

# Audio

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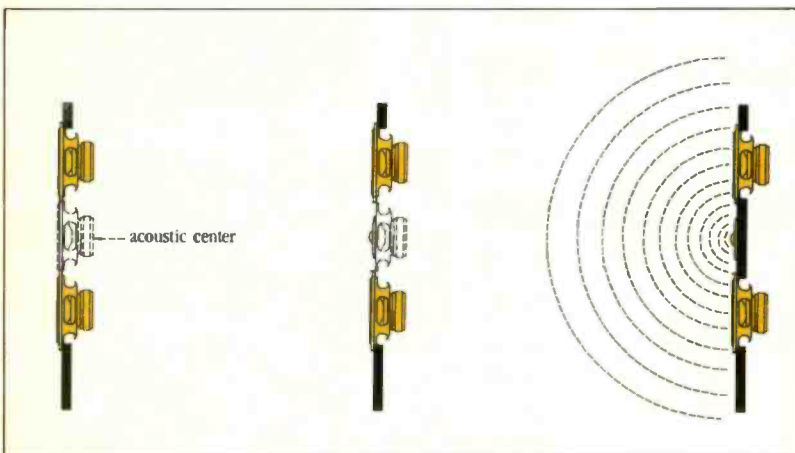
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# Audio

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## CD Costs Redux

Dear Editor:

I would like to respond to J. Michael Gatiens letter ("Signals & Noise," June 1989). I have some additional information that may give a clearer picture of the CD cost question raised in this column by reader David A. Morton (October 1988).

In his letter, Mr. Gatiens paraphrases what Mr. Morton had said previously: "The average cost of these purchases [recordings bought through CD and record clubs] demonstrates overcharging by record labels at the retail level." He further states that Mr. Morton did not have sufficient information on which to base his opinion. Well, I guess that depends on whether you're a record label or a consumer. I recently came across some interesting figures in an April 1989 *Mix* magazine article. Jack Kiernan, senior vice president of Philips and DuPont Optical (PDO), had presented this information at a meeting of the International Tape/Disc Association. Unfortunately, the article doesn't name who did the research, but possibly Mr. Kiernan himself, or PDO, did the fact-finding.

For the period 1986 through 1988, retail prices declined 31%; wholesale, 23%, and replicator costs, 70%. For 1986, the shares of CD revenues were around the following: Retailers had a 19% share; wholesalers, 61%, and replicators, 20%. In 1988, it was as follows: Retailers, 17%; wholesalers, 77%, and replicators, 6%. (These figures are only approximations, as I was working from poorly defined bar graphs.) Interestingly, Mr. Kiernan also noted in his article that the replicators' gross margin on CDs was then 4% to 5% lower than on tape or vinyl. The retailers' and replicators' share had dropped, and the wholesalers' had risen 12%. Another fact from this article: Of the 200 million production units in the U.S., 120 million are captured-production, meaning that 120 million CDs a year are produced by replicators that are owned either partially or wholly by the labels they service. This seems to indicate that for those 120 million units, the wholesalers' share is even larger.

Think about it. Out of a \$12.98 selling price, a major label is taking perhaps as much as \$9. To go further, remove the 65¢ that Mr. Gatiens says

goes to the artist in question, and there's \$8.35 left. Translate that into 500,000 units, and the label gets \$4,175,000, while replicators are getting \$100,000 or less, retailers somewhat more. As a consumer, I don't think it's especially fair that price cuts come only at the retailers' and replicators' expense.

As for the music club question, I know nothing about them except that they usually seem to be run by a major label. They charge regular list prices (\$15.98 or so) for their CDs, with some kind of bonus for buying at regular club prices (buy one, get one at half price, etc.). With the profit that labels are making at retail (70% or more), they can afford to give away three CDs for every one they sell—and have money left over.

Everyone deserves a profit, and this issue is very complex, but when a CD can be manufactured for \$2 (or less, in some cases I've heard of), coupled with a 31% drop in share at retail, I'd say music companies could give us discs for \$9.98 or \$10.98 and not be hurt too badly. Which leads me to agree with Mr. Morton. I think he has the information to base his opinion on.

Ron Carlson  
 Ogden, Iowa

## Binaural Oversight

Dear Editor:

Thank you for recognizing my work in "Binaural Overview, Parts I and II" (November and December 1989). However, I'm afraid these articles on binaural technology contained several significant inaccuracies.

First, Myers 3D Audio is a trademark of PM Productions in San Jose, Cal. The 3D Audio processing computer described as being "as big as a refrigerator" was developed while I was working on my first-generation 3-D audio technology at Myers Laboratories. We were the first in the world (October 1985) to process sound in real time to create a binaural image by purely mathematical modelling. No head-related transforms were used. The processing was performed by using a mathematical model that I created of the human binaural auditory system. This work has been embodied in U.S. Patent 4817149 and related international patents, and is now considered

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to be a fundamental patent in audio technology.

The "refrigerator-size" computer that was mentioned as needed for the sound processing has long been replaced by VLSI chips, and is of very small size and weight.

Also, I am no longer Ralph Schaefer's partner, as the article stated. I knew Mr. Schaefer at Myers Laboratories, but I left there over three years ago to start PM Productions, which has been developing a second-generation 3-D audio technology known as Myers 3D Audio. Our work is now complete, and within months, product will be forthcoming on Compact Disc and motion picture soundtracks.

I appreciate the opportunity to make these clarifications. I have been working on developing 3-D audio technology for 12 years now and have pioneered much of the work in this field. It is important to my work and my company that the history be kept clear.

Pete Myers  
Producer/Director  
PM Productions  
San Jose, Cal.

### It Happens Every Lirpa

Dear Editor:

As I was reading through the October 1989 issue, I noticed two listings for stereo gear from the prestigious manufacturer known only as Lirpa Labs. Both the IV-XXXI tonearm and the U8-IT surround sound processor sound like unique and revolutionary products. I wonder if you are familiar with some of the company's other stereo equipment.

The Lirpa Labs Model M-666 turntable is the only table specifically designed to play records in reverse. Its unique pentagram-shaped platter helps reduce vibrations to the stylus. The Lirpa Labs Model R-ICBM loudspeaker is also revolutionary in design. It is uniquely suitable for rap music. Each speaker consists of a satellite enclosure housing a 1-inch cellophane dome tweeter and a separate box for the lower frequencies. The 6 x 6 x 6-foot box has a 24-inch bass drum mounted to an opening in the front, which would normally hold a woofer. An electromagnet controls a mallet, which strikes the drumhead to re-cre-

ate those difficult lower frequencies. To keep the sound accurate and balanced, a crossover is included; it has a low-pass filter that cuts off everything above 20 Hz. Another product from Lirpa Labs is their innovative LD/LP/CD/CED combi-player/microwave oven. This space-saving appliance includes a dinner-music shuffler that randomly chooses songs from an impressive selection of elevator favorites. I was disappointed to find these advanced components missing from your buyer's guide but hope to see them listed in the future.

Stephen F. McMillan  
Athens, Ga.

### Club Fan

Dear Editor:

For the past four years, I have been a member of the RCA Compact Disc Club, located in Indianapolis. The Club started much like other record clubs, offering to sell one CD at full price and a second at half. At first, I happily received the catalog (about every three weeks) and had the opportunity to choose the "selection of the month," an alternative, or nothing. The catalog provides a brief description of the work, a picture of the CD cover, and comments from *Fanfare*, *Gramophone*, or a newspaper music critic.

My interest in music is classical, with a specialization in the baroque period. It seemed, as time went by, that the Club's scope of baroque music increased, offering me better and broader choices. Last summer, I purchased the new *Penguin Classical CD Guide*. Checking my music library against the *Guide*, I was very happy to have the selection I had made from the Club each month confirmed independently by the *Guide*'s editors as generally top-level. My classical music background is at the novice level, and I am especially grateful to the Club for starting me off on the right foot by offering classical selections that are outstanding. I know I wouldn't have been able to acquire music of the same quality by browsing at the local record stores, and I would have spent more.

If this is not good enough news, the Club (along with the rest of RCA) was recently taken over by BMG. Since the change, there have been some really important developments. First, the

range of labels continues to increase; BMG seems to be able to attract many European classical labels I don't generally see in the stores. Second, for over a year they have been offering, at periodic intervals, opportunities to choose three CDs for the price of one (how can they do that?) and a bonus certificate for a half-price selection. These incentives have really helped me build up my library with the best, at very low cost. Finally, the level of service is outstanding. Whenever I have a problem, they take care of it effectively, without hassles.

If readers have not considered joining a classical music club to build their libraries, I recommend without any hesitation the BMG CD Club.

Jack E. Loman  
Madison, Wisc.

### Polarity Revisited

Dear Editor:

The book review of R. C. Johnsen's *The Wood Effect* (August 1989) led me to do some experimenting. I inserted a polarity-inverting stage in my stereo system that could be switched in and out instantly by remote control. I listened to various kinds of music from FM and CD and to my own recorded voice. I could not convince myself of ever hearing a difference as I switched back and forth.

Then I decided to use a known wave shape, simulating an asymmetrical transient by injecting a train of pulses 1.2 mS wide and repeating about six times per second. Pulse width was selected to fit into the 30 to 350-Hz range of my woofers, and it produced a radiated near-field pulse shape of about 3-to-1 asymmetry. There was still no effect at the normal listening position, so I moved in close, with my ear about a foot from the woofer face. Now I could hear a difference—or did I imagine it? With the pulse moving the cone toward me, it sounded a bit fuller and a bit brighter when reversed.

What does it mean? Well, not much. But there may be a few souls out there who can hear a difference in their music when the conditions are right. All I know is, I am not one of them. I wonder if any readers have had experience with this subject.

Kurt Staiger  
Indianapolis, Ind.





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## Comments on Voltage-Spike Protectors

When discussing surge protectors in the May 1989 issue, you said that the house fuse will blow or the circuit breaker trip if a surge protector goes bad. However, some devices, such as GE's Voltage Spike Protector and their Electronic Protection Center, do not depend on a circuit-interruption device within the house's wiring system.

I had a question about testing the voltage-spike protector to determine whether or not the metal-oxide varistor (MOV) was still good. It was answered by a GE engineer, who said that larger and later devices, such as the Electronic Protection Center, may eventually incorporate an indicator light which would show the condition of the MOV.

I decided that one could determine whether an MOV was still functioning by measuring its leakage current and comparing it to the leakage current measured when the unit was still new. If, in the later measurement, the current decreases, one can assume that the thermal fuse in series with the MOV has blown. In normal service, one would expect a slight increase, or no increase, whenever measurements are made.—Name withheld

## Absolute Phase . . . er, Polarity

Q. I can't tell if I have my system hooked up properly. I have heard a lot about absolute phase. Because of the way my system appears to work, I don't see how I can ever hook it up right. My preamp's manual shows:

Phono In through Main Out—inverted  
Tuner In through Main Out—inverted  
AUX In through Main Out—inverted  
Tape In through Main Out—inverted  
Phono In through Tape Out—noninverting  
Tuner In through Tape Out—noninverting  
AUX In through Tape Out—noninverting

Maybe I just don't know what absolute phase means.—Robert Forman, Westbury, N.Y.

A. By reading your letter, I believe you have a pretty good idea of what is meant by absolute phase. If one looks at the signal path through a device—or perhaps a whole audio system—from input to output, that device or system will have correct absolute phase (or, more properly, polarity) if the signal at its output is noninverted as compared to the phase of the signal at its input.

Audio signals are alternating current (a.c.), which means that the signal voltage is alternately positive and negative with respect to ground. If your system reproduces the positive half-waves as negative, and vice versa, it's inverting.

There are those who believe that absolute phase must be maintained between the input and output of a system for best sonic results. While I myself am not convinced of this concept's validity, I can see that your preamp poses no obstacle to this. Note that all signals coming from the main outputs are inverted. If your amplifier also inverts polarity, then the two inversions cancel out. If your amp is noninverting, you need only reverse the connections of both speakers, connecting each speaker's positive terminal to the negative terminal of the amp. (Make sure you only reverse the connections at one end of the speaker cable, or you'll be right back where you started.)

Signals fed to your tape outputs are not inverted. As long as your tape deck does not invert polarity, you have no problem, since the tape's output will have the same inverted polarity as all other signals when fed to your amp and speaker system. And the amp and speaker, as we've just seen, can invert the signal for you.

There are still two problems left. Do the other components in your system invert polarity or not? And how accurate is the polarity in the recordings and broadcasts you listen to? If all your signal sources have the same polarity, inverting or not, you can maintain absolute phase in your system as described above; if not, you'll have to set your system's polarity to be correct for whatever signal source is most important to you.

The polarity of recordings and broadcasts is beyond your control. Many recordings are made with no attention to polarity whatsoever, which means that some are correct, some are inverted, and some have inverted polarity for some instruments and voices but not others. Moreover, you have no way of knowing which FM stations invert polarity and which do not; conceivably, a station might invert some programs and not others, depending on the studio or control room in use.

If you're willing to go to the trouble, you can try reversing polarity at both

speakers (or at your amplifier output, if that's accessible) to see how much difference you hear from this and which signal sources sound best each way. Remember, you'll have to check polarity for each recording you play.

*Editor's Note:* A further discussion of the audible effects of polarity can be found in *The Wood Effect* by R. C. Johnsen, which was reviewed here in August of last year. Richard C. Heyser's "Acoustic Rosetta Stone," which was published in *Audio* in January 1979, details a method by which recordings, and indeed the entire signal chain, can be placed in a noninverted state.—E.P.

## Damage to CD Players

Q. Is it harmful to leave a Compact Disc player in the pause mode for an extended length of time? Would any mechanical components be damaged? I understand that it is not advisable to leave a tape deck in pause for long periods and would think the same holds true for a CD player. Also, is it harmful to leave a CD in the player when the unit is not in use?—S. F. Brogden, Placentia, Cal.

A. The CD players I have used shut down both their mechanical and electronic circuits if left in pause mode. Thus, no damage to the turntable motor or laser should occur. No owner's manual I have seen refers to such problems. Not all players do shut down, however.

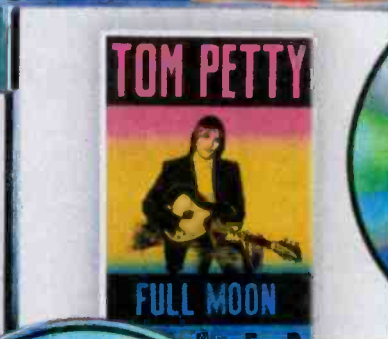
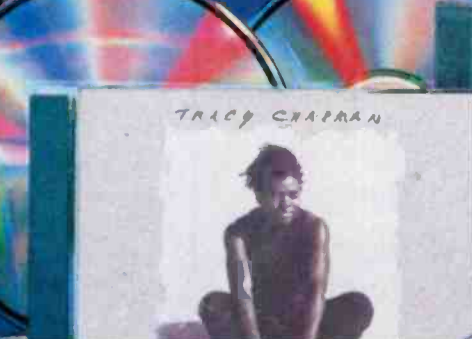
A tape deck is something else again. If the pause is to be effective, the deck's motor must be running continuously when the unit is in pause mode. Because of this, the pause feature should not be used if the deck is to be left idling for any length of time.

I cannot see any reason to expect a CD to be damaged if it is left in the player—even when the unit is not in use. I have seen players which don't have anything approaching an airtight seal around their disc trays. Thus, dust could settle on the disc, so CDs should be returned to the box immediately after they have been played. **A**

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### Gilding the Lily

**Q.** Can a dbx 224X noise-reduction system be used with the audio portion of a Hi-Fi VCR when recording LPs or CDs? I'm speaking, of course, of the high-fidelity recording mode, not the standard longitudinal tracks.—Richard Dean, Hamilton, Mich.

**A.** Yes, a noise-reduction unit can be used with a Hi-Fi VCR, but I see no good reason for doing so. The Hi-Fi VCR's audio signal has an S/N ratio that's already so high—about 80 dB—that use of a noise-reduction device would be gilding the lily. There is a wise principle that says you should not introduce more components into the audio chain than strictly necessary. While each component offers the opportunity to improve the sound in some way, it also presents the possibility of somehow adversely affecting the sound. In other words, we have a cost/benefit situation. When the benefit is very little, why risk the cost?

### More Gilding

**Q.** I have a dbx NR system that allows me to record tapes with both dbx and Dolby NR, either Dolby B or C. Is this a good idea? If so, which would be better, Dolby B or C NR?—Don Paulsen, Des Plaines, Ill.

**A.** Generally, if you want to avoid possible aberrations in frequency response and other respects, it is not a good idea to use two noise-reduction systems in tandem. However, you really can't know unless you try, so you might as well experiment. The cost is zero, except for time.

I suspect that better results would be obtained by coupling dbx with Dolby C NR, rather than with Dolby B NR, inasmuch as Dolby C NR does a better job of maintaining good response in the upper treble when recording at high amplitudes. Noise-reduction systems tend to exaggerate departures from flat response. Since dbx NR already does a superlative job of reducing noise, it seems you have little to gain by coupling dbx with Dolby B or C NR. With dbx NR, the achievable S/N is usually better than 80 dB.

### Automatic Level Control, Part II

The May 1989 column contained an item about the use of automatic level control (ALC) in some tape decks,

generally lower priced ones. As I have some experience with these circuits, I would like to share my impressions with readers.

When my friend and I were heavily involved in recording music from radio, we noticed, when using a deck with ALC, that there was a lag time before the source material was recorded at normal level. For example, if a song began with a loud passage, the initial milliseconds would be recorded softly and then grow progressively louder. It was as if the ALC circuit was unsure of the level of the incoming signal and set itself low at the start.

A nice thing about manual control of volume, as opposed to ALC, is that one can fade the program material in or out if desired. For example, if there isn't enough tape at the end of a cassette to finish dubbing a selection, a fade-out is preferable to an abrupt end. Similarly, fade-in is desirable at the outset of a tape if one begins in the middle of a selection.—Ki Suk Hahn, West Covina, Cal.

### Still More on Hi-Fi VCR Recording

In the January and November 1989 columns, readers Brent Jessee and John H. Markell, respectively, discussed the problem of dropouts when using Hi-Fi VCRs for audio recording. While considering results to be very good overall, Jessee stated that dropouts are a serious problem, even with the best videotapes; that the number of dropouts increases with tape use; that the problem is aggravated in slow speed, and that, unlike PCM processors, Hi-Fi VCRs provide no method of dropout compensation. Markell agreed that high speed is necessary to minimize dropouts, but felt that the problem resides more in the sync circuits of given VCRs than in the tape or the nature of Hi-Fi VCR recording. Very different views are expressed by reader Leo Backman of Helsinki, Finland:

*Dropouts tend to become fewer [emphasis added] as the tape is used. I have observed a reduction factor of about 5 to 50 with various brands of videotape. The reduction is due to the polishing action of the heads as they scan the tape's surface. This removes the excess impurities and magnetic oxide flakes, although permanent defects—such as scratches—remain.*

*However, in the first and last 10 turns of the tape, dropouts invariably increase. This phenomenon occurs in every tape system, including DAT. The loose oxide flakes are squeezed between the first turns of the tape as it is wound onto the hard reel hub. Being of a stone-hard substance, the particles cause irrevocable surface damage. Hence it would be desirable for manufacturers to coat the reel hubs with something soft, like chamois. I've done just that and gotten consistent service from a VHS videotape with over 250 passes; the first 10 meters have experienced no increase in dropouts.*

*It is erroneous to claim that tape dropouts pass the heads more slowly at slow speed (and therefore are more likely to have a significant audible effect). Quite the opposite is true. The slower the tape speed, the higher the relative speed between the heads and the tape because the heads and the tape are moving in substantially the same direction. It is fairly accurate to state that the relative head-to-tape speed is the scanning velocity of the heads minus the tape speed. So, halving the tape speed increases head-to-tape speed. (This increment raises the output voltage of the Hi-Fi heads, which is why Hi-Fi VCRs often have slightly better S/N figures at LP rather than SP speed.)*

*I'm not convinced that sync loss is the reason for increased dropout rates. My experience is that the problem is due to misalignment of the tape path or the guide post.*

*The problem of incompatibility between recording on one VCR and playback on another is often the result of a slight offset of the audio FM carriers. The NTSC standard puts these at 1.3 and 1.7 MHz for the left and right channels, respectively. A steady FM carrier requires a well-optimized adjustment in recording current, which isn't always the case with factory-adjusted VCRs. Thus, FM audio retrieval is somewhat prone to dropouts and sudden carrier loss. Still, we've come a long way from the dark ages of early Hi-Fi VCRs. **A***

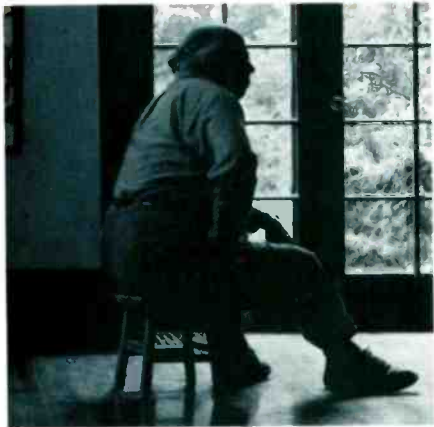
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Henry Kloss is the creator of the dominant speaker models of the '50s (Acoustic Research), '60s (KLH) and '70s (Advent)—as well as of Cambridge SoundWorks' highly acclaimed Ensemble and Ambiance speaker systems. While packing a stereo system into a suitcase before a recent vacation, Henry realized that an amplifier, a portable CD player and two small speakers take up the same amount of space as required for an acoustic suspension woofer enclosure to reproduce really deep bass. That was the inspiration for BassCase. Model Eleven's bass speaker enclosure which doubles as the entire system's carrying case.

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## COMMERCIAL CLANGOR



I am not hiding it—I am a musical classicist, going for “classical” music because, in its many forms, I find it musically rewarding for my own ears and mind. But I pick no bones with the composers of present-day salable commercial music, not to mention the musicians who perform the same. Why should I?

Many such composers are miniaturists perform. They produce those tiny gems of musical wisdom you hear for a minute or less, as the ads fit into the second-by-second time schedule on somebody’s air. But there are also the opposite, the composers of “beautiful” background stuff for banks and supermarkets, who must write at less than heavenly lengths (see Robert Schumann on Schubert) for just as long as business hours continue. And don’t forget the commercial film/TV composers—a similar breed, if operating on a higher plane (sometimes reaching the genuine heights) and on a very large scale, too.

Alas, there are millions of little ads and not very many big films—much more background music than film/TV scores. Who wants to spend a lifetime composing one-minute symphonies? Plenty do. Or, on the copy side, writing great spoken dramas that last 59 sec-

onds. This is they way it is today. Write to fit!

These composers and script writers are doing what they must: Make a buck and nourish the kids; satisfy those in command and keep business humming. They seldom quit and go off somewhere—say, to invent a new omelet. They stay. And hope. Hope for a chance, even in a few seconds, to be devilishly ingenious, deeply persuasive, clever, tricky, memorable, and thereby win praise and promotion. It can happen. Meanwhile, they get paid at least.

Now, short of such miracles, wouldn’t you settle for at least a chance to do your thing in spite of the boss, just for your own inner joy? For the sheer pleasure of getting away with it, so to speak? Sneak in something clever, or outrageous, or really novel, for the heck of it? Pure frustration, but life thrives on frustration. Like the TV soap hero who, turning momentarily away from the camera, makes a ghostly face at the nearest startled technician, or the opera star who tries to break up her colleagues with ribald remarks sotto voce, right on stage, so that *opera seria* dissolves into helpless giggles. All these events make us feel better, though we may lose our jobs.

As I always say, is audio any different? An equal number of audio engineers chafe under the heels of commercial necessity, their bright ideas for better sound squelched mercilessly from above. Even here, you may get away with an electronic trick now and then, and so much the better if the Powers above don’t even notice. . . .

So back to music and audio. Last autumn, right at the beginning of the Christmas season—that is, the day after Halloween—I was prowling around in a huge 24-hour A & P, complete with the usual background shopping music, which never stops, 24 hours a day. Beautiful music? Definitely. Unobtrusive, never loud, and not a soul pays the slightest attention. But it has to be *there*, just the same. As I moved from the 101 brands of dish detergent toward Produce, I became aware of the yearly Carol Conversion. In the last three months of the year, every kind of commercial background music converts to the ubiquitous Christmas carol—all the familiar tunes in endlessly similar arrangements, just enough to awaken holiday thoughts in each shopping breast. You cannot get away from this persuasion. Wherever you go, it is there—banks, malls, elevators, restaurants, restrooms. A & P adds its dutiful share to the endless sonics as a matter of course. What else? Nobody listens, but everybody enjoys.

Suddenly, in the middle of Produce, I stopped with a package of cellophanned spinach in my hand. What was *that*? Yes, Christmas carols. But what was this composer doing? I began to hear very odd harmonies, then some astonishing, if unobtrusive, blats and brays—a sliding trombone, a gently raucous horn, a slither in the strings. *What* was going on here? I glanced apprehensively toward the manager’s desk. Everything totally normal. All was well in A & P land, but the sound went on—and on.

I was stopped dead in my tracks, shopping cart and all. Was this a secret message coming only to me? You bet! Absolutely nobody else heard it, as far as could be seen—neither management nor patrons.

I was holding up traffic, astonished, then captivated. This man was doing the most interesting, friendly things with those eternal and repetitious carol

Illustration: Betsy Everitt



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Stereo Review  
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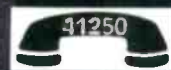
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We proclaim more and more sermons against loud music, not only as an offense to many people (mostly older), but as a danger. Like drugs.

tunes. Incredibly, a composer of "beautiful" music was playing games with Christmas and getting away with it handsomely. I was charmed. I wanted to go and shake his hand at the end of his sequence but, of course, he was only a tape. Here was musical sense galore, a delightful bit of whimsy and perfectly attuned to the situation—if anybody had listened. But does anybody ever listen? Well, I do.

I also sensed that the performing musicians (with maybe a touch of synthesizer here and there) were obviously enjoying themselves too, along with the good-humored composer. They were clearly in on the deal, for anybody who gave them half an ear. In all this, there was no disrespect intended to the well-known spirit of Christmas, just musical affection—a rare commodity in a supermarket! But nobody heard.

I checked out my spinach and wondered, as I climbed into my car. Are we killing the public ear for music in all areas, via such a monstrous amount of audio that everybody ignores? Even in the A & P? This is the thought I came up with last month. It is surely worth exploring again.

I now come up with another thought. To balance the soft or background music common in both supermarket and highbrow classical home environment—it's six of one, half a dozen of the other as far as I am concerned—we have LOUD music.

We play our music softly all too often, so we *don't have to listen to it*. Roll over, Beethoven—roll in your grave! Is it not then reasonable to say that we play other music LOUD in order to pay more attention to it, to allow it to affect us more effectively?

Yes, of course, hideously loud rock/pop is a phenomenon of our day that is part of the tensions that keep us all hopping, and especially the young. As such, it is real, legitimate, undeniable—if not necessarily desirable in the long run (deafness threatens). LOUD music is all too close in nature to drugs, the "causes" very much akin. We proclaim more and more sermons against loud music, not only as an offense to many people (mostly older), but as a danger. Just like drugs. I received, recently, a whole sheet of warnings from some worthy institution,

designed to teach youngsters why loud music is dangerous. It sounded all too much like the similar warnings we pass out about drugs, AIDS, and so on. No harm done, and the intentions are top level. But results? Listen to the nearest sports car with stereo and judge for yourself.

My point is, simply, that we have dulled our mental ears for musical sound to such an extent already that we must turn it up LOUD if we are to get its sense. Otherwise, we don't hear it consciously at all.

Fortunately, a great deal of classical music is intended to be loud, whether chamber music in an appropriately small room or a big symphony in a large hall—or even last issue's marching band music by Berlioz. So classical music has much to build upon, and we hi-fi bugs and audio fans are right, decidedly, in our insistence on full volume where indicated. The classical "background" people, no matter how sophisticated, are wrong and should know it.

All music, I say, should be treated with respect for its own meaning, its own intention—whether loud or soft, silly or profound.

With this in mind, I have lately been doing a thing I have never done before, deliberately listening to hundreds of radio ads (all-audio and thus more relevant to our biz than TV ads) with intent to downplay the ad message and, instead, listen closely to the music. (Normally, I turn the ad down as quickly as I can so that, like the rest of us, I can ignore it at a low volume!) This has been variously a painful experience, but interesting. I wanted to see what was really going on, in musical terms, by putting to work my best sense for musical observation. Occasionally, it has been fun; mostly I just groan, then scribble a few notes on a pad of paper.

A subsidiary, non-music thought: There are many ad stereotypes, unthinking patterns of sameness that hit the ad biz and are swallowed whole as the latest way to persuade. This happens in every area but especially, I say, in the ads.

For instance, the one-minute phone drama. Brilliant idea, it first appeared about 30 years ago, but the guys still keep rediscovering it—just as if it were

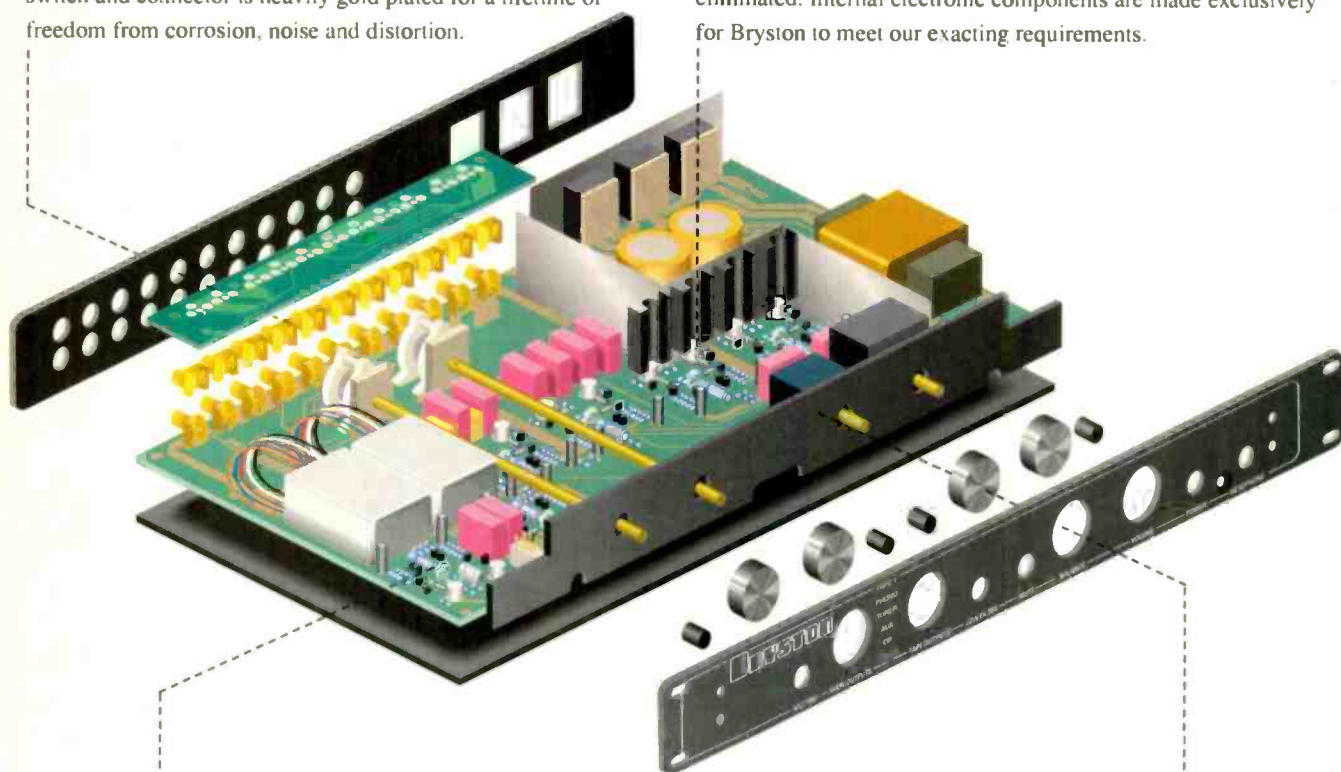
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All music, I say, should be treated with respect for its own meaning, its own intention—whether loud or soft, silly or profound.

brand-new. *Brrrrrrrr*. I had to listen to a thousand such fake phone calls in my little project, and some of them really annoyed me: I thought they were my own phone. (I get as many ads on the phone as I do via radio. My answer is invariable: "Sorry." *Clunk*. That is my privilege.) Oddly, the phone ad is now an art. Used to be that the producers tried hard to simulate a real phone, and even used audio filters to simulate a phone voice. Now this isn't bothered with, most of the time. A stylized buzz, not *remotely* like a real phone, nevertheless indicates "phone." The two voices mostly are now the same audio—we know what's going on. Why be literal? Thus does Art begin! (Where it will end, I do not know.)

And—still postponing music—there was Harry and Marge. Do you remember Harry and Marge? For years, they were the characters in dozens of those little one-minute ad dramas. Probably for lack of enough brainpower to think up other acceptable names. ("Quick,

Henry, the Flit"? That was Dr. Seuss, long before pesticides.) You surely know why Harry and Marge were retired? Not old age. Just too WASP—white Anglo-Saxon Protestant. But do we now have, say, Hikaru and Hiroko, José and Carmen? Not very often. Instead, we go the safe way. Not wasp, but honey—as in honeybee. A thousand ad dramas a day now begin with "Honey. . .," and nobody can complain of bias. Works for both sexes, too.

