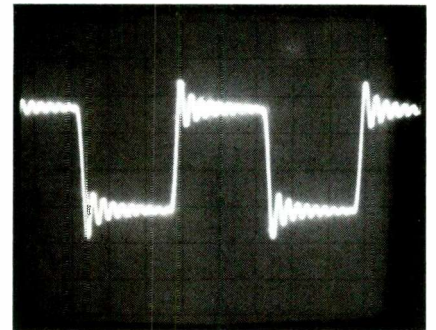


Fig. 7—Single-pulse reproduction.

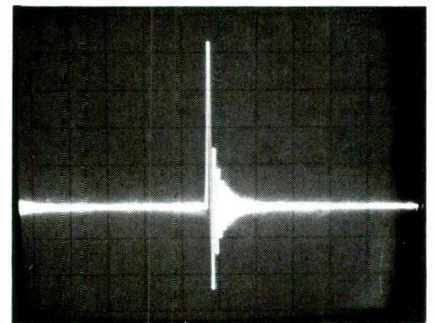
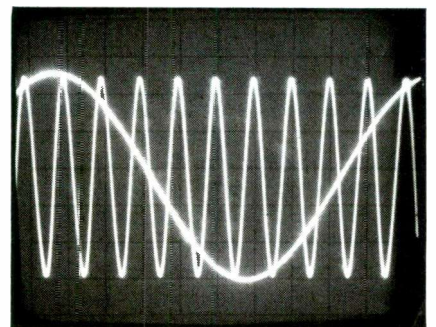


Fig. 8—Two-tone phase check (2 kHz left-channel, 20 kHz right-channel).



3

**SEARS**  
**564.97500350**  
**CD PLAYER**

**Manufacturer's Specifications****Frequency Response:** 5 Hz to 20 kHz.**Dynamic Range:** Greater than 90 dB.**Channel Separation:** 90 dB at 1 kHz.**Harmonic Distortion:** 0.003% at 1 kHz.**Output Levels:** Line, 2.0 V; phones, 7.8 mW at 8 ohms.**Number of Programmable Selections:** 16.**Power Consumption:** 35 watts.**Dimensions:** 13-3/16 in. (33.5 cm) W × 3 1/2 in. (8.8 cm) H × 10 5/8 in. (27 cm) D.**Weight:** 13.2 lbs. (6 kg).**Price:** \$599.00.**Company Address:** Sears, Roebuck & Co., Sears Tower, Chicago, Ill. 60684.

For literature, circle No. 91



This Sears Compact Disc player had, when I tested it, the dubious distinction of being the lowest priced CD player to be marketed in the United States. Indeed, Sears even reduced the already low price by \$100.00 for a month in their pre-Christmas catalog. I use the word "dubious" simply because my tests reveal that attempting to come in with a lower priced product than anyone else's doesn't always result in instant success for the product; neither does it

necessarily enhance the image of the manufacturer. I fully expected the Sears unit to be missing certain sophisticated programming features, and indeed I was correct in that regard. I did *not*, however, expect the tracking capability or error-correction capability of the machine to be as poor as they turned out to be, but more about that presently.

The Sears CD player is a front-loading unit which has the now-familiar slide-out drawer for disc loading. It features

# READ THIS AD AND YOU'LL BUY A HARMAN KARDON CASSETTE DECK



That's a bold statement, but Harman Kardon has been making bold audio statements for over thirty years, introducing the world's first high fidelity receiver, the first stereo receiver and ultrawideband frequency response. Harman Kardon was also the first company to use Dolby<sup>®</sup> in a cassette deck.

Today, Harman Kardon products continue to be so technologically advanced that "state-of-the-art" falls short of describing them. They have become "state-of-the-mind," the highest level at which the mind can create.

The CD491 is Harman Kardon's most sophisticated state-of-the-mind cassette deck and one of the few in the world that can equal the full range of human hearing. The CD491 has a remarkable 20Hz to 24kHz frequency response using any tape formulation, not just expensive metal tape. An audiophile would settle for nothing less. Even more remarkable is that in a national challenge<sup>2</sup>, Harman Kardon measured frequency response and beat 98% of the competition, including units costing twice as much.

The CD491 incorporates a dual capstan transport with twin flywheels to insure perfect movement of the tape across its 3 high performance heads. The dual capstan serves to isolate the tape from the cassette shell while the dynamically balanced flywheels help generate a

consistently accurate tape speed. Together they enable the CD491 to reduce wow-and-flutter to an inaudible .025%. The only "wow" you'll ever hear is the reaction of people listening to your Harman Kardon cassette deck.

The CD491 incorporates Dolby HK Pro<sup>1</sup> for extended frequency response, plus Dolby B and C<sup>1</sup> for maximum noise reduction. Three precision heads offer improved performance and the convenience of monitoring while recording. Included is a Sendust head to withstand high record levels without overload and a ferrite playback head for extended high frequency response.

The combined benefits of the CD491's performance features allow for the accurate recording of more dynamic audio signals than previously possible. In fact, the large signal response (frequency response at 0V<sub>u</sub>) of the CD491 is a virtually unrivaled 20Hz-20kHz  $\pm$  3dB. This is especially significant as more demanding forms of software, such as digital audio, become available.

So, while other manufacturers continue to pile on unnecessary features and gimmicks, Harman Kardon continues to develop only fundamentally advanced audio equipment.

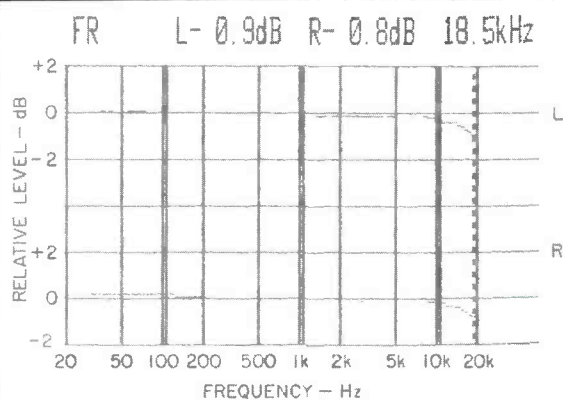
(1) Dolby is the registered trademark of Dolby Laboratories Inc.

(2) In 1982, Harman Kardon challenged individuals to bring in their cassette decks to a local HK dealer. All units were cleaned and demagnetized in order to insure fair test results. The Harman Kardon unit was factory packed.

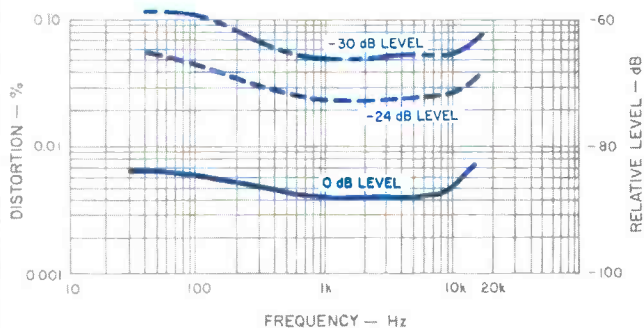
## harman/kardon

Our state-of-the-mind is tomorrow's state-of-the-art.

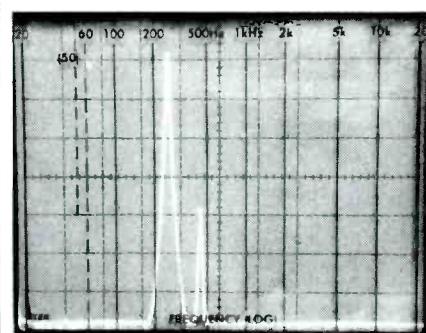
THD was low at middle and low frequencies. At the high end, I ran into an inaudible beat frequency masquerading as THD.



**Fig. 1—Frequency response, left (top) and right channels, at 0-dB level.**



**Fig. 2—THD vs. frequency at levels of (from top to bottom) -30, -24, and 0 dB, from 41 Hz to 16 kHz (see text).**



**Fig. 3—Spectrum analysis, 0 Hz to 50 kHz, showing 19-kHz tone (tall spike) and spurious beat tone at 25.1 kHz (small spike).**

random programming for up to 16 selections (tracks only, no Index recognition), track-by-track forward and reverse searching, and repeat-play of either the entire disc or of any specific tracks that have been programmed into memory. Numbered LED indicators show the track being played as well as tracks that have been memorized during programming. If there are more than 16 selections on a disc, the last LED remains illuminated as play progresses to higher numbered tracks. The player does not incorporate any sort of time display.

The Sears unit is extremely compact, standing only 3½ inches tall and measuring less than 13¼ inches wide. It appears to be extremely shallow from front to back as well, but this is in part illusory, since the power transformer projects out the back for well over 2 additional inches. Both the front panel and the metal wrap are light silver colored, and nomenclature is highly legible.

### Control Layout

The power on/off pushbutton and stereo phone jack are located to the left of the disc-tray slot. That slot is normally dust-protected by a metal flap which swings out of the way when the tray comes forward to accept a disc. Tray motion is initiated by touching an "Open/Close" button to the right of the disc compartment. "Repeat" and "Play" buttons are located just below the "Open/Close" button. "Pause," "Stop" and "Search" touch pads are to the right of the "Play" button, along the lower edge of the player. The "Search" button takes the form of a rocker pad; touching one side of it moves the pickup forward (to the next track of a disc), while touching its other end moves the laser pickup backwards, to the start of the current selection or to previous tracks, if touched repeatedly.

The upper right corner is devoted to the LED track display (16 numbered LEDs) and four separate status indicator lights. These are labelled "Disc In," "Repeat," "Play" and "Pause." Three more touch buttons, below the bank of track LEDs, are used for programming operations. These are labelled "Program," "Memory" and "Clear."

The rear panel is equipped with the usual pair of output jacks, the aforementioned protruding power transformer, some metal heat-sink fins, and a rather mysterious switch called a "Pickup Fixing Switch" which must be set to the off position in addition to removing a shipping screw before you can use the player. No doubt the "Pickup Fixing Switch" activates some sort of electromechanical device which locks the laser pickup in place to avoid damage during transport.

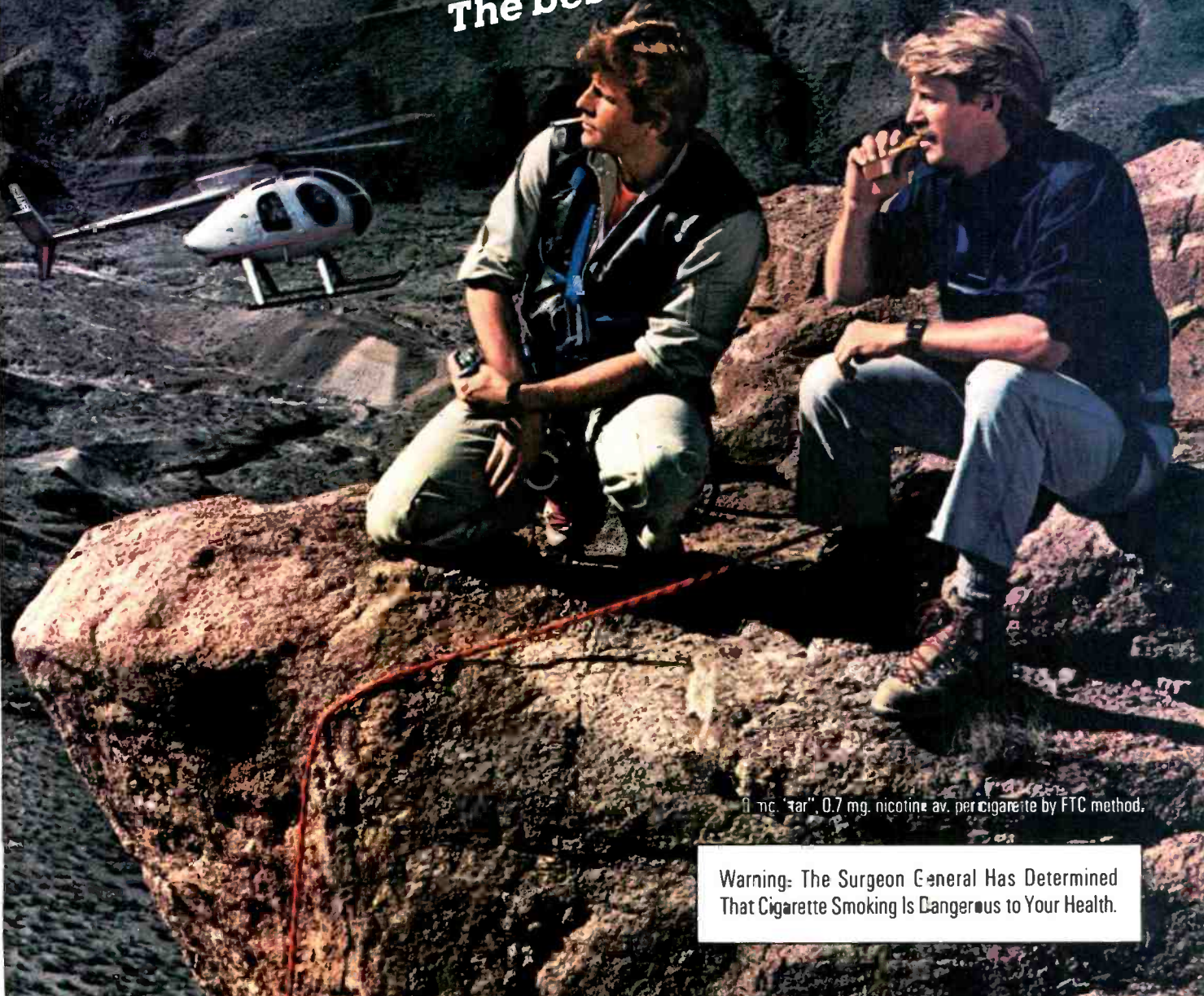
### Measurements

The player exhibited a roll-off of approximately 1 dB at 20 kHz for both channels, as seen in Fig. 1. (Note that vertical sensitivity in this plot is 2 dB per division.) The cursor was deliberately set at 18.5 kHz, rather than at 20 kHz, so that it would not be obscured by the solid vertical 20-kHz line on the graph.

