Audio

SEPTEMBER 1983 • $1.75 • Ⓕ 06030

REVIEWS OF NEW DIGITAL DISCS

TAPE TEST
77 CASSETTES LAB RATED

STUDIO IN THE HOME:
DO IT THE PRO WAY

TESTED:
LUXMAN RX-103 RECEIVER
"A TOUCH OF LUXURY"

SONY CD-701ES
SI GENERATION
DI ISC
PI

0

270301


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They don't just reduce tape noise. They eliminate it. Technics cassette decks with Dolby* B, C and dbx.®

This remarkable series of Technics cassette decks represents an important technological advance in the fight against tape noise. Because unlike other decks that give you only one or the other, Technics now gives you: Dolby B noise reduction for compatibility with your present tape collection. Dolby C for compatibility with the new "C" encoded tapes. And dbx to eliminate virtually every decibel of audible tape noise. All in one deck.

dbx is effective because it compresses a musical signal so its dynamic range is cut in half. When the tape is played back, the origina dynamic range is restored, but the noise level is pushed below the level of audibility.

This allows loud passages to be recorded without distortion and soft ones without hiss.

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In addition, there is automatic tape bias and EQ setting, expanded range (−40db to +18db) three-color FL meters to handle all the dynamic range dbx gives you, the accuracy and precision of two-motor drive and more.

Explore all of the Technics cassette decks with Dolby B, C and dbx. After all, why own a deck that just reduces tape noise, when you can own one that also eliminates it. Technics.

Technics
The science of sound

Audio

SEPTEMBER 1983 VOL. 67, NO. 9

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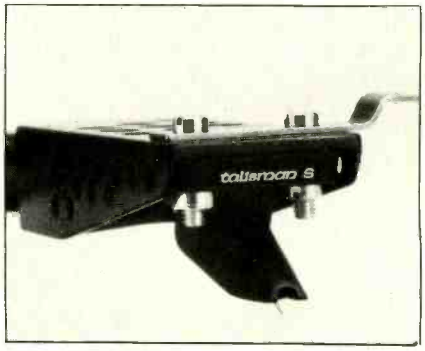

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SANSUI DOESN'T CLAIM TO HAVE THE WORLD'S ONLY DISTORTION-FREE RECEIVER. NOW WE HAVE FOUR.

Unlike most high fidelity companies, Sansui doesn't reserve its most advanced technology exclusively for the top-of-the-line model.

That's why every model in our new "Z" Quartz Synthesizer Compu Receiver line (Z-9000X, Z-7000X, Z-5000X, Z-3000X) is distortion-free.

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Z-9000X	130 w.	.005%
Z-7000X	100 w.	.005%
Z-5000X	70 w.	.007%
Z-3000X	55 w.	.008%

Sansui

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Sansui Electric Co., Ltd., Tokyo, Japan

Putting more pleasure in sound

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IVAN BERGER

LAB NOTES

It's easy to think of the Compact Disc as a Japanese creation. Dozens of Japanese companies have been advertising for months as if they each had invented it, and most brands of CD players are Japanese.

In actuality, though, the basic system did not originate in Japan, but in the laboratories of Philips, in The Netherlands. (Holland is actually just part of the country, but for brevity's sake, we'll call it that from here on.) A few months back, I and a group of other audio writers spent some time in Europe, looking into CD's roots, as guests of Philips and of Polygram.

Philips is a much bigger company than many of the Japanese firms whose names are household words in the U.S. That's partially because Philips doesn't sell much here under its own name, but through such subsidiaries as Magnavox, Sylvania, Philco, Norelco, Signetics and Amperex. An even more universal presence is the Compact Cassette which, like the Compact Disc, emerged from the Philips Laboratories in Eindhoven.

The Labs themselves are as big as many companies, employing 4,000 people, 240 of them working on patents alone. Funding comes directly from the corporate budget: The labs receive 1.5% of the company's turnover. That gives them a certain desirable independence, according to the lab's Director for Consumer Electronics, Dr. C. A. A. J. Greebe:

"Between the product divisions and us, there is a low-pass filter. So, we can do research no operating division believes in yet, but which we feel will be needed in a few years. Hence, we were doing early research on digital error correction, back when you couldn't make the necessary electronics because they would have been too big.

"Because we are corporate, we have free exchange of manpower and technology with different divisions. Hence our work on CD with the Elcoma (ICs and other electronic components), audio, and pro audio divisions. Most of our people enter research work from college, then go to the product divisions at about age 35—we get people with original outlook, they get people with wide knowledge and experience." (It may also help the lab politically to have alumni in all the operating divisions.)

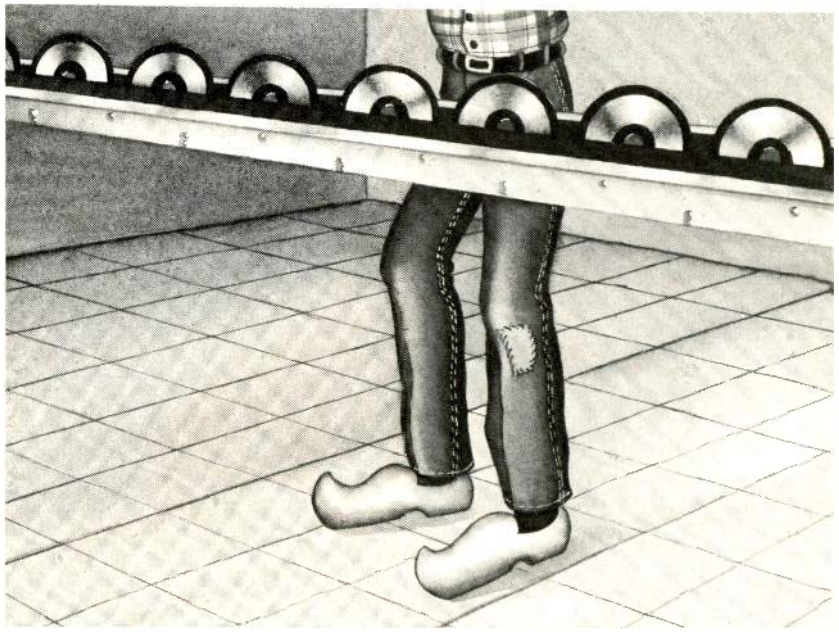

Illustration: Jennifer Skopp

"Aside from the Japanese labs, few labs have one discipline called 'consumer electronics.' Here, that includes research on perception (in conjunction with Eindhoven Technical University) and on computer architecture (with the Elcoma division).

"For speakers, you need a materials research department. The Japanese are heavy on this—it's common for them to put 300 students onto researching the table of elements and combinations. The small manufacturer is in grave danger here."

The history of CD, according to Dr. P. Bögels, (Director of Development, Technology/Innovation, Audio) goes back to 1969, when Philips began work on what eventually became the LaserVision video disc. Even at that point, the system was considered as a potential audio medium too, and in 1974, Philips separated the audio and video development tracks.

The first try for an audio laser disc used low-density FM recording followed, a year later, by a higher density, and therefore smaller, digital disc. There wasn't much digitally recorded material at that point though. Denon was probably first to make digital recordings for eventual LP release, back in 1972; Soundstream began mastering for commercial record companies in 1978; 3M delivered its first digital recorder in 1979, and Sony introduced a digital recorder in 1976. So digital source material was beginning to emerge.

In 1977, a 12-inch digital disc was demonstrated by Sony, Hitachi and Mitsubishi. JVC announced its VHD/AHD 12-inch video/audio disc system in 1978.

By 1979, there were four contending home disc systems: An 11.5-cm (4½-inch) system from Philips, tracked by lasers, and two stylus-tracked Teldec systems, the 13.5-cm ($5^{9}/_{16}$-inch) mini-disc and 7.0-cm (2¾-inch) micro disc capacitive (*Audio*, June 1981), as well as the stylus-tracked AHD system. About that time, Philips and Sony were conferring on a mutual digital disc standard, eventually agreeing on a system using Philips modulation techniques and Sony error-correction systems, which was submitted to the Japanese MITI Digital Audio Disc committee in June 1980. In 1981, Matsushita adopted the system, even though JVC, developer of the competing AHD system, was a

For years you have been fed some pretty tall stories about cassette tape. Denon only makes one claim for DX-Series Cassettes. We don't say they will play on the moon; we don't say they will survive being baked in ovens. We hope that they won't tip over your chair or shatter your stemware. We only say that Denon DX-Series Cassette Tape will sound more like real music than any other brand on the market.

"YOU DON'T LISTEN TO SPECIFICATIONS; YOU LISTEN TO MUSIC."

Most cassette tape advertising tries to impress you with specifications. The trouble is that specifications do not necessarily equate to *musicality*.

Most manufacturers specifications are based on static measurements, the tape's response to steady test tones. Denon DX-Series Cassette Tape goes one step further: it also minimizes Dynamic Distortion, the distortion created by actual musical signals.

"DENON WILL BECOME 'THE AUDIOPHILES CASSETTE TAPE.'"

True audiophiles realize the A-B testing is not the real gauge of sound quality. Only extended listening can tell you if a component—or a tape—is superior.

Perform this test for yourself. Make a recording on Denon DX-Cassette Tape first listening to the source. Then playback your DX-Tape recording and compare the two experiences.

The message is in the music.

"YOU WILL DISCOVER A CASSETTE TAPE THAT SOUNDS LIKE REAL MUSIC."

Nippon Columbia Co., Ltd., No. 14-14, 4-Chome, Akasaka, Minato-Ku, Tokyo 107, Japan

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"Why a compressor? Because CD's dynamic range is too wide for many home listening situations, even when not all that range is used."

Illustration: Rick Tulka

Matsushita subsidiary. With Matsushita and Sony joining hands (for once) on a common system, it was settled: CD would be the final system.

Somewhere along the way, the disc size increased from 11.5 to 12.0 cm (4.72 inch). According to an interview with Sony's new President, Norio Ohga, in *Electronics*, that was at his insistence, so the disc would have enough playing time—about 70 minutes—to hold Beethoven's Ninth Symphony or other similarly long works. (In that, CD echoes the LP's history, since the LP's groove spacing and speed were at least partially selected with an eye towards accomodating an entire symphony of average length.) The Compact Disc is now officially billed as holding 60 minutes of sound ("to make it acceptable to record firms," says Ohga), but is actually capable of holding 74 minutes.

It's also possible, says Dr. Bögels, to accomodate four sound channels, though with less playing time. Other improvements coming up will include improved lenses, the use of CD for computer data storage, and simpler, digital servo systems.

We saw one future development in progress at the Labs: A digital sound processor for reverberation, equalization, scratch and pop removal, and compression of the digital signal.

Philips sees the future hi-fi system as being digital almost all through. The few remaining analog sources would go through a selector switch (with, presumably, a phono preamp for the turntable) and feed an analog-to-digital convertor. The output from the A/D convertor, and from the system's purely digital sound sources, would feed a purely digital selector circuit and a digital sound processor. Output would only be converted back to analog in the power amps and in the output to the analog tape deck (if any).

The digital processor would have many functions, including reverb, equalization, filtering, scratch and impulse noise removal, and compression. Doing all this digitally allows precise and flexible control as well as complex processing without loss of sound quality. For example, a digital signal can be delayed without quality loss, either for reverberation or to let an advance copy of the signal precede it as a control for the actual processing circuits.

The automated equalizer function of the processor was, like such existing automated equalizers as the dbx 2020, a simple, 10-band octave equalizer with 1-dB resolution—albeit with a signal-to-noise ratio of 124 dB! The demonstrator, a Dr. Vandenbulcke (Project Leader for Digital Audio), talked of such other possibilities as tone control, "physiological volume" (loudness?) control, and parametric bandpass filters.

I could not help but think of Acoustic Research's ADSP, which digitally analyzes and corrects room as well as system response, using variable bands sometimes as narrow as 1 Hz, a far more sophisticated system. But according to Vandenbulcke (if I interpret my rapid notes correctly), "Based on perception studies, we feel it's best not to equalize the reverberation—it's best to leave the tailoff alone."

I was more impressed by the demonstration of record-scratch removal. Comparing the signal from an old record before and after processing, I found the ticks and pops all gone. Some surface hiss remained ("We're working on that," Vandenbulcke said. "It isn't easy."), made even more audible by the absence of other distracting defects. The system simply muted out impulse noises for about 10 mS, rather than interpolating to fill in the gaps. Vandenbulcke says, "We are convinced that this is the best that will ever be needed for consumer use." Based on what I heard, he may be right. Digital processing was used here because this form of processing requires delay, which can be far quieter with digital than with analog circuits.

But why a compressor? That, Vandenbulcke explained, is because CD's dynamic range is too wide for many home listening situations—even though CD recordings don't use the medium's entire dynamic range. More on that, next month.

Billions of Bits

We try to check things carefully. So when Len Feldman wrote in the April issue that the Sony PCM-701's video monitor jack could "be connected to a TV monitor, should you wish to watch the billions of 'bits' form . . . patterns on the screen," I wondered whether those bits really did mount up into the billions. So I checked it, with my calculator.

It turns out they do—but that it takes nearly half an hour per billion. In the 701's 16-bit mode, it records 44,056 "words" of 16 bits apiece, each second, for a total of 704,896 bits of data per second. That's 42,293,760 bits per minute, and 2,537,600,000 per hour—or a billion bits every 23.64 minutes. Since a TV frame is on screen for just 1/30 second, the number of data bits you'd see on screen at any given moment would be just 6,830 bits.

I've been careful here to refer to "bits of data," because a PCM system also records additional bits used only for error-checking and correction. If you count those bits, the numbers above would become a little larger, and the times given would be a bit shorter. The number of bits actually on your screen would be smaller than calculated, too, because most TV sets and monitors "over-scan" the picture, projecting parts of the image beyond the visible portion of the screen.

As to 14-bit mode, the number of bits per unit time would be 7/8 as large, and the time required to output a given number would be 1-1/7 times larger. So a billion bits would take 27.02 minutes.

Buff Stuff from TDK.

You, the audiophile, are the toughest critic we know when it comes to sound performance. You're very selective in deciding the perfect equipment for your recording and listening needs.

And you're just as selective in choosing your recording tape. TDK knows that. So we developed a line of high performance audio cassettes that meet your critical requirements.

We call it the TDK Professional Reference Series.

You're probably using TDK SA-X high bias cassettes now because of their superior performance characteristics. In addition, TDK has developed normal bias AD-X which uses TDK's famous Avilyn particle formulation and delivers a wider dynamic range with far less distortion than ever before. Plus, TDK's unique metal bias MA-R cassette which features high-energy performance in a one-of-a-kind unibody die-cast metal frame.

The TDK Professional Reference Series...it'll sound impressive to your ears. So share the pleasure with your friends; they'll appreciate it.

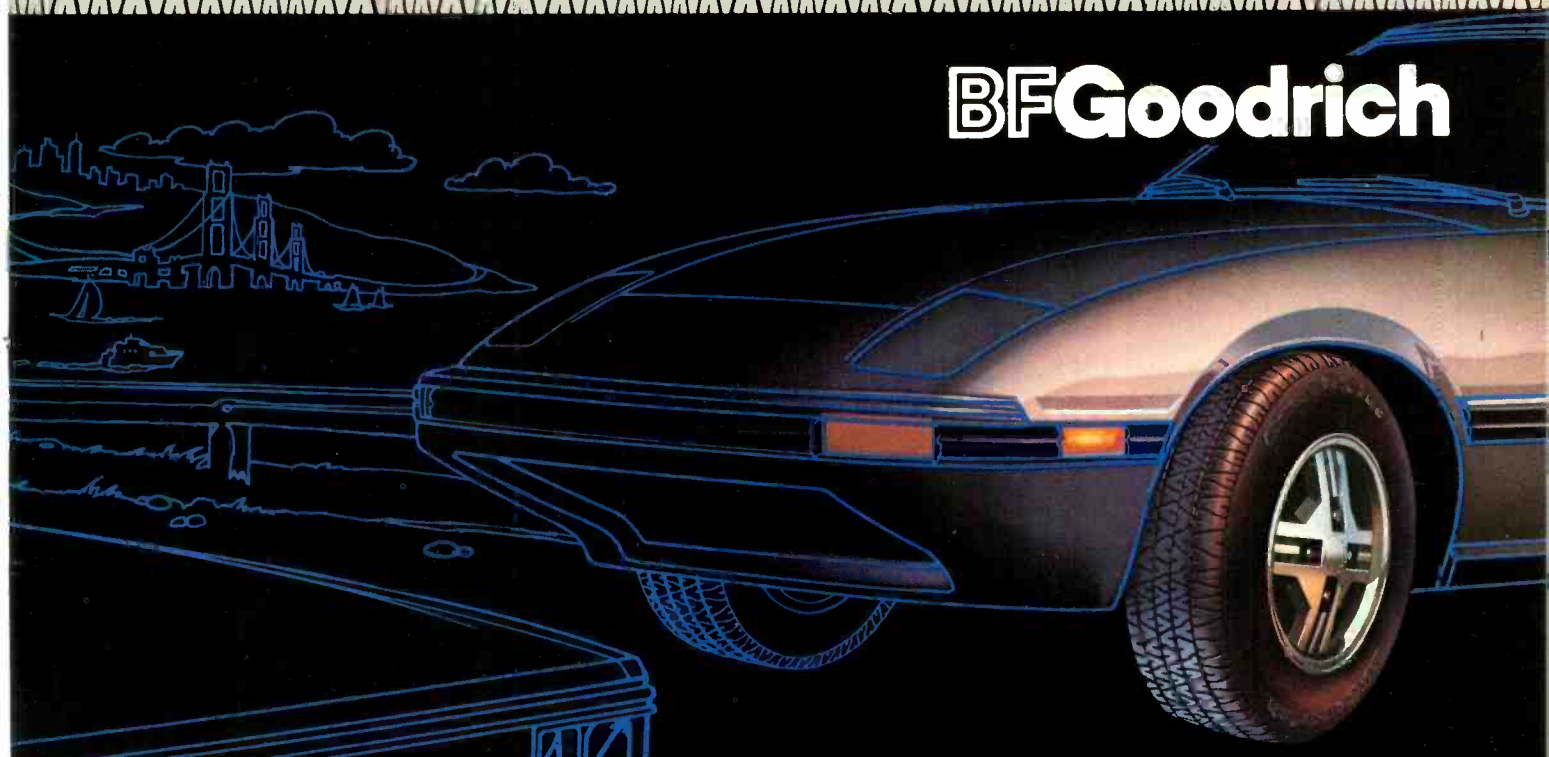
TDK®
THE MACHINE FOR YOUR MACHINE

T/A® HIGH TECH® RADIALS

Objective: Create European-style radials that set new standards in design and performance.
Solution: The Comp T/A® 60V and 70V

The Comp T/A® radial is world-renowned for its innovative construction that combines BFGoodrich state-of-the-art technology with European-style design and performance. And now, the Comp T/A is available in 60V and 70V series sizes.

BFGoodrich



Its black-on-black design and outstanding handling give our Comp T/A® tires the qualities of a European-born radial. The Comp T/A even holds the prestigious V-speed rating—the highest rating attainable in Europe.

Other Comp T/A radial achievements include superior handling and cornering, ultra-responsive steering, and sizing for direct application on most original equipment wheels.

The design of the Comp T/A radial includes this unique combination of advanced materials and technology:

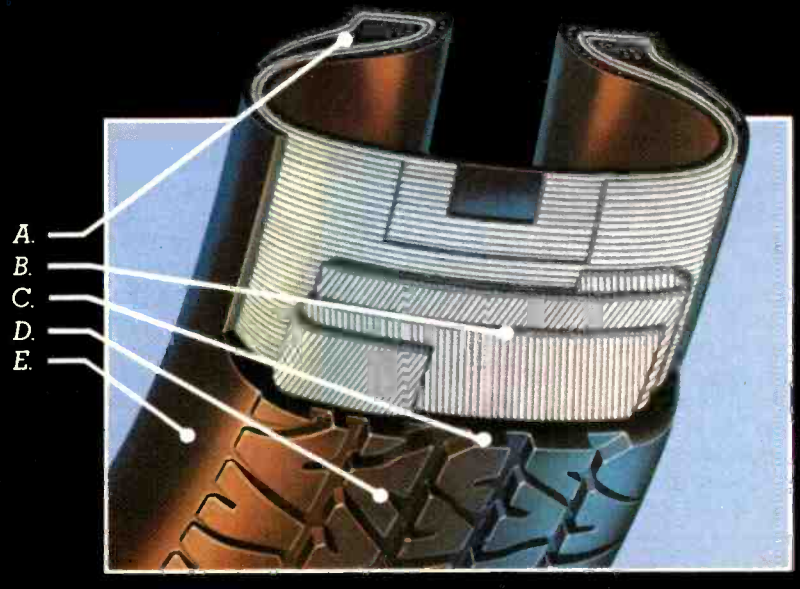
A. High-modulus bead fillers provide quick steering response and high-speed handling.

B. Lightweight folded fiberglass belts and rayon carcass optimize ride comfort.

C. Dual compound tread offers outstanding traction and mileage.

D. Computer-optimized tread offers outstanding handling and cornering.

E. Low aspect ratio helps ensure stability.



The Comp T/A radial is available in 50V, 55V, 60V, and 70V series sizes. BFGoodrich makes a complete line of advanced T/A® High Tech® Radials. When you're ready for a tire with exceptional performance, there's a T/A High Tech Radial designed for you.

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IVAN BERGER

FINE TUNING

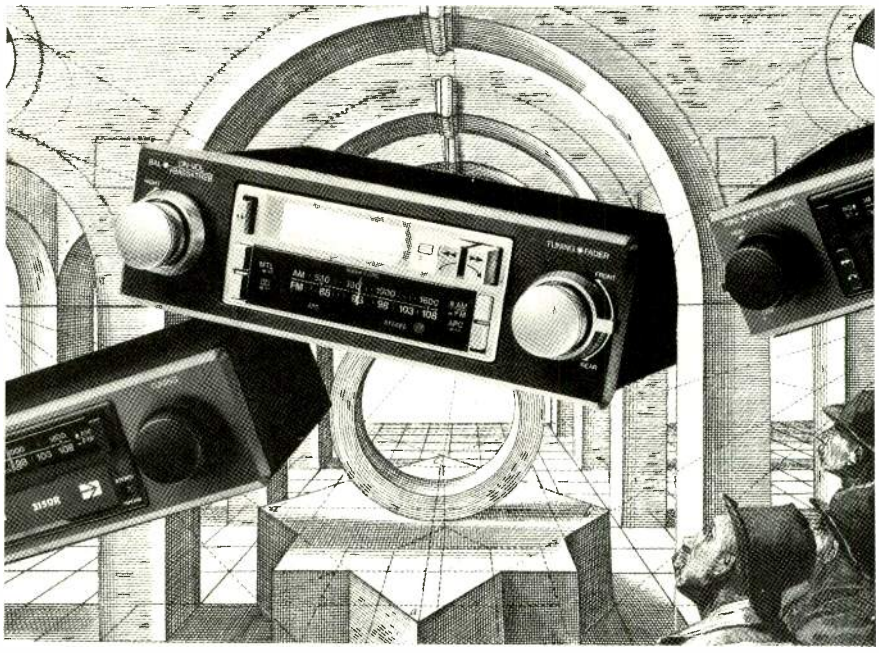

Illustration: Marc Yankus

In our last thrilling episode, we took delivery on a $5,000 sound system—and found imperfections in it. But we'd expected those. A custom sound system, like a custom suit, must go back for a final fitting.

Some of those imperfections would have been straightened out before I took delivery, if we hadn't had a publication deadline to meet. Others were because my concerns were not quite the same as those of even the average high-end mobile listener—not just in my mainly classical listening tastes, but also in my need for various nonstandard system features that had taken extra time to install.

So the car went back to New England Radio for fine tuning. Influenced by the stereo perspective of the GM/Delco/Bose design *(Audio,* December 1982), I suggested toeing the speakers in so that each front-seat occupant would be on the axis of the far speaker and off-axis from the near one. New England Radio toed in the speakers about 10° or 12°, which helped far more than I would have hoped from such a mild angle (that's the improvement which I said last month would be visible in our photos—but you had to look darn close to see it), but we'll try a more extreme one in Phase II, a month or two hence. Getting off the near-side tweeter's axis might also help tame the slight high-end peak.

The crossover frequencies were also changed: The woofer crossover went down to 85 Hz, and the midrange's lower crossover point went to 150 Hz, which eliminated the front-to-rear separation I had noted. The midrange's upper crossover point was lowered, too, from 3 kHz to 2.4 kHz; since the tweeter still crosses in at 3 kHz, this leaves a small notch in the system's response. This makes it smoother, probably indicating some resonance between 2.4 and 3 kHz. (I've since measured resonances at 32 and 80 Hz, and a system response sloping at about 4 dB/octave, with 2- and 6-kHz peaks and a 4-kHz dip.)

Come Phase II, we're also going to shrink the woofer enclosure. New England Radio's Mark Weir is against woofers which use the trunk's large (and unpredictably sized) cavity as an enclosure, because of unpredictable bass peaks and poor woofer damping (leading, in extreme cases, to short woofer life), and because it lets the bass from both stereo channels mix. I'm not convinced that mixing bass below 100 Hz will hurt the sound, at least under car listening conditions; but until I get a chance to hear what difference it makes, I'll maintain an open mind.

Still, the only way I see to maintain the car's practical utility as a vehicle is to either use a free-air woofer (a designer friend says he'll have suitable drivers for that, shortly), to use woofers requiring smaller enclosures, or cutting down from two subwoofers to just one.

Purists may feel you need two for stereo imaging (though others contest the existence of imaging at these frequencies). But with both woofers cheek by jowl behind me, there's no hope of that in any case. My only concern, then, is whether one woofer alone can give me bass as rich as what I'm now getting.

Whether I wind up with one woofer or two though, we'll rebuild the enclosure to take up less trunk space, and provide for installing 6 × 9 speakers for test. If I do go to a more compact woofer system, this one won't be wasted—it sounds good enough to take upstairs and put into my home system. In the meantime, removing the enclosure when I need full trunk space has been simplified by the installation of two large Cinch-Jones connectors between the amp rack on the back of the enclosure and the wiring in the car. That disables the main amplifier system, of course, but it leaves me the small Alpine amp and the ADS speakers in the doors.

Those speakers' grilles have been secured with an adhesive, and haven't fallen off in many slams, so far. The radio has been angled a bit more toward the driver, so I can load tapes more easily; with the tape slot centered, it was awkward. In Phase II, the original Saab radio console will be replaced with a custom version, moving the radio controls a convenient inch higher, allowing the reinstallation of my Burbank Audio-Safe over the receiver as an anti-theft measure, and putting more clearance between the test-equipment shelf and my right ankle.

John France, an engineer at Rock-Ford-Fosgate, feels that, while biamplification always makes a dramatic difference, triamping is far less cost-effective. That sounds reasonable, and I intend to try cutting back to simple biamping in Phase II as well, to see how much difference it makes. If I go biamp, I can cut out one amp and crossover; if I cut back to one woofer, I'll be able to cut out one more amp

There's More to Noise Reduction Than Silence.

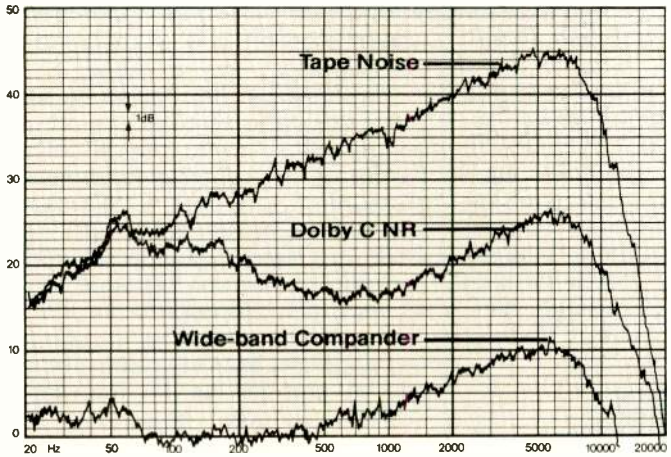

FIGURE 1: NOISE AND NOISE REDUCTION IN THE ABSENCE OF MUSIC.
Noise from biased cassette tape without noise reduction, the effects of Dolby C-type noise reduction, and the effects of a wide-band compander are shown in the *absence* of any signal.* Dolby C's noise reduction effect results in an overall perceived noise level below the ambient noise of many listening rooms, even at high playback levels. In the absence of signals, the conventional wide-band compander provides still more electrical noise reduction (but usually no more audible noise reduction).

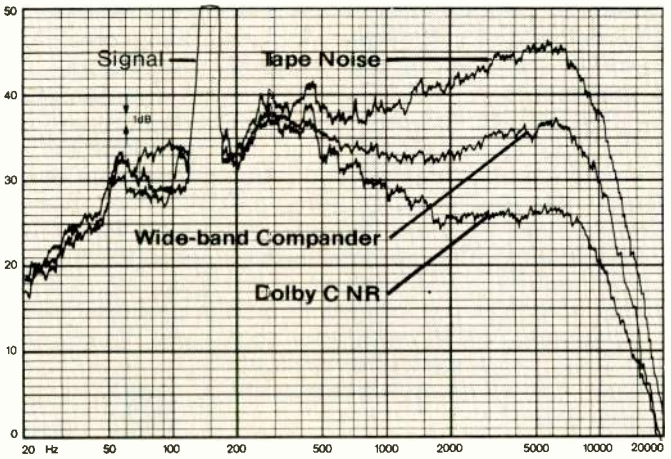

FIGURE 2: NOISE AND NOISE REDUCTION IN THE PRESENCE OF MUSIC.
In the *presence* of a signal (148 Hz, D below middle C on the piano, recorded at Dolby level), in all cases noise in the region of the signal will be masked by it. However, at higher frequencies, especially between 2 kHz and 10 kHz where tape hiss is clearly audible, Dolby noise reduction provides almost as much noise reduction as if the signal weren't there, while the compander allows the noise to increase to a considerably higher level than with Dolby C.

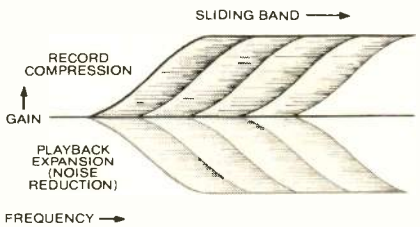

FIGURE 3: THE SLIDING BAND PRINCIPLE.
Dolby noise reduction operates over a band of frequencies which slides up out of the way of the music, resulting in noise reduction just where there is no musical signal to hide the noise. Thus the perceived noise level is consistently low at all times.

Providing noise reduction on silence is not all that difficult. For years, conventional wide-band companders have been available which dramatically reduce noise — between selections on a tape or record.

Yet it is just as important to have noise reduction when there is music playing. While music will mask noise part of the time, there are times when it won't. A bass drum note, for example, cannot hide tape hiss, no matter how loud the drum is: the ear can detect both simultaneously.

Conventional noise reduction systems effect noise reduction at the time of playback by turning down the volume when there is little or no music present. This turns down the noise as well. But they also turn the volume back up again on louder music, and so turn the noise back up at the same time. Thus the bass drum note is accompanied by a burst of tape hiss — hiss which is audible if there is no music at higher frequencies to hide it.

This problem is called noise modulation. It means that with a conventional NR system, the noise level is constantly shifting up and down with changes in the level of the music. But Dolby noise reduction, on the other hand, is free of noise modulation on virtually any type of music (Figures 1 and 2).

Unlike conventional companders, Dolby noise reduction operates over a constantly changing, or sliding band of frequencies (Figure 3). The band extends low enough to provide very effective noise reduction on silence. But in the presence of music, the band slides up just out of the way of the music, so that noise at frequencies above the music is almost as effectively reduced as if the music weren't there.

Both Dolby B-type and Dolby C-type noise reduction are sliding-band systems. With the standard B-type system, noise reduction begins at 500 Hz and increases to 10 dB at 4 kHz and above, while with the new C-type system, noise reduction begins at 100 Hz and increases to 20 dB at 1 kHz and above. With either system, the presence of music does not prevent noise reduction from occurring where it is still needed.

*70μs equalization, measured with a constant-bandwidth wave analyzer, and weighted (CCIR/ARM) to reflect the ear's sensitivity to noise and noise reduction effects.

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(using one side of the Power VI for the woofer, the other for the midrange speakers).

One or both of those cuts should shrink the system enough to get the electronics out of the trunk and underneath the Saab's lift-up rear seat, where they'll be less in the way, and less visible to potential thieves when I open my trunk. I worried about ventilation under there, but John France feels that the amplifiers will actually run cooler there: "The passenger compartment never gets as hot in summer as the trunk does."

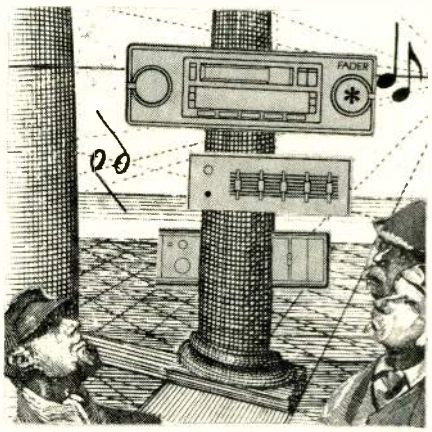
Equipment Notes

I won't say much here about the Alpine 7347, since I'll get my chance when we do a full-dress test report on it. It is a definite improvement on my previous Alpine (which wasn't their top model anyway), able to receive good FM and AM over greater distances, and with far quieter tape electronics. Its human engineering is good. I like the fact that its tuner can be switched off separately, so you don't get a blast of local rock while you're flipping a classical tape over—though I wish that the light which illuminates the tape slot didn't go off with the tuner.

Of the Alpine's three noise-reduction systems, I like Dolby C NR the best. With Dolby B NR, when you're this close to the speakers, you can still hear hiss. The dbx system, by contrast, is too good: If the recording engineers really excercise its wide dynamic range, you find yourself fiddling with the volume control to keep it within the narrower range between road noise and your ear's overload point. Add DNR to Dolby B NR (as many car-stereo systems now do), and a mild, adjustable compressor to dbx NR, and I'd like these systems just as much as I now like Dolby C NR. I'd get more from dbx NR if my car were really quiet too.

Having Dolby C NR in the car allows me, at last, to use the "C" setting of my Pioneer CT-9R home deck; since I do most of my taping for the car, that feature lay fallow for a year or two till I got a car player with a matching decoder. The only catch is that now I'd like a Walkman-type portable tape player—and while you can get models with dbx or, shortly, dbx outboard adaptors for other models, I know of no such portables with Dolby C NR. Aw, shucks.

The Audiomobile preamp has five controls: Volume, balance, and equalization sliders for 50 Hz, 2 kHz and 10 kHz, plus overload lamps for each channel. I use 50 Hz to kick up the low bass when I want it, 2 kHz either to emphasize upper midrange frequencies for vocal clarity or tame them on material which over-emphasizes them, and 10 kHz to control that touch of tizziness and to cut hiss on older (especially non-Dolby) tapes. For broader corrections of the top or bottom part of the frequency spectrum, I use the Alpine's tone controls.



"With Dolby B NR, you can hear the hiss. But dbx is *too* good—wider dynamic range than the road noise allows."

The Rockford-Fosgate amplifiers are new designs. "They have the rare combination of high power with high definition, plus a lot of head room and good reliability," says Weir. The Power VI, used for the woofers, is a four-channel amplifier with a built-in, two-way crossover; bridged to a two-channel configuration, as was done here, it develops about 75 watts per channel into the 8-ohm KEF subwoofers (about double that into 4-ohm car speakers, of course). According to Rockford-Fosgate, these amps actually put out more power than specified, for the sake of headroom and to be sure of attaining full rated power when they're hot, or when the battery is a little low. We're planning a test report on the VI.

"Unfortunately, the crossover section is not usable when the amp is in its bridged stereo mode, and is not as flexible as the separate Audiomobile crossovers," says Weir, so that capability of the amplifier wasn't used. The Power II, a straight two-channel amplifier without crossover, develops about 45 watts per channel into the 8-ohm Audax drivers—more than enough for midrange use, as both common sense and my ears tell me. ("It may seem overpowered now," says Weir, "But with the windows open in the summer, it won't seem to be, [*Editor's Note*: It's now summer, and he's right.—*I.B.*] and with dbx in the system now and possibly digital players in the future, you might wind up using all this power.)

"The Philips EN-220 amp used for the treble is one of the few amps almost specifically designed to drive tweeters—very smooth, open and clean at the top." Into our 8-ohm tweeters, it delivers 10 watts per channel.

Four-ohm drivers require lower driving voltages than 8-ohm ones, which makes them more practical for car use. So why use 8-ohm drivers? "Most driver manufacturers make their best speakers in 8-ohm varieties," says Weir. "Don't ask me why. Also, an 8-ohm load is much further from the amplifier's minimum load impedance, which tends to improve the damping. As driver impedance reaches the amplifier's minimum load-handling capacity, amplifiers begin to become somewhat unstable. And bass-amplifier bridging usually requires 8-ohm impedance."

The drivers aren't the whole story, of course. The enclosures are equally important. Custom enclosures like this cost more, but can be more accurately matched to the speakers than the random spaces behind a car's interior panels can. Building enclosures which sound good, look good, and don't get in the way requires the skill and talents of a cabinet maker, all of which were provided by Bruce Harvey, New England Radio's installation manager.

Don't expect to get such systems from the average mass-market installer. Says Weir, "It only pays when the total system price, with installation, starts edging up toward the $2,000

mark. At that point, where sound quality becomes more of a factor than a few more dollars, I can't see going for passively crossed-over speakers, flush-mounted into random spaces. And for cars like Saab 99s, which are notoriously difficult for standard installation techniques, it's that last viable alternative, the one that generally works best. You get all kinds of freedom and versatility that way."

Still to Come

As you may gather from all this, my goal is not to make this the state-of-the-art show car of all time, but to get the best possible sound for the least possible money. My progress, and the lessons I learn en route, will be detailed in future Roadsigns.

Shortly after this goes to the printer, I'm going back to New England Radio on a Sunday, for a day of experiments and tinkering. Mark and I will be making what corrections we can by ear, then measuring the frequency response for the first time, to see how close we got that way. Then we'll make the final frequency adjustments for more balanced sound.

We'll also spend some time experimenting with speaker placement, to find how best to achieve good stereo perspective. Among the potential solutions are a center-channel speaker (suggested by John France), increasing the front-speaker toe-in (my idea, based on the GM/Delco/Bose system), and driving a central speaker with one channel, while the other feeds both speakers on the sides.

I may also copy another GM/Delco/Bose technique, which the Audiomobile crossover setup makes easy, of doing all my balancing and fading in the mid and upper frequencies, so that bass level and overall sound volume remain constant at all fader settings.

After the front channels are tuned to my satisfaction, I'll begin experimenting with rear-channel speakers and their placement. I'll also be using the car, by then, as a test bed to road-test car-stereo gear; the road-tests will supplement lab tests in some cases, and substitute for them, in others.

Next month, though, I'll interrupt the narration of this project to tell what was new in car stereo at CES. The tinkering goes on, however.

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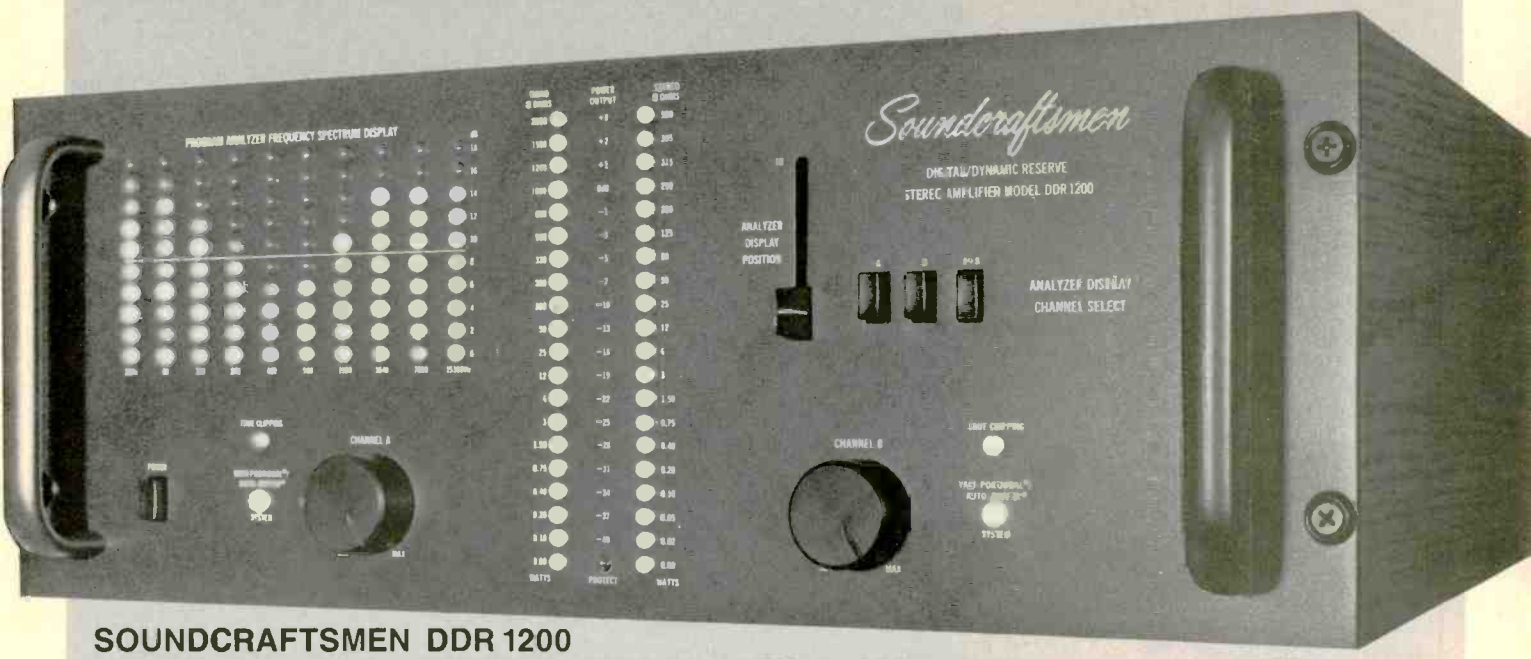

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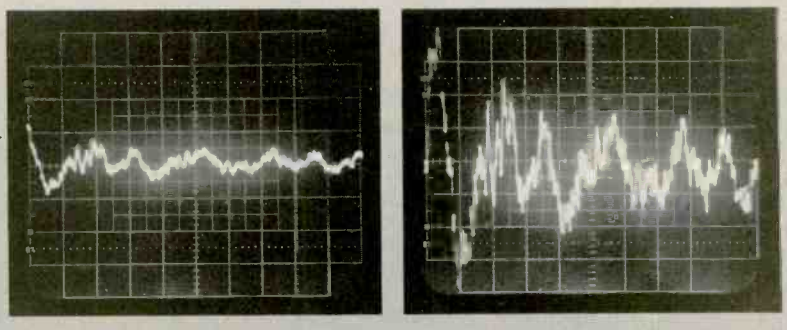
CONVENTIONAL RECORD
Oscilloscope photo shows music playing at normal listening level. Only **1 watt** of power is required for average level, but **16 watts** are needed to produce "peaks."