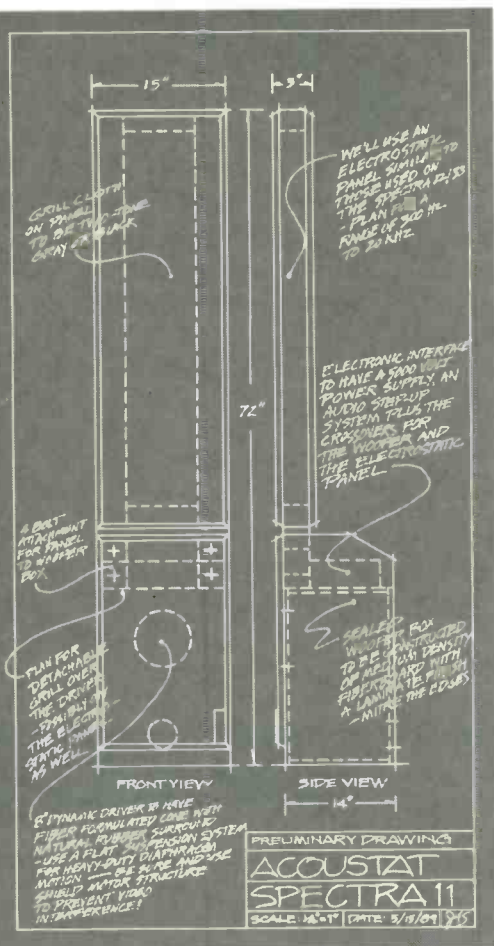
Then there's the grandfather stereotype, along with grandma. Every grandfather must have a rolling quaver in his voice and speak in loud trumpet tones, high up in pitch. No human grandfather was ever known to speak that way. Grandma is actress-husky with a basso voice. She is an actress, presumably retired from the stage. Matter of fact, most ad housewives, young or old, have the traditional actress huskiness—a breathy, low-pitch sound and a diction for the stage. Do they sound like housewives? Not at all,

but no matter. We get the idea, in less than 59 seconds. Again, Art blossoming—even in moments. You can't keep it down.

Then (still avoiding music, if not audio), there are the ad announcers, or whatever they are now called. My favorite type is what I call the Wheedle-Wheedle. He is unctuous, oh-so-confidential, very, very personal, and only about 6 inches away. He practically sprays out sincerity and The Message. Oddly, the women can't really produce this wheedle-wheedle effect. Purely anatomical, I guess. But I did catch one lady at it. I instantly dubbed it the Wet Sound. She needed a towel.

Ah yes, the national ads. Comment on their music coming up. The way you say you are a nationwide company is by making America a person. "America says . . ." etc. And you always pronounce it with three Ms—*Ammerica*. Invariably! Just listen, and you shall hear. In fact, you'll hear still more one of these months. A

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## PAPER CHASE

**A**s most readers of *Audio* know, the Audio Engineering Society holds two conventions each year, one in this country and one in Europe. Several special regional conferences are also convened on specific subjects of interest to audio engineers. While the main conventions feature exhibits of glittering new audio equipment, mostly professional, the serious business of AES conventions is the presentation of papers that cover virtually every aspect of audio science and technology. Naturally, these papers reflect the trends and developments in current audio interests. Of course, in recent years digital audio has been predominant and will likely remain so for the foreseeable future. Every aspect of digital audio is being assiduously researched in laboratories throughout the world.

The success of an AES convention is judged not only on high attendance and the number of product exhibitors, but also on the number and, most especially, the quality of the papers presented. Over the past few years, the papers have been remarkably consistent in their high quality. By and large, these papers are written by some of the most brilliant scientists and engineers in audio. As you might expect, many of these papers cover some of the most arcane and complex areas of audio, and are quite beyond the ken of most audiophiles. Yet at nearly all AES conventions, a number of papers are presented which have relevance to the well-rounded audiophile. They often provide deeper insight into a subject than does the literature generally available to him.

At the recent 87th Convention of the AES in New York City, I spotted several papers which should be fascinating reading for the audiophile with an inquiring mind. Preprint No. 2850 (D-2) is "The Influence of Room Acoustics on Reproduced Sound, Part I: Selection and Training of Subjects for Listening Tests." This covers some of the research activities of the Archimedes Project, a joint effort of the Technical University of Denmark, Bang & Olufsen, and KEF. There is fascinating information here on the selection of subjects, who must meet certain criteria of value in conducting repeatable, statistically significant listening tests on



loudspeakers. Understandably, the Technical University's Acoustics Laboratory wants people with normal hearing to participate in these tests—but what is "normal hearing"? As this paper so succinctly puts it, "An otologically normal person is a person in a normal state of health who at the time of testing is free of excess wax in the ear canals, is without known ear pathology, and has no history of undue exposure to noise." (Obviously, this precludes boilermakers and devotees of rock concerts!) Potential panelists are asked many pertinent questions with respect to their audio equipment (if any), listening frequency and duration, music preference, frequency of attendance at live concerts, etc.

Preprint No. 2825 (D-8), "Sound Quality Assessment: Concepts and Criteria," is by Tomasz Letowski of Penn State University. The author states, "Although the concept of sound quality is widely used, the term itself is not clear and does not have a precise meaning. Such a situation causes various conceptual and practical problems. In addition, despite a large number of terms describing sound character, these terms do not form a system of well-defined and clearly linked perceptual parameters. Such a system

and several related definitions are discussed here." Needless to say, this particular paper is required reading for those reviewers given to florid and fanciful terminology when describing sound quality!

Preprint No. 2874 (W3/5-E), "In-the-Ear Recording and Pinna Acoustic Response Playback," by my pioneering friends Don and Carolyn Davis of Synergetic Audio Concepts, discusses an exciting concept in the ongoing quest for a closer approach to reality in recorded music. In the ITE/PAR system, the ears of a live person, rather than a dummy head, are used as a "human microphone." This is accomplished via special clinical microphones whose soft silicone probes allow recording in the pressure zone of the eardrum. The signals from these low-noise, wide-frequency-range, wide-dynamic-range microphones are stored on a DAT recorder. Playback is via the PAR geometry, which uses synchronized loudspeakers in front of, and to each side of, the listener's ears. No pun intended, but this is heady stuff, with interesting implications for the future.

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All of which leads to one simple conclusion. The company that wrote the book on digital audio has just inaugurated a whole new chapter.

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From in-ear recording to fiber optics, the papers given at AES conventions can give you a privileged glimpse into audio.

videodiscs. Stereo surround broadcasts on TV are also becoming fairly common. Preprint No. 2855 (G-6), "Stereosurround—A Compatible Multi-channel Encoding/Decoding Process for Audio and Audio/Video Applications," affords a good overview of surround sound technology and a look at special applications developed by engineers at Shure. You'll note in the title that "audio" is treated separately from "audio/video." This is because the stereo surround processing detailed in this paper can be straightforwardly applied to music recording, without any video involvement. I can tell you that a fairly prominent small record company is seriously investigating the use of this process in specialized CD recordings.

Finally, one of the most important papers given at the 87th Convention is Preprint No. 2872 (W2-A), "Fiber Optics: The New Medium for Audio," by Ronald Ajemian and Albert B. Grundy. This was actually a workshop and tutorial on fiber optics, featuring really fascinating demonstrations. I can assure you that fiber optics is currently very important in audio and will absolutely be a major factor in digital audio and video in the not-too-distant future. Even if the previous preprints do not interest you, I urge you to acquire this one. Yes, it is that important, and reading it will provide a basic understanding of this seminal development, which is having a profound effect on audio/video technology. The paper outlines the historical background of light transmission, which, surprisingly, goes all the way back to 1870! Parts of the preface to this paper are worth quoting:

A Nobel Prize was awarded to Arthur Schawlow and Charles H. Townes for developing the laser, which was first successfully operated by Theodor H. Maiman in 1960. Then the manufacturing process of lasers from semiconductor material was realized in 1962. At the same time, semiconductor photodiodes were developed for receiver elements. Now the only thing left was to find a suitable transmission medium.

It finally happened in England in 1966, when Charles H. Kao and George A. Hockham of Standard Telecommunication Labs published a paper proposing that optical fibers could be used as a transmission medium if their losses



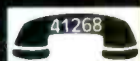
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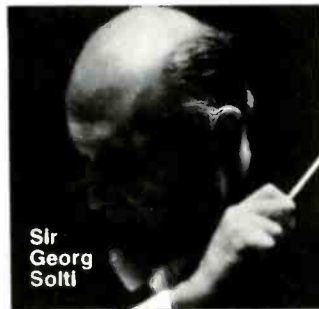
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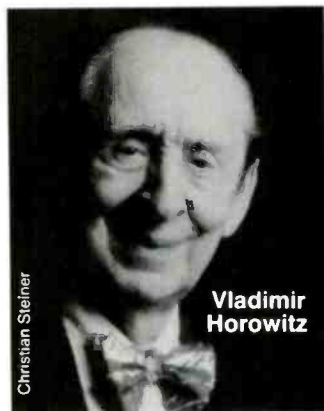
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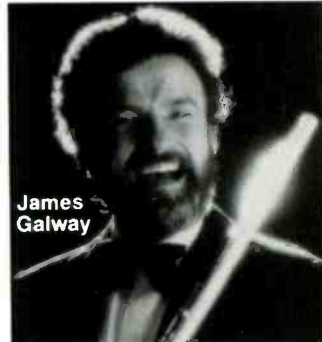
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**James Galway: Greatest Hits** Memory, Angel Of Music, Perhaps Love, Sabre Dance, Clair de lune, more. RCA 73233

**Beethoven, Symphony No. 9 (Choral)** Norrington conducts. Angel Digital 00467

**Copland, Billy The Kid; Rodeo (Complete Ballet)** St. Louis Sym./Slatkin. Angel Digital 41491

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Though many AES papers are forbiddingly technical, there are always some that make fascinating reading for audiophiles.

could be reduced to 20 dB/km. They knew that high losses of over 1,000 dB/km were the result of impurities in the glass, not of the glass itself. By reducing these impurities, a low-loss fiber may be produced for telecommunications.

Finally, in 1970, Robert Maurer and associates at Corning Glass Works de-

veloped the first fiber with losses way under 20 dB/km. And by 1972, lab samples were revealed as low as 4 dB/km. Since then, Corning Glass Works, Bell Telephone Labs, and also Nippon Sheet Glass Company of Japan have developed glass fibers with losses at about 0.2 dB/km. There is also research being

done with plastic materials as well as glass.

As you know, thousands of miles of fiber-optic cables are now in place in the telephone companies' networks. In Cerritos, Cal., a suburb of Los Angeles, some 600 new houses are having fiber-optic links to the telephone companies' fiber-optic networks installed. At present, such links cost about \$3,000, but as with most innovations, widespread use will eventually make them more affordable.

It is important to recognize that in the next few years, digital technology will play a major role in the daily lives of the American consumer. Home entertainment (both audio and video), information systems, interactive banking and shopping, and a host of other services will be available in digital format—all through the miracle of fiber optics. A computer terminal in the home will control this multitude of services. Envision, if you will, a centralized CD and video-disc library of virtually every recording in existence. (The library would be equipped with the very best playback systems.) In practical use, a person could simply punch a code into his home computer to choose whatever music or video he wanted. The music would then be played through his audio system, interlinked via fiber optics, and he would look at the video on his digital high-definition TV.

If all this sounds like some science fiction vision of the future, it most assuredly is not. At the upcoming Summer Consumer Electronics Show, it is quite likely that one company, and perhaps several, will introduce fiber-optic systems to interlink audio components such as amps and preamps. These components will, of course, have their own A/D and D/A converters. Initial cost for such systems could be around \$1,800 to \$2,000—not out of line with some of the very expensive, exotic audiophile cable now on the market. The advent of fiber-optic interconnects should finally put an end to the oft-fanciful performance claims made for audiophile cables.

The preprints I have discussed are available from the Audio Engineering Society, 60 East 42nd St., New York, N.Y. 10165. Each preprint costs \$5 for nonmembers, \$4 for members. **A**

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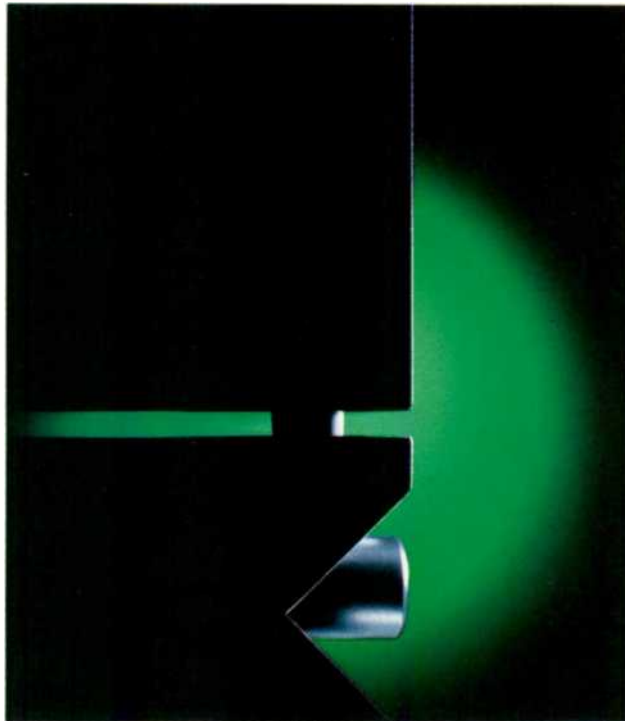


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*Ken Kessler HiFi News & Record Reviews, March 1989*

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*Alvin Gold HiFi Answers, December 1988*

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## THE LOWDOWN ON HIGH DEF



**P**ick up any consumer electronics magazine these days, and the probability is high that it will contain an item on high-definition television (HDTV). Take a look at any electronics trade publication, and you are virtually assured of seeing something about HDTV. Even newspapers carry articles about HDTV on nearly a regular basis. High-definition television is the current hot topic, and it most certainly will continue to command the spotlight in consumer electronics. Unfortunately, much of what is published is misleading and, in some cases, a complete myth.

Perhaps the single most damaging report that has appeared in print was about several public demonstrations of HDTV: Most people saw very little difference between HDTV and NTSC (our present standard) when they were presented side by side. (When referring to HDTV here, I mean the 1,125/60 standard of 1,125 scanning lines and 60 fields/30 frames per second, the only proposed system for which hardware exists and which can be readily demonstrated.) It is true that when HDTV and NTSC were compared, most people only noticed the difference in as-

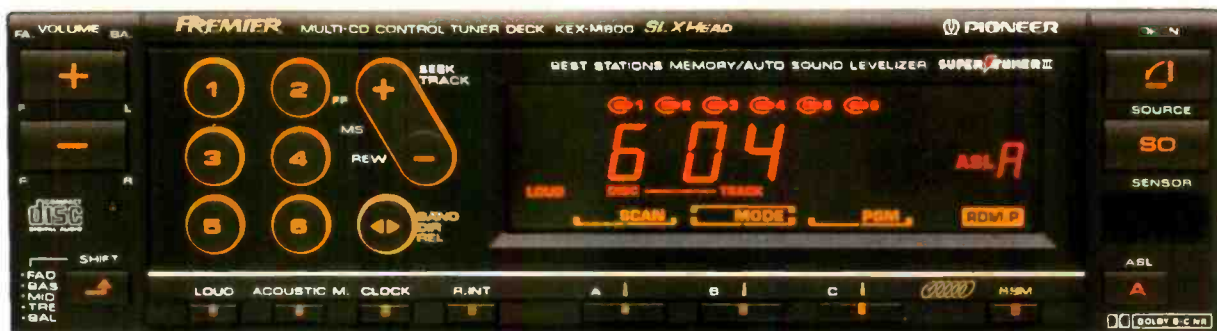
pect ratio (ratio of width versus height—4 by 3 for NTSC, 16 by 9 for HDTV) and not the picture quality. However, what went unreported was how the demonstration was conducted, and this is the key to why the results were not more dramatic. In a consumer test conducted by Home Box Office in October 1987 in a Danbury, Connecticut shopping mall and in several sites in New York, NTSC was displayed on a 26-inch, high-end consumer monitor; HDTV was displayed on a 28-inch, direct-view monitor. Beyond five picture heights away, viewers were unable to tell the difference in picture quality. The most favorable response came from viewers three picture heights away, and understandably, most of the negative responses came from those viewers who were in the row which was seven picture heights away. Ideally, one should view HDTV from a *maximum* of three or four picture heights. This distance allows the eye to see the vast improvement in resolution and was an original design parameter for HDTV. Furthermore, viewing a 25-inch-wide screen from 6 feet away will not have the impact that viewing a 75-inch-wide screen from 18 feet will have, even though the apparent picture size is still the same. The average HDTV demonstration being presented to the public does not allow such intimate viewing.

A much more effective demonstration would greatly increase picture size so that sitting within three picture heights would become the norm. Once that happens, you will see overwhelming acceptance of this new technology. In fact, true home HDTV should *never* be displayed with a picture less than 5 feet wide. (I will refer to picture sizes from projectors in width, since this more accurately describes *relative* picture sizes—particularly when considering the different aspect ratios of NTSC and HDTV.)

To prove this point as well as to foster the advent of HDTV and show just how exciting it can be, the company I work for, Barco, Inc., which manufactures video projectors, put on a demonstration at the 1989 Winter Consumer Electronics Show in Las Vegas and again at the Summer CES in Chicago. In each demonstration, a screen was set up that was 12 feet wide and 6¾ feet high, yielding a perfect aspect ratio of 16 by 9, and a full surround sound system was provided by Fosgate. All of this was put into a living-room type of setting, and 1,125/60 HDTV was displayed. The response was overwhelming. Nobody made any negative comments, and the majority only spoke in superlatives. Dale Cripps, publisher of *HDTV Newsletter*, said that it was "our favorite HDTV demonstration of all time. . . . Did pictures that large overpower the audience? In fact, when the HDTV pictures came on after a brief showing of NTSC pictures, the audience was not thrown back but rather sat straight up or leaned forward in astonishment. It is this form of HDTV demonstration that will make the difference in the marketing of HDTV." And that is precisely the point. Contrary to what has been reported, when HDTV is presented properly, the pictures are stunning. So much so, that the next two questions almost inevitably are, "How much does it cost?" and "How soon can I get it?" If there is not a large public demand for HDTV right now, it is only because the public has not had proper exposure to this technology. Once you see HDTV properly demonstrated, it is very difficult to go back to NTSC on any size picture.

HDTV creates an interesting phenomenon. Critics state that the aver-

*James C. Davies is National Sales Manager of Consumer Products for Barco, Inc., manufacturers of video projectors based in Smyrna, Georgia.*



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SPECIFICATIONS PRO-EQ 44: THD: .01 @ 2V RMS...S/N RATIO: 114dB-10V RMS output, -100db-2V RMS output. ISO CENTER FREQUENCIES (Hz): 40, 50, 63, 80, 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1K, 1.6K, 4K, 6.3K, 10K, 16K...BOOST/CUT INDIVIDUAL CONTROLS:  $\pm 22$ dB (all other controls at max);  $\pm 15$ dB (all other controls set at zero).

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By controlling the software, which is stored in Hollywood vaults, the U.S. *can* control the development of HDTV.

age person doesn't care whether he can see the blades of grass on a football field or that Dan Rather may have 5 o'clock shadow. The average person, say the critics, thinks television is fine the way it is. I strongly disagree. There is much more to HDTV than just seeing the blades of grass. Even with NTSC, we can see a noticeable difference between film and video. Video has that certain "live" look to it that film does not, while film has a resolution and subtlety that video lacks. When you take the strengths of both formats and combine them into high-definition television, you come up with a new viewing experience, not video and not film. It is High Definition, and it actually looks *better* than 35-mm film because it has that "live" look without scratches, dust, or other objectionable "noise" in the picture. The best way to describe HDTV is to say you have a picture that has the liveness or presence of video with the resolution and subtlety of 35-mm film. It is akin to looking out a window. A term has been coined to describe the experience, "telepresence." It is very exciting. And it's addicting. Indeed, the biggest danger in the implementation of HDTV in this country is that we all could become couch potatoes.

One major point of misinformation about HDTV is that the Federal Communications Commission is going to set a standard for HDTV and that it must be compatible with existing systems. In fact, the FCC really does not relish the idea of getting involved in any standards rule-making and most likely will only render a decision on a *transmission* standard because they have to. What the FCC did say was that whatever transmission standard is adopted, keeping in mind that this only refers to terrestrial broadcasters, it must meet any *one* of three criteria: (1) it must be spectrum compatible but does not have to be NTSC compatible, which means that it must work within a 6-MHz bandwidth but does *not* have to be compatible with NTSC; (2) it can be spectrum compatible *and* NTSC compatible, or (3) it can be an augmentation type of system, which means the main body of the picture would be sent within a standard 6-MHz bandwidth and detail information and side panels (to give it the wider aspect ratio) would

be sent within a different 6-MHz chunk of spectrum. The FCC also stated that broadcasters cannot cease NTSC broadcasting; just how long they are prohibited from turning off NTSC was not stated. But notice that nothing was said as to what *production* standard HDTV would take. Cable, direct broadcast satellite (DBS), VCRs, videodiscs, etc. are not mentioned, and the companies involved are free to settle on whatever they want. In fact, there is no legal reason why manufacturers could not start delivering HD hardware and software tomorrow. Reason dictates,



however, that everyone be in unison when HDTV is introduced—but terrestrial broadcasters are clearly at a disadvantage since there is currently no satisfactory method of delivering full HDTV via their 6-MHz channels without introducing artifacts.

As an interesting aside, coming this year to the industrial video market are HDTV laser videodisc players and HDTV half-inch VCRs. True, they are costly (in the \$25,000 to \$60,000 range), but they are coming nonetheless. And the standard is 1,125/60. Actually, 1,125/60 is the de facto production standard. Hardware exists off the shelf, and four studios are presently producing 1,125/60 HDTV—1125 Productions, Rebo High Definition Studio, and Zbig Vision, all in New York, and Powder Moon Productions in Salt Lake City. These people are not concerned about proposed transmissions standards, only that they want no artifacts or signal degradation.

Perhaps the biggest deception being foisted on the American public is that we must set our own standard

independent of the Japanese and Europeans so that we can rejuvenate our consumer electronics industry. In Washington, politicians are citing HDTV as a magic elixir for all our problems, from the negative trade balance to maintaining our technological lead in the world. Why not control the development in a more creative way? We have the ultimate ace up our sleeve—a lock on virtually the entire world's supply of high-definition software. It's stored in Hollywood. True, it's film, but it is essentially high definition. What good is HD hardware without something to show? It took decades to produce all the films and TV shows that Hollywood has accumulated. All the studios in the world are not going to create sufficient software to meet the immediate demands for high definition. The United States *can* control the development of HDTV by controlling high-definition software. And we will have a positive effect on our trade balance at the same time. Let's do what we do best—being innovative in combining technology and marketing expertise.

Since much has been written about HDTV's incompatibility with our existing NTSC standard, there is concern over the obsolescence of all video equipment now in use. While it is true that HDTV is not compatible with existing hardware (although some proposed HDTV transmission standards provide for an NTSC-compatible signal), incompatibility should not be a concern. It is just another standard, the same as Compact Discs presented a new standard for the storage of audio. When CDs were introduced, no one was concerned that they weren't compatible with vinyl records or cassettes, and no one complained much—at least not publicly. For the past several years, the three have existed side by side and the marketplace is deciding which it likes better. So far, the evidence suggests that CD will win out. The same will happen with HDTV and NTSC. The two will coexist for a period of time, and I believe that eventually HDTV will win out because it delivers vastly superior pictures.

Can you imagine someone publicly stating that CDs should be compatible with vinyl records? Moreover, can you imagine someone saying the two

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# Audio

The Equipment Authority


The downgrading of superior technology for the sake of compatibility makes no sense; it merely defeats the purpose and impedes progress.

should be compatible even though current levels of technology would mean the quality of CDs would have to be downgraded to ensure that compatibility? He would probably be laughed out of the room. But this is precisely what is happening right now with HDTV. There are those who claim HDTV should be compatible with NTSC even though all proposed compatible transmission systems that are demonstrable exhibit artifacts, thereby downgrading the quality of the original HDTV images. It doesn't make sense to downgrade a superior technology just for the sake of compatibility; this is defeating the purpose. If compatibility can be achieved without any degradation whatsoever, fine. But no one has shown such a system as yet, so let's keep high-definition TV pure and forget this compatibility business. Sacrificing quality for the sake of compatibility is not my idea of progress.

One proposed solution to the compatibility issue is that of the open-architecture receiver. Simply, this is a television receiver that is capable of displaying both HDTV and NTSC. Therefore, no compromise has to be made in the transmission system since the television set is fully capable of displaying whatever it gets. (Although you would not necessarily have compatibility between HDTV signals and NTSC sets.) There are many models of industrial video projectors that essentially have open architecture, but on a much grander scale. In the computer industry, there are rarely single display and resolution standards within a company's own product lines, much less between manufacturers, so manufacturers of video projectors must build products that can handle anything that is made. This ranges from NTSC on the low end up to exotic, ultra-high resolution CAD/CAM systems and beyond, with resolution specifications far in excess of any proposed HDTV standard. It is difficult to build projectors with these capabilities, but they do exist and most work quite well. The point is that as soon as you start thinking in terms of open architecture, the cost goes up substantially. On top of that, consumers will be confused. And wait until salespeople get hold of the specifications sheet on an open-architecture receiver! Most video salespeople co-

not yet understand what resolution is, so how could they deal with different sets of resolution specs for the same piece of equipment? One receiver, one standard, thank you. Another argument for totally separate systems.

Why don't we have HDTV consumer hardware and software available now? The technology very definitely exists, and it can be delivered. Of course, it will be expensive at first, but as they always have, costs will come down. Then where is the holdup? Remember, broadcasters have the largest investment to protect and are in the most precarious position. They are the only ones awaiting a major technological solution to delivery problems, so it obviously behooves them if HDTV's introduction is delayed until such a solution presents itself. One sure-fire way to get something delayed is to get politicians involved. In this case, not only are the politicians involved, but they are woefully misinformed. Their understanding of HDTV and the consumer electronics industry apparently is minimal. Meanwhile, Japan moves ahead full steam, and even Europe pulls ahead with their HDTV program, Eureka 95. What the broadcasters might do is pool some capital in a crash program to solve the technological problems themselves. Don't try to slow the inevitable by shifting the burden somewhere else, such as to the taxpayer, by requesting government funding for R & D programs. The consumer is left holding the short end of the remote control by not only having to pay R & D costs through taxes (a notoriously inefficient method) but also by having to wait years for the results.

High-definition television has the potential to impact the average American in ways we cannot even imagine now. It will change our lifestyle as television itself did. Let's not lose sight of the objective, which is to implement a vastly improved audio/visual medium for communicating, educating, and entertaining. Let's not degrade it just to protect some specialized interests. Let's not burden it by attempting to use it to cure social and political ills that existed long before. The marketplace is perfectly capable of making decisions—just clear the way to bring on the choices. It's going to happen, and it can't happen soon enough. 



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# EXCLUSIVE U.S. TEST!!!

LEONARD FELDMAN

## Thomson CD *Recorder*

NO LONGER A PIPE DREAM, Thomson's magneto-optical Compact Disc *recorder* can be made right now—and for a reasonable cost! Test results are spectacular, but the recordings can't be played on conventional CD players.

**I**t looked for all the world like an ordinary CD player. Dietmar Uhde, Manager of the Physics and Chemistry R & D Labs of the German Thomson-Brandt Division of Thomson Consumer Electronics, carefully unwrapped the prototype magneto-optical disc (MOD) recorder and hooked it up in my lab. This was an exciting day for all of us. (Editor Gene Pitts accompanied Mr. Uhde, as did Friedhelm Zucker, another scientist from the Thomson-Brandt R & D lab in Villingen, West Germany.) There were, of course, no published specs, since this prototype is not in actual production as a commercial product. But as I was to learn in just a few hours of testing and listening, the DR 1000 MOD recorder is in every other way a real—make that, *superb*—feat of engineering. Its performance was so good, in fact, that I wouldn't mind owning it even in its present prototypical form.

Unfortunately, I wasn't allowed to keep the unit for the several days or more that I usually take to evaluate such a sophisticated component; my time with this remarkable product was limited to just a few hours. Before I tell you how well it performed as an ordinary CD player *and* as a CD recorder with unlimited erasability, you're probably wondering, as I was, just how the MOD works. To begin with, the MOD recorder is only partially compatible with CDs. Specifically, it has been designed to *play* ordinary CDs

properly. However, a magneto-optical disc recorded on this Thomson unit cannot be played back on a conventional CD player—at least not on CD players as they are configured today. (This is not to say that the optical assembly of some future CD players couldn't be fairly easily altered to read these recordable discs.) The problem has to do with the reflectivity of the information-bearing surface of the two media: MODs have a reflectivity of only 20%, while the reflectivity of CDs is almost 100%.

The MOD recording medium is a thin layer of magnetic terbium-iron-cobalt alloy. (Terbium is a dark brown, rare-earth metallic element.) This magneto-optical layer is applied by means of cathode-vapor, high-vacuum sputtering onto a 4.7-inch (12-cm) polycarbonate or glass disc. A percent spiral track guides the recording laser and already allows for the coded maximum playing time of 74 minutes. The first tracks, the lead-in tracks, are pre-recorded onto the blank discs by their manufacturer. These tracks tell the DR 1000 MOD what sort of disc has been inserted and how the laser strength and magnetic field are to be set for recording.

Within the recorder, local heating of the disc's magneto-optical layer to the material's Curie point, 180° C, reduces its coercivity to a low enough level that an external magnetic field at the recording point can reverse the layer's polarity. For playback, the Kerr effect is employed: Areas whose magnetization

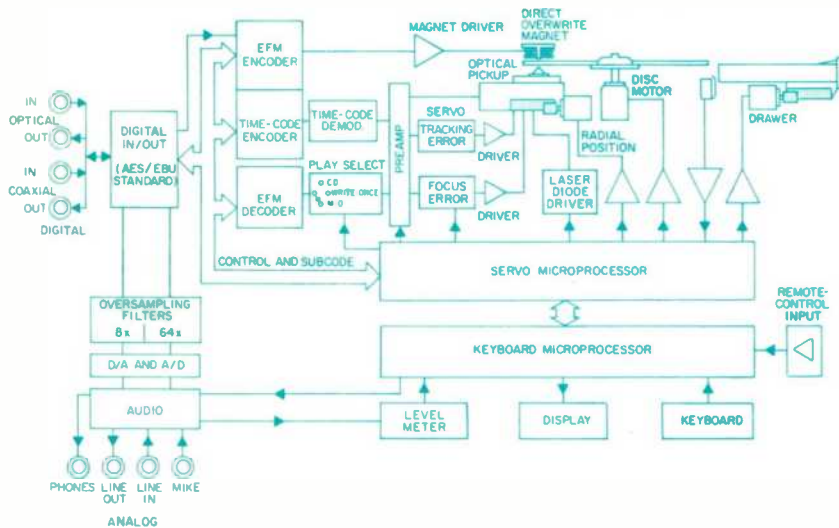


data-compression system

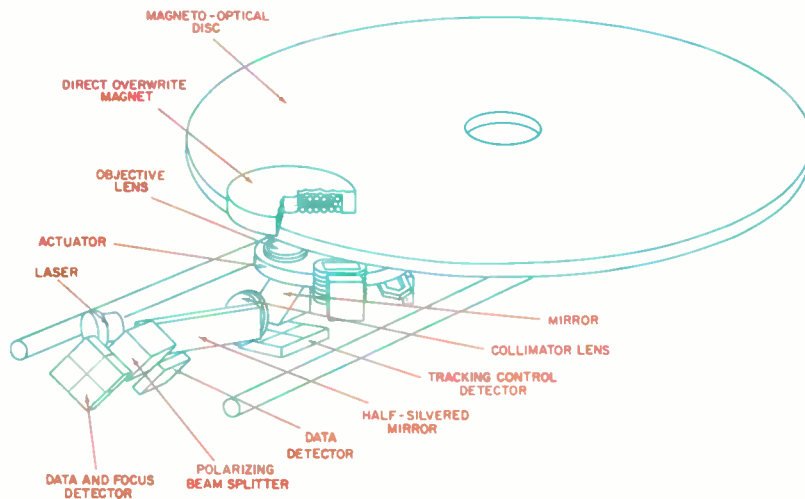
gives 16-bit sound quality

from recordings made with

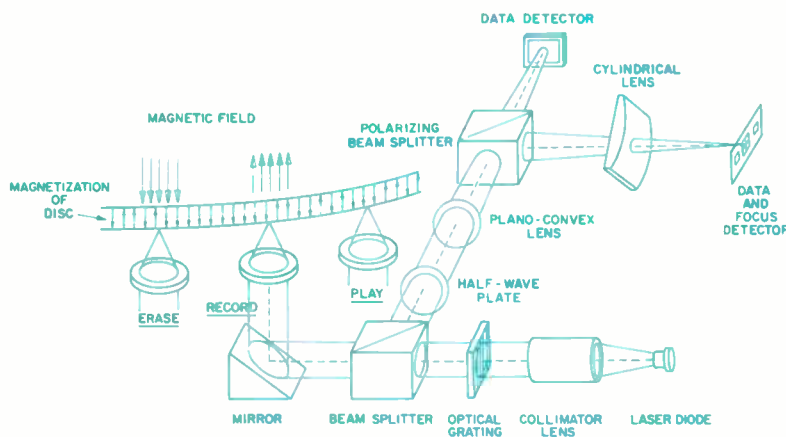
four-bit quantization.