Harmonic distortion at mid-frequencies, for maximum ("0") recorded level, measured 0.004%, rising slightly to 0.0055% at 41 Hz (the lowest test frequency on my Philips test disc). At the high end of the spectrum, I ran into a

# Winston America's Best.

Excellence.  
The best live up to it.



11 mg. "tar", 0.7 mg. nicotine av. per cigarette by FTC method.

Warning- The Surgeon General Has Determined  
That Cigarette Smoking Is Dangerous to Your Health.



## DRAGON-CT

# Definition Of Perfection!

You've watched tonearms weave while tracking a disc; you've heard pitch vary; you've closed your eyes and listened to instruments wander in space. Perhaps you thought it was your imagination! Some days the problem seems worse than on others.

It's not your imagination. It's groove eccentricity. Records aren't perfect. Disc center holes may be too large, off center, or both. Unless you mount a disc perfectly, the groove won't be concentric with the axis of rotation, and, if the spindle hole is off center, the groove will be eccentric no matter what you do.

As the stylus tracks an eccentric groove, it weaves back and forth changing relative speed and generating wow. And, as the stylus deflects from side to side, interchannel phase and separation vary (so does distortion!), and instruments wander about. *Even if the disc and turntable meet international standards*, groove eccentricity can produce peak wow of as much as 1/2% at the inner groove—*far* more than you'd expect from a turntable!

DRAGON-CT *solves* these problems. Its Absolute Center Search System measures actual groove eccentricity and relocates the disc so that the groove is concentric within 20 microns! The procedure is automatic and takes only a few seconds. Once DRAGON-CT has relocated the disc, eccentricity wow vanishes, pitch stabilizes, and instruments remain fixed in space.

DRAGON-CT is an *integrated* disc-playing system designed for today's finest cartridges. It's high-rigidity, low-mass, semi-automatic tonearm has extraordinary warp-tracking ability thanks to its precision bearings and viscous damping system. A unique double-cabinet, dual-suspension construction isolates the disc from external vibration and acoustic feedback and ensures remarkable sonic clarity.

You'll find DRAGON-CT at select Nakamichi dealers. You owe it to yourself to find out how good your records can sound!

For more information, write Nakamichi U.S.A. Corporation, 1101 Colorado Avenue, Santa Monica, CA 90401.



**Nakamichi**

Enter No. 23 on Reader Service Card

This unit exhibits the poorest tracking and error-correction capability I have encountered in any CD player tested to date.

situation which has come up with a couple of CD players previously tested. A high-level "beat" frequency showed up, causing the distortion meter to read 0.5% or so. Since this "beat" component is not, strictly speaking, harmonic distortion, I have stopped the plot of distortion versus frequency (Fig. 2) at 16 kHz. Figure 3 is a spectrum analyzer sweep from 0 Hz to 50 kHz (linearly swept, with each horizontal division equal to 5 kHz). The desired signal was at 19 kHz (the tall spike near center-screen), while the supersonic beat is seen around 6 kHz above the desired output. If you take the difference between 44.1 kHz (the sampling frequency) and 19 kHz, sure enough you come up with a difference of 25.1 kHz—the frequency of the beat observed in Fig. 3. Needless to say, this beat is not audible, but it is present on some CD players and not on others.

Output linearity was accurate to within 0.2 dB from 0-dB record level down to -60 dB. Stereo separation is plotted for the left and right channels in Fig. 4. I measured between 82.5 and 85 dB of separation at mid-frequencies. Separation decreased very slightly to between 77 and 78 dB at the high end of the spectrum.

SMPTE-IM distortion measured 0.007% at 0-dB record level, increasing to 0.03% at a -20 dB output level of the test disc. Signal-to-noise analysis, without and with A-weighting, is shown in the plots of Fig. 5. Unweighted S/N measured 95.4 dB, while weighted S/N was exactly 100 dB below reference (0 dB) output level.

Reproduction of a 1-kHz, digitally generated square-wave signal, shown in the 'scope photo of Fig. 6, is typical of the shape encountered with those CD players using multi-pole, steep-analog filters. The same also applies to the digitally generated unit-pulse test signal shown in the oscilloscope photo of Fig. 7.

I have received at least three letters from readers of *Audio* in recent weeks, all of them pointing out an error which I have been making in some of my reports on CD players. The readers point out that my analyses of phase linearity, using the test signals available on my Philips test disc, have been wrong. As one of these readers points out, an 11-pole filter, such as that used in many CD players, will introduce a phase shift at 20 kHz which is well in excess of 360° of error. Thus, my reporting of angular errors amounting to 25° or 30° or 60° in the past should more than likely have been 385° (360° + 25°), 390°, or 420°. In truth, once the error exceeds 360°, it is impossible to accurately pinpoint the angular error using the particular pair of signals provided on the Philips test disc. With those CD players using digital filters ahead of D/A conversion, plus gentle one- or two-pole filters with higher frequency cutoffs, the test signals remain valid, and I shall continue to use them and to show the resulting 'scope photo. In the case of this Sears player, however, I have elected to use another pair of test signals available on the same test disc, 200 Hz and 2 kHz (see Fig. 8).

At least at these lower frequencies, we can see that both signals have their positive-going crossings of the zero axis at the same point, indicating little or no phase error. What happens at 20 kHz with respect to actual phase error is anyone's guess—at least until someone comes up with a test signal that is valid for accurately determining such phase errors. I thank the readers who wrote for setting me

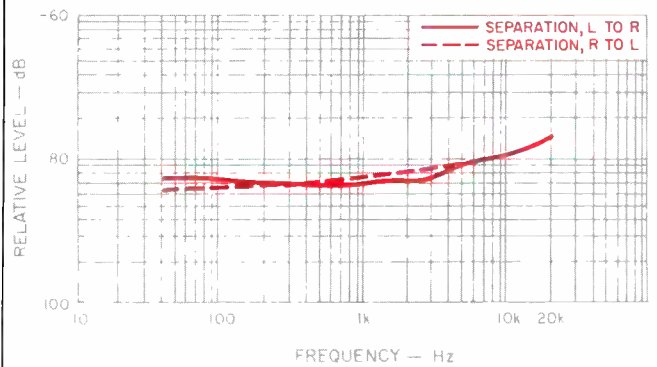
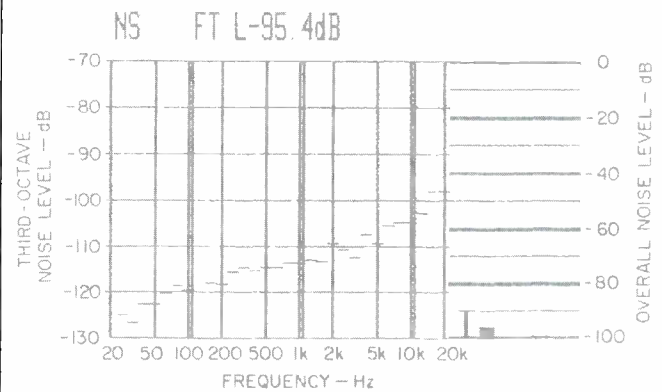
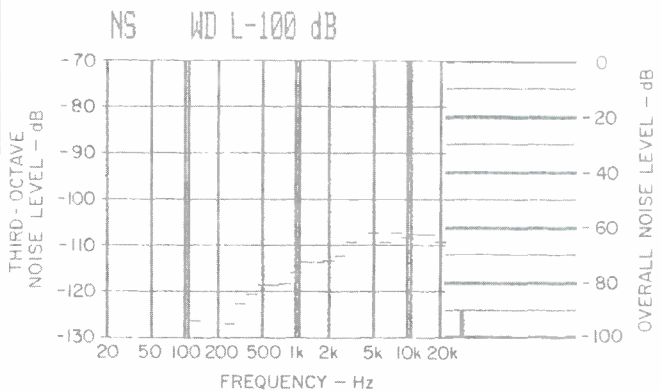


Fig. 4—Separation vs. frequency.



A



B

Fig. 5—S/N analysis, both unweighted (A) and A-weighted (B).

Minor surface scratches that don't affect playback on my reference CD player immediately presented difficulties to this one.

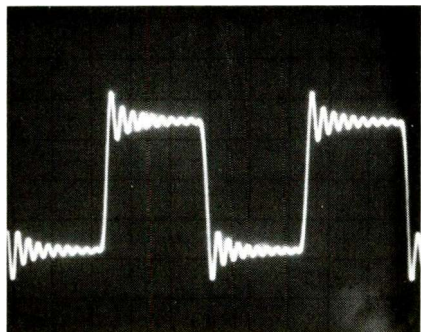


Fig. 6—Response to 1-kHz square wave.

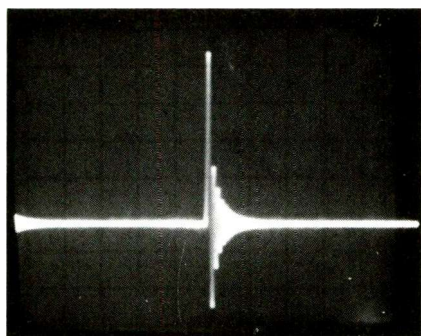


Fig. 7—Single-pulse reproduction.

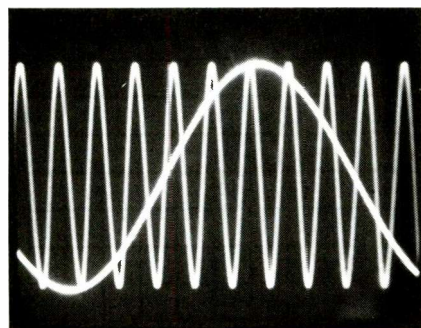


Fig. 8—Two-tone phase check (200 Hz left-channel, 2 kHz right-channel; see text).

straight on this point, though in all honesty, I doubt whether it would have made much difference in terms of my subjective evaluations of the various CD players in question.

Up to this point, I had been mentally equating the Sears CD player's limited programming features and random-access features with its very low retail price. I was certainly willing to accept the former in return for the latter—until I used my special tracking and error-correction test disc. Readers of earlier reports will recall that this disc contains a radial wedge of increasing width (to simulate opaque scratches on the surface of a disc), several black dots of increasing diameter (to simulate dust particles on the surface of a disc), and a simulated fingerprint smudge. Most of the CD players I have tested were able to play right through wedge thicknesses of 800 microns and through dust specks having maximum diameters of 600 microns. A very few machines were even able to play right through all of the defects (up to 900 microns on the wedge and 800 microns for the black dust dots). The Sears CD player was unable to track the wedge when it was only 500-microns wide, and it failed to play through a dust speck 500 microns in diameter. This is the poorest error-correction or tracking capability I have encountered in any CD player tested to date. What it means is that, unless your CDs are absolutely perfect, free of even minute scratches and free of any manufacturing defects or "bubbles" in the surface of the plastic, you may well experience tracking difficulties. To make matters worse, susceptibility to mistracking caused by mechanical shocks applied to the body of the player was not very good either.

#### Use and Listening Tests

Several Compact Discs in my collection already have minor surface scratches. These scratches don't seem to affect playback on my reference CD player, but they immediately presented difficulties to the Sears unit—difficulties that resulted in audible mistracking, muting, and skipping. Since the unit performed perfectly when playing my test discs and when reproducing music from discs known to be free of any minor scratches, I cannot conclude that I was given an atypical sample to test. On the other hand, neither can I conclude that other units of the same model will do as poorly as this one when tracking Compact Discs, since some production variations in tracking ability must surely exist from unit to unit.