DIGITAL AUDIO DISC
Oscilloscope photo shows same music playing at same normal listening level. Again only **1 watt** is required for average level, but **500 watts** are needed to produce the... **'digital/dynamic peaks" without distortion!**

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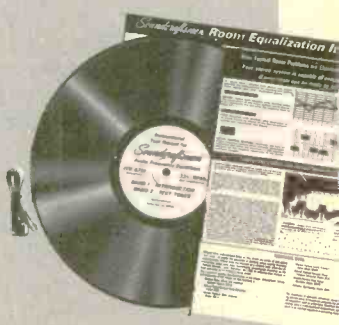

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BERT WHYTE

CD DOINGS

The NEC CD-803E is one of the few CD players offering wireless remote control of all functions.

The Summer Consumer Electronics Show, held in Chicago June 5th through 8th, may well have been a reflection of the economic recovery that is leading the country out of the recession. According to the EIA, an all-time CES record was set with an attendance of 83,311. Buoyed by the "official" U.S. introduction of the digital Compact Disc and many high-tech products in the computer field, the mood was very positive and upbeat, with most of the audio contingent expressing satisfaction with the Show.

Once again the video games, computers, computer software and telephones got the lion's share of space in the daily trade papers, but it was hard to ignore audio, for the Compact Disc was everywhere. Apparently, many of the high-end audio companies at the Conrad Hilton felt obliged to use the CD for demonstration purposes. Thus, a stroll through the halls of that hotel was a good opportunity to audition quite a variety of CD players. The companies who actually manufacture CD players were scattered throughout the main exhibits. A good percentage of the players shown were production models, while there were also a number of prototypes.

Naturally, most of these manufacturers claim their players have special features that make them superior to the competition. As you might expect, most of these features are in the area of special bells and whistles functions, but there are some technical differences between a number of the CD players. With our present relatively limited experience with CD playback, it is too early to draw any firm conclusions as to which unit affords the best CD reproduction.

Among CD players I saw at the show was the NEC CD-803E. This vertical-play unit is physically one of the biggest players in the market. Up to 99 selections can be programmed to play in any order. The CD-803E is one of the few CD players offering wireless remote control of *all* functions. There is digital display of a number of time functions as well as track number. Purportedly, the CD-803E is equipped with a phase-shift correction filter, similar to the Meyer Sound MS-8201, which I reported on in the March 1983 issue of *Audio*. The CD-803E is expected to sell for $1,000.

Marantz introduced their CD73 programmable CD player. Unlike most Japanese CD players, the CD73 uses the Philips oversampling and noise-shaping D-to-A technology, which is said to permit the use of an anti-aliasing filter with a far less steep cutoff than the Sony-type filter. This also allows Marantz to use a digital rather than an analog filter. A front-loader, the CD73 will sell for $999.

Yamaha's CD-1 player is one of the most uncluttered and elegantly styled players I have seen. A front-loader, Yamaha makes much of its own high-gain phase-detector servo-tracking system and independent, 16-bit linear D-to-A converters for each channel. (Most CD players use one converter and a switch to derive left and right channels.) Yamaha also uses independent power supplies for digital and analog circuits, and they claim superior error correction with a double Cross-Interleave Reed-Solomon code.

Sansui says their PC-V1000 CD player should be available by the time you read this. The player has a horizontal slot for front loading, and they claim their three-beam laser pickup will afford accurate signal retrieval even when a CD is scratched beyond the capability of the more common single-beam laser pickup. The Sansui PC-V1000 has a specially developed combination digital/analog filter, intended to reduce analog processing to a minimum. A wireless remote control gives random access to individual tracks. The price of the Sansui PC-V1000 CD player is $1,000.

Akai was showing its CD-D1 digital disc player. The unit uses front loading and offers a 10-key, high-speed random-access programmer which can program 24 selections in any order of playback. Akai claims a special D-to-A converter affords superior sound. The CD-D1 will also cost $1,000.

Magnavox (owned by Philips) was making a big splash considering that they were the only company with three different CD player models. Their Super Compact, the FD-1000, is a very basic unit. It is the smallest CD player on the market, and has top loading but no programmability. The FD-2000 is also a top-loading player, in a slim-line configuration with many conveniences. The FD-3000 is a front-loading CD player with full programming capability and other bells and whistles. All of these Magnavox CD players use the

"Naturally, most CD player manufacturers claim their units have special features that make them superior to their competition."

Philips oversampling and noise-shaping technology, permitting a gentler cutoff by the anti-aliasing filter. The only price, thus far, is $800 for the ultra-compact FD-1000.

Denon has 200 of their dealers demonstrating CDs, mostly of their own manufacture, with a prototype DCD-2000 CD player. This unit will not be marketed, but will give way to a more sophisticated second-generation unit. At this CES, Denon was demonstrating its professional DN-3000F, for broadcast applications. As you might expect of a unit of this type, all its mechanisms are heavy-duty for extended use and long-term stability. Such amenities as precision cueing and delayed starting are provided as well as extensive time base information display. Twin VU output-level meters are supplied, and the output level of the DN-3000F is +4 dBm balanced.

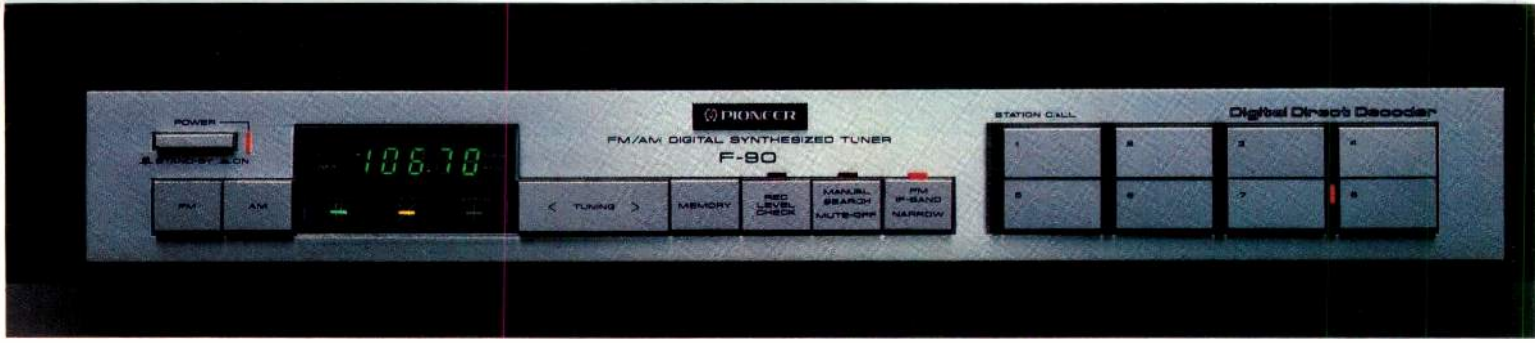
Kyocera showed its DA-01 CD player, a front-loading vertical-play unit. It has programmed play for up to 24 selections and an elaborate track manipulating function which permits indexing (selection of sections within a given recording) and all sorts of other retrieval functions. The Kyocera DA-01 is said to be much favored by digital people in the know, because the unit not only uses the Philips over-sampling and noise-shaping technology, but employs a phase-shift correction filter as well. Price of the DA-01 is $1,050.

Technics attracted a lot of attention with its SL-P10 CD player. The unit features one of the most elaborate programming functions of any CD player now on the market. Up to 63 individual selections can be programmed and played in any sequence. Press a button on the SL-P10 and a motorized loading door swings open. Insert a CD into the vertical slot—and presto!—the disc is automatically loaded into the slot and the door closes. Matsushita manufactures their Technics SL-P10 player and they are particularly proud of the fact that virtually every part of the unit is made by them. Special ICs and LSIs were developed for the unit, as were 16-bit high-speed D/A converters, a precision error-correction LSI using Technics' Super Decoding Algorithm, and even the semi conductor laser pickup system. The Technics SL-P10 will cost $1,000.

Sony was not officially at the SCES, but they were holding forth at a mid-town hotel where, among other things, they were showing their second-generation CD player! Yes, that *is* a bit startling, when other companies have yet to get their first CD players to market. There are various refinements of course, one of the principal things being the inclusion of a phase shift correction filter. Sony apparently is one of the few companies making CD players where the program remains audible in the fast forward and reverse modes. Sony's new CDP-701ES will retail for $1,500 and be available in September. Our review starts on page 50.

As to the CD software situation, important steps have been taken to ensure a structured, orderly, reliable release schedule. The Compact Disc Group was formed under the auspices of the RIAA (Recording Industry Assn. of America); the members of this group are virtually all manufacturers of CD players and most of the record companies who are—or will be—producing CDs. They have issued their first catalog and it will be updated quarterly, perhaps going monthly in 1984. In the meanwhile the Polygram group (Decca, Philips, Deutsche Grammophon, et al.), have pledged to have 100 titles available in the U.S. by August 1, 1983. Thereafter, 30 new titles per month will be released, with a total of 200 for all of 1983. Eighty of the 100 CD titles are classical, 20 are pop. Polygram expects to increase the capacity of its Hanover, Germany CD pressing plant to 10 million discs in 1984!

Obviously, this column was devoted to the Compact Digital Disc at its official debut at the 1983 SCES. I think it is one of the most significant new audio technologies to emerge since the introduction of stereophonic sound in 1958. It must be noted that it is not just the Compact Disc in itself that is so important, but the startling changes in virtually all aspects of audio and recording it will engender.



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Most highly-touted, so-called technological breakthroughs are actually so subtle only a handful of people in the world can actually discern that there's a difference.

The rest of us, audiophiles and normal human beings alike, must be content to subtract the old specs from the new and assume there really is an audible difference.

But not with the F-90 tuner. A new tuner with design technology that *High Fidelity* says represents"...a stunning breakthrough in FM tuner performance thanks to a circuit it (Pioneer) calls a Digital Direct Decoder..."

Not only are the new F-90's specs remarkably superior to the naked eye, its sound quality and reception capabilities are unmistakably better to the naked ear.

Coupled with its companion amplifier, the A-90, you have a system that produces much cleaner, more musical sound. The kind of sound the musicians and recording engineers had in mind in the first place.

The reason is an exclusive, revolutionary new technology invented by Pioneer engineers. The Digital Direct Decoder is an unconventional circuit that uses a 1.26 MHz pulse train and a pure 38 KHz sine wave, thereby eliminating the need for a conventional noise filter (which creates distortion, harmonics, and limits frequency response).

Consequently, Total Harmonic Distortion at 1 KHz has been reduced to 0.0095% (mono) and 0.02% (stereo), which you'll have to agree is an exceptional improvement over conventional tuners.

Signal-to-noise ratio is an astonishing 93dB (mono), 86dB (stereo).

Furthermore, alternate channel selectivity (always a nemesis and rarely exceeding 60dB before) has been raised significantly to 90dB at 80dBf, eliminating neighboring station "bleed over" once and for all.

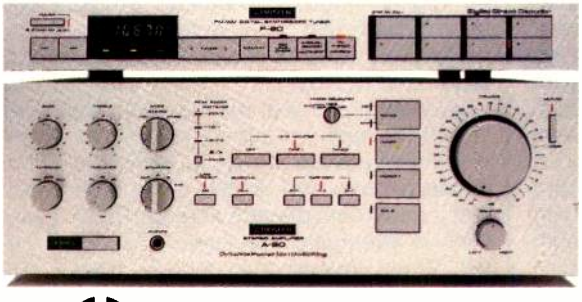
And, whereas the better tuners available before produced stereo channel separation numbers no higher than 50dB, the F-90's numbers are up 30% to 65dB.

Suffice it to say, you can expect the same outstanding performance from our new A-90 integrated amplifier.

To begin with, there's 200 watts per channel of exceptionally clean power. (0.002% THD, 20-20,000 Hz at rated power, both channels driven, 8 ohms.)

And signal-to-noise ratio is a superior 115dB that combines with the above numbers to get distortion levels that read at the level of immeasurability.

The reasons: our new dynamic power supply, non-switching amp circuits, an FET Buffer circuit, D.C. Servo circuit, and a new, higher specification on even the lowliest components.



Naturally, we recommend you audition both the F-90 and A-90 at your earliest convenience.

Because mere words can't describe a difference so remarkable it can actually be heard with your own two ears.

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EDWARD TATNALL CANBY

TAPE-WISE TRICKS

Is it still possible to produce a semi-pro recording of your nonprofit entertainment group—chorus, glee club, high school band, church choir, musical show, bell ringers and a hundred other enterprises—and follow through to an LP and/or cassette, hopefully available to the general public?

Well, of course! There never was more and better equipment than right now. If you have money, you can buy anything, and that means all the way from the services of a major record producer, say RCA, through quantities of excellent small concerns and one-man recording operations. Or you can buy your own recording equipment and do it yourself, at least as far as the finished tape, reel to reel. (Cassette recorders, no matter how good, do not rate in this league.)

Unfortunately, we don't all have money and the prices have gone up to painful levels, as you may have discovered. And then there is digital. Must *everything* now be digital? Digital, we hear (quite correctly), is horribly expensive. Generally speaking, you can't edit it—the essential for any publication of your recording—short of using some incredible thing costing maybe $100,000. Does this spell the end of small-time recording enterprise?

Well, if you'll put up a stiff back and forget digital, for the time being, I assure you that you will survive handily. You will not be priced out of the market, unless dozens and dozens of still available, still operating, state-of-the-art, reel-to-reel analog recorders suddenly vanish overnight, along with millions of dollars worth of ancillary equipment for the production of top-quality recordings. The situation here is much as it is elsewhere—we boast the finest and most varied recording equipment ever seen and heard, nor was there ever a better time, technically speaking, to produce your own semi-pro records. Even the pressings are vastly improved over the sadly noisy products I remember from a dozen or so years ago. Yours can be every bit as smooth and quiet as those you buy in the professional lines—and sometimes your cassettes will be even better than commercial ones because in that area, mass production requires high-speed duplication; your relatively small production runs can be economically produced at lower speeds and thus with potentially better quality.

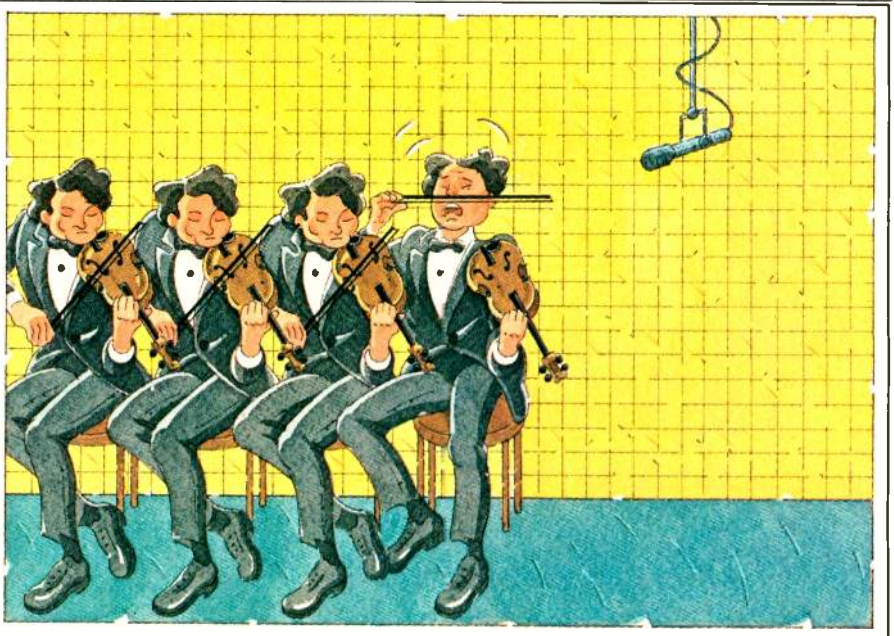

Illustration: Philip Anderson

Digital will come to all of us, you may be sure, but in its own good time. The fact is, I must say, that this genuinely revolutionary new electronic technique is actually more important in the line of technical procedure, making for new flexibility in the engineering sense, than as a revolutionary sonic advance. Sounds crazy (in view of all you have heard) but it is true.

When it comes to recording your high school band, present-day digital methods will merely cost you more, for an end improvement on present LP and cassette that for the most part will not be noticeable to your audience. Let's be realistic. Other things count. Not all of your listeners—very few—will have the super-expensive playback systems to fully reproduce those added digital virtues, ultra-clean sound and, in particular, very wide dynamic range. The world of sound is not necessarily all audiophile.

Very simply, digital will not seriously intrude, in semi-pro record making as elsewhere (unless we let it), until it is cheap enough and simple enough so that it undercuts present analog. That I think is eventually inevitable. But not yet. When indeed this actually happens, not so far in the future (via the usual chips, ICs prefabricated and mass produced), then we in the modest economy of the semi-pro recording area will benefit as much as anyone else. Look at the already established examples. The home computer, the pocket calculator, the all-electronic watch. That's us in the future.

Meanwhile, if you just happen to have access to a digital recorder, if you can afford the cost without strain, or can beg, borrow or temporarily steal one, you might just try. Digital now carries enormous prestige. It puts your recording in the gold credit card category, even if an analog job might be just as good for your purpose. But move carefully! You *must* always edit your recording-session tapes in some fashion, if only to remove the garbage before, between and after the relevant material. Be absolutely certain that in borrowing or hiring a digital recorder, you are not painting yourself into a corner with it: Be sure that the digital follow-up procedures are available to you, right through to the cutting of your disc or the duplication of your published cassette, and that you can afford whatever all this may cost. Also, that the persons who must do your editing will work to your artistic satisfaction, preferably with yourself hovering over one shoulder in very close attendance. Otherwise, you may end up with a digital disaster. Lovely sound quality, but what happened to the last five notes of Band II?

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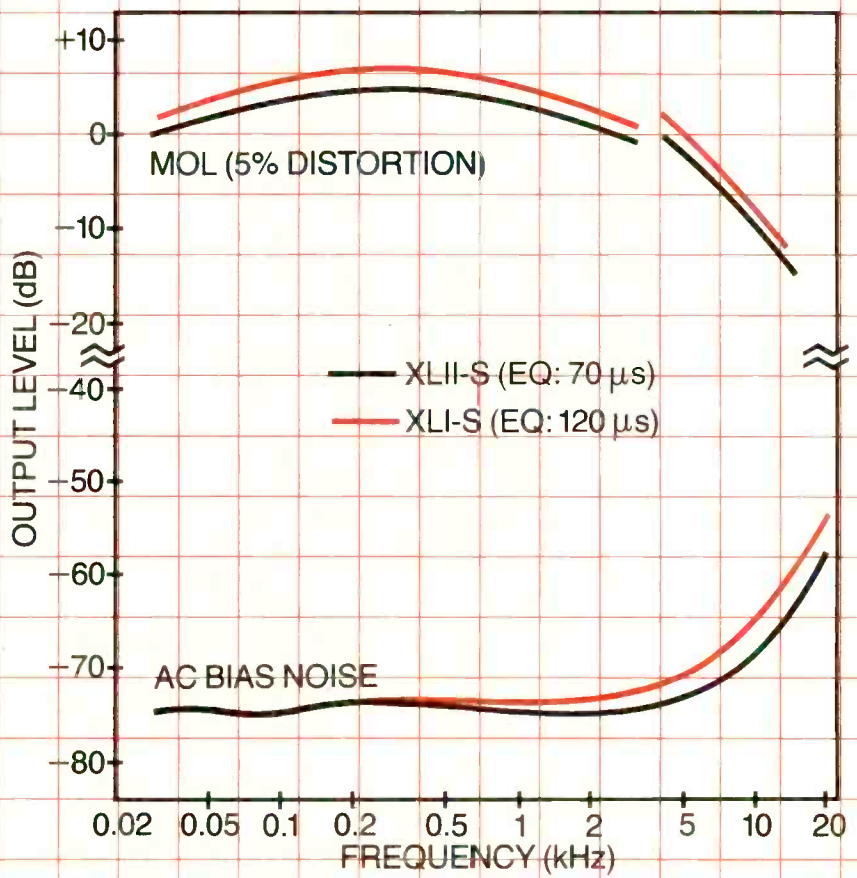

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You'll see both these improvements covered in detail in future Audiophile Files. In the meantime, we suggest you listen to them.

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IT'S WORTH IT.

"This year, 1983, my singers did the same music, two whole verses, without flatting, and so a 50-year wrong was righted."

(Do you happen to know the Beethoven *Coriolanus* Overture, the one that begins with what sounds like a series of enormous sneezes, *Aah-CHOO?* I once almost died laughing at a commercial recording, actually put on the market, which to my utter astonishment omitted the first sneeze and began with the second.)

All of the above sage comment, as you might guess, has come to mind as a result of my own latest semi-pro recording sessions, one this Spring and its twin of a year ago, done with my perennial home chorus, the Canby Singers of New York, who perform, as they say, a cappella, an incorrect term for singing without instrumental accompaniment. I've been intermittently involved with attempts to record them—since they are always right at hand—ever since 1955 or so when the wonders of magnetic tape began reaching out to those of us who weren't recording professionals. These latest two sessions put me back in the business—if you can call it that—rather surprisingly, after some five years of neglect.

Recording a chorus, I can tell you, is no easy thing, especially if you try to do most of it yourself instead of just following orders. Most of my experiments, frankly, were a dead loss, either musically, or technically, or more often, both at once. Though we did progress by the early '60s where, with friendly engineering assistance and a huge two-case Ampex 350-series stereo machine, we produced the music for our two Nonesuch recordings, still now extant after some 20 years.

I got back into chorus recording for the best of reasons. When I gave up, after a series of not too successful tries that left both me and the performers totally exhausted, I had learned a *very* great deal about what not to do in semi-pro recording. It took me five years to digest all the no-no's before, miraculously, I began to rethink a bit and to discover in my mind some new ways that might work better for all concerned. They are worth passing on to you, even though not all are strictly audio engineering. In recording, as anybody knows, audio and music (or whatever) are inextricably combined. Whatever affects one hits the other, and vice versa. There is nothing so

"And then there is digital. Must *everything* now be digital? . . . Does this spell the end of small-time recording enterprise?"

dismal to hear as a superb tape recording—in the audio—of an unusable performance. Too deadly dull or, worse, too hysterically excited; or full of mistakes or, maybe, just *one* inflexible (and uneditable) mistake. Or, equally sad, superb sound out of wrongly placed mikes, badly balanced, emphasizing the wrong things, diminishing the right ones. It's hell, I say. Except, of course, when—miraculously—everything goes right. Engineering *and* performance.

To achieve that on a semi-pro basis takes every bit of constructive thinking you can manage, and the worst thing you can do, I have found, is to go by the professional book, doing just what the Big Guys do. Some aspects—yes. But nothing slavish. So, for better or worse, I'll be giving you some of my thoughts on workable semi-pro procedure, to feed into your own personal computers when next you do your own recording.

In a way it's a matter of limits. Or should I say, compromises. You have to work hard, sometimes for years, to find the well known happy medium for your situation, as between strictly pro and unfortunately amateur. That goes across the board, from performance to engineering. I've oscillated erratically, myself, over the entire span between totally pro big-time recording (which I do not *do*, I merely watch!) and the wholly amateur type, so deceptively easy with all those nice cassette machines in their millions hovering in every hand.

(At my most recent singing rehearsal—not for recording—two kids came into our church auditorium with their hands partly full of a few little packages of some sort and asked whether they could record us. I suspect they had a miniature cassette machine. I said that the church wasn't mine and they would have to see the proper authority, the caretaker in the other room. That was the last of them. No recording was done.)

In this oscillation you live and learn. My first-ever recording of any sort was informal, around 1933. On college vacation in the big city, four or five of us discovered what looked like a telephone booth and crammed into it, to sing Thomas Morely's "My Bonnie Lass She Smileth" onto a pregrooved, uncoated aluminum, 78-rpm disc, activated automatically by a quarter. I still have that piece of aluminum somewhere, and if you want to hear how poor S/N can be and still allow audio intelligence to be made manifest, you should just listen. The noise is perhaps three times as loud as the signal; the disc plays only about a minute. And yet, says the intelligence unequivocally, we not only sang "faw, law, law" instead of 'fa, la, la" but we flatted almost a whole tone. Some things get through *any* amount of surface noise. This year, 1983, my singers did the same music, two whole verses, without

"At the beginning of tape I was obsessed—most of us were—with the extraordinary freedom it brought to recording."

flatting, and so a 50-year wrong was righted.

At the beginning of tape I was obsessed—most of us were—with the extraordinary freedom it brought to recording. We mistakenly thought that this meant a kind of extreme informality, where you could record any old thing without anybody even noticing. Quite true, technically; but results were predictable, as we now can understand. The ratio of useful material to useless audio jargon was (and remains) about 1:100,000. There have been marginal benefits, of course, most noticeably in folk/ethnic recording where an unobtrusive presence has often brought superb recorded material, so to speak, out of the bush. But that is a special usage.

My initial enthusiastic mistake was to think that now (huzza, huzza!), I could just set up a tape recorder at the Canby Singers meetings and lo—we would have *records*. This was early-on, remember—we were all pretty unsophisticated then in terms of tape recording. I recall all too well my first sessions, at a church in upper Manhattan, to which I hauled the original Ampex 600 mono reel-to-reel recorder, the first machine with two tracks on one tape (one at a time). We tried this and that, and I got nowhere. *But* nowhere! I didn't even know how to edit in those days. The chorus was intimidated by all the preparations—mike cable, electric connections, etc., etc. and very quickly became uptight. This was new, remember. And I was trying to run the machine myself as well as conduct. Yet because nobody else was on hand—just me, as usual—I could not get those singers to rise to the occasion and sing well. As everybody knows, recording can be a terrible letdown the first time, when you realize you have no audience—except a vague and imaginary one. When, just as you get nicely started, a police car goes whooping by and ruins the take, then discouragement is instantaneous. It grows, it mushrooms. I have nothing but bits and pieces of music, plus much lecturing from a frantic me, on those old tapes.

But the opposite? Let's do it like the Real Pros—schedule a formal recording session with all the trimmings. This was my next step and it did, as one could guess, produce results. But at what a cost! Didn't the pros always record for six hours at a time and always at three in the morning? Didn't they invariably get down 20 takes of each portion of the music in hand? We could not manage quite that, but we tried. Once, we recorded from Saturday morning until around one o'clock at night, with sandwich breaks. Ugh! If you think our published records sound a bit anemic here and there, however lovely, you will now understand. *That* was what I gave up for good, five years ago. Now we do it better—and I'll tell you how—later. A

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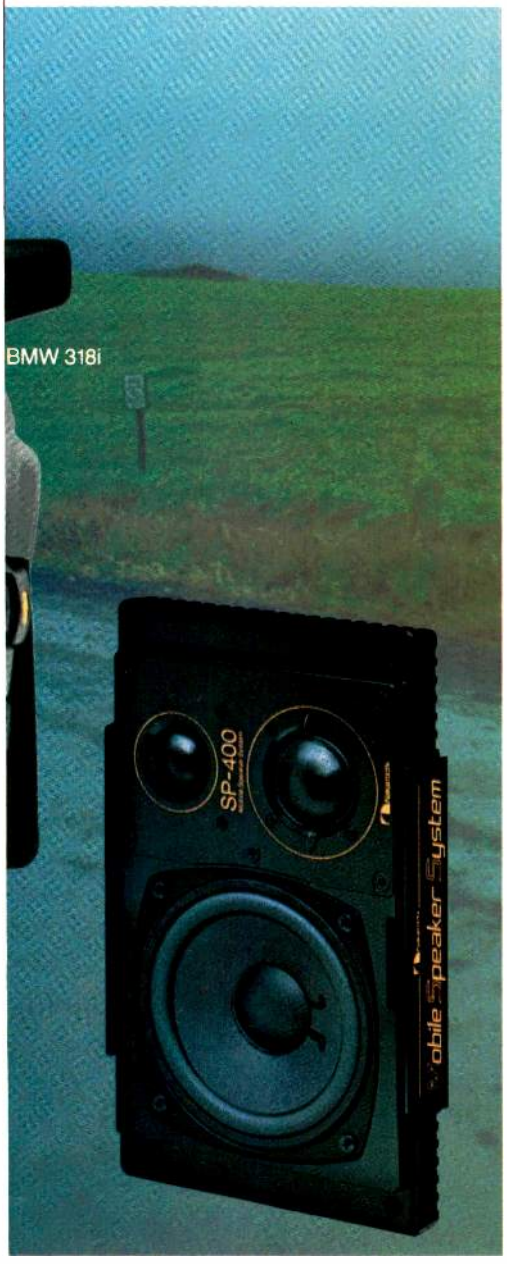

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PARIS AUDIO: Los Angeles
PETER'S AUTO RADIO: San Francisco
THE RADIOMAN: San Diego
REUS AUTOSOUND: Villa Park
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TAPE GUIDE

HERMAN BURSTEIN

Unbalancing Act

Q. I have been using AKG microphones in a balanced-line configuration, terminating in line transformers to plug into the high-impedance input of my tape deck. I recently acquired a mixer whose instructions indicate that the inputs are low impedance. My problem is how and whether to convert to unbalanced line for the input to this mixer. I assume that one of the two balanced-line terminals from the microphone should be grounded to the cable shield, leaving only one hot connection. Which one should be grounded? Where should this ground connection be made? May I continue to use my existing three-wire (two inner conductors plus shield) microphone cable in an unbalanced line configuration? Should I leave the unused conductor unconnected at both ends?—Wayne Welty, Decatur, Ga.

A. I don't think it makes any difference which hot lead is grounded. Ordinarily, the ground connection should be made at both ends of the cable. Sometimes, however, it may turn out that grounding just at one end or the other minimizes hum. I think you can continue using your present cable without problems. You will have higher capacitance than with two-wire cable, but this should not raise a problem with a low-impedance mike and a cable that is not excessively long. [*Editor's Note:* Make sure, though, that you ground the same pin on each mike, to maintain polarity.—*I.B.*]

Can A New Head Cause Static?

Q. My portable cassette deck recently had a new head installed. At first it sounded great, but now I occasionally hear a static noise that I never heard before. This happens only when playing back tapes recorded from TV programs; I place the mike in front of the TV speaker and keep the TV at normal volume. When I record my voice, there is no such noise. Do you know what could cause this?—Wade Marshall, Chicago, Ill.

A. Inasmuch as your problem occurs only with tapes recorded from TV and not from other sources, it seems most unlikely that the fault could be in your deck. Perhaps your new tape head is reproducing high frequencies better than the old one, and therefore allows you to hear things you didn't before. Perhaps when your deck was in for repair, its bias was adjusted for better treble response. And there is the possibility that your TV isn't working as well as before. For example, if there is high-voltage arcing in your set (more likely to occur when the weather is humid), a mike placed close to the set could pick up the snapping sound although your ears don't pick it up where you sit.

Tape Squeak

Q. I have a problem with a well-known tape brand that I have been using lately. These tapes usually develop an annoying squeak or chirping near the end. Sometimes the problem occurs nearer the beginning, and the squeak is accompanied by a slowing of the tape. Tapes of other manufacturers do not seem to have this problem. Could you tell me what the problem might be?—Mary Mulry, Gainesville, Fla.

A. It has been found on a number of occasions that some very good tapes are not compatible with some very good decks from the aspect of squeal or squeak. This might be true of all tapes of a particular type made by a manufacturer, or it might be true only of a particular batch of these tapes. If you can exchange your troublesome tapes for new ones of the same brand, the latter might work satisfactorily.

The squeak may be due to the environment in which the tapes are used (temperature and humidity conditions), to an incompatible lubricant contained in the tape, or to a set of cassette shells which are difficult for your deck to handle. It is hard to be more precise without getting involved with a great deal of highly detailed measurement and analysis.

Fielding a Question

Q. I scanned the tape path of my deck with a magnetometer and was surprised to find some fields of about 12 Gauss right in the region of the tape path. These fields are present only when the reel motors are running, and the meter returns to zero when I push

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

stop. I've had the deck a couple of months and so far have not noticed any sign of erasure or high-frequency loss, but with this high a measured value of magnetic field, it may be that over a period of time the tapes will experience such effects. If the magnetometer readings seem excessive to you, please tell me if you think I should have the matter checked by the manufacturer.—J. M. Reilly, New Castle, Del.

A. It doesn't seem that the field strength you measured presents a problem. I go partly on the basis that you have noticed no signs of high-frequency loss. Further, the spacing of the tape from the fields and its orientation with respect to the fields may be such as to minimize the loss. (The greatest danger is when the *heads* show an appreciable magnetic field.)

On the other hand, I see no reason why you should not bring the matter to the attention of the deck manufacturer. If you get an interesting reply, I would appreciate hearing further from you.

(Mr. Reilly did query the manufacturer and received the following reply: "The magnetic field you are encountering is caused by a solenoid and should not affect the deck's performance.")

Brand X Tape

Q. I see advertisements for 1800-foot tape reels, used once, for about $1 per reel. Do you know the source of this tape? Would it be dependable? It seems odd that such tape be used only once and then discarded and resold.—James E. Allan, Fairborn, Oh.

A. I have no way of knowing the source of this tape and what kind it is. I do not even know whether it is truly audio tape; it might be slitted video or computer tape. And I usually have suspicions about such "bargains;" for example about its lubrication, its shedding charateristics, its magnetic properties (whether it will work suitably with the bias and equalization typically found in home decks), with the accuracy of its slitting (whether it will tend to skew or jam as it travels between the guides and other elements of the tape path), with the number of splices in the tape, and so forth.

You might buy one of these tapes and determine for yourself whether it is satisfactory.

Will KEF's new Standard Series Loudspeakers meet the standards of the British Hi-Fi reviewers?

Here's what the British Hi-Fi press said about the original Standard Series:

CARLTON

"As we have come to expect from KEF, the construction and finish are exemplary."

"...very precise and detailed...quite good depth discrimination."

"...output well in excess of what people would tolerate in their home."

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HI-FI NEWS & RECORD REVIEW
1982

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November, 1981

CODA

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AUDIOCLINIC

JOSEPH GIOVANELLI

Speaker Cable

Q. Is there any advantage in using 16-gauge wire instead of 18-gauge wire when connecting a pair of speakers that will be located approximately 100 feet from the amplifier?—Steve Hood, Independence, Iowa

A. Considering the run of 100 feet of cable between your amplifier and your speakers, there is definitely an advantage in using 16-gauge wire over 18-gauge line. In fact, losses are great enough because of this long cable run that even the 16-gauge wire is not large enough. I suggest that you use 14-gauge wire or even heavier.

Such a wire size is too cumbersome to allow fastening it directly to the speakers. You will need to splice in a short length of No. 18 or perhaps No. 16 wire in order to make the proper connections to the speaker. Another alternative is a special connector.

It may be that you are using a "wall box" from which your speaker cables will emerge. This is often the case. In that instance, the splicing can be done within the box, using wire nuts or perhaps solder and electrical tape. Of course, the heavy-gauge wire could also be brought to a connector and its mating connector could be fitted to the lighter gauge wire. If you use this latter method, ***Do not use standard electrical plugs and outlets!*** This scheme is likely to result in the accidental application of 117 volts to the loudspeakers, with disastrous results! It is also a potential fire hazard.

Receiver Fading

Q. I own an AM/FM stereo receiver. When I play it at a low volume, the sound sometimes fades in and out or the sound shifts from one speaker to the other. What could be causing this?—David Huffman, Terre Haute, Ind.

A. I can think of two causes for the problem you have described.

First, there may be a defective electrolytic capacitor in one channel. This would account for the volume sometimes fading out, causing a shift of stereo balance over to the channel not affected by the problem. The receiver will play properly when run at higher volume because the added signal feeding into the defective capacitor shocks it into more or less normal operation.

The cure for a defective capacitor is to replace it—after doing some signal tracing to locate the bad one. The offending component might be a coupling capacitor or it might be an emitter-bypass capacitor.

The second cause for erratic volume might be a dirty or oxidized control. If most of the oxidation is at the lower end of the control, the contact between the element and the slider will not be solid, leading to volume changes.

In a similar manner, oxidation of contacts in tape monitor, selector and mode switches—as well as the balance control—all can produce annoying fluctuations in volume.

In any event, the cure is to spray the offender with suitable contact cleaner and immediately exercise the knob. This will allow the cleaning agent to spread over the innards of the element and thereby do its job.

"Formed" Electrolytic Capacitors

Q. My Dynaco PAT-5 is so wired that, even when its power switch is off, there is a small amount of power still applied to the circuitry to keep the electrolytic capacitors "formed"—to prevent deterioration.

What would be the results in this connection if I left my power amplifier on all the time? I am concerned about keeping its electrolytic capacitors "formed".—Charles E. Cump, Denver, Col.

A. If you use a piece of equipment regularly, there is no need to keep it turned on just to "form" its electrolytic capacitors. Deterioration of the dielectric will not be a problem except where the equipment is used infrequently.

Should this be the case, turn the equipment on at regular intervals, even though you may not wish to use it.

Piezo Tweeter Termination

Q. I replaced the tweeters in my system. The originals were rated at 20 watts at 6 ohms. The replacements are piezos. I was told that I should place a 6-ohm resistor across the terminals of each tweeter to be sure that the crossover network functions properly. The tweeters sound good as they stand, without the resistors.

Is my setup all right or should I use the resistors?—Thomas J. Rose, Bradley Beach, N.J.

A. What you were told about the need for connecting a resistor across the terminals of each tweeter was correct. With this resistor in place, the crossover network will produce the proper crossover frequency. Therefore, you are likely to notice an improvement in sound with the resistors installed over what you are hearing now. Without the resistors, the tweeters will be fed by frequencies which are lower than those intended to be reproduced by the tweeters. This will produce an overlap between the tweeters and midrange units, which may create audible peaks in the frequency response.

Tape Out and Preamplifier Out

Q. Is "Tape Out" or "Rec Out" on a receiver the same as "Preamplifier Out"?—Roger Ross, Peshastin, Wash.

A. "Tape Out" and "Rec Out" are not the same as "Preamplifier Out." "Tape Out" is extracted ahead of all volume and tone controls, whereas "Preamplifier Out" is taken from a later point in the circuit in order to include these functions.

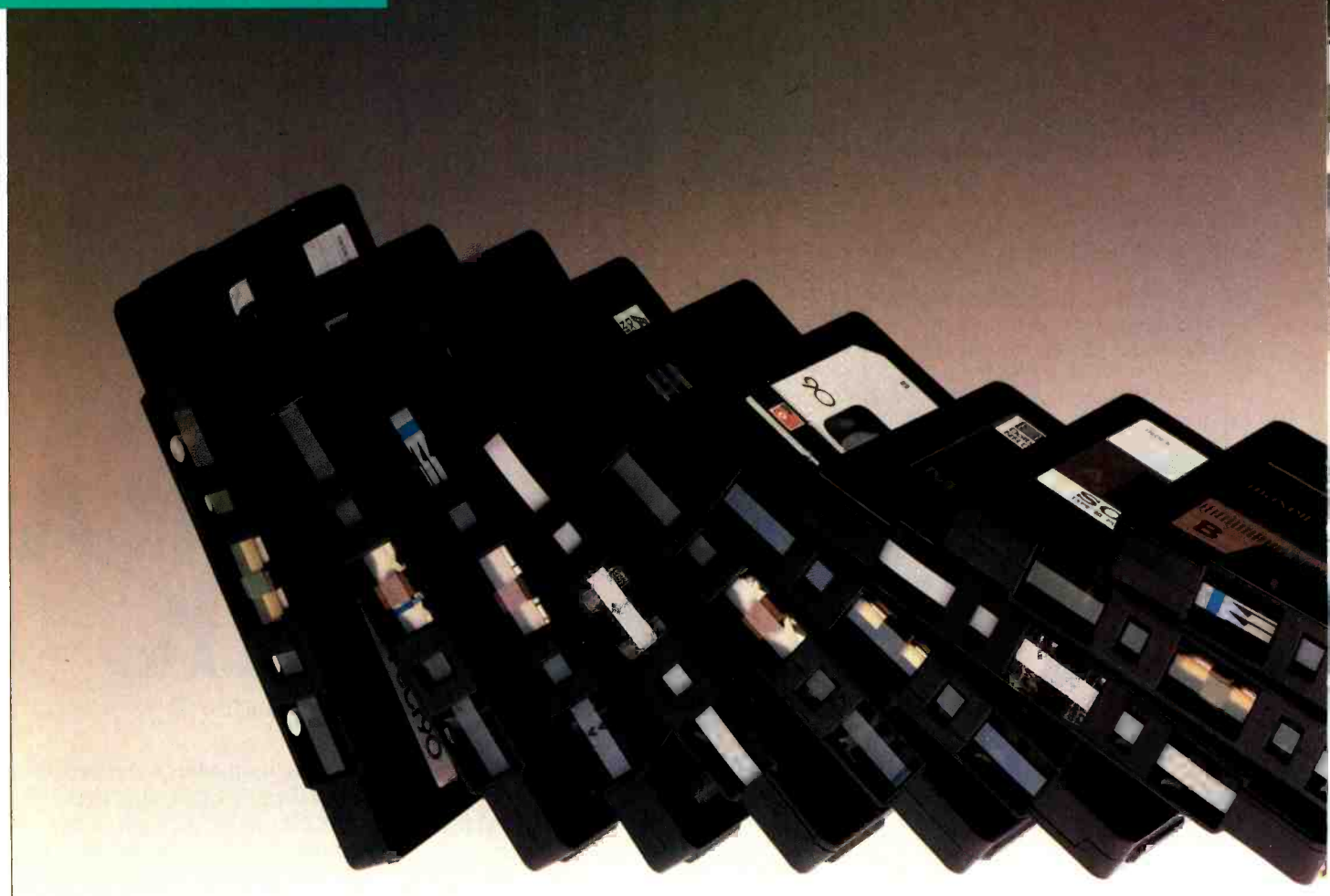
If you have a problem or question about audio, write to Mr. Joseph Giovanelli at AUDIO Magazine, 1515 Broadway, New York, N.Y. 10036. All letters are answered. Please enclose a stamped, self-addressed envelope.