**Fig. 1**—Block diagram of the Thomson DR 1000 MOD recorder. This unit can play CDs and re-recordable magneto-optical discs, and could be modified to play and record "write-once" discs.



**Fig. 2**—Physical layout of the optical system.



**Fig. 3**—Principles of Thomson's magneto-optical record/playback system. The system shown is an earlier version, which used discs that could be recorded only once.

is of opposite polarity reflect polarized or unidirectional light differently. The small change in direction of the polarized light reflected from the surface is a mere 0.5°, but this is sufficient to allow the system to differentiate between binary zeros and ones. The system also detects places where no change in polarization angle has taken place, indicating that no recording has been made.

Thomson's first generation of optical disc recorders made use of a permanent magnet, recording digital bits by means of rapid laser bursts. The disadvantage of this method was that erasure required a separate run or "pass," with the laser continuously at full recording power. In the current MOD, the laser stays on during recording, but a powerful modulator is brought to bear on the magnetic field. Its magnetic polarity is controlled by the digital data stream. Erasing and recording occur in the same sweep of the laser assembly. A recent reduction in the thickness of the medium's recording layer substantially reduced the amount of heat required. Instead of a 60-mW laser used in earlier prototypes, the DR 1000 MOD that I tested uses 25 mW of laser power in recording, of which only 5.5 mW reach the disc. The laser power at the disc's surface is switched down to 0.8 mW for playback of magneto-optical discs and only 0.4 mW for playback of conventional CDs.

Dietmar Uhde maintains that long-term stability of the stored information is no problem, nor does he foresee any limitation on the number of read/write cycles. The user lead-in area on each blank disc is a track directory to be recorded by the user. When the disc is loaded, this directory is read into a 64-kilobyte memory; if new material is then recorded, this information is updated and is recorded back onto the user lead-in track before the disc can be removed. As you'd expect, access to tracks and passages is about as fast as on good CD players.

A block diagram of the MOD recorder is shown in Fig. 1, while Fig. 2 shows

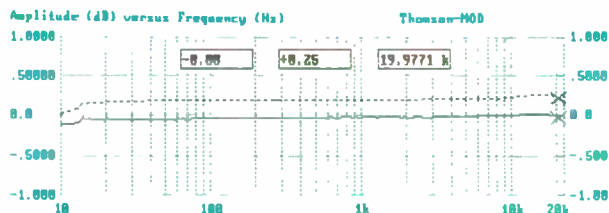
the physical layout of the optical system for the MOD. Figure 3 illustrates the principles of magneto-optical recording and playback using polarity reversal of magnetic fields to change the reflectivity angle of polarized light.

Playback operating features of the DR 1000 MOD are very similar to those found on CD players. There's program repeat, A-B segment repeat, and full disc repeat. The display shows the track number and either the elapsed playing time of the current track, the time remaining in that track, or remaining time on the disc. Playback is programmable, with up to 39 program steps available.

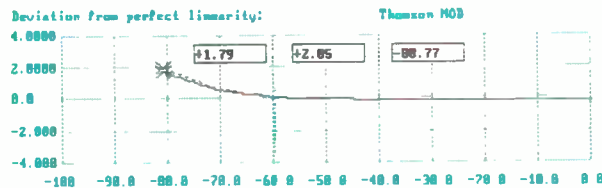
As I mentioned earlier, at first glance the Thomson DR 1000 MOD recorder looks like an ordinary CD player. A power switch is at the lower left, and nearby are the usual transport push-buttons plus a record/pause button. The stop button also opens and closes the disc drawer, which is above this row of pushbuttons. A large display area is located to the right of the disc drawer, and below it are 10 numbered buttons for programming and accessing tracks. The row of controls below the number buttons handles display, level balance, headphone volume, memory (program storage), repeat functions, and the encoding of start IDs when making a recording. At the right end of the panel are the microphone and headphone jacks, a multi-function knob similar to those on Thomson Digital Line components (covered in *Audio* last issue), and several additional buttons for data reduction—one of the heretofore undreamt-of capabilities of microprocessor control.

Data reduction uses a technique called Multiple Spectral Audio Coding, a joint project of Thomson and the University of Duisburg. This data-compression process uses four-bit quantization to *quadruple* the system's normal recording time! Mr. Uhde reported that experts on a listening panel were unable to distinguish between ordinary 16-bit music recordings and a music recording made using this sophisticated four-bit compression system. The digital recording of still photographs has already been demonstrated as well. With about 600 megabytes of storage capacity, MOD can become a totally interactive medium. As Mr. Uhde explained it, if a blue laser diode were substituted for the laser currently being used, the size of the heated area would shrink and tracks could be spaced even more closely together. Storage capacity might then be quad-

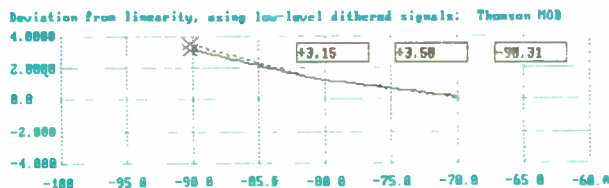
**Fig. 4**  
Frequency response for CD playback. Displacement between left channel (solid curve) and right channel (dashed curve) is due to slight differences in output levels.



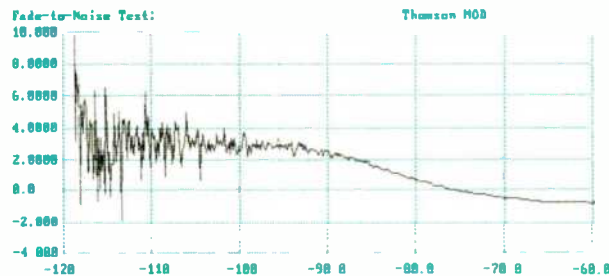
**Fig. 5**  
Deviation from linearity for undithered signals on CD.



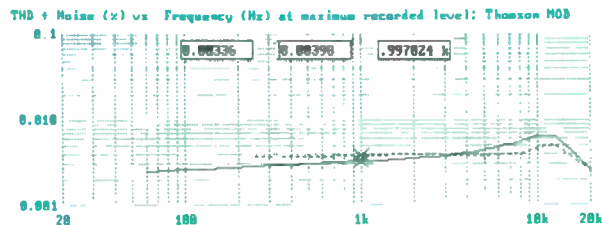
**Fig. 6**  
Low-level linearity for dithered signals on CD.



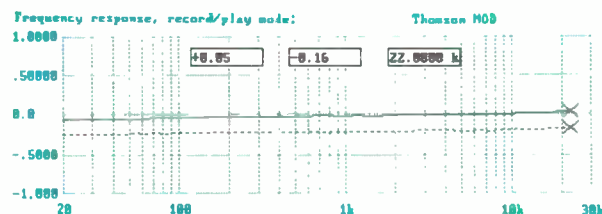
**Fig. 7**  
Fade-to-noise test for CD playback.

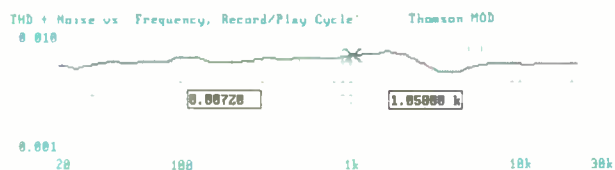


**Fig. 8**  
THD + N vs. frequency for CD playback.

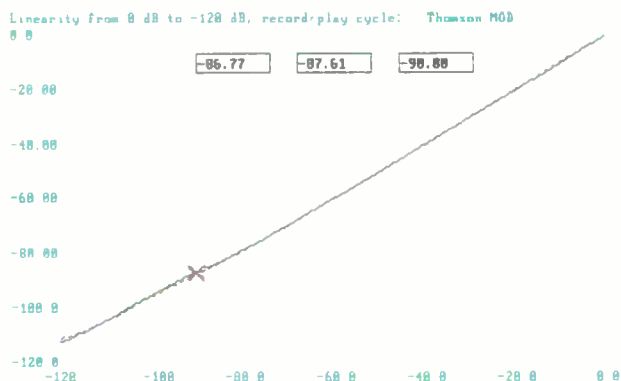


**Fig. 9**  
Frequency response, record/play mode.





**Fig. 10**  
THD + N vs. frequency,  
record/play cycle.



**Fig. 11**  
Record/play linearity,  
input vs. output;  
see text.

## SOONER OR LATER IN THIS

decade, recordable CDs will come. Now that I've actually tested them, I'm hoping it's sooner rather than later.

rupted. The next goal, he further stated, would be to record one hour of video on a 12-cm (CD-sized) disc!

The rear panel of the DR 1000 MOD has analog line in and line out jacks as well as optical and coaxial digital line in and line out jacks. This permits digital interconnection of a CD player and a DAT recorder with the Thomson DR 1000 MOD for recording onto or from the magneto-optical disc.

There was not nearly enough time to conduct all the lab and listening tests that I wanted to make. Since I had to ration my time, I decided to measure some fundamental performance characteristics of the unit as if it were a CD player, using my trusty CBS CD-1 test disc. I then made additional measurements using digitally generated test tones that I recorded onto a blank magneto-optical disc.

Figure 4 shows playback frequency response of the system in CD playback

mode. Response was almost absolutely flat from below 20 Hz up to 20 kHz. The output levels of the two channels differed by some 0.2 dB, which accounts for the +0.25 dB reading at 20 kHz on the right channel. In fact, that channel was also perfectly flat when referred to its own 1-kHz output level.

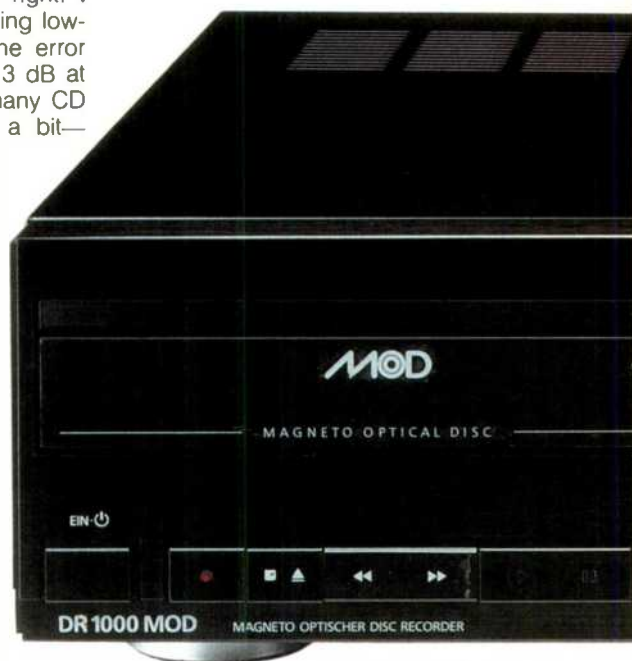
Figure 5 is the familiar plot of deviation from perfect linearity that I show when testing CD players. Using undithered signals, deviation at -80 dB was less than 2.0 dB for the left channel and just over 2.0 dB for the right. I repeated the test, this time using low-level dithered signals, and the error amounted to a bit more than 3 dB at -90 dB (Fig. 6). I've seen many CD players—some costing quite a bit—that didn't do as well at such low levels.

The results for the fade-to-noise test, shown in Fig. 7, provided good correlation with the results obtained in Fig. 6 and also enabled me to see how the MOD recorder's EIA dynamic range compared with that of ordinary CD players. From the data plotted in Fig. 7, I calculated that the EIA dynamic range for this unit was between 105 and 110 dB in playback mode.

Figure 8 is a plot of THD + N versus frequency. At 1 kHz, THD + N was only 0.00336% on the left channel and

0.00398% on the right, both readings referred to maximum digital recorded level. Notice that, unlike some CD players I've tested, the DR 1000 MOD exhibited no sharp rise of THD + N as the high-frequency end of the spectrum was approached. Often, I see high readings here, due not so much to actual harmonic distortion as to out-of-band "beats" caused by the D/A converter and other elements in the playback circuit. No such beats were in evidence with the Thomson unit in its CD playback mode.

There were many more measurements of CD playback I wanted to make, but only a short time remained to make my first-ever magneto-optical digital disc recording and play it back. I think I know how Tom Edison must have felt when he yelled into that horn and made those first indentations in tinfoil 113 years ago! Rather than recite "Mary Had a Little Lamb," as Edison had done, I let my Audio Precision System One test gear generate 16-bit digital signals at 44.1 kHz. With the aid of the gentlemen from Thomson, I recorded the signals onto an MOD and then held my breath as I played back the first one—a sweep of frequencies from 20 Hz to 20 kHz. The response when the recording was played back, shown in Fig. 9, was as flat as that shown in Fig. 4, if not flatter. Again, the right channel's output was slightly different from the left channel's, but both were





within 0.1 dB or less over the range from 20 Hz to 20 kHz!


Distortion plus noise for the complete record/play cycle of a full-level (0-dB) signal, though not as low as for playback of the prerecorded test disc, nevertheless equalled that of many top-quality CD players. In Fig. 10, only one channel is shown, but both channels yielded practically identical readings at all frequencies. At 1 kHz, THD + N was 0.0072% for the complete record/play cycle.

Perhaps the most interesting result was obtained when I recorded a test signal which decreased in amplitude, in 2-dB steps, from maximum recorded level down to 120 dB below maximum. This test signal was generated in the digital domain and recorded onto a blank section of the magneto-optical disc. During playback, a plot was made of output versus original input level, and as you can see from Fig. 11, linearity was superb. Admittedly, this

time the test signal was dithered, but deviation from perfect linearity at -90 dB was not much more than it had been at -80 dB in the test shown in Fig. 5. Mr. Uhde smiled knowingly when I pointed this out to him. From his remarks, I gathered that the combination of A/D and D/A conversion used in the complete record/play cycle of the DR 1000 MOD was calibrated so that whatever slight linearity error is introduced during the record cycle is at least partly compensated for during playback. This is one of the tricks a manufacturer can perform when he has total control of a system, from input to record function and then to playback function.

In the little time that remained, I did manage to make a short voice recording, just to convince myself that the Thomson unit could digitally record more than mere test tones. As expected, the sound of my voice reproduced via a pair of headphones was as good

as anything I had recorded and played back on my two DAT recorders. I'm not suggesting, certainly, that MOD will make DAT obsolete. For one thing, DAT will likely be with us long before we see commercial MOD recorders on dealers' shelves. But even if this should not be the case, each format has its advantages. For example, I can hardly envision a portable Walkman type of magneto-optical recorder, yet there are already DAT recorders smaller than the first portable analog cassette recorders were.

No one can know, at this point, whether or not the Thomson approach to recordable/erasable digital discs will become the world standard. This much I am willing to predict: We will have recordable CDs of one kind or another, sooner or later, during this new decade. Based on my brief experience with the Thomson DR 1000 MOD recorder, I hope it's sooner rather than later. 







# GREATEST CASSETTE TEST EVER

# 88 TAPES TESTED

Howard A. Roberson

In November 1987, *Audio* published "Mass Cassette Test: We Review 35 New Tapes." This time, I am covering 88 tapes—that is, the great majority of formulations available in the United States, including those from mail-order firms. The tapes evaluated are 36 Type I, 36 Type II, and 16 Type IV cassettes. The brands are BASF, Certron, Chrome Master (from Master Hi-Tech Video), DAK, Denon, Fuji, Goldstar, Greencorp, JVC, Laser (Swire Magnetics), Maxell, Memorex (Memtek Products), Nakamichi, Realistic (Radio Shack), SKC, Sony, TDK, That's (That's America), and Visa (Interworld Electronics).

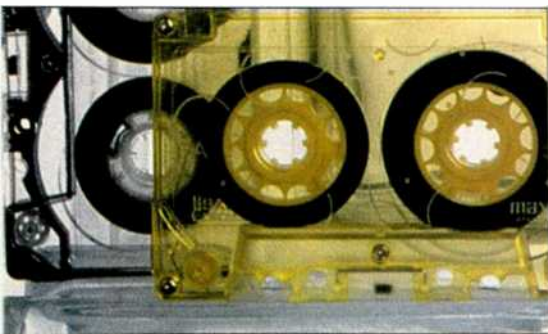
I did not include tape formulations which were being updated or were about to be dropped at the time of the testing, nor did I include tapes from manufacturers who did not reply to my request for literature and test samples. For example, because 3M was in the process of readying a new Black Watch tape line, these cassettes are not covered here. After the last survey, one reader asked that Teac be included next time. Alas, Teac is no longer distributing cassette tapes in this country.

The following brief descriptions of each formulation are based on statements in the manufacturers' spec sheets and catalogs. The tapes are grouped alphabetically by brand.

BASF Ferro Extra I is an updating of the previous LH Extra I. Ferro Super I is a new premium normal-bias tape with



a high maximum output level (MOL) and extended sensitivity that are "ideal for recording loud rock and roll music." It is coated with a microscopically close-grained layer of ultrafine "megadium" oxide particles for outstanding uniform alignment. Ferro Maxima I, the newest BASF Type I formulation, uses a dual-layer micro-coating technology and proprietary megadium iron oxide. The Type II Chrome Extra II is an updated version of Chromdioxid Extra II, offering the low noise floor typical of chrome tape "with extremely high frequency response and an S/N of 63 dB." Chrome Maxima II retains the double-layer chrome formulation of Chrome Maxima and uses a new wide-window shell which features 12 rigid bracing struts in the critical magnetic head area. Metal Maxima IV (Type IV) is available only in C-120 cassettes, which can accommodate two 60-minute Compact Discs.



The Certron tapes are HD and UX, both Type I cassettes. I had also planned to include Certron LN, which I purchased locally, along with HD, in a discount department store. (Certron had supplied just UX, feeling it would best meet my basic criteria.) However, I dropped the LN formulation from the testing when the two samples failed criteria for minimum performance. The manufacturer refers to HD as the "performance and economy tape for music or voice" and to their UX formulation as the "quality music tape for all recording applications."

Chrome Master LX-II (Type I), the single tape from Master Hi-Tech Video, is "engineered to perform a notch above the standard normal-bias tapes," and DAK promises satisfying performance from their MLX (Type I) and MLX<sup>2</sup> (Type II) formulations.

Denon's tapes have Dynamic Balance (DB) hubs for smoother rotation and a more even tape wrap. One of their Type I tapes, DX1, utilizes a gamma-ferric-oxide formulation for wider dynamic range; their other Type I tape, DX4, uses a nonporous ferric oxide to "ensure a high MOL, exceeding the performance level for its class." In HD6 (Type II), a cobalt-doped ferric oxide has been used to ensure high MOL

while offering a low noise level over the entire frequency range. A similar formulation has been used in HD7, with ultrafine particles for further improvements. An unusual Type II formulation, HD8 "combines pure-metal particles with cobalt-doped ferric oxide." Its extended frequency response, says Denon, approaches that of a Type IV tape. The pure-metal formulation of HD-M (Type IV) allows the "most accurate reproduction of the music possible." The Type II and IV cassettes have high-precision shell halves using a dual-window housing that "reduces resonance due to external interference, mechanism noises, and tape vibration."

From Fuji come DR-I (Type I); DR-II, FR-IIx, and FR-IIx PRO (Type II), and FR Metal (Type IV). The Pure Ferrix magnetic particles of DR-I "provide the best balance of sensitivity, frequency response, MOL, and bias noise." The Type II tapes, DR-II, FR-IIx, and FR-IIx PRO, all use Super-Fine Beridox particles to secure high MOLs and low noise. The DR-II tape has a new large-window cassette shell to ensure "stable tape transport and minimal distortion," while the new high-precision shell for FR-IIx "offers highly reliable transport stability and minimizes wow and flutter and modulation noise." Fuji's FR-IIx PRO, which has a new shell and tape mechanism, uses the company's "exclusive Double-Orientation technique to ensure minimum distortion at high output levels." The Type IV FR Metal tape has Super-Fine Metalix particles that are densely packed and uniformly aligned via Double-Orientation technology.

Goldstar offers HP and HR (Type I), CRX (Type II), and MT (Type IV). The HP and HR formulations use gamma-hematite crystal particles to "ensure outstanding output and sensitivity through the full range of frequency responses." The HR tape's improved particles offer greater resistance to saturation "for the extra touch of detail and refinement." Goldstar's CRX uses sensitive, cobalt-doped iron-oxide particles to retain "all the energy and excitement of the original sound," and MT has very minute pure-metal particles said to be of high coercivity and unequalled uniformity to get "the ultimate in high-frequency response and the best dynamic range possible."

Greencorp's Type I tapes, XDS and Music+, use gamma-ferric and super-gamma-ferric particles, respectively. Their Type II CR has premium-quality chromium dioxide, which performs "far better than so-called chrome-bias ferric-oxide tapes."

The JVC GI (Type I), AFII (Type II), and AFIV (Type IV) tapes are in the

manufacturer's Fidelity Series, offering attractive and well-performing shells. The GI formulation provides "high cost performance with JVC quality," while AFII delivers "tight, well-dispersed sound with super-low noise." This tape has high MOL and reduced modulation noise. The AFIV tape has been upgraded and specially designed for digital sources, using ultrafine pure-metal particles, a new binder system, and high-orientation technology. Its new, heat-resistant shell has many features, including precision molding and accurately shaped and positioned hubs, pins, and guides.

The single tape from Swire Magnetics is Laser XL Plus. This Type I tape has an "extra low-noise formulation for excellent music or voice recordings."

The Maxell Type I tapes are Frill, UR-F, UDI, and XLI-S, and their Type II tapes are Capsule II, UDX-II, UDII, XLII, and XLII-S. The MX is Maxell's single Type IV formulation. Frill, UR-F, Capsule II, and UDX-II make up Maxell's Lifestyle cassette line. Pure crystal-oxide Frill tape, available in C-46 only, comes in various colors to appeal to 9- to 12-year-olds, while UR-F cassettes are targeted more at teenage users. These UR-F cassettes' "micron-sized particles are densely packed for uniform output over the entire frequency range." The Capsule II's special, rounded case facilitates carrying it in a pocket or bag; the tape's micron-sized particles are "Clear Epitaxial oxide for greater output, lower noise, and wide dynamic range." The Arrow cassette shell of UDX-II combines high precision with strength and stability, while the small, uniform particle size of the tape facilitates tight packing for "more sound output, lower noise, and wide dynamic range." Maxell's newly developed Nonpore Epitaxial particles, used in UDI, deliver greater magnetic energy, and this tape's High Resonance-proof (HR) cassette mechanism is said to offer a "high level of anti-resonance capability." Maxell's XLI-S is a normal-position tape with new Super-Energy, fine Epitaxial magnetic particles which are oriented to expand the dynamic range while delivering ultralow noise. This tape also features Absorption Control Treatment (ACT), a special surface treatment, and the Super Silent-Phase Accuracy (SS-PA) cassette mechanism. Maxell's UDII uses newly developed ultrafine Clear Epitaxial magnetic particles and benefits from a new calendaring process that smoothes its surface. The HR mechanism, described above, is used in both UDII and XLII. The latter tape has even finer particles, and both have the same High Endurance (HE) binder. The XLII-S tape has improved sensitivity at mid

Tape	Maximum Output Level (dB, re: 400-Hz Dolby Level)						S/N Ratio (dBA)	Response Limit (-3 dB) at Dolby Level (kHz)	Mod. Noise (dB)	Bias (dB)	Sens. (dB)
	HDL <sub>3</sub> = 3%			SOL							
	40	125	800	2k	4k	10k					
BASF Ferro Extra I	+2.1	+5.8	+6.5	+7.2	+4.8	-3.5	57.0	9.8	-47.2	+0.4	+0.4
BASF Ferro Super I	+1.5	+5.8	+6.2	+8.2	+6.1	-2.5	58.7	10.2	-51.4	+0.4	0.0
BASF Ferro Maxima I	+3.0	+6.7	+6.5	+8.2	+5.8	-3.0	59.7	10.0	-51.3	+0.3	+0.3
Certron HD	-1.8	+2.4	+3.1	+6.4	+4.0	-4.3	55.2	9.1	-48.8	+0.7	-2.2
Certron UX	-0.7	+3.8	+4.1	+6.5	+4.1	-4.0	55.6	9.1	-48.0	+0.6	-1.3
Chrome Master LX-II	0.0	+3.8	+3.6	+6.1	+3.6	-4.9	55.5	8.8	-46.4	+0.8	-1.6
DAK MLX	+2.4	+6.4	+7.1	+7.7	+5.7	-2.8	57.0	10.0	-50.6	+0.5	+0.6
Denon DX1	+0.2	+4.1	+4.2	+6.3	+4.0	-4.9	57.1	8.9	-49.6	+1.0	-1.3
Denon DX4	+4.8	+8.7	+7.9	+8.1	+6.2	-2.9	58.8	10.1	-48.2	+1.0	+0.7
Fuji DR-I	+0.6	+4.4	+5.3	+7.0	+4.5	-4.0	56.7	9.2	-48.3	+0.2	-0.8
Goldstar HP	-3.7	+1.0	+3.0	+6.4	+4.5	-4.2	54.1	9.2	-50.4	0.0	-1.4
Goldstar HR	+5.0	+8.7	+8.1	+8.2	+6.1	-3.0	58.8	10.0	-47.4	+0.7	+1.1
Greencorp XDS	+0.9	+4.9	+5.7	+7.1	+4.5	-4.0	56.0	9.1	-48.6	+0.1	-0.2
Greencorp Music+	+3.0	+7.4	+6.7	+7.5	+5.1	-4.0	58.0	8.8	-47.8	+0.1	+0.3
JVC GI	-1.3	+3.2	+4.1	+6.7	+4.2	-4.1	55.5	9.3	-47.8	+0.1	-1.1
Laser XL Plus	0.0	+4.0	+4.8	+6.8	+3.9	-4.6	54.4	8.7	-49.3	-1.0	-0.2
Maxell Frill	+1.5	+5.4	+5.0	+7.5	+5.0	-3.6	57.0	9.6	-50.0	-0.2	+0.3
Maxell UR-F	+1.6	+5.5	+5.4	+7.5	+5.0	-3.6	57.0	9.6	-51.0	-0.1	+0.2
Maxell UDI	+3.0	+6.8	+6.9	+8.3	+6.1	-2.8	60.3	10.1	-50.5	+0.2	+0.4
Maxell XLI-S	+2.8	+6.8	+7.2	+8.2	+6.2	-2.7	60.5	10.0	-53.1	+0.5	+0.2
Memorex dBS	-0.4	+3.4	+5.4	+6.4	+4.9	-4.9	54.6	9.0	-46.0	-1.0	+0.4
Memorex MRX I	+0.4	+3.9	+5.7	+7.0	+5.0	-4.0	55.9	9.1	-51.9	-1.0	+0.6
Nakamichi EXII	+3.5	+7.1	+8.0	+8.6	+6.3	-3.2	59.5	10.2	-47.9	+0.8	+0.4
Realistic Supertape LN	+0.2	+4.5	+5.3	+6.5	+4.2	-5.0	55.6	8.6	-48.2	-1.3	+0.5
Realistic Supertape XR	+1.7	+5.6	+6.6	+7.5	+5.1	-4.0	57.5	8.8	-47.6	-0.7	+1.1
SKC GX	+1.5	+5.5	+6.1	+7.3	+5.0	-3.8	56.0	9.6	-49.6	-0.2	0.0
SKC AX	+2.9	+6.6	+7.2	+8.2	+6.1	-3.3	57.0	10.0	-52.0	+0.2	+0.2
Sony HF	+0.7	+5.0	+5.5	+7.5	+5.2	-3.6	57.3	9.6	-50.6	+0.1	-0.8
Sony HF-S	+3.8	+7.8	+7.9	+8.5	+6.1	-3.3	60.3	10.0	-50.6	+0.2	+0.7
TDK D	+2.3	+6.4	+6.8	+7.5	+5.4	-3.5	57.4	9.8	-52.2	+0.1	+0.1
TDK AD	+3.1	+7.0	+8.1	+8.5	+6.3	-2.5	60.6	10.5	-49.6	+0.8	+0.5
TDK AR	+4.7	+8.5	+8.5	+8.2	+6.1	-3.5	61.6	10.0	-50.0	+0.1	+1.5
TDK AR-X	+4.3	+8.2	+9.2	+8.8	+6.6	-2.5	61.7	10.5	-51.3	+1.8	+1.5
That's CD	+1.5	+5.9	+6.8	+8.0	+6.0	-2.7	59.3	10.2	-52.8	+1.0	0.0
Visa High Performance I	+0.3	+4.4	+4.9	+7.1	+4.6	-4.3	55.4	9.3	-47.0	-0.4	-0.5
Visa Superferro UFX I	+1.8	+5.6	+4.9	+7.3	+4.6	-3.9	56.8	9.2	-45.8	-0.8	+0.3

and high frequencies, and improved MOLs are claimed in these areas. Modulation noise is well suppressed with the use of the SS-PA mechanism. The MX tape has further improved, Super Stabilized Pure (SSP) metal magnetic particles, which are ultra small and reportedly provide outstanding resistance to oxidation. High orientation and packing are achieved with a newly developed high-dispersion processing technology.

Memorex's tapes are dBS and MRX I (Type I) and HBS II and CDX II (Type II). The dBS tape's special formulation provides "clear, lifelike reproduction of rock, pop, jazz, or country music." A new shell and mechanism ensure smooth tape performance. The MRX I uses a "uniquely formulated ferric-oxide composition" for higher output and greater headroom. The company's HBS II has an "improved highly sensitive crystal-ferrite formulation" and a new calendaring process; these combine to deliver "full sound and reduced tape noise." Memorex CDX II is a Type II metal formulation that offers "better than metal performance with high-bias

convenience" and "makes distortion and saturation a thing of the past."

Nakamichi has generally updated the formulations and shells of their EXII (Type I), SX and SXII (Type II), and ZX (Type IV) tapes.

The Realistic tapes, purchased at my local Radio Shack, are Supertape LN and XR (Type I), Supertape HD and MII (Type II), and Supertape MIV (Type IV). The LN has a high-flux-density oxide formula for high output and low noise, XR "delivers optimum performance at normal bias for greater musical detail," HD "captures loudest and softest passages while reducing noise," MII is a superb Type II metal tape with an "exceptionally wide dynamic range and superior signal-to-noise ratio," and MIV metal-particle tape is "highly recommended for recording from digital Compact Discs."

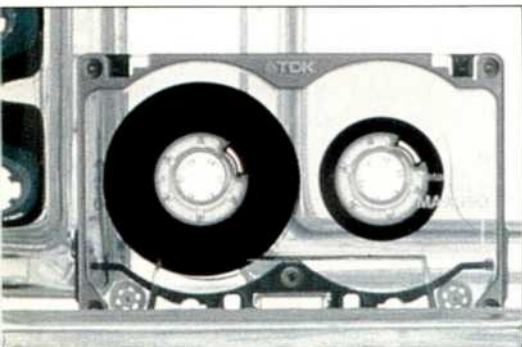
SKC's tapes are GX and AX (Type I), QX and CD (Type II), and ZX (Type IV). The GX tape uses a special ferric oxide for high output and delivers "full dynamic range with excellent signal-to-noise ratio." It has a new crystal-clear, one-piece precision cassette

shell. The company's AX tape uses a formulation for which it claims superior fidelity, and the "new wide-window, high-precision cassette shell assures perfect tape operation." The QX tape is also said to have a superior formulation and an ultra-high-density finish that provide extended high-frequency response. It features "outstanding dynamic range and sensitivity across the entire frequency spectrum." The advanced pure-chrome formula of CD tape is said to deliver "extraordinary reproduction in all musical ranges." It combines ultra-high recording density and low background noise and "exceeds all requirements for high-fidelity Compact Disc recording." The ZX Type IV tape has specially treated, pure-iron particles to assure extended frequency response. It uses a "precision cassette shell for superior alignment and greater guidance accuracy."

Sony HF (Type I) is good for "all-purpose recording—voice and music." Sony's other Type I offering, HF-S, has "Micro-fine Crystal Gamma particles for more accurate recording of music" plus Sony's High Polymer Binder Sys-

tem. Type II UX tape uses Micro-fine Uniaxial particles for excellent linearity and "dynamic reproduction in hi-fi tape decks and automobile stereos." The UX-S formulation's Super-fine Super Uniaxial particles reportedly provide "an extra measure of fidelity in music recording," while UX-ES utilizes Ultra-fine High Power Uniaxial particles to make a "high-bias tape designed for impeccable fidelity for digital audio and live recording." The fourth Type II sample from Sony, UX-Pro, is a "professional reference tape that is unbeatable for digital audio and live music recording"; it features a ceramic tape guide that reduces noise and vibration. A new, lower cost Type IV tape, Metal-SR utilizes a recently developed Fine Dynametal formulation to obtain "outstanding magnetic performance and a dramatic reduction in bias noise and distortion." The Metal-ES has ultrafine Extralloy particles in a dual coating that secures reduced noise with improved high-frequency and midrange responses. Metal Master is very similar to Metal-ES magnetically but has a unique ceramic shell. The tape guide and outer one-piece rigid shell are made from "ceramic composite material specially designed to dampen external vibrations and reduce modulation noise."