As matters stand, it really doesn't matter how good the reproduced sound was when I played mint-condition CDs. The fact is that CDs are not indestructible and, with repeated playing and handling, are likely to become scratched, however superficially. The standards set for CDs by Philips and Sony allow for several sophisticated levels of error correction to take care of such minor defects in discs. Whoever made this unit for Sears, whether by design (in an effort to keep costs down) or for other reasons, has either failed to take full advantage of the error-correction capabilities inherent in the CD format or has come up with an inferior servo-tracking system. Whatever the reason, if I were looking for the right CD player to buy, I would want to think carefully (and, preferably, check several more Sears units) before I opted for this model.

*Leonard Feldman*



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The new 500 CROLYN® High Grade cassette will exceed even *your* high standards. We engineered it for you, the audiophile. We want to hear from you. We challenge you to compare it with the likes of XL-IIS and SA-X. Hear the difference genuine chromium dioxide tape makes versus cobalt-iron oxide imitations or other "chrome equivalent" tapes. Also, ask about 100 Metal HG and Tri-Oxide Ferro HG.

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#### Rating vs. Leading Premium Cassettes

	500 CROLYN® HG
Tape Background Noise	SUPERIOR
S/N, Low Frequency	SUPERIOR
S/N High Frequency	EQUAL
Dynamic Range	SUPERIOR
Frequency Response	EQUAL
Shell Quality	EQUAL
Overall Listening Quality	SUPERIOR

Specific test results available on request. For free cassette offer, technical information or the PDMagnetics dealer serving your area, write us at address below.

## PDMagnetics

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\*Offer expires July 30, 1984.

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# EQUIPMENT PROFILE

# 4

## SANYO DAD 8 COMPACT DISC PLAYER

### Manufacturer's Specifications

**Frequency Response:** 5 Hz to 20 kHz.

**Dynamic Range:** Greater than 90 dB.

**Channel Separation:** 90 dB at 1 kHz.

**Harmonic Distortion:** 0.006% at 1 kHz.

**Output Level:** 1.4 V.

**Headphone Output:** 15 mW at 8 ohms.

**Number of Programmable Selections:** 16.

**Power Consumption:** 35 watts.

**Dimensions:** 13¼ in. (33.5 cm) W × 5½ in. (14 cm) H × 10⅞ in. (27 cm) D.

**Weight:** 15 lbs. (6.8 kg).

**Price:** \$699.95.

**Company Address:** 1200 West Artesia Blvd., Compton, Cal. 90220.

For literature, circle No. 92



Sanyo has chosen to configure their first CD player as a front-loading machine with a hinged door which swings open to accept the disc. An automatic loading mechanism then closes the door, orienting the disc vertically for playing. The player features one of the most elaborate display arrangements I have encountered in any CD player to date. A real-time counter display can be set to show the time from

the beginning of a given musical selection, or total time elapsed from the beginning of the disc being played. "Multi Display" readout shows "Music No." (track number) and either "Index No.," "Next No." (when multiple selections have been programmed for sequential play), or "Program No." Up to 16 selections may be programmed into the memory of the DAD 8, so you can listen to that many tracks

If noise, hum and distortion turn you off, turn on Sansui's new AU-D77X\* integrated amplifier for pure, true sound.

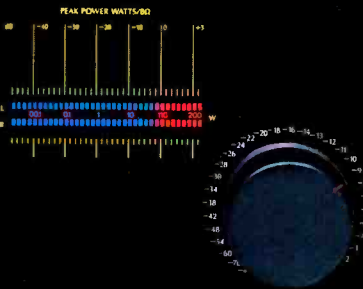
Only Sansui offers a trio of exclusive noise-eliminating innovations.

First, the unique Super Feed-forward DC power amplifier system routs virtually all types of distortion at all frequencies in the power amplifier.

Then, DD/DC circuitry, another Sansui breakthrough, produces high speed response and unmeasurable TIM in the predriver stage of the power amp.

And finally, Sansui's latest contribution to silent performance, the newly developed Ground Free circuit that substantially reduces Interface Hum Distortion (IHM) in the output, driver and pre-amp stages of the amplifier.

The result is clean, uncluttered music—virtually free of noise, hum and



Sansui's new GF amplifiers depart from the conventional to assure inaudible distortion even at the highest level of sound.

distortion. (You also get this impeccable performance with Sansui's 130-watt\* top-of-the-line AU-D11 MK II integrated amp.)

One outstanding performer deserves another. The TU-S77X tuner adds a new dimension to the state-of-the-art. Its new FM multiplex decoder improves channel separation and reduces distortion significantly. Also available is the TU-S77AMX tuner which automatically receives and switches to every approved AM stereo broadcast system.

The AU-D77X and TU-S77X make the perfect tuner/amp combination for people who appreciate great technology as much as they enjoy the silence in great sound. Get the "Silent Treatment" at your Sansui audio specialist, or write: SANSUI ELECTRONICS CORPORATION, Lyndhurst, NJ 07071; Carson, CA 90746 Sansui Electric Co., Ltd., Tokyo, Japan

# THE SILENT TREATMENT

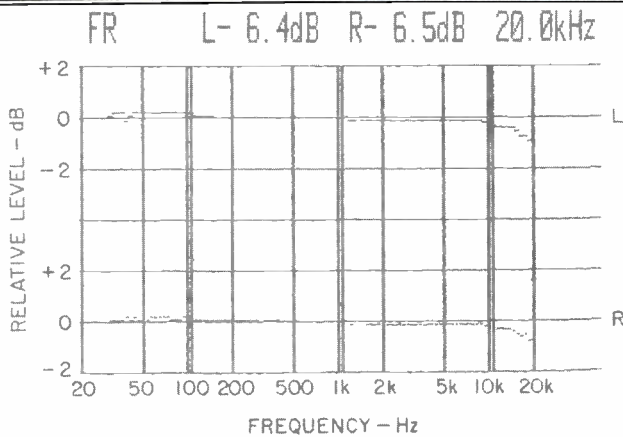


*Putting More Pleasure in Sound*

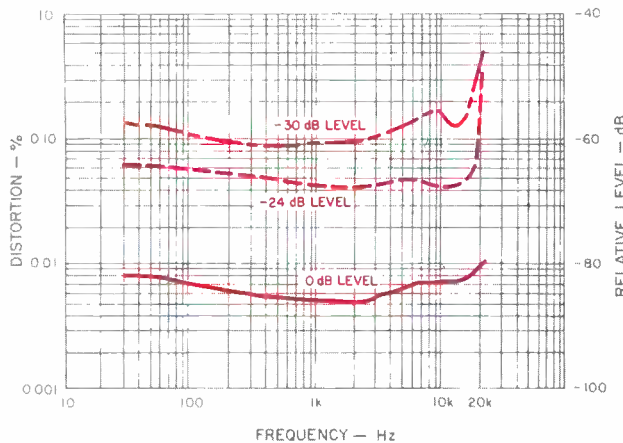
**Sansui**

\*AU-D77X—110 watts, 0.0028% THD; AU-D11 MK II—130 watts, 0.0025% THD. Minimum RMS, both channels driven into 8 ohms, from 10-20kHz.

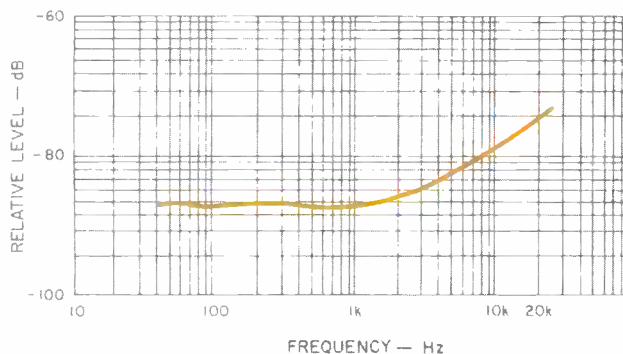
The DAD 8 features one of the most elaborate display arrangements I've yet seen in a CD player, with digital readouts for time and selection.



**Fig. 1—Frequency response, left (top) and right channels, at 0-dB (maximum) level.**



**Fig. 2—THD vs. frequency at levels of (top to bottom) -30, -24 and 0 dB.**



**Fig. 3—Channel separation vs. frequency.**

(or track and index combinations) in any order you choose. There is also a repeat-play function.

### Control Layout

The power on/off button is at the upper left corner of the front panel, near the disc-compartment door which occupies fully one-half the panel's width. The "Real Time Counter" and "Multi Display" readouts are just to the right of the disc door, one above the other. The "Multi Display" mode is indicated by three labelled LEDs just below the readout, for use in setting up selection programs. Ten numeric keys, used for programming track and index numbers, are just below the displays.

At the top of the right-most section of the panel are the "Open/Close" touch button, which controls the door, and two more buttons which set the real-time counter to display either the time from the start of the current selection or total time from the beginning of the disc. Below are the main function controls: "Back Access" and "Fwd Access" (which move the laser pickup back to the start of the current selection or ahead to the start of the next one), plus the standard "Play," fast reverse, fast forward, "Repeat," "Stop" and "Pause" functions.

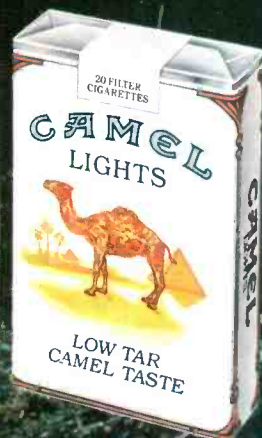
Pushbuttons associated with programming are located at the lower right of the front panel. The "Memory" switch stores selected program or index numbers and recalls memorized selections in the order in which they are to be played, "Memory Clear" removes memorized selections (one at a time), "Program Clear" erases an entire memorized programming sequence, "Recall" will call up program contents in reverse order (from last to first), and "Program Play" initiates play of programmed selections. Also located in this area of the panel are a "Program Write/Display" button (which selects the mode for the multi-purpose display), a stereo headphone jack, and a headphone output-level control. The rear panel of the DAD 8 is equipped with a single pair of stereo output jacks. This unit does not have an overall output-level control.

### Measurements

Figure 1 shows measured frequency response for both left and right channels of this Sanyo player. Evidently, in the sample I tested, the multi-pole, low-pass filter component tolerances were a bit off, for, as the notation above the response plots shows, response at 20 kHz was down 6.4 dB for the left channel and -6.5 dB for the right. Note, however, that at the spot frequency just below 20 kHz (which happens to be 18.5 kHz on my test instrument), response was down a little less than 1 dB.

Harmonic distortion at mid-frequencies, for a maximum recorded level, measured 0.0055%, rising to 0.008% at 41 Hz (the lowest continuous test frequency on the Philips test disc) and to a comparatively high 0.1% at the highest test frequency available (19,997 Hz). The relative distortion levels remained the same at lower recorded levels. As shown in Fig. 2, distortion measured 0.045% at mid-frequencies for a -24 dB recorded level, rising to 0.065% at 41 Hz and 0.35% at the highest test frequency. The distortion versus frequency curve exhibited a consistent shape at the still lower test level of -30 dB below maximum recorded output.

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9 mg  
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**GOODYEAR**

Though Sanyo chose unusual names for track and program numbers, they're as valid as other terms used. I just wish manufacturers would get together on this.

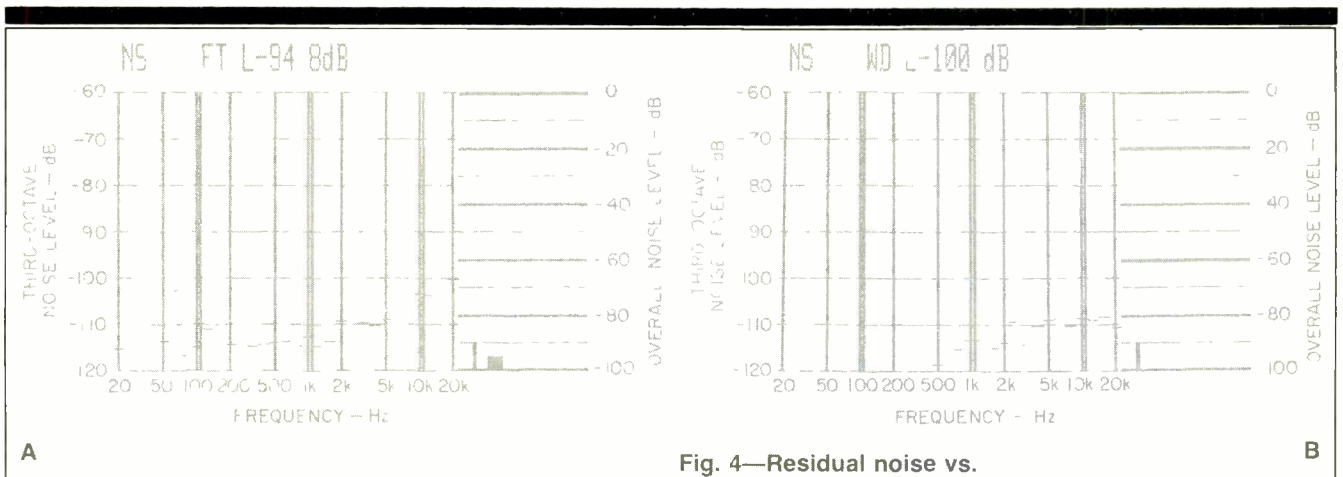


Fig. 4—Residual noise vs. frequency, unweighted (A) and A-weighted (B).