MASS TAPE TEST

HOWARD A. ROBERSON

This year our tape survey covers 77 different formulations: 37 Type I (ferric/normal), 24 Type II (chrome-type/high bias), one Type III (ferrichrome type), and 15 Type IV (metal particle). About 50 manufacturers were contacted and asked to supply three C-90s of each of their tapes for the testing. The majority of them made some response, though some declined to supply samples, so the reader may find that a tape of interest is not covered. A few supplied C-60s as well, and those were subjected to some brief tests. The data reported, however, are primarily on the C-90s, with the exception of Magnex's metal Studio 4 which was available only in C-60s.

In general, the coverage is only on new or updated formulations; it is possible that some of those tested had only new shells or labels. New manufacturers not covered in any past surveys are DLK Acoustical Products, Irish, Magnex, MIS (Magnetic Information Systems), PD Magnetics, Swire, and Yamaha. Tapes not covered this time but in a previous survey and still in the manufacturers' lines are Denon DX1, DX3, DX7 and DXM; Memorex MRX-1; RKO XD, Broadcast I and Ultrachrome, and Sony FeCr. Speaking



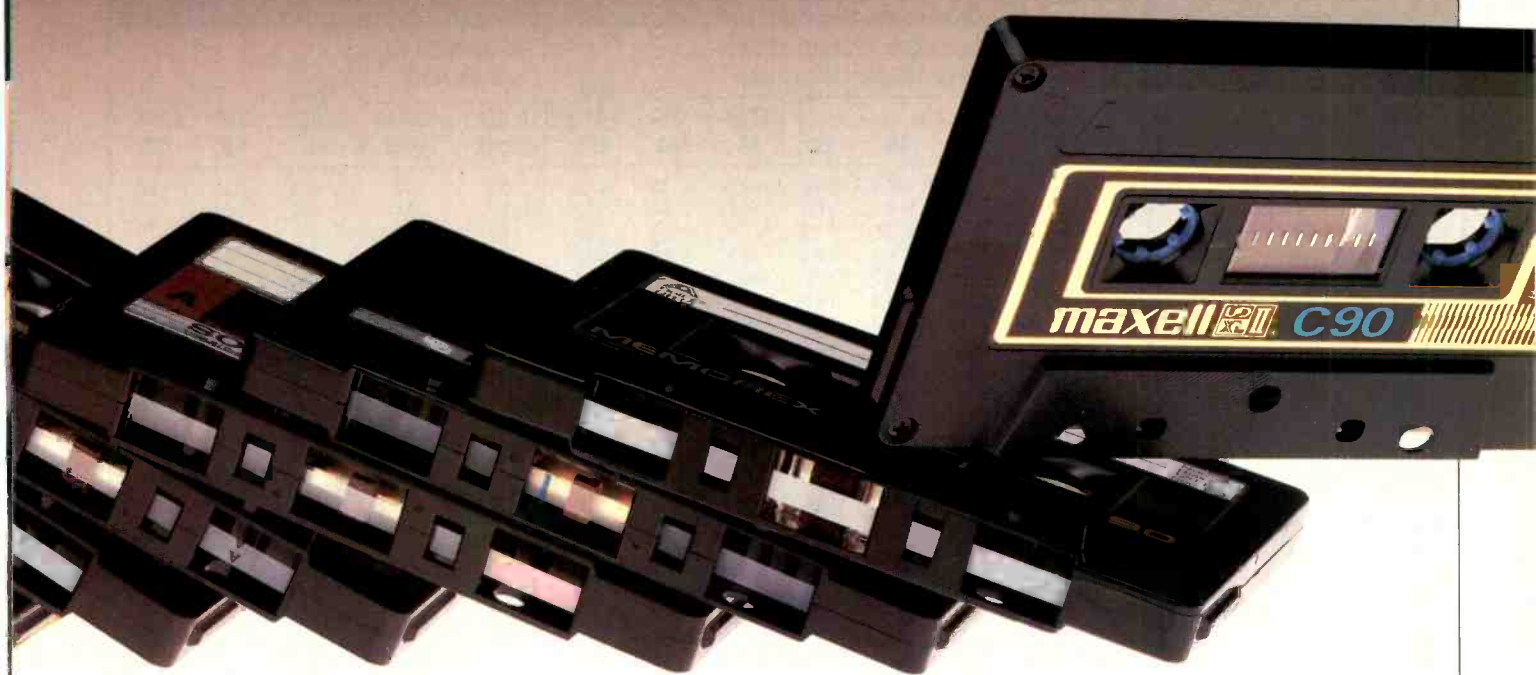
Photograph: Robert Lewis

77 CASSET

of Memorex tapes, they are from what is now Memtek Products, a division of Tandy Corporation. I feel certain that most of our readers know that Realistic is a Radio Shack brand name and that Scotch comes from the 3M Company. From now on, all references will be to brand name in these three cases.

A fair amount of good technical background information was received. Because of the large number of tapes covered, however, the specifications will not be listed and discussed, thereby saving space for more essential things. I will make a few comments, however, basically relaying what some of the manufacturers have said about their new offerings.

BASF emphasized improved Type I formulations with refined shells. There are also new names and packaging. Denon stated that the new DX4 has "extremely low static distortion" and is also free from "dynamic distortion." Fuji's new line first appeared about a year ago, and includes the benefits of "mono particle dispersion," "micro integrated orientation" and "high absorption polymer." JVC introduced the Dynarec line of cassettes, two Type Is and one Type II and one Type IV. Their F1 is the Type I tape in the popular series. Lorian announced new Type I and II formulations to "match or beat the best selling tapes." Maxell announced improvements in magnetic particles, binder system chemistry and mechanical construction, and the new "XL S, UD-XL and MX tapes incorporate major technological breakthroughs." The Memorex brand was expanded with the introduction of the dB Series, "an economical alternative to America's favorite audio tape." Sony has added UCX, a lower cost version "of the revolutionary UCX-S tape with the same microfine magnetic particles." In a sense, it replaces EHF, and the new BHF and



TTES RATED

"Bias and sensitivity differences of a dB or less from standard aren't detrimental—but greater ones cause Dolby mistracking on some decks."

AHF replace HFX and SHF, respectively. The performance of TDK's improved line benefits from increased remanence and coercivity for most tapes, reduced print-through for a number of them, and "making the Laboratory Standard Mechanism standard for all cassettes, except MA-R and D."

The Test Program

Each cassette was first tested by being fast wound and played for its entire length. There were no failures, though some chattered quite a bit. With both standard level tapes and the new IEC reference tapes, the Nakamichi 582's meters, output levels and bias current were calibrated for each of the tape types. The reference tapes for IEC Types I and II were provided by BASF, the tape for Type III came from Sony, and TDK supplied the Type IV reference tape. With the bias figure determined and the 400-Hz output voltage measured with a standard test tone with each IEC tape, every cassette was checked for bias requirements and sensitivity, both expressed in dB relative to the IEC tape. Differences of a dB or less from the reference should not be considered detrimental, but greater deviations could cause Dolby mistracking—*if* the deck is set up to match the IEC tapes.

Each and every tape was also checked on both sides using a pink-noise source and a ⅓-octave RTA: This is an excellent way to see the effect of bias differences and to observe changes in skew with time or from turning the cassette over. High-frequency response variations shown by the RTA require checking to pinpoint whether the cause is skew- or bias-related. Based upon these checks and the earlier ones on bias and sensitivity, one C-90 was selected as typical from each group of three. Bias was adjusted for the best response at 20 dB below Dolby level, but the response was not actually taken,

TABLE II—TEST RESULTS

			MAXIMUM RECORD LEVEL dB re 400-Hz Dolby Level						S/N	RESPONSE AT −3 db (kHz)		MOD		
			HDL_3 = 3%				TTIM = 3%							
BRAND	DESIGNATION	TYPE	100	400	1k	2k	5k	10k	RATIO dBA	0 dB Level	−20 dB Level	NOISE dB	BIAS dB	SENS dB
BASF	Performance I	I	+ 5.0	+ 6.4	+ 7.4	+3.6	−1.3	− 7.6	57.2	10.2	23.0	−45.6	−0.8	+0.2
BASF	Pro I Super	I	+ 6.2	+ 7.6	+ 8.6	+8.3	−0.2	− 6.4	57.2	10.7	22.7	−49.2	+0.5	+0.7
Certron	HE	I	+ 0.4	+ 1.0	+ 2.5	+1.9	−4.2	−10.5	52.1	8.7	23.3	−42.2	−5.1	−0.6
Certron	FRXI	I	+ 5.6	+ 6.3	+ 6.3	+4.3	−2.5	− 8.7	58.8	10.0	23.0	−46.8	−0.7	+0.9
Denon	DX4	I	+ 6.6	+ 7.7	+ 8.2	+7.2	+0.3	− 5.5	58.1	11.4	23.2	−48.3	0.0	+1.9
DLK	PRO-FI 1	I	+ 4.4	+ 5.0	+ 5.3	+4.6	−2.5	− 8.3	57.4	8.8	23.1	−41.0	−2.2	+0.4
Fuji	DR	I	+ 3.0	+ 4.4	+ 5.9	+3.6	−1.5	− 7.8	55.9	9.9	22.7	−49.8	+0.2	−0.9
Fuji	ER	I	+ 6.3	+ 7.2	+ 7.8	+5.4	−1.2	− 7.8	59.4	10.2	23.2	−49.3	0.0	+0.3
Fuji	FR-I	I	+ 7.0	+ 8.1	+ 8.5	+5.2	−0.6	− 7.5	60.2	10.9	23.5	−49.7	+0.2	+0.2
Irish	2000	I	+ 1.3	+ 2.3	+ 3.3	+1.8	−4.5	−10.7	53.4	9.0	20.9	−47.2	−0.3	−1.4
Irish	7000	I	+ 0.5	+ 1.8	+ 3.7	+3.9	−2.1	− 8.5	52.0	9.5	21.3	−46.7	−1.2	−1.1
JVC	F1	I	+ 2.9	+ 4.2	+ 5.9	+3.4	−3.5	−10.3	54.2	9.2	22.9	−46.8	−1.2	−0.3
JVC	DA1	I	+ 4.0	+ 5.5	+ 7.3	+5.8	−1.8	− 7.9	56.0	10.0	21.7	−50.0	−0.5	−0.4
JVC	DA3	I	+ 4.2	+ 5.5	+ 6.2	+3.4	−2.5	− 9.0	58.2	10.1	22.3	−47.8	0.0	+0.1
Loran	Normal	I	+ 3.1	+ 4.2	+ 5.3	+3.4	−2.3	− 8.8	56.9	9.7	22.5	−49.2	0.0	−1.1
Magnex	Studio LH	I	+ 3.7	+ 4.2	+ 4.1	+3.0	−2.5	− 8.5	56.1	9.8	23.7	−40.8	−1.8	+0.6
Magnex	Studio 1	I	+ 3.4	+ 5.1	+ 6.6	+5.4	−1.5	− 7.5	56.8	10.2	23.1	−42.0	0.0	+0.3
Maxell	LN	I	+ 2.1	+ 2.9	+ 3.6	+1.8	−4.0	− 9.5	53.2	9.3	22.0	−49.2	−1.1	−1.5
Maxell	UD	I	+ 5.8	+ 7.0	+ 7.4	+4.9	−1.0	− 7.3	59.0	10.7	22.8	−47.5	−0.2	+0.4
Maxell	UD-XL I	I	+ 6.7	+ 8.2	+ 9.4	+7.0	−0.3	− 6.6	59.4	11.1	23.9	−50.1	+0.2	+0.5
Maxell	XL I-S	I	+ 7.3	+ 8.6	+ 7.9	+3.6	−2.5	− 8.8	61.0	10.8	22.6	−51.3	+0.3	+1.3
Memorex	dB	I	+ 3.6	+ 5.4	+ 7.6	+7.3	−2.5	− 9.1	57.6	9.2	23.4	−45.9	−1.4	+0.4
MIS	XR	I	+ 3.8	+ 5.5	+ 7.7	+7.1	−2.0	− 9.1	56.5	9.5	24.3	−47.6	−1.3	+3.7
Nakamichi	EXII	I	+ 5.4	+ 6.8	+ 7.9	+4.2	−1.6	− 8.4	58.1	10.2	23.5	−47.5	0.0	+0.2
PD Magnetics	Tri-Oxide Ferro	I	+ 5.5	+ 6.6	+ 7.1	+5.7	−2.2	− 8.6	56.9	10.4	22.6	−47.4	−1.2	+0.5
Realistic	Supertape Gold	I	+ 4.6	+ 5.7	+ 6.5	+3.0	−2.6	− 8.9	55.7	10.3	22.8	−44.2	−1.1	+0.4
Scotch	XSI	I	+ 4.4	+ 5.7	+ 6.2	+4.2	−2.8	− 9.1	57.7	9.9	23.2	−48.0	−0.7	0.0
Sony	LNX	I	+ 3.1	+ 4.4	+ 5.6	+2.9	−3.4	− 9.3	53.7	10.2	22.6	−48.0	−0.6	−0.9
Sony	BHF	I	+ 6.4	+ 8.1	+ 9.5	+5.3	0.0	− 7.0	58.3	10.9	23.3	−46.9	+0.1	+0.6
Sony	AHF	I	+ 6.4	+ 7.9	+ 9.1	+5.2	+0.2	− 6.5	60.3	11.1	23.3	−50.2	+0.6	−0.1
Swire	Laser XL	I	− 2.8	− 1.5	− 0.1	−2.6	−3.2	− 9.5	49.7	9.3	21.8	−46.0	−1.5	−2.5
Swire	Laser UHDI	I	+ 2.7	+ 3.3	+ 3.6	+1.0	−2.4	− 9.2	54.6	10.0	23.6	−47.8	−0.3	−0.7
TDK	D	I	+ 3.9	+ 5.3	+ 6.7	+3.6	−2.4	− 9.0	55.7	9.5	22.9	−49.3	−1.0	−0.4
TDK	AD	I	+ 4.8	+ 6.3	+ 7.9	+4.7	−1.0	− 7.2	58.8	10.6	23.2	−47.4	+0.4	−0.4
TDK	AD-X	I	+ 7.8	+ 9.3	+10.0	+6.0	+0.3	− 6.5	60.4	10.9	24.1	−48.0	+0.4	+0.6
Yamaha	NR	I	+ 4.9	+ 6.3	+ 7.6	+4.8	−1.0	− 7.4	58.8	10.6	23.4	−45.0	+0.2	−0.1
Yamaha	NR-X	I	+ 7.9	+ 9.5	+10.1	+8.1	+0.3	− 6.3	60.8	11.1	24.7	−47.9	+0.6	+0.3
BASF	Pro II Chrome	II	+ 4.1	+ 5.9	+ 6.6	+2.9	−4.5	− 9.6	61.5	9.1	21.9	−52.3	0.0	−0.2
Certron	FRXII	II	− 0.9	+ 0.7	+ 0.8	−0.1	−6.2	−10.7	56.8	8.3	23.1	−41.8	+0.1	−0.1

although the −3 dB upper limit was. Many tests have shown that there is substantially no difference in −20 dB responses among almost all tapes of all types, when bias is set for best response with each tape. The responses were plotted at Dolby level (with the same bias setting) to show how the tapes compared in high-frequency headroom. Differences here are indicative of how well a formulation will do in recording music with high levels of high-frequency energy.

As stated above, the higher level response checks were made at Dolby level, with a reference flux level of 200 nWb/m at 400 Hz. The IEC (and the forthcoming EIA) level reference is 250 nWb/m (at 315 Hz), which is just about 2 dB higher. I would find it appealing to be able to say that the reference level I use follows international standards, but unfortunately there are very few cassette decks which give the user the slightest indication where 250 nWb/m might be. Almost every deck does have that little Dolby double-D symbol, however, and a number of decks, including Nakamichi, have meter zero at Dolby level. So the response tests discussed above and the checks for MRLs (maximum record levels) all refer to Dolby level. In the case of the MRLs, the figures given are for the change in input recording level relative to that producing Dolby level on the tape. The actual record/playback values that would be obtained on a particular deck would be lowered by the usual compression or saturation effects.

The MRLs are very important: Good tapes have high MRLs, and poor tapes have low ones. High MRLs let the user record at a higher level for the same distortion limit, and higher MRLs usually go with higher signal-to-noise ratios—in other words, greater dynamic range.

MRLs were measured at 100, 400, 1000 and 2000 Hz with a single tone, and with twin tones at 5 and 6 kHz, 7

			MAXIMUM RECORD LEVEL dB re 400-Hz Dolby Level						S/N	RESPONSE AT −3 db (kHz)		MOD		
			HDL_3 = 3%				TTIM = 3%		RATIO	0 dB	−20 dB	NOISE	BIAS	SENS
BRAND	DESIGNATION	TYPE	100	400	1k	2k	5k	10k	dBA	Level	Level	dB	dB	dB
Denon	DX7	II	+ 4.7	+ 6.1	+ 6.2	+2.9	−6.1	−11.2	59.6	9.2	23.3	−49.4	−0.1	+1.3
DLK	PRO-FI 2	II	+ 1.2	+ 2.5	+ 2.8	+1.4	−5.8	−10.4	56.5	8.2	22.6	−46.2	−0.1	−0.5
DLK	PRO-FI 3	II	+ 1.2	+ 2.7	+ 3.1	+1.4	−7.0	−12.3	56.0	9.4	22.5	−51.3	+0.5	−0.5
Fuji	FR-II	II	+ 4.8	+ 6.4	+ 7.2	+4.4	−4.8	−10.3	60.0	10.1	22.3	−51.4	−0.5	+1.2
JVC	DA7	II	+ 2.9	+ 4.7	+ 5.4	+2.2	−7.7	−12.3	59.4	8.9	24.1	−50.0	0.0	+1.1
Loran	High Bias	II	+ 6.3	+ 7.6	+ 8.4	+4.3	−2.2	− 7.6	60.9	10.8	23.1	−48.6	+1.1	+1.7
Magnex	Studio 2	II	+ 3.5	+ 4.6	+ 4.5	+2.9	−5.5	− 7.6	59.4	9.6	24.4	−44.2	0.0	+0.1
Maxell	UD-XL II	II	+ 4.9	+ 6.3	+ 7.0	+4.0	−4.8	−10.2	60.6	10.0	22.1	−50.1	+0.2	+0.8
Maxell	XL II-S	II	+ 7.0	+ 8.6	+ 7.7	+3.8	−6.0	−11.3	63.4	10.3	25.1	−50.7	+0.2	+2.7
Memorex	HBII	II	+ 2.3	+ 3.7	+ 4.0	+2.1	−5.7	−10.9	59.0	9.7	23.5	−45.7	+0.5	0.0
Nakamichi	SX	II	+ 4.6	+ 6.2	+ 7.3	+4.2	−4.6	− 9.9	59.5	9.9	21.7	−48.4	−0.4	+1.3
Nakamichi	SXII	II	+ 4.9	+ 6.7	+ 7.7	+5.1	−4.7	− 9.9	60.5	11.2	23.9	−50.6	+0.1	+2.5
PD Magnetics	500 Crolyn	II	+ 2.9	+ 4.5	+ 4.3	+1.1	−7.6	−12.6	60.1	8.6	22.0	−46.4	−0.6	0.0
Realistic	Supertape Hi-Bias	II	+ 1.5	+ 2.7	+ 2.8	+0.5	−5.8	−10.9	57.1	9.3	21.8	−45.3	−0.4	+1.1
Scotch	XSII	II	+ 3.9	+ 5.5	+ 6.1	+2.7	−5.9	−11.2	58.6	9.6	24.1	−50.5	0.0	+1.4
Sony	UCX	II	+ 6.7	+ 8.2	+ 8.8	+4.5	−4.6	−10.0	62.2	10.1	22.6	−49.8	−0.5	+2.3
Sony	UCX-S	II	+ 6.1	+ 7.8	+ 8.7	+4.2	−4.3	− 9.9	62.5	10.3	21.9	−48.5	−0.1	+2.0
Swire	Laser UHDII	II	+ 1.8	+ 3.5	+ 3.0	−0.2	−8.9	−13.8	59.8	8.0	21.5	−46.4	−0.2	−0.9
TDK	SA	II	+ 5.9	+ 7.6	+ 8.5	+3.7	−4.0	− 9.9	61.6	9.9	20.3	−50.3	−0.1	+1.3
TDK	SA-X	II	+ 5.1	+ 7.0	+ 8.1	+5.2	−4.6	−10.3	61.9	11.1	23.8	−50.7	0.0	+2.8
Yamaha	CR	II	+ 4.8	+ 6.2	+ 6.7	+4.4	−5.5	−10.8	60.2	9.4	22.2	−49.3	−0.5	+0.9
Yamaha	CR-X	II	+ 6.4	+ 8.1	+ 9.1	+5.2	−4.1	− 9.7	61.1	11.3	22.7	−49.9	+0.3	+2.7
BASF	Ferrochrom III	III	+ 6.4	+ 9.2	+ 7.9	+3.6	−7.6	−13.1	64.2	9.4	23.8	−50.8	+1.5	−0.4
BASF	Metal IV	IV	+ 6.5	+ 8.1	+ 8.8	+5.5	−2.2	− 7.3	60.3	12.5	25.5	−50.5	0.0	−0.5
Fuji	FR Metal	IV	+ 8.6	+11.0	+12.6	+7.4	−0.3	− 5.9	63.3	12.7	23.9	−47.7	+0.7	+0.2
JVC	ME-PII	IV	+ 7.3	+ 9.0	+10.0	+6.6	−0.5	− 6.5	60.6	12.2	23.1	−51.6	+0.4	−0.7
Loran	Metal	IV	+ 8.7	+ 9.9	+ 9.6	+6.1	−1.7	− 6.8	62.1	12.7	25.4	−47.1	−0.2	+0.3
Magnex	Studio 4	IV	+ 7.2	+ 9.1	+ 9.8	+5.7	−1.6	− 6.8	60.9	12.9	25.4	−49.0	−0.1	0.0
Maxell	MX	IV	+ 8.7	+10.7	+11.9	+7.6	−0.3	− 5.8	64.0	13.0	25.0	−52.6	0.0	+0.6
Memorex	Metal IV	IV	+ 7.7	+ 9.8	+10.9	+5.9	−0.6	− 6.1	62.3	13.1	25.5	−48.3	+0.6	+0.2
Nakamichi	ZX	IV	+ 7.1	+ 9.2	+10.6	+6.6	−1.3	− 6.6	62.2	12.7	25.3	−50.2	0.0	0.0
PD Magnetics	1100 Metal	IV	+ 7.8	+10.1	+11.2	+6.4	−1.0	− 6.3	62.7	13.3	25.4	−49.7	+0.5	+0.1
Realistic	Supertape Metal	IV	+ 7.3	+ 9.2	+ 9.6	+5.5	−2.1	− 7.6	62.3	12.7	25.5	−48.9	−0.5	−0.1
Scotch	XSM	IV	+ 6.2	+ 7.9	+ 8.5	+4.9	−2.6	− 7.5	60.1	12.8	25.6	−48.0	−0.6	−0.3
Sony	Metallic	IV	+ 9.7	+11.7	+12.8	+7.7	+0.6	− 4.8	64.0	13.5	25.1	−49.4	+0.6	+0.7
TDK	MA	IV	+10.3	+12.5	+13.3	+8.2	+0.7	− 5.3	65.3	13.0	24.5	−49.2	+0.7	+0.9
TDK	MA-R	IV	+ 8.1	+10.2	+10.9	+6.2	−1.5	− 6.9	62.1	13.0	25.7	−50.8	−0.6	+0.2
Yamaha	MR	IV	+ 7.2	+ 9.4	+10.7	+6.5	−1.4	− 7.2	62.0	13.1	25.4	−50.2	+0.2	−0.6

"Most tapes have low skew, consistent bias and sensitivity needs, stable output levels without audible dropouts, and pretty equal flutter."

and 8 kHz, and 10 and 11 kHz. The defined limit was 3% for the third-order products of distortion. The twin-tone tests required use of a spectrum analyzer to examine the relevant distortion products. The noise level from each tape, both with A and CCIR/ARM weightings, was measured while in record mode but with no input signal.

The reported signal-to-noise ratio (in dBA) is the total of the 400-Hz MRL figure and that for the measured ratio between Dolby level and tape noise. (CCIR/ARM figures were 2.6 dB lower than dBA figures.) Modulation noise was measured by recording a 1-kHz tone at +3 dB, notching out the tone in playback and passing the result through a 500- to 1500-Hz filter. The residual is made up of tape noise and sidebands of energy from modulation caused by the high-level tone. High modulation noise can give a rather buzzy quality to a high-level recording, particularly with something like an isolated trumpet.

A 3000-Hz tone was recorded, and the playback was checked for output-level stability, dropouts, and flutter. A wandering output level can be quite detrimental, particularly if it is rapid. Dropouts, of course, can be very obvious if they are deep and of some duration. Flutter *is* important, but in most cases, not that much will show up in tests on one deck. If the figures are extreme, then they have some significance. Some fast checks of 15-kHz play loss were made of Type I tapes, but no data are reported in this survey as the problem appeared to be considerably lessened with some of the new formulations.

Test Results

Most numerical data from the tests are listed in Table I. Note that the tapes are in alphabetical order for each of the IEC types. The exact 3-dB down points for both levels are given in the table, and, of course, they appear for Dolby level in the plots of the swept responses. Overlaid on each of those are dashed lines showing the MRLs from the table. An interesting facet (with a couple of exceptions) is that the signal-to-noise ratio for Type I tapes is usually just about 50 dB higher than the 1-kHz MRL. A similar relationship exists for the other tape types, albeit with a different base number. There is a great deal of data shown, but if you are looking for the "best" tape, let me suggest this approach: Scan the 1-kHz MRLs to find the tapes with the highest values, also checking the 10-kHz MRL figure. Then, look at the signal-to-noise ratio and the high-frequency limit (−3 dB) at the 0-dB record level. Finally, make certain the modulation noise is low. If you cannot adjust bias and record sensitivity on your deck, any selection made should match what your recorder was set up for.

Since our last survey, many characteristics of cassette tapes have improved, all to the benefit of the user. To help save space and minimize repetition, general statements will be made here and not repeated for the comments on the individual tapes: (1) The majority of tapes have very low tape skew, and are also consistent in sensitivity and bias needs; (2) the great majority of tapes have output levels that are stable within 0.3 dB and do *not* have dropouts that even approach audibility, and (3) most tapes had pretty much the same amount of flutter in the tests.

Type I Tapes

Two of the tapes reported on here had 1-kHz MRLs of at least 10 dB above Dolby level. With the exception of 0 dB high-frequency headroom, these tapes matched some of the metal tapes. With the use of Dolby C or dbx NR, the Type I tapes and their low distortion on most recorders become quite appealing.

BASF Performance I: Certainly a good Type I tape and very consistent in all of its characteristics. A great improvement over the previous version. (C-90, $4.19)

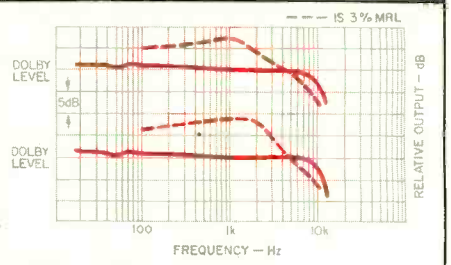
BASF Pro I Super: One of the best Type I tapes with very high MRLs across the band. This was very consistent throughout the testing. (C-90, $5.99)

Certron HE: This is a limited-use tape with very low bias needs, delivering but small MRLs with high tape and modulation noise. (C-90, $2.59)

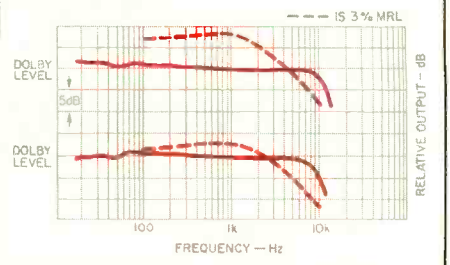
Certron FRXI: This is a great improvement over the HE formulation. FRXI has good MRLs and lower noise than most other Type I tapes. (C-90, $3.99)

Denon DX4: Denon is correct about

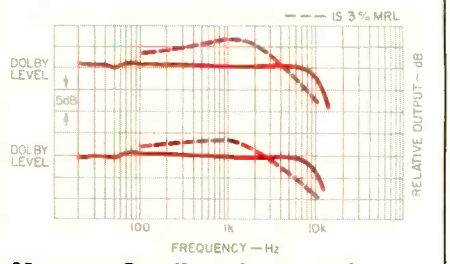
TYPE I



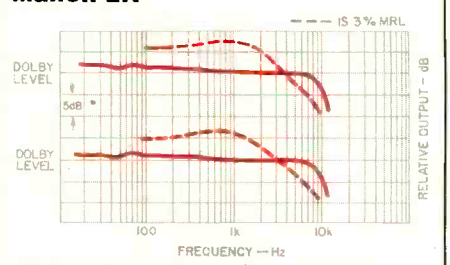
BASF Performance I (top) and Pro I Super



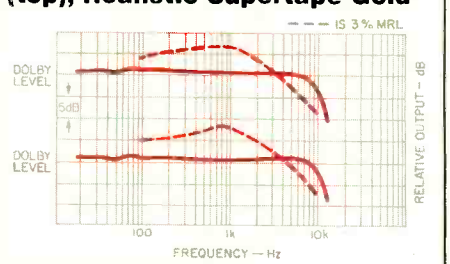
Fuji FR-I (top) and Irish 2000



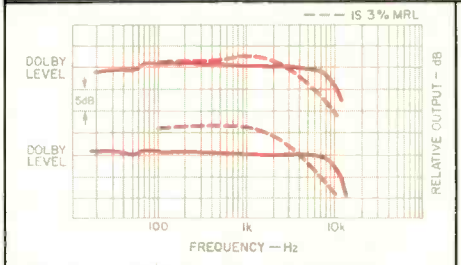
Magnex Studio 1 (top) and Maxell LN



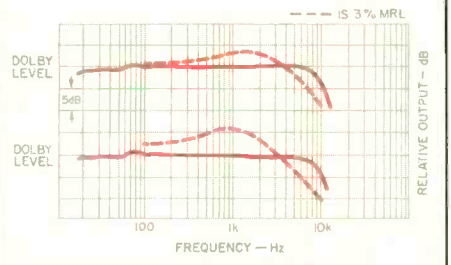
PD Magnetics Tri-Oxide Ferro (top), Realistic Supertape Gold



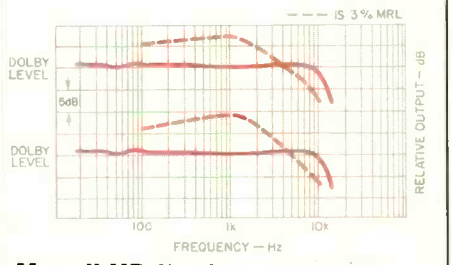
TDK D (top) and AD



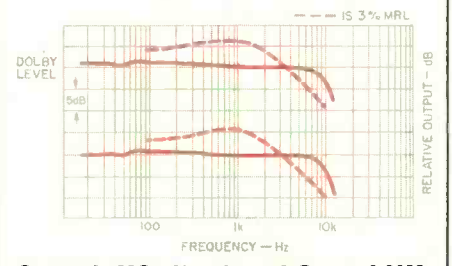
Certron HE (top) and FRXI



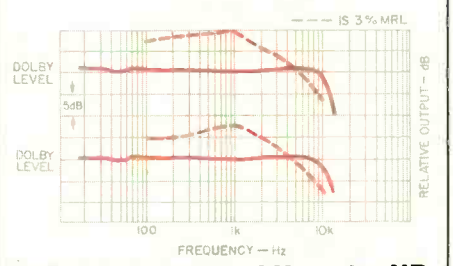
Irish 7000 (top) and JVC F1



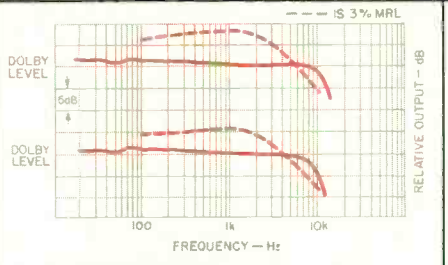
Maxell UD (top) and UD-XL I



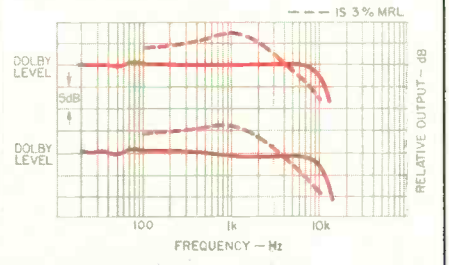
Scotch XSI (top) and Sony LNX



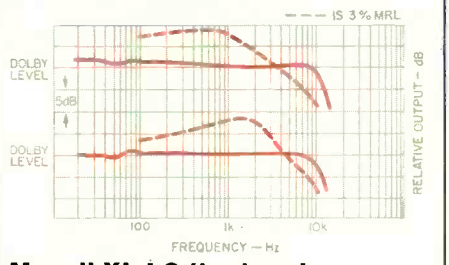
TDK AD-X (top) and Yamaha NR



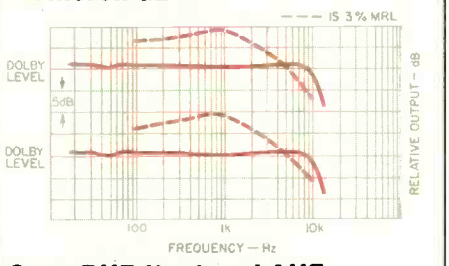
Denon DX4 (top) and DLK Pro-FI 1



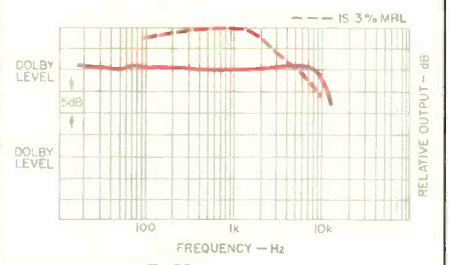
JVC DA1 (top) and DA3



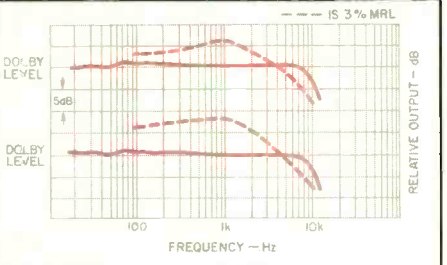
Maxell XL I-S (top) and Memorex dB



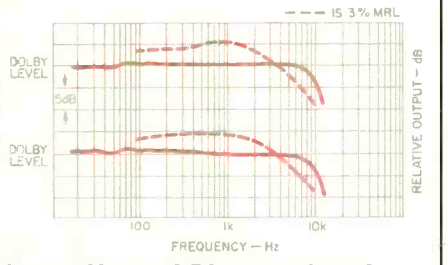
Sony BHF (top) and AHF



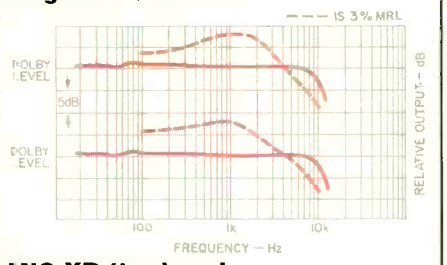
Yamaha NR-X



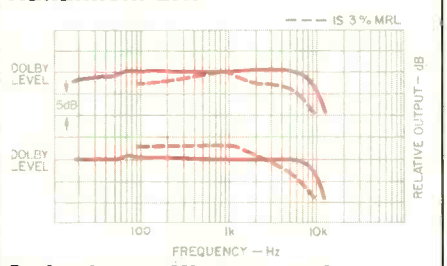
Fuji DR (top) and ER



Loran Normal Bias (top) and Magnex Studio LH



MIS XR (top) and Nakamichi EXII



Swire Laser XL (top) and Laser UHDI

"Type II tapes are improving. But quite a few still do not match the better Type I tapes in MRL or signal-to-noise ratios."

this tape. It is an excellent addition to the Type I tape selections, with very high MRLs and low noise. Excellent consistency, one of the best in this regard. (C-90, $5.99)

DLK PRO-FI 1: In most respects, this tape is quite good. The modulation noise was very high, perhaps related to the fact that the 3-kHz level varied rapidly over a range of almost 1 dB in playback. (C-90, $2.79)

Fuji DR: This is a good Type I tape in all respects, and it had better output stability than most. (C-90; $4.75)

Fuji ER: This is one of the better tapes, with high MRLs and very low noise. (C-90, $5.75)

Fuji FR-I: This is one of the best tapes in this category, with very high MRLs and very low noise. (C-90, $7.50)

Irish 2000: With low MRLs and so-so consistency, including occasional detectable dropouts, this is one of the poorer Type I tapes tested. (C-90, $2.15)

Irish 7000: Overall, this tape is close in performance to the other Irish tape: Unimpressive MRLs and inconsistent performance, wandering skew. (C-90, $2.70)

JVC F1: Not a bad tape for noncritical uses, with reasonable MRLs and excellent consistency. (C-90, $3.95)

JVC DA1: This is quite a good tape with good MRLs and excellent amplitude stability. There was a 1 dB spread in bias needs. Flutter was slightly high. (C-90, $5.25)

JVC DA3: This formulation was slightly different from DA1, perhaps somewhat better because of the lower noise. Consistency was among the best. (C-90, $6.95)

Loran Normal: This has fairly good MRLs, though not up to the standard set by the best Type Is. Bias and sensitivity were completely consistent, but skew was not. (C-90, $7.95)

Magnex Studio LH: This was the first Italian-manufactured tape to be tested, so there was great curiosity on what the results would be. This is their lower quality Type I tape, and the MRLs were not that great and the noise a bit high. (C-90, $3.99)

Magnex Studio 1: This formulation is certainly better than the LH from Magnex, as is shown in the higher MRLs, but there was little improvement in the noise performance. The C-60s were a close match for the C-90s. (C-90, $4.59)

Maxell LN: A nonpremium tape for not-too-demanding applications, due to its low MRLs. Excellent consistency.

Maxell UD: A tape of good performance with fairly high MRLs and good noise performance. Very consistent, with excellent output-level stability. Lower flutter than most.

Maxell UD-XL I: An excellent tape, with very high MRLs, good responses and low noise. Very consistent in all respects, with superior output-level smoothness and stability. Lower flutter than most.

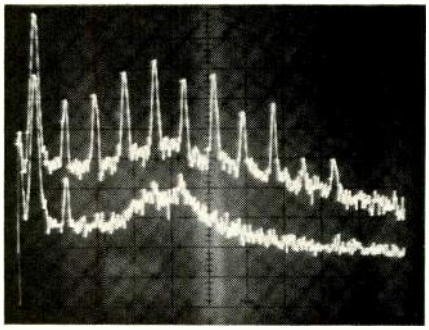


Fig. 1—Spectrum of playback of 2-kHz tone recorded at 3 dB above Dolby level for Swire Laser UHDI (top) and Swire Laser XL (bottom); see text. Vertical scale, 10 dB/division; horizontal, 2 kHz/division.

Maxell XL I-S: This is also an excellent tape, but I expected to find its high-frequency MRLs higher than those for UD-XL I, not lower. A very consistent tape, albeit not as smooth as UD-XL I. (C-90, $7.29)

Memorex dB: This is quite good for a nonpremium tape, with fairly high MRLs and good consistency. (C-90, $3.79)

MIS XR: The cassettes received were identified as high bias, but standard high bias reduced the 400-Hz level by 4 dB! With Type I bias, there was still some high-end roll-off, but lowering the bias 1.3 dB below the IEC tape's level got the results in the table. Actually, quite good in all respects, with nice MRLs and good consistency. The flutter was higher than most cassettes. (C-90, $2.04)

Nakamichi EXII: This is a very good tape, with fairly good MRLs, low noise and excellent consistency, even between C-60s and C-90s. (C-90, $5.40)

PD Magnetics Tri-Oxide Ferro: This new entry into our tape testing performed quite well, bringing good MRLs, very good consistency, and low flutter. (C-90, $4.99)

Realistic Supertape Gold: This is another good Type 1 tape with fairly high MRLs. Consistency was good, though output-level stability was just fair. (C-90, $3.99)

Scotch XSI: This is a good tape that is superior to a number of others with the same MRLs because of its lower noise. Flutter was much lower than most.

Sony LNX: This nonpremium tape shows some limitations with so-so MRLs and noise. The consistency was excellent in general, and the output level was very stable. The flutter was one of the lowest measured of all tapes. (C-90, $3.15)

Sony BHF: This is an excellent tape, with very high MRLs, low noise, excellent consistency, and low flutter. A very worthwhile improvement over HFX. (C-90, $4.25)

Sony AHF: This is an excellent tape, quite close to BHF, although with even lower noise and flutter. (C-90, $5.20)

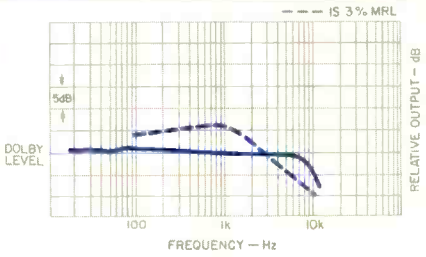
Swire Laser XL: The MRLs are so low for this tape that it would be quite limited for recording most music for any purpose. Bias and sensitivity also very low, not matching most decks. (C-90, $1.89)

Swire Laser UHDI: The data listed in Table I indicates a considerable improvement in basic performance, although not at an impressive level. Of more significance, however, was the fact that the tape output evidenced what appeared to be a high-frequency oscillation. A spectrum-analyzer scan (Fig. 1) showed that with the test tones, there were harmonics up to the 17th (!) at high level. The cause was not determined, but the tape certainly has a limitation, to say the least. In the same figure, a sweep of the Laser XL tape (displaced downward for clarity) shows that it is not standard with the brand. (C-90, $2.59)

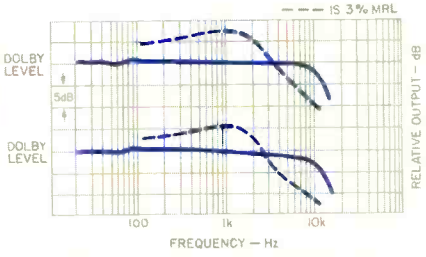
TDK D: Not bad at all for a nonpremium tape, with reasonable MRLs and excellent consistency including the match of C-60s to C-90s. (C-90, $3.39)

TDK AD: With improvements gained substantially in every category, this is certainly one of the better Type I tapes.