The TDK D (Type I) has new Pure Grained Ferric particles, a high-dispersion binder system, and advanced tape-coating technology. Improved MOL and high-frequency sensitivity result in a "fresher, clearer sound." The Pure Linear Ferric ultrafine particles in AD have uniform dispersion and high packing density. This tape is said to provide "superb performance and sound quality for use with digital sources." The ultrafine, nonporous fer-



ric particles in AR are in a special new binder system. TDK claims that AR's "low-frequency MOL is equal to that of metal tape." In AR-X, a dual coating of "ultrafine, high recording density Avilyn particles" has been used: "Overall magnetic properties are extremely balanced, with very high, yet carefully controlled, values." Even finer Avilyn particles, with a more perfect needle

shape, are used in the upgraded formulation of the SD Type II tape. Noise remains low, and "sensitivity and MOL are improved." The SA cassettes use "ultrafine high recording density Super Avilyn magnetic particles which have been further improved to achieve a higher packing density." Bias noise is low, while MOLs are higher. A dual, high-density coating of ultrafine Super Avilyn particles in SA-X result in "ultra-low noise plus improved MOL over the entire frequency range." In one of their Type IV tapes, MA, TDK uses unique Finavinx particles that "have been further improved to give even higher performance than before." High packing density achieves unusually good magnetic performance. Ultrafine Finavinx particles, highly dispersed in a uniform dense packing, are found in MA-X. It has the "sound quality for the digital age's top-grade cassette." Although MA-XG is much like MA-X, it uses a shell assembly incorporating a center die-cast metal section. The shells of all TDK tapes are improved over previous versions.

The Type I That's CD tape, from That's America, uses a "highly dispersed and densely packed Flush Surface Cobalt formulation" to ensure a "crisp, clear sound and wide dynamic range across the entire audio spectrum." That's CD-II (Type II) is an "all-new, high-bias-position tape with a dynamic range comparable to metal tape performance." The formulation has Submicro Cobalt Gamma particles. With its Super Alloy formulation, CD-MH "delivers the brightest, hottest highs and the most dynamic recording in the high-bias position." An Anti-Vibrational Resin (AVR) shell is also featured. That's CD-IV (Type IV) uses what the manufacturer calls a Nano Dynamic Tactoid formulation. In combination with the AVR shell, the maker claims this tape delivers "outstanding response from the most demanding digital sources."

The Visa tapes from Interworld Electronics are High Performance I and High Tech Turbo Superferro UFX I (Type I) and Professional Chromdioxid CX II and High Tech Turbo Superchrom UCX II-S (Type II). From here on, these tapes will be referred to as High Performance I, Superferro UFX I, Chromdioxid CX II, and Superchrom UCX II-S, respectively. No literature was received on the Visa formulations.

#### TEST METHODS

With a few exceptions, manufacturers supplied three C-90 samples of each formulation evaluated. Maxell Frill comes only in a C-46 length; Certron: HD, Chrome Master LX-II, and Goldstar MT were obtained in C-60 lengths,

and BASF Metal Maxima IV is available only in the C-120 length. As most readers probably know, a number of formulations are now available in C-75 (or C-74 or C-76) and/or C-100 or C-110 lengths. I asked each maker of such lengths to supply two samples of each formulation for cross-checks with their C-90s. I examined the packaging and unwrapped all samples of all lengths, noting any pull-tab instructions. Every sample was fast-wound once in each direction before any other tests.

I used a Nakamichi 582 deck for substantially all of the record/playback tests. I also used a Nakamichi CR-7A and Akai, Kenwood, Teac, and Technics recorders for some cross-checks. Bias and sensitivity figures for both sides of every sample were measured relative to the standard IEC Type I, II, and IV reference tapes. A meter in relative-decibel mode measured bias at an internal point in the 582 deck.

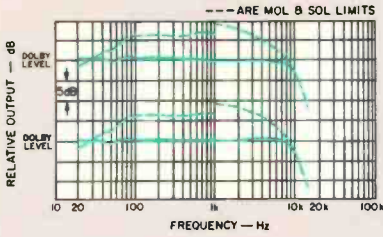
Using the first side of the first sample, I adjusted the record head's azimuth for the best high-frequency response, compensating for any skew between it and the playback head. I set bias for the smoothest overall record/playback response at 20 dB below Dolby level, using a pink-noise source and a third-octave RTA for the playback display. Subsequently, I checked for skew and changes in bias requirements for the second side of the first sample and for both sides of other samples. I noted any other deviations from flat response for later reference. The 582's 400-Hz calibration tone was the source for measuring sensitivity in relative decibels.

I made record/playback response plots for the 88 formulations at Dolby level (200 nWb/m at 400 Hz) using a function generator and an X-Y recorder. The -3 dB points at the high-frequency end are indicated in the accompanying Tables. I secured more exact data, however, with my Audio Precision System One test system, used for the majority of all other tests. Let me emphasize that although there are references to Dolby level, no tests were run with any sort of noise reduction. I measured MOLs at 11 points from 20 Hz to 1 kHz with a distortion limit of 3%, and measured saturation output levels (SOLs) at nine points from 1 to 16 kHz. The data was used for obtaining limit curves on each frequency response plot.

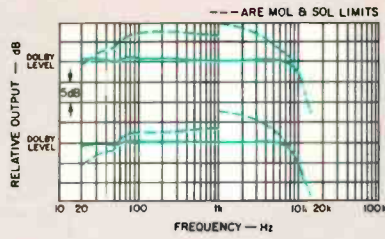
The signal-to-noise ratio was the difference between the signal level which caused 3% distortion at 400 Hz and tape noise measured with IEC A-weighting. I recorded a 3-kHz tone and played it back to assess flutter. *I remind the reader: The deck has a considerable effect on the exact flut-*

# TYPE I

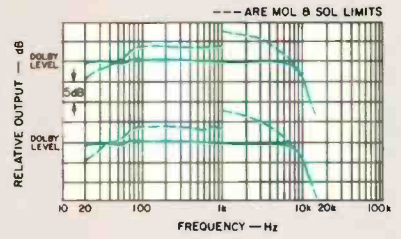
BASF Ferro Extra I (top) and Ferro Super I



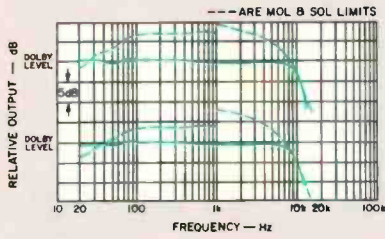
BASF Ferro Maxima I (top) and Certron HD



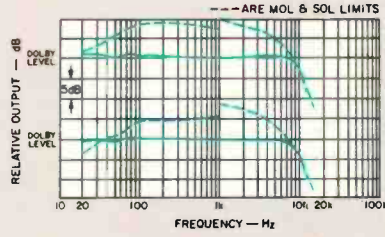
Certron UX (top) and Chrome Master LX-II



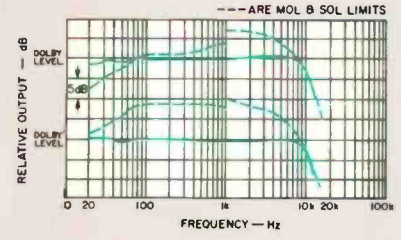
DAK MLX (top) and Denon DX1



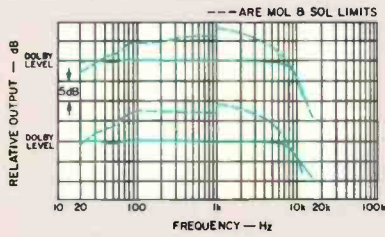
Denon DX4 (top) and Fuji DR-I



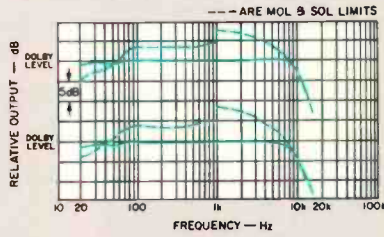
Goldstar HP (top) and HR



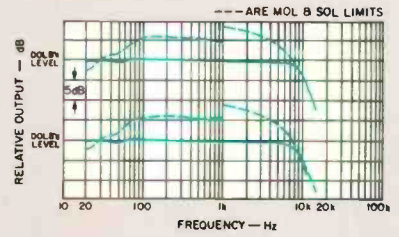
Greencorp XDS (top) and Music+



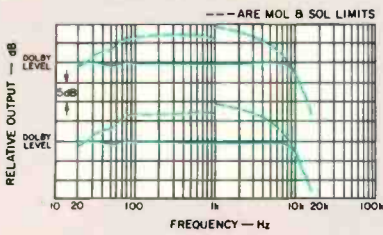
JVC GI (top) and Laser XL Plus



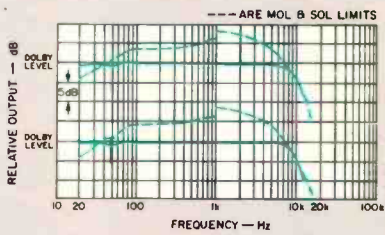
Maxell Frill (top) and UR-F



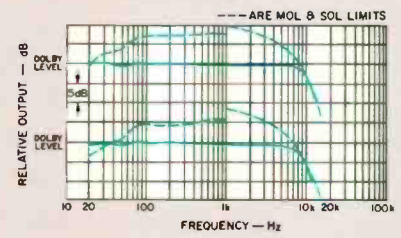
Maxell UDI (top) and XLI-S



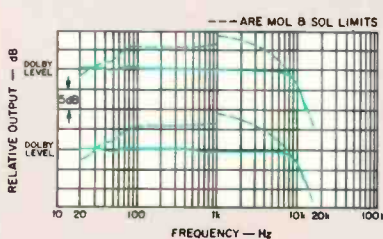
Memorex dBS (top) and MRX I



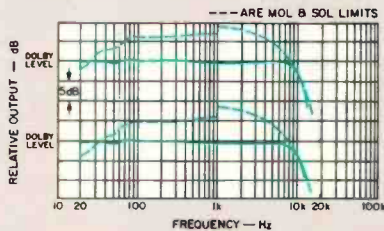
Nakamichi EXII (top) and Realistic Supertape LN



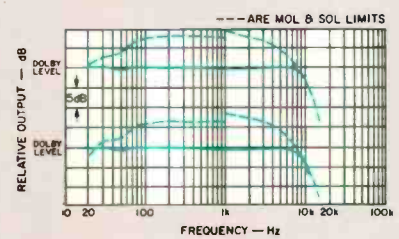
Realistic Supertape XR (top) and SKC GX



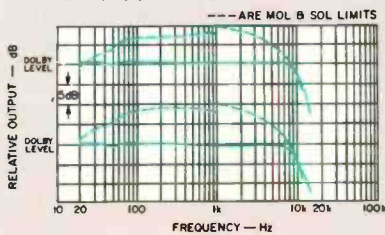
SKC AX (top) and Sony HF



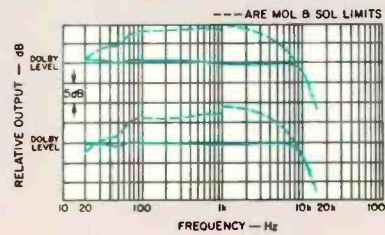
Sony HF-S (top) and TDK D



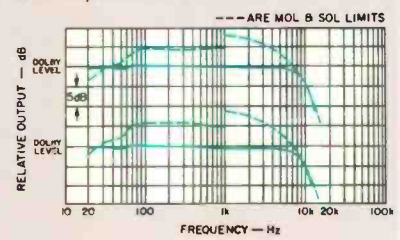
TDK AD (top) and AR



TDK AR-X (top) and That's CD

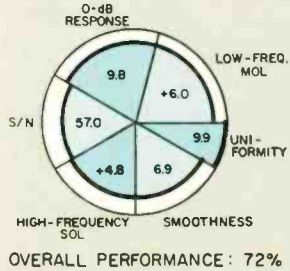


Visa High Performance I (top) and Superferro UFX I

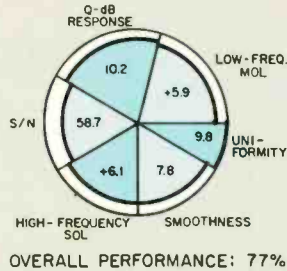


# TYPE I

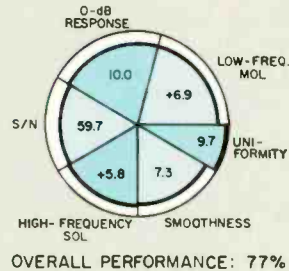
*BASF Ferro Extra I*



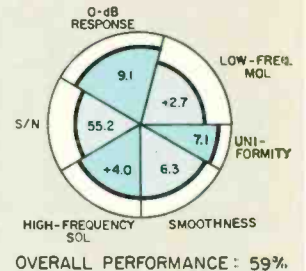
*BASF Ferro Super I*



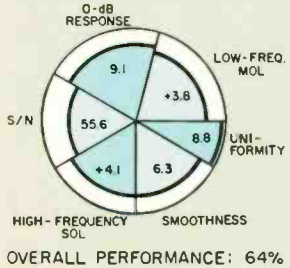
*BASF Ferro Maxima I*



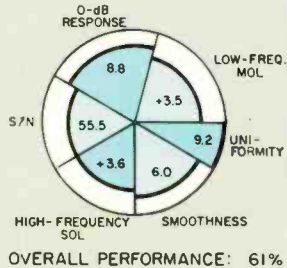
*Certron HD*



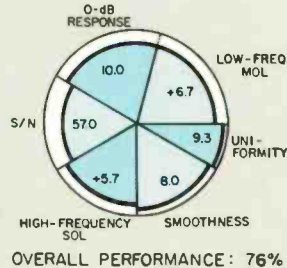
*Certron UX*



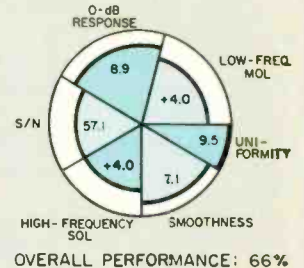
*Chrome Master LX-II*



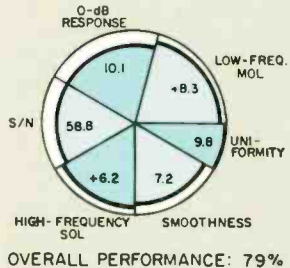
*DAK MLX*



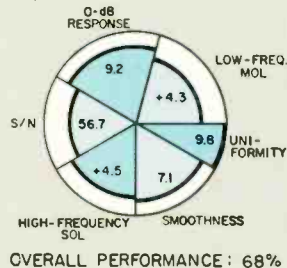
*Denon DX1*



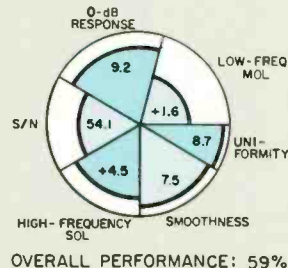
*Denon DX4*



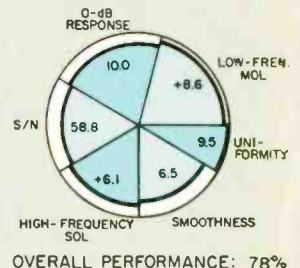
*Fuji DR-I*



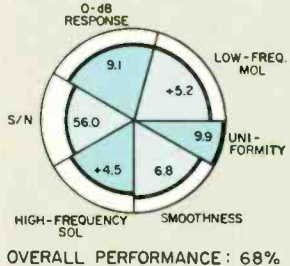
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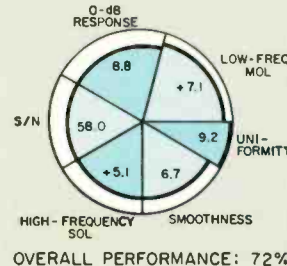
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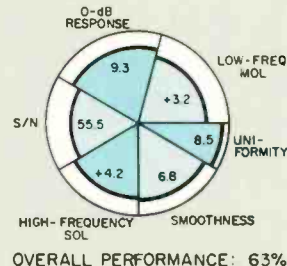
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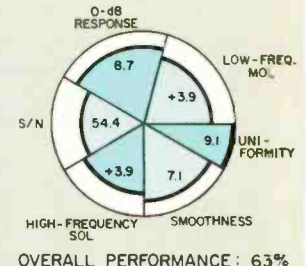
*Greencorp Music+*



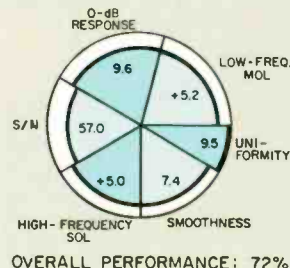
*JVC GI*



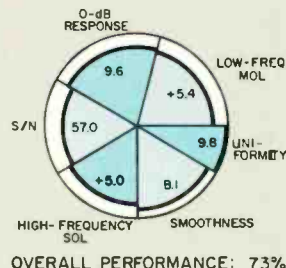
*Laser XL Plus*



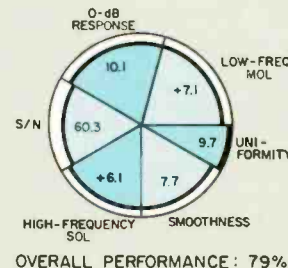
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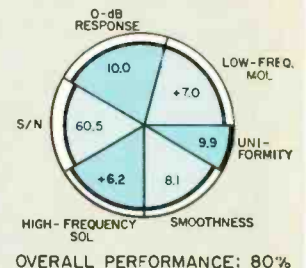
*Maxell UR-F*



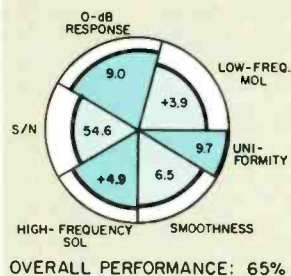
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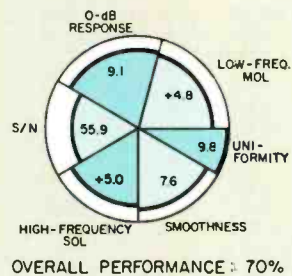
*Maxell XLI-S*



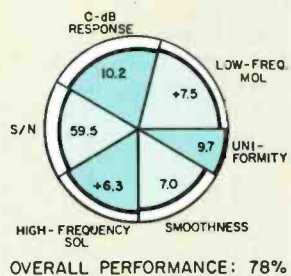
*Memorex dBS*



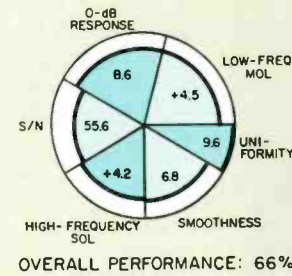
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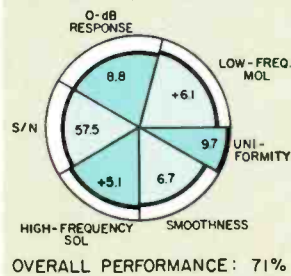
*Nakamichi EXII*



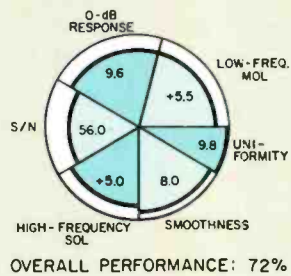
*Realistic Supertape LN*



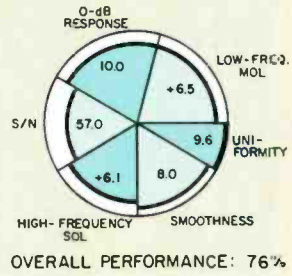
*Realistic Supertape XR*



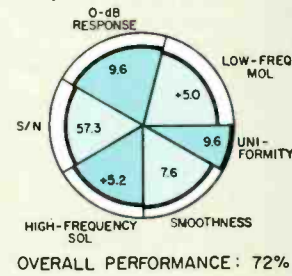
*SKC GX*



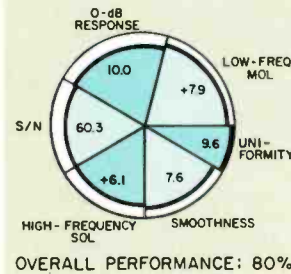
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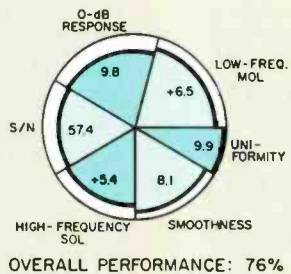
*Sony HF*



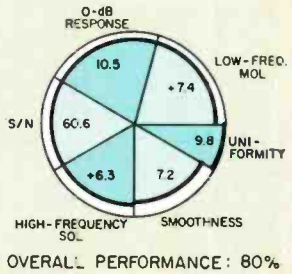
*Sony HF-S*



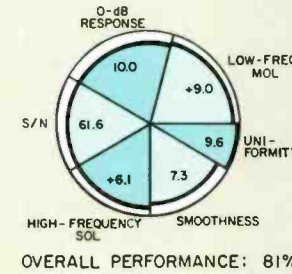
*TDK D*



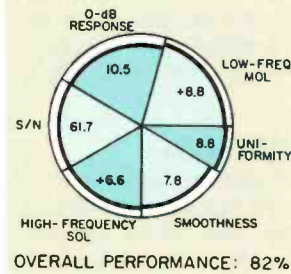
*TDK AD*



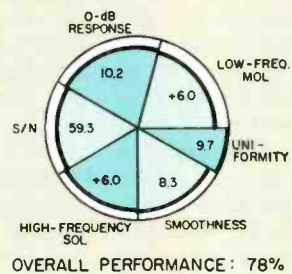
*TDK AR*



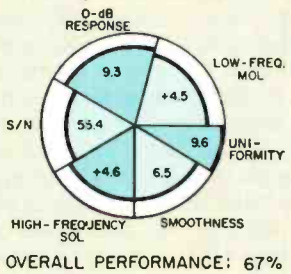
*TDK AR-X*



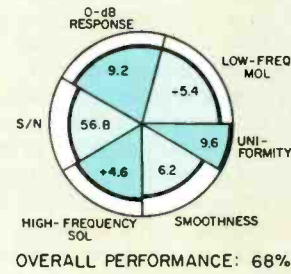
*That's CD*



*Visa High Performance I*



*Visa Superferro UFX I*



ter—for any tape. The same 3-kHz tone was used in testing for dropouts and to determine the degree of level stability at this moderately high frequency. I measured modulation noise after recording a high-level 1-kHz test tone. The playback passed through a 500-to-1,500 Hz bandpass filter, and the tone was then notched out by using the THD + N filter of the Audio Precision System One. The playback level of the tone without the notch served as the reference for the measuring meter. A bar graph displayed the noise levels;

the modulation noise figure reported in the Tables is the average of the minimum and maximum indications. I noted in the discussions of the tapes whether the noise was smooth (steady in level) or varied noticeably with time.

**USE TESTS**

It was easy to remove the wrapping from most samples. I had some difficulty with cassettes from Chrome Master, Goldstar, and Laser, and less difficulty with JVC and Realistic tapes; the Denon, Sony, TDK, and That's samples

were the easiest to unwrap. Many of the manufacturers include little arrows and "Open" to show which way to pull the tab. Sony gives the specific, helpful suggestion, "Pull diag." Many cassettes do not unwrap well if the tab is pulled straight, perpendicular to the long edge of the box. Quite a few cassettes opened easiest with the box held so that "Open" appeared upside down.

Most of the cassettes come with pressure-sensitive labels. Some of the tapes from BASF, Certron, Denon (DX1

Tape	Maximum Output Level (dB, re: 400-Hz Dolby Level)						S/N Ratio (dBA)	Response Limit (-3 dB) at Dolby Level (kHz)	Mod. Noise (dB)	Bias (dB)	Sens. (dB)
	HDL <sub>3</sub> = 3%			SOL							
	40	125	800	2k	4k	10k					
BASF Chrome Extra II	+0.5	+4.9	+5.1	+5.2	+2.1	-6.3	61.5	8.0	-52.4	+0.9	+0.1
BASF Chrome Maxima II	+2.4	+6.7	+6.0	+6.0	+2.5	-4.9	63.7	8.5	-54.6	+1.1	+1.6
DAK MLX <sup>2</sup>	-1.0	+3.6	+3.1	+4.2	+1.0	-6.9	61.6	7.3	-50.7	+0.4	-0.2
Denon HD6	+0.5	+4.7	+4.7	+7.3	+3.7	-4.6	60.2	8.9	-49.3	+0.3	+0.9
Denon HD7	+1.9	+6.8	+6.8	+7.7	+3.8	-3.8	62.1	9.4	-52.2	+0.3	+2.4
Denon HD8	+3.6	+7.7	+7.8	+9.7	+6.4	-0.1	60.6	12.6	-50.7	+0.6	+3.7
Fuji DR-II	0.0	+4.6	+5.3	+7.2	+3.8	-3.9	60.9	9.3	-51.9	+0.8	+1.2
Fuji FR-IIx	+2.2	+6.4	+6.9	+8.1	+4.6	-3.8	62.5	9.5	-51.3	+0.7	+1.6
Fuji FR-IIx PRO	+2.1	+6.4	+6.5	+7.9	+4.2	-3.9	62.1	9.4	-50.5	+0.8	+1.5
Goldstar CRX	+2.3	+6.3	+6.6	+7.6	+3.9	-3.8	62.1	9.5	-54.1	+0.1	+2.3
Greencorp CR	-1.3	+3.3	+3.8	+4.8	+1.5	-6.1	60.8	7.7	-49.8	+0.2	+0.2
JVC AFII	-1.0	+3.1	+4.4	+7.2	+3.9	-3.9	57.5	9.2	-51.8	+1.2	+0.3
Maxell Capsule II	-0.6	+3.9	+3.4	+6.5	+2.8	-6.1	59.7	8.3	-51.0	-0.1	+1.4
Maxell UDX-II	+0.8	+5.0	+5.0	+7.6	+3.9	-3.9	60.3	9.4	-53.4	0.0	+1.1
Maxell UDII	+1.6	+5.8	+6.0	+7.7	+4.2	-3.9	60.8	9.5	-55.4	0.0	+1.3
Maxell XLII	+0.8	+5.1	+5.0	+7.5	+3.8	-4.0	60.9	9.4	-51.8	+0.6	+1.2
Maxell XLII-S	+0.3	+4.7	+5.0	+7.6	+3.9	-3.8	61.7	9.3	-53.2	+1.0	+0.6
Memorex HBS II	0.0	+4.3	+4.5	+7.0	+3.6	-4.4	60.2	9.0	-51.4	+0.1	+1.0
Memorex CDX II	+3.3	+7.5	+8.0	+10.1	+6.4	-0.2	61.5	12.5	-50.9	+1.4	+3.0
Nakamichi SX	+2.1	+6.5	+6.6	+8.2	+4.6	-3.7	63.8	9.6	-52.8	+0.8	+1.6
Nakamichi SXII	+1.0	+5.4	+5.9	+6.6	+2.7	-4.2	63.9	7.7	-51.6	+1.7	+2.0
Realistic Supertape HD	+0.5	+5.3	+5.8	+7.7	+4.3	-3.6	60.9	9.9	-52.7	-0.1	+1.1
Realistic Supertape MII	+4.0	+8.4	+8.5	+10.2	+6.9	0.0	61.2	13.0	-50.2	+1.6	+3.6
SKC QX	-1.3	+3.2	+3.2	+6.9	+3.6	-4.5	57.9	9.0	-49.6	0.0	+0.5
SKC CD	-2.5	+2.6	+2.6	+4.3	+1.3	-6.3	60.6	8.4	-51.9	+0.8	-0.9
Sony UX	+0.2	+4.8	+4.2	+7.6	+3.8	-4.3	60.0	9.1	-47.8	-0.6	+1.5
Sony UX-S	+2.0	+6.2	+6.7	+7.8	+4.6	-3.6	63.7	9.7	-51.4	+0.9	+1.2
Sony UX-ES	+2.7	+7.0	+7.4	+8.9	+5.4	-2.5	62.0	10.5	-53.8	+1.1	+1.5
Sony UX-Pro	+2.7	+7.1	+7.0	+8.7	+5.3	-2.5	62.1	10.5	-54.0	+1.3	+1.4
TDK SD	+0.3	+5.1	+5.7	+7.8	+4.7	-3.7	61.6	9.6	-51.8	+0.8	+1.2
TDK SA	+1.5	+5.9	+6.5	+7.8	+4.8	-3.6	63.0	9.7	-51.1	+0.6	+1.6
TDK SA-X	+3.0	+7.2	+7.2	+7.6	+3.5	-3.9	65.4	8.9	-51.6	+1.0	+3.0
That's CD-II	-0.4	+4.2	+4.7	+6.5	+3.4	-4.3	61.8	9.0	-51.6	+1.0	+0.2
That's CD-MH	+2.3	+7.0	+8.0	+9.9	+6.3	-0.1	60.7	12.5	-49.3	+1.8	+2.8
Visa Chromdioxid CX II	-5.2	-0.1	+0.3	+3.0	-0.1	-7.5	58.2	6.4	-52.2	-0.2	-1.7
Visa Superchrom UCX II-S	-3.7	+1.7	+1.4	+3.2	-0.5	-7.4	59.3	6.4	-50.2	-0.1	-1.2

only), Goldstar, Greencorp, JVC, Realistic (all), and Visa are supplied with labels already affixed. Labels vary in size and surface, offering a wide range of writing area. I can't take the space to report the details of what I found, but be aware that some labels may be too small for needed notes and/or have a coated surface that is very hard to write on. In general, affixed labels are easier to write on.

Most of the supplied boxes are of good quality, much better than some provided several years ago. Certron and Greencorp had the poorest boxes; the quality of Realistic and Visa boxes was somewhat higher. In general, Fuji, Maxell, Nakamichi, Sony, TDK, and That's supplied the best boxes, with the Denon and JVC boxes very close in quality. I examined the shells very carefully for signs of distorted shape or poor assembly, rating BASF, Denon, Fuji, JVC, Maxell, Nakamichi, Sony, TDK, and That's as having the best shells. Of all the samples provided, I

judged the Sony Metal Master and TDK MA-XG shells to be outstanding.

Most of the cassettes have tactile clues for picking out side A or B. This is very helpful for those with vision problems or when looking is undesirable, as when driving. A single raised dot for side A and a double raised dot for side B are used on all the Greencorp tapes as well as on most tapes from Denon, Maxell, and TDK and on one JVC tape. Raised or engraved letters are used on all the Goldstar, Nakamichi, and Realistic tapes; on most of the Fuji, SKC, and Sony tapes, and on one tape apiece from Certron, Maxell, and Memorex. I congratulate Fuji for including "A" and "B" in Braille on the shell halves of FR Metal; the dot pattern can also be decoded by the sighted. I hope more cassettes will include this information in the future. The triangular window of the That's cassettes also gives good tactile clues.

The great majority of the samples were quiet during fast-winding. The mi-

nor exceptions, still acceptably quiet, were some cassettes from Certron, Goldstar, Memorex, Realistic, SKC, and Visa.

### MEASUREMENTS

The survey presents measurements on each of the 88 tapes in tabular and graphic formats. The Tables summarize selected data. The rectangular graphs of frequency response at Dolby level show flatness, low-frequency compression, and high-frequency headroom (solid curves); the left-hand dashed curve on each of these graphs shows MOL, while the right-hand dashed curve shows SOL. The pie charts illustrate each tape's performance for MOL, SOL, and four additional parameters.

The three Tables list the MOL (3% distortion limit) at 40, 125, and 800 Hz. I selected 40 Hz because it lies in a frequency region important in music for organ and other sources of low-frequency energy. I picked 125 and



800 Hz because this range covers most of the area of generally flat music spectra. Also, most tape/recorder combinations reach their maximum MOLs in the same area.

When I examined the MOL data for all tapes, I determined that all the MOL curves were very similar if I normalized each to its 125-Hz level. The MOL at 125 Hz was a hinge point, as it were, with most MOL curves fairly level between that point and 800 Hz but sloping off much more rapidly below 125 Hz. I should note that some formulations have a noticeable drop in MOL from 800 Hz to 1 kHz: A 1-kHz figure in place of the 800-Hz reading could imply lower mid-band MOLs than actually measured.

The Tables also present SOL data for 2, 4, and 10 kHz. The SOL curves were very similar in shape, particularly within a tape type. When the curves were normalized to 4 kHz, the similarities were even more obvious.

The S/N ratios listed in the Tables are referenced to the MOL at 400 Hz, which is shown in the pie charts. The data for response limits in the Tables shows the frequencies at which output rolls off by 3 dB when recording at Dolby level. The Tables also list modulation noise from a high-level 1-kHz tone. The results given for bias and sensitivity are the averages of the bias and sensitivity values for both sides of all samples.