Output linearity was accurate to within 0.2 dB from maximum output level down to -60 dB, and within 1 dB down to well below -80 dB. Stereo separation (Fig. 3) ranged from 86 dB at mid-frequencies to 73 dB at the high-frequency extremes. SMPTE-IM distortion was a very low 0.0025% at 0-dB output level, increasing to 0.03% at a -20 dB recording level.

Plots of residual noise were made using the facilities of my Sound Technology 1500A tester. Results for both unweighted and weighted S/N are shown in Figs. 4A and 4B. Overall unweighted S/N was 94.8 dB; using an A-weighting network, S/N measured exactly 100 dB below maximum recorded level.

Examination of a reproduced 1-kHz square wave (Fig. 5) and a unit pulse (Fig. 6) reveals that Sanyo uses an analog multi-pole filter after D/A conversion, as opposed to a digital filter. This is the same approach followed by many manufacturers (including Sony, Hitachi, Sharp, and Toshiba). Phase relationships between the 2-kHz left-channel signal and the 20-kHz right-channel signal shown in Fig. 7 are typical of those obtained for other CD players employing this type of filtration. Had there been no phase displacement between the two signals, both would cross the zero axis in the same (positive-going) direction at the same time. Here we see a half-cycle error at 20 kHz (about a 25  $\mu$ S delay), but actual error could be higher by a multiple of 360°, for reasons explained in the Sears CD test in this issue.

Using the specially prepared Philips tracking and error-correction disc, I determined that the DAD 8 was able to play through the entire opaque wedge, applied to the disc's surface, which simulates scratches of increasing severity. In other words, the error-correction level built into the DAD 8 was able to correct or substitute for "missing" data that extended over a linear distance of 900 microns or better. On the other hand, confronted with a black dot (simulating dirt particles) of 600-microns diameter, I detected muting of the disc's program material. As for the fingerprint-smudge simulation, the player's tracking system and pickup were able to ignore it entirely.

#### Use and Listening Tests

The Sanyo DAD 8 has excellent programming capabilities and offers rapid access to any desired track or index. I

Fig. 5—Reproduction of 1-kHz square wave.

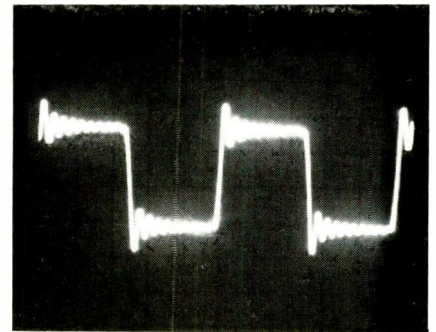


Fig. 6—Single-pulse test.

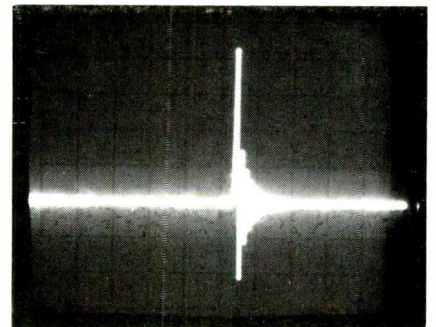
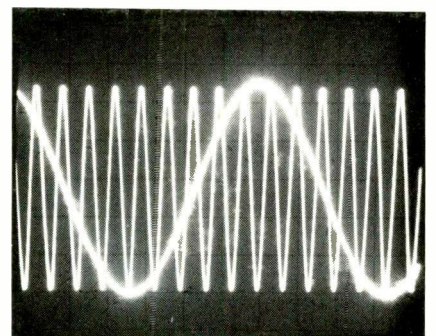


Fig. 7—Phase linearity test, 2- and 20-kHz signals.



# Most high-quality tonearms are oversized and overpriced.

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Take a good look at those high-priced separate tonearms and you'll find most of them are designed to solve problems they created for themselves.

After all, every tonearm has the same essential job to do: let the stylus function as intended. Specifically: track the groove accurately, bring the tonearm along as the groove spirals inward from lead-in to run-out, and leave no trace of its passage on the groove.

To do that job well, a tonearm needs the right geometry, perfect balance, precise and stable settings for tracking force and anti-skating, extremely low bearing friction, and immunity to resonance and external shock.

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□ The straight-line tube that made everyone else go straight. (It's made of Dual's own XM300 aluminum and magnesium alloy—the best material on any tonearm for low mass, rigidity and self-damping.)

□ The entire tonearm perfectly balanced in all planes, and suspended within a four-point gimbal on ultra-low-friction bearings made and polished to aerospace standards.

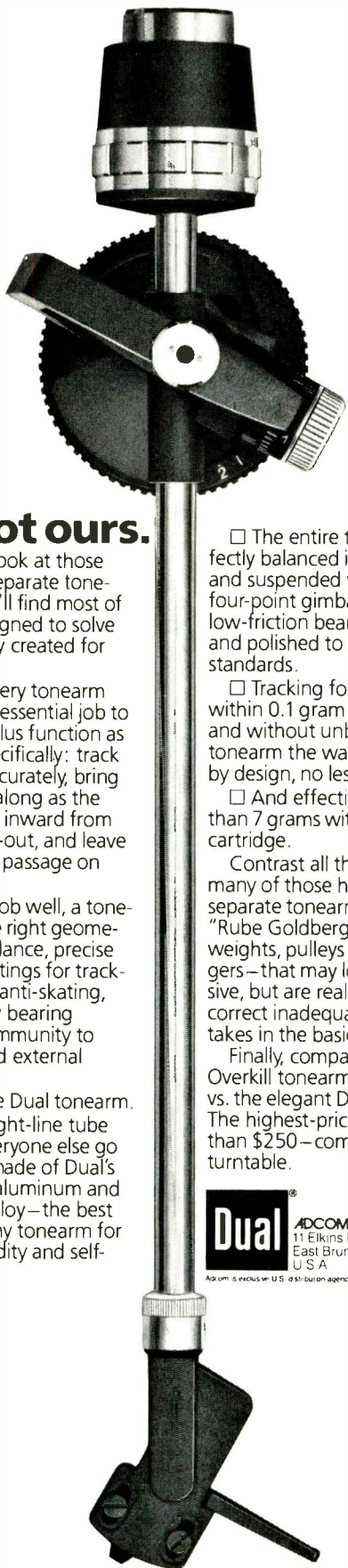
□ Tracking force applied within 0.1 gram tolerances, and without unbalancing the tonearm the way others do—by design, no less!

□ And effective mass less than 7 grams with the ULM™ cartridge.

Contrast all this with so many of those highly-touted separate tonearms with their "Rube Goldberg" gizmos—weights, pulleys and outriggers—that may look impressive, but are really there to correct inadequacies or mistakes in the basic design.

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I don't find steep-analog, post D/A filters objectionable, but I can now clearly discern the difference in sound between this type and digital filtering.

would hope that, sooner or later, some standards of nomenclature will be set up for CD players and discs. I found it a bit confusing, at first, that Sanyo refers to what I (and others) have been calling a "track number" as a "music number." Adding a bit more to the confusion is Sanyo's referring to the programmed selections as "program number," which many might interpret as meaning track number as well. In other words, Sanyo calls the individual musical selections found on a disc "music numbers," while the sequence of programmed instructions you, the user, feed into memory are designated by Sanyo as "program numbers." I can't fault Sanyo for choosing such designations; they're probably as valid as some of the other descriptive terms that have been used. I simply wish that all manufacturers would get together on what to call these items. About the only one that everyone seems agreed upon is "index," the subdivision within a track ("music program"?) that is digitally identified in only a few of the currently available CDs.

The Sanyo player did well in its ability to withstand minor shocks or tapping of the surface while maintaining proper tracking. Sound quality was not substantially different from that observed with other CD players employing steep-analog, post-D/A filters. While some have criticized this particular circuit approach, I have not found it objectionable, though I can now clearly discern the difference in reproduced sound between players that employ this type of filtering and those that use digital filtering and oversampling.

My disc collection continues to grow, and I was particularly delighted with the way Telarc's CD of Beethoven's Third Piano Concerto (Rudolf Serkin at the keyboard, with the Boston Symphony conducted by Seiji Ozawa) sounded when played on the Sanyo DAD 8. Other recent additions to my collection which did well were a Philips CD of Schubert's Fourth and Fifth Symphonies (Neville Marriner conducting the Academy of St. Martin-in-the-Fields Orchestra) and a CBS Masterworks recording of the late Glenn Gould playing Bach's *Goldberg Variations*. Needless to say, all three of these recordings are "digital" from start to finish, as opposed to many CDs in my collection which are remakes of recordings from analog open-reel master tapes. I have nothing against transferring musically worthy performances from analog master tapes to Compact Discs (the results are usually better than what could be obtained in an LP version), but I feel that I am better able to distinguish minor differences between CD players when the source material is digital all the way through.

To sum it all up, the Sanyo DAD 8 has a great deal of programming versatility and flexibility. Its front-panel functions are easy to understand and use once you read the owner's manual through at least once (it's only 10 pages in length, counting the front cover and the published specification page). Sound quality is much like that of other players using similar circuitry. I liked the fact that it is necessary to touch the "Open/Close" button to load a disc into the compartment drawer, for I've always been somewhat intimidated by those mechanisms which just about grab the disc out of your hand and swallow it up inside the door, ready or not. Sanyo's approach to disc loading is a bit less frenetic and more reasonable, in my opinion. *Leonard Feldman*





C37-7001 BEETHOVEN SYMPHONY NO. 5 in C Minor, Op. 67  
Otmar SUITNER conducting  
STAATSKAPELLE BERLIN



38C37-7026 HANDEL TRIO SONATAS  
Heinz HOLLIGER, oboe  
KLAUS THUNEMANN, bassoon YOSHIO NAGASHIMA, contrabass  
CHRISTIANE JACOTTEY, harpsichord and Impresario of L'Essor continuo



C37-7003 MOZART STRING QUARTET  
NO. 17 in B Flat Major, KV 458 "HUNTING"  
NO. 15 in D Minor, KV 421  
SMETANA QUARTET



C37-7004 DIE GROSSE SILBERMANNORGEL  
DES DOMES ZU FREIBERG  
J.S. BACH  
Hans OTTO, organ



38C37-7011 BEETHOVEN SYMPHONY NO. 3  
"EREOICA" in E Flat Major, Op. 55  
Otmar SUITNER conducting  
STAATSKAPELLE BERLIN



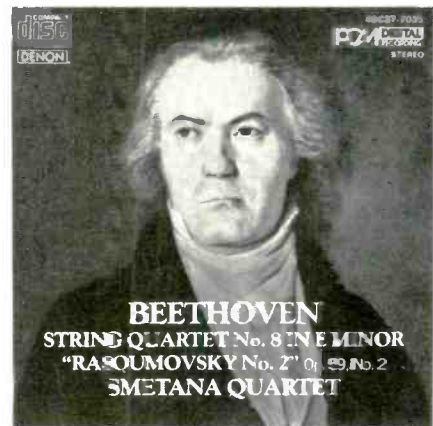
38C37-7013 ANTONIO VIVALDI: THE FOUR SEASONS  
Gunnars LARSENS violin  
Rudolf BAUMGARTNER: direction  
FESTIVAL STRINGS LUCERNE

**DENON REFERENCE  
COMPACT DISCS.**

**MAKE  
THESE  
YOUR  
FIRST  
CD'S.**



38C37-7032 BEETHOVEN NO. 7 in A Major, Op. 92  
Otmar SUITNER conducting  
STAATSKAPELLE BERLIN



38C37-7033 BEETHOVEN STRING QUARTET NO. 8  
in E Minor, Op. 59, NO. 2  
RASOUMOVSKY NO. 2  
SMETANA QUARTET

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## EUTAXIC EURYTHMICS

**Sweet Dreams (Are Made of This):**  
Eurythmics  
RCA PCD1-4681.

This is an extraordinary pop album in both technical and musical terms, and it is a treasurable CD. The Eurythmics, vocalist Annie Lennox and synthesizer whiz David Stewart, together write and create hypnotic technopop songs of startling intensity. These songs are complex sound paintings in which Lennox's unique voice travels from fore- to background within shifting vistas of synthesizers, acoustic instruments, and special effects that include the sounds of subways and seashores.