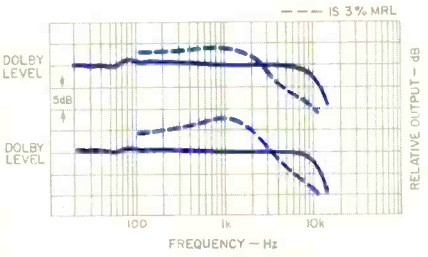
TYPE II



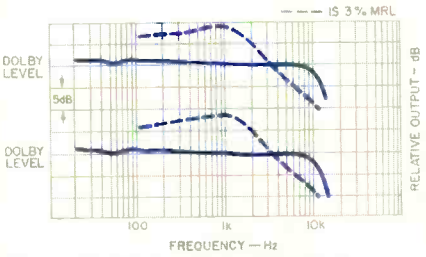
BASF Pro II Chrome



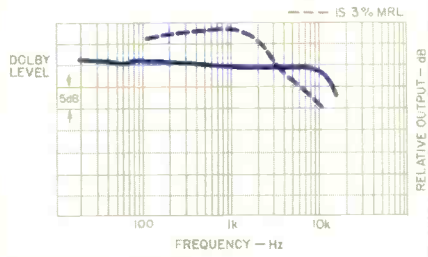
Fuji FR-II (top) and JVC DA7



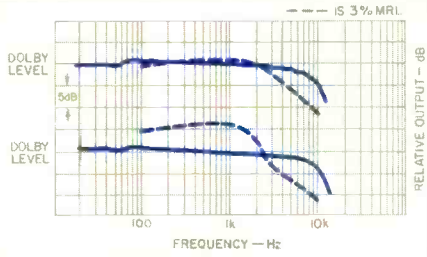
Memorex HBII (top) and Nakamichi SX



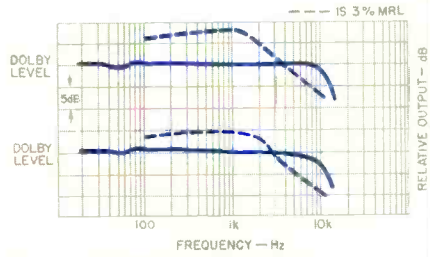
Sony UCX (top) and UCX-S



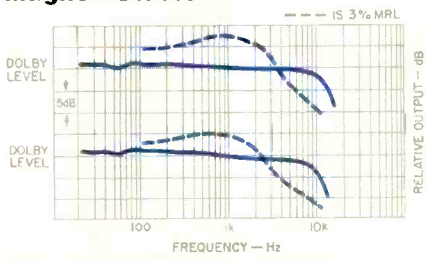
Yamaha CR-X



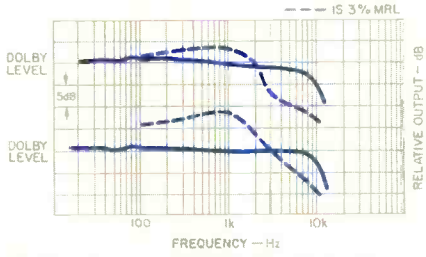
Certron FRXII (top) and Denon DX7



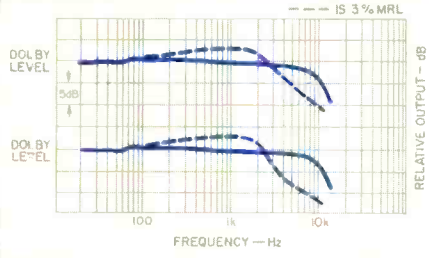
Loran High Bias (top) and Magnex Studio 2



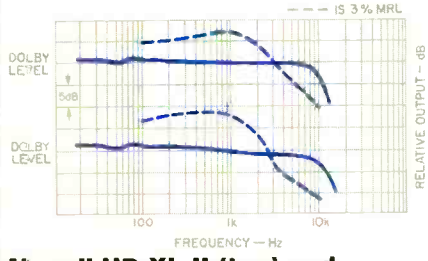
Nakamichi SXII (top) and PD Magnetics 500 Crolyn



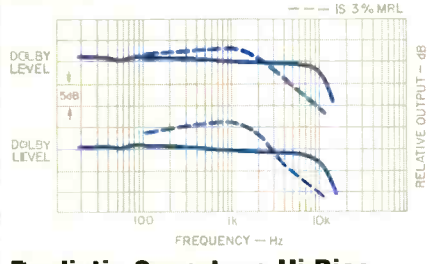
Swire Laser UHDII (top) and TDK SA



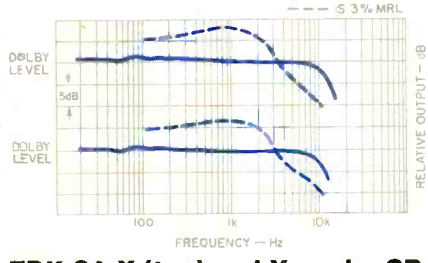
DLK Pro-FI 2 (top) and Pro-FI 3



Maxell UD-XL II (top) and XL II-S



Realistic Supertape Hi-Bias (top) and Scotch XSII



TDK SA-X (top) and Yamaha CR

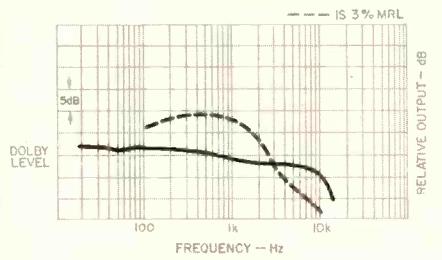
"For Types I and II, the distortion limit changes greatly from tape to tape. With Type IV tapes, the effect of a particular choice is less obvious."

Consistency was excellent, including the C-60/C-90 match. (C-90, $4.79)
TDK AD-X: This is one of the best Type I tapes, with outstanding MRLs, superior noise performance, and excellent consistency, including an especially good match between C-90s and C-60s. The output-level stability was better than most, and the flutter was lower than average. (C-90, $5.49)
Yamaha NR: This is another new entry into the testing of tapes, and a very good one it is, with high MRLs and low noise. There was some skewing, however, and some record-sensitivity differences from one side to the other. (C-90, $4.90)
Yamaha NR-X: With the best MRLs at most frequencies and close to the best signal-to-noise ratio, this could be the best Type I at this time. The three samples were completely consistent.

Type II Tapes

In a similar fashion to the Type I tapes, the Type II formulations show general increases in MRLs and signal-to-noise ratios. Quite a few Type II tapes, however, do not match those of the better Type I tapes anywhere in the band, nor do they have better signal-to-noise ratios. In other words, a Type II tape *might* be better than a particular Type I tape—but make careful comparisons between formulations.
BASF Pro II Chrome: This tape shows very good performance, with high MRLs and very low noise. All of the samples were completely consistent, and the output-level stability was excellent. There were no perturbations that could even be called dropouts; one of the best tapes in this regard. (C-90, $6.29)
Certron FRXII: This was one of the poorer Type IIs in this survey, with low MRLs and high noise. (C-90, $3.99)
Denon DX7: One of the good Type II tapes, with fairly high MRLs, low noise, and lower-than-average flutter. (C-90, $7.00)
DLK PRO-FI 2: This is a so-so tape, with low MRLs and high noise. The samples also had varying skew, and the flutter was higher than most. (C-90, $4.29)
DLK PRO-FI 3: Overall, this formulation was little different from the above, and it suffered from the same deficiencies. (C-90, $5.49)

TYPE III



BASF Ferrochrom III

Fuji FR-II: This is one of the better Type II tapes, with good MRLs and low noise, along with excellent consistency. (C-90, $7.50)
JVC DA7: The low-frequency MRLs are fairly good, but the high-frequency ones are on the low side. Excellent consistency doesn't help quite enough. (C-90, $7.45)
Loran High Bias: With excellent MRLs, good responses and low noise, this is one of the best Type II tapes in most important respects. (C-90, $7.95)
Magnex Studio 2: This tape is in the middle of the tested group with average MRLs, noise levels and responses. The C-90/C-60 match was very good. (C-90, $5.09)
Maxell UD-XL II: Certainly one of the better Type II tapes, with high MRLs, low noise and flutter and outstanding consistency. The output-level stability was perhaps the best of all tapes, with no dropouts of any type observed.
Maxell XLII-S: This is one of the best of the Type II tapes: High MRLs, low noise, good responses, and excellent consistency, to say nothing of low flutter. (C-90, $7.29)
Memorex HBII: With average MRLs and noise levels and some occasional inconsistencies, this tape gets a rating of average. (C-90, $4.79)
Nakamichi SX: With its good MRLs and excellent consistency, including C-60s, this is one of the better tapes. Flutter was less than most. (C-90, $6.30)
Nakamichi SXII: With its higher MRLs, lower noise and better responses, this tape is close to the best of the Type II tapes. (C-90, $8.00)
PD Magnetics 500 Crolyn: With rather low MRLs, unimpressive responses, and limited consistency, this tape does not rate well in comparison to most other tapes in this test group. (C-90, $6.79)
Realistic Supertape Hi-Bias: This tape is one of the poorer entries, with low MRLs, high noise, and bad skewing for one side compared to the other. (C-90, $4.99)
Scotch XSII: This is a fairly good Type II tape with good consistency, average MRLs.
Sony UCX: This is one of the best of the Type II tapes, certainly a most worthwhile addition to the offerings. Its MRLs are among the highest, with low noise to match. The consistency was excellent, as was the output-level stability, and no dropouts of any nature were observed. (C-90, $6.15)
Sony UCX-S: This is one of the best of the Type II tapes, very close to UCX, in fact. The flutter was very low, one of the best. (C-90, $7.00)
Swire UHDII: One of the poorer Type II formulations, with low MRLs, restricted responses, and miscellaneous inconsistencies. (C-90, $2.59)
TDK SA: This is one of the best Type II tapes, with very high MRLs, low noise, excellent consistency and low flutter. Its output-level stability was one of the best, and there were no dropouts observed. (C-90, $6.19)
TDK SA-X: In general, this was very close to SA in the tests, with a more extended frequency response. C-60s were also very consistent and a close match to the C-90s. Overall, one of the best. (C-90, $6.99)
Yamaha CR: One of the better tapes, with high MRLs and low noise. Lower flutter than most. (C-90, $6.20)
Yamaha CR-X: One of the best of the Type II tapes, and a worthwhile addition to what's available. High MRLs and low noise come along with good responses. (C-90, $6.97)

Type III

BASF Ferrochrom III: There aren't many Type III tapes around, and the tilted frequency response at 0 dB is not to be applauded. The current BASF version does offer good MRLs, especially at the low end, and the noise performance is excellent. The consistency was excellent, including the output-level stability. (C-90, $5.99)

Type IV

More manufacturers continue to join the once-small group making metal-particle tapes. There have been noticeable improvements in the performance of tapes in other type groups, but metal tapes are improving also, and they remain the tapes with superior MRLs, signal-to-noise ratios (sometimes), and frequency responses (all the time).

BASF Metal IV: The 0-dB response of this tape shows it to be metal type, but it is not exceptional in other respects. As shown in the plot figure, the C-120 response was actually peaked up and more extended than that for the C-90. The C-120's 400-Hz MRL was about +4 dB with the bias used, so it was limited in that respect, although it could be appealing for some uses. (C-90, $11.49)

Fuji FR Metal: With very high MRLs and low noise, this is one of the best of the Type IV tapes. There was some spread in the bias needs among the three samples (0.8 dB). (C-90, $10.75)

JVC ME-PII: This is basically a typical metal tape with generally very good performance, though not standing out from the group. (C-90, $16.95)

Loran Metal: This is another typical metal tape, in the middle of the group. (C-90, $15.75)

Magnex Studio 4: The results in the table were from the C-60s supplied (C-90s not available yet). Overall, the results fit in the middle of this high-performing group. Flutter was lower than most. (C-60, $7.99)

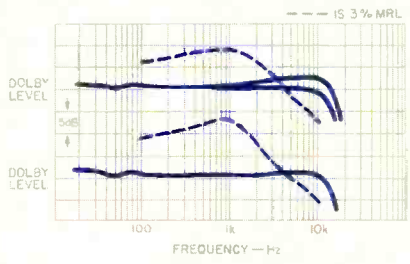
Maxell MX: The improvements announced have made this one of the best of the Type IV tapes, with very high MRLs and low noise. The flutter was very low, one of the best in that regard.

Memorex Metal IV: This is another tape in the middle of this well-performing group. It was generally very consistent, but there was some output-level wandering at times. The flutter was among the lowest. (C-90, $6.29)

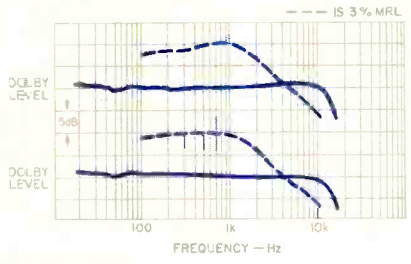
Nakamichi ZX: Yet another of the well-performing Type IV tapes. Consistency quite good, including the match between C-90s and C-60s. (C-90, $9.00)

PD Magnetics 1100 Metal: This is quite impressive for a newcomer, for it is a bit above average in this well-performing group. (C-90, $11.99)

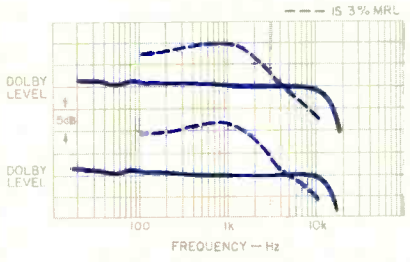
TYPE IV



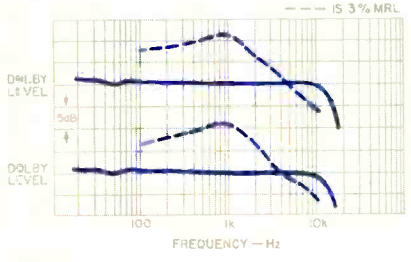
BASF Metal IV (top) C-120 (wider response) & C-90 and Fuji FR Metal



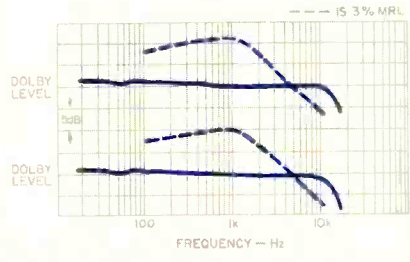
JVC ME-PII (top) and Loran Metal



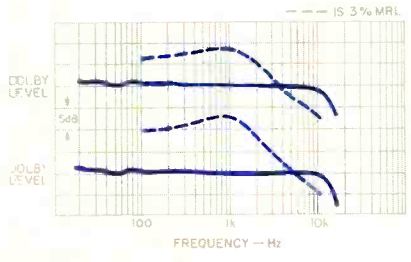
Magnex Studio 4 (top) and Maxell MX



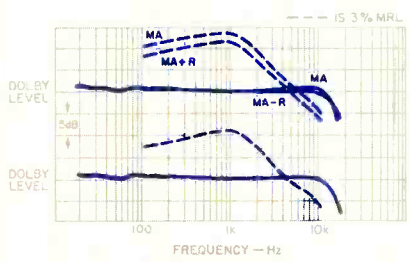
Memorex Metal IV (top) and Nakamichi ZX



PD Magnetics 1100 Metal (top) and Realistic Supertape Metal



Scotch XSM (top) and Sony Metallic



TDK MA and MA-R (top) and Yamaha MR

"Good tapes have high MRLs, letting the user record at higher levels for the same distortion—in other words, more dynamic range."

Realistic Supertape Metal: Another tape in the pack of metal tapes, it was completely consistent, one of the best metal tapes in that respect. (C-90, $6.99)
Scotch XSM: The MRLs are low for this tape in this Type IV grouping, and it is reflected in the relatively low signal-to-noise ratio. This is perhaps the most consistent of all the tapes tested.
Sony Metallic: This is one of the best of the Type IV tapes, with very high MRLs, low noise, and good responses. The consistency was excellent, and the flutter was among the lowest of all cassettes tested. (C-90, $11.50)

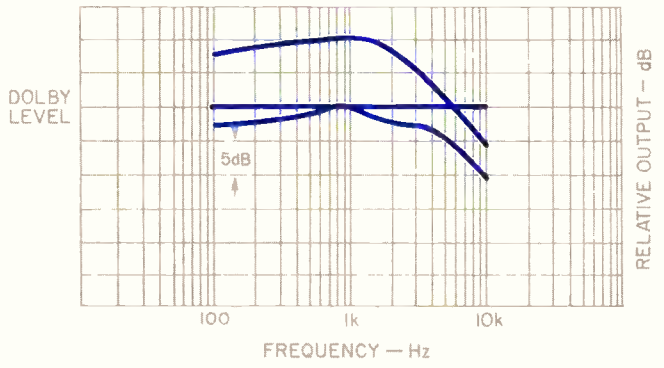


Fig. 2—Range of MRLs for Type I tapes.

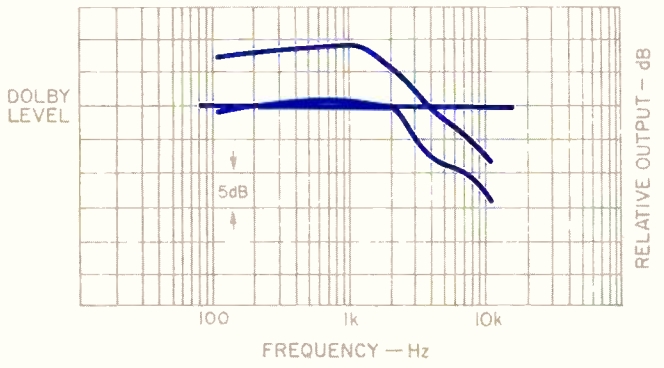


Fig. 3—Range of MRLs for Type II tapes.

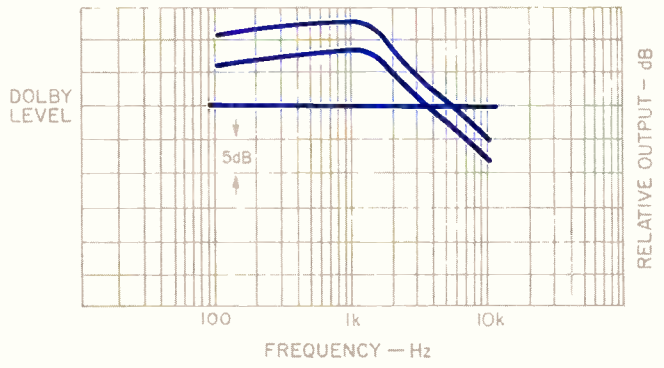


Fig. 4—Range of MRLs for Type IV tapes.

TDK MA: With the highest MRLs and the best signal-to-noise ratio of all Type IV tapes, it might well be the best of all 77 tapes tested in this survey. There were some slight inconsistencies among the samples, so I can't say it's best unreservedly. (C-90, $8.99)
TDK MA-R: While this is one of the better Type IV tapes, it did not measure up to the results I obtained with the MA samples. (I rechecked mid-band MRLs for both formulations a couple of times.) I must say that it was one of the best tapes for consistency, and the flutter was among the lowest measured. (C-90, $11.99)
Yamaha MR: This is a good entry into the Type IV metal tapes. The results were very consistent, but the flutter was on the high side. (C-90, $9.03)

Summary

I'm certain that most readers got the message that I believe that high MRLs may be the most significant parameter for good tape performance. Figures 2 to 4 show the range of MRLs measured for the various tape types (except III, of course). For Types I and II, it is obvious that the distortion limit changes greatly from one tape to the other. With Type IV tapes, the effect of particular choices is less obvious. A review of the results in Table I will confirm that it is possible to select a tape or two from Type I or II that will match at least one of the metal tapes in most respects. Do remember, though, that the higher coercivity of the metal tapes makes them much more stable and less likely to change with time, or with such external influences as heat, stray magnetic fields or pressure. The metal tapes cover quite a wide price range, however, and that situation might also affect your choices.

As suggested in past reports, check such matters as labels, boxes and cassette shells. The low cost of budget tapes usually seems emphasized by their poor quality in these areas. Some wrappings were quite hard to remove—challenging my patience and strength. I did like those with the easy-pull tabs, such as Fuji, JVC, Nakamichi and TDK. Always remember: The best tape for you is the tape that works best with *your* deck and gives you the greatest listening pleasure. I hope this article helps you achieve that goal.

Home Studio

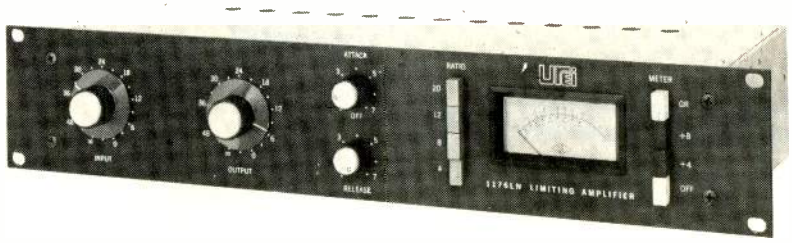
DO IT THE PRO WAY

How does a pro set up his home studio? Want to add some of the studio effects to your home-brew tapes? Here are a few answers from Contributing Editor Jon Tiven.

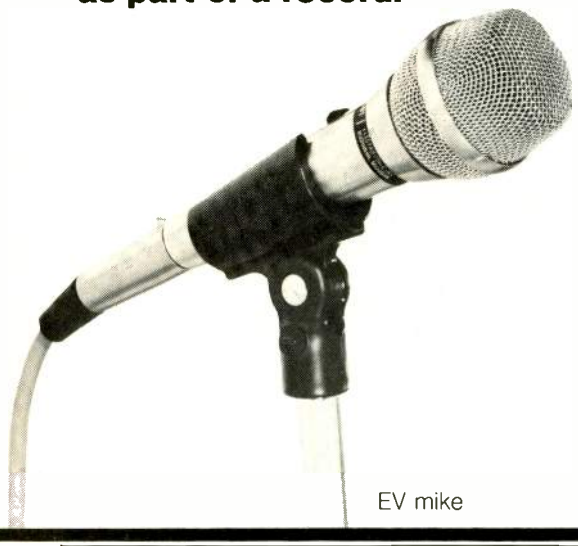
Over 10 years ago, when TEAC introduced their Model 3340, a medium-priced, four-channel open-reel recorder, the private at-home studio became the focus of many new products. Today, only a short time elapses between the introduction of a special sonic effect box into the studio or pro market and the emergence of a near-relative effect box for the aspiring amateur. And this is for good reason, because four-channel recording gave basement studios, based on bouncing signals from one tape recorder to another, a new

Photograph: Robert Lewis

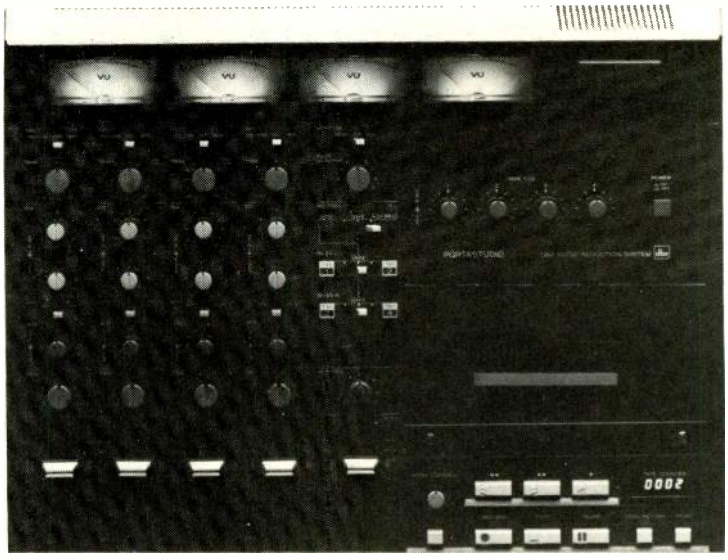
"It's become a fairly common occurrence for recordings made entirely at home to be issued as records. In other cases, a basic track, cut at home, winds up as part of a record."



UREI limiter



EV mike



TEAC Portastudio

chance to approximate pro sound. Indeed, using the TEAC 3340 or one of its imitators, at-home studios have produced a number of hits, or at least portions of hits. No longer would generation after generation of sound quality be lost, since the 3340 made it possible to record several instruments at once without the usual Gordian knot of patch cords. In short, the overdub had come into the home.

Recently, with the advent of drum-machine-based music, it's become a fairly common occurence for recordings made entirely at home to be issued as records. In many other cases, the basic track, after being transferred to a 24-track machine, is incorporated into the master tape and eventually into a disc. There is a reason beyond simple economics for this; the atmosphere allowed by such informal set-ups is far more conducive to creative performances than is the cold and stodgy ambience of most professional studios. The less-rigid home studio often captures music that isn't easily duplicated. For example, Bruce Springsteen's most recent album, *Nebraska,* was recorded on a home-style four-track cassette machine; considering how many hours he is reputed to spend in studios, which go for $150 per 60-minute bite, the savings in production costs on *Nebraska* must have been phenomenal. It is possible to make great-sounding tapes at home; the technological gap is narrowing.

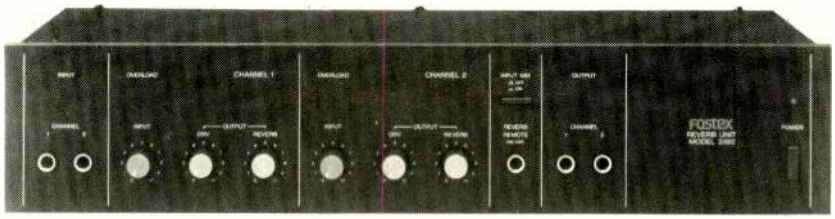
In my experience, most folks who have home studios aren't out to make records there or even do it for the money; it's simply a facility for enjoyment. So in hopes of making the home studio proprietor better aware of what's available to him, without killing the ol' bank account, I've compiled a guide, loosely speaking, to the various types of home studio gear. Along the way, I'll name a few specific models, but these units aren't the only ones around; they're just good examples of the type.

Tape Decks

When TEAC's 3340 first emerged, it was perfect for your basic rock band, because the guys generally had the other half of what was needed—the mixing board—from their P.A. system. But many home recordists had to buy their own mixers—that is, until fairly recently when the manufacturers started to produce all-in-one machines. Two good examples are the TEAC Portastudio and the Fostex Model 250, both four-track cassette decks that operate at 3¾ ips, have built-in noise reduction, and—most important—contain their own built-in mixers. The fact that they are cassette based eases the use of backwards recording and tape-handling in general, and even better, the sound of these units is superb. To top it off, the controls are user-friendly, which gives the recorder-mixer marriage a tremendous shot in the arm. Being able to control the EQ as well as handle outboard gear and four-channel bussing was almost as much of a boon to home recording as the introduction of the four-track recorder was. Add in such features as variable speed control, sliding faders, and zero-return functions, and these recorders become outright aids instead of obstacles that could block the creative experience.

As far as choosing a deck for receiving the mixdown, the same general rules apply to your prospective machine as they would to any tape deck you'd consider. Ease of careful maintenance is even more crucial than before, however, and one should also choose a deck that runs at 15 ips to insure that the master tape accurately reflects the sound one has achieved

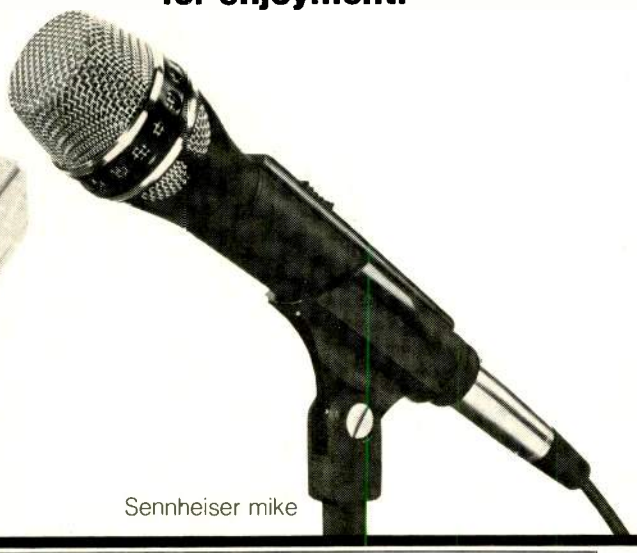
Fostex compressor



Fostex reverb

"In my experience, most folks who have home studios aren't out to make records there or even to do it for the money; they're simply facilities for enjoyment."

Fostex 250



Sennheiser mike

on the four-track. Both Technics and TEAC have excellent decks for this purpose, but they're not the only manufacturers making quality reel-to-reel decks and there are many options in this category. Other brands to consider are Otari, Revox and Tandberg, though they may be more expensive.

Reverb and Delay

There is much confusion here as many people refer to both reverb and delay as "echo." There is, however, quite a difference between these functions, and each can be used to good effect in the home studio. To clarify, delay is a single, articulate recreation of a signal, added a certain few milliseconds later. It's often used for a thickening effect or used in tandem with harmonic modulation to achieve phasing, flanging or a chorus (dependent upon the length of delay). Reverb is the creation of many short delays which are added almost at once to make the signal appear as if it had been recorded in a certain size and shape of environment. It delivers what some call a larger sound or a room sound (natural reverb is often referred to as ambient sound). These effects can be achieved through various means—digital, analogue or (in the case of reverb) even the spring system, and each has its own characteristics.

The most common reverb unit is probably the spring system, found in many guitar amplifiers and recently improved upon greatly by audio manufacturers. Fostex has a unit which incorporates a short electronic delay with a spring reverb system, and it delivers an excellent sound, particularly for vocals. In a slightly higher price bracket, the Mic-Mix Master Room XL-121 is an exceptional unit that allows the user to equalize the reverb and also has a built-in preamplifier. If one wishes to really go all out, manufacturers have come up with digital delay/reverb chambers. The Dynacord version has four different delay settings, four decays, and a digital delay built in as well. The unit is exceptional, but the price ($1500 approximately) will be prohibitive to some.

Where reverb was traditionally accomplished through the spring system, delay was accomplished through an auxiliary tape machine recording the signal on a tape loop and playing back the information milliseconds later. The invention of digital delay added flexibility and ease to this function, and the past five years has seen the price of home digital delay units dip well under $500. MXR's unit is a fine value for the money, as it includes easily operable modulation, phase inversion for the delay, and has an overall design which is nearly unbeatable. The Fostex reverb unit is also good and is designed to hook in to the Portastudio or 250 with great ease. The Dynacord DDL sounds good but isn't as flexible when it comes to choosing an exact number of milliseconds of delay. This particular effect is used to great advantage on most vocals that you hear on today's records, and is also quite useful for adding color to keyboards (in the shorter delay settings), guitars (in the chorus settings) or just about any musical instrument.

Compression and Limiting

The compressor/limiter is what some refer to as the invisible effect because if it's doing its job, you shouldn't really hear it. What it's designed to do is to even out the volume of a performance which otherwise would be too loud in places and too soft in others. The side effects of compression, if it's not done accurately, can make the background noise level jump around unpleasantly.

"It's the quality of the performance, not the equipment, that determines the worth of the tape."

Similarly, a limiter will strangle a vocalist if it's used with too much enthusiasm. There should be enough signal-to-noise in your system to handle most signal sources, but out in the real world there's hardly a vocal or acoustic guitar performance recorded without the aid of a compressor. Indeed, most records are put though limiters as a standard part of the mastering process, to prevent overcutting. At its worst, an overcut record will throw the stylus out of the groove.

The Fostex compressor is a reasonably priced unit that does the trick, in stereo yet, and has a built-in noise gate which is only effective when there is the most extreme amount of extraneous noise, as it isn't particularly sensitive. Another firm in this area is dbx, which may be more familiar for their noise-reduction system. However, they also have a compressor which some term the "One-Knob Wonder" because there aren't very many controls on it; even a pilot light is missing. Whatever your feelings about lots of bells and whistles, the sound of this unit is quite amazing. The UREI limiter is considered by many to be the industry standard, and although it's pretty expensive when purchased new, it is possible to purchase a used one for about $300. This unit retains its value pretty well if it has been reasonably maintained.

Noise Gates

The original purpose of the noise gate was to eliminate unwanted signals by sensing when the wanted signal was coming through and refusing to allow hum and buzzing while the wanted instrument/vocal was not active. As the word "gate" implies, it acts like a door, shutting off the track when intruders threaten the integrity of the recording.

Experimentation has proven gates to be effective in tandem with reverb units to control decay time, and they are also highly useful in general recording. They can be used to key one signal to the rhythm of another track—for instance, if you want to sound a keyboard note in time to the track, you can play a sustained passage on the keyboard and have the drums key it through the gate.

The Omni Craft GT4 is probably the best unit of this type available in the low price range, as it is quite flexible and responds with great accuracy and precision. The one problem is that it doesn't have an on/off switch or indicator; but this is a small complaint when taking into account the possibilities that the unit opens up.

The Rockman

This interesting little unit from Scholz is entitled to a space all by itself for good reason—it's sort of the all-in-one effect for the recordist or performer, with built-in compression, reverb, chorus, distortion, and preset EQ positions. Unfortunately, there is no inherent ability to control the amount of these effects; it just provides a "produced" sound instantly. There is a lot to be said for this unit, but it isn't a true substitute for the other effects—just a handy way to get a thicker sound without much thought. Still, it's hard to argue with the results one can achieve with The Rockman, particularly by plugging an electric guitar into it and feeding it directly into the board. The home recordist will find it a bargain at around $200.

Speakers

There is no such thing as being objective about speakers, and everyone's speakers tend to reflect their own personal tastes. For mixing, it is best to use speakers with as flat a response as possible. Don't be fooled into using tiny box monitors with 4-inch drivers simply because 4-inch speakers are used in street stereos where you want your record to be played. The mix that sounds good on your hi-fi system will also sound good on the small box, but the reverse isn't necessarily true.

Microphones

A hot mike in today's studio may tomorrow be outmoded, as the recording industry tends to be faddish in this department. AKG, E-V, Sennheiser, Shure, Sony and Neumann tend to stay within the parameters of what is acceptable, but personal taste and price will often determine your choice here. Used pro audio shops will often have exceptional microphones at very low prices simply because a certain style has fallen out of a studio's favor, so this is a highly recommended way of acquiring a top-notch mike. I was able to acquire a couple of second-hand Sony mikes at a fifth of the list price because they were battery-powered units "and the clients used to always leave them on and burn out the batteries." As the saying goes, one man's ceiling is another man's floor.

A Few Last Words

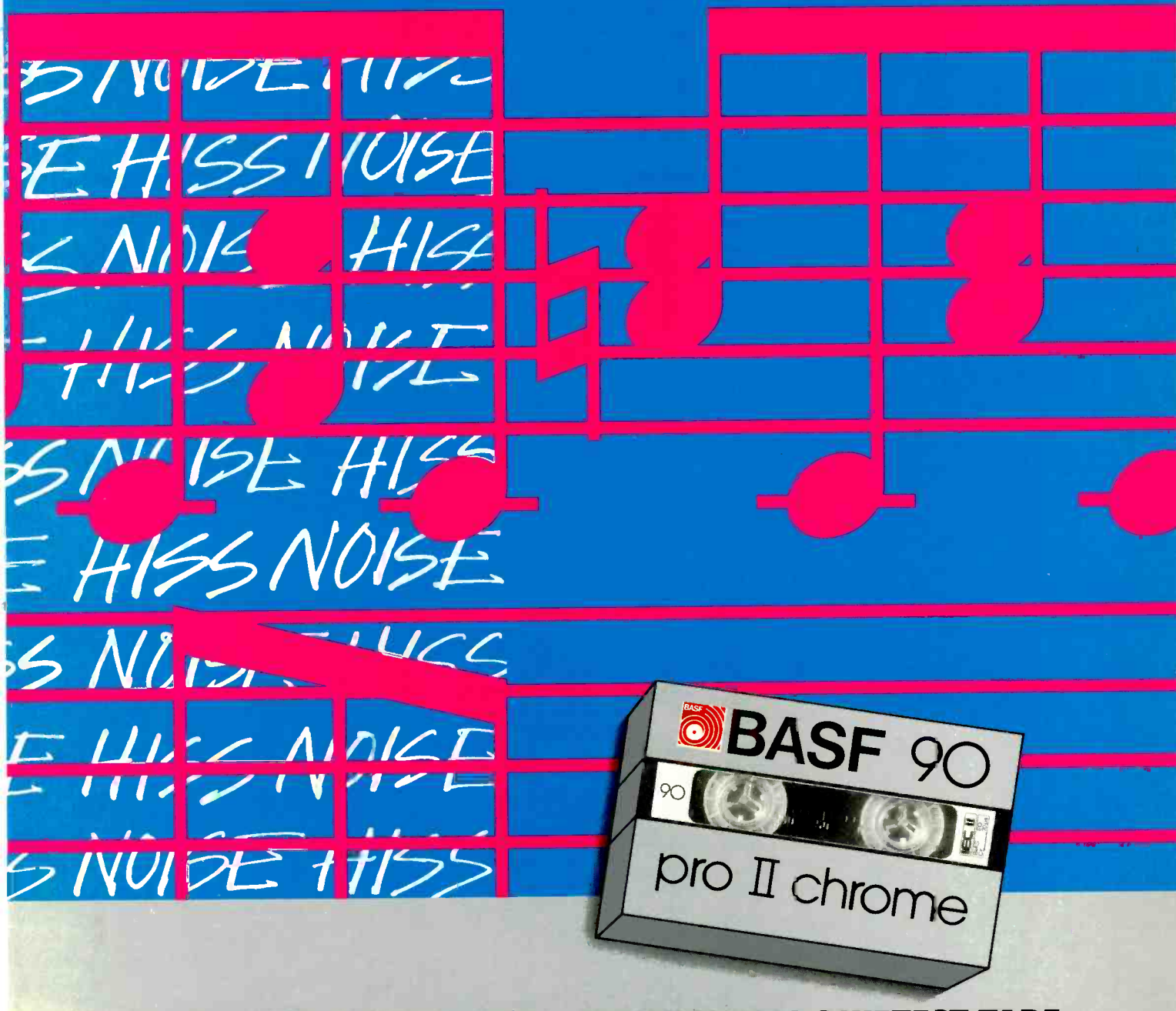
There is much to say about this subject, too much to detail in anything less than a very extensive book, so my apologies for any topics that I have breezed by. Line recording versus miked performances, baffling, microphone placement, bouncing, stereo spread, and lots of other subjects of great importance haven't been touched, due to the limitations of space. Perhaps if there is a demand, possible future articles will delve deeper into some aspect of non-commercial recording. And as each studio device becomes more familiar to the public ear, a simplified version will probably become available to the consumer at a greatly reduced price.

But keep in mind that whatever the limitations of your home studio, the musical performance it captures and the person running it ultimately determine the quality of the tapes, not the equipment itself. The first Beatles and Stones records were made on two- and three-track recorders, in many ways more primitive than the studio machines many of you have in your basements. So get those patch cords in place and run with it—and if you're lucky you might even be making a record before you know it.

"Used professional mikes can be had at low prices."

AKG mike

HEAR ALL OF THE MUSIC AND NONE OF THE TAPE...



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THE WORLD'S QUIETEST TAPE

If you won't settle for anything less than pure music, accept nothing less than BASF Pure Chrome audio tape. Unlike ferric oxide tapes, BASF Pure Chrome is made of perfectly shaped chromium dioxide particles. And that exclusive Chrome formulation delivers the lowest background noise of any tape in the world, as well as outstanding sensitivity in the critical high frequency range. And this extraordinary tape is designed especially for the Type II Chrome Bias position. So make sure you're hearing all of the music and none of the tape. Make the switch today to the world's quietest tape. BASF Chrome.

BASF
Chrome Audio & Video Tapes

Enter No. 17 on Reader Service Card

1

SONY
CDP-701 ES COMPACT DISC PLAYER

Manufacturer's Specifications
Frequency Response: 5 Hz to 20 kHz, ±0.5 dB.
S/N: 95 dB.
Channel Separation: 90 dB.
Harmonic Distortion: 0.003% at 1 kHz.
Wow and Flutter: Unmeasurable.
Audio Output Level: 2.0 volts rms.
Headphone Output Level: 28 mW (32 ohms).

Power Consumption: 120 V, 60 Hz, 32 watts.
Dimensions: 16.93 in. (43.0 cm) W × 4.13 in. (10.5 cm) H × 15.08 in. (38.3 cm) D.
Weight: 25.3 lbs. (11.5 kg).
Price: $1,500.00.
Company Address: Sony Drive, Park Ridge, N.J. 07656.
For literature, circle No. 90

It is less than a year since I first tested a CD player and reported my findings in *Audio*. That first CD player was a Sony CDP-101. It was also the very first CD player to actually become available to American consumers, having reached the initial selection of Sony dealers in March and April of 1983. Not content with having won the race to the marketplace, Sony has now come up with a second-generation CD player, the CDP-701 ES. It seems that "701" is the company's favorite number for all second-generation high-tech products, as witness their PCM-701, the second-generation digital audio processor (for use with VCRs) that we tested a few months ago. The new CDP-701 ES incorporates many programmable features not present on the earlier model but which have found their way into CD players introduced by some of Sony's competitors. The new buttons and displays are all additional to the controls and displays present on the first model, so let's quickly review those basic controls; then I'll tell you about the new ones.

The power switch and "timer play" switch have been shifted to the lower left of the new front panel. After the power switch is pushed, the digital display area to the right of the disc-loading drawer displays the numeral 1. Touch the "Open/Close" button on the disc drawer and it opens smoothly. Drop the disc you want to play into the drawer (no centering, no spindle to fumble with), touch either the "Play" or the "Open/Close" button once again, and the drawer closes quickly, centering the disc on the drive spindle which is inside. If you pressed the "Play" button, disc play begins in a couple of seconds. If you only closed the drawer with the "Open/Close" button, you then have the option of touching either the "Play" button to start that function or of depressing the track-advance button to select any track on the disc. There's a track-reverse mode too; one push of the button brings you back to the beginning of the track being played, while two pushes brings you to the start of the last previous selection, etc. The "Pause" button is located just beneath the "Play" button.