The Dolby-level response curves sweep from about 19 Hz to a high-frequency point several decibels down, where I terminated the X-Y plotting by lifting the pen. I plotted the curves by hand from previously obtained data for MOL (from 20 Hz to 1 kHz) and for SOL (from 1 to 16 kHz). The falling response and SOL curves become coincident at around 10 kHz. Some small discrepancies may appear in some graphs from hand plotting or because of small plotter shifts, particularly as I lifted the pen. The MOL and SOL curves on the response plots can be used to obtain MOL and SOL figures for frequencies not covered in the Tables. There is a fairly consistent difference between the SOL figures reported here and the 3% TTIM (twin-tone intermodulation) distortion limit I have reported in the past. (Both TTIM and the third-harmonic distortion used for MOL are third-order distortions.) By deducting 4 dB from an SOL figure, you will obtain the TTIM limit within about 2 dB. The actual difference between the 1-kHz saturation output limit (SOL) and the lower, third-order distortion limit (MOL) is shown on every response plot.

The pie charts are similar to those used in my last survey, but I have

made some changes. Three of the six parameters are the same: The 400-Hz MOL ("Low-Freq. MOL"), the -3 dB point at Dolby level ("0-dB Response"), and the A-weighted "S/N." The new parameters are "Smoothness," "Uniformity," and 4-kHz SOL ("High-Frequency SOL").

All of these are self-explanatory except for "Smoothness" and "Uniformity." Since my last survey, I have tried to find better ways of reporting results without being misleading or making things too complicated. My "Smoothness" parameter does not refer to the quality of the tape surface but to various defects which roughen the sound, such as modulation noise, flutter, 3-kHz amplitude variations, and dropouts. "Uniformity" combines ratings for response flatness at -20 dB recording level, 10-kHz skew, deviations in bias and sensitivity from IEC reference, and the variation in bias and sensitivity between samples of a tape.

The angles of the pie segments were selected to correspond to the importance of the parameter. I picked 75° (20.8% of the circle) for 400-Hz MOL and 0-dB response; 60° (16.7%) for 4-kHz SOL, S/N ratio, and smoothness; and 30° (8.3%) for uniformity. In each segment, the shaded area shows the relative performance (in percent) of that tape. The formulas for each parameter are now logarithmic, giving less weight to differences between very good and excellent performance than to those between minimum and acceptable. For example, a 2-dB rise in MOL is given more weight when it increases MOL from 0 dB (Dolby level) to a more useful +2 dB than when it increases MOL from +6 (which is already good) to +8 dB. The total performance figure is the sum of the six parameter percentages, all properly weighted to match their respective contributions (angles).

The numbers within each pie segment represent actual measured performance rather than percentage ratings. In "Low-Freq. MOL," the range from 0 to 100% corresponds to levels from +0.3 to +12 dB. For "0-dB Response," the range is from 4.2 to 15 kHz. The "S/N" range is from 52 to 70 dBA. For "High-Frequency SOL," the range is from 0 to +10 dB. "Smoothness" and "Uniformity" have numerical ratings from 0 to 10 (0 to 100%), where 10 equals perfect performance.

The brief comments on each of the tapes are arranged alphabetically by brand within tape types. Most of these formulations showed good smoothness and very good uniformity, so no details are given on these parameters unless something was particularly good—or bad.

## TYPE I TAPES

Type I tapes can have fairly high MOLs up to 1 kHz or so. Although they do not have high SOLs at the highest frequencies or really extended response at 0 dB, they are nonetheless better than many Type II tapes in these regards. The best-performing Type I tapes, with 400-Hz MOLs of +6 dB or more, have S/N ratios that are a match



for many Type II tapes. The average Type I overall performance rating is 72, and the maximum rating any Type I tape earned was 82%; these tapes' parameter figures (except for smoothness and uniformity) cannot match those of Type IV tapes. Comments on relative performance consider only the 36 Type I tapes, unless stated otherwise.

**BASF Ferro Extra I:** The performance is well balanced among the various parameters, but lower modulation noise and reduced amplitude variation at 3 kHz would be desirable. Overall, a rating of 72%.

**BASF Ferro Super I:** Improved performance over Ferro Extra I was provided in SOLs, S/N ratio, and 0-dB response. Smoothness is better because of lower modulation noise. Overall: 77%, well above average.

**BASF Ferro Maxima I:** Small differences from Ferro Super I can be seen in the Table and the pie charts. Its MOLs and S/N were higher, its SOLs a little lower. Overall: 77%, well above average.

**Certron HD:** The low MOLs are obvious, particularly the -1.8 dB at 40 Hz. Notice that tape saturation below 60 Hz pulled the response curve down. The 59% rating is tied for the lowest for Type I.

**Certron UX:** Its MOLs are better than HD's, but compression is still apparent at the lowest frequencies. Uniformity is also better, helping to bring the overall rating up to 64%, still noticeably lower than the Type I average.

**Chrome Master LX-II:** Compression at the lowest frequencies shows in the response plot. Performance is undistinguished in all parameters. Overall: 61%, rather poor.

**DAK MLX:** The tape had good performance in MOLs, SOLs, S/N, and 0-dB

response. Flutter was lower than with most other cassettes. Overall, a well-above-average rating of 76%.

**Denon DX1:** The response plot shows compression at low frequencies. The uniformity was good, but other parameters were relatively poor, leading to a below-average rating of 66%.

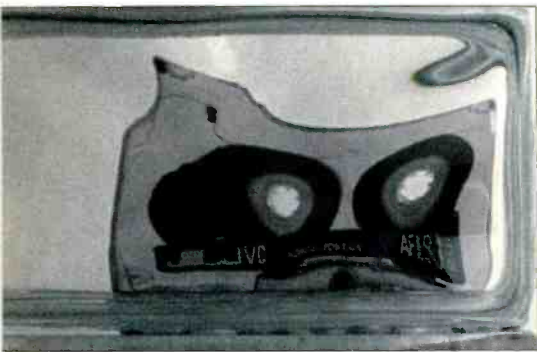
**Denon DX4:** Compared to DX1, this formulation showed very significant improvement in most parameters, particularly MOLs and SOLs. Flutter was lower than with most other tapes. The high rating of 79% is excelled by just five of the other 35 Type I cassettes.

**Fuji DR-I:** Compression at low frequencies shows in the response plot, while amplitude stability at 3 kHz was excellent. Generally below-average results led to a rating of 68%.

**Goldstar HP:** Its 40-Hz MOL, the lowest of these Type I tapes, is related to the very noticeable compression below 60 Hz. Modulation noise was fairly low, but its level varied widely with time. The pie chart calls attention to the 400-Hz MOL and S/N figures, which contribute to the tied-for-worst overall rating of 59%.

**Goldstar HR:** The results were quite good for most parameters, providing a significant improvement over HP. Smoothness was not very good, however, primarily because of the relatively high modulation noise. Overall, the rating is a far-above-average 78%, bettered by only seven Type I tapes.

**Greencorp XDS:** In general, the performance was well balanced. Slight com-



pression appears at the lowest frequencies. The below-average results for most parameters add up to a 68% rating.

**Greencorp Music +:** Improvements over XDS were obtained in MOLs, SOLs, and S/N ratio. Uniformity was slightly lower than with XDS because of the measurable 10-kHz skew. Overall: 72%.

**JVC GI:** Compression at low frequencies is apparent. Low MOLs and S/N, in combination with so-so performance in other areas, result in a rating of 63%.

**Laser XL Plus:** With the exception of good uniformity and low flutter, performance is poor in all areas. The overall

rating earned is 63%, near bottom for Type I cassettes.

**Maxell Frill:** This C-46 tape, marketed to young people, delivers a fairly consistent level of performance. Slight compression showed at the lowest frequencies. Measured flutter was noticeably lower than for most other cassettes. Overall: 72%.

**Maxell UR-F:** Because the Frill and UR-F formulations are basically the same, it was not surprising to see a close match in performance. Flutter was lower than for most other cassettes, and smoothness and uniformity were good. Overall: 73%.

**Maxell UDI:** Performance was good in all areas. Flutter was lower than for most other cassettes. With no weak areas, UDI delivers a high rating of 79%, exceeded by only five other Type I cassettes.

**Maxell XLI-S:** Performance was fine in all areas. Flutter was lower than for many other cassettes, and modulation noise was the lowest of all Type I tapes. The high rating of 80% is surpassed by only two other Type I tapes.

**Memorex dBS:** The low MOLs are reflected in the compression below 60 Hz. The high modulation noise caused a relatively low smoothness rating. Flutter was lower than for many other cassettes, but performance in other areas resulted in a low 65% rating.

**Memorex MRX I:** This formulation delivered small but worthwhile improvements over dBS. The MRX I did have a noticeably lower level of modulation noise, and the compression was less. Flutter was lower than average. Overall: 70%, only slightly below the Type I average.

**Nakamichi EXII:** Good performance was obtained in all areas, as shown in the Table, response plot, and pie chart. Smoothness was slightly low because of some 3-kHz amplitude variations and slight skew. Overall, a far-above-average rating of 78%.

**Realistic Supertape LN:** The performance is fairly well balanced but at a relatively low level. Slight compression is evident at the lowest frequencies. The rating is 66%, below average.

**Realistic Supertape XR:** Performance in most areas was better than that of LN. The virtual elimination of that tape's low-frequency compression is certainly notable. Supertape XR's flutter was lower than that of many other cassettes, but some dropouts approached audibility. Overall: 71%.

**SKC GX:** Performance was average in all areas with the exceptions that S/N was slightly poorer and flutter was slightly better in comparison to other Type I cassettes. Overall: 72%.

**SKC AX:** In comparison to GX, the performance showed worthwhile, albeit

slight, improvements in almost all parameters. The result: AX gets an overall rating of 76%, well above average.

**Sony HF:** Performance was average in most areas. The relatively low MOLs caused slight compression at the lowest frequencies. Overall: 72%.

**Sony HF-S:** The listing in the Table demonstrates how much better this tape's MOL, SOL, and S/N performances were than those of HF. The better results with HF-S are also apparent in the response plot and pie chart. The high overall rating of 80% is bested by only two other Type I tapes.

**TDK D:** Performance was good in most areas. The S/N ratio wasn't impressive, but the modulation noise was low and steady, a desirable attribute. Flutter was lower than for many cassettes. Overall: 76%, well above average.

**TDK AD:** Definite improvements over TDK D appeared in MOLs, 0-dB response, S/N, and SOL. The 10.5-kHz response limit was the best figure obtained for a Type I tape (matched by TDK AR-X). Smoothness was not as good as for D, due to higher modulation noise and slightly deeper dropouts. The high overall rating of 80% is surpassed by just two other Type I tapes.

**TDK AR:** The MOLs were the highest of all 36 Type I cassettes, and performance in other areas was at least good. Modulation noise was fairly low and was steady in level. Flutter was lower than for many other cassettes. The overall rating is a high 81%, surpassed by just one other Type I tape.

**TDK AR-X:** The SOLs were the highest of all 36 Type I tapes, and performance in other areas was at least good. The 10.5-kHz response limit was the best for a Type I tape (matched by TDK AD). Modulation noise was low and steady in level. Flutter was lower than average. The high overall rating of 82% is the highest for all Type I tapes—in fact, it is close to the best for Type II tapes as well.

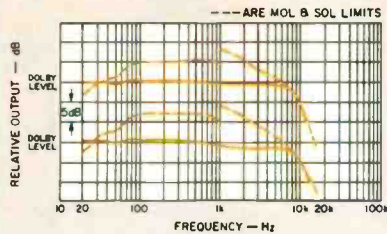
**That's CD:** In general, performance was good in all areas. Just slight compression appeared at the lowest frequencies. Modulation noise was low and steady in level, helping to make smoothness very good, the best for all Type I tapes. Overall: 78%, far above average.

**Visa High Performance I:** The MOLs were somewhat low, and low-frequency compression was obvious. Modulation noise was somewhat high and minor dropouts were frequent, leading to a smoothness rating that is poorer than average. Flutter was lower than for many other cassettes. Overall, a well-below-average rating of 67%.

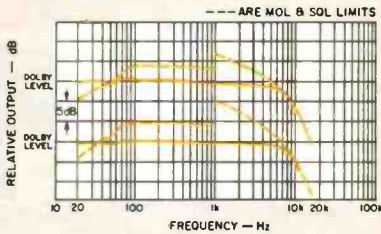
**Visa Superferro UFX I:** The higher MOLs of this formulation reduced the

# TYPE II

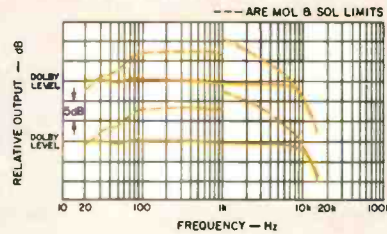
*BASF Chrome Extra II (top) and Chrome Maxima II*



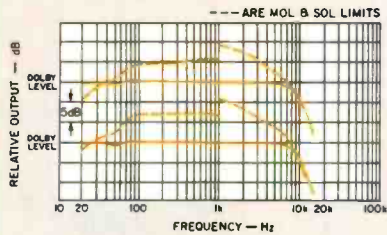
*DAK MLX<sup>2</sup> (top) and Denon HD6*



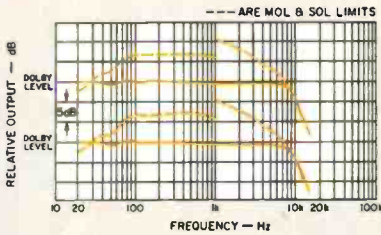
*Denon HD7 (top) and HD8*



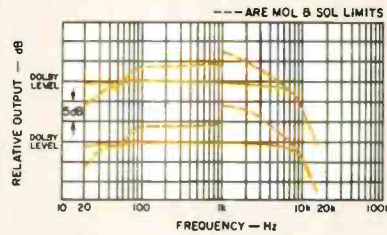
*Fuji DR-II (top) and FR-IIx*



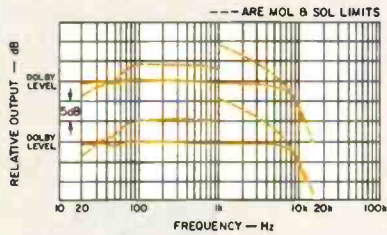
*Fuji FR-IIx PRO (top) and Goldstar CRX*



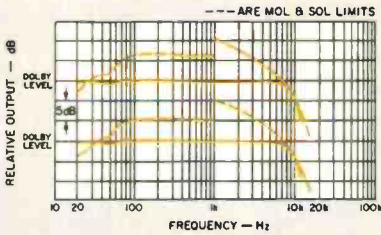
*Greencorp CR (top) and JVC AFlI*



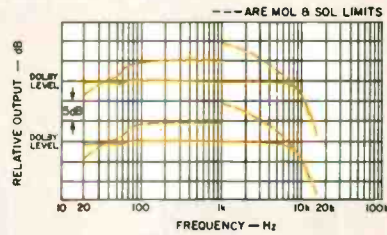
*Maxell Capsule II (top) and UDX-II*



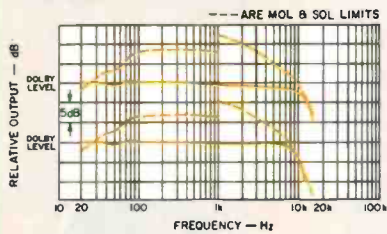
*Maxell UDII (top) and XLII*



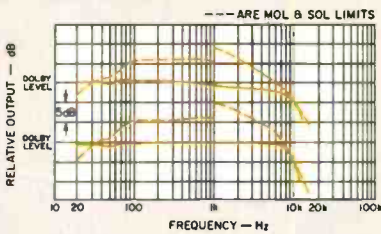
*Maxell XII-S (top) and Memorex HBS II*



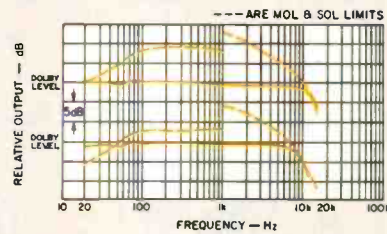
*Memorex CDX II (top) and Nakamichi SX*



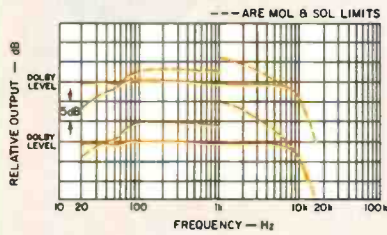
*Nakamichi SXII (top) and Realistic Supertape HD*



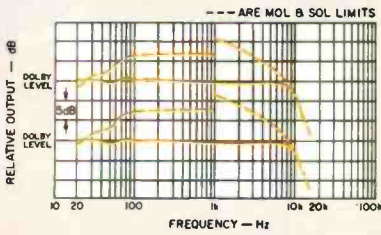
*Realistic Supertape MII (top) and SKC QX*



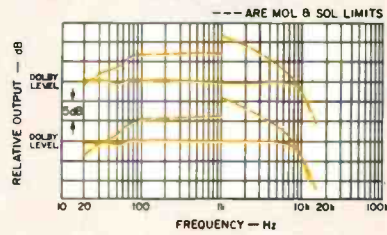
*SKC CD (top) and Sony UX*



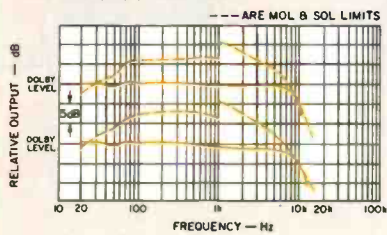
*Sony UX-S (top) and UX-ES*



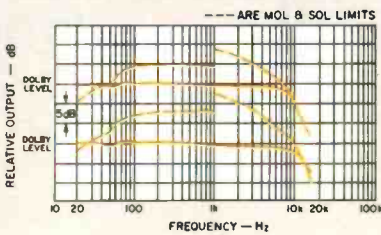
*Sony UX-Pro (top) and TDK SD*



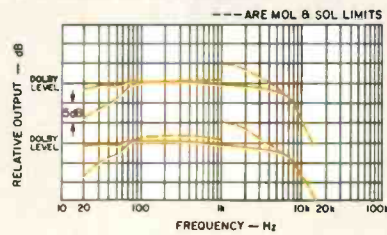
*TDK SA (top) and SA-X*



*That's CD-II (top) and CD-MH*

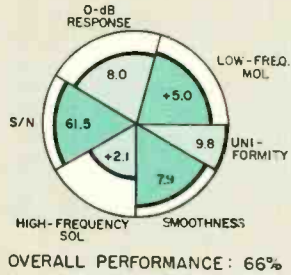


*Visa Chromdioxid CX II (top) and Superchrom UCX II-S*

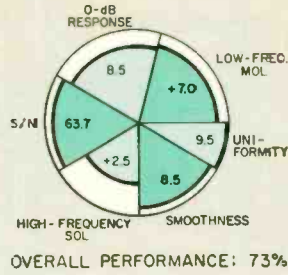


# TYPE II

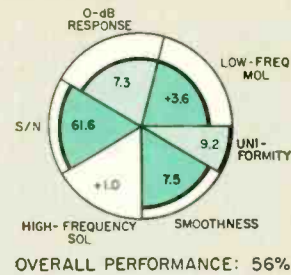
**BASF Chrome Extra II**



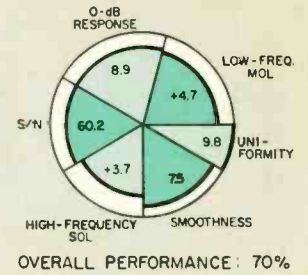
**BASF Chrome Maxima II**



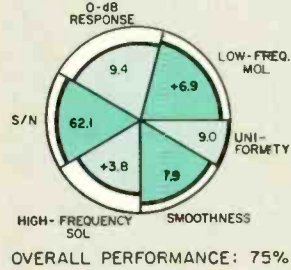
**DAK MLX<sup>2</sup>**



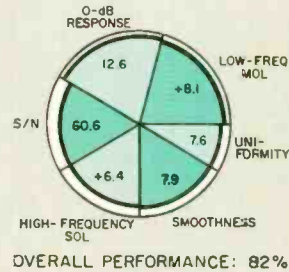
**Denon HD6**



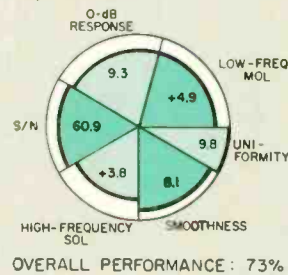
**Denon HD7**



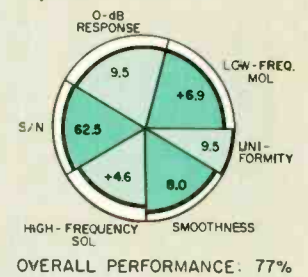
**Denon HD8**



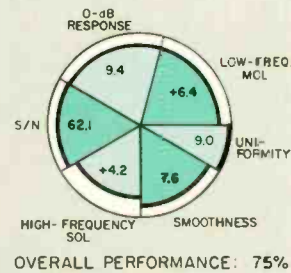
**Fuji DR-II**



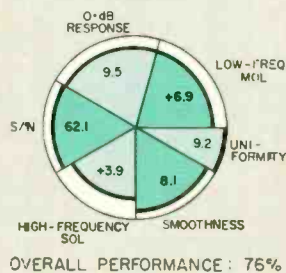
**Fuji FR-IIx**



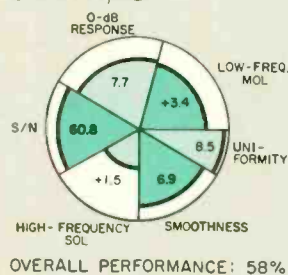
**Fuji FR-IIx PRO**



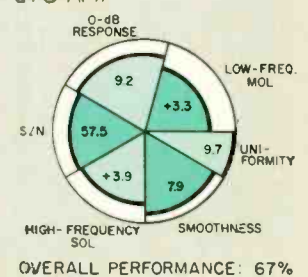
**Goldstar CRX**



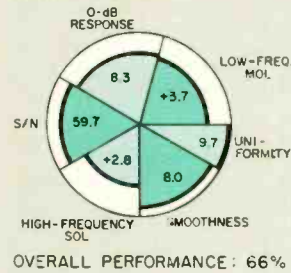
**Greencorp CR**



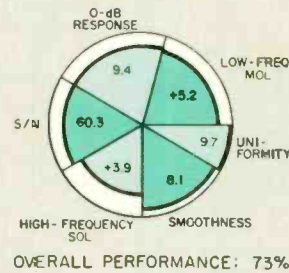
**JVC AFII**



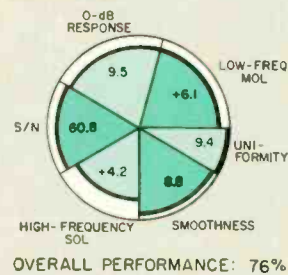
**Maxell Capsule II**



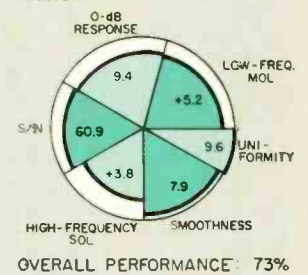
**Maxell UDX-II**



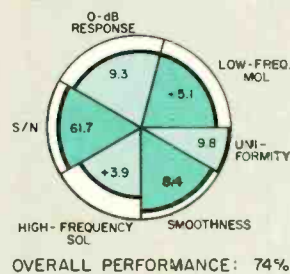
**Maxell UDII**



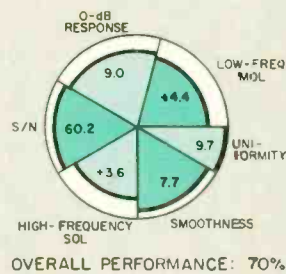
**Maxell XLII**



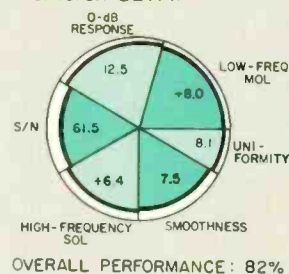
**Maxell XLII-S**



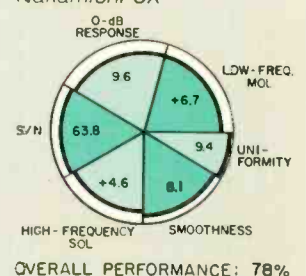
**Memorex HBS II**



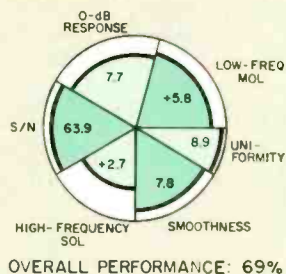
**Memorex CDX II**



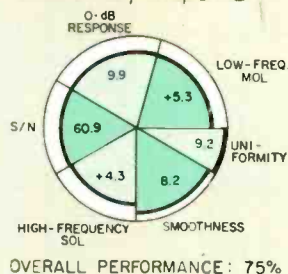
**Nakamichi SX**



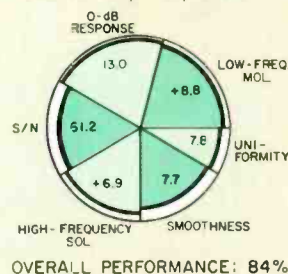
*Nakamichi SXII*



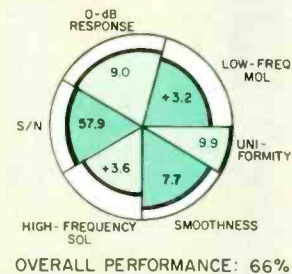
*Realistic Supertape HD*



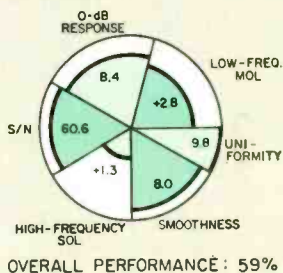
*Realistic Supertape MII*



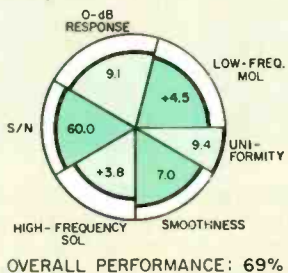
*SKC QX*



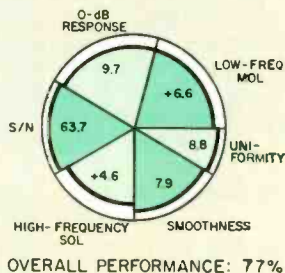
*SKC CD*



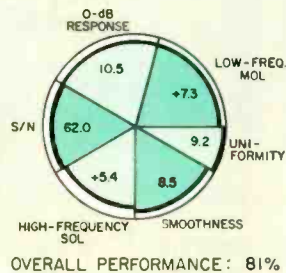
*Sony UX*



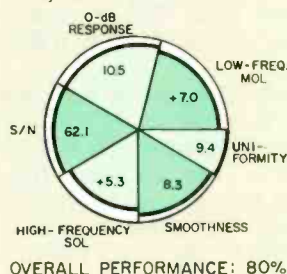
*Sony UX-S*



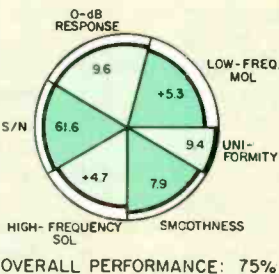
*Sony UX-ES*



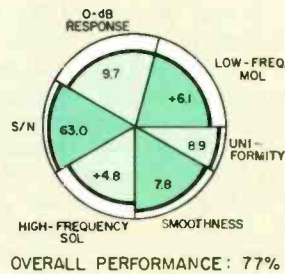
*Sony UX-Pro*



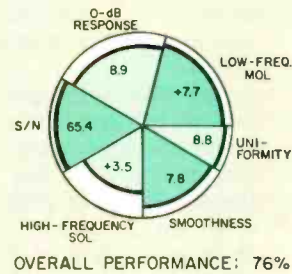
*TDK SD*



*TDK SA*



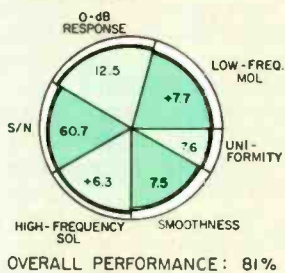
*TDK SA-X*



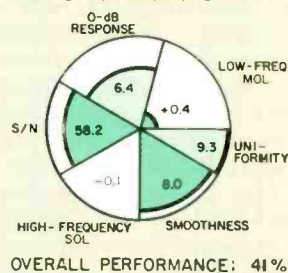
*That's CD-II*



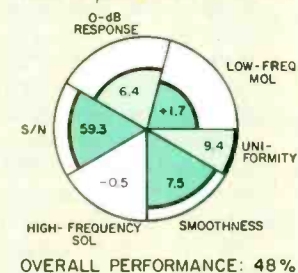
*That's CD-MH*



*Visa Chromdioxid CX II*



*Visa Superchrom UCX II-S*



low-frequency compression. Modulation noise was high and minor drop-outs were rather common, making for a poor smoothness rating. The below-average overall rating of 68% is the net result.

**TYPE II TAPES**

Many Type II tapes have relatively low SOLs at the higher frequencies, but they usually have higher S/N ratios than Type I formulations. Most Type II tapes also have poorer 0-dB response than the Type I tapes. The fundamental

reasons for all three characteristics are that the greater high-frequency boost in record equalization used with Type II tapes increases the high-frequency saturation (causing poorer SOL and response), while the complementary equalization used in playback results in greater reduction of tape noise (causing better S/N) than with Type I tapes. The average Type II overall rating is 71%. The maximum rating any Type II tape earned was 84%, and Type II tapes' parameter figures (particularly those for 400-Hz MOL, S/N

ratio, and 4-kHz SOL) cannot match those for Type IV tapes. Comments on relative performance consider only the 36 Type II cassettes, unless stated otherwise. **BASF Chrome Extra II:** Its moderate MOLs were reflected in slight compression at the lowest frequencies. Low SOLs and somewhat restricted 0-dB response contribute further to its below-average rating of 66%. **BASF Chrome Maxima II:** This formulation was better than Chrome Extra II in MOLs, 0-dB response, S/N, and modu-

Tape	Maximum Output Level (dB, re: 400-Hz Dolby Level)						S/N Ratio (dBA)	Response Limit (-3 dB) at Dolby Level (kHz)	Mod. Noise (dB)	Bias (dB)	Sens. (dB)
	HDL <sub>3</sub> = 3%			SOL							
	40	125	800	2k	4k	10k					
BASF Metal Maxima IV	+0.4	+5.5	+6.1	+9.9	+7.7	-1.0	58.9	11.0	-48.2	+2.9	-4.4
Denon HD-M	+2.4	+7.9	+9.0	+10.8	+8.0	0.0	63.3	12.4	-51.8	+0.6	0.0
Fuji FR Metal	+6.1	+10.8	+11.3	+12.0	+8.6	+0.1	66.2	12.5	-49.3	+0.9	+1.1
Goldstar MT	+3.0	+8.1	+9.8	+11.1	+7.8	-0.2	64.4	11.7	-52.2	+0.3	+0.8
JVC AFIV	+2.4	+7.9	+9.1	+11.2	+8.1	-0.2	63.6	12.1	-53.4	+1.1	+0.2
Maxell MX	+3.1	+7.9	+8.9	+10.9	+7.5	-0.5	63.4	11.8	-53.2	+0.9	+0.3
Nakamichi ZX	+4.5	+9.6	+11.4	+12.1	+8.8	0.0	65.0	12.1	-52.1	+0.8	+1.1
Realistic Supertape MIV	+4.5	+9.1	+10.2	+11.7	+8.6	0.0	63.6	12.1	-51.0	+1.0	+0.6
SKC ZX	+3.0	+7.5	+9.5	+11.0	+7.8	-0.7	64.1	11.7	-52.6	+0.7	+0.3
Sony Metal-SR	+3.7	+8.7	+9.8	+11.2	+8.2	-0.1	64.7	12.2	-52.6	+0.1	+0.9
Sony Metal-ES	+5.7	+10.7	+11.4	+12.0	+8.1	0.0	67.0	12.4	-52.0	+2.2	+0.8
Sony Metal Master	+5.1	+10.0	+11.0	+11.8	+7.8	-0.2	66.9	11.4	-52.9	+2.1	+0.8
TDK MA	+2.9	+8.0	+10.0	+11.7	+8.6	-0.6	64.0	11.6	-50.1	+1.0	+0.5
TDK MA-X	+4.2	+9.0	+10.8	+11.8	+8.7	0.0	64.7	12.1	-52.4	+0.1	+1.2
TDK MA-XG	+4.9	+9.9	+11.3	+12.2	+8.9	+0.6	65.0	12.7	-54.2	+0.8	+1.2
That's CD-IV	+4.2	+8.7	+10.1	+11.4	+8.4	-0.1	64.9	12.1	-51.7	+1.5	+0.5

lation noise, although SOLs remained low. Overall: 73%.

**DAK MLX<sup>2</sup>:** Performance is limited in substantially all areas, especially with low MOLs and SOLs and poor 0-dB response. Flutter was erratic—sometimes quite low, sometimes higher than average. Overall, a rather poor rating of 56%.

**Denon HD6:** Moderate MOLs resulted in slight compression at the lowest frequencies. Performance in other areas was generally average. Overall: 70%.

**Denon HD7:** Improvements over HD6 emerged in substantially all areas. Modulation noise was fairly low and steady in level. Dropouts were low in value and merely occasional—one of the better results. Overall: 75%.