The original LP was beautifully produced and engineered by Stewart, Adam Williams, and R. Crash. However, the CD version is better still. In comparative A-B listening, the CD recording presents a wider dynamic range, eliminating a slight sense of compression found in the original. This, coupled with the total lack of surface noise, allows even the faintest ping of a chime to maintain its character among crashing banks of synthesizers and percussion.

*Sweet Dreams* contains 10 examples and 40 minutes of sophisticated, inventive music-making and recording. Reverberation and double-tracking are used not only to enrich Lennox's voice, but to add riveting contrapuntal vocal passages as well. A truly effective technique Stewart uses often, but not to excess, is to build layer upon layer of instrumentation, deftly blending these layers into a complex whole, and then whisking the whole into oblivion.

"The Walk," an ominous rhythmic number suggesting alienation and failed love, is less well-known than this album's two hits, "Love Is a Stranger" and the title song, but it is a clearer example of this particular technique. The sound of a rising wind opens this cut and is swiftly overlaid with synthesized bass, percussion, chime accents, and swelling keyboard-synthesized strings. Lennox's sinuous voice slides snakelike over the instrumentals. A vocal backdrop is added, a weave of male voices and Lennox double-tracked. By the first refrain of the chorus "Step away—walk away," the golden voice of a muted trumpet cuts into the whole, followed by some subtle



Illustration: Rick Tulka

acoustic piano work. This mass of sound is suddenly, electronically, sucked into silence, leaving only a skeleton of vocals, drum, and one maracas-like percussion instrument to deliver the next "Step away" chorus. It is terrifically effective.

The CD's crystalline reproduction permits each instrument to come through with real definition, no matter how faint or how deeply buried in the mix it is. There is a palpable feeling of depth, a real spatial presence, and an invigorating sense of movement from channel to channel and from fore- to background.

The Eurythmics are a savvy, talented, thoroughly modern duo. They use the full gamut of electronic wizardry to reshape basic pop forms. They rarely repeat themselves without an interesting variation on their basic theme. This CD is endlessly entertaining, a sonic delight, and a must for your collection.

*Paulette Weiss*

**Living in Oz:** Rick Springfield  
RCA PCD1-4660.

Rick Springfield's third RCA offering, *Living in Oz*, is yeoman commercial rock. Not that it isn't pleasant; there are some attractive rock tunes (the reg-

gae-inflected "Alyson"), some poignant lyrics ("Me & Johnny"), and even one cut with both moving and unusual subject matter plus unique all-acoustic string instrumentation ("Like Father, Like Son"). There are some sonically intriguing special effects included as well, and the overall production is quite good. Still, this CD doesn't qualify as a prime choice for your collection.

Acting as his own producer, along with Bill Drescher, Springfield has weakened some fine arrangements by presenting chunks of each selection in a single aural plane. He repeatedly opts for a rock-symphonic blend of massed instruments that provides no sense of depth. Although his vocals have moments in the foreground, they are often pulled back into the mass of sound. When this occurs, these massed vocals and instrumentals are concentrated in the phantom center channel, further limiting any sense of spaciousness.

When instruments are permitted to make their presence felt cleanly in space, as in the beautiful guitar and chimes figure in the title song, in segments of "Me & Johnny" where the guitar is firmly located in the left channel, and in the startling, often innovative introductory passages of almost

Today's Chevrolet

# Welcome aboard Starship Camaro.

**Camaro Berlinetta** Climb in. Buckle up. Adjust the retractable, touch-sensitive instrument pods so your hands never have to leave the wheel to control vital functions. Turn the key and watch the system monitor perform seven preflight tests as the engine sparks to life. Blip the throttle and watch the vacuum-fluorescent tach dance to the rhythm of your right foot.

To orchestrate your voyage, dial up a symphony on the pivoting, pod-style Delco AM/FM stereo with vacuum-fluorescent display and optional graphic equalizer. (Radio may be deleted for credit.)

Now, put it in gear, give it some gas and watch the digital speedometer numbers multiply. Your journey has begun.



Let's get it together...buckle up.



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taking charge

# Great Lies of Hi-Fi

## #2

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every cut, the recording shows moments of production brilliance—in marked contrast to the uninspired handling of the rest. Several extraordinary aural grabbers here—the crystalline tinkling of wind chimes coupled with what sounds like water running over bamboo sticks which introduces "The Human Touch" and the faint street sounds of a wailing siren and a dog barking, cut sharply by the slam of a door and a human sigh that begins "Souls"—can't quite compensate for the grandiose orchestrated electronics that mar the album.

One notable exception to all this is "Like Father, Like Son," which is outstanding for several reasons. It breaks the pattern of the great rock-orchestral mass of sound characteristic of the other nine cuts. Springfield's vocals are clearly defined in the foreground over a simple, dramatic string accompaniment which was arranged by Springfield, John Philip Shenale, and Tom Scott. Springfield's reading of this poignant song about the succession of generations is truly expressive. "Like Father" exposes his gift for dramatic vocal interpretation, a talent mostly obscured in the great wash of sound which dominates the other selections.

The CD version offers little improvement over the LP recording. RCA's original disc surfaces are quite clean, so unless you are an avid Rick Springfield fan and must own a copy of *Living in Oz* that you can listen to in unscratched purity for many years to come, buy the LP and pocket the difference for the trip back to Kansas.

*Paulette Weiss*

#### **Darn That Dream RealTime RT 3009.**

The jazz quintet on this recording has some well-known players—Art Pepper on alto sax, Joe Farrell on tenor sax, and John Dentz on drums. The group is rounded out with George Cables on acoustic piano and Tony Dumas on acoustic bass.

This is a typical studio recording with somewhat dry acoustics. The quintet plays such numbers as the title song, "Sweet Lorraine," "Who Can I Turn To," and several lesser-known pieces.

While this is not pure avant-garde jazz, there is little reference to melodic



*Rick Springfield*

lines and quite a bit of virtuosic noodling to showcase the talents of the players.

A nice, clean, open recording with a lot of presence. The jazz here may be a bit too progressive for most tastes, but it will please aficionados of this kind of music.

*Bert Whyte*

**Gershwin: Rhapsody in Blue, An American in Paris.** The Cincinnati Symphony Orchestra, Erich Kunzel; Eugene List, piano.  
**Telarc CD-80058.**

Eugene List became famous during World War II, when he played piano for Truman, Churchill and Stalin at the Potsdam Conference. He has long been associated with "Rhapsody in Blue," having played it countless times the world over. In the early '50s, the late Bob Fine was making a mono recording of List playing "Rhapsody in Blue" with the Eastman-Rochester Orchestra. I was making a stereo recording at the same time, but, unfortunately, the tapes have been lost.

You might say Eugene List almost "owns" "Rhapsody in Blue," so close is his identification with it. Which is why it is all the more strange, that while his performance here is good, it seems to lack the excitement his readings of this work have generated in the past. Some of the snap and sparkle is missing. Perhaps my memory of the Eastman performance is coloring my opinion, but I particularly remember the rhythmic drive and propulsive energy he displayed. In any case, enrobed in the clean, vibrant Telarc sound, this is still one of the better "Rhapsody in Blue" recordings available.

The "American in Paris" fares quite well under the baton of Erich Kunzel,

# The New York Times

## Reviews the New Ohm Walsh 4

**A**nother classic reappearing in new guise is the radically unconventional loudspeaker designed about a decade back by the late Lincoln Walsh, a California physicist who had done pioneering work in sound reproduction. His patents were acquired by Ohm Acoustics Corporation of Brooklyn, N.Y., resulting in the Ohm Walsh 2 loudspeaker, which at \$750 per pair remains one of the best buys among omnidirectional models.

In its effort to make a speaker affordable for the majority of listeners, Ohm had stopped short of producing what might be called the ultimate design based on the Walsh principle. It has now at last gone all the way with the new Ohm Walsh 4, which boasts all the notable virtues of the earlier model but extends the bass to 32 Hertz. This allows it to conjure up with almost tactile impact the deep shudder of a low C played on an organ pedal or the wallop of a bass drum. With a stupendous power capacity of 500 watts, the Ohm Walsh 4 accommodates with apparent ease even the most hair-raising sonic peaks contained on the new laser disks. It is doubtful whether such generous power limits will ever be reached in normal listening. The point is that full concert volume can be reached comfortably by this speaker even in the most spacious setting, assuming of course that it is driven by a sufficiently strong-muscled amplifier.

The basic notion of Lincoln Walsh utilized in this design involved an upright, pyramidal cone open to all sides that radiates sound in all directions and upward toward the ceiling. As is the case with other omnidirectional speakers, this creates a remarkably open and spacious sound. At the same time, the unique pattern of wave propagation along the surface of the cone maintains crucial phase relationships throughout the audible spectrum, accounting for the remarkable clarity of sound. Thanks to an auxiliary directional tweeter, very precise stereo imaging is obtained despite the omnidirectional sound spread. In effect, this speaker reconciles the usually contradictory aspects of frontal radiation and omnidirectional sound, yielding an uncommon degree of musical truthfulness. And the price of \$1,500 per pair might not deter listeners who recognize a classic.



The Ohm Walsh 4 accommodates with apparent ease even the most hair-raising sonic peaks contained on the new laser disks.

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Eduardo Mata lacks the Gallic sensibility necessary for the essentially French music of Ravel.



Eduardo Mata

with a spirited, lively performance and a sound of outstanding clarity and good balances. Brass sound is particularly good, as is the thumping power of a great bass drum. The raucous "Paris taxi horns" also deserve a special mention.

Bert Whyte

This set is probably the only version on CD, and is likely to be the best available for some time. The sound is live and natural, reflecting the best that a simple, two-omnidirectional mike approach can give.

John M. Eargle

**Haydn/Hummel: The Classic Trumpet Concerti.** The Y Chamber Symphony of New York, Gerard Schwarz. Delos D/CD 3001.

This welcome CD is from the very first digital recordings made by Delos some four or five years ago. At that time, Schwarz was still one of the best trumpet virtuosos around. He hadn't yet put his trumpet away for good, and he was in superb form. But our loss of a trumpeter is our gain of a conductor.

Both concertos are given spirited performances, and Schwarz's playing is entirely effortless. His cadenza in the Haydn is breathtaking, both in intricacy and in execution.

**Ravel: Bolero, Alborada del gracioso, Rhapsodie espagnole.** The Dallas Symphony Orchestra, Eduardo Mata. RCA RCD1-4438.

The problem is this music is French, not Spanish. Mata lacks the Gallic sensibility abounding, for example, in the Dutoit/Montreal recordings of these works. But matters of style apart, the Dallas ensemble plays beautifully.

The basic pickup of the orchestra is superb, and the general feeling of warmth and ambience is just fine—until the music stops. The artificial reverberation added during post-processing is all wrong. It is too long, and it is too colored. There is absolutely nothing wrong with tasteful use of any

signal processor which will correct a problem. But when there are perfectly natural sound reverberators around, why settle for anything less? If this major problem were corrected, these would be exemplary sonic examples.

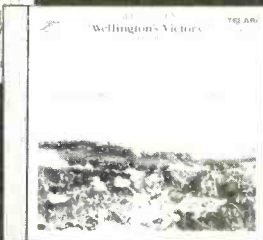
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John M. Eargle

**Schubert: The Trout.** The Cleveland Quartet; Alfred Brendel, piano. Philips 400 078-2.

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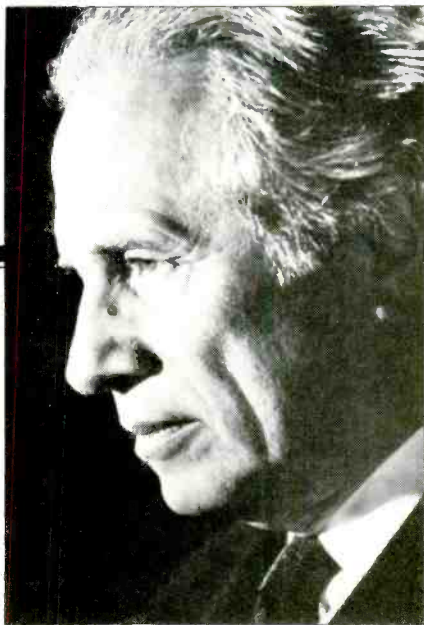
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Antal Dorati

The piano sound is very clean and highly articulate. There is a snag, however. Perhaps in their desire to show off the virtuosity of Alfred Brendel, the Philips engineers have overbalanced the recording. The piano is too prominent, projected too far forward, and the sound of the quartet is recessed and attenuated. Inner detail simply does not emerge, and the continuing imbalance makes it most difficult to enjoy the fine performance. *Bert Whyte*

**Richard Strauss: Don Juan, Till Eulenspiegel, Death and Transfiguration.** The Detroit Symphony Orchestra, Antal Dorati.  
London 400 085-2.