The digital display of the CDP-701 is much larger than that of the earlier CDP-101 and it displays more items. After a disc is loaded into the player, it is automatically scanned and a ruler-like display, calibrated in minutes, appears. Highlighted markers along the ruler show the approximate time at which breaks between successive tracks occur. During play, there is a continuously flashing marker that moves along the ruler to indicate the approximate point of play within the track. Time into a track is displayed in minutes and seconds, while a second real-time display tells you how many minutes and seconds of playing time remain on the disc. In addition to displaying track numbers, the display area also shows "Index" numbers. I do not yet own any CD discs which have this "Index" feature, but I have been told that CD discs will incorporate index points within long selections, such as movements of a symphony. You could then access specific sections within the track, as Index 1, 2, 3, etc. within the track divisions.

Additional buttons carried over from the earlier model include double- and triple-arrow fast-forward and reverse buttons, which let you zip forward or back *while listening to the program material*. These functions are completely analogous to the fast-scan functions now found on most video tape recorders, except that as the buttons are held down, you don't hear a change in pitch of the music, just a fast sampling of what's on the disc so that you can elect to stop at a desired spot. Three repeat-play buttons offer as many options, specifically, repeat of the track being played, repeat play of the entire disc or repeat of specifically designated material (from one point to another) on the disc.

A "Reset" button cancels play at any point, returns the laser pickup to its internal "rest" position and stops the disc's rotation. Adjacent to the elaborate display area is an infrared sensor to which instructions are sent by the wireless remote control unit supplied with the CDP-701. This unit is identical in every way to the one supplied with the earlier model. This slim, hand-held module, powered by two "AA" batteries, duplicates just about all of the front panel functions, including the memory repeat options, fast audible scanning, and track selection. In addition, a 0 to 9 set of numeric buttons allows you to "dial up" any track you would like to hear without having to step through lower or higher numbers to get to it.

"The major circuit difference from the CDP-701 is double decoding, for better separation . . . but even the older one got 80 dB."

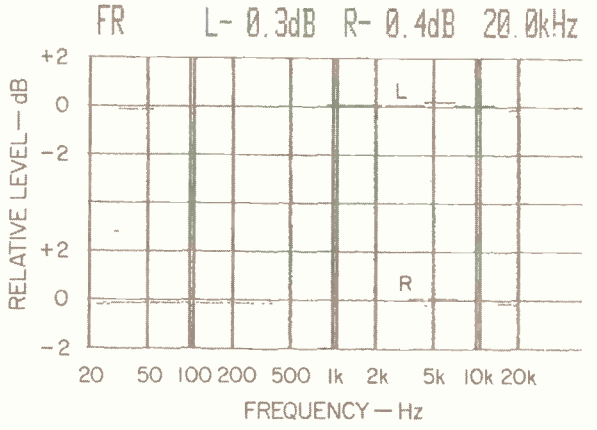


Fig. 1—Frequency response, left (top) and right channels, at 0 dB (max.) level.

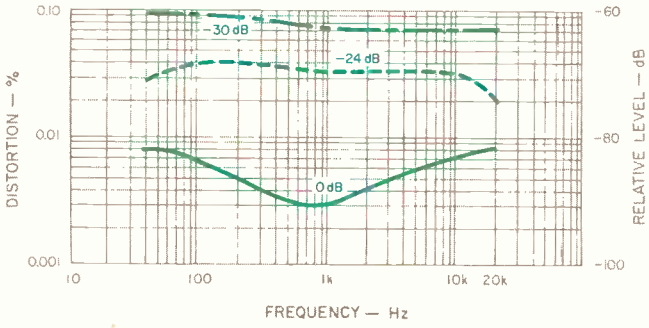


Fig. 2—Harmonic distortion vs. frequency at levels of 0 dB (bottom curve), −24 dB (middle curve), and −30 dB (upper curve).

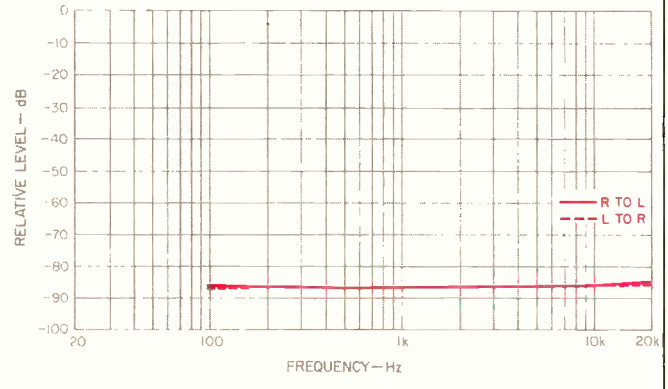


Fig. 3—Channel separation vs. frequency.

New Features

Four totally new programming and access features have been added to the Sony CDP-701 and greatly enhance its versatility. First, there is "Music Scan." When this button is pressed, the player offers you 10 seconds worth of music from each track of the disc, allowing you to "audition" the various selections. When you hear something you like, you have but to touch the "Play" button, and that track will continue playing from that point onward.

The second new feature is known by its acronym, RMS (Random Music Selection). Using a combination of numeric touch buttons, a button labeled "Track" and another touch button labeled "Start," you can program up to eight different tracks to be played in any order that you wish. As the program track numbers are being chosen, the display shows you how many choices you have made thus far, appending a minus sign (−) to the number, so you won't confuse it with a track number. A "Clear" button cancels all or any part of the program, should you change your mind about what you want to hear or the order in which you want to hear it.

The third new feature allows you to initiate play at any point within any track of a CD disc. This sequence of programming is started by touching a button labeled "Location." This is followed by keying in the desired track number and the minutes and seconds into that track where you want to begin. Alternatively, you can use the fourth feature, the Indexing subcode. The "Start" button initiates the search and begins play at the desired point in the disc. This feature, as well as the other new programming capabilities, are accompanied by appropriately informative displays in the enlarged display area.

The stereo headphone jack, located at the left end of the panel on the CDP-101, has been shifted over to the lower right corner of the panel on the CDP-701, along with a step-type attenuator which adjusts headphone volume in 6-dB steps (to a maximum attenuation of 24 dB) to take care of the different efficiencies of different headphones.

Analog signals are extracted from the rear of the CDP-101 via a pair of phono jacks. There's a "beep" on/off switch which works in conjunction with the hand-held, wireless remote-control unit. If you want the system to "beep" and confirm that remote instructions have been received, leave the switch on. A multi-terminal "Accessory Port" socket is intended for connection to a CRT or video monitor for display of such things as track subcodes, disc table of contents, videotex or teletext. My sources say that a range of such accessories should be available in early to mid 1984.

Measurements

As far as I was able to tell, very little has changed in terms of circuitry inside the CDP-701, compared with the circuitry of the CDP-101. I am informed by a Sony spokesperson that one major difference involves the use of double decoding, by which is meant that separate D/A decoders are used for the left and right channel information. The earlier approach used a single D/A decoder to alternately decode left and right samples back into the analog domain, after which multiplexing techniques were used to separate the two sets

"The Sony played all the way through the test wedge and black dots without muting, and acted as if the simulated fingerprints weren't there."

of audio information. Ostensibly, this new approach is supposed to yield better separation between channels, among other things. Since the older approach yielded separation figures of around 80 dB, I'm not certain that any audible benefits accrue from the new double-decoding approach.

Once again I used the test discs supplied by Philips for evaluating the static performance of the CDP-701 on the test bench. The musical sampler, with its opaque tapered-wedge "scratch," black-dot "dust," and "fingerprint" simulations, was also used to evaluate the error-correction capabilities of the new Sony player. I decided to go back to the Sony test disc I had used in some of my earliest CD player test reports for measuring channel separation, since, for some unexplained reason, Philips did not include separation tests, per se, on their otherwise very comprehensive test disc. Of course, the test signals that the Philips disc offers for THD measurement could be used for checking cross-talk too, since the signals are encoded on only one channel in each track.

Frequency response plots for both the left and right channels of this CD player are shown in Fig. 1. Note that the sensitivity of the amplitude (vertical) scale has been expanded to 2 dB per division. Maximum deviation from absolutely flat response was −0.3 dB for the left channel and −0.4 dB for the right channel at 20 kHz, the highest test frequency of the sweep.

Several tracks of the Philips test record are devoted to measurement of total harmonic distortion over the range of frequencies from 41 Hz to 20 kHz. Furthermore, in a digital audio system, best distortion figures are obtained just below 0-dB record levels, so the disc also includes a series of test tones at −24 and −30 dB with which the tester can measure how THD rises with decreasing signal levels. The three curves of Fig. 2 show THD versus frequency at these three different output levels from the player. At mid-frequencies, THD measured 0.003% referred to maximum output. At lower recording levels, as expected, THD increases, although even at a −30 dB level it was still acceptable with readings of 0.075%. Results were virtually identical for the left and right channels.

Signals at 997 Hz are also provided on the test disc for checking linearity of the playback system. Levels are 0, −1, −6, −12, −24, −60, −80, and −90 dB. I detected no significant deviation from perfect linearity until the test got down to −80 dB, which my instruments read as −78.5 dB.

Using the appropriate tracks on my other (Sony) test disc, I plotted channel separation at the four test frequencies it provided. Results are shown in Fig. 3. Separation was around 85 to 86 dB for both channels and remained a high 84 dB at 20 kHz for the left channel and 84.5 dB for the right channel. These readings probably include some residual noise of the test setup, rather than being just the actual cross-talk which was not detectable as such on our oscilloscope display.

Two tracks are provided on the Philips test disc for checking SMPTE-IM. With these, I measured 0.0065% IM at 0 dB level, 0.04% at a −20 dB record level. Signal-to-noise ratio measured exactly −97 dB with reference to 0 dB (maximum) output level, A weighted.

Square waves at frequencies of 100 Hz, 400 Hz, 1 kHz, and 5 kHz are provided on the Philips Test Disc, as are various tone bursts, pulse signals, and phase-checking pairs of signals. I found that the 1-kHz square-wave signal is a good one to display (see Fig. 4), since it clearly shows the degree of "ringing" that is produced by the sharp cutoff filter found in this and other players.

The single pulse incorporated in the Philips discs that I used to evaluate transient response of this player consists of a single sample at full scale, followed by 127 samples at zero amplitude. As is evident in Fig. 5, this test signal was reproduced with a fair amount of ringing, of both positive and negative polarity, following the unit pulse itself.

Of the several phase-check tests available on my Philips test disc, the one that I elected to use is one in which a 2-kHz signal is recorded on one channel while a 20-kHz signal is recorded on the other. In this test the positive-going crossing of the zero-axis of the lower frequency signal is supposed to occur at the same instant that the higher frequency signal crosses the zero axis, also in a positive-going direction. Examining the two sets of sine-waves in Fig. 6 carefully, you will notice that, in fact, the low-frequency

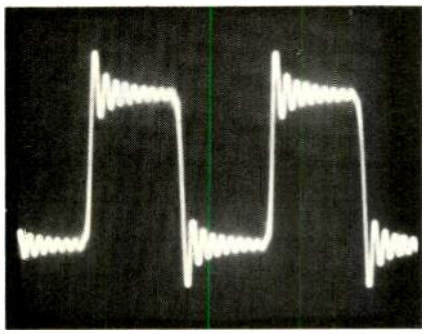


Fig. 4— Reproduction of 1-kHz square wave.

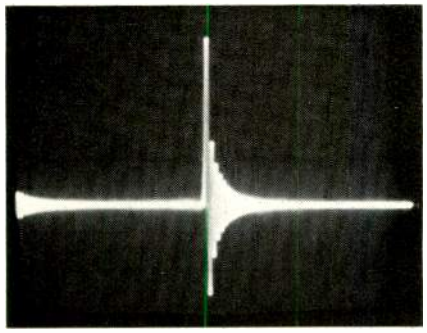


Fig. 5— Single-pulse test.

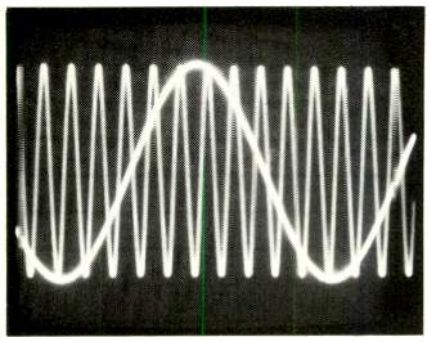


Fig. 6— Phase-linearity test, 2-kHz and 20-kHz signals.

"I was particularly pleased by the 'Location' feature. The scanning feature is welcome too. As for the dislikes, there weren't any."

signal crosses the zero axis in a positive-going direction a few microseconds ahead of the high-frequency signal's positive crossing of the zero axis. As near as I can tell, the high-frequency signal is displaced relative to the mid-frequency signal by approximately 20 degrees. That works out to a phase-error time delay of around 3 microseconds.

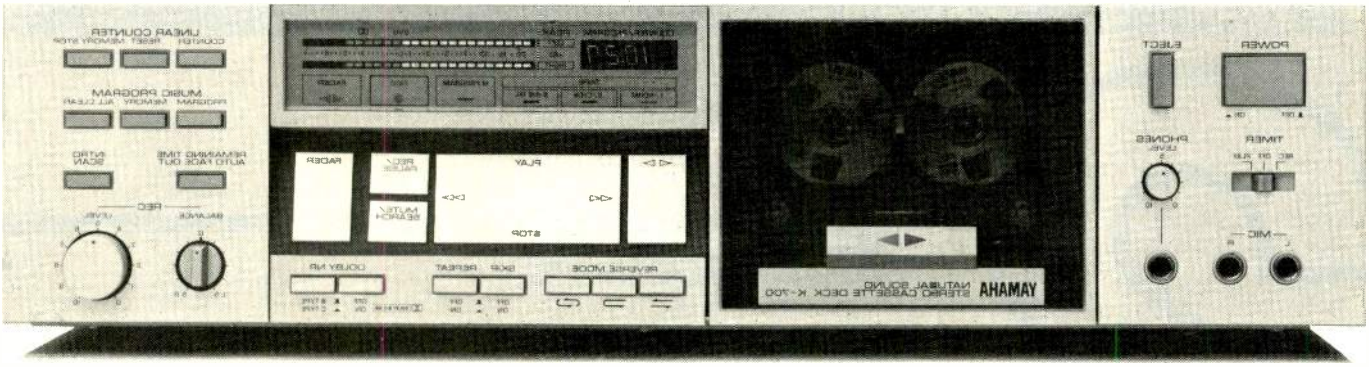
Using the Philips musical test disc with the opaque wedge "scratch," the black-dot "dust" and the "fingerprint" simulations, I noted that the Sony CDP-701 played all the way through the 900-micron width of the wedge with no muting. That's the greatest width of the opaque wedge, and about as good as any error correction system could be expected to perform. Neither did the system mute when playing selections that were covered by any of the three "black dots" meant to simulate dust particles of increasing diameter on the surface of the test disc. As for the fingerprint simulation, the Sony CDP-701 ignored it completely, playing right through the selections that were marred by this defect as if it weren't even present.

Use and Listening Tests

During the tests of the CDP-701, I was fortunate enough to be able to compare its sonic performance with that of the earlier CDP-101, and I must tell you in all honesty that I could not hear any difference between the two. Both reproduced sound with that special clarity and transparency which has become associated, in my mind at least, with the sound of compact digital audio discs. During my recent trip to Eindhoven (Philips) and Hannover (Polygram Records), I shopped several record stores in Amsterdam and added substantially to my collection of CD discs. Among my new discs is a sampler from Nimbus Records, who specialize in natural sounding recordings, ones not subjected to manipulations such as limiting, compression and multi-mike techniques. Those critics who have been quick to offer negative judgments about various CD players and about the new CD medium itself might do well to listen to some of the cuts on this disc. Others to be recommended are the Philips digital recordings of some Bach organ works, including the well-known *Toccata and Fugue in D minor*, played by Daniel Chorzempa on an organ in the De Bovenkerk Church in Kampen, The Netherlands, and the Bach *Brandenburg Concertos* with Neville Marriner and the Academy of St. Martin-in-the-Fields. These discs and several others that I listened to on the Sony CDP-701, did justice to the new player—and to CD in general.

As for my specific likes and dislikes concerning the CDP-701, I was particularly pleased with the "Location" feature which allowed me to "get into" a track at a specific location. Since my tastes run to classical music more than pop, I invariably find that the "tracks" on CD discs are quite long. If I want to hear just a passage instead of an entire movement, it's nice to be able to get to it directly. The scanning feature is welcome too, and will probably be enjoyed even more by those listeners who buy pop CD albums containing as many as 10 to 15 separate tracks. It is a credit to Sony that, even though I was supplied with only a Japanese version of the owner's manual for the CDP-701, I was able to figure out all of the new programming features and how to operate them. Since my literacy in Japanese is nil, you can surmise that the panel layout of the CDP-701 (ergonomics is the "in" word for panel layout these days) was superb. So was the product . . . and so was the music. As for the dislikes . . . there weren't any! *Leonard Feldman*

The slim hand-held remote control unit for the Sony CDP-701 ES duplicates just about all of the front panel functions.



THE REVERSE IS ALSO TRUE.

Most audio manufacturers don't provide for automatic azimuth adjustment in their auto reverse cassette decks. So side B never sounds as good as side A. Yamaha doesn't do things like most audio manufacturers. Introducing the K-700 auto reverse cassette deck. The only one that sounds as good as a Yamaha – in both directions.

To insure reproduction accuracy, we developed a special high-precision rotating head mechanism that permits precise, independent adjustment of head azimuth in both directions. And the head itself is the same pure Sendust type used in our top-of-the-line deck. The result is uncompromised sound quality with auto reverse convenience.

But that's just the beginning of the K-700's convenience. During recording, the K-700 counts down remaining tape time, automatically fades out at the end of the tape, then automatically fades back in after the tape is reversed and continues recording. Another fader button allows professional sounding fade-ins or fade-outs at any point during recording. You can also preprogram up to 15 selections to be recorded or played back in any order.

Then there's Intro Scan, Search, Blank Skip, Repeat, Auto Source Change, Auto Tape Selector, Dolby* B and C, Real-time Digital Counter, and an optional remote control unit.

How much for all this? Much less than you'd expect to pay for this much deck. The K-700. It's all true. Find out at your Yamaha dealer. Or write for complete information: Yamaha Electronics Corporation, USA, P.O. Box 6660, Buena Park, CA 90622.

*Dolby is a registered trademark of Dolby Labs, Inc.

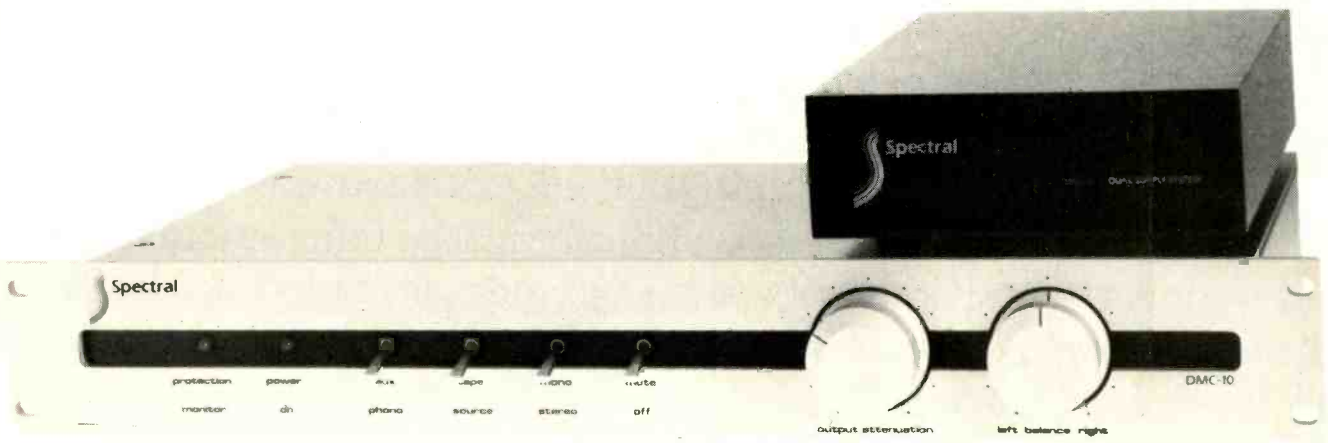
FOR THE MUSIC IN YOU.

YAMAHA

2

SPECTRAL DMC-10 PREAMPLIFIER

Manufacturer's Specifications
Frequency Response: 1 Hz to 4 MHz, +0, −1 db.
Maximum Output: 8 V.
THD: 0.01%.
IHF IM Distortion: 0.01%.
Phono Input Sensitivity: 0.15 mV for 0.5 V output at 1 kHz.
Phono Input Overload: 150 mV.
S/N Ratio: 95 dB, IHF A-weighted, for 5-mV signal at MM input.
High-Level Sensitivity: 100 mV.
Phono Input Impedance: 47 kilohms, 100 pF.
Weight: 24 lbs. (11 kg).
Price: $1,985.00.
Company Address: Box 4475, Mountain View, Cal. 94042.
For literature, circle No. 91



My first experience with a Spectral preamp was in about 1978 at a hi-fi store in Woodland Hills, California. I was impressed with three things: It sounded good, it had a good signal-to-noise ratio with moving-coil cartridges without a step-up device, and it had an unusual circuit topology in that the extra gain needed for MC cartridges was in the output amplifier rather than in the phono stage. I tried to get a unit for evaluation at that time but for various reasons, didn't succeed.

Now, some five years later, I get to play with one for my first profile as a returning reviewer for this magazine. [*Editor's Note:* I'm extremely pleased about this.—*E.P.*] First of all, I'm really impressed with the appearance and construction of this preamp. It is one of the nicest pieces of audio gear I've seen, especially its main circuit board. Parts quality, soldering, and general level of construction are first class. Not apparent in the pictures is that the rear panel and main circuit board slide out the back of the chassis as a unit upon removal of four screws in the rear panel. This makes for easy repair and update.

Front-panel controls include, from left to right, four two-position toggle switches and two rotary controls for volume and balance. The first switch selects phono or one auxiliary input, the second is a tape/source monitor, the third is for

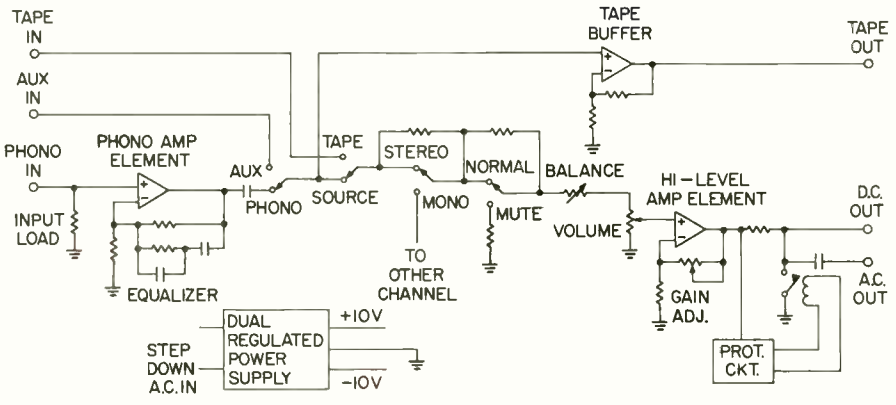


Fig. 1—Block diagram and gain structure.

mono/stereo, and the fourth is a 20-dB mute. Also on the front panel are two LED indicators, for power on and to indicate the action of the output amplifier protection circuit.

A separate power supply provides two separate a.c. feeds for the preamp proper. It incorporates a large power transformer, a three-prong a.c. socket, a 115-230 V a.c. selector switch, the main power-line fuse, a 5-pin XLR connector, and a display which shows the logo and the model number when the power supply is plugged in.

Circuit Description

A block diagram of the DMC-10 is shown in Fig 1. The circuitry consists of five major circuit blocks—a phono equalizer stage, a tape-out buffer, a high-level amplifier, high-level amp protection circuit, and the power supply. Not shown in this diagram are attenuators in the tape-in and AUX signal paths before signal selection. The gain of the phono circuit is a fixed 40 dB. Total gain of the output section, including mode switch, volume and balance loss when phono is selected, is about 34 dB with the internal adjustable gain pots at maximum. This gives sufficient overall gain, 74 dB, for moving-coil use. With the adjustable output-amplifier gain pots at minimum, output gain is reduced about 23 dB for an overall phono gain of 40 + 11 or 51 dB. AUX and tape inputs go through attenuators, with the result that gain from AUX or tape to main output varies from −1.4 to +22 dB over the range of the output gain pots. To complete the picture of this unusual gain structure, the tape-output buffers have +12 dB gain, so that AUX to tape-out gain is 0 dB. When phono is selected, gain to tape out is 52 dB. Since the tape-out buffers are run off the same supply voltages as the phono preamp, the input of the tape-output buffer will clip before the phono preamp's does. This gain in the tape buffers was probably included to get sufficient tape recorder feed levels with low-output moving-coil cartridges. The possibility exists that the tape-out buffers could clip when using a high-output moving-magnet pickup on strong record modulations. More about this under the measurements section.

The actual circuit is shown in Fig. 2. As can be seen, the two main amplifier blocks have similar circuitry. A dual monolithic N-channel FET forms an input differential amplifier, the sources being fed from constant-current diodes, and a potentiometer to adjust output d.c. level to zero volts. This FET stage is direct-coupled to a differential PNP-transistor second stage whose load is an NPN-transistor current mirror. The net effect of the composite second stage is to provide gain and to convert the sum of the differential signal to a single-ended signal with respect to ground at the collectors of the right-hand PNP and NPN transistors. A variable bias rheostat allows a d.c. spread to bias the gates of the output devices, which are MOS-FET transistors connected as source followers. Two P-channel MOS-FETS are used in parallel to more nearly match the characteristics of the one N-channel MOS-FET.

Negative feedback is taken around the phono preamp in the form of an RC network that provides RIAA equalization. Non-frequency-selective negative feedback is applied to the output amplifier, the series arm of which is variable to control overall closed-loop gain. Idling current in the MOS-FET output stages is about 20 mA in order to adequately drive their loads, which is as low as 100 ohms for the output amp.

The output of the phono preamp is coupled to the selector switch through a 10-μF polypropylene and polystyrene parallel combination from Wonder Cap. Output from the output amplifier is either direct-coupled or through a 10-μF capacitor, depending upon which output jacks are used. The input coupling to the phono circuit is through a small ferrite-core choke to attenuate r.f. interference. A phono loading socket, with a switch that provides four selected resistors down to 10 ohms, allows for good flexibility of input termination.

The power supply for the DMC-10 is unusual in that half-wave rectification is used to develop the unregulated plus and minus d.c. voltages which are about ±28 volts. Ripple of the unregulated voltages shouldn't be a problem as each supply has 4,000 μF of filter capacitance for a total of 16,000 μF! This is in the range of power-amplifier filter capacitance. Separate rectifiers, filter capacitors, and regulators are used for each channel. The regulators are integrated-circuit, three-terminal devices that provide ±18 V for all the circuitry except for the transistors which power the mute relay and the indicators in the protection circuitry, which operate on unregulated +28 V.

"The circuit had about 0.5-μS rise and fall times for any position of the volume and internal gain controls, at any level up to clipping. Extraordinary!"

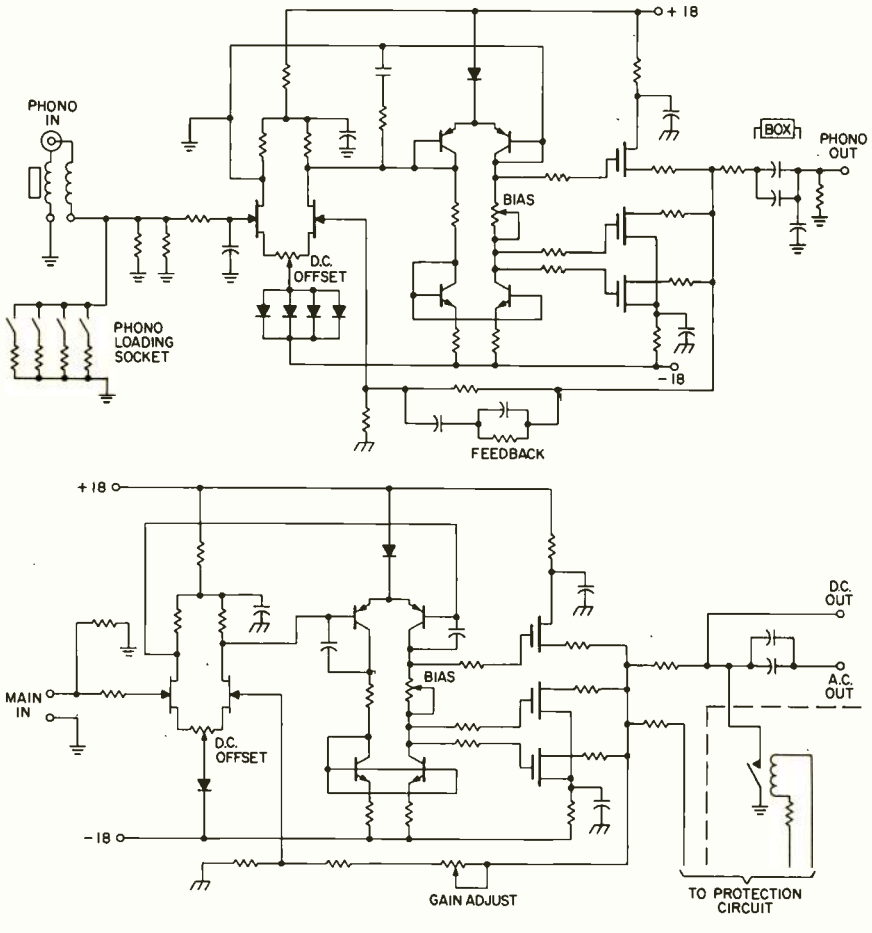


Fig. 2—Schematics of phono preamp (A) and high-level amp (B) sections.

The protection circuitry consists of a quad comparator for each channel and a two-transistor arrangement to drive the mute relay and front-panel indicator. The comparator circuits are sensitive to two properties of the output signals from the output amplifiers: The integrated d.c. value, with a time constant of one second, and the energy present above the audio range. If either or both of these quantities reach protection thresholds, the final stage of the comparator circuit goes negative, which operates the mute relay and changes the color of the protection indicator LED from green to red. All of this protection is in the interests of protecting one's power amplifier and speakers.

Measurements

Circuit gains and IHF sensitivities were measured first. IHF sensitivity is that input signal which produces 0.5 V out of the main preamp output for the related input function, with volume control at maximum (see Table I). Phono noise with "A" weighting was measured for various bandwidths and source impedances. IHF noise specifications call for an input signal of 5 mV at 1 kHz for moving-magnet inputs and 500 μV for moving-coil inputs. The source or terminating impedance for noise measurements for moving-magnet inputs is an RLC network composed of a 500-mH inductor in series with 1 kilohm, this series network in parallel with 125 pF of capacitance. This simulates a typical moving-magnet cartridge fairly well. Source impedance for moving coil is to be 100 ohms. Since the phono stage of the DMC-10 can be used for either, measurements are done for both conditions. Further, the procedure specifies that the unit's volume control be set to produce 0.5 V output in order to simulate typical conditions of use. Noise as referred to the input is shown in Table II. The IHF signal-to-noise ratio of the phono input as a moving-magnet preamp is 5,000 μV to 0.48 μV, or 80.4 dB. As a moving-coil preamp, it's 500 μV to 0.12 μV, or 72.0 dB. If one considers the phono signal-to-noise ratio by reference to the older 10 mV at 1 kHz, 20 Hz to 20 kHz bandwidth, and shorted input, the result is 93 dB. Clearly, the DMC-10 is a quiet preamp when used with moving magnets. As a moving-coil input it is satisfactorily quiet, but paralleled bipolar devices in other preamps have yielded input noise levels that are some 10 to 15 dB quieter.

Phono equalization error for a resistive source is shown in Fig. 3. Input impedance of the phono stage over a bandwidth of 20-20 kHz is equivalent to 44 kilohms in parallel with 270 pF.

Phono total harmonic distortion was under 0.01% from 20-20 kHz at levels below clipping. CCIF two-tone distortion

"With the Koetsu, the sound was even more open and detailed, and I found myself getting into the music and forgetting reviewing."

with equal-amplitude 10-kHz and 11-kHz signals yielded a first-order difference 1-kHz signal of less than 0.01% up to clipping. SMPTE-IM distortion was also less than 0.01% up to clipping.

Phono overload versus frequency was measured at the output of the phono circuit and at tape out. The results appear in Table III. Several things are apparent here. One is that the phono preamp clips at a lower output voltage than the tape-out buffer. When referenced to tape out, the 1 kHz input level for overload is rather low, but in respect to overloading the phono output, it is acceptably high at 80 mV. The phono circuit is not affected by the tape buffer clipping, so when listening through the whole circuit phono input acceptance is okay. If one wants to avoid tape-buffer clipping when recording, it would be wise to seek lower output moving-magnet pickups.

Table I—Gain and IHF sensitivity.

	Gain, dB		IHF Sensitivity, mV	
	Left	Right	Left	Right
AUX or Tape to Main Out				
Internal Line Gain Max.	22.3	21.9	585	585
Internal Line Gain Min.	−1.4	−1.4	38	40
AUX to Tape Out	0	0	500	500
Phono to Main Out				
Internal Line Gain Max.	74.6	74.2	0.093	0.097
Internal Line Gain Min.	50.9	50.9	1.42	1.42
Phono to Tape Out	52.4	52.4		

Scope photos of pre-equalized square waves are shown in Fig. 4. Figure 5 shows one very good property of this phono circuit. If a 10-kHz pre-equalized square wave is increased in level until clipping is reached at tape output, the waveform stays symmetrical. Many, if not most, preamps begin to develop asymmetries in such a signal well below clipping.

Phono channel-to-channel crosstalk was measured on a pre-equalized basis. Both channels were essentially the same. The crosstalk for a square wave was in phase. For sine waves, crosstalk was −100 dB from 20 to 500 Hz, rising to −93 dB at 1 kHz, −83 dB at 5 kHz, −71.4 dB at 20 kHz and −66 dB at 50 kHz. This is excellent, indeed.

An unusual feature of the output amplifier in the DMC-10 is that its high-frequency bandwidth is essentially constant over the full range of the volume control and variable output amplifier gain. The manufacturer's specs for a rise time of 20 nS are rather optimistic. In order to observe a square-wave output of more than about 200 mV P-P, it was necessary to disable the protection circuitry. It was found that the circuit had about 0.5 μS rise and fall times for any position of the volume control and internal gain controls at any level up to clipping. Extraordinary! This corresponds to a high-frequency bandwidth of about 700 kHz. Low-frequency response of the output amp extends flat to d.c. at the direct-coupled output jacks. Using the d.c.-coupled outputs, the −3 dB frequency naturally depends on the load, being 1.6 Hz for a 10-kilohm load, 0.32 Hz for 50 kilohms, and 0.16 Hz for 100 kilohms. These are calculated responses for the 10-μF output coupling capacitors.

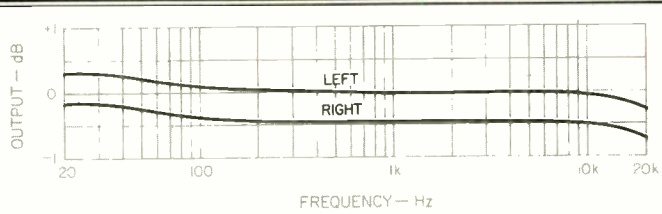


Fig. 3—RIAA equalization error (note expanded scale).

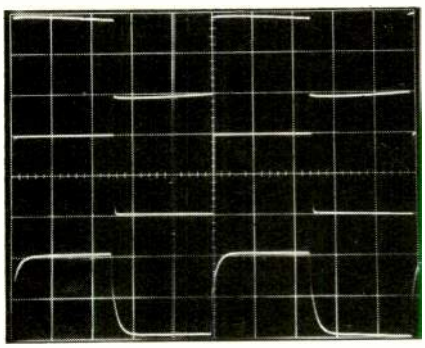


Fig. 4—Phono response to pre-equalized square waves: (top) 40 Hz, 5 mS/cm; (middle) 1 kHz, 200 μS/cm; (bottom) 10 kHz, 20 μS/cm.

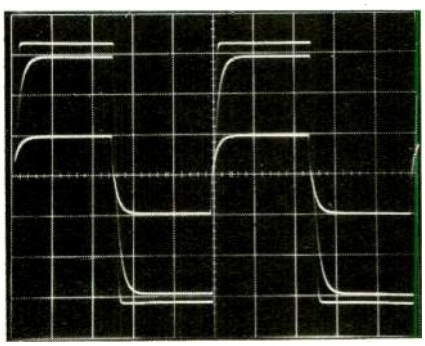


Fig. 5—Large-signal square-wave phono response; 10-kHz pre-equalized square wave, measured at tape output. (Scales: Horizontal, 20 μS/cm; vertical, 5 V/cm).

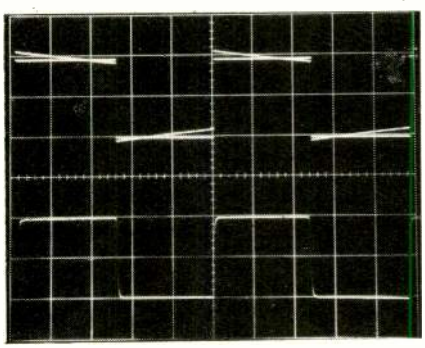


Fig. 6—Reponse of output amplifiers with IHF standard load to 20-Hz, top, and 20-kHz, square waves. Top is with a.c. and d.c. coupling, 10 mS/cm. Bottom is 10 μS/cm; both 1 V/cm.

"I would have to say that this preamp is one of the few solid-state preamps that I like. The DMC-10 is a very high-quality unit."

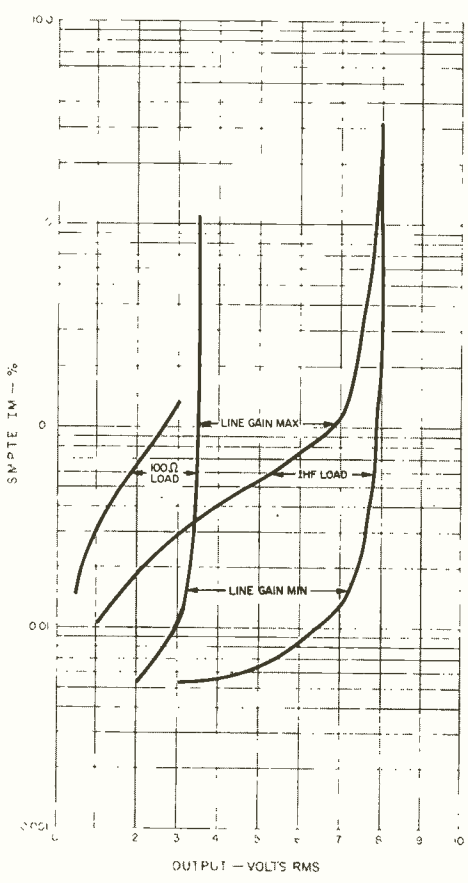


Fig. 7—Distortion (SMPTE-IM) vs. output for 100-ohm and IHF loads, with line gain at minimum and maximum.

Square-wave responses for the output amp are shown in Fig. 6 for 20 Hz and 20 kHz and an IHF load of 10 kilohms in parallel with 1,000 pF. The tilted 20-Hz trace is for the a.c.-coupled outputs.

IHF signal-to-noise ratio for the AUX or tape input is measured with a 500 mV input signal with the volume control adjusted for 500 mV out of the preamp. Noise is measured with "A" weighting and an input termination of 1 kilohm, with internal gain at maximum, the signal-to-noise ratios were −84.0 and −78.2 dB for left and right channels. With internal gain at minimum, −102.3 and −100.3 dB were obtained. The reason for the difference in signal-to-noise ratio for the two extremes of output amplifier gain is that at minimum gain the volume control is at or near maximum and maximum signal gets into the input stage in respect to its referred input noise. Crosstalk between channels for the output section was measured, with an input termination of 1 kilohm. The crosstalk for square-wave signals was in phase. Results were essentially the same for both channels; −91.5 dB (noise) at 20 Hz, rising to −73.4 dB at 500 Hz, −67.5 dB at 1 kHz, −47.5 dB at 10 kHz, −41.6 dB at 20 kHz, and −33.1 dB at 50 kHz.

Input impedance for AUX or tape inputs was 13.4 kilohms, and output impedance was about 100 ohms.

Spectral rates the DMC-10 at 1 V output into a 100-ohm load, with THD or IM distortion of less than 0.01% from 20 Hz to 20 kHz. With a 100-ohm load, one has to use the d.c.-coupled outputs or suffer a low-frequency −3 dB point of 160 Hz at the a.c.-coupled outputs. For a 100-ohm load at 1 V output, THD was less than 0.01% from 20 Hz to 20 kHz. Clipping occured at 4.5 V rms, with the plus half-cycle flattening first. The preceding was at maximum internal output gain. With an IHF load, THD was about 0.015% at 5 V rms output, with clipping at 9.5 V rms. With IHF load and minimum output amp gain, THD was less than 0.01% up to clipping, from 20 Hz to 20 kHz. SMPTE IM distortion versus output, load, and minimum and maximum output amp gain is shown in Fig. 7. The higher of the two channels is plotted.

Table II—Noise, referred to input.

Bandwidth	Source Impedance, Ohms	Referred Input Noise, nV Left	Right
400 Hz to 20 kHz	0	107	105
20 Hz to 20 kHz	0	220	270
A-Weighted	0	110	110
A-Weighted	100 ohms	125	125
A-Weighted	1 kilohm	225	225
A-Weighted	IHF MM	480	480

Use and Listening Tests

Equipment used for evaluating the DMC-10 consisted of an Infinity Air Bearing turntable with either a Grado Signature IV moving-magnet cartridge or a Koetsu EMC-1B "Black" moving coil, Marantz Model 9 or Sumo Gold Power amplifiers, Infinity RS-II speakers, and Stax SR-X/Mk. 3 headphones.

Table III—Phono overload vs. frequency.