**Denon HD8:** This unusual formulation provided a balanced, good performance—particularly evident when its pie chart is compared to others. The 0-dB response was second best for Type IIs and Type IVs. The uniformity rating was low because of the very high sensitivity and a response peak near 20 kHz at -20 dB record/playback level. The high overall rating is 82%, exceeded by just one other Type II cassette in this survey.

**Fuji DR-II:** The performance was fairly well balanced, though not impressive. Somewhat low MOLs caused some compression at the lowest frequencies. Flutter was low; indeed, it was among the best for all tapes covered in this survey. Overall: 73%.

**Fuji FR-IIx:** Worthwhile improvements were shown over DR-II in higher MOLs and SOLs, better 0-dB response, and higher S/N ratio. Modulation noise was fairly low and very steady in level. Overall: 77%, well above average.

**Fuji FR-IIx PRO:** This tape is very close to FR-IIx magnetically, and the two

tapes' performances differed very little. The FR-IIx PRO produced slightly higher modulation noise, but it was steady in level. The small differences led to a slightly lower rating of 75%—still above average.

**Goldstar CRX:** Performance was fairly well balanced, with the exception of the relatively low SOL rating, characteristic of many Type II tapes. The modulation noise was low and steady in level. Overall: 76%.

**Greencorp CR:** Low MOLs caused compression at the lowest frequencies, SOLs were quite low, and the 0-dB response was among the more limited ones. The tape did not get a high smoothness rating because it had more dropouts than average and occasional high flutter. High skew affected the uniformity rating. The overall rating is a rather poor 58%.

**JVC AFII:** The low MOLs caused obvious compression below 60 Hz. S/N ratio was the poorest for a Type II tape, yet flutter was better than for many other cassettes. Overall: 67%.

**Maxell Capsule II:** In most areas, the performance was just a bit below average. Compression occurred at the lowest frequencies because of the low MOLs. Modulation noise was fairly low and steady in level. Flutter was one of the lowest for all tapes. Overall: 66%.

**Maxell UDX-II:** This formulation had higher MOLs and SOLs, more extended 0-dB response, and lower modulation noise than Capsule II. Flutter was just average, however. The net result is a just-above-average overall performance rating of 73%.

**Maxell UDII:** Moving up a notch in Maxell's line brought further improvements in all major parameters. Uniformity was slightly lower because of high sensitivity. Dropouts were low in value

and just occasional; UDII is one of the best formulations in this regard. Overall, an above-average rating of 76%.

**Maxell XLI:** The results were a lot like those for UDX-II. For most parameters, there was very little reason to prefer one over the other. The modulation noise was fairly low and steady in level. Overall: 73%.

**Maxell XLII-S:** The results were also very close to those for UDX-II. The XLII-S delivered a higher S/N ratio, always beneficial. The modulation noise was low and steady in value; dropouts were few and minor. Overall: 74%.

**Memorex HBS II:** The MOLs were low enough to cause compression at lower frequencies, and SOLs were somewhat low. Other results were average. Overall: 70%.

**Memorex CDX II:** High MOLs and SOLs delivered uncommon and desirable performance for a Type II tape. The 0-dB response is well extended and bettered by only three out of all 88 tapes. Higher bias requirements and sensitivity than in the IEC reference tape reduce the uniformity rating. The high overall rating of 82% is bettered by only one Type II tape.

**Nakamichi SX:** MOLs and SOLs are good, and S/N is better than most. Modulation noise is fairly low and has a steady level. The combination earns an overall rating of 78%, one of the better scores for Type II tapes.

**Nakamichi SXII:** The S/N ratio is almost the same as for SX, but everything else is poorer. The reduction in 0-dB response and SOL levels is most obvious. The overall rating is 69%, slightly lower than average for Type IIs.

**Realistic Supertape HD:** Performance is generally above average, but low MOLs cause some compression at the lowest frequencies. The 0-dB re-

sponse is quite good, and the modulation noise low. Overall: 75%.

**Realistic Supertape MII:** I wouldn't have thought of Radio Shack as the source of the formulation with the highest Type II MOLs and SOLs, but it's true! The 0-dB response was the most extended of all tapes, including Type IVs. Modulation noise was not particularly low, but it was steady. Uniformity was reduced by high bias, high sensitivity, and a response peak near 20 kHz at -20 dB. The overall rating is 84%, the best for all Type I and II tapes.

**SKC QX:** Low MOLs are reflected in the noticeable compression below 60 Hz. Most of the other results were below average. Overall: 66%.

**SKC CD:** Lower MOLs and SOLs in comparison to QX were not expected, but the pie charts emphasize the difference. Compression at the lowest frequencies, however, was actually less. Modulation noise was steady and fairly low, and dropouts were minimal. Overall: 59%.

**Sony UX:** The lowest ranked sample of Sony's Type II line showed compression effects at low frequencies from the low MOLs. The SOLs, while relatively better, were just average. Smoothness was not very good because of high modulation noise and many small dropouts. Overall: 69%.

**Sony UX-S:** Improvements over UX in MOLs, SOLs, 0-dB response, and S/N made this tape much more impressive. Smoothness was better because of lower modulation noise and very few dropouts. Overall, a good performance rating of 77%.

**Sony UX-ES:** This formulation gave still better performance in MOLs, SOLs, 0-dB response, modulation noise, uniformity, and overall smoothness. The S/N ratio was a bit poorer than for UX. The high overall rating was 81%, exceeded by only three Type II tapes.

**Sony UX-Pro:** Because this formulation and UX-ES are substantially the same, it is not surprising that their performances matched. Small differences in a couple of the figures dropped UX-Pro's rating 1%, but it's still a high 80%.

**TDK SD:** The MOLs were rather low at the lowest frequencies, and compression appears in the response plot. Other parameters were average or above. Modulation noise was steady. Overall, a 75% rating.

**TDK SA:** Moving up one position in the TDK Type II line secures some improvement in MOLs and a worthwhile increase in S/N ratio. Uniformity was slightly less because of high sensitivity. The net result was a higher overall rating of 77%, which is good.

**TDK SA-X:** This tape provided high MOLs and a high S/N ratio—the high-

est for Type I and II tapes. In fact, S/N is higher than for many Type IV tapes.

The SOL and 0-dB response results, however, were not as good. This tape's overall rating is 76%.

**That's CD-II:** The low MOLs caused compression at low frequencies, and the SOLs were just fair. Other parameters were average or slightly above. Overall: 71%.

**That's CD-MH:** This Type II formulation had significantly better MOLs, SOLs, and 0-dB response than CD-II. Its S/N ratio, however, was slightly lower and its modulation noise about 2 dB higher. The uniformity rating was also noticeably lower because of higher bias requirements and sensitivity than the IEC reference, and a response peak near 20 kHz at -20 dB. Even so, CD-MH's overall rating is a high 81%, surpassed by just three other Type II tapes.

**Visa Chromdioxid CX II:** Very poor MOLs caused obvious compression below 70 Hz. SOLs were also very low; in fact, the 4-kHz SOL was so low that no shading appears on the pie chart. The 0-dB response was the poorest for all 88 tapes, matched only by the other Visa tape. Overall: 41%, lowest in the survey.

**Visa Superchrom UCX II-S:** This Visa formulation showed slightly improved MOLs and a 1-dB increase in S/N ratio. Low-frequency compression was reduced, but modulation noise was actually higher. Although flutter was on the low side, smoothness was affected negatively by poor dropout performance. The overall rating was 48%, second lowest of all tapes.

#### TYPE IV TAPES

The better metal-particle Type IV tapes stand out as the best overall performers, primarily because of their very high MOLs and reduced high-frequency saturation (which yields greater response extension at 0 dB). Signal-to-noise ratios have been improved since Type IV tapes first appeared, which has increased their advantage even more. With the proliferation of CDs as sources, both at home and via broadcast, performance at the high-frequency end has become more critical. Thus, metal-particle tapes are of ever greater interest to the serious recordist. The average Type IV overall rating is 88%; the highest is 92%. My comments on relative performance consider only these 16 tapes, unless stated otherwise.

**BASF Metal Maxima IV:** The C-120 length of this cassette does offer some possible advantages. I had difficulty, however, setting bias for a flat response at -20 dB. Even with close-to-maximum bias from the deck, the response was up 5.3 dB at 10 kHz and

up 9 dB at 20 kHz. Lower frequencies were very much overbiased. The 0-dB response shows evidence of the high-frequency peaking. Tests on other decks confirmed the excessive output at higher frequencies with any normal amount of bias. Relatively low MOLs and S/N, along with poor uniformity, resulted in poor overall performance. Uniformity was low because of very high bias and very low sensitivity. Flut-



ter was lower than for most other tapes. Overall, a 76% rating, lowest for Type IV tapes.

**Denon HD-M:** High MOLs and SOLs, extended response, and good S/N characterize this average Type IV tape. Modulation noise was fairly low and smooth in character. Overall: 86%.

**Fuji FR Metal:** Very high MOLs and SOLs, the third-best S/N, and extended 0-dB response make for one of the best Type IV tapes. The smoothness suffered a bit from the relatively high modulation noise. Overall, a tied-for-third rating of 90%.

**Goldstar MT:** High MOLs and SOLs and a good S/N are among the desirable properties shown. The modulation noise was low and steady, but smoothness suffered from somewhat high flutter and some dropouts. Overall: 86%.

**JVC AFIV:** High MOLs and SOLs, extended 0-dB response, and low modulation noise are features of this Type IV tape. Smoothness was helped by low flutter but was hurt more by some dropouts. Overall: 86%.

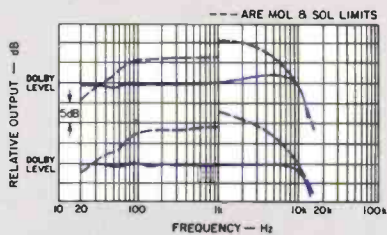
**Maxell MX:** The high MOLs and SOLs were typical for Type IV tapes. Modulation noise was low and steady and flutter was quite low, both contributing to a good smoothness rating and the overall rating of 87%.

**Nakamichi ZX:** Very high MOLs and SOLs, good 0-dB response, and a high S/N ratio made a good combination. The modulation noise was low and steady, but minor dropouts appeared occasionally. Overall, a tied-for-third rating of 90%.

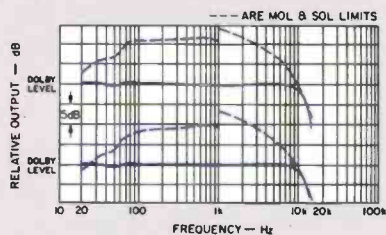
**Realistic Supertape MIV:** The nice, high MOLs and SOLs and a well-extended response are above average for Type IV tapes. The S/N ratio is quite good and the modulation noise

## TYPE IV

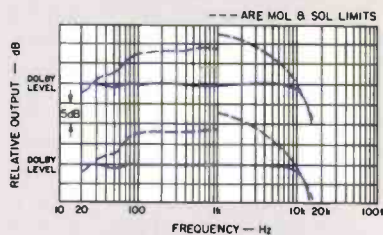
*BASF Metal Maxima IV (top)  
and Denon HD-M*



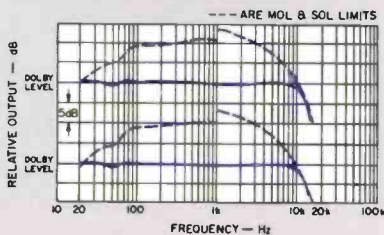
*Fuji FR Metal (top) and Goldstar MT*



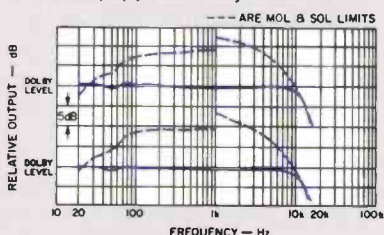
*JVC AFIV (top) and Maxell MX*



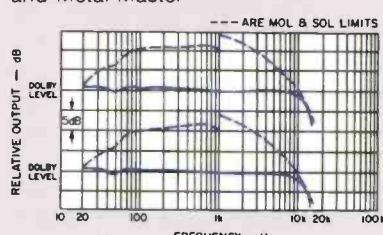
*Nakamichi ZX (top)  
and Realistic Supertape MIV*



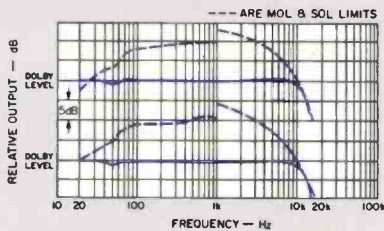
*SKC ZX (top) and Sony Metal-SR*



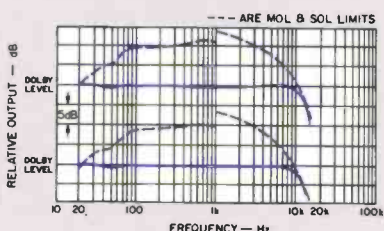
*Sony Metal-ES (top)  
and Metal Master*



*TDK MA (top) and MA-X*



*TDK MA-XG (top) and That's CD-IV*



smooth, albeit not very low. Overall, a rating of 89%.

**SKC ZX:** MOLs and SOLs were fairly high but below average for metal-particle tapes. The 0-dB response was not as extended as for many Type IVs. The S/N ratio was good and the modulation noise low and steady. High flutter and poor dropout performance, however, caused a low smoothness rating. Overall: 84%.

**Sony Metal-SR:** The high ratings for MOLs and SOLs were a bit of a surprise for a tape introduced as a low-cost option. The S/N ratio and 0-dB response were also good, and modulation noise was low and steady. Overall, a rating of 89%.

**Sony Metal-ES:** Very high MOLs and SOLs combine with the best S/N ratio and a well-extended 0-dB response to make a very well-performing tape. Low and steady modulation noise and below-average flutter are additional pluses. Overall, Metal-ES receives a next-to-best rating of 91%.

**Sony Metal Master:** I expected the same performance as with Metal-ES, but I got very slightly poorer MOLs and SOLs—still very high. The S/N ratio was within 0.1 dB. The 0-dB response

was not as extended (by 1 kHz), but modulation noise was slightly lower. Overall, the performance rating dropped 1%, to 90%, tying this tape for third best.

**TDK MA:** Quite high MOLs and very high SOLs make a good combination, but the 0-dB response is not well extended for a Type IV tape. Relatively high, if steady, modulation noise lowered the smoothness rating. Overall, its rating is 87%.

**TDK MA-X:** Quite high MOLs and very high SOLs are combined with good response. The S/N ratio is improved over MA; modulation noise is lower, and also steady. Overall, tied for third at 90%.

**TDK MA-XG:** Very high MOLs and the best SOLs make a potent combination, especially with the addition of a good S/N ratio and the most extended response of all Type IV tapes. Modulation noise was also one of the lowest measured, and it was steady in level. Flutter was lower than for most tapes. Overall, at 92%, the best of all 88 tapes.

**That's CD-IV:** MOLs and SOLs were quite high, and the response extension and S/N ratio were both rather good.

With one of the tested samples, flutter was very low; it was average for the others. Overall: 89%.

### RATING THE RESULTS

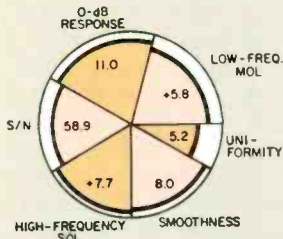
When I selected the six parameters and chose all of the various modifying factors, I certainly believed Type IV tapes would have the highest ratings. I thought Type II tapes might edge out the Type I tapes, primarily because of their higher signal-to-noise ratios. In fact, the average overall performance figure was 72% for Type Is and 71% for Type IIs, substantially the same. This is an unimportant difference, to be sure, particularly compared to the 88% figure for the average Type IV. The Type I tapes were generally superior to the Type IIs in 400-Hz MOL, 0-dB response, and 4-kHz SOL. The Type IIs were usually superior to Type Is in signal-to-noise ratio and modulation noise. The Type IVs were superior to both other types in all of the above areas most of the time. Keep in mind that these comparisons are of the average results for each tape type. In deciding what tapes you should use, comparisons must still be made between specific tapes.

Do the high-rated formulations sound better on decks other than the Nakamichi 582? I compared the above results (for quite a few tapes) with results obtained using the Nakamichi CR-7A, Akai GX-R99, and Kenwood KX-660HX decks. There were differences from deck to deck, such as noticeably lower MOLs and SOLs and



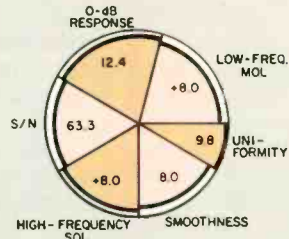
# TYPE IV

*BASF Metal Maxima IV*



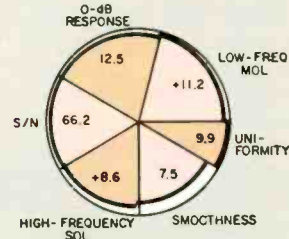
OVERALL PERFORMANCE: 76%

*Denon HD-M*



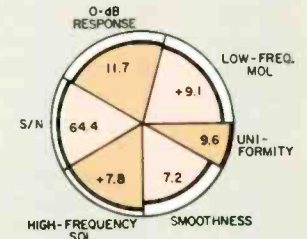
OVERALL PERFORMANCE: 86%

*Fuji FR Metal*



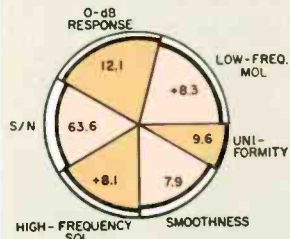
OVERALL PERFORMANCE: 90%

*Goldstar MT*



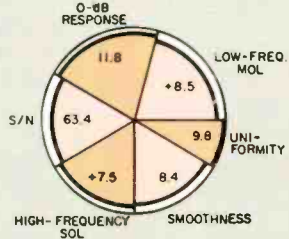
OVERALL PERFORMANCE: 86%

*JVC AFIV*



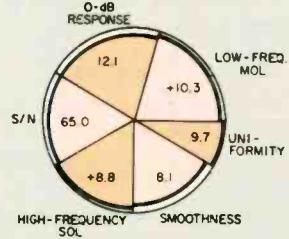
OVERALL PERFORMANCE: 86%

*Maxell MX*



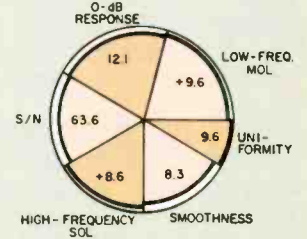
OVERALL PERFORMANCE: 87%

*Nakamichi ZX*



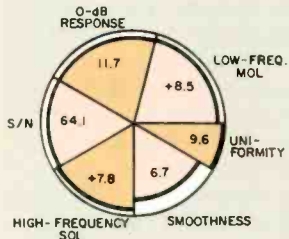
OVERALL PERFORMANCE: 90%

*Realistic Supertape MIV*



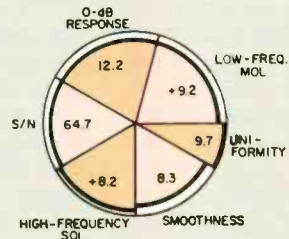
OVERALL PERFORMANCE: 89%

*SKC ZX*



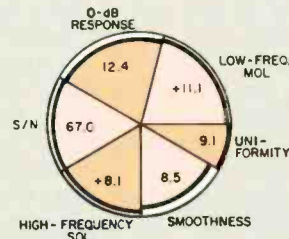
OVERALL PERFORMANCE: 84%

*Sony Metal-SR*



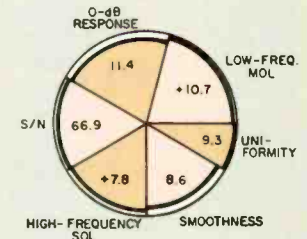
OVERALL PERFORMANCE: 89%

*Sony Metal-ES*



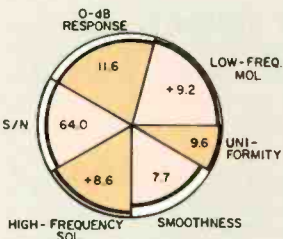
OVERALL PERFORMANCE: 91%

*Sony Metal Master*



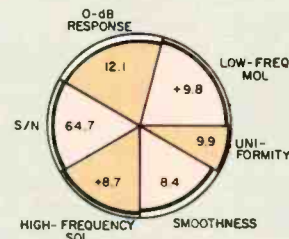
OVERALL PERFORMANCE: 90%

*TDK MA*



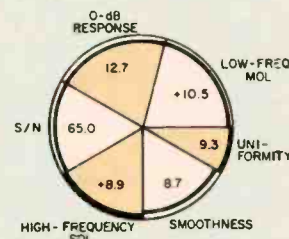
OVERALL PERFORMANCE: 87%

*TDK MA-X*



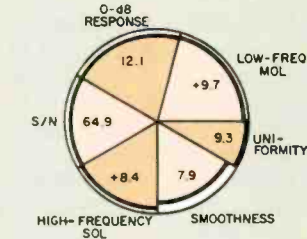
OVERALL PERFORMANCE: 90%

*TDK MA-XG*



OVERALL PERFORMANCE: 92%

*That's CD-IV*



OVERALL PERFORMANCE: 89%

less extended responses on the Akai (and even more so on the Kenwood). The response rises near 20 kHz were nearly the same on the CR-7A as on the Nakamichi 582 that I used for the main tests, but they were lower on the Akai and lower still on the Kenwood. Skew was less on the Akai (whose record and playback heads share a single housing) and was not a factor on the two-head Kenwood. (Low-skew cassettes should be of interest, however, to anyone who records on one deck and plays back on another.)

Despite these differences, the relative rankings of the tapes remained the

same, within a small margin of error, on all decks. Based on some of the results, one tape should not be chosen over another just because of a 1% or 2% performance difference. Also, the ratings were based solely on measured performance, ignoring price and the convenience or apparent quality of the boxes, labels, and shells. I was unable to measure some of the claimed advantages of certain shells, such as reduced vibration.

I do recommend a careful review of the data if a change in tape is considered. Give particular thought to the type of music to be recorded. Tapes

that showed compression at the lowest frequencies would be bad choices in general but particularly so for organ music and disco (to say nothing of cannon shots). Recording with dbx NR will be most successful if the tape has no such compression. Music with obvious cymbal crashes, synthesizers, etc. will not record well on Type II tapes that have poor SOLs unless the recording level is kept low. This would be possible with those formulations whose low noise permits reducing the level with little compromise (see "How Hot Are CDs?" July 1989). Type IV tapes, with their superior performance, do

yield recordings that are better and easier to make.

My own approach to setting record levels is to make them as high as I can without causing any distortion detectable by careful listening. I know some recordists prefer to approach the problem by setting levels to get the softest passages above the noise level. My own experience is that it's more difficult to find the softest section than the loudest. It is also quite possible that levels set for the softest passages will be too high for the peaks. The majority of critical listeners I know comment on sonic problems caused by high levels, such as harshness, brittleness, and muddiness. Little is said, in general, when the S/N ratio is not quite what is wanted in a quiet passage.

### FURTHER CHECKS

To get a better sense of what would happen when using lower priced decks that do not have adjustable bias, I made record/playback responses with the Kenwood KX-660HX, Teac V-500X, and Technics RS-B48R decks. I left the Kenwood's bias trim pot in its center detent; the other two decks do not have front-panel bias adjustments. All decks were operated with Dolby C NR to intentionally exaggerate any discrepancies in bias and/or sensitivity between the deck settings and the needs of the selected tapes. I picked tapes of each type that fell into three groups—those with just about the same bias and sensitivity as the IEC reference for their type, those with close-to-reference sensitivity but a 1-dB greater bias requirement, and those with high bias requirements and sensitivity as compared to the IEC reference. The selected tapes were TDK D, Greencorp CR, and Denon HD-M for the first group; That's CD, BASF Chrome Extra II, and Maxell MX for the second group; and TDK AR-X, Memorex CDX II, and Sony Metal-ES for the third group.

The TDK D was an excellent match for the Kenwood deck, but That's CD was not, and the TDK AR-X had excessive boost at the highest frequencies (even at high levels). Greencorp CR and Maxell MX were the best matches for the Kenwood among the Type II and IV tapes, and the other tapes were reasonably good with the Kenwood deck. The Teac V-500X was quite good with TDK AR-X but had terrible droop with TDK D. All the Type II tapes rolled off to some extent on the Teac, but Sony Metal-ES was a good tape for this deck. The Technics deck had good response with TDK D, excessive high-frequency boost with That's CD, and enormous boost with TDK AR-X. Greencorp CR's response was nice

and flat on this deck, and Memorex CDX II had excessive boost—which was no surprise, considering its high bias requirement. All Type IV tapes exhibited treble boost with this deck, and I noted fantastic boost with Sony Metal-ES. So even on inexpensive decks, these bias and sensitivity differences may cause response deviations, which Dolby C NR would usually exaggerate. A play-trim control designed to Dolby Labs' requirements can eliminate this exaggeration.

The C-90 length was the de facto standard for all the main evaluations, but I wondered what the results would be if one of the new lengths was used. To check this, I tried tapes in the C-75 range (including some C-74 and C-76 cassettes), as well as C-100 and C-110 tapes, from Denon, Fuji, Goldstar, Maxell, Memorex, Sony, TDK, and That's. I also checked BASF Chrome Extra II in C-120, though this is not really a new length.

I ran my bias and sensitivity checks for these tape lengths at the same time I tested the C-90s, to make sure of consistent results when comparing lengths. I also checked to see if the new-length samples had the same skew. In the majority of cases there was, fortunately, very little difference in bias, sensitivity, or skew between different lengths of the same tape. Most of the tapes were very close to each other, including Denon HD6 and HD-M (C-75s and C-100s) and HD8 (C-100); Fuji FR-IIx PRO (C-74); Maxell XLII, XLII-S, and MX (C-100s); Memorex HBS II (C-76 and C-100); Sony Metal-SR (C-100); TDK SA (C-76 and C-100) and MA in the C-110 length (actually an exact match to the C-90 version's bias, sensitivity, and skew); and the C-74 lengths of That's CD-II, CD-MH, and CD-IV. Goldstar's CRX tapes were rather puzzling, as the C-76s had higher bias and much lower sensitivity than the C-90s, while the C-100s had much lower bias. Denon's HD8 in C-75 had somewhat higher bias and lower sensitivity than in C-90.

I also compared the new lengths to the C-90s for 125-Hz MOL, 4-kHz SOL, and 0-dB response. In general, little or nothing was lost by using a new length; in some cases, slight improvements accrued. Most of the C-100s did show a small loss in 125-Hz MOL. Goldstar CRX in C-75 and C-100 lengths had noticeable losses in performance for all parameters, making me wonder if the new-length cassettes were really the same actual formulation as the C-90s. The Maxell XLII, XLII-S, and MX in C-100s, and That's CD-II in C-74 and C-100, had greater 4-kHz SOLs and slightly better 0-dB responses. The response of TDK MA in C-110

improved by 1 kHz. In C-74, That's CD-IV had higher 125-Hz MOL and slightly better 0-dB response.

I wondered what the so-called real-time counters on my decks would show with the new lengths and therefore used some of these tapes on the Nakamichi CR-7A, the Akai GX-R99, and the Kenwood KX-660HX. The first two decks display both elapsed and remaining time, and the Kenwood displays just elapsed time; all three retain basic time calibrations during fast-winds. Many counters that show elapsed or remaining time require the user to select a setting for the particular length, so I set the Nakamichi and Akai decks for C-90 tapes. The Nakamichi showed 46 to 47 minutes remaining at the start of play after the initial calibration for all new lengths, from C-74 to C-110. At the end of each tape, the deck displayed about 47 minutes elapsed, with the exception of 39:13 for the C-75 tape. The Akai showed remaining times of from 35:30 to 39:10 for the C-74 to C-76 tapes, 45:03 for C-100, and 50:34 for C-110—not always right, but much closer than the results I got with the Nakamichi. The elapsed times were slightly high for the C-74 to C-76 tapes and correct for the C-100 and C-110 tapes. The elapsed times for the Kenwood were close to correct for all tape lengths. For those who like using real-time counters, as I do, a warning: Be careful about what the counter displays with a new length. Some counters are apt to suddenly recalibrate themselves at unexpected points along the new-length tapes.

### FINAL THOUGHTS

Cassette tapes continue to improve, and new distributors and manufacturers offer us more and more choices. Under many circumstances, a high-ranked tape used on a high-quality deck with Dolby C or dbx NR can approach the sound of a Compact Disc. We all observe DAT players and recorders starting to become more common. The recordable CD is about here, maybe. Are cassettes here to stay?

Dolby Laboratories has recently announced the Dolby S-type recording system, specifically designed to utilize a high-quality cassette deck with today's best tape formulations. The combination should provide performance which "subjectively equals that of digital consumer media under home listening conditions." The cassette's future looks good to me.

The recordist has even more formulations to choose from than the 88 covered here, for whatever purpose and whatever type of cassette recorder. I hope the material in this survey truly helps you make good choices. **A**

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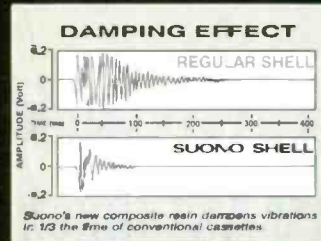
- **First with 3-D Domed Shell Technology.** Reduces modulation noise, inhibiting vibratory standing waves for outstanding output.
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# That's

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They began by setting performance goals beyond the best premium level systems available. In the end, they'd created two of the finest audio systems ever engineered for the automobile.

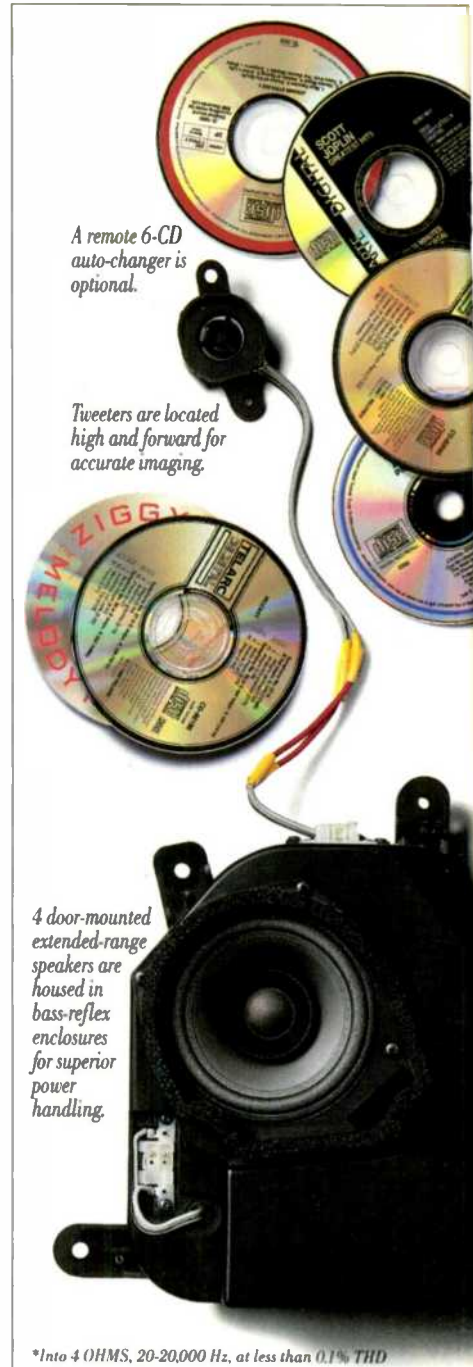
The first is the standard Lexus 7-speaker high-output audio system with bi-amplified subwoofer. Its

continuous average



*The Lexus LS 400*

output is 65 watts,\* with a maximum of 140—enough power to please the ear



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The power mast antenna even adjusts to 3 positions for ideal AM and FM reception.

The LS 400 audio system is pre-equalized to the interior's unique acoustics.



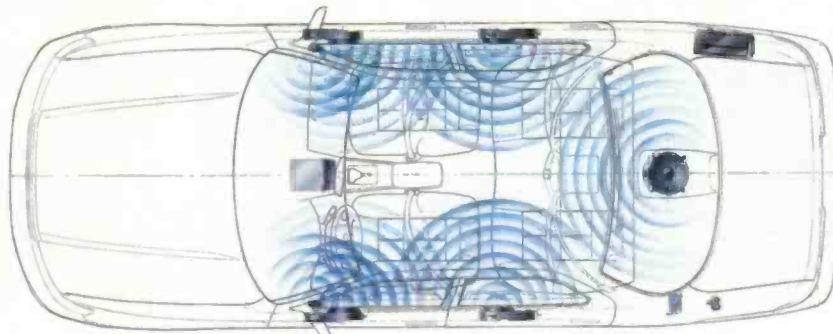
The Lexus/Nakamichi system is even equalized for the difference between cloth and leather trim.

## BASS



A bi-amplified 8-inch subwoofer punches out deep, tight bass.

The Premium ETR radio/auto-reverse cassette includes an FM diversity tuner with dual antennas.



7 speakers are ideally-located for accurate balance and sound staging. Electronic cross-over networks feed specific frequencies to each.



Its RMS output power is nearly doubled to 126 watts,\* with a maximum of 220. The result? Bass response so deep, so tight, you don't just hear it. You feel it.

And with its more sophisticated specifications, refined circuit design and advanced speaker technology, you'll hear sound reproduction like you've never heard before in a car.

But then, doing what's never been done before is what Lexus is all about.