This is another masterpiece from Jim Lock of London's recording team. As usual, Jim's balances between hall acoustics and orchestral detail are near ideal. There is a wide stage image and realistic depth perspective. Dynamic range is very wide. In fact, the "death moment" in "Death and Transfiguration," an explosive outburst from bass trombones and tuba of tremendous sonority, will give you quite a start. String sound is clean and bright but not edgy. Brass is especially brazen and well projected.

Dorati has done wonders for the Detroit Symphony, whose playing here, especially in "Death and Transfiguration," is notable for good execution and expressiveness. Dorati has always had success with the music of Richard Strauss, and his performances of "Don Juan" and "Till Eulenspiegel" are excellent, while his "Death and Transfiguration" ranks as one of the best available. *Bert Whyte*

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# ROCK/POP RECORDINGS

MICHAEL TEARSON  
JON & SALLY TIVEN

## ANKLE BITERS



Illustration: Rick Tulka

**Learning to Crawl:** The Pretenders  
Sire 23980-1, \$8.98.

Sound: B Performance: A-

The album's title is said to refer to the daughter of lead Pretender Chrissie Hynde and chief Kink Ray Davies. But it reflects on the band as well, for The Pretenders have had to survive the departure and sudden deaths of two members, first James Honeyman-Scott and then Pete Farndon.

As a memorial, The Pretenders released an interim single. Both sides are included here, a year after release. The A side, "Back on the Chain Gang," had first appeared in the film soundtrack of *The King of Comedy*. The bittersweet song has a glorious melody. It is both memorable and durable, one of Chrissie's best. The flip, "My City Was Gone," tells of a prodigal's return to Ohio only to find the whole place paved over. A tough, funky beat, lifted from The Talking Heads version of "Take Me to the River," propels the song. Guest Pretenders were Tony Butler and former Rockpiller Billy Bremner. Recorded about this time as well was a remake of a Persuaders' ballad, "Thin Line Between Love and Hate." Bremner, joined by Andrew Bodnar and Paul Carrack, is on this one.

The rest of the album introduces new Pretenders Robbie McIntosh and Malcolm Foster, who join Martin Chambers' steady drums and the charismatic Chrissie Hynde out front on voice and guitar.

Most of the new songs are pretty

classy, even if they cover familiar ground. "2000 Miles" is a lovely Christmas song in flowing 6/8 time. "Thumbalina" dusts off some licks from Chuck Berry's "You Can't Catch Me" to tell a kids-on-the-road story. "Middle of the Road" is a rocker aimed squarely at radio's gut, with a structure like Dobbie Gray's "In Crowd." "Time the Avenger" swipes the guitar riff that sparked The Outsiders' "Time Won't Let Me." The result is a mutated update with rocket drive.

That leaves only three songs as lesser lights: The giggly rocker "Watching the Clothes," the thumping "I Hurt You," and the pretty "Show Me," which recycles the melody of Chrissie's "Kid."

The Pretenders have survived a treacherous retrenching with a terrific, if transitional, album. Chris Thomas' valuable hand as producer is an important catalyst.

Funny, this release feels more like a collection of unrelated songs than an album, but so did The Beatles' *Yesterday ... and Today*, which is as much fun to listen to now as it was on release over 15 years ago. *Learning to Crawl* feels like it will age just as well.

Michael Tearson

**Colour By Numbers:** Culture Club  
Virgin/Epic QE 39107.

Sound: C+ Performance: B-

The slick, latter-day Motown stylings of Culture Club and its very visible leader/frontman Boy George have

completely seduced America, if four hits from a debut album are any indication. And it usually is.

I'll say this: Their success caught me totally by surprise, since their first album basically left me unmoved—that is, until those hit songs got rubbed into my genetic code through unavoidable repetition. The second album, *Colour By Numbers*, looks poised to repeat that success.

If anything, what is most impressive about this album is the fresh confidence that exudes from it; finding out one's concept really does turn vinyl into precious metal will do that. Boy George and cohorts deliver some very attractive new sides here. Preceding the album, one of them, "Church of the Poison Mind," appeared as a single, and was the best Culture Club song yet. Along with an insistent, urgent Smokey Robinson and The Miracles groove, it introduced Helen Terry's vocals to the stew. After this single Ms. Terry joined the band, and she sings on most tracks here. "Church" is still

### Culture Club





an obvious standout, but the album follows its lead with a silky sound which ranges from the ersatz Motown of "Church" to gently moving modern sounds. They are always smooth, never obtrusive, and thus almost annoyingly polite.

Attractive as their music is, Culture Club still leaves me cold most of the time. I can enjoy their stuff while I'm doing other things, like housework, but it'll never get mistaken here for genius. Aren't hit songs enough?

Michael Tearson

**Alive She Cried:** The Doors  
Elektra 60269-1, \$8.98.

Sound: B Performance: A

A fellow has to be suspicious of an album of previously unreleased live performances from 1968-70. However, these are performances by The Doors, and the disc adds to their brief legacy, especially since no songs included in the previous live album, the double-pocket *Absolutely Live*, were included here, no matter how mutated. Most importantly, this release gives a good chance to observe the late Jim Morrison at work and play.

For me, the biggest surprise is the sound quality, which is clear and present enough to put *Absolutely Live* to shame. In fact, it is so good I must ask how much studio doctoring of the tapes has been done. The question goes unanswered, either in credits or liner notes, but that does not detract from how much I like this album.

Track selection is fascinating. There are two songs which had never before been on a Doors album, and both are strong. For the blues "Little Red Rooster," John Sebastian sits in on harmonica, and the song is played appropriately low-down. Van Morrison's "Gloria" is a stunner. It comes from a sound check when the band was playing only for themselves and shows an added exuberance.

Jim Morrison, poet, surfaces in three separate places. "Horse Latitudes" finds its way into the middle of "Moonlight Drive," just as Jim's "Graveyard Poem" is worked into the middle of an extended "Light My Fire." "Texas Radio and The Big Beat" here is a spoken version which predates the song on



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With *Cage the Songbird*, Crystal Gayle has made the leap to pure pop singer. And she is very good, too.



Crystal Gayle

**Cage the Songbird:** Crystal Gayle  
Warner Bros. 23958, \$8.98.

Sound: B- Performance: B

This is no country album. Crystal Gayle has made the leap to pure pop singer. And she is very good, too.

*Cage the Songbird* ranges from attractive, medium rock ("The Sound of Goodbye") to the wistful closing song, "Take Me Home," which Crystal Gayle first sang from Tom Waits' songs for the film *One from the Heart*. This is an album of smooth and varied textures and excellent song choices. The title song, which comes from the Elton John songbook, obviously is one that means a lot to Crystal, for she dedicates it to Edith Piaf and really gets emotional doing this number, hitting some lovely and clear high notes.

Some of the arrangements are a bit strained, like that of Rodney Crowell's "Victim or a Fool" which takes the song a tad too fast and forces Crystal to gloss the emotional content to keep the tempo. Further, the strings really blunt this song.

But what is most important here is that Crystal Gayle is a wonderful singer with superlative diction. Her diction is so good that it, too, can get between her and a song's core, but such occasions are rare here. To get to *Cage the Songbird*, Crystal Gayle has grown a lot.

Michael Tearson

**White Shoes:** Emmylou Harris  
Warner Bros. 23961, \$8.98

Sound: B- Performance: B+

*White Shoes* has turned out to be that rock 'n' roll album Emmylou Harris has been threatening to do for years. It demonstrates an important lesson: The drummer is absolutely critical in determining the style of an arrangement.

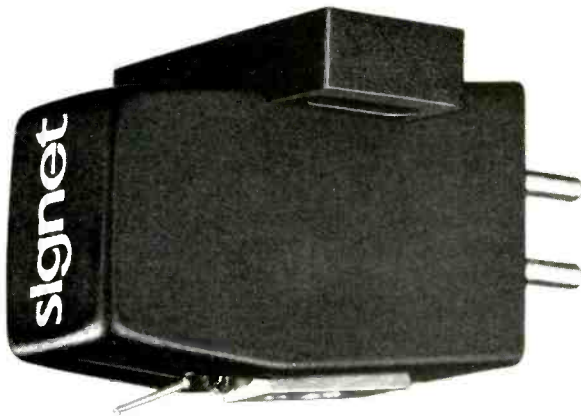
the *L.A. Woman* album by two years. Taken from a long-lost Danish video, it segues into "Love Me Two Times." "You Make Me Real" completes the set.

What is revealed anew is The Doors' restless penchant for rearranging their material in live performance from the

studio versions. This had to have helped keep them fresh and interested.

*Alive She Cried* is clearly an album for The Doors aficionado. I really don't think it is intended to win over any new converts. It constitutes a noteworthy addition of unexpectedly fine quality, and that's plenty. Michael Tearson

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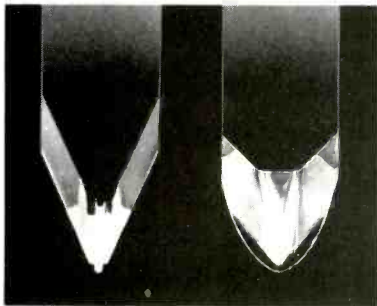
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Consider the lead song on side two, Rodney Crowell's "It's Only Rock 'N' Roll." Ironically, this is the most country song on the album entirely because of the way Emmylou's long-term drummer, John Ware, plays it. For the rest of the side, former Doobie Brother Keith Knudsen is drummer, and the difference is slap-in-the-face obvious. The next track is Harris' cover of the T-Bone Burnett arrangement of "Diamonds Are a Girl's Best Friend." Simply by changing the drummer and leaving the rest essentially intact, the sound becomes tougher and harder and not at all country. Just with a sturdier beat. Incidentally, on "Diamonds," Emmylou sings/speaks her most laconic performance on record.

All through this album Emmylou is singing with the abandon and emotion she has only shown on record on last year's *Last Date*, which was recorded live. Even on the ballads she is more aggressive. Take her brave rearrangement of the Donna Summer song "On the Radio," done entirely as a slow song. She really puts a lot into it and neatly pulls it off, too. She won't make you forget the original, but she has brought whole new meaning to the song. Knudsen played drums here, too.

Brian Ahern's production is classy as ever but with a bit of a raw edge that



Emmylou Harris

the material demands. Nobody will mistake *White Shoes* for punk, but spunk it's got. And that is most welcome from the usually reserved Emmylou Harris. *Michael Tearson*

**What Is Beat?:** The English Beat  
**I.R.S. SP 70040, cassette CS 70040,**  
 \$8.98 each.

Sound: B Performance: A

In the summer of '83, The English Beat split into splinters. Thus, this retrospective stands as a monument to what was probably the best ska band to emerge, in 1980, on England's Two Tone label, with their more rocking than reggae beat. The 13 selections on

*What Is Beat?* include just about everything a "best of" album by The Beat should. There are several tracks not available on any previous album, too. Some are singles ("What's Your Best Thing" and "Too Nice to Talk To"), some are extended remixes ("Save It for Later" and "I Confess") and some are live tracks ("Get a Job" and "Stand Down Margaret").

For this release, I strongly recommend the cassette version, which has four bonus tracks at the same price, all of them unavailable elsewhere and all superb. These include U.K. singles, "Psychedelic Rockers" and "Which Side of the Bed," and additional live tracks, "Ranking Full Stop" and "Mirror



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The English Beat, with their more rocking than reggae beat, was probably the best ska band to emerge in England in 1980.

in the Bathroom." The original studio version of "Mirror" also opens the album, so its reappearance as closer of the cassette lends a nice touch. The one shortcoming of the cassette is the relative lack of annotation. Sound is quite comparable to the disc, with successful remastering.