	Tape Out		Phono Out	
Frequency, Hz	Input, mV	Output, V	Input, mV	Output, V
20	2.95	11.7	8.2	8.0
100	6.25	11.7	17.6	8.0
1k	28.3	11.7	80.0	8.0
5k	72.0	11.7	205.0	8.0
10k	137.0	11.6	390.0	8.0
20k	270.0	11.6	77.5	8.0

First listening was with the Grado cartridge. Reproduction was open and detailed, with good imaging. Bass was extended and tight, midrange and highs were well defined without high-frequency edge or irritation. Spectral balance and harmonic structure was similar to a developmental reference tube preamp used for comparison, though replication of space and "air" about instruments was not as good as with the tube preamp. With the Koetsu pickup, circuit gain was more than adequate, as was subjective signal-to-noise ratio. Sound with the Koetsu was even more open and detailed, and I found myself really getting into and enjoying music and forgetting reviewing. I would have to say this preamp is one of the few solid-state preamps that I like.

In summary, the DMC-10 is a very high-quality, well-made unit that should appeal to the serious audiophile and music lover. I would recommend that potential preamp buyers give it a serious listen. *Bascom H. King*

TEST-DRIVE IT BRISKLY. BUT DO IT LEISURELY.

PONTIAC 2000

When you take one for a spin, take your time. There's a lot this car wants to tell you.

Pontiac 2000 is an energetic, state of the art, front-wheel-drive compact.

Its performance, fit and finish are impressive, to say the least.

An overhead cam 4-cylinder engine with electronic fuel injection and a 5-speed manual gearbox are standard.

It's available in sedan, coupe, hatchback or wagon.

As you can see, Pontiac 2000 is quite good looking. As your test drive will prove, it's also fun to drive. Leisurely or briskly.

And as your Pontiac dealer will show you, it's very easy to own.

What a car!

Some Pontiacs are equipped with engines produced by other GM divisions, subsidiaries, or affiliated companies worldwide. See your Pontiac dealer for details.

GM

MARK OF EXCELLENCE

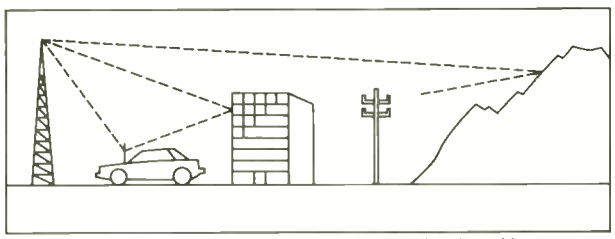
PONTIAC WE BUILD EXCITEMENT

SUPERTUNER™ III. AN FM CAR STEREO WITH RECEPTION SO CLEAR YOU'LL THINK YOU'RE LISTENING TO THIS.

You know what often happens just when the music really starts cooking on your car's FM stereo.

Because your car's moving, and FM reception conditions are constantly changing, you can end up with something that sounds like bacon sizzling on a hot griddle.

The static, the whine, the fading, the cutting in and out of stations. The kind of stuff that makes you grind your teeth.



A lot of things stand in the way of good reception. Like buildings. Mountains. Even telephone poles. The radio signals bounce off them and cut into the direct signal. Causing listening havoc for those who don't have a new Supertuner III.

Even with all the advancements in tuner technology, you've been left with only two alternatives.

Switch stations. Or pop in a cassette.

But now, there's Supertuner III. From Pioneer.

A car tuner that doesn't merely rely on convenience gadgets to make you happy.

But one that actually delivers the clean, clear FM reception you should be getting in this day and age.

The kind of interference free sound you thought you could only get from a cassette.

ADVANCED TECHNOLOGY THAT VIRTUALLY ELIMINATES THE SOUND OF *&%#! FROM YOUR CAR STEREO.

Nothing interrupts the pleasure of listening to music on your car's FM stereo more than interference.

Engineers have a bunch of tongue-twisting names for the phenomena that causes this to happen.

Names like multipathing and three-signal-intermodulation.

You, on the other hand, also call it names. Like "that *&%#! static" or "the *&%#! station's cutting in and out" or "I'm losing the *&%#! signal." (Not to mention your temper.)

But because nothing is more important than music to the engineers at Pioneer, they've been working continuously developing the technology to virtually eliminate the sound of static and *&%#! from your car.

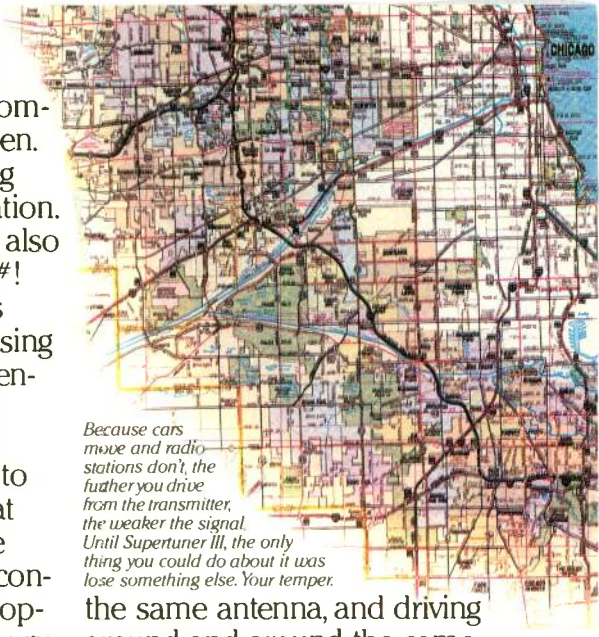
WHICH TUNER GETS THE BEST RECEPTION IS NOW PERFECTLY CLEAR.

It's one thing to boast that only Supertuner III can all but eliminate the aforementioned irritants to your listening pleasure.

But Pioneer wanted to prove it. By road testing Supertuner III against the highest quality FM stereo tuners currently available.

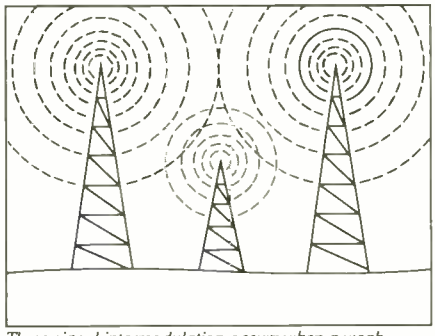
The test was conducted in perhaps the worst reception area in America. Chicago, Illinois. If Supertuner III performed well here, it would perform well anywhere.

Using the same car, with the same antenna, and driving around and around the same block on the Near North Side (where the John Hancock Building and the Sears Tower, the world's third and tallest structures, respectively, create FM listening havoc), Pioneer put one tuner after another to the test.



Because cars move and radio stations don't, the further you drive from the transmitter, the weaker the signal. Until Supertuner III, the only thing you could do about it was lose something else. Your temper.

And the clear winner, time after time, in both downtown and suburban conditions, was Supertuner III. Only Supertuner III received stations with no sound of sizzling bacon. And only Supertuner III could capture and lock in the weak stations.



Three-signal-intermodulation occurs when a weak signal is surrounded by two stronger ones. And, as they say, only the strong survive. So you get stations cutting in and out or "bleeding" into each other. Unless you have a new Supertuner III.

Reading this description of the test may be somewhat convincing. But not nearly as convincing as actually hearing the performance of Supertuner III.

To do that, you'll have to go to your nearest car stereo dealer and ask him for a demonstration of the new Supertuner III.

There's a very good chance he'll already have one installed in his car.

That alone should tell you something.

PIONEER®

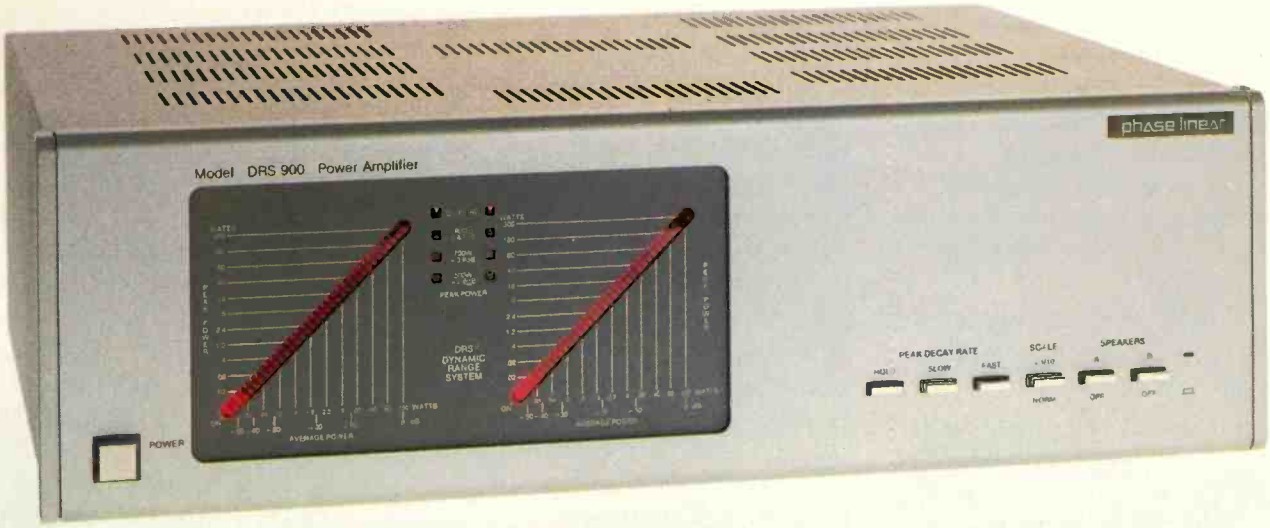
Because the music matters.

3

PHASE LINEAR DRS 900 POWER AMPLIFIER

Manufacturer's Specifications
Power Output: 150 watts per channel, 8 ohms, 20 Hz to 20 kHz.
Rated THD: 0.015%.
Frequency Response: 10 Hz to 40 kHz, +0, −1.0 dB.
SMPTE-IM: Less than 0.009%.
S/N: 100 dB.
Damping Factor: 330 at 1 kHz.
Input Impedance: 49 kilohms.
Input Sensitivity: 0.8 volts rms for 150 watts output.
Slew Rate: 100 volts/microsecond.
Rise Time: Less than 1.0 microsecond.
Power Requirements: 120 V a.c., 60 Hz, 350 watts.
Dimensions: 17½ in. (44.5 cm) W × 10½ in. (26.7 cm) H × 18 in. (45.7 cm) D.

Weight: 38 lbs. (17.3 kg).
Price: $1095.00.
Company Address: 4134 N. United Parkway, Schiller Park, Ill. 60176.
For literature, circle No. 92



When I tested Phase Linear's CD player a few months ago, it was delivered to me personally by some of the marketing and engineering people from the company. At that time, they noticed that I also had (among the many pieces of audio equipment waiting to be tested) their new DRS 900 power amplifier. They urged me to listen to the CD player (theirs or anyone else's) using that amplifier. Now I know why!

Given the awesome dynamic range of CD software, the more headroom an amplifier has, the more likely it will be able to reproduce those CD disc peaks without sending the amp into momentary (but audible) clipping. In the case of

the Phase Linear DRS 900, the reserve power isn't just limited to short-term peaks; I was able to push the amp to an output level of more than 350 watts even using a steady-state sine-wave tone. Using the EIA tone-burst signal specified for measuring dynamic headroom, I came up with a figure of 4.0 dB. To the best of my recollection, that's the highest dynamic headroom I've ever measured for any high-fidelity power amplifier. Remember, this amp has a nominal rating of 150 watts per channel; adding 4 dB of dynamic headroom to that means that it can handle short-term peaks of up to nearly 377 watts without any sign of peak clipping. But I'm getting ahead of myself; let's take a look at the physical layout of the DRS 900.

The front panel of this amplifier is equipped with a most unusual power metering system for each channel. It offers a simultaneous display of peak output power (in the form of a "dot" indicator light) and average output power (in the form of an illuminated "bar"). Located between the two dynamic metering displays are two columns of red LEDs, calibrated for peak output power, and a yellow LED which indicates clipping. The on/off switch for the amplifier is located at the lower left of the front panel. Three pushbuttons to the right of the panel meters control the rate of decay of the peak-indicating "dots" in the metering system. Those labeled "Slow" and "Fast" control the speed of the dots' descent, while the "Hold" button allows the highest dot position to be held for later observation or reference.

Three more buttons are located to the right of these switches. The first of these expands the meter range when it is depressed, changing full-scale readings by a factor of 10 to one. The remaining two buttons, which may be pushed singly or in combination, select either or both possible sets of speakers.

The rear panel of the DRS 900 has a pair of phono-tip input jacks at the left, two pairs of color-coded, 5-way speaker-wire binding posts near the center, and a line fuseholder containing a 10-ampere, 250-volt line fuse. There are no fuses in the speaker output circuits, but Phase Linear does recommend appropriate fusing of whatever loudspeakers are to be used with this amplifier.

Circuit Highlights

The Phase Linear DRS 900 has *two* positive and *two* negative power supplies, each pair with different maximum voltages. When the voltage across the base and collector of the output transistors (that is, the difference between the supply and signal voltages) falls low enough to threaten non-linear operation of these transistors, the higher voltage power supply is automatically switched to the output stage. This automatic power-supply selection occurs independently for the positive and negative halves of the output stage—more efficient than powering both halves from a high-voltage supply when only one polarity of the program signal requires the additional voltage.

The power supplies of this amplifier, according to Phase Linear's engineers, have been designed to provide adequate energy reserves for even highly compressed program material. All power-handling components, including transformer, heat sinks and semiconductors, have been selected or designed for long-term operation. All power-supply switching (except for on/off switching) is done *after* rectification and filtration to ensure freedom from line-frequency voids when an instantaneous burst of power is required.

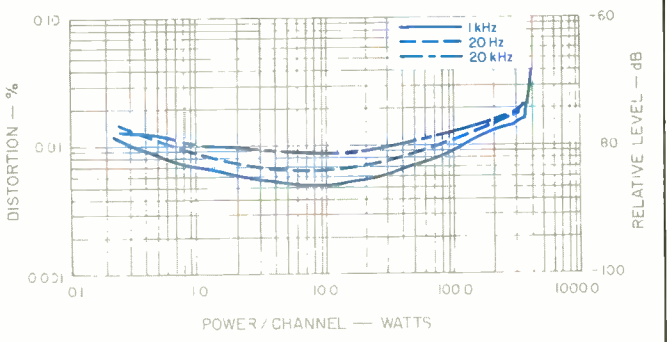


Fig. 1—Power output vs. distortion, 8 ohms.

Laboratory Measurements

For an amplifier rated at 150 watts per channel, the actual steady-state power output capabilities of this product completely surprised me. The DRS 900 delivered 360 watts per channel at mid-frequencies; not for brief periods using pulses or tone bursts, but *continuously*. Phase Linear might well have given the DRS 900 an "official" rating of 325 watts per channel (it delivered 331 watts at the standard 20 Hz and 20 kHz test frequencies), but they probably refrained from doing so since that would have necessitated an FCC one-hour preconditioning test at a constant output level of 118 watts or so, which might have produced an excessive amount of heat. In our own tests, preconditioning for one hour was done at 50 watts (one third the "official" power rating) and the amplifier came through without any difficulty.

A plot of power output versus harmonic distortion is shown in Fig. 1. SMPTE-IM at rated power or below measured 0.006%. CCIF-IM (using the twin-tone method of measurement and reading any IM-produced 1-kHz component as a percentage of the combined equivalent level of the two tones) measured only 0.0037%. IHF-IM was too low to be observed with our spectrum analyzer, whose dynamic range is limited to 80 dB (corresponding to an equivalent percentage of 0.01%).

Frequency response of the amplifier extended from 13 Hz to 95 kHz for a 1-dB roll-off and from 6.5 Hz to 190 kHz for a 3-dB roll-off. Damping factor measured in excess of 200, limited no doubt by the very short length of 14-gauge wire which I use between an amplifier's output terminals and the inputs to my test setup. Dynamic headroom, as already mentioned, was an incredibly high 4.0 dB. Input sensitivity for 1 watt of output into 8-ohm loads was 76 mV, which works out to 930 millivolts for 150 watts of output. The amplifier was unconditionally stable under no-load and 2-μF capacitance load conditions. While no power specification

"When Phase Linear states that this amplifier has more than enough dynamic range for 16-bit digital audio, they aren't kidding!"

is given for 4-ohm operation of the amplifier, we did test it under 4-ohm and 2-ohm load conditions and found it to be stable under these load conditions as well. The A-weighted signal-to-noise ratio, referred to 1 watt, measured 90 dB; referred to 150 watts, that would be 111.7 dB. If you want to reference the noise to the short-term peak-power capability of this amplifier, you can add another 4 dB or so to the S/N number, for a total "dynamic range" between clipping and noise floor of nearly 116 dB. When Phase Linear states (in their owner's manual) that this amplifier has more than enough dynamic range to handle any 16-bit digital audio program source, they aren't kidding!

Use and Listening Tests

While I no longer had the Phase Linear CD Player at the time that I tested this amplifier, I did have two other CD players on hand, as well as a wider selection of CDs. (The discs were acquired during a recent trip to Eindhoven, The Netherlands; Hasselt, Belgium, and Hannover, West Germany, where I and several other guests of Magnavox, Philips and Polygram were shown the intricacies of CD player and disc manufacturing.)

Suffice it to say here that the DRS 900 is ideally suited to this type of program source. At average listening levels of between 1 and 5 watts, (the metering system is ideal for determining such things), peaks as high as 200 watts occurred during the playing of some of these discs. Take, for example, a Philips sampler which contains 14 pop and classical selections. I expected the cut of Kabalevsky's "Colas Breugnon" (performed by the Boston Pops, under John Williams) to exhibit showy dynamics, and it did. I was surprised at how much power was required to properly reproduce a piano's percussive sounds when I listened to Chopin's *Fantasie-Impromptu* in a performance by Bella Davidovich. I think most of us have never realized just how much compression is being applied to piano works recorded and pressed on standard LPs. Happily, the Phase Linear DRS 900 was up to the task of handling these short- and long-term fortes from CDs with an effortlessness that nicely complemented the new discs and players.

It almost goes without saying that an amplifier able to do this well with the most demanding of source material did equally well when presented with more traditional forms of program sources. It was flawless with Dolby C cassette tapes that I consider to be well recorded, FM programs received from the one station in my listening area that avoids compression almost entirely and—yes—even some of my favorite direct-to-disc and digitally mastered LPs. In short, the Phase Linear DRS 900 is an amplifier for now—and for the foreseeable future. *Leonard Feldman*

4

GENESIS MODEL 210 SPEAKER

Manufacturer's Specifications
Enclosure Type: Vented.
Bass Damping: 4th-order Butterworth.
Drivers: 8-in. cone woofer, 10-in. passive radiator, 1-in. dome tweeter.
Impedance: 8 ohms.
Sensitivity: 89 dB/watt.
Frequency Response: 38 Hz to 20 kHz, ±4 dB.
Amplifier Power: 15 to 100 watts.
Dimensions: 31 in. (78.7 cm) W × 16½ in. (41.9 cm) H × 10½ in. (26.7cm) D.
Weight: 50 lbs. (22.7 kg).
Price: $560.00 per pair.
Company Address: Newington Park, Newington, NH 03801.
For literature, circle No. 93

The Genesis Model 210 is a two-way loudspeaker system utilizing a 200-mm (8-inch) woofer which, in conjunction with a 254-mm (10-inch) passive radiator, covers the frequency range from 38 Hz to 1.8 kHz, and a 25-mm (1-inch) inverted-dome tweeter which handles the upper ranges to beyond normal audibility limits. The system is housed in an enclosure whose maximum dimension is less than 80 cm.

A snap-on grille assembly protects the loudspeaker cones against inquisitive finger-pokes from youngsters and provides ease of cleaning for the black grille cloth. Loudspeaker electrical connection is made to well-marked gripping terminals in a recessed cavity on the rear of the enclosure. A two-position toggle switch, also mounted within the cavity, allows for selection of either "Normal" or "Decrease" tweeter level to match the properties of the listening environment.

Although finished on all four sides, the Genesis 210 is a bit large for a bookshelf system; the label on the grille clearly signifies this as a floor-mount system with the tweeter on top. Supplied as a matched pair, the 210s are clearly identified for proper stereo position with the words "Left" and "Right" on the rear of the separate enclosures.

Measurements

The measured load impedance which the Genesis 210 presents to a power amplifier is plotted in Fig. 1. The plot

"Female and male vocal material is reasonably accurate—and extreme highs and deep bass are well reproduced."

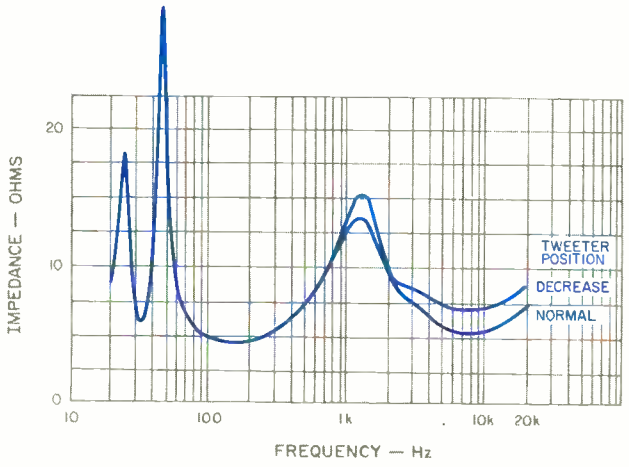


Fig. 1—Impedance for both settings of tweeter control.

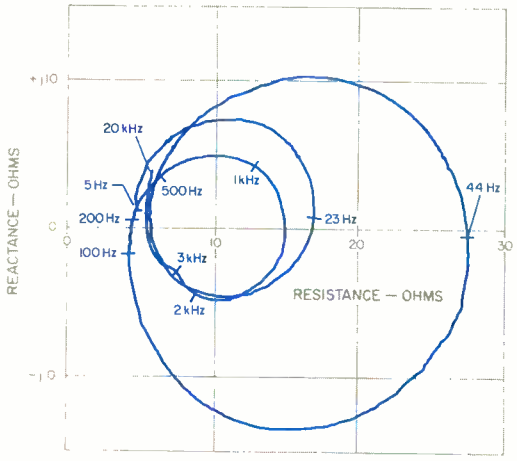


Fig. 2—Complex impedance for "Normal" switch setting.

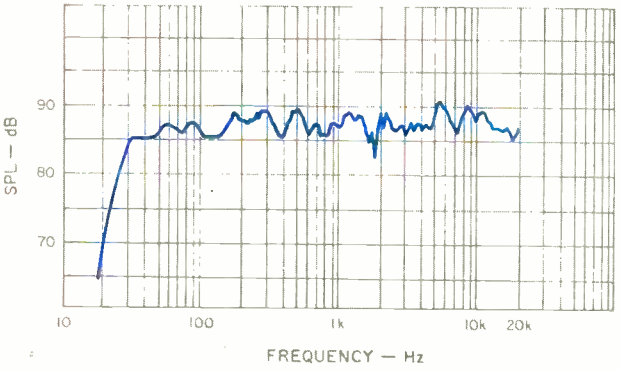


Fig. 3—One-meter on-axis sound pressure amplitude for a constant-voltage drive corresponding to 1 average watt into 8 ohms.

shows impedance for both switch settings of the rear-panel tweeter control. Although rated by Genesis Physics as an 8-ohm system, the minimum impedance lies closer to 4 ohms, at a frequency of 150 Hz. The complex impedance plot for the "Normal" tweeter setting, Fig. 2, shows a 53° phase lag at around 60 Hz. Even at 80 Hz, the phase lag is 45°. This is a substantial reactive load, which could place heavy demands on a power amplifier driven near its maximum capability. Amplifiers designed to work with noninductive resistance loads might find this system to be a challenge on thundering bass passages. The impedance variations are much more gentle above 100 Hz. Although I tested the system as though it had the 8-ohm value cited by Genesis, I recommend that the user treat it as a 4-ohm system, both with respect to connecting wire and choice of power amp.

The one-meter on-axis anechoic frequency response for a constant-voltage drive is plotted in Figs. 3 and 4. Figure 3 is the amplitude response and Fig. 4 is the phase response. The test voltage in both cases corresponds to an average power of one watt into an 8-ohm resistance. Genesis achieves their rated sensitivity of 89 dB SPL at this drive voltage. Low-frequency response is maintained down to 29 Hz, then rapidly drops at a rate approaching 24 dB per octave. Although the 210 is rated ±4 dB from 38 Hz to 20 kHz, the actual measured response extends a half octave below the stated low-frequency cutoff and a quarter octave above the 20-kHz cutoff, while staying within the ±4 dB limits. This understatement of a parameter that is the goal of many speaker designers (not to mention ad copy writers) is a bit unique. The anechoic response is somewhat marred by irregularities in the 60 to 200 Hz range, but smooths out above 200 Hz. The amplitude response is taken with the tweeter switch in the "Normal" position and the grille in place. Measurement shows that the "Decrease" tweeter position drops the response above 2.5 kHz by an average of slightly less than 2 dB, too small an increment to warrant a second plot on the scale of Fig. 3. Of more significance is the fact that the grille assembly introduces response irregularities that amount to 6 dB peak-to-peak in the range above 4 kHz. The peak at 5.3 kHz, dip at 7 kHz, and peak at 8 kHz are, in fact, due to the grille. In effect, the tweeter switch will have less control on the high frequency sound than the grille does. One should remove the grille for best sound, but grille or no grille, the anechoic SPL is acceptably good.

The phase response, Fig. 4, shows the actual acoustic transfer taking place in the 4 to 6 kHz range. A low-frequency acoustic phase transition occurs around 300 Hz, and appears to be due to the very steep low-frequency cutoff of this system design. The midrange has an average phase shift near 0° at a time delay of 3.2747 mS and one meter distance. The tweeter has an average shift of +60° when corrected for a time delay of 3.0663 mS at the same one-meter distance. Although the combined response is non-minimum phase, with a time difference of 0.2084 mS between tweeter and midrange, the average amplitude response is uniform, with no evidence of arrival-time cancellation notches.

The three-meter room test, Fig. 5, shows severe irregularities in response below 1 kHz. In this test the 210 is placed on a rug-covered floor and the frequency spectrum is mea-

"Measured response extends a half-octave below and a quarter-octave above the rated band. This understatement is unique."

sured for the first 11 mS of sound which arrives at the listening location. The listening location is three meters from the front of the enclosure and one meter above the floor, at the normal position that would be occupied by the head of a seated listener. The irregularities in early sound response are due to the interference between the direct sound and shallow-angle floor reflections. The reason for this is the very low position of the bass driver, coupled with the system's broard vertical dispersion pattern; this combination allows a strong, grazing sound incidence between floor and listener. The difference in time delay between these two arrivals is about 1.18 mS, which gives a comb-filter response that is periodic at 850-Hz frequency intervals. I recommend raising the Genesis 210 at least a half meter above the floor, if this is possible. Because of the vertical polar pattern of the tweeter, the maximum height of such a raised configuration should not be greater than that which places the center of the loudspeaker at listening level.

Horizontal and vertical polar-energy responses are plotted in Figs. 6 and 7, respectively. As in the three-meter room test, the "Left" speaker was used for the polar response measurements. I assumed, since no instructions were supplied by Genesis on this, that the "Left" speaker is to be placed so as to reproduce the left channel of stereophonic sound, that is, toward one's left as he faces the center of the stereo speaker configuration. That is how I listened to the system prior to doing the laboratory tests. The horizontal response shows that this speaker gives a more uniform dispersion if used as a right channel reproducer. It is not much of a difference when seated more than 30° off axis, but has an effect within 20° of frontal position. Better stereo lateralization would occur if the speakers were either rotated inward toward the listening position or were swapped left for right. I recommend rotation toward the listening position.

Vertical dispersion is quite good above the front axis, and there are no signs of hot spots or beaming in the Genesis 210. The broad horizontal and vertical dispersion shows that these speakers should be placed away from large objects, either beside them or above them, in order to minimize the chance of strong early reflection coming back into the principal listening area. Stereo imaging should be excellent, according to these measurements, if these precautions are taken.

Harmonic distortion for the tones of E_1, A_2 and A_4 is shown in Fig. 8. Third-harmonic distortion for A_2 and A_4 remains low up to the highest test limits, but second-harmonic distortion levels are a bit higher than I would have expected for a system of this high quality. And, although low E lies within the power-handling range of the Genesis, severe acoustic distress becomes evident at 20 average watts.

Intermodulation distortion on A_4, caused by simultaneous application of low E at the same drive level, is plotted in Fig. 9. At low levels the distortion on A_4 is principally phase modulation. As power is raised, this gradually is augmented by amplitude modulation until, at 10 average watts, A_4 has a 10° peak-to-peak phase modulation combined with a 10% peak-to-peak amplitude modulation due to the lower tone. In addition, there is a small average displacement of the sound source toward the listening position, which amounts to a time shift of 35 μS or about 1 centimeter image shift. At 25

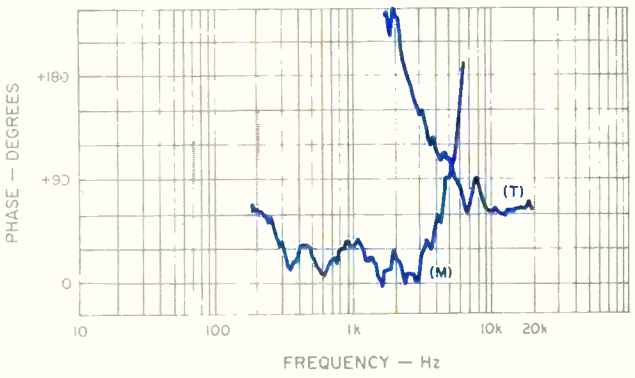


Fig. 4—One-meter on-axis anechoic phase response corrected for midrange time delay of 3.2747 mS (M) and tweeter time delay of 3.0663 mS (T).

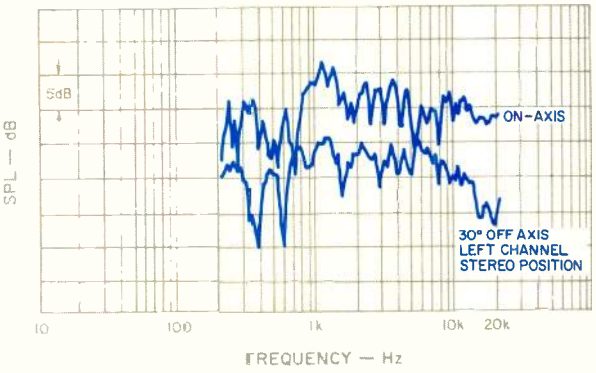


Fig. 5—Three-meter room test plots separated 10 dB for clarity.

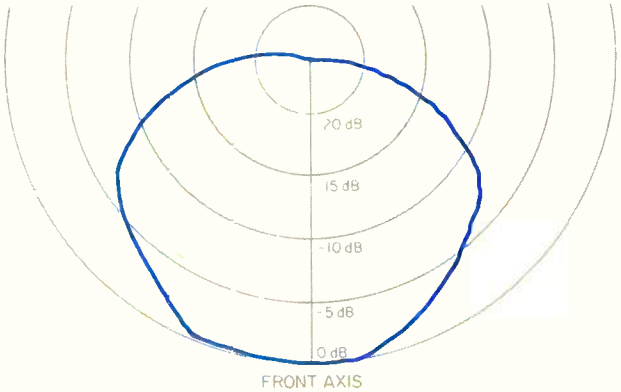


Fig. 6—Horizontal polar-energy response.

"My tests show that the Genesis should handle complicated dynamic passages without blur, but hard-driving bass can cause smearing."

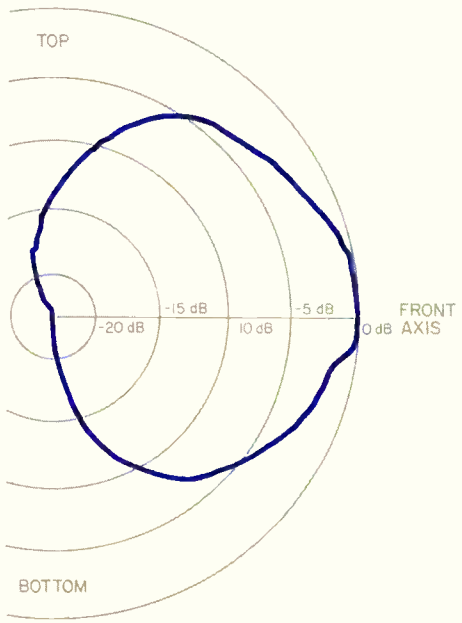


Fig. 7—Vertical polar-energy response.

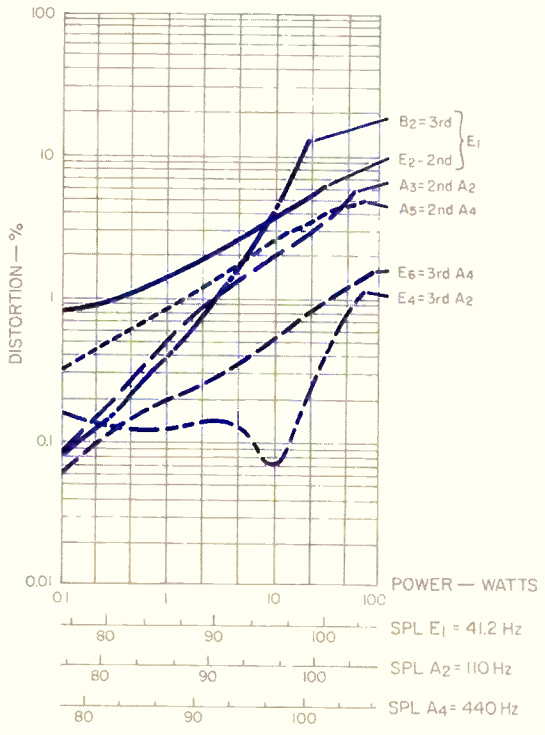


Fig. 8—Harmonic distortion for the tones E_1 (41.2 Hz), A_2 (110 Hz) and A_4 (440 Hz).

average watts the tone of A_4 has a 15° phase modulation and 20% amplitude modulation, both peak to peak. On the whole, the IM is moderately high, indicating a tendency toward acoustic-image smearing at high bass drive levels.

The Genesis 210 handily passed both the crescendo and the acoustic transfer gain tests. In the crescendo test, a tone burst, smothered by a suddenly applied noise of 20-dB higher average level in a 20-kHz band, suffered less than 0.1-dB change for Middle C and less than 0.2-dB change for a tone of A_4. Both of these tests were conducted for peak power levels of signal plus noise up to 300 watts (assuming the speaker were of 8-ohms impedance). In the acoustic transfer gain test, the ratio of sound pressure to applied voltage remained within 0.05 dB of ideal from 100 mW to 10 watts for the tones of Middle C, A_2, and A_4. A_2 and A_4 were able to maintain this linearity up to 60 average watts, while Middle C dropped by 0.5 dB at this level.

On the whole, the harmonic, IM, crescendo, and gain tests indicate that the Genesis should be able to handle complicated dynamics of solo instruments as well as orchestral passages without blurring of the stereo illusion or instrumental wander. However, hard-driving bass can cause a muddiness and orchestral smearing at very high levels.

The energy-time curve is plotted in Fig. 10. The first arrival, at 3.07 mS, is due to the tweeter. The second arrival, commencing at 3.2 mS, is principally due to the lower frequency driver, although some irregularities exist because of sound scattering from the grille assembly. Transient response is principally complete within the first millisecond. Although the transient response could be improved, for this one-meter axial measuring position, by delaying the tweeter sound relative to the woofer by about 0.2 mS, the overall response of the present system is moderately good, in my opinion.

Use and Listening Tests

In the listening test the loudspeakers were placed against a draped wall and on a rug-covered floor. The speaker marked "Left" was placed on my left, as I faced the system, with the "Right" speaker to my right. I experimented with several positions, including pulling the speakers away from the wall and rotating them relative to my listening location. The best response, to my ears, was obtained when the speakers were backed almost against the wall and rotated toward my listening position. The tweeter switch had, to my ears, a minor influence on sound quality, and I conducted most of the tests with the rear-mounted tweeter switch in its Normal position.

The bass response of the Genesis 210 is very strong, too strong for fully accurate spectral balance in my opinion. I found that the tendency toward bottom dominance could be minimized by using a modest amount of bass-cut equalization on the program material. I was frankly surprised to see the results of the anechoic frequency response measurement later, since the listening performance seemed to have quite a bit more low- and mid-bass than the measured free-field response indicates. I was never completely satisfied with the spectral balance I obtained from the 210s. Piano has a coloration which, in my opinion, exhibits a nasal

"I was surprised at the anechoic frequency response. The listening performance seems to have quite a bit more low and mid bass than measured."

Fig. 9—IM distortion on A_4 (440 Hz) caused by E_1 (41.2 Hz), mixed one-to-one.

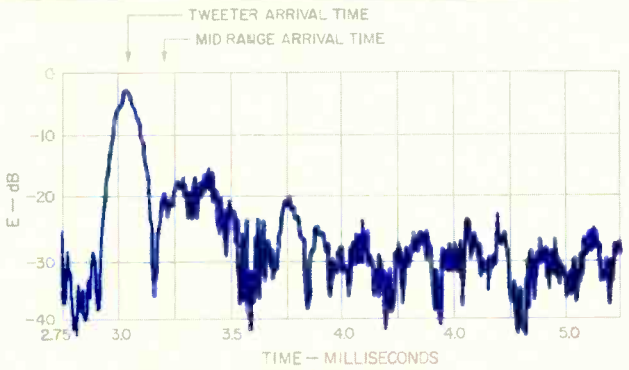


Fig. 10—One-meter on-axis energy-time response.

quality. This property was shared by all material, but was most prominent on piano.

The stereo illusion of the 210s has reasonable localization of solo instruments, but tends toward a central clustering of stereo material. This is strictly my own personal opinion and may not be shared by others, but recorded material that normally, to me, gives the illusion of a broad lateral spread, tends to shrink toward stage center. This was verified by A-B comparison on the same material with a speaker system which I had previously tested.

Female and male vocal material is reasonably accurate, but the bass response must be pulled down a bit to prevent "chestiness" in male vocals. Extreme highs and deep bass are well reproduced and certain types of wide range material, such as synthesizer, come alive on the 210.

Richard C. Heyser

5

SUMIKO MDC-800 TONEARM/ TALISMAN S CARTRIDGE

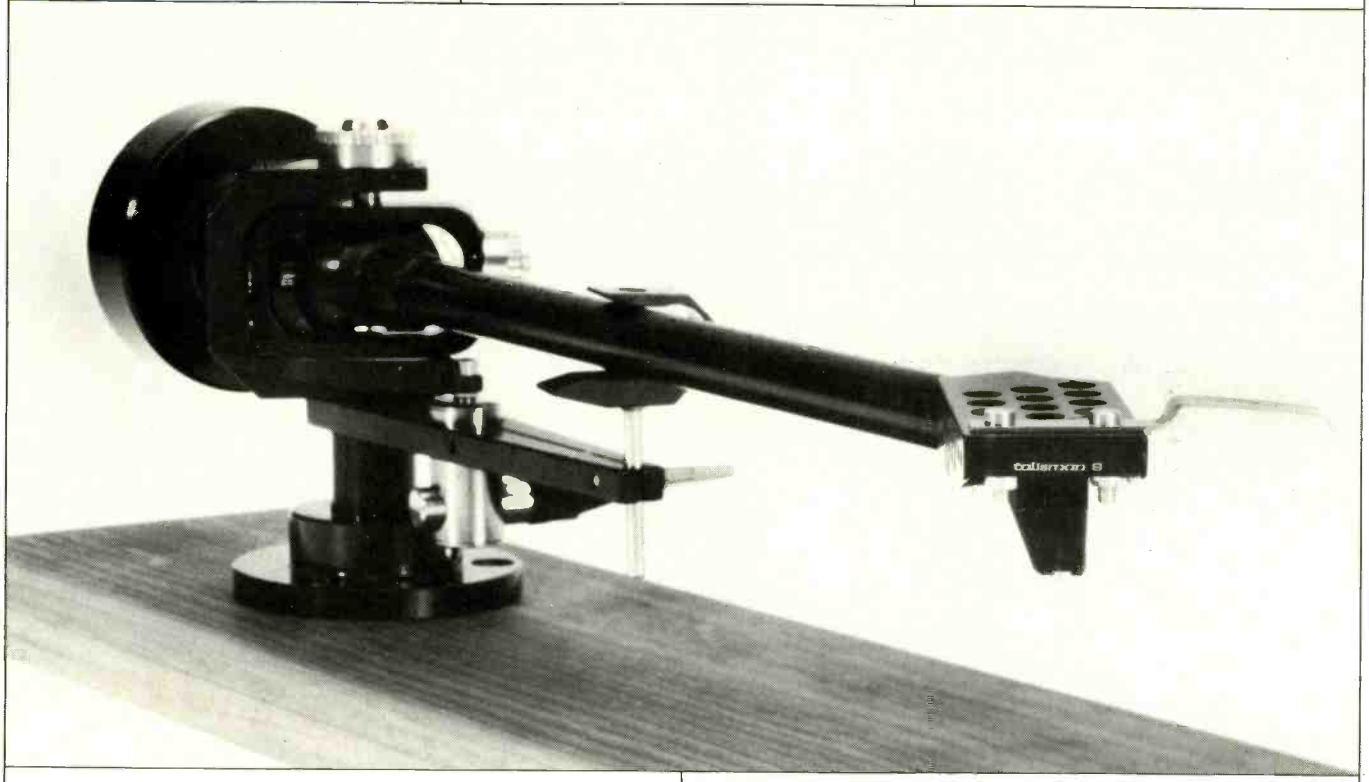
Manufacturer's Specifications

Tonearm

Overall Length: 10.4 inches.
Pivot-Stylus Distance: 9 inches.
Recommended Tracking Force Range: 0 to 1.5 grams.
Total Cable Capacitance: 100 pF.
Price: $1,200.00.

Cartridge

Type: Moving coil.
Cantilever: Sapphire tube.
Output Voltage: 0.26 mV at 1 kHz, 5 cm/S.
Internal Impedance: 9.2 ohms.
Recommended Load Impedance: 40 to 100 ohms.
Frequency Response: 10 Hz to 60 kHz.
Channel Separation: Greater than 30 dB at 1 kHz.
Channel Balance: Within 0.5 dB.
Compliance: 15×10^{-6} cm/dyne.
Recommended Tracking Force Range: 1.5 to 2.5 grams.
Stylus Type: Line contact.
Tip Dimensions: 0.2 × 1.2 mil.
Weight: 6.3 grams.
Price: $300.00.
Company Address: P.O. Box 5046, Berkeley, Cal. 94705.
For literature, circle No. 94



Sumiko is an American company located in Berkeley, California which both imports and manufactures high-quality audio products. A few years ago David Fletcher, one of the principals of Sumiko and who has a background in physics (he worked at Lawrence Berkeley Laboratory of the University of California), decided that tonearm design could be improved if both inertial stability and energy transmission problems could be solved simultaneously. For a number of years, he made a study of the problems which cause tonearms to degrade the quality of sound. He then collaborated with Duncan Davidson, a master machinist who had turned out critical parts for the NASA lunar lander and deep space telescopes, and after two years of design and development "The Arm" was produced. It was later given the model number MDC-800. The pride which prompted Dave Fletcher to call it "The Arm" is certainly justified to a great extent as revealed by the technical measurements which I performed and by the comments of the listening panel.