1

## REVOX B226-S CD PLAYER

### Manufacturer's Specifications

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

**THD:** 0.004%, 20 Hz to 20 kHz.

**S/N:** Unweighted, 102 dB; A-weighted, 108 dB.

**Separation:** Greater than 90 dB, 20 Hz to 20 kHz.

**Output Level:** Fixed, 2.5 V; variable, 0 to 2.5 V; digital, 0.5 V peak to peak; headphones, 4.5 V peak to peak.

**Channel Balance:** Greater than 0.2 dB.

**Search Time:** Less than 3 S for any CD location.

**Number of Program Steps:** 19 set by disc time, track number, or user-set markers.

**Remote Control:** Optional, via Revox B208 hand-held remote (\$160), B210 table-top remote (\$995), B207 infrared transmitter (\$350), or B200-S controller (\$1,295).

**Power Requirements:** 120 V a.c., 60 Hz, 25 watts.

**Dimensions:** 18 $\frac{7}{8}$  in. W  $\times$  4 $\frac{5}{8}$  in. H  $\times$  13 in. D (48 cm  $\times$  11.8 cm  $\times$  33.2 cm).

**Weight:** 20.9 lbs. (9.5 kg).

**Price:** \$1,895.

**Company Address:** 1425 Elm Hill Pike, Nashville, Tenn. 37210.

For literature, circle No. 90





Have you ever wondered why some CD players cost well under \$200 while others sell for up to \$2,000 and more? The Revox B226-S provides some of the answers, both in terms of its convenience features and its sonic and measured performance. The B226-S CD player features 16-bit, four-times oversampling, proving that such late innovations as eight-times oversampling, 16-times oversampling, or even 64-times oversampling and 1-bit D/A conversion are not the only ways in which proper D/A retrieval may be accomplished. This player is part of Revox's new 200-S series of audio components. Happily, with these components, Revox has finally abandoned the rather bulky look and the two-tone gray color scheme of its earlier units. The 200-S series is distinguished by elegant, low-profile styling, an attractive black and gold color scheme, and glossy black-lacquered side panels.

The B226-S has a newly designed transport built on a precision-tooled aluminum die-cast plate and a new D/A converter used in the Studer professional CD players. As you might expect from a player in this price category, there's a direct digital output, should you choose to feed digital audio data to a separate D/A converter. The player can be programmed with up to 19 selections for playback in any sequence. Additionally, you can program this unit to play several tracks in the order in which they appear on the disc, using up only one of the 19 program slots in doing so. Sections of a specific selection can be "marked," and such sections also can be intermixed in the programming. You can even program in a pause at any step in the programming sequence, and if you wish, you can program the unit to shut itself off (with the player in the standby mode) at the end of your programming steps. Among the convenience features are variable headphone output, variable outputs for feeding a power amplifier or a powered speaker system directly, and standard fixed-level outputs.

The die-cast, drive-mechanism chassis is mounted on a damped suspension for resonance-free operation. According to Revox, this also lessens the dependence on error-correction circuitry.

### Control Layout

The front panel is divided into main and auxiliary keypads, with an electroluminescent display centered beneath the disc tray. Main controls at the right side of the panel include a "Power" switch, a "Load" button that opens and closes the disc tray, a "Pause" button, an "Index" advance button for those discs that have index points within tracks, and a large button labelled "Play/Next" to initiate play and to advance to the next track during play.

Numeric keys at the upper left of the panel are used for direct access to any track, from 1 to a theoretical maximum of 99. These numbered keys are also used during track programming and for programming time segments.

Auxiliary keys are found along the lower right and lower left of the front panel. The controls at the lower right include keys for scanning up and down (output level drops 12 dB during scan) and for raising and lowering volume at the variable line or headphone outputs. Other keys in this area are for "Display" (selecting elapsed or remaining disc or track time), "Autostop" (which puts the player in pause

mode after the current selection), "Locate" (which puts the player in pause mode at the start of the current track), and "Stop." A stereo headphone jack is at the panel's lower right corner.

At the lower left of the panel are additional auxiliary keys for the various types of programming that can be done with the B226-S. These include a "Program" key, a "Cursor" key to access any position on the display for editing, "Program Step" keys for paging backwards or forwards through a program, a "Mark" key for identifying segments during programming, a "Store" key, a "Loop" key for continuous re-play of a disc or a program sequence, and a "Track/Time" key that switches between track and time indications during programming.

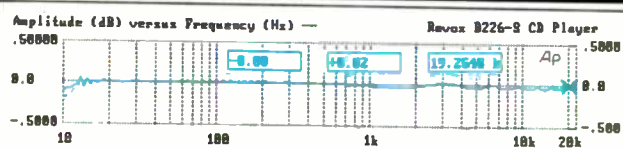
The central display shows program step number; track and index numbers; the various playing time indications; "Pause," "Autostop," and "Loop" indications (when these functions have been activated), and a graphic indication of volume settings when the headphone or the variable line output level is being adjusted.

The rear panel has pairs of fixed- and variable-level output jacks, two digital coaxial output jacks wired in parallel (there is no optical output), and a multi-pin socket for Revox's multi-room Easyline infrared control system. Revox offers a 55-function hand-held remote, the B208, and a new table-top remote, the B210, both of which can be used with the Easyline system and other Revox components. The B210 can learn the infrared signals of other manufacturers' products, and it is a two-way unit. If used with the B207 infrared transmitter and a B200-S controller, the B210 can receive and display status information from Revox 200-S series components. When used with the B226-S CD player, it can show virtually everything on this unit's display, including track number, time, and whether a disc is loaded or not.

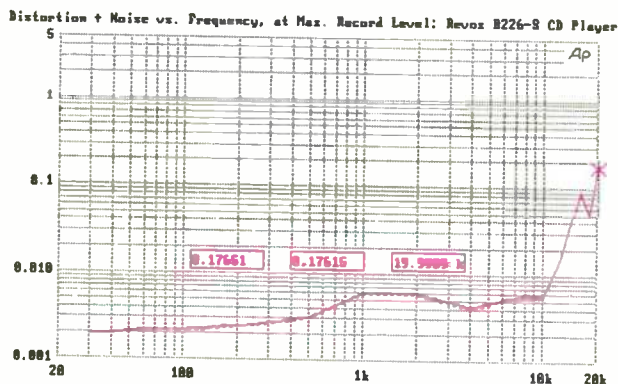
### Measurements

This is the first CD player I tested after my Audio Precision System One test equipment was upgraded to the digital signal processing (DSP) mode. Accordingly, you will see some graphs I have not been able to produce before. I am

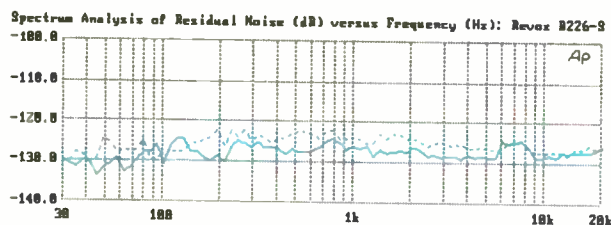
Rarely, if ever, have I seen a player with such response accuracy at the upper limit; it was only off by 0.02 dB at 20 kHz.



**Fig. 1—Frequency response.** Left channel is solid curve, right channel is dashed, here and through Fig. 5.



**Fig. 2—THD + N vs. frequency at 0-dB (maximum) recorded level.**



**Fig. 3—Spectrum analysis of residual noise when playing "no-signal" track of CD-1 test disc; see text.**

now able to explore the capabilities of components far beyond anything I've been able to do in the past, as I will explain when I describe some of the new graphs and acquired data.

In addition to the DSP mode and the digital domain upgrading my test system now incorporates, Audio Precision's new version of their software enables me to call out actual data values on the graphs themselves. You can see the first example of this in Fig. 1, where frequency response

of the CD player is plotted. I set the cursor on the graph to about 20 kHz and was able to read directly that response was absolutely flat for the left channel and was up 0.02 dB for the right. Rarely, if ever, have I seen a CD player exhibit such response accuracy at the upper frequency limit.

Interchannel phase error was virtually nonexistent. Even at 20 kHz, the difference between channels amounted to an insignificant 0.3°. The graph of this was so close to a perfect straight line that I saw no need to present it here.

Figure 2 shows how THD + N varied as a function of frequency. At 1 kHz, THD + N measured only 0.006%. The rise in apparent THD + N at 20 kHz was caused not so much by actual harmonic distortion components as by small amounts of "beats" that were visible on a scope when higher frequency test signals were reproduced. In any case, even at 20 kHz, THD + N was on the order of 0.176% for either channel, as shown by the readouts in Fig. 2.

When I measured THD + N versus signal level (not shown), I got a reading of more than 84 dB below reference for a 1-kHz signal at maximum (0-dB) recorded level. (This corresponds to 0.006%, providing perfect correlation with the test shown in Fig. 2.) The reading of about 84 dB was actually the highest point on the curve: THD + N was at least 97 dB below reference at recorded levels from -90 to -60 dB, rising to 94 dB below reference at -30 dB and to about 91 dB below reference at -10 dB. To make room for a more revealing test which I can now make, I will no longer show a plot of this—except when there is something unusual about the curve. I also checked SMPTE-IM distortion, which I found to be 0.00313% for the left channel and 0.00280% for the right.

When playing the "silent" track of my CBS CD-1 test disc, I measured an A-weighted S/N ratio of 114.07 dB for the left channel and 110.88 dB for the right, as compared with Revox's claim of 108 dB. A spectral analysis of the residual noise over the audible frequency range (Fig. 3) revealed that this is one of the rare CD players that has provided virtually perfect isolation between its digital and analog audio circuitry and its power-supply circuitry. There is absolutely no "peak" in the noise level at the power-line frequency of 60 Hz or its harmonics.

Separation in the worst-case direction (left to right) was 98 dB at 16 kHz. The slope of the curves (which I am no longer showing) indicated that separation at 20 kHz should still be well in excess of what Revox claims. Separation was greater than 110 dB at all frequencies from about 100 Hz to 4 kHz.

As I have indicated in several of my recent evaluations of CD players, I consider low-level linearity to be an important criterion in distinguishing among the "good," "better," and "best" players currently available. Frankly, I don't care what methodology is used in D/A conversion, as long as good linearity extends all the way down to very low levels. Figure 4 is a plot of *deviation* from perfect linearity versus recorded level. Linearity was just about perfect down to -80 dB, but at -90 dB, it was off by -2.57 dB for the left channel and by -3.38 dB for the right. These are not the best linearity numbers I have ever obtained, but they are well above average.

Results were excellent when I used dithered test signals at low levels (-70 to -100 dB). As plotted in Fig. 5,



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The Revox was among the best I've ever measured in the fade-to-noise test and in low-level linearity for dithered signals.

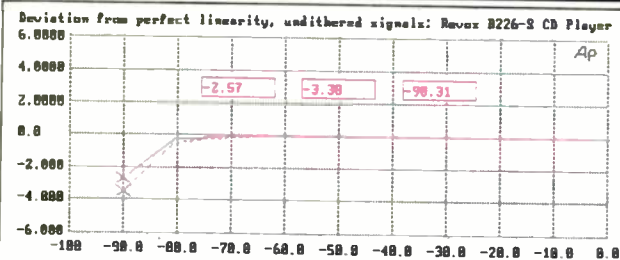


Fig. 4—Deviation from perfect linearity for undithered signals.

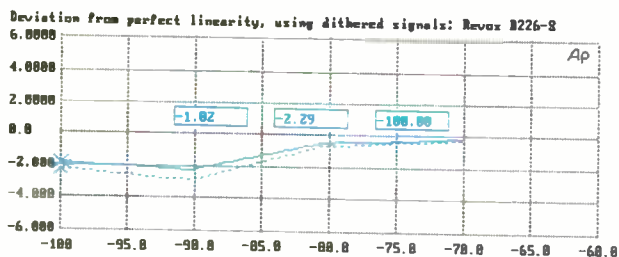


Fig. 5—Deviation from perfect linearity for low-level, dithered signals.

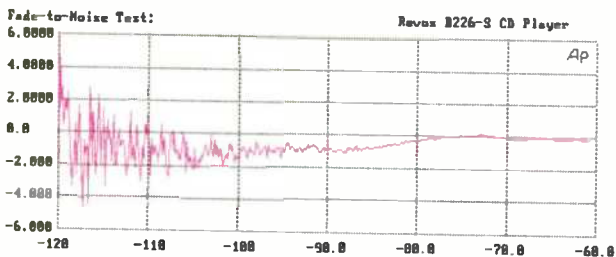


Fig. 6—Fade-to-noise test.

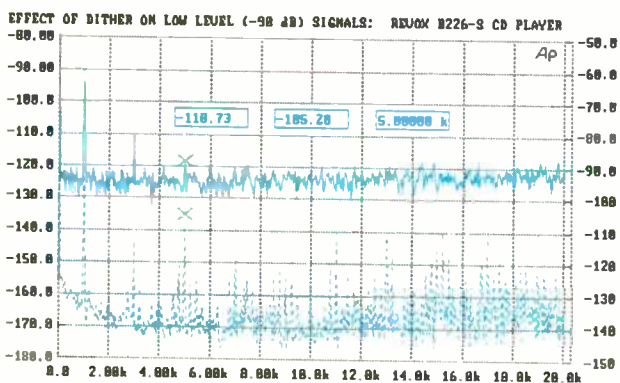


Fig. 7—Spectrum analysis of signal at  $-90$  dB with dither (top curve) and without dither (bottom curve). Use scale at left for top curve and scale at right for bottom. See text.

deviation from perfect linearity was off by only  $-1.82$  dB for the left channel and  $-2.29$  dB for the right. These results are among the best I have ever seen, as are the results obtained using the "fade-to-noise" test signals on the CD-1 test disc (Fig. 6). These signals are also dithered and extend from  $-60$  to  $-120$  dB. The signal is masked by the noise at a level of about  $-110$  dB, which corresponds to the EIA dynamic range of the player. Note, too, how linearity remains accurate, within about 2 dB, all the way down to  $-120$  dB.

Dynamic range, in accordance with the EIAJ method, yielded figures of 97.06 dB for the left channel and 96.83 dB for the right. Frequency accuracy of the player's internal master clock was 0.0098%.

Ever since I learned about the benefits of "dither" in recording sound digitally, I have wanted to be able to demonstrate those advantages. I have also suspected that all CD players would exhibit improvements in low-level signal reproduction if those signals were originally recorded with the proper amount and type of dither. Now, at last, with my DSP-enhanced test gear, I am able to show the effect of dither in low-level signals as well as to compare its effect from one player to the next. So, let the Revox B226-S serve as a reference player for this new test.

Using the FFT spectrum analysis capability of the test equipment, I played two tracks of the CD-1 test disc. The third index point of track 19 has a 1-kHz dithered test tone recorded at 90 dB below maximum recorded level. A spectrum analysis of this test signal, over the audible spectrum, is shown in the top curve of Fig. 7. (Refer to the left-hand decibel scale to read this plot.) Notice that the only significant harmonic component is the one that occurred at 3 kHz, the third harmonic of the 1-kHz test tone. (The test tone itself shows as a peak at exactly  $-90$  dB.) Contrast this with the bottom curve, which was made using undithered signals at the same level. (Refer to the right-hand scale to read the bottom plot.) A large assortment of distortion components—especially at the higher odd-order harmonics—are now visible, along with many other undesired spurious components throughout the audible range. The fifth harmonic's amplitude is down only 105.2 dB with the undithered signal; with the dithered signal, it is down more than 118.73 dB. Close examination reveals, however, that while adding dither decreases distortion components, it adds somewhat to the residual random noise level. Thus, ignoring the peaks in the bottom curve, average noise level seems to be hovering between  $-130$  and  $-140$  dB; in the case of the dithered signals, average noise ranges between  $-120$  and  $-130$  dB. Since the noise level will still be inaudible under normal listening conditions, this is a small price to pay for "cleaning up" the low-level signals and delivering them with greater waveform accuracy than would otherwise be possible in a 16-bit digital system.

In testing player monotonicity, I have had a hard time trying to interpret this complex signal (let alone trying to synchronize it) by viewing it on an oscilloscope. Now I can abandon the oscilloscope, thanks to the waveform-versus-time plotting capability of the DSP FFT enhancement incorporated in my test setup. By capturing a portion of the test signal using an FFT, I am able to expand the waveform

**“It is so clearly superior to past amplifiers in the low- to mid-priced range—not to mention most amplifiers two to three times its price—that I can unhesitatingly recommend it for even the most demanding high end system.”**

*Anthony Cordesman*

**stereophile**

vol. 8, no. 4



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The Revox B226-S may be the perfect choice for those who appreciate ergonomics, convenience, and sound that is above reproach.

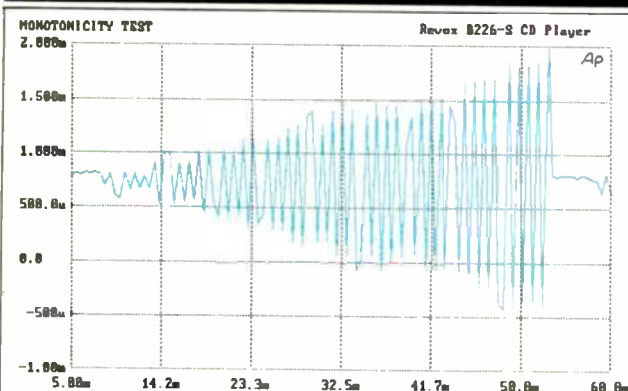


Fig. 8—Monotonicity test; see text.

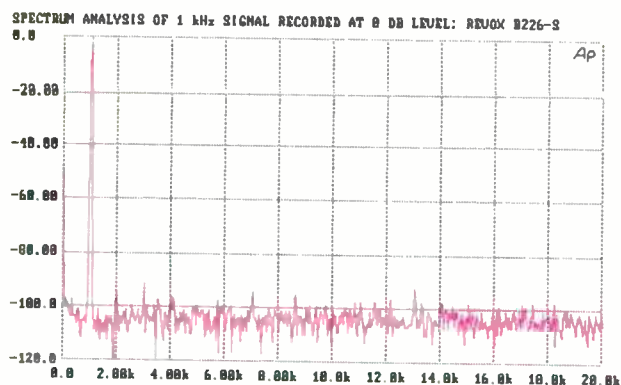


Fig. 9—Spectrum analysis of signal recorded at 0 dB; see text.

of CD players with digital filtering, which virtually all quality players have nowadays. Considering the present state of CD player development, these waveforms no longer show significant differences between most units, and I am omitting them from here on.

Figure 9 is a spectrum analysis of a 1-kHz signal recorded at maximum level and reproduced by the B226-S CD player. While Fig. 2, measured using analog analysis, shows THD *plus noise*, doing the same analysis by means of DSP and FFT facilities yielded the results shown. Note that the most significant harmonic distortion components (third, seventh, and 13th harmonics) are between  $-90$  and  $-95$  dB. Taking the square root of the sum of the squares of these minute distortion components yields a net THD of about 0.0031%, as against the figure of 0.006% for THD *plus noise* obtained using analog measurement techniques.

Revox's claims for excellent tracking were substantiated when I played the defects tracks of my test discs, which have calibrated lengths of missing data. This player was able to track segments with full 1.5-mm data gaps. That's as high an error-correction capability as I have seen. Furthermore, tapping briskly on the top and side surfaces of this player did not cause mistracking.

#### Use and Listening Tests

I particularly liked the way programming is accomplished with the B226-S. The user is given a great many options, and each is thoroughly explained in the multi-lingual owner's manual, with some 33 pages each for English, French, and German. The "power off" feature at the end of a program will be appreciated by all of us who tend to nap while listening to music late at night (or during the day).

Some of my recently acquired discs served as good audition material for this elegant player. Among them were a couple of new Debuss releases engineered by my good friend John Eargle; these included a disc of Mozart and Beethoven Piano and Wind Quintets (D/CD-3024) and another featuring Brahms' String Quintet No. 2 and Quintet for Clarinet and Strings in B Minor (DE-3066). Both discs have several quiet passages that are very useful in assessing the clarity of low-level reproduction—something the Revox B226-S seems particularly able to deliver.

Start-up from pause was especially fast—well under 1 S. Track access was also extremely fast. No matter what track you are playing, merely push the number keys for another track, push the "Play/Next" button, and off goes the laser pickup to find and play the track of your choice. Although index selection can be done only in the forward direction, the fast scan modes accelerate as you hold down the appropriate buttons, so it doesn't take too long to backtrack one or more index points.

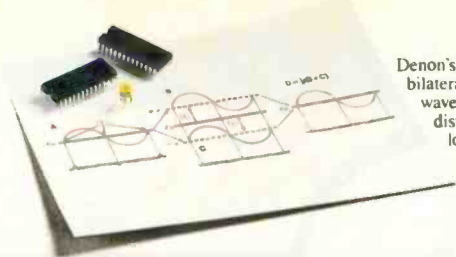
For me, the timing of this evaluation couldn't have been better. I wanted to put my newly enhanced Audio Precision test gear through its paces on a top-quality CD player rather than an average one. The Revox B226-S was a perfect choice for this purpose, and if you can afford the rather steep price, it may well be the perfect choice for music lovers who appreciate good ergonomics, carefully thought-out convenience features, and most importantly, sound quality beyond reproach.

Leonard Feldman

display so that a single cycle of the waveform sequence may be examined in detail. That's what I've done for the display shown in Fig. 8, and if you've read my previous reports on CD players, I think you'll have to admit this new display is a lot clearer and more detailed than a 'scope photo. I'll have to reserve judgment about this player's monotonicity because, with so much detail now available, I have nothing to compare it with! My first impression would be that the monotonicity looks quite good, despite the slight displacement (about  $750 \mu\text{V}$ ) of the entire series of steps from the zero axis. A perfect monotonicity pattern would have successive steps increasing uniformly in both positive and negative directions.

A unit-pulse waveform showed that the B226-S does not invert signal polarity. Its square-wave response was typical

Starting with the first digital recording of music in 1972, Denon has produced an unbroken string of digital audio breakthroughs.



Denon's LAMBDA processor bilaterally offsets the digital waveform to eliminate the distortion that occurs when low-level waveforms cross the zero line.

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Denon's CD player innovations include the Super Linear Converter, the 20-bit digital filter, the real 20-bit converter and noise-shaping filter circuitry.

Denon's latest digital advancement is the LAMBDA Real 20-Bit Super Linear Converter in the DCD-1560. The LAMBDA system's digital offset processor and dual 20-bit converters eliminate the most common source of distortion in CD players: the zero crossings of low-level signals.

Denon's consistent leadership in digital audio technology may explain why earlier generation

Denons often sound better than current competitors' models. And why a leading hi-fi journal found that a moderately-priced Denon equalled or outperformed all others tested, including machines costing over \$1800.

What makes Denon CD players better? Perhaps it's that Denon performs every step in the music chain from recording artists through pressing CDs. And that Denon has concentrated on one thing and only one thing for 80 years.

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DCD-1560 shown with the optional side panels available for most Denon models. Prices quoted are manufacturer's suggested retail prices and may vary.

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## 2

HEATH  
AJ-2520  
TUNER**Manufacturer's Specifications  
FM Tuner Section****Usable Sensitivity, Mono:** 10.8 dBf.**50-dB Quieting Sensitivity, Stereo:** 37.0 dBf.**S/N:** Mono, 82 dB; stereo, 74 dB.**THD, 1 kHz, at 65 dBf:** Mono, 0.1%; stereo, 0.12%.**Alternate-Channel Selectivity:** 50 dB.**Adjacent-Channel Selectivity:** 5 dB.**Capture Ratio:** 1.3 dB.**I.f. Rejection:** 80 dB.**AM Suppression:** 55 dB.**Image Rejection:** 50 dB.**Spurious Rejection:** 75 dB.**Separation, 1 kHz:** 40 dB.**AM Tuner Section****Sensitivity:** 15  $\mu$ V.**S/N:** 53 dB.**Alternate-Channel Selectivity:** 50 dB.**I.f. Rejection:** 60 dB.**Image Rejection:** 45 dB.**General Specifications****Power Requirements:** 120 V a.c., 60 Hz, 14 watts.**Dimensions:** 17<sup>7</sup>/<sub>16</sub> in. W x 2<sup>11</sup>/<sub>16</sub> in. H x 14<sup>3</sup>/<sub>16</sub> in. D (44.3 cm x 6.8 cm x 4.6 cm).**Weight:** 7.3 lbs. (3.3 kg).**Price:** Wired, \$249; kit, \$229.**Company Address:** Benton Harbor, Mich. 49022.

For literature, circle No. 91

The Heath Company has always been considered to be one of the finest suppliers of do-it-yourself electronic kits. Throughout the company's history, Heathkits have been noted for their ease of assembly and the accuracy and clarity of their instruction booklets. Many of Heath's products are available in assembled and kit versions; the AJ-2520 tuner is one of these.

Audio Editor Gene Pitts undertook to build the AJ-2520 from a kit. He supplied the finished tuner to me, along with the identical model factory-wired by Heath. This allowed me to compare performance of the completed kit version with that of the factory-wired model. Before I tell you about the results of this comparison test, let's take a look at the features and controls of this latest tuner from Heath.





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# Threshold

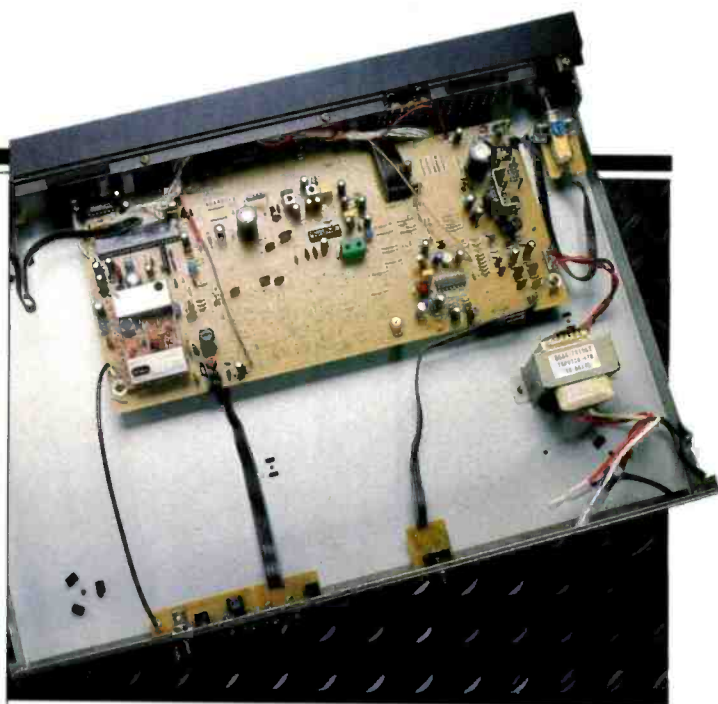
model SA/12®  
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power amplifier



If you follow the excellent step-by-step instructions Heath provides, it's almost impossible *not* to assemble a neat-looking tuner.

The AJ-2520 is a quartz-locked frequency-synthesized stereo tuner. Sixteen AM or FM station frequencies can be stored in memory for instant recall. In the event of a power failure, these frequencies will be retained in memory for one week. I removed the cover from both the kit and factory-wired versions and found that just about all of the tuner circuitry was contained on a single large circuit board. It had many unfilled holes, suggesting that Heath may use the same p.c. board for other models—perhaps for a tuner/preamplifier or even as part of a complete AM/FM receiver.

The only physical differences between the two units that I could detect were a loose tuning knob and one end of a 2.2-megohm resistor that was dangling inside the chassis of the kit version. The tuning knob was easily tightened with a  $\frac{3}{8}$ -inch socket wrench (it probably loosened in shipment), while the dangling end of the 2.2-megohm resistor was rejoined to one side of the line cord by means of a wire nut which had evidently worked loose. The resistor plays no part in the actual operation of the tuner but merely serves as a high-resistance path to chassis ground. The wiring done by Mr. Pitts was neat, as neat as that in the factory-wired set. (I'm not just saying this because he is my editor!) But with all due respect to his skill as a kit builder, I hasten to add that it's almost impossible *not* to come up with a neat-looking assembled tuner if you follow the excellent step-by-step instructions Heath provides.



#### Control Layout

A large square power switch is at the left end of the front panel. To its right are eight station preset buttons, each with two numbers above it. The nearby "Shift" button determines which of the two numbered preset frequencies (1 or 9, 2 or 10, etc.) should be called up. This arrangement keeps the front panel less cluttered than would be the case if 16 separate preset buttons were provided. The "Memory" button, just below "Shift," is used for storing the individual station frequencies.

Further to the right is the AM/FM selector button, and to its right is the display area that shows tuned-to frequency, selected band (AM or FM), presence of a stereo signal, three levels of incoming signal strength (using three LEDs), and an indicator that lights up when stations are properly center tuned. The "Mode" switch to the right of the display selects stereo or mono operation, and the next switch chooses manual or seek tuning. The large rotary tuning knob at the right end of the panel cannot be turned completely; it can be adjusted only about 30° in either direction from its neutral position. It will raise tuned frequency when turned to the right and will lower the frequency when turned to the left.

The rear panel of the AJ-2520 is equipped with 75-ohm coaxial and 300-ohm screw terminals. A separately supplied AM loopstick can be affixed to a clip on the rear panel or placed at some distance from the tuner for somewhat better reception. (The tuner's metal chassis may interfere with reception by attenuating incoming signal strength.) A simple accessory FM T-antenna is included with both the kit and wired versions. As usual, the owner's manual recommends the use of a better outdoor FM antenna if noise or poor reception is encountered when using the minimal antenna supplied. A pair of stereo output jacks completes the rear-panel layout.

#### Measurements

Identical tests were made for the factory-wired tuner and the tuner assembled from the kit. For all Figures shown, the "A" graph represents the results obtained with the factory-



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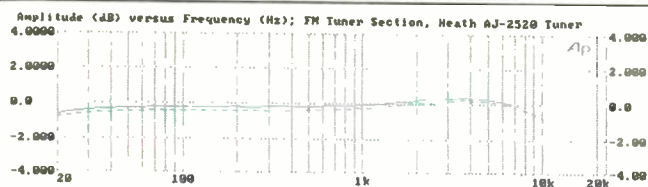


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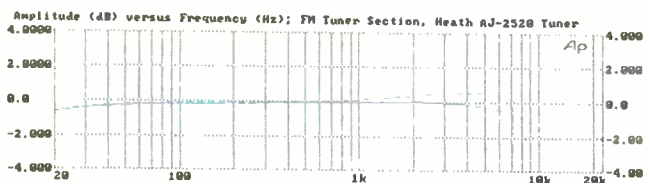
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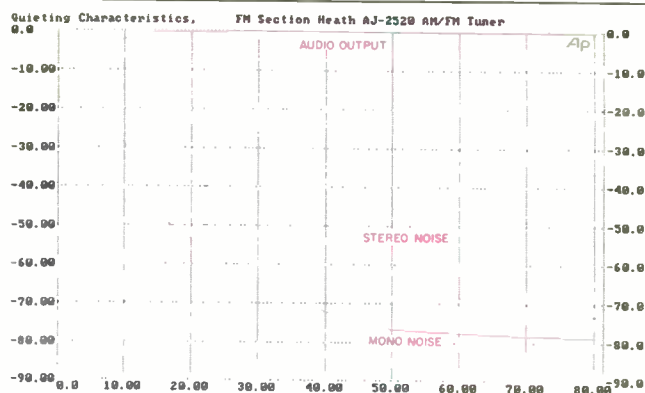
There was virtually no difference in response between the kit-built and factory-wired units.



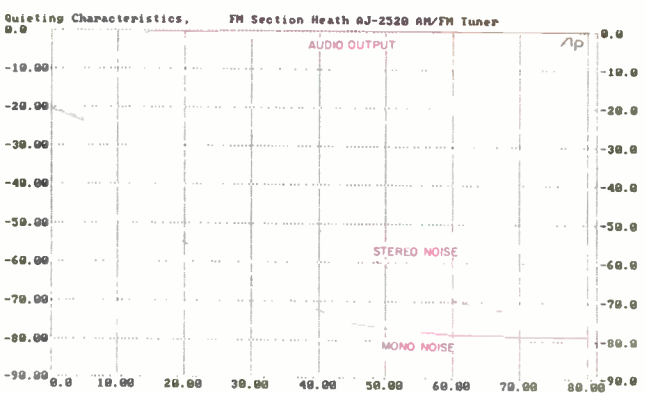
**Fig. 1A—FM frequency response for left channel (solid curve) and right channel (dashed curve) of factory-wired version. Curves have been displaced for clarity.**



**Fig. 1B—FM frequency response for left channel (solid curve) and right channel (dashed curve) of kit version.**



A



**Fig. 2—FM quieting characteristics of factory-wired version (A) and kit version (B).**

wired tuner, and the "B" graph represents the performance of the kit-built tuner.

Figure 1 shows FM frequency response. Response was virtually identical for both tuners except for a slight difference in output level between channels at the treble end of the spectrum for the kit version (Fig. 1B). In Fig. 1A, the solid curve (left channel) and dashed curve (right channel) were deliberately offset for clarity. Had this not been done, the curves would have been identical in amplitude and shape. For the factory-wired tuner, response was off by 2.6 dB at 15 kHz. For the kit version, response at 15 kHz was down 3.3 dB on the left channel and 2.4 dB on the right. Response at the bass end of the spectrum was substantially the same (within 0.1 dB) for both units.