If you already know The English Beat, you'll want this set for what you don't yet have. If you've missed them entirely or only know a few singles, then this is the one to get, for their rocking sound and infectious ska beat can't fail to elicit smiles and tapping feet. *Michael Tearson*



The English Beat

**Mummer:** XTC  
**Virgin V2264, \$10.98.**

Sound: A— Performance: A—

After XTC's disappointing *English Settlement* of last year, we didn't expect a work of such unbridled brilliance and quality as *Mummer*. Finally, just as the group is on the verge of breaking up (drummer Dave Gregory left the band after recording only a few tracks), Andy Partridge has discovered a new sound for XTC that's somewhere in between contemporary New Wave and psychedelic Beatles (à la "Tomorrow Never Knows") and comes up with one of the most progressive New Wave records ever heard. In keeping with this group's spate of luck, their American record company has deemed *Mummer* too noncommercial to be released here. Only the British version is available at present, although it seems unreasonable to expect that no American company has the smarts to acquire it.

The arrangements, as on the last album, mostly favor acoustic rather than electric guitars, but this time the record is far more produced. Mellotrons weave in and out of "Deliver Us from the Elements," and when XTC finally breaks into a familiar rock groove on "Funk Pop a Roil" (the last track on the album), it means something special rather than just being another track. "In Loving Memory of a Name" is one of the best songs The Beatles never



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David Sanborn

David Sanborn's style of saxophone playing has become the sound that most sax players emulate.

wrote, and "Love on a Farmboy's Wages" gives Colin Moulding room to stretch out in his Ronnie Lane-esque way. Suffice it to say that true fans of the group won't be disappointed after several listenings, and those who never got there might be surprised. Also, an import single of "Love on a Farmboy's Wages" has two more recent Partridge compositions which are also excellent.

Andy Partridge has produced an album by an eccentric musical poet, Peter Blegvad, on which he contributed a lot of musical backing that XTC fans should find quite interesting. According to the American record companies, XTC is a closed chapter, but judging by their records, Andy Partridge is only starting to blossom. Stay tuned for further details. *Jon & Sally Tiven*

**Backstreet:** David Sanborn  
Warner Bros. 23906, \$8.98.

Sound: A Performance: A +

If you hear a saxophone on a record these days—be it rock, jazz, or R&B—chances are it's David Sanborn or someone imitating him. He has become the singularly most distinctive and well-liked instrumental voice to emerge in music since the age of the guitar hero. Having done the session-man route for the likes of The Rolling Stones, Bruce Springsteen, David Bowie, James Taylor, Carly Simon—the list is endless—his particular style of saxophone-playing has become the sound that most sax players emulate, either consciously or subconsciously. Just as Chuck Berry created a guitar style that's heard on just about every rock record, and Bernard Purdie created a drummer's vocabulary, Sanborn has created a litany of relationships between notes that has become an integral part of today's music.

He isn't content to rest on his laurels,

and merely because he can rake it in playing on other people's records, doesn't give him an excuse not to make his own records. His latest, *Backstreet*, is a phenomenal combination of popping rhythm tracks and virtuoso soloing that is thoughtful, inspired, and obviously heartfelt. His mu-

sical conspirators—primarily Marcus Miller, Hiram Bullock, and Michael Colina—frame Sanborn's playing in a sonic picture that does him nothing but good. Impeccably recorded, well composed and brilliantly played, this has got to be everybody's instrumental record of the year. *Jon & Sally Tiven*

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### WELL STRUNG

**Beethoven: The Complete String Quartets, Vol. 2; The Middle String Quartets (Op. 59, 74, 95).** The Juilliard String Quartet.

**CBS 13M 37869**, digital, three-record set.

The Juilliard Quartet's Beethoven in this monumental series is generally a pleasure to hear, particularly in the smoothly polished sound and the accuracy of pitch—where, traditionally, a lot of liberties have been taken in earlier times, deliberately and involuntarily. The music is not easy to play. This must be the hardest working foursome around, judging from the perfect agreement among them, playing as one. The personal style of the Juilliard, over the years, is also easily recognizable; groups in this category do indeed develop personalities of their own.

For all of that, the Juilliard is not among the really top quartets, present or past. Even in Beethoven, though their versions of these works must have matured over many years. As we might say, it takes soul to play string quartets, and particularly Beethoven, who requires soul beyond soul! As I hear them, that soul is just not big enough in the Juilliard. Somehow, they sacrifice it to smoothness, accuracy, even a kind of geniality that is, of course, always pleasing in itself. Good reason for their popularity.

How can one tell, in the listening? Well, you *know*, if you have listened enough before. Then, you can sense inner echoes of other performances, somehow filed in memory; the music computer in your own head is busy making thousands, millions of comparisons, from specific single notes to mu-

sical shapes, small and large, to moods, atmosphere, emphasis, drama—though on a first hearing this is naturally impossible. We all have to start somewhere with a first hearing.

The Juilliard tends to play metronomically, with a relatively rigid beat that obscures and neutralizes the telling details of shapes and phrases; they play quite fast, which gives a sense of haste and superficiality, again in comparison with memorable past performance. More seriously, there seems a lack of forcefulness in the first violin, which is somehow distant and hesitant where normally it is the leader.

On the recording side, digital via Sony, familiar arguments arise—for these are deliberately live performances with an audience. The musicians, as expected, are all for it, and understandably. But are we, the ultimate listeners via electronics? CBS has done a skilled job, taking advantage of a famous but sonically chilly chamber-music hall, the Coolidge Auditorium at the Library of Congress. The audience is semi-isolated, the



quartet and the mikes in an inset box of a stage with heavy curtains at the sides and across the top, which keeps the coughs and such to a real minimum. The mikes (see photos in booklet) are hung directly above the players, only a few feet, and I count seven of them, evidently three spaced pairs and one directly overhead. Though some engineers will take offense—seven mikes for four players?—the sound is clean, well balanced and the instrumental tone impeccable, which is the intention, without a doubt.

That is exactly what we hear: A close-up quartet in a dry and smallish space, the stage. And out beyond those curtains, a faint sense of the considerably larger hall itself, also dry, and of its attendant audience.

Not an inspiring effect, but it'll do. Never objectionable. Just accurately dull. The music is what counts. And the fi, digital-quality, with which the strings are recorded.

**Berwald: Septet in B Flat; Prokofiev: Overture on Hebrew Themes; Janacek: Concertino.** Amsterdam Nonet. **Nonesuch 71412, \$5.98.**

The binding element in this slightly diffuse record is the Nonet, in varied mixtures of winds, strings and piano. Good combinations for the recording mike—therefore good listening in a generally classical way. The Dutch are, of all Europeans, the most determinedly classical players.

The major work is by that verbose but delightful unknown Swede, Berwald, who composed his chamber music and symphonies, to no avail (even though he was a friend of Liszt and such), in the middle of the last century. He is a very real composer, though not well organized and given to a lot of Romantic padding. Lovely harmonies, catchy, quirky bits of melody, a feeling of directness and honesty without pretense, are the things that make him so listenable today. He fills side one of this record.

Who's ever heard of Prokofiev's little Hebrew overture? It was one of my favorites decades ago on 78 shellac—and, if I am right, the clarinetist was Benny Goodman, in the days when he was first barging forth into the classics, with Bartok, Mozart, Brahms, et al. This

little 1919 piece was written in New York (for a Jerusalem combo) and its "Hebrew" themes, wherever they came from, will make instant sense to any New Yorker; Benny Goodman, if it was he, had the idea to perfection! You could dance the hora to it. Not these good Dutch burghers! They play "Jewish" like the seven dwarfs in Disneyland, and it is not good. Lumpy is the best word. (There is a later full-orchestra version with three recordings listed in Schwann; I wouldn't trust any of them, myself.)

As for Janacek, he was one of those curious late-blooming Romantics who went right on composing into the time of "modern" music, adapting, as well as they could, to jazz, blats, nose-thumbing and the rest of the anti-Romantic world between the big Wars. Janacek did best, perhaps, in his operas, but his many other works, notably chamber music, are coming back too. This "Concertino" is late, 1924, smack in the middle of the Gershwin era and

the most extreme "modern" music. To us today it sounds what it is, late Romantic, but there are many interesting bits of 1924 in it, even so, once you understand when it was composed—by a man then entering his '70s.

So this is three records in one. At a genuine bargain-basement price, too. Good recording, very recent; an odd acoustic space with a kind of flutter reverb (multiple reflections, no doubt, in the actual hall). I liked that sound though it would look awful on a 'scope or similar.

**P. D. Q. Bach: A Little Nightmare Music, Royal Firewater Music, Octoot.** The N. Y. Pick-Up Ensemble, Prof. Peter Schickele. **Vanguard VSD 79448, \$8.98.**

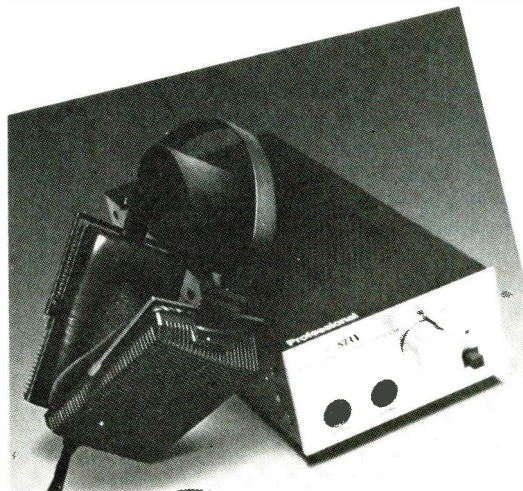
The annual P.D.Q. is here again—or is it more often? The Professor lives on and is creative, in his own zany way. Sometimes the titles, or the texts, are as good as, or even better than, the

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Prof. Peter Schickele (P.D.Q. Bach)

music. This one runs about par for the P.D.Q. course.

The first item, the "Little Nightmare," is an opera ("in one irrevocable act") and, like much of Prof. Schickele's musical material, is designed for the eye as well as the ear. Never mind; this opera is absolutely charming because it is so utterly simple. An excellent—really excellent—performance, note for note, of the Mozart "Kleine Nachtmusik," Little Night Music, upon which is

P.D.Q. Bach's "Little Nightmare" is an opera "in one irrevocable act," and is designed for the eye as well as the ear.

superimposed a brace of amusing operatic arias, with hilariously studious and repetitive texts on the pitfalls of being an opera singer. Most ingenious! And very musical—Peter Schickele at his best. It is particularly astonishing that the basic Mozart is so neatly and beautifully played—by the Pick-Up orchestra. One would expect a bit of hamming, to say the least. I was really delighted.

The other items are more typical of P.D.Q., inconsequential as music, though amusing, depending too much (for us who listen via recording) on visual props. We are told what goes on, say, oboes (or was it clarinets?) playing their reeds minus instrument, horns minus horn, only the cupped mouthpiece itself, and so on. We can hear most of it. But the visual byplay on the spot must have a far greater belywhacking impact. On stage, all this P.D.Q. stuff is done in appropriate pseudo-18th century costume. Appropriate? Well, P.D.Q.'s dates are always

listed as—by God, they left them off this album. Anyhow, he died long before he was born. Oh, by the way, is there a Salieri in the opera? Of course! P.D.Q. is always up to date.

**Rameau: Le Temple de la Gloire.** La Grande Ecurie et La Chambre du Roy, Jean-Claude Malgoire.

**CBS I2M 37858**, digital, two-record set.

Sound: A+ Recording: A Surfaces: A

We still do not hear enough of the best music from that peculiarly self-isolated nation, France, but things are improving. This is really a splendid and moving album—an album in the true sense, with gorgeous packaging, handsome art and satisfying booklet explanations of the whole circumstances of the work, plus complete text in the usual assortment of languages. Which is not to say that this is easy listening, unless you are up on French music and French stylings in perfor-

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Malgoire balances the more difficult vocal music with a flood of the expected all-instrumental ballet music common in French opera.

mance. But the more difficult vocal music, beautifully put forth, is balanced by a flood of the expected all-instrumental ballet music common in French opera. So this is not just a loud, unceasing bellow of voices! (That for those who dislike opera on records.)

The work is composed in the enormously decorated French Baroque manner, familiar in harpsichord music, chamber works and so on; both arias and recitatives are highly decorated, the gentle melodies underneath not too easy to perceive at first hearing. As one listens, inevitably, the ornaments recede and the sense comes through. As, I might say, it also does in jazz. Different sound, similar technique. You'll do best to follow the recitatives with text in hand (and translations) since, after all, it is speech.

There's no word about the instruments used here, but they seem to be of the "authentic" variety throughout, including the violins. In any case, the careful style, with very small vibrato,

would make even a standard violin sound new and different. The string sound is wonderfully lush and sheer, sort of like a silk stocking, from fiddles to bass. The oboes have that fruity sound, the flutes the woody sound, which come from using original instruments, so much more colorful (if less loud) than ours. More flavor. Even the horns sound older: Are they valveless, like the originals? Could be. All this is beautifully recorded in a large space that somehow fits the idea of the Court at Versailles to perfection—at least on records. The space is there, but not obtrusive; the performers are close but not too close, always well balanced and clearly *in* that space, no loud voice uncomfortably close to your nose, as in all too many opera recordings. I've heard some pretty raucous French recordings in my day but this isn't one of them. I'd call the digital sound faultless, especially in the louder, more intense vocal passages—not a trace of distortion.