MEASURED DATA

Sumiko MDC-800 Tonearm Specification	Measurements and Comments
Pivot to Stylus	9.0 in. (22.9 cm)
Pivot to Rear of Arm	2.63 in. (6.7 cm)
Height Adjustment Range	1.38 to 2.25 in. (3.5 to 5.7 cm)
Tracking Force Adjustment	2 grams max. with knob, 3 grams max. with counterweight
Tracking Force Calibration	None, use separate gauge
Cartridge Weight Range	5 to 18 grams
Counterweights	Six, for different cartridge weights
Counterweight Mounting	Two-stage damper
Sidethrust Correction	Knob above pivots; good uniformity
Pivot Damping	None
Lifting Devices	Finger lift on headshell, plus damped lever
Headshell Offset	25°
Overhang Adjustment	Slots in headshell used with alignment fixture
Bearing Alignment	Excellent in both planes
Bearing Friction	Less than 40 mg; too low to measure accurately
Bearing Type	Gimbal; no discernible play
Lead Torque	Negligible
Arm Lead Capacity, pF	Internal, 23; external, 70; total, 93
Arm Lead Resistance, ohms	Internal, 0.75; external, 0.1; total, 0.85
External Lead Length	46 in. (117 cm)
Structural Resonances	Very dead; slight click when tapped
Base Mounting	0.625 in. diameter hole, plus three flange screws

MEASURED DATA

Talisman S Cartridge Specification	Measurements and Comments
Coil Inductance	30 mH
Coil Resistance	8.9 ohms
Tracking Force	1.7 to 2.2 grams, depending on level
Output Voltage	0.25 mV/cm/S
Cartridge Mass	6.25 grams
Microphony	Very low
Hum Rejection	Excellent
High-Frequency Resonance	23.8 kHz
Rise Time	12 μS
Low-Frequency Resonance	8 Hz
Low-Frequency Q	3.2
Recommended Load Resistance	40 ohms or greater has no effect
Recommended Load Capacitance	Anything less than 600 pF has no effect
Recommended Tracking Force	2.0 grams

First Impressions

I must confess that, even though I have a laboratory full of test equipment, when I first unpacked the Sumiko MDC-800 tonearm, I immediately made some quick tests by hand, ones which any of you can also do. First I gripped the tonearm base with one hand and the arm tube in the other, and then pushed and pulled the arm tube to see if I could detect any play in the bearings. Then I tapped the arm tube with my finger nail. I was impressed. I could detect no play in the bearings and the arm tube emitted a short tick sound when tapped. After I had mounted the counterweight on the rear of the arm tube, I tapped the arm again and the tick sound was even quieter. Loose bearings and resonant arm tubes will color the sound reproduction and although some tonearms with these problems can be euphonic, when used with certain other audio components, they are not truthful. The MDC-800 is not one of these.

Design Background

Dave Fletcher's basic design goal was to cause mechanical energy, transmitted to the arm by the phono cartridge while playing a record, to be directed from the headshell through the arm pipe, the bearings, and the arm pillar to the turntable suspension, where it would be dissipated. One idea was to use the same material for the headshell, arm pipe, and pillar, since the velocity of energy propagation would be the same all along the transmission path and reflected energy would be reduced. Such energy reflections can occur when the transmission path is interrupted by junctions between materials which have different energy-velocity characteristics. The couplings between the headshell and bearing parts to the arm pipe are made by rigidly joining them using an expansion and contraction technique, rather than by using screws or adhesives as is usually done. This is accomplished by making the opening in the headshell slightly undersize and the diameter of the arm tube slightly oversize, then heating the headshell so that it expands while cooling the arm tube so that it contracts. The two parts are then brought together, aligned, and allowed to

"The low-frequency resonance is at about 8 Hz. Output is high, but the roll-off below is steep, so warps should not cause overload problems."

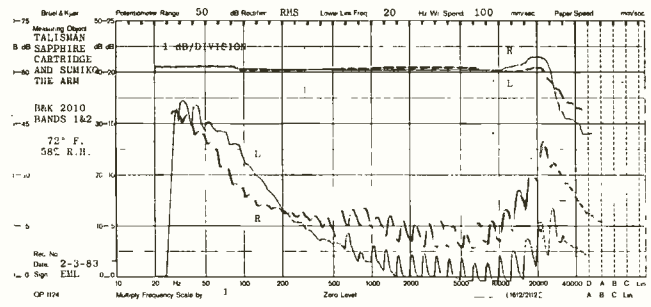


Fig. 1—Frequency response and interchannel crosstalk, B & K 2010, of arm and cartridge.

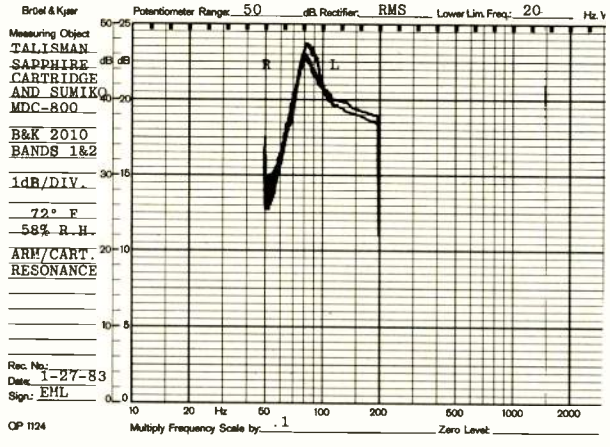


Fig. 2—Low-frequency tonearm/cartridge resonance is at 8 Hz with a "Q" of 3.2, B & K 2010.

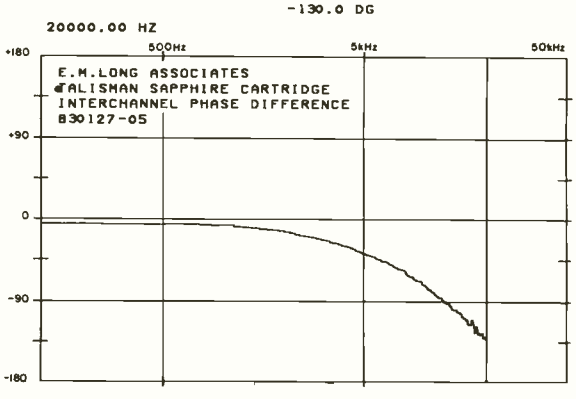


Fig. 3—Interchannel phase of tonearm and cartridge as a function of frequency (B & K 2011 pink noise). Maximum phase shift is 130° at 20 kHz, equivalent to 18 μS.

return to normal temperature. This causes the two parts to be rigidly joined, and since they are made of the same material, they will expand or contract together and always maintain the same rigid relationship. This technique also means that there is no intermediary material to reflect energy back to the cartridge and be picked up as delayed energy to blur the details of the sound.

Features

The MDC-800 is a dynamic-balance type, which uses a counterweight to balance the mass of the cartridge and a spring to adjust the tracking force. This technique would allow you to play a record on a turntable hung upside down and, indeed, this is exactly how Audio Empire used to demonstrate their tonearm at audio shows back in the '60s. While playing records upside down is not generally recommended (except in Australia where it corrects for reversals in absolute polarity), it does show the immunity of such a design to outside forces which could affect performance. Six counterbalances of different mass are provided so that the arm can be set up for cartridges of different mass. This in done to insure that, when the tonearm is balanced, the counterweight is near the arm pillar, which minimizes inertia in both the horizontal and vertical planes. This also reduces the effects of record eccentricity and warp. The vertical and horizontal bearings are equidistant from the pivot point of the tonearm and this, with the very low bearing friction, further reduces such effects. Each counterweight consists of a container with lead shot and epoxy, which is locked to a mounting hub. The mounting hub is decoupled from the tonearm by a two-stage damper which absorbs energy and keeps it from reflecting back down the arm tube to the cartridge. The headshell is machined from a solid block of aluminum and the arm tube is grain oriented by drawing it from heavier gauge aluminum tubing. The gold-plated cartridge clips are machined, rather than stamped, and are silver-soldered to the silver-plated copper arm-tube wires. A short section of litz wire carries the signal around the pivot bearings where it is silver soldered to the arm pillar wiring, which, again, is silver-plated copper wire. MIL-spec connectors are used at the base of the pillar and on the detachable cable, which has gold-plated phono plugs at the other end. The mounting base is milled to provide a concave section directly opposite the set screw. After the arm height is adjusted, the screw is tightened, locking the arm in a three-point mount which allows no play.

Locating and mounting the MDC-800 tonearm on the turntable are made easy by a solid-aluminum arm-mounting tool specially made and designed for the MDC-800. The tool also allows the cartridge to be mounted to the tonearm and precisely adjusted while away from the turntable, which means that changing cartridges is easy. In fact, because of this tool, the MDC-800 is the easiest tonearm to set up and to change cartridges on that I've ever seen.

The Talisman S, which is manufactured to Sumiko specifications, is a moderate-compliance, moving-coil cartridge with a line-contact stylus set in a sapphire-tube cantilever. The letter after the name stands for the material used for the cantilever; there are also A and B models which use aluminum and boron respectively. The A model uses an elliptical

"The MDC-800/Talisman S had a more spacious sound, albeit with slightly less stable images, than the reference system."

stylus while the B and S models use a line-contact stylus. The solid-metal cartridge body has been designed to fit as tightly as possible around the working parts to minimize any vibrational effects which might be excited by mechanical or acoustical energy. A second-generation samarium-cobalt magnet together with a single pole piece is used in what Sumiko calls a Direct Field Focus design which causes the magnetic field to be strongest at the coil, without the normally required yokes.

Measurements and Listening Tests

The technical measurements and listening tests were made with the Sumiko MDC-800 tonearm mounted on the SOTA turntable which I reported upon previously. The technical tests were made before the listening sessions, to insure that the tonearm/cartridge combination was adjusted for maximum performance. This also insures that no potential problems were overlooked which could effect the listening evaluations. During the listening sessions, I used the Sumiko BA-20 stabilizer clamp on each record. All the interconnections between components were treated with Sumiko's Tweek, a fluid which, by increasing contact area and lowering resistance, increases the clarity and definition of the reproduced sound.

Figure 1 shows the response and crosstalk for the Talisman S cartridge and the MDC-800 tonearm and indicates a slight increase in output through the midrange and a rise in output at 20 kHz. The crosstalk is different for each channel but is still very low. The interchannel balance is within 0.5 dB in the midrange, increasing to 2 dB at 20 kHz, which is still very good. The members of the listening panel were unanimous in describing the sound generally as being forward and bright but still very close to the reference system, which also has somewhat this type of sound.

Figure 2 shows the low-frequency tonearm/cartridge resonance which is at about 8 Hz. The output is about 10 dB higher than in the rest of the range, but the rolloff below 8 Hz is very steep, which means that record warps should not cause overload problems. I played some warped records to verify this.

I have wondered for a long while how I could show the correlation between listening-panel comments about the spatial quality of tonearm/cartridge combinations in terms of phase difference between channels. In the past I have shown this difference by using a 1-kHz square wave and showing the left channel versus right channel as an X/Y oscilloscope display. This time I was able to measure the interchannel phase difference, using the B&K 2011 wideband pink-noise record and the Nicolet 660A-2D Fast Fourier Transform (FFT) Analyzer. The result shown in Fig. 3 includes the phase difference of the record caused by the cutterhead but is probably better than average, and such differences can be expected from typical records. The listening panel commented that the MDC-800/Talisman S combination presented a more spacious sound, albeit with slightly less stable images than the reference system. The curve of Fig. 3 shows that as the frequency increases, the interchannel phase difference increases and becomes 130° at 20 kHz. When the phase approaches 180° it tends toward a complete reversal of polarity which could possibly affect

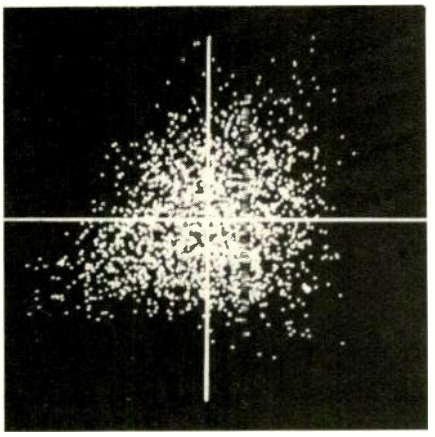


Fig. 4—Interchannel phase of cartridge, left vs. right channel, B & K 2011 Band 7 pink noise.

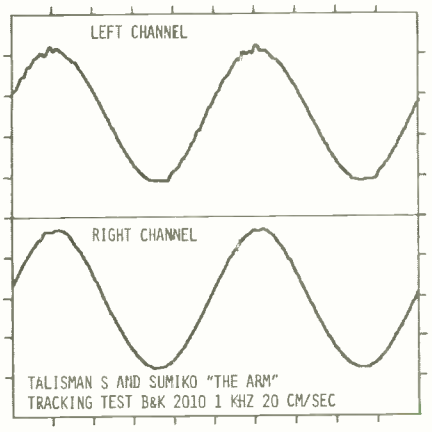


Fig. 5—Tracking of arm and cartridge at 1 kHz, 20 cm/S lateral modulation, with 1.8-gram tracking force, B & K 2010.

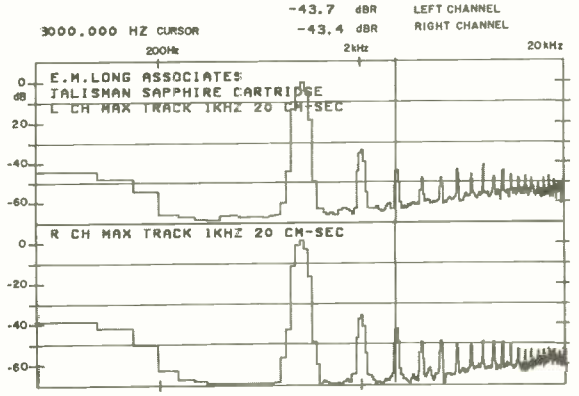


Fig. 6—Spectral components caused by slight mistracking of 1-kHz signal shown in Fig. 5. Level of third harmonic (3 kHz) is 0.63%. Note increase in output at 6th and 8th harmonics (see text).

"You can play your present recordings with a technical excellence which, like many older musical performances, is hard to surpass."

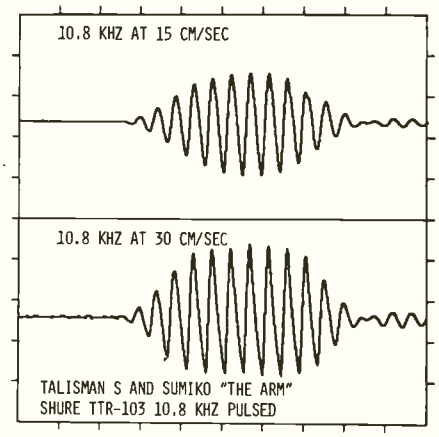


Fig. 7—Arm/cartridge output at 15 cm/S and 30 cm/S, 10.8-kHz pulse test. Note slight compression of signal at 30 cm/S, a very high level.

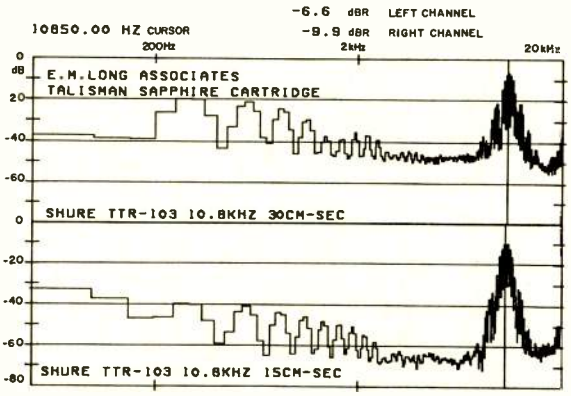


Fig. 8—Spectrum of distortion products for 15- and 30-cm/S signals shown in Fig. 7. Frequencies above 200 Hz are at least 30 dB down for the 15 cm/S signal, but increase in level for 30 cm/S signal (see text).

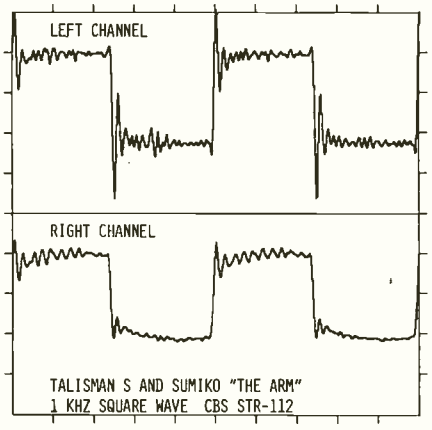


Fig. 9—Arm/cartridge output for 1-kHz square wave, CBS STR-112.

the perceived brightness in the 10- to 20-kHz range as well as affect the ability of the listening panel to localize sound sources. Figure 4 is a left-channel versus right-channel display, captured by the Nicolet Explorer III dual-channel digital oscilloscope, of the same wideband pink-noise signal. It may be compared, in a general way, with the results shown in previous reports for a 1-kHz square-wave test signal.

Figure 5 shows the left- and right-channel waveforms for a 1-kHz signal at 20 cm/S recorded velocity, at which level the MDC-800/Talisman S is just barely mistracking. Figure 6 shows the spectral components due to this slight mistracking with the cursor set at 3 kHz (the third harmonic). This is down almost 44 dB below (at 0.63%) the 1-kHz signal, which is quite good. The shape of the harmonic spectrum also tends to correlate with the listening panel's comments regarding the brightness of the sound since the levels at 6 and 8 kHz are slightly higher than the 3-kHz level.

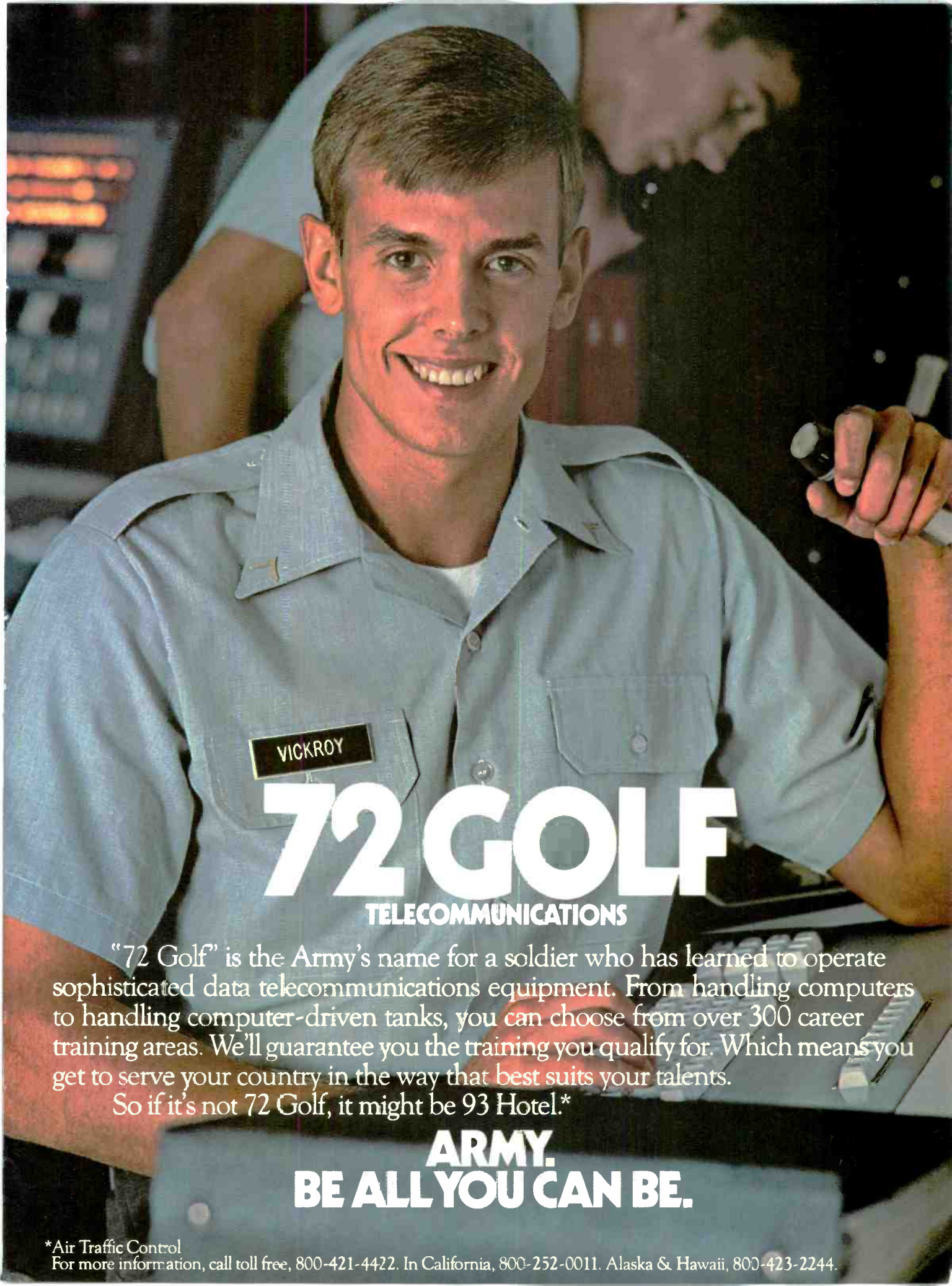
Figure 7 is the digital oscilloscope display of the 10.8-kHz pulse signals from the Shure TTR-103 test record. In the past, both the left and right channels were shown, but Fig. 7 shows the output at two different levels, 15 and 30 cm/S respectively. At 30 cm/S, a slight flattening of the envelope would indicate that some compression is taking place. However, no comments were made by the listening panel in this regard, so this effect must be slight. The distortion components, shown in Fig. 8, which appear at lower frequencies, are quite low for the 15-cm/S signal and are still respectable even with the severe 30 cm/S signal. This is not to say that the effects are not being heard, it merely indicates that they are not significantly different than those heard with the reference system, which also uses a high-quality, moving-coil cartridge.

Figure 9 shows the output of the MDC-800/Talisman combination when reproducing the 1-kHz square wave on the CBS STR-112 test record. The overshoot verifies the high-frequency rise in response shown in Fig. 1, while the ringing shows that there is high-frequency phase shift. The rise-time display is not shown for the Talisman S cartridge, but it was measured as 12 μS, which is very good.

Conclusions

The Sumiko MDC-800 tonearm and Talisman S cartridge proved to be an excellent combination, capable of reproducing detail and clarity in even hard-to-track records. In fact, it was so good that I pulled out a new copy of an old recording of *Symphonie Fantastique* (RCA LM-1900 with Charles Munch conducting the Boston Symphony Orchestra). This album has bells recorded at such a high level that I never could find a mono cartridge that would track it, including the Weathers capacitance cartridge and arm, which had extremely high compliance. The MDC-800/Talisman S played the *Symphonie Fantastique* in all its glory, as it had all the other difficult-to-track recordings which I tried. The Compact Disc may offer improved technical performance for future recordings, but the Sumiko MDC-800 tonearm and Talisman S phono cartridge combination will let you play your present recordings with a level of technical excellence which, like many of the older musical performances, is hard to surpass.

Edward M. Long



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6

LUXMAN RX-103 RECEIVER

Manufacturer's Specifications

FM Tuner Section

Usable Sensitivity: Mono, 10.3 dBf (1.8μV/300 ohms).
Fifty-dB Quieting Sensitivity: Mono, 16.4 dBf (3.6μV/300 ohms).
S/N: Mono, 78 dB.
THD: Mono, 0.05% at 1 kHz, 0.06% at 100 Hz, 0.08% at 6 kHz; stereo, 0.06% at 1 kHz, 0.08% at 100 Hz, 0.10% at 6 kHz.
Capture Ratio: Wide, 1.2 dB; narrow, 3.3 dB.
Image Rejection: 70 dB.
I.f. Rejection: 100 dB.
Spurious Response Rejection: 85 dB.
AM Suppression: 65 dB.
Alternate Channel Selectivity: Wide, 60 dB; narrow, 90 dB.
Adjacent Channel Selectivity: Wide, 6 dB; narrow, 20 dB.
Stereo Separation: Wide, 55 dB at 1 kHz.
SCA Rejection: 60 dB.

AM Tuner Section

Usable Sensitivity: Loop, 550 μV per m; external antenna, 15 μV.
Image Rejection: 40 dB.
S/N: 50 dB.
THD: 0.3%.

Amplifier Section

Power Output: 90 watts per channel, both channels driven, 8-ohm loads, 20 Hz to 20 kHz.
Rated THD: 0.018%.
Input Sensitivity: MM phono, 2.5 mV for rated output; MC phono, 150 μV for rated output; high level, 150 mV for rated output; main amplifier, 950 mV for rated output.
Phono Overload: MM, 200 mV.
S/N: MM phono, 86 dB; high level, 102 dB.
Residual Noise: 0.5 mV.
Tone Control Range: Bass, +7 to −10 dB at 100 Hz; treble, +6 to −10 dB at 10 kHz.
Subsonic Filter: 30 Hz, 6 dB/octave.
High-Cut Filter: 7 kHz, 6 dB/octave.
Loudness Control: Volume at −30 dB, +8 dB at 100 Hz, +7.5 dB at 10 kHz.

General Specifications

Power Consumption: 120 V, 60 Hz, 3.1 A.
Dimensions: 17.8 in. (45.3 cm) W × 5.8 in. (14.7 cm) H × 17.9 in. (45.5 cm) D.
Weight: 34.1 lbs. (15.5 kg).
Price: $995.00.
Company Address: Luxman Division, Alpine Electronics, P.O. Box 2859, Torrance, Calif. 90509.
For literature, circle No. 95

Cosmetically, the RX-103 is a far cry from some of the earliest Luxman receivers to arrive in this country some 10 years ago when that 55-year-old company first established its own subsidiary in the United States. Those receivers were widely acclaimed for the elegance of their styling (a senior engineer and director of the Lux Corporation of Japan had the last word on product design and styling, and his sense of good taste was unerring) as well as for their excellent sonic and measured performance. Front panels were always somewhat understated and subdued, with colors carefully chosen, knobs painstakingly selected to complement the rest of the panel's accoutrements. One felt the overall appearance without was consistent with the superb electronic performance within.

Let me say at the outset that the superb performance is still very much present in this latest round of receivers, if the top-of-the-line RX-103 is any indicator of the rest of the line. As for the styling, well, I'm sure there are those who will love the RX-103's clear lucite-block pushbutton selectors, flashing LED indicators (which abound and, in actual use, do perform useful functions), its busy arrays of rotary knobs and pushbuttons, and its four-tone color scheme (more, if you count the colors of the various indicator lights). I suspect that there are some who will even love "Servo-Face." What is Servo-Face, you ask? It is Luxman's name for its futuristic motor-driven section of the front panel. With power off, the right half of the panel rests flush with the front surfaces of the rotary bass, treble, balance, loudness and master volume controls, at the same time covering up seven small pushbuttons which handle secondary functions of tape monitor selection (there are two circuits here), tape dubbing, subsonic and high-cut filter activation, mono/FM muting, and MM/MC cartridge input selection.

Push the power switch at the lower left of the panel and the gentle whirring of a motor is heard, as the Servo-Face section of the panel recedes so that you can get at the aforementioned knobs and buttons. I am informed that the "practical" purpose of Servo-Face (I just love that name, don't you?) is to prevent idle fingers from upsetting preferred control settings when the master of the system is not present. If that is so, it would seem to me to be more important that Servo-Face operate in just the reverse way—blocking access to the knobs when the receiver is turned on and working. As I said, you will either love it or think it a bit silly, but it should in no way detract from an appreciation of the excellent audio and r.f. engineering which has gone into the RX-103.

To the left of the Servo-Face section of the panel are several transparent lucite blocks which serve as program source selector buttons (FM, AM, Phono and AUX) and as "Up" and "Down" AM or FM tuning buttons for the frequency-synthesized tuner. When a given program selector button is pushed, subdued red lighting is emitted from behind that button and is visible in front of the button. Blocks at the extreme left end of the panel serve as the power on/off switch and as speaker selector switches (one or two pairs of speakers can be connected to the RX-103). Just to the right of these are "Store," "Memory Scan," and eight preset station buttons, plus a button labelled "FM Memory A/B." With the aid of this last-named button, it is possible to store

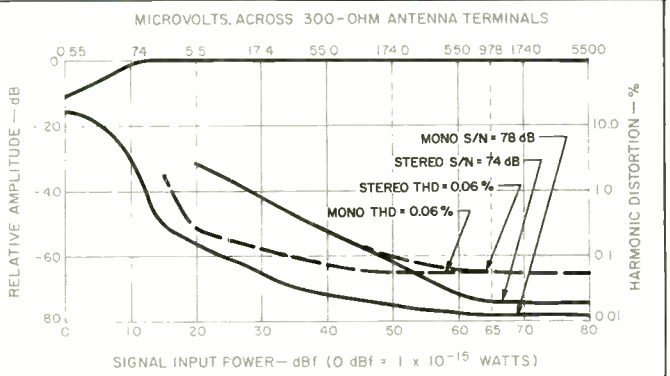


Fig. 1—Mono and stereo quieting and distortion characteristics, FM section.

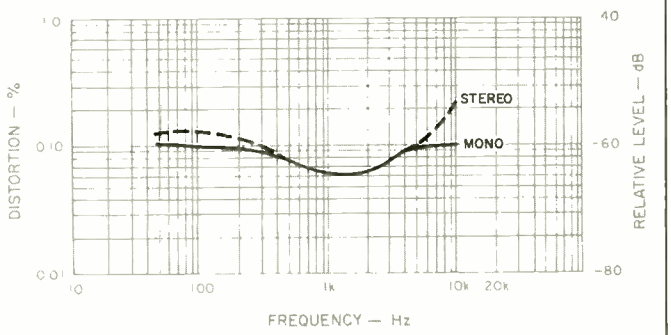


Fig. 2—THD vs. frequency, FM tuner section.

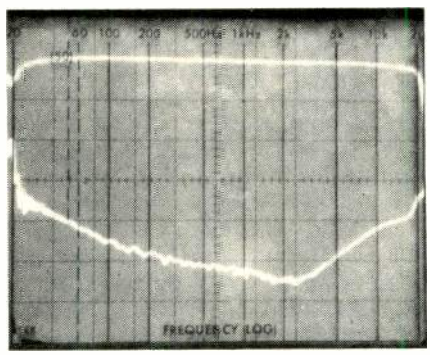


Fig. 3—Frequency response (upper trace) and stereo separation (lower trace), FM tuner section.

"It was obvious from the listening tests that Luxman's engineers had not lost their touch—or their sense of what constitutes good sound."

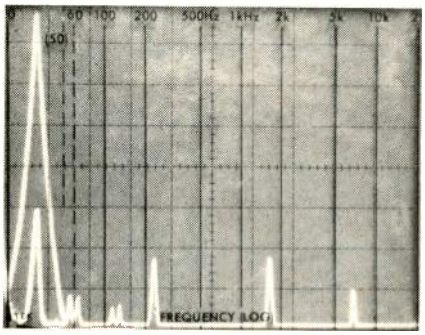


Fig. 4—Spectrum analysis of crosstalk products for a 5-kHz, left-only signal, FM tuner section.

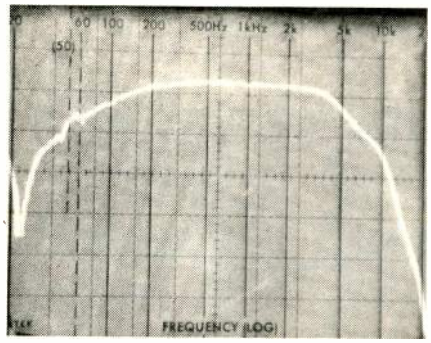


Fig. 5—Frequency response, AM tuner section.

up to 16 favorite FM stations, since stations can be memorized as A1, A2, etc. or B1, B2, etc. depending upon the setting of the A/B switch when a given station frequency is placed into memory. When AM reception is selected, however, only eight favorite station frequencies can be stored since the A/B switch is not active in the AM tuning mode.

Most of the remainder of the front panel is devoted to forms of display, including a fluorescent power output level display, preset station indicators, numeric frequency display (in MHz for FM or kHz for AM), signal strength indicator, FM tuning indicator (which lights up when optimum tuning has been achieved), and a stereo indicator. In addition, there are several tiny red LED indicators which light up to tell you what Luxman's automatic Computer Analyzed Tuning (C.A.T., for short) is doing. This circuit adjusts such tuner parameters as i.f. bandwidth (narrow and wide settings are not user selectable, but are adjusted according to reception conditions "sensed" by the tuner), antenna attenuator, high-blend circuit, and an anti-"birdie" filter. Any or all of these may be turned on automatically, and if they are, associated LEDs in the display area tell you so. Of course, if you don't agree with C.A.T.'s decisions you always have the option of depressing a C.A.T. on/off button located to the right of the display area. A headphone jack and a remote-control on/off switch complete the front panel layout.

A hand-held infrared remote control unit supplied with the RX-103 enables you to operate many of the receiver's functions remotely (power on/off, volume, muting, input selection, memory scanning, FM A/B selection and tape monitor switching). And if you happen to own Luxman's matching turntable (PX-101) and matching cassette deck (their KX-102 or KX-101), multiconductor cables provided with those components connect to special sockets on the rear panel of the RX-103, enabling you to operate most of the controls on these other components from the same remote, too.

Coaxial as well as screw-terminal 75-ohm antenna connection facilities, plus 300-ohm and external AM antenna terminals are grouped together at the upper left of the rear panel. A true AM loop antenna is supplied separately and snaps into a bracket on the rear panel, and it can be oriented for best AM reception. In addition to the usual array of phono- and high-level input and tape input and output jacks, the rear panel of the receiver is equipped with pairs of "Preamplifier Output" and "Main Amplifier" input jacks, plus a switch to connect and disconnect these two sections of the receiver to plug sound processors into the signal path. Two sets of color-coded speaker connection terminals, four convenience a.c. receptacles, and a chassis ground terminal complete the rear panel layout.

Circuit Highlights

Neither the owner's manual nor the press releases issued by Alpine, who have the American distributing rights for Luxman products, tells us very much about the circuitry of the RX-103 receiver. We do know that the amplifier section uses Luxman's well-known "Duo Beta" circuit which provides minimum overall loop feedback in the audio range but adds a second subsonic feedback loop to reduce output impedance at near-d.c. frequencies and reduce various forms of dynamic intermodulation distortion, in addition to stabilizing the output stages against d.c. drift. Having explored this circuit in earlier amplifiers, I can tell you that it is a valid and effective approach to audio power amplifier design, one that has been emulated by several other firms who specialize in superb-sounding high-end amplifiers.

The tuner section employs frequency-synthesized tuning, of course, with the added attraction of that innovative C.A.T. circuit that takes the guesswork out of optimum FM tuning.

FM Measurements

Usable FM sensitivity in mono measured 10.8 dBf (1.9 μV across 300 ohms), while stereo usable sensitivity was 18 dBf (4.4 μV/300), just a bit above the ideally set stereo switching threshold of 17 dBf. Fifty-dB quieting in mono required an input signal strength of only 14.7 dBf (3.0 μV/300 ohms), while in stereo, the 50-dB quieting level was reached with an input signal of 37.2 dBf (40 μV). At 65-dBf signal level, signal-to-noise ratio in mono was 78 dB, exactly as specified by Luxman, while at the same signal strength input in stereo, S/N measured 74 dB. Harmonic distortion, for a 1-kHz modulating signal, measured 0.06% in both mono and stereo. Distortion and quieting for both mono and stereo reception are plotted as a function of signal input levels in Fig. 1, while in Fig. 2 I have plotted harmonic distortion versus audio frequency (for strong signal levels)

"Dynamic headroom was high for a receiver in this power class, a full 1.7 dB. In music power terms, that means it can deliver short-term peaks of 133 watts."

for both mono and stereo. At 100 Hz, THD was 0.1% in mono and 0.13% in stereo, while at 6 kHz, distortion was 0.1% in mono and 0.11% in stereo.

Figure 3 is a 'scope photo taken from my spectrum analyzer. Sweeps are logarithmic from 20 Hz to 20 kHz. The upper trace shows stereo FM frequency response for the FM tuner section of the Luxman RX-103; deviation from flat response was no more than +0.3 dB or −0.4 dB at any frequency from 30 Hz to 15 kHz. The lower trace shows crosstalk or separation as measured at the output of the unmodulated channel. Separation measured an outstandingly high 58 dB on one channel and 61 dB on the other at 1 kHz. At 100 Hz, the separation readings were 47 and 48 dB, while at 10 kHz, separation was still a very high 39 dB for each channel.

Figure 4 illustrates what happened when I applied a 5-kHz modulating signal to the left channel. The tall spike at the left of the 'scope display is the desired output signal. Sweep was linear this time, extending from 0 Hz to 50 kHz. The second sweep shows what was present at the output of the unmodulated channel. Separation is indicated by the shorter spike nestled inside the desired output indication, and amounts to around 46 dB at that frequency ('scope vertical sensitivity is 10 dB per division). Other crosstalk components, seen to the right of the display, consist of harmonics of the 5-kHz modulating signal, small amounts of 19- and 38-kHz outputs, and one or two other spurious crosstalk signals.

Because of the automatic action of Luxman's C.A.T. circuitry, it was not possible to "force" the tuner into its narrow i.f. mode on the test bench. Therefore, we were only able to measure remaining i.f.-bandwidth-dependent parameters in the normal or "wide" position. Under those conditions, capture ratio measured an excellent 1.1 dB, while alternate-channel selectivity was 63 dB. Image rejection measured 73 dB while i.f. and spurious rejection measured 100 and 88 dB respectively. Figure 5 is the usual frequency response curve for the AM tuner section of the receiver. If you are willing to tolerate a "±6 dB" notation (the way most manufacturers quote AM frequency response, if they quote it at all), the response of this AM section is really not all that bad, extending as it does from around 65 Hz to between 5 and 6 kHz.

Power Amplifier and Preamplifier Measurements

The power amplifier section of the Luxman RX-103 delivered a full 100 watts per channel at mid-frequencies before THD reached the rated level of 0.018%. The reason for Luxman's 90-watt rating was obviously the power limits at 20 Hz and 20 kHz, which turned out to be exactly 90 watts, as claimed. Dynamic headroom was rather high for a receiver in this power class, measuring a full 1.7 dB. Translated to music power terms, this means that the amplifier can deliver short-term signal peaks of 133 watts per channel without clipping. Figure 6 is a plot of THD versus power output for the three key test frequencies of 20 Hz, 1 kHz, and 20 kHz. Damping factor for the power amplifier measured 47, referred to 50 Hz and 8-ohm loads. Considering the low amount of overall feedback employed in the Duo-Beta circuitry, I was impressed with the receiver's relatively low

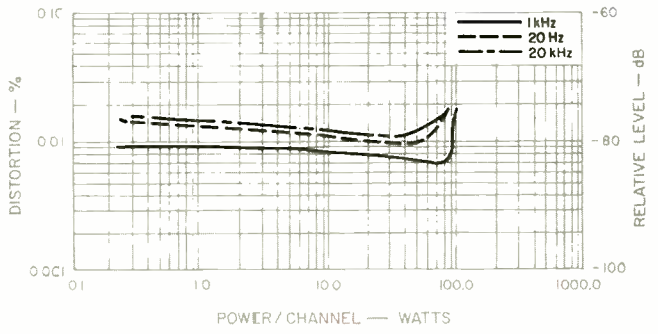


Fig. 6—Power output per channel vs. THD.

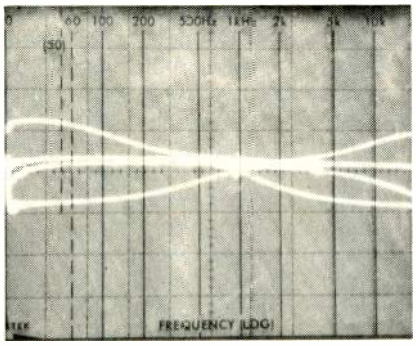


Fig. 7—Tone control and filter characteristics.

output impedance, as indicated by such a high damping factor. The amplifier operated safely into 2-ohm loads, and it was stable under a wide variety of capacitive and inductive loading conditions. CCIF-IM (twin tone) distortion measured 0.0027% at rated output, while IHF-IM was lower than 0.01%, the lowest that I am able to observe on my spectrum analyzer.

Figure 7 is a 'scope photo of multiple sweeps taken with my spectrum analyzer, showing bass and treble action as well as the characteristics of the low-cut and high-cut filters. The bass and treble control action is rather unusual in that when bass and treble boost are employed, midrange frequency response is left relatively unaltered, whereas when bass or treble cut is introduced, the turnover point seems to shift more towards the mid-frequencies. In later listening tests, I discovered this arrangement is more effective than the usual fixed-pivot-point tone control designs.

Input sensitivity measured 0.25 mV for the MM phono inputs, 0.015 mV for the MC phono inputs, and 18 mV for the high-level (AUX and tape) inputs. Measurements are referred to 1-watt output. RIAA equalization was accurate to within 0.3 dB, with most of the deviation occurring on the plus side. Frequency response through the high-level inputs was flat within 1 dB from 10 Hz to 24 kHz, within 3 dB from 5 Hz to 50 kHz.

"This tuner section really 'knows' how best to handle any incoming signals without the user worrying about what settings to use."

Signal-to-noise ratio for the moving-magnet phono inputs measured 77 dB, referred to 1-watt output, with a 5-mV input at 1 kHz. In the moving-coil setting of the selector switch, with input reference level reduced to 0.5 mV, signal-to-noise was still a very satisfactory 72 dB. With a 0.5-V signal applied to the high-level inputs and output adjusted (by means of the master volume control) to 1-watt output, signal-to-noise measured 79 dB, while residual noise with volume control turned fully counterclockwise was 83 dB below 1 watt. Expressed in voltage terms across 8 ohms, that works out to be 0.2 mV, or 8 dB better than claimed by Luxman. Phono overload was a very high 230 mV for the moving-magnet phono inputs and a more-than-adequate 26 mV for the moving-coil inputs.