And what a dedicated performance! These singers and players are so earnest, so passionate, so accurate in every turn and twist of the complex lines, that one feels they must have spent years on the work. Such superb tenor singing, in particular! This selflessly musical cooperation is a thing that should be heard, after so many achiever operas with each singer proclaiming *listen to me!* Modesty is the word. This joint effort adds up to far more than a modest recording.

You can take the story or leave it, but note that the words are by, of all people, Voltaire. He was currying favor at Court, and he also greatly admired his co-celebrity, Rameau. He failed and the opera didn't last. The King didn't like Voltaire's text at all, especially the included lecture on Kingship. Afterwards, he favored poor Voltaire with an icy stare. That settled that.

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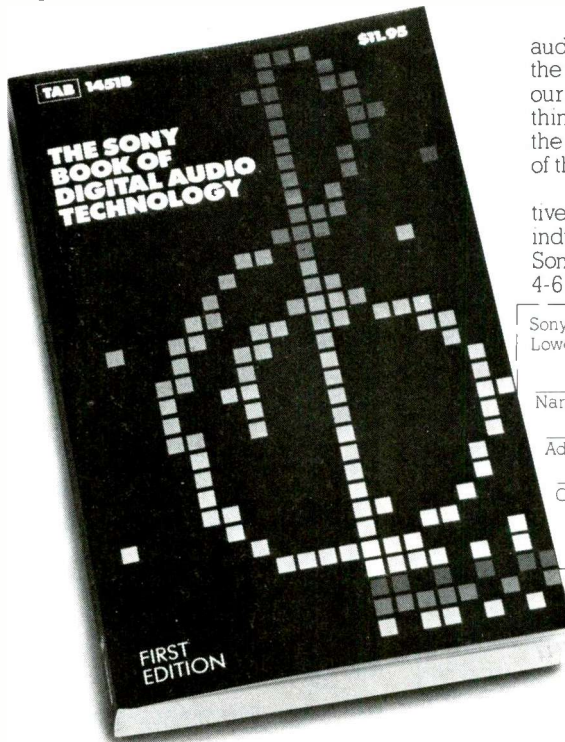
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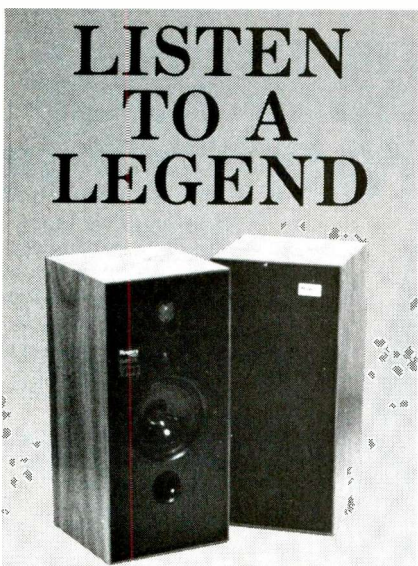
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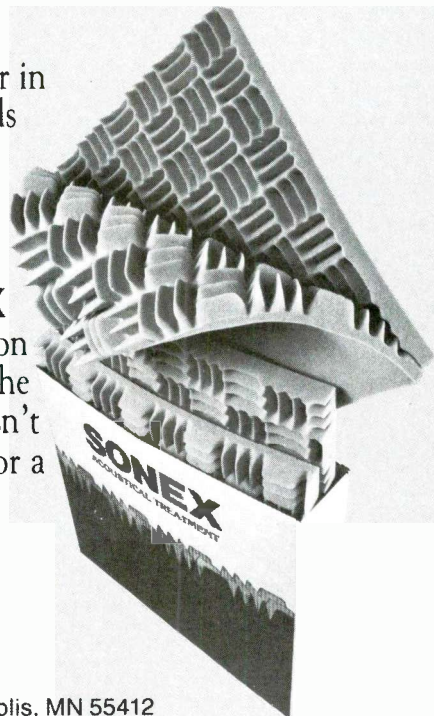
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THURSDAY, MARCH 22, 7:30 to 10:30 p.m.

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PLEASE NOTE THAT *AudioVisions* will **NOT** BE OPEN FOR BUSINESS WHILE THESE SPECIAL EVENTS ARE BEING HELD. **Refreshments will be served**, and admission will be free of charge. However, seating is limited, and tickets **must** be presented for admission. To obtain your tickets, call or visit *AudioVisions* prior to the date(s) of the event(s) that you wish to attend. Everyone attending one of these events will be given a gift of a special "**AudioVisions COURTESY COUPON.**" This coupon will entitle you to an honest lifetime **10% discount** from our already attractive prices on all accessories, including audiophile recordings, cables, record cleaning machines and products, etc., as well as a **7% discount** from our attractive prices on all of our select pieces of audio furniture. This gift will be our way of saying "thank you" for visiting with us.

## ● JAMES THIEL ●

If you have heard your favorite music reproduced through Thiel speakers, you are well acquainted with the thrill, the sheer joy, the tingles up and down your spine that you feel when the seemingly impossible happens: You close your eyes, and, defying your grasp of reality, suddenly the musicians themselves are there with you, in the room, all in their appropriate locations. Then, with your eyes opened once again, you see the very handsome cabinets merely standing there, inanimate, not seeming to be making any sound whatsoever even though the music continues to play. While Thiel speakers offer performance that may be nothing short of miraculous, be assured that they are the work, not of angels, but of real, live people, and are being made, not in heaven, but in Kentucky (which is, as we know, the state that offers us fast horses, great bourbon, and beautiful, saucy women). Making one of his very rare public appearances, Mr. Thiel, assisted by one of the audio world's favorite people, Kathy Gornik, will be giving a seminar entitled:

HONEST MUSIC REPRODUCTION

or

REALITY CAN BE FUN

or

LET'S LISTEN TO MUSIC!!!

SUNDAY, APRIL 1, 12:30 to 5:30 p.m.

On April first? No, we are *not* fooling! Please note that Thiel speakers are demonstrated at *AudioVisions* with electronics by **BRYSTON** and by **BELLES**, with turntables by **ORACLE** (the "Alexandria" and the classic "Delphi"), with tonearms by **SUMIKO**, and with carefully selected speaker cables and patch cords, etc. If you have not yet heard Thiel speakers (the amazing **04a**, \$750/pair; the internationally famous **03a**, \$1300/pair; and the phenomenal new **Cs3**, \$1800/pair), we suggest that you make an appointment to do so in advance of the April 1 seminar. *We want to remind you that the very first presentation anywhere for consumers of the latest Thiel triumph, the new Cs3 model, took place right here at AudioVisions, on June 25, 1983. Now, some months later, The Absolute Sound is describing the Cs3 as "SUPERB."*

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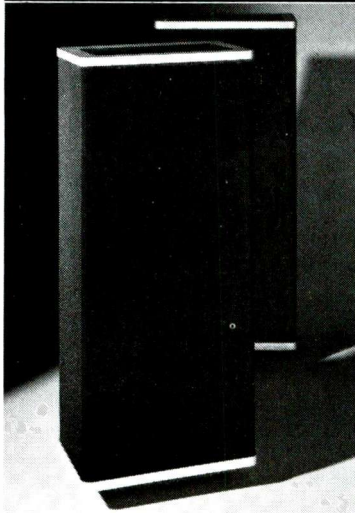
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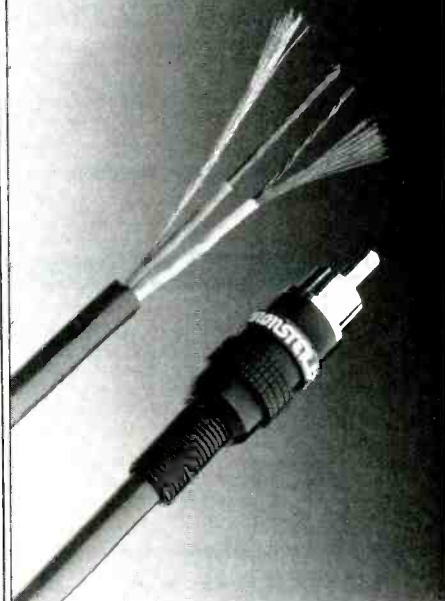
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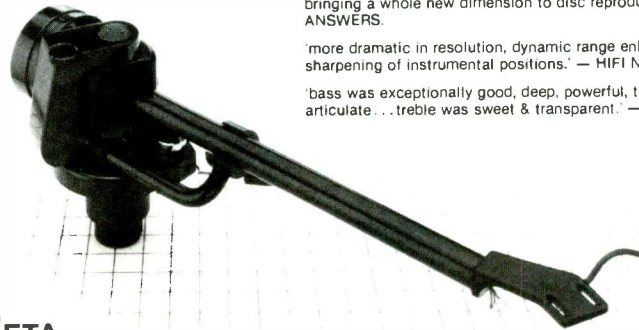
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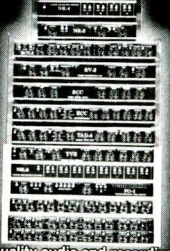
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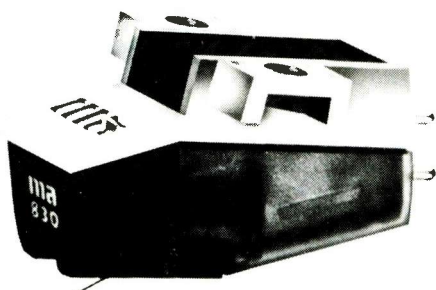
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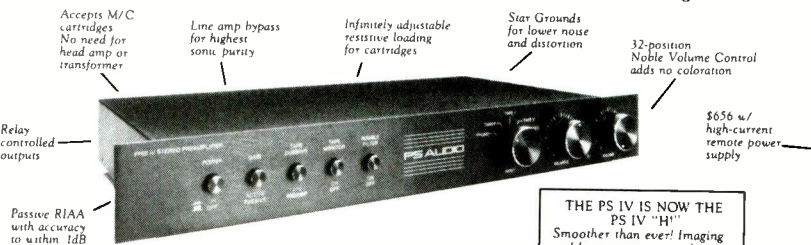
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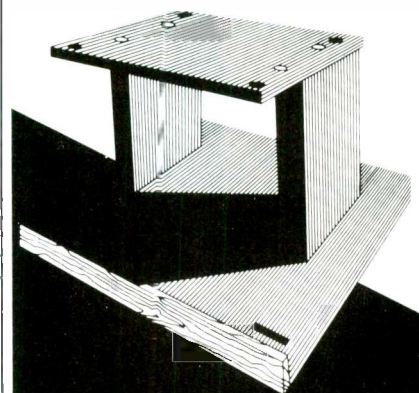
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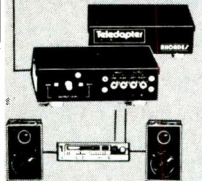
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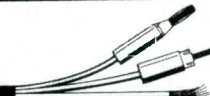
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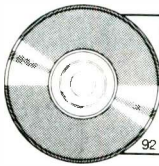
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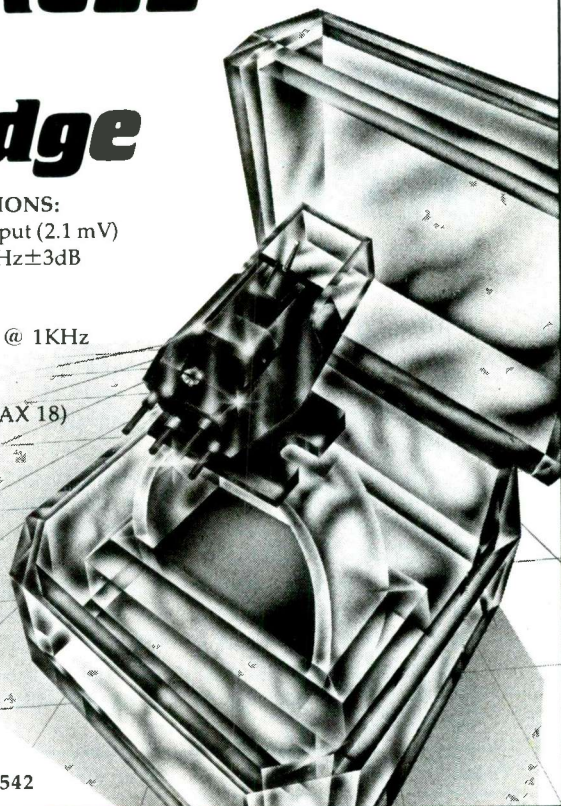
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