Use and Listening Tests

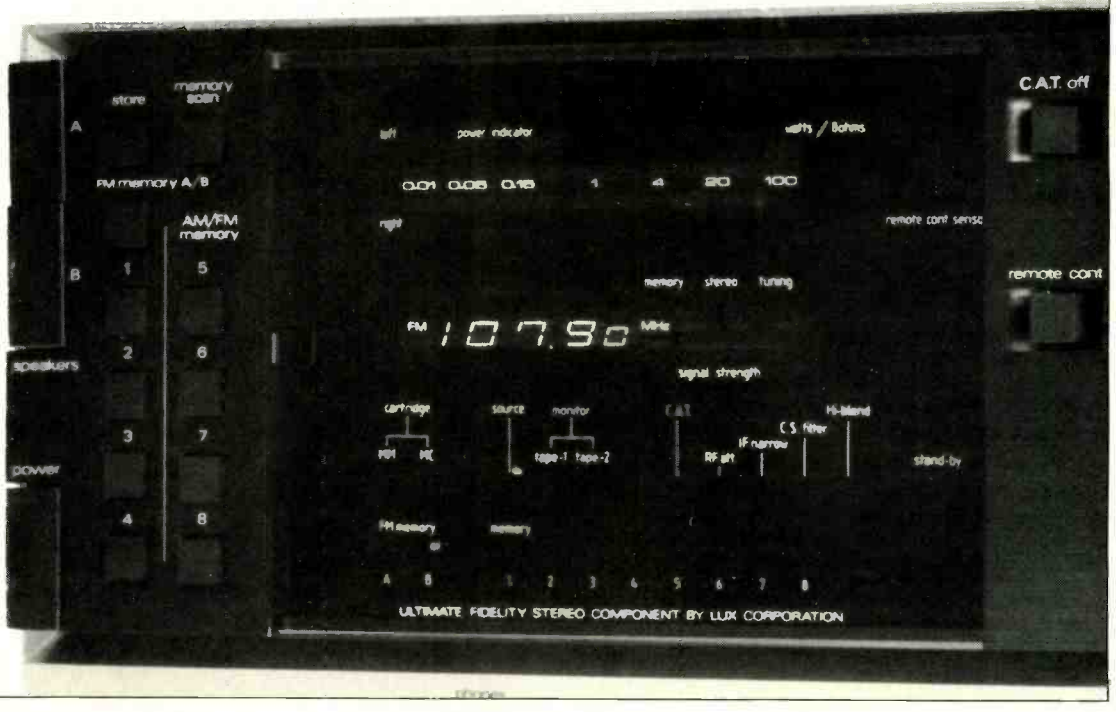
It was obvious from the first moment that I turned on the RX-103 for listening tests that the Luxman engineers had not lost their touch—or their sense of what constitutes good sound in an all-in-one receiver. Where I live, at least, having all that station storage capacity is very welcome, since there are actually more than eight FM stations that I want to be able to recall easily (not because that many broadcast a high-quality, high-fidelity signal, but because I sometimes want to hear their programming). I hooked up my regular turntable as well as my own Compact Disc player (via the AUX inputs) and listened to a variety of program material. Although my reference speakers are not very efficient, the relatively high power of the Luxman receiver, plus its high dynamic headroom, provided adequate sound levels even with CDs having very wide dynamic range. The fluorescent power output meters are a worthwhile enhancement to the receiver, especially under circumstances such as mine, where I was running the receiver at peak output levels very close to clipping.

Conventional records were reproduced flawlessly with the Luxman RX-103, too, though I must confess that I'm getting a bit spoiled by Compact Discs these days. I therefore don't spend as much time listening to vinyl LPs as I used to when evaluating new equipment.

Perhaps the most outstanding portion of the receiver is the FM tuner section. Not that the measured numbers are the best I have ever seen in a tuner or a receiver, far from it. What's nice about this tuner section is that it really "knows" how best to handle any incoming signals without the user having to worry about which settings will be best under a given set of reception conditions. To some inveterate knob twirlers, this may seem a negative feature, but to the music lover who simply wants the best possible FM reception under a given set of conditions, the RX-103's C.A.T. feature will be much appreciated.

I have seen the RX-103 at audio dealers' showrooms hooked up to a Luxman turntable and cassette deck in what constitutes one of the most sophisticated one-brand systems imaginable. It's under those conditions that the hand-held remote control unit really comes into its own. But even when used with the receiver alone, the remote unit adds a touch of luxury to the installation. The surprising thing is that, to the best of my knowledge, Luxman is the only company that has attempted to incorporate one of the few positive advantages of one-brand systems, such as wireless remote control, into a top-quality component, thereby giving us the best of both worlds. Yes, I liked the Luxman RX-103 very much, and, after a while, I even learned to ignore Servo-Face entirely; the receiver has so many other good things going for it.

Leonard Feldman



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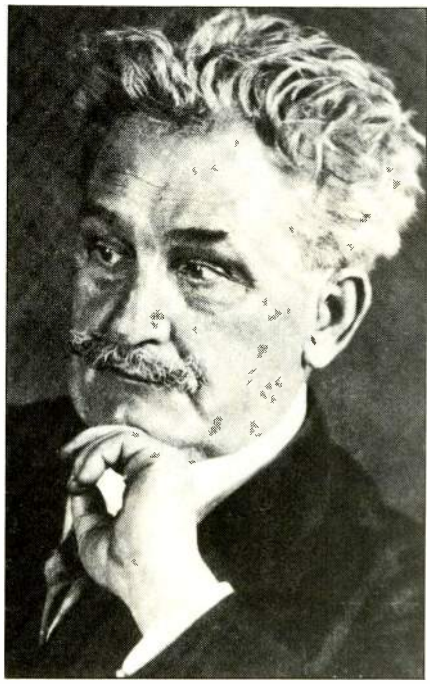


Photograph: The Bettmann Archive

Janáček: Idyll for String Orchestra; Mladi ("Youth") for Wind Sextet. Los Angeles Chamber Orchestra, Gerard Schwarz.
Nonesuch D-79033, digital, $11.98.
Janáček: Piano Sonata 1.X.; On An Overgrown Path; In The Mist. Ivan Moravec, piano.
Nonesuch D-79041, digital, $11.98.

Far less known to the general musical public than Dvořák and Smetana, Janáček was in the direct line following those composers, one of those late Romantics who lived and worked far into our own century, not immune to its radical changes but somehow preserving the flavor of their own times.

These two Nonesuch digitals explore music even less known—since Janáček's biggest reputation is in 20th century opera—and yet, as you will quickly find, it is music full of pleasant familiarity, ever so clearly Czech or, rather, Bohemian, full to the brim with the lilting folk music of that area.

The first of these discs spans almost 50 years. The "Idyll" dates from 1877, when Janáček was 23, spang in the middle of the late Romantic greats whose names still lead in all our music; the "Mladi" or "Youth Sextet" was composed when Janáček was turning 70—in the midst of the most raucous 1920s. They aren't that different, these two, and most of that difference is the natural evolution of an active mind, writing with more concentration in the late years. The Roaring Twenties are only faintly heard in the "Mladi," a mild and gentle dissonance that falls back into earlier harmony.

The piano recording comes in between, in the early 1900s, and emphasizes the point. Here again it's basically a Romantic idiom, yet with a restless changeability, an instability of harmony, that is accurately of the period. This was a time of passionate politics and nationalism; the Sonata 1.X. (a political date, October 1st, which we would write 10/1) shows some of that feeling to us but not, of course, in the violent fashion of later music—and indeed, one senses that Janáček was a gentle soul, inward, introspective, if fluent and easy in his music to an extraordinary degree.

All in all, it is a curious idiom for listening, whether early or late, this music. There is a kind of out-of-focus quality, a deliberate hesitancy; the square tunes and the open harmonies are disguised in odd-shaped rhythms, irregular phrases. I was reminded, unexpectedly, of the higher orders of rock music today. By contrast with Janáček, other composers who lived on into the 20th century for extended periods—Sibelius, Rachmaninoff, Strauss, Elgar, Saint-Saëns—seem show-off extroverts.

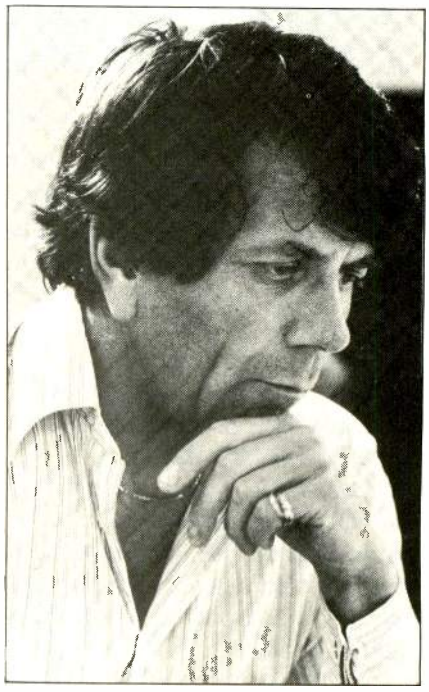
One side of the Idyll was recorded on JVC digital equipment, the other on 3M; the piano sonata was recorded on Sony. If you can spot any difference, your engineering ear is better than mine!

Purcell: Instrumental music from Gordian Knot; Abdelazer; Trumpet Sonata in D Major, etc. English Chamber Orchestra, Leppard.
CBS IM 36707, digital.

The performance of Baroque music has been changing so fast lately that we now find all sorts of ways of doing it, ranging from good old-fashioned symphonic right through the all-authentic (with instruments of the period or modern exact copies)—existing at the same time. The more old-fashioned approaches, as in this recording, are not necessarily the worse ones, nor the better. It all depends. You have to take each on points.

This collection of a batch of orchestral suites, plus an orchestral sonata for trumpet and strings, comes out of three major Purcell stage works, that being the major source of such music. Stage or no, however, these correspond to the later suites by Handel, his Water and Fire Music, plus assorted synthetic suites put together in recent times. They comprise in Purcell, as in Handel, a sequence of short numbers, dance music fast and slow, airs—tunes—overtures at the beginning, making for a hearty and familiar sound, a bit richer and less predictable in Purcell than in Handel.

Leppard uses modern instruments, but a properly small orchestra, which marks the in-between stage in Baroque performance. With the modern instruments go, alas, some remaining misuses of ornaments, trills, in a way that will horrify the pure of mind who like their old music authentic (including myself!). Similarily with excessive slowdowns (ritards) at some endings. Who cares? Some do, some don't. My only more substantive criticism is simply that the playing tends to be on the rough side, not very well coordinated, if full of energy.



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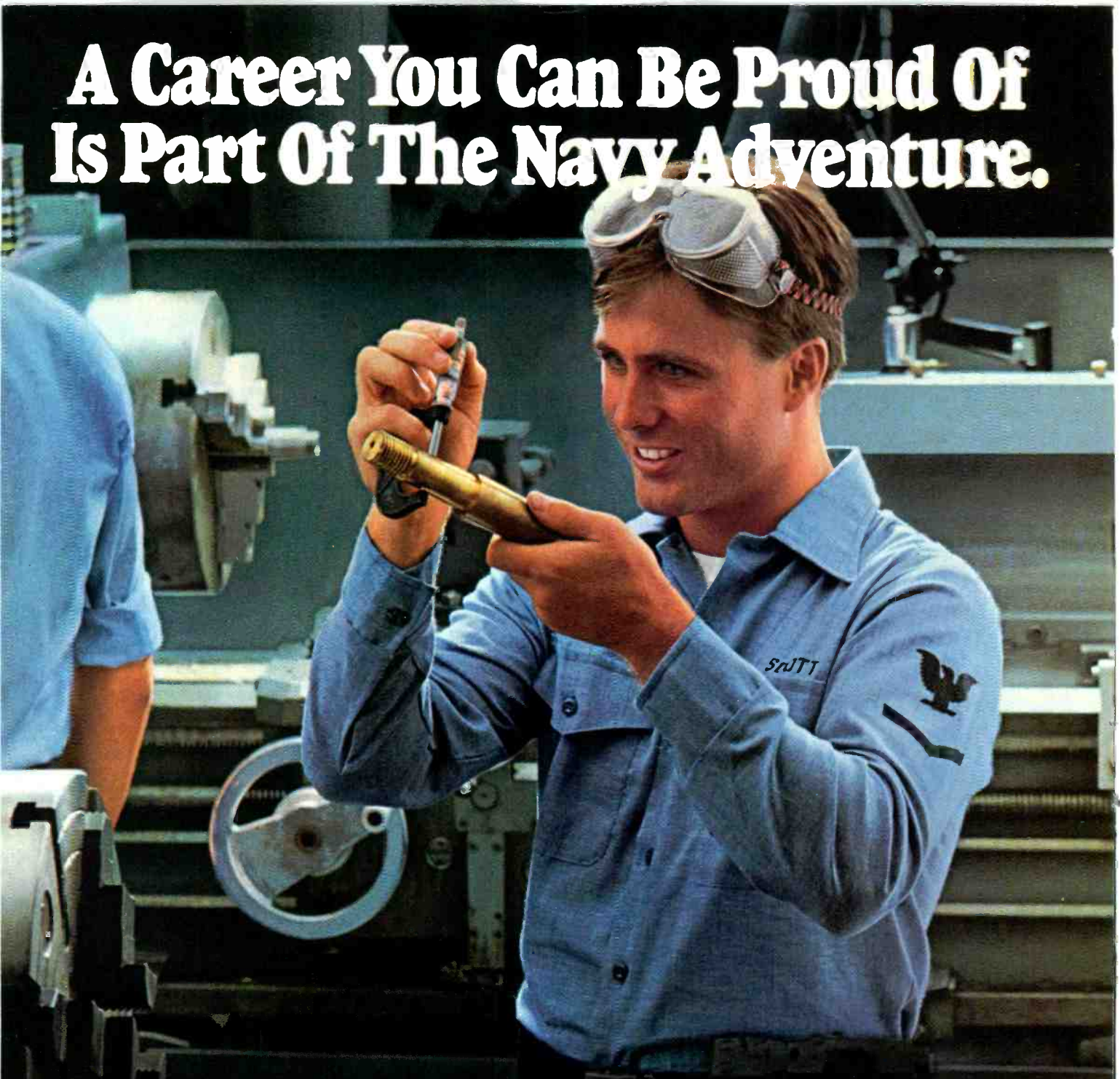

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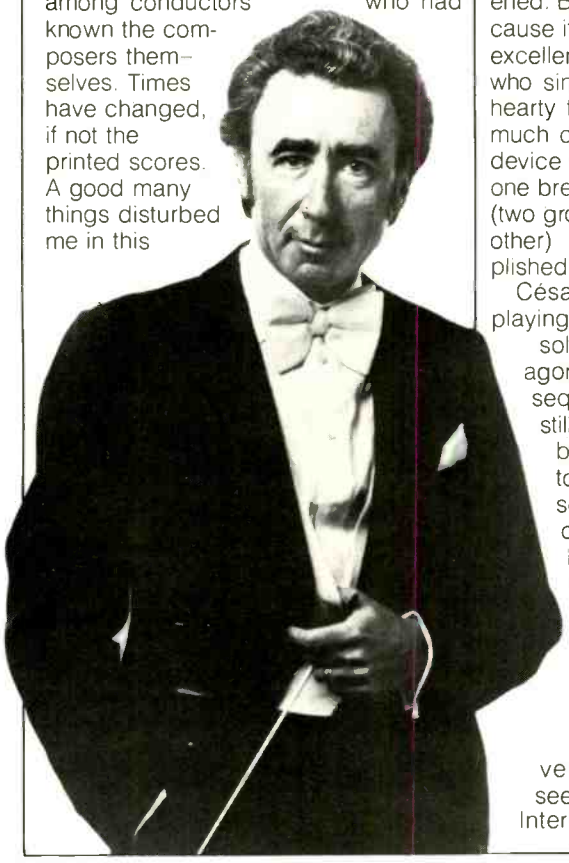
"Both the Debussy and Franck selections are generally well played and well balanced, as well as nicely recorded."

If you know any Purcell, you will find all sorts of familiar items here even if you think you've never heard the music before. Like Handel, Purcell borrowed from himself at every opportunity. So, too, with Bach, and it is a problem, often enough, to discover which of numerous versions is the original—it really doesn't much matter in Purcell. Some of these tunes, for example, can be heard in his harpsichord suites.

Debussy: La Mer; Nocturnes. Houston Symphony Orchestra, Women of the Houston Symphony Chorale, Comissiona.
Vanguard VA 25015, digital, $7.98.
Franck: Symphony in D minor. Houston Symphony Orchestra, Comissiona.
Vanguard VA 25016, digital, $7.98.

My first knowledge of these familiar works goes back to their earliest recordings on 78, at a time when Debussy was modern and César Franck was not far from it; the original traditions of playing then surely still persisted among conductors who had known the composers themselves. Times have changed, if not the printed scores. A good many things disturbed me in this Texas-Roumanian set of performances but they are not necessarily criticisms, just observations. The music is generally well played, well balanced as well as nicely recorded.



Most of all, I noticed a certain squareness, a bit of stiffness, as compared with the sensuous, opulent sound of earlier Debussy playing. The first four descending notes of "La Mer," for instance, contained such mystery, such a sense of space, the grandeur of the vast ocean—how they did it is hard to say: Here, there are just four notes, repeated. No magic. Other coloristic climaxes in this marvelously imaginative piece are suddenly underplayed, just so many notes in passing. That's where direct tradition is breaking down! Glitches, drop-outs in the continuity of sense. Not all the time; just at a few important places. Don't take it to heart.

"Fêtes," that evening festival that fades away into the night after the climax, goes nervously fast, then fades unconvincingly, at least for these ears. The magic is not missing, just lessened. But "Sirènes," seldom heard because it requires a women's chorus, is excellent, partly thanks to the women, who sing with Texas verve, rather too hearty for sirens, to be sure, but with much conviction. The clever Debussy device whereby they seem to sing on one breath for whole minutes at a time (two groups, one cross-fading into the other) was never so neatly accomplished.

César Franck similarly. In earlier playings it was full of an enormous solemnity, of ominous violence, of agonizing sweetness, the harmonic sequences (a Franck trademark) still fresh and amazing. It's all here, but in a more businesslike way, to the point and rather quickly so. That makes it sound more old fashioned than it is. The lovely slow movement, so much like that of the Beethoven 7th, yet so atmospheric, goes far too fast for my tolerance—half the impressiveness is lost. And yet—music must change. You could well enjoy this more than the older versions, which might today seem too mannered, too slow. Interesting minor technical point:

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"These Locatelli 'Caprices' are most unusual, both in the music itself and in the playing, which shows great technique."

There is some noticeable pre-echo before "Fêtes" on the Debussy disc. Ha! Can't be on the tape, which is digital. Must, then, be in the cutting. Only an all-digital CD can totally eliminate this old disc problem.

The Royal Ballet: Elite Syncopations. Music by Scott Joplin and others. Orchestra of the Royal Ballet, Gammon.
Vanguard Everyman SRV 373, $3.98.

Do I believe what I see—an LP record for under $4.00? Maybe somebody got absent minded. Or nostalgic.

This one, I would say, is mostly for laughs, and not the ones intended over there in Blighty. A *British* Joplin fest? It would be fine if some of the rock groups and maybe a few of their pink-haired successors might take up Joplin again. But dear me, this isn't *that* sort of music. This is Royal, official. Frankly, I have never heard more un-raggy rag playing in my life. I couldn't believe that, either. Imagine Queen Liz, or maybe better (if you remember her) good old Queen Mary-with-the-funny-hats, doin' a boogie or cake walk or even a Charleston in front of Parliament assembled, and you have it exactly.

No, it isn't solemn and isn't supposed to be, after all. It purports to be humorous and maybe the ballet itself was fun to look at—I never saw it. But we have no ballet here, just this so-called rag stuff.

By the way, the "others" designation includes quite a batch of rag men in addition to Joplin, the Big Name. Note that most of the music, of course, is arranged for the small orchestra, or for piano, percussion and bass. Some items are the piano original. Twenty-foot grand, no doubt, just the kind that Joplin used.

Jack Glatzer Plays the Caprices of Locatelli.
Golden Crest RE 7077, digital, $9.98.

This is musically a most unusual disc, in the music itself and in the playing. We all know the Paganini Caprices, whether we want to or not—and the many later works based on a few of them as themes. Who's ever heard of these extraordinary works, of a slightly earlier time? They date from about 1725 and were originally cadenzas for a dozen violin concerti—two written out for each concerto (presumably for a choice—or was it for two movements?).

These, then, are Baroque virtuoso excercises, whereas the later Paganini Caprices rate as early-Romantic; but in Italy there is not that much difference. In 1725 the Italians were still stylistic leaders, ahead of their time, but by the early 1800s they were lagging behind, the Germans having taken over the lead.

It takes a player, of course, to produce the sound. As must be pointed out again and again today, the big-name instrumentalists are not alone. The musical woods are full of superb musicians who don't happen to have the temperament, backing, or whatever, to reach the top. If you think any famous name could play these better than Jack Glatzer, out of Texas, you are nuts. A most extraordinary technique and with it a perfect sense of pitch, executed with never the slightest wobble or bobble—it's amazing. Very fine digitally recorded sound, too.

Berlioz: Symphonie Fantastique. Cleveland Orchestra, Lorin Maazel.
Telarc DG 10076, digital, $17.98.

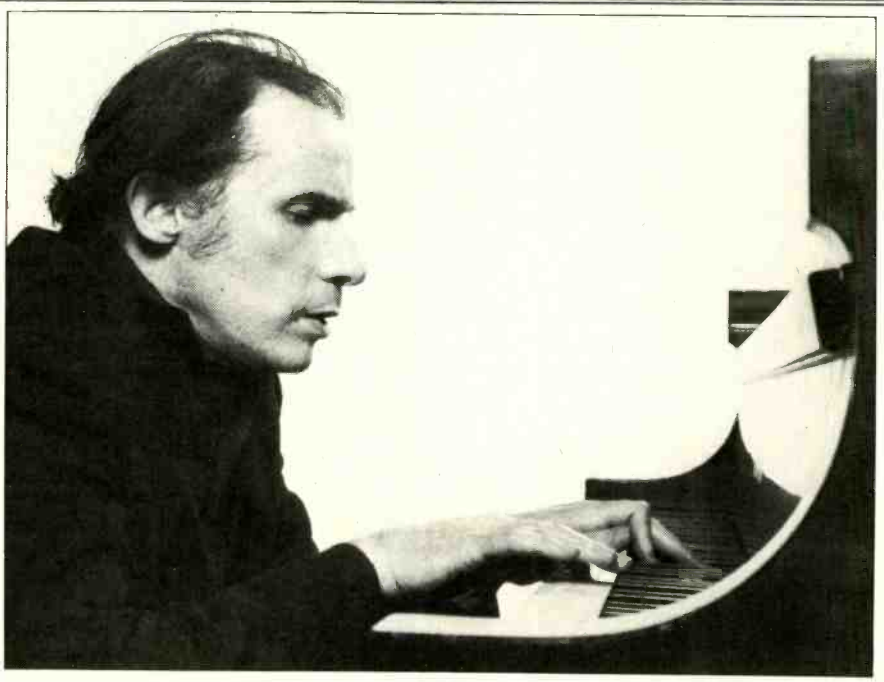
The Telarc-Soundstream engineering combo is just about infallible, disc after disc, but the music is, occasionally, something else. Telarc's home orchestra is the famed Cleveland, and Maazel, at least when this one was made, came with it. This is another of those Romantic bellwether pieces, one of the earliest, full of mystery, magic, horror, sweet sentiment and, above all, heroics. As a kid I just thought it was crazy—but got to like it for all of its impassioned polemics. It has to be done that way! Otherwise it is meaningless. You skimp, it shrivels and dies.

It dies here. I could not finish the two sides. I have never heard a colder, more prosaic reading, strictly—at least by the sound—let's get this business done and over with. Either Maazel is an even colder fish than I had supposed, or he merely hates this piece. What can a good orchestra do? Well, this.

You pays your money and you gets the sound. But not the music.

BERT WHYTE

GOULD GOLD



Glenn Gould

Johann Sebastian Bach: The Goldberg Variations. Glenn Gould, piano.
CBS/Sony 38DC 35.

Gould recorded this work early in his career and it helped establish him as a major artist. That he was able to make a new digital recording of this music before his untimely death in September of 1982, is fitting.

The LP won two Grammy awards for its performance value; this CD shows just how good the digital medium can be. The piano sound is slightly close-up and acoustically dry, but this only serves to preserve every last detail and nuance of Gould's incredible virtuosity. The piano sound is utterly clean, with razor-sharp transient attack. In fact, in some of the fiendishly difficult runs, there is no smearing of detail and every note remains completely articulated. One must remember that here at last is a piano recording without any compression of dynamics. If you want to play this recording at realistic "in the room" levels, be careful! Gould plays some huge triple-fortissimo chords of crushing sonority which are reproducible only if you have a brute amplifier with plenty of headroom and a speaker that can handle this assault without break-up and distortion. This is thrilling music-making of high order, which no analog recording could possibly convey. Highly recommended. *Bert Whyte*

Schubert: Symphony No. 9, "The Great." Berlin Radio Symphony Orchestra, Heinz Rögner.
Denon 38C37-7035, $17.95.

To my knowledge, this is the first recording of the Schubert 9th to appear on digital disc. Here we have an obscure conductor with a lesser-known orchestra. The performance is fairly straightforward and well paced, but hardly of the heaven-storming variety of a Toscanini. The orchestra plays well however, with excellent string work. Sonically, this is a nice balance between good orchestral detail and fairly spacious acoustics. Lovely pianissimos are magic when they are totally unsullied by noise. Plenty of sonority from the contrabasses and brass, while first and second violins are just a shade grainy and bright.

Bert Whyte

J. S. Bach: Die Orgelmeisterwerke. Helmuth Rilling, organ.
Denon 38C37-7039, $17.95.

More of good old Johann Sebastian, this time some of his most familiar works for organ. This digital recording was made in the Gedachtniskirche in Stuttgart, Germany on what appears to be a large, fairly modern, organ.

The ever-popular d-minor Toccata and Fugue opens the program, followed by Prelude and Fugue in b minor, Fantasy and Fugue in g minor, and the towering Passacaglia and Fugue in c minor.

The acoustics of the church are nearly ideal. About a 3½-second reverb time, allowing for plenty of ambience with no loss of detail, running together or overlayering of sound. Digital recording is well-known for its superior low frequency response. On this recording, Mr. Rilling does not make frequent use of his 32-foot pedal stops; but when he does, the shuddering pedal tones are there in all their full-bodied power. The organ is bright, clear and articulate and Mr. Rilling's performance is quite good, if a little too literal. *Bert Whyte*

Lorin Maazel

Shostakovich: Symphony No. 5. The Cleveland Orchestra, Lorin Maazel. **Telarc CD-80067,** $17.95.

This rendering of the Shostakovich 5th Symphony is sonically miles ahead of the Bernstein/New York Philharmonic recording reviewed in July. Telarc's three Schoeps omni-mike array furnishes just as much detail as the bloated multi-mike pick-up of the Bernstein recording, but with a much more natural perspective. Orchestral balances are more reasonable, sound is far cleaner and more open, bass response has much greater weight and dynamic impact. There is no compression of the wide dynamic range of this work. In the performance area, Maazel doesn't generate the excitement of Bernstein, but with the superior Telarc sound, the reading is more than satisfactory. First and second violins are not edgy, but they are a bit brighter than I heard in the Telarc Firebird.

Bert Whyte

Raise!: Earth, Wind & Fire **CBS/Sony 35DP 15.**

A big pop orchestra here with plenty of high-voltage brass and percussion but, surprisingly, violins, violas and cellos as well. The songs are all unknown to me, but for the most part they

"A quite compelling and neatly structured performance of the most accessible of all Beethoven symphonies; good overall sound."

generate a lot of excitement in an upbeat type of sound typical of Earth, Wind & Fire. All is very clean and precise, with percussion particularly sharp, together with a lot of weight. Frankly, I didn't think this recording was as innovative and novel as some I've heard from this group. Obviously, the music was transferred from a multitrack analog recording, and very well done. *Bert Whyte*

Beethoven: Symphony No. 6, Pastorale. Staatskapelle Berlin, Otmar Suitner.
Denon 38C37-7040, $17.95.

Conductor Otmar Suitner is not known to me, nor does he appear to have any great recognition in this country. Nonetheless, he leads the Staatskapelle Berlin in a quite compelling and neatly structured performance

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"A big pop orchestra helps Earth, Wind & Fire generate a lot of excitement; a well-done transfer from multi-track analog."

of this most accessible of all Beethoven symphonies. Further, he elicits some excellent playing from the orchestra, and, in fact, gets more cohesion from the string section than many more-prestigious ensembles exhibit. The recording venue isn't noted, but the acoustics are warm without being over-reverberant or obscuring orchestral detail. Orchestral balances are generally good, although the contrabass could have used a bit more weight. The overall sound is good, but there is a slightly grainy overlay and first and second violins are a touch overbright. No so-called digital screech, mind you, but they could have been smoother. Suitner's "Storm" is not as tempestuous as it might be, but he still sustains interest. *Bert Whyte*

Handel: Trio Sonatas. Heinz Holliger, oboe; Maurice Bourgue, oboe; Klaus Thunemann, bassoon; Yoshio Nagashima, contrabass; Christiane Jaccottet, harpsichord & improvised basso continuo.
Denon 38C37-7026, $17.95.

Lovely little pieces, beautifully played and recorded, with the utter silence of digital sound lending a new dimension of listening pleasure to chamber music. The Sonata in F Major for oboe, bassoon, contrabass and basso continuo, is by far the most interesting work. The sound is bright, clear, clean and compellingly natural. In the music, echoes (or are they foretastes) of Handel's oratorios can be heard. Most enjoyable. *Bert Whyte*

MICHAEL TEARSON
JON & SALLY TIVEN

REGGAE ROOTS

Illustration: Rick Tulka

Confrontation: Bob Marley & The Wailers
Island ILPS 9760, $8.98.

Sound: A– Performance: A

Many musical greats have left behind unfinished recorded material that does not do them justice. And too often, once they're in the grave, some producer or other starts adding his touches to "clean up" the tracks, making the record sound "the way I knew he'd want it to." The result is usually something like Jimi Hendrix's *Crash Landing* or Buddy Holly's posthumous albums.

But unlike the drug casualties, the car accident victims, or plane crash mortalities, Bob Marley was very much aware that he had only a few years left, and he maintained a pretty well-focused control over his last sessions. As a result, *Confrontation* is a very strong, complete and consistent album. Unlike the other discs which have been released since his death, many containing very early sessions which Marley himself would have disowned, this latest release is pretty much what one would hope for on a new Marley album, i.e. some of his finest material at least since *Exodus*.

Songs such as "Give Thanks," "Trench Town," and "Buffalo Soldier" stand with Marley's best work. His importance as a poet and musician have only started to be fully recognized, and *Confrontation* only adds to his stature. We can only hope that there's more in the vaults, if this release is a representative sampling. *Jon & Sally Tiven*

Too Low For Zero: Elton John
Geffen GHS 4006, $8.98

Sound: B– Performance C+

Elton John is working again with the associates with whom he did his best work. Not only is he back with his band (Dee Murray on bass, Davey Johnstone on guitar and Nigel Olsson on drums), but he is once more writing melodies for Bernie Taupin's lyrics.

Not surprisingly, *Too Low For Zero* is EJ's best album in a long, long time, but it still is no classic. Songs and performances are fine, and some songs are kinda memorable: "Cold as Christmas (in the Middle of July)," "I Guess That's Why They Call It the Blues," featuring guest harmonica by Stevie Wonder, and the rocker "Whipping Boy." But as a whole, the album just glides by.

Chris Thomas' production, with Bill Price at the knobs, is suitably elegant for the romantic numbers, yet all too inoffensive on the energetic ones.

But at last a return to form for Elton John. All he needs now is some new "Rocket Man" to put him back on top. *Michael Tearson*

Texas Flood: Stevie Ray Vaughan & Double Trouble
Epic BFE 38734.

Sound: B Performance: B

The hype given this record, by word of mouth and by the record company, leads you to expect the second coming of Jimi Hendrix, or that Vaughan is the most original lead guitarist to hit the planet in 10 years. If the buildup hadn't been quite so intense, *Texas Flood* might be taken as a nice little blues album by a three-piece Texas band. While there is a certain amount of charm here, the album is limited vocally; Vaughan also sings—sort of. However, it looks like his record company wants something more—The New Guitar Hero.

Admittedly, Vaughan is a fine technician, and he has played on the new Bowie album and been given the nod of approval by stone blues fanatics like The Rolling Stones and Jackson Browne. But as good as it is, there's nothing really earth shattering here, at least no better than there was on a zillion Buddy Guy records. *Jon & Sally Tiven*

Stevie Ray Vaughan & Double Trouble

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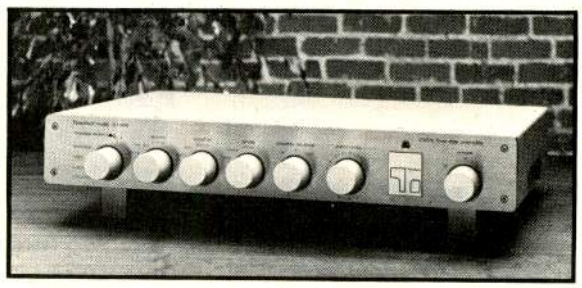

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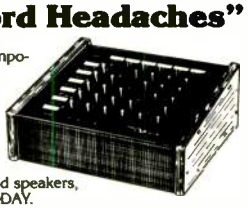

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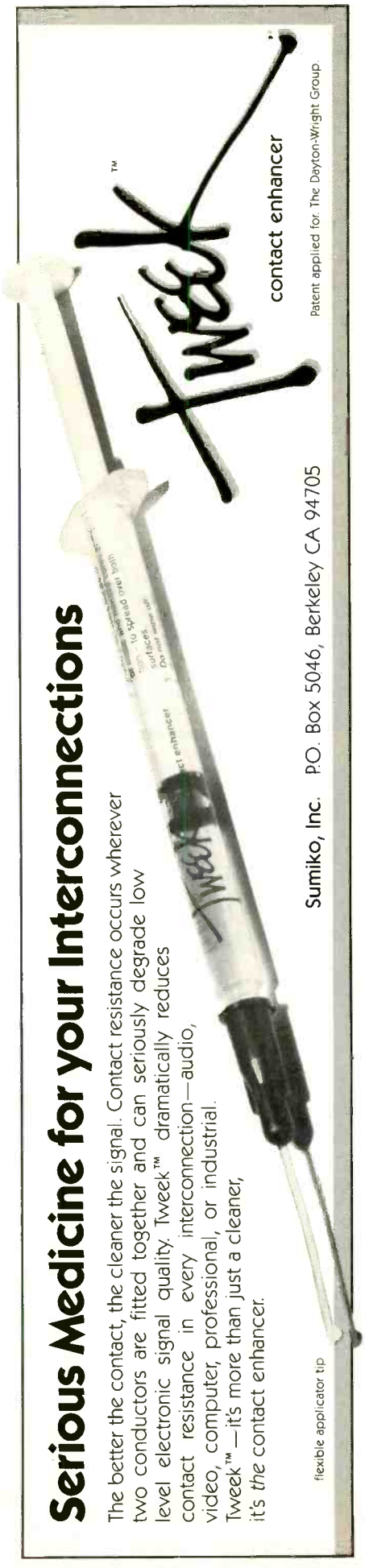

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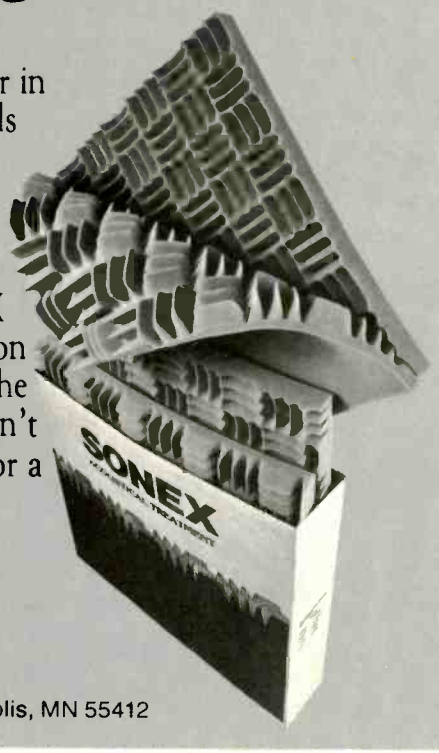

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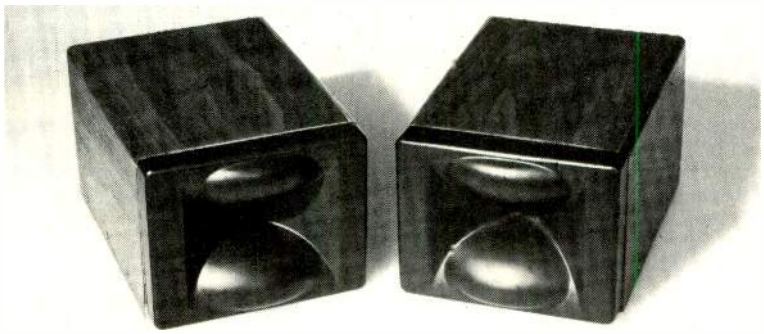

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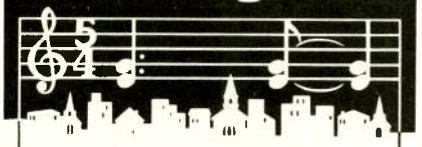

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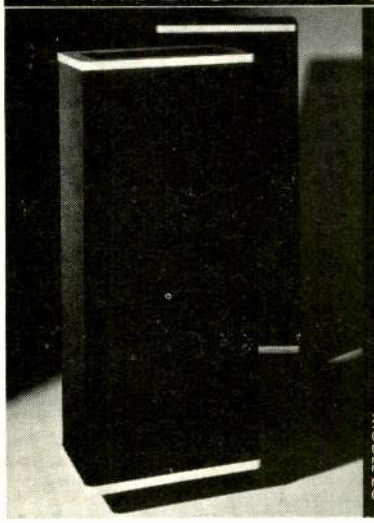

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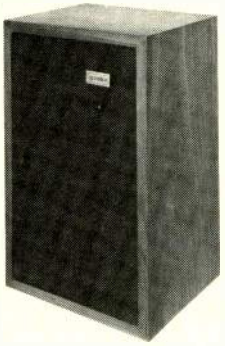

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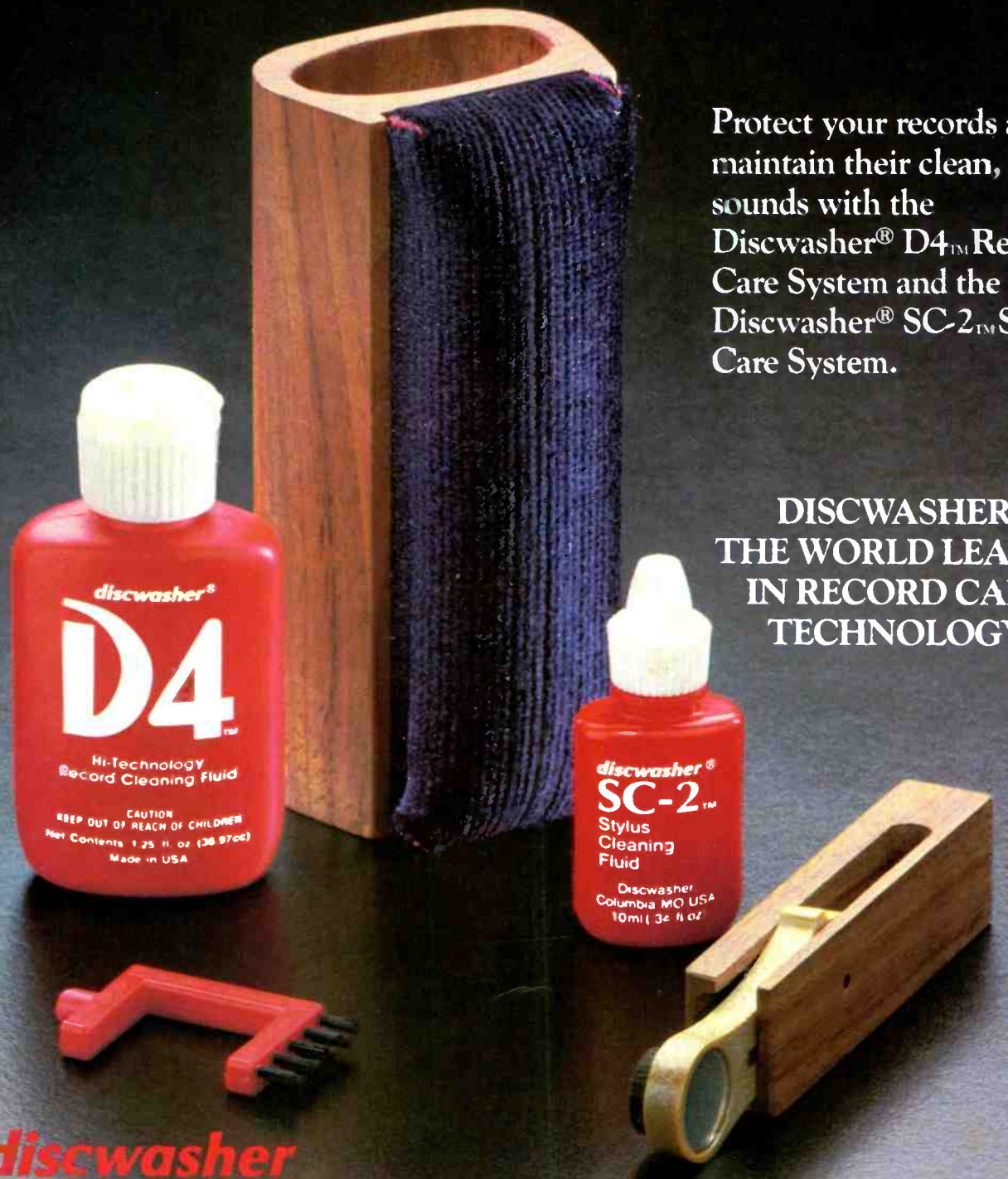

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