Figure 2 shows mono and stereo quieting characteristics. Talk about two peas in a pod! Best signal-to-noise ratio in mono for both units was 78 dB, short of the 82 dB claimed by Heath but certainly excellent for a tuner in this price category. In stereo, at a signal input level of 65 dBf, the kit-built version actually exhibited a tiny bit better S/N ratio than

the factory-wired unit (71.3 dB against 70 dB). When a really strong signal was applied (80 dBf), the tuners settled in with signal-to-noise ratios of 72.3 dB for the factory-wired unit and 73.0 dB for the kit unit. Notice that a transition from mono to stereo takes place between 30 and 40 dBf for both units. The exact threshold cannot easily be determined from these curves, because the automatic plotting system of my Audio Precision test gear takes readings at discrete signal levels. In any case, the point of transition seems to be well chosen, since by the time the signal dropped to 40 dBf, signal-to-noise ratio for the factory-wired tuner was 50 dB in stereo (slightly better for the kit), and listening to stereo with greater background noise than this is not particularly pleasant, to say the least.

Figure 3 shows an interesting phenomenon that I've noticed on many tuners before. If you carefully tune an FM circuit for lowest distortion in mono, you may not always get the lowest possible distortion in stereo (and vice versa). Take a look at Figs. 3A and 3B. For the factory-wired tuner, lowest THD + N at strong signal levels, using a 1-kHz test

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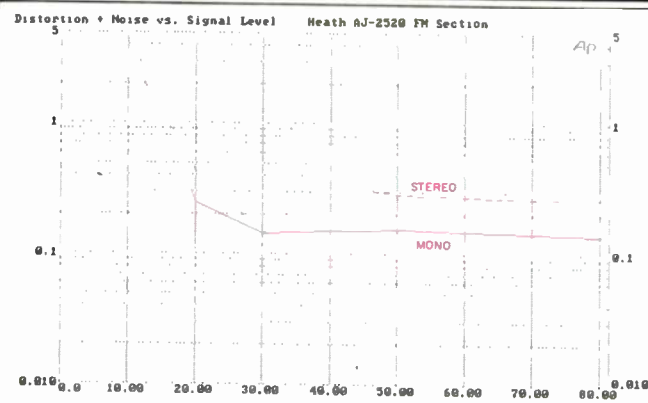
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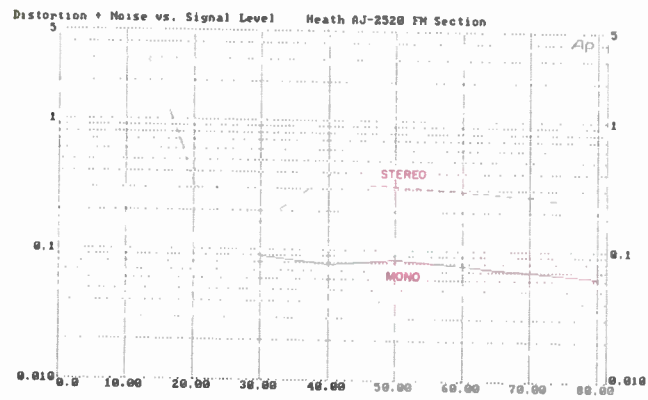
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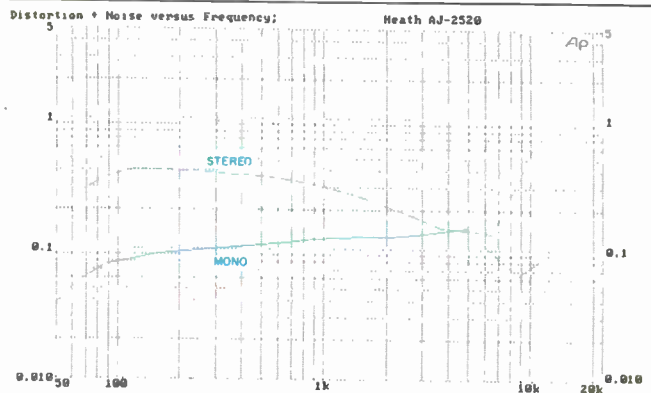
The transition from mono to stereo is well chosen; it occurs just at the point where stereo noise would start to be unpleasant.



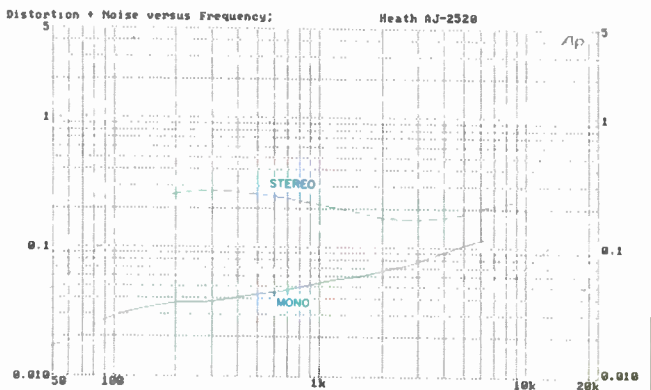
A  
B



**Fig. 3—THD + N vs. signal level for FM section of factory-wired version (A) and kit version (B).**



A  
B



**Fig. 4—THD + N vs. frequency for FM section of factory-wired version (A) and kit version (B).**

signal, was about 0.15% for mono and 0.28% for stereo. For the kit-built tuner, THD + N at 65 dBf was 0.075% in mono and 0.28% in stereo. In this instance, stereo THD + N did not follow the same pattern as did mono THD + N. Still, for mono, the kit-built tuner actually did better than the published spec, though the factory-wired tuner didn't meet the mono THD spec by only a small amount.

Mono usable sensitivity is also defined by this data; it's the point where THD + N is -30 dB, or 3.162%. In this case (which I don't regard as particularly important), the factory-wired tuner did slightly better than the kit, with a reading of 12 dBf versus 12.9 dBf.

At the 100-Hz test frequency, the kit version posted slightly better results for distortion than the factory-wired version; at 6 kHz, the reverse was true. As shown in Fig. 4, THD + N at 100 Hz was 0.078% in mono and 0.37% in stereo for the factory-wired unit and was 0.028% in mono and 0.12% in stereo for the kit version. At the test frequency of 6 kHz, the results were 0.1% in mono and 0.14% in stereo for the

factory-assembled tuner and were 0.12% in mono and 0.2% in stereo for the kit.

Plots of FM stereo separation are presented in Fig. 5. One aspect of both tuners that I did not like at all was the presence of a great deal of 19- and 38-kHz subcarrier products at the outputs of each unit. These signals could have an adverse effect on Dolby noise reduction when taping FM programs. The subcarrier products were so great, in fact, that when I made the usual separation measurements using a simple two-channel sequential sweep on my test instrument, it appeared that separation was no more than about 23 dB or so. To arrive at meaningful separation curves, I had to alter the test parameters so as to treat the second sweep as a measurement of crosstalk, adding a bandpass filter that swept along with the plots. Under these conditions, the true separation at 1 kHz (or crosstalk, if you prefer) was 52 dB for the factory-wired tuner and just over 60 dB for the kit unit! At 100 Hz, separation was 46 dB for the factory-wired version and 47.5 dB for the kit. At 10 kHz,



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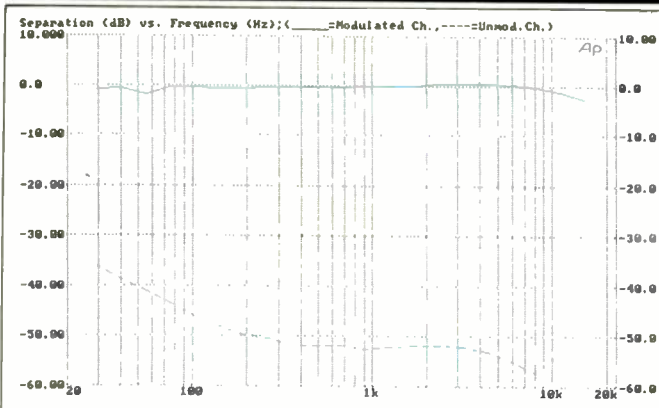
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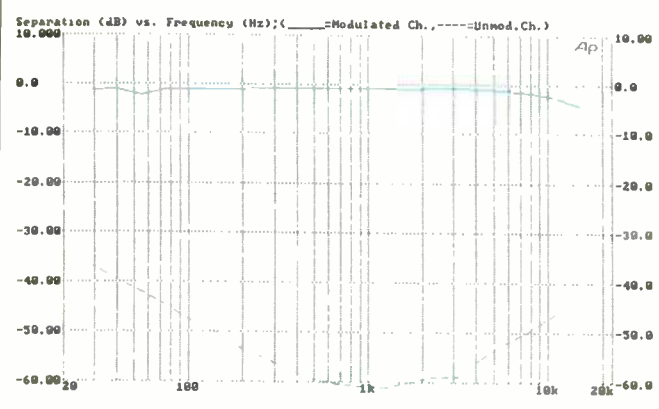


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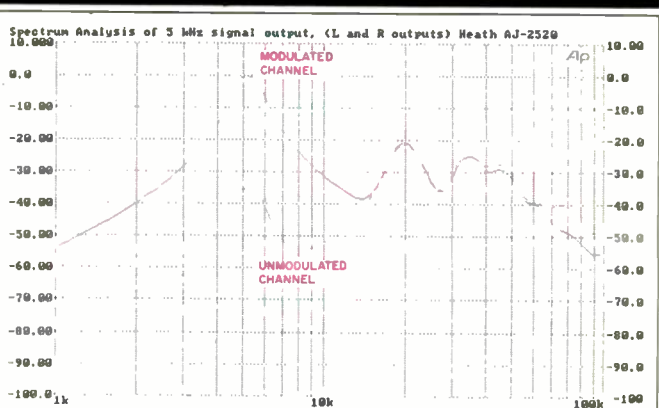
Sometimes the kit-built version performed slightly better than the factory unit, but at other times, the reverse was true.



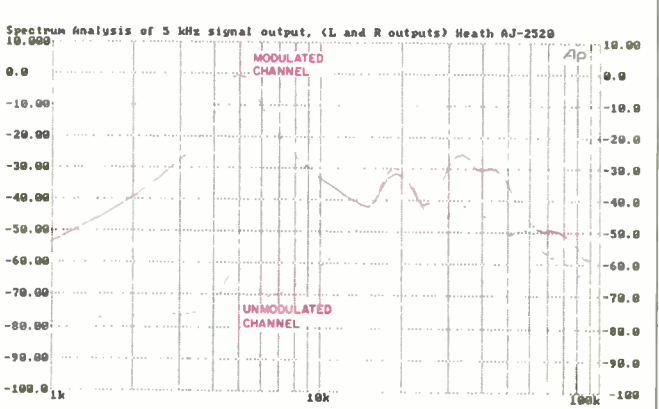
A  
B



**Fig. 5—FM frequency response and separation of factory-wired version (A) and kit version (B).**



A  
B



**Fig. 6—Spectrum analysis, showing crosstalk products, for FM section of factory-wired version (A) and kit version (B).**

separation measured a very impressive 53 dB for the factory-wired unit and 47.7 dB for the kit.

Figure 6 clearly illustrates the 19- and 38-kHz leakage. A 5-kHz signal was used to modulate one channel, and the output from that channel is represented by the solid curve in each of the two graphs; the dashed curve represents the output for the unmodulated channel. In both versions of the AJ-2520, output of the 19-kHz pilot carrier was down only a bit below -20 dB compared with the fully modulated, 5-kHz signal. Such amounts of subcarrier signal may be tolerable in car stereo FM tuners but should not be present in a tuner intended for use in a home system that will include a tape deck. Interestingly, the amount of 38-kHz subcarrier present at the outputs of the factory-wired version was the same for both channels, whereas in the kit, the modulated channel's output of spurious 38-kHz subcarrier and sidebands was greater than the unmodulated channel's. I have no explana-

tion for this difference but maintain that, here again, there was far too much of these high-frequency signals in both tuners.

Secondary performance characteristics were remarkably close between the tuners, with the kit version generally edging out the factory-wired version slightly. Capture ratio was 1.5 dB for both units. Alternate-channel selectivity measured 52 dB for the factory-wired unit and 54 dB for the completed kit. AM rejection was 55 dB for both units, exactly as claimed by Heath. I.f. rejection was 80 dB for the factory-wired unit, 82 dB for the kit. Image rejection measured 55 dB for both units, while spurious response was 78 dB for the factory-wired unit and 80 dB for the kit. Image rejection measured 53 dB for both units.

As usual, about the only thing I thought worth testing in the AM tuner section was frequency response. Results are shown in Fig. 7. The -6 dB treble roll-off point for the



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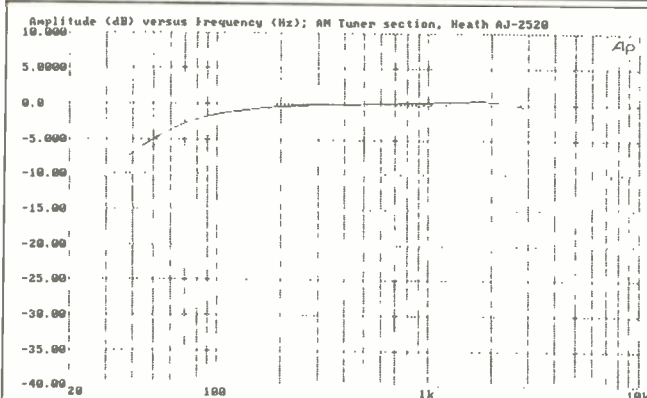
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B

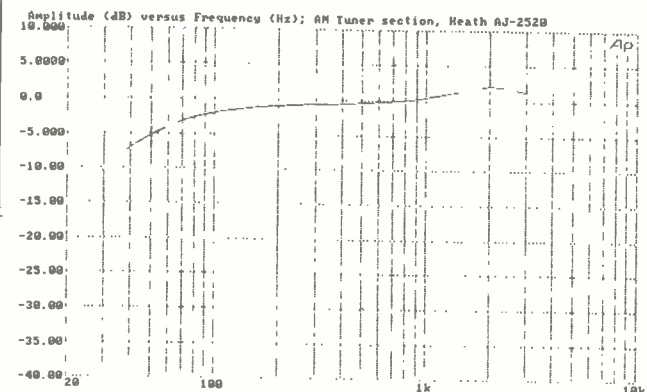


Fig. 7—AM frequency response of factory-wired version (A) and kit (B).

factory-wired unit occurred at 4.0 kHz, which is not bad for a tuner in this price range. Owing to a slight peak centered at around 2 kHz in the kit version's response, the -6 dB treble roll-off point occurred at 4.3 kHz, making it the "winner" in the AM sweepstakes, if anyone really cares.

#### Use and Listening Tests

Mr. Pitts will have something to say about how easy (or how hard) it was to build the AJ-2520 kit. I would simply like to comment about how the moderately priced AM/FM tuner performed.

I hooked up each of the units to an AudioPrism 7500 indoor antenna that I recently tested for *Audio* (December 1989). As I logged station after station on the FM dial of each tuner, for a total of 45 usable signals, I was unable to detect any difference in sound quality between the two units. However, I should stress that because of the rather low figures for alternate-channel selectivity achieved by this tuner (and the very low figure for adjacent-channel selectivity claimed but not measured by me), there were many

instances in which I intercepted strong signals over a "spread" of 400 kHz (200 kHz to either side of the actual transmitter frequency). This, therefore, is not a tuner for use in crowded metropolitan areas, where signals are often only 200 kHz apart, unless you intend to use a highly directional, rotatable outdoor antenna that can home in on the closely spaced signals you want to pick up. Of course, if you live in a relatively remote area where FM stations are spread across the dial, the poor selectivity of this tuner will not give you any grief.

One thing does remain clear. If you do elect to buy the AJ-2520, don't be afraid to buy it as a kit. You'll have fun putting it together, and its performance will be as good as that of Heath's factory-wired unit if you follow instructions and don't try to outsmart the assembly manual's author by anticipating steps. Finally, you'll save enough money to buy a couple of CDs (or some tape) in choosing the kit, and that's something to consider as well. *Leonard Feldman*

#### Kit Builder's Report

I spent about five hours on this kit, which I would rate as "moderate" or "easy" in difficulty; I am including in this about an hour searching out and setting up my construction gear. Heath says you'll need a pair of long-nosed pliers, a pair of regular pliers, wire strippers, diagonal cutters, a Phillips screwdriver, a 22- to 25-watt soldering iron, and a VOM, VTVM, or DMM. I've always felt that building a kit freed up enough money to indulge myself in a truly first-rate piece of electronics hardware. In this case, I bought myself a pair of Mathias Klein telephone installer's pliers from Specialized, which publishes a catalog that is the handtool freak's version of our *Best of Audio*. Next kit gets a production-line soldering iron with automatic temperature control.

There's a bunch of parts in this kit, but virtually all the assembly is of hardware parts into the chassis; that is, there is no stuffing of p.c. boards. You do need, however, to watch what you're doing, to keep your concentration and avoid interruptions. It's helpful, too, to separate all the different parts out so that you don't keep hunting for something that you know was just there. There are eight sizes of screws which I sorted into an egg carton; I should have put labels into each of the eight holes. As it was, I had to double-check against the life-sized drawings in Heath's invaluable illustration booklet almost every time I used one. All the other parts were easy to find, however, after they were spread out.

Full credit to Heath on this booklet as well as on the manual. I found no errors, though a very few may have been there, and I did make a couple which I had to go back and fix up. (No, I won't tell you what they were.) Such things can be avoided by doing *one* step at a time and checking off *each* step as it is completed.

It doesn't seem to me that you save very much money in doing up a kit, so you're going to have to get some psychic pay from the actual labor. Me, I like to do such things. Whether you will or not, I can't tell. It's hard to go wrong on this level of project, even if it's your very first one, but if you should, Heath does have a good customer service organization. All in all, this is worth doing if only to gain a greater appreciation of what happens at the manufacturing level when the pros make a piece of gear. *E.P.*



## REFERENCE RECORDINGS TEST VIDEODISC: A VIDEO STANDARD

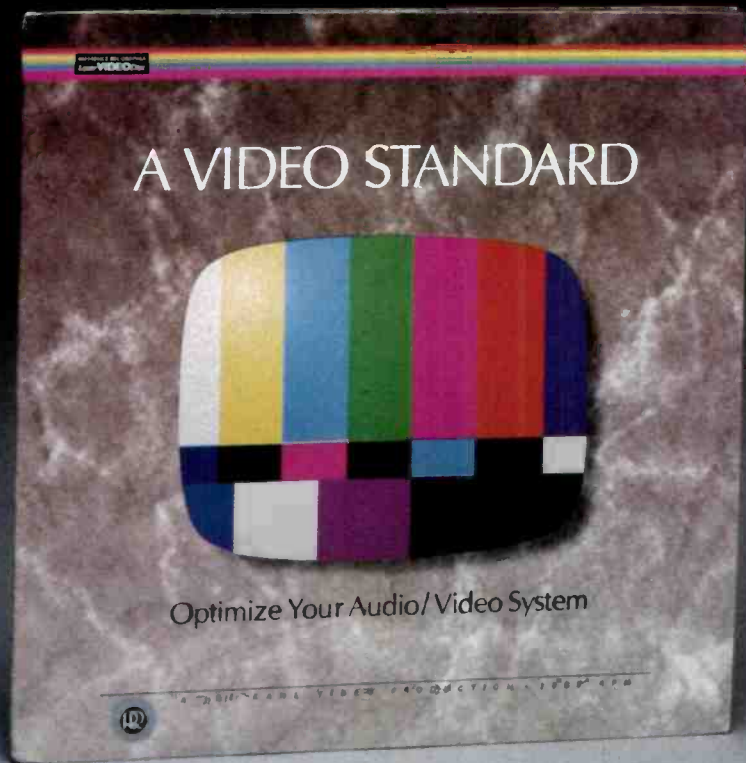
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Although video demonstration and test discs for sales and repair have been available within the industry for years, Reference Recordings' 12-inch laser videodisc, *A Video Standard* (21610), is the first such disc intended for consumers. With its wealth of calibrated video and audio test signals, it can be used to check not only laser videodisc and CDV players, but entire audio/video systems.

Laser videodiscs, like CDs, store audio in precise digital form as well as delivering audio and picture information as well as, or better than, any other consumer system. The resulting audio and video test signals come as close to the quality of good generators as the consumer is likely to get without investing thousands of dollars, and can be used as source material for system alignment and adjustment.

This Reference Recordings videodisc is in the constant angular velocity (CAV) mode, in which the disc maintains a constant rate of one revolution per video frame, yielding a maximum playing time of 30 minutes per side. *A Video Standard* is recorded on one side of the disc; the other side is blank. Using the CAV mode lets you use still-frame on any player for static video signals, and in effect extends the quantity of video material squeezed onto that single side. (Some recent players use digital technology to get special effects from extended-play constant linear velocity [CLV] discs, which hold up to one hour per side. These players route all special effects, including still-frame, through the digital circuitry, which often seems to cause a small loss of picture quality.)

The program material on *A Video Standard* is divided into eight chap-



ters: "Video Control," "Studio Video Production," "Electronic Field Production," "Transferring Film to Video and Audio Demo," "Audio Demonstration with Video Test Signals," "Audio Test Signals," "Monitor Calibration Test Signals," and "Who's Who." Chapters 1 and 8 have useful information but no test signals. Many (but by no means all) of the signals can be used and understood simply by reading the legends that appear on the screen. The quality of the video signals drops when these labels appear onscreen. In every case, however, there are some frames without these labels, from which clean measurements can be taken.

Chapters 2, 5, and 7 have test patterns. Since laser videodiscs play from the center outwards, and CAV discs turn at constant speed, performance is best at the outer, longer tracks. The frames in Chapter 7 theoretically deliver the best quality, while those in Chapters 2 and 5 are more useful as

tests of the player's uniformity of performance through a recording. Among the more useful patterns found in all three chapters are 75% color bars with pluge (a signal used for setting black levels, multi-burst, gray scale, red raster, cross-hatch, gray raster at various levels, and luminance sweep.

To use the information to its fullest in all these tracks (and in the more elaborate tracks found in Chapter 7) requires a battery of test instruments few amateurs are likely to have—waveform monitors, vectorscopes, color analyzers, etc. And using these test frames and the test equipment requires an intimate knowledge of television signals, which most users are also unlikely to have. Packed with the disc are a blue filter for eyeballing monitor setup and an instruction manual with solid, but not complete, information on how to calibrate a monitor without all the test gear. What's there is very informative, but don't expect an entire course in



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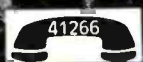
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television theory and practice. You may wish there were references to a good textbook where you could get complete explanations, but I know of no single textbook which would do the job.

The quality of the test signals is very good for the laser videodisc medium—

as good as service-grade equipment but not as good as the broadcast or laboratory-grade generators (Shiba-Soku TG-7) with which I compared it. Video S/N was 47.3 dB, unweighted, and 50.1 dB, weighted; chroma S/N was 46.7 dB for AM (amplitude modulation, which controls color intensity)

and 46.2 dB for PM (phase modulation, which controls hue). These are typical results for very good videodiscs. The system is capable of 10 dB more on luminance and even more on chrominance, but discs capable of such performance are not generally available. These measurements were made with a ShibaSoku 925R video noise meter from playback on a Pioneer CLD-91 CD/videodisc player.

Other useful information in Chapter 2 is about studio setup, camera registration and placement, the production switcher, and studio audio checking. Chapter 3, which leads you into the world of electronic field production with Betacams, includes a wonderful demonstration of wide-screen video, with black borders at the top and bottom. I hope it encourages more people to clamor for "letterboxing" movies instead of the common practice of cutting off the sides of a wide-screen image to fill the height of the video screen ("pan and scan"). Chapter 4 tells you maybe more than you want to know about how film is transferred to video, but the analysis of the strengths and weaknesses of using negative or positive film for the transfer will help you appreciate good transfers. The still-frame sequences in Chapter 4 are mainly informational, but the clip of an SMPTE resolution chart will confirm resolution of your system up to about 400 horizontal and 340 vertical lines. (Remember that you read horizontal resolution off the calibrated vertical wedges and vertical resolution off the horizontal wedges.) Although most of Chapter 5 is occupied with test signals, there is enough theory by illustration, plus details of the laser videodisc manufacturing process, to make fascinating viewing. Most important, however, is a set of recommendations for the setup of a viewing room, with specific measurements provided on monitor height, room illumination, and speaker placement.

Audio is presented on all of the segments except the still-frame sequences. Both analog and digital tracks are used frequently, with different information on each. Audio follows the video, or is background for it, in the early chapters. Chapter 5 has specific audio demonstrations. On the analog tracks are Walton's "Facade Suite,"

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Pachelbel's "Kanon," and Respighi's "Church Windows." On the digital tracks are "Honeysuckle Rose" and "Misturada."

If you take the time to set up your viewing room as illustrated in this chapter, or use some other well-thought-out speaker placement, you'll

be ready for the exhaustive audio tests in Chapter 6. There really is a 93-dB dynamic range in Chapter 6, so heed the warnings on adjusting, or you may find yourself doing damage to your equipment (or, if that holds up, your ears). After "chapter stop" (a signal which tells the player to stop and then

go into pause or still-frame mode) come a warning about volume levels and a -20 dB pink-noise reference. These are followed by a comprehensive set of tones for both listening tests and instrument measurements, with chapter stops before the tests most likely to cause system failure or ear damage. Tones for setting Dolby and Dolby Pro-Logic surround decoders are provided, and each channel—including the surround ones—is separately exercised. Tones are provided in 20-dB steps down to -93 dB, all measuring within 1 dB of their ratings. There are also sweeps from 15 to 100 Hz and from 100 Hz to 21 kHz. More complex tones are provided for inter-modulation, D/A converter monotonicity, and square-wave reproduction. The initial listening tests for correct speaker connection, Dolby level, log sweeps, and narrow-band noise sweeps do not require test instruments, but the other tests do. The dynamic range of the disc's digital track was 93 dB, which is also the rated S/N ratio. Stereo separation and interchannel crosstalk on the digital tracks were also 93 dB; that's important in video-discs, which sometimes carry multiple mono soundtracks in different languages. Distortion of the digital signal was better than 0.01%, but the best I could measure on the analog tracks was 0.1%. Comparing these figures with those from the NAB test CD showed that the distortion on digital material was about double that of the CD, and the dynamic range about 10 dB better. All in all, if your system can meet the performance level set by the disc, it is quite good. Better performance may not be noticeable, except by the 24-karat golden-eared.

Reference Recordings' *A Video Standard* is not a test generator, but for anyone with a really good laser video-disc player and \$59.95, it can be an acceptable substitute for thousands of dollars' worth of test gear. While many high-quality test CDs are available, this is the only laser videodisc available to consumers that tests the video portion of the A/V system. It is informative on basic video testing and various production and manufacturing techniques. For that much entertainment, education, and utility, it is well worth the price. *Lancelot Braithwaite*

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## DIAMONDS IN THE RUFF



**The Flemish Masters.** Pomerium Musices, Alexander Blachly.  
**Classic Masters CMCD-1007, CD;**  
**AAD; 69:07.**

An interesting album of pure choral music, this CD, and indeed right up my own alley. The director, Alexander Blachly, was briefly, in his younger days, a member of my own chorus, the Canby Singers—at that point, he was a somewhat callow and inexperienced student. Has he learnt plenty! I must wistfully admit that this sort of group, singing this music this way, is as close to my unachieved ideals as anybody in New York City is likely to come. Somehow, Blachly has managed to get together a really in-tune, blending group of singers in a big city where loud, soloistic opera voices are the professional norm. Yet Blachly's singers are of professional grade—the amount of touring, recording, and local concert-giving this ensemble does is certainly that demanding.

Strange, the way culture often takes on a sort of flooding aspect, the artists of one area or country pouring outward to invade and inundate other musical centers. Thus, waves of Italian musicians came north to France, Germany, England, and as far as Russia during the Italian ascendancy of the 18th century. In the 16th and earlier, it went the

other way. The "Flems," as I like to call them, the musicians of the lowlands which are now Belgium, Holland, and Luxembourg (where German gives way to French, Dutch, and Flemish), travelled south. They conquered Italy by the dozens and hundreds—even though much of their music had Italian roots and their Catholic church and its language had come up from Italy. It is a group of these composers—by no means all the biggest names—which we hear on this record, mostly in church music to Latin texts but also in a number of "secular" works sung in, you guessed it, Italian.

Pomerium Musices avoids all sorts of musical pitfalls common in this area of performance. Good blend is first, and the singing is minus opera, minus big solo voices competing for loudness! Second, the music *moves*, thank the Lord. To this day (and notably in England), 16th-century church music is still often sung with much mystery and at a snail's pace (quite arbitrarily, since there is no such indication in history) for a moving but false impact, supposedly a "cathedral" sound. A Victorian figment if there ever was one.

Finally and best of all, Mr. Blachly understands that the words are the things that propel this music—their meaning, and their shape in particular. There were no bar lines; there was no

baroque beat to tap a foot to. This means good phrasing, shaping of the melodic lines, unless the music is to degenerate into meaninglessness. It often does, but not here.

To be sure, the words are not always clear for the ear that doesn't know them by heart (as most listeners of that day did). And musical complexity demands some sacrifice of intelligibility. With the texts in hand, though, the words are easily followed and, thus, the real sense of the music.

Blachly rightly uses a small solo group with a bit more personal quality for the works sung in Italian. They still blend, as indeed they should. A wisely produced album for maximum communication in recorded form, and Christopher Greenleaf, of this magazine, did the recording and editing.

*Edward Tatnall Canby*

**Schubert: Complete Songs, Vol. 4.** Philip Langridge, tenor; Graham Johnson, piano.  
**Hyperion CDJ33004, CD; DDD; 69:02.**

This fourth volume of the Hyperion Schubert Edition is a wonderful recording. Most of the songs are relatively obscure unless you're something of a Schubert fanatic, but most certainly are worth knowing and some are gems. Moreover, they are delivered with such style and conviction that you almost feel Schubert is speaking directly to you.

As pianist for the entire Schubert series, planned for completion by 1997, Graham Johnson is the thread on which all of the Schubert Edition pearls are strung (to change the metaphor slightly). Given the option, he goes for the forthright, but his focus is unwaveringly on Schubert's requirements and those of his singer. Fussy self-indulgence is notable by its absence.

The singer in this volume is Philip Langridge, of whom I had never heard before; I certainly expect to hear of him again. He is as deeply into these songs as Johnson, and he brings to them a true lieder quality, if not all aspects of the German vocal method one tends to associate with the genre. He is capable of a clarion ring at the top, a warm steadiness at the bottom (where many a tenor with such a top would be struggling), and a gorgeous-

Illustration: Rick Tulka

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ly sustained pianissimo in the middle. The voice does turn dryer at higher amplitude levels, but it retains its flexibility and, above all, the expressiveness that Langridge brings to all these songs.

The songs themselves will be the yawner for those who look for familiar names. To my taste, the first setting of "Sängers Morgenlied," "Am Strome," and "Nachtstück" all are worth the price of admission here, but it would be idle to suppose that listeners will flock to them the way they do to "Der Erlkönig" or "Ständchen." That's a pity, particularly considering the excellent background material—plus some excessively fanciful metaphors—in Johnson's notes for the booklet, which contains full texts and translations.

Hyperion lists no venue for the recording, which was made in September 1988. The acoustic is just lively enough to suggest a fairly spacious room without veiling any of the apt details that make these readings so very special.

Robert Long

**Carl Philipp Emanuel Bach: Sonatas in B Minor and C Minor for Clavier and Violin Obligato.** Huguette Dreyfus, harpsichord and fortepiano; Eduard Melkus, violin.

Denon CO-72434, CD; DDD; 49:36.

**Carl Philipp Emanuel Bach: The Complete Keyboard Fantasias.** Evelyn Garvey, fortepiano.

Elan 2214, CD; ADD; 62:36. (Available from Allegro Imports, 3434 Southeast Milwaukie Ave., Portland, Ore. 97202.)

The 200th anniversary of C. P. E. Bach's death, in 1988, was only an impetus for the continuing exploration of this middle son of J. S. Bach, born in 1714. He was one of the most influential minds of the 18th century, "the" Bach when his father's music was virtually unknown to a changed musical world. He was also one of Mozart's great mentors (42 years older), along with the youngest Bach, J. C., and, in later years, Joseph Haydn. For us today, C.P.E. is suddenly interesting because he, of all composers, best

represents the curious "in-between" period that came after the late baroque and before the so-called classic music, now returned to wide popularity with Mozart. You can hear both in this music—Mozart *and* baroque (to oversimplify!)—all in the one man.

The Fantasia, appearing on both of these recordings, was already a traditional form from earlier times. The familiar (J. S.) Bach Toccata and Fugue in D Minor for Organ is essentially a showy Fantasia, and there is the big Fantasia and Fugue in G Minor for Organ. The C. P. E. Bach Fantasias are on a smaller scale but are equally remarkable for their improvisatory manner, full of violent changes, fancy runs, weird harmonies, and much profundity of expression. C.P.E.'s faster music is brilliant and often quite Mozart-like, but at the drop of a slow movement (so to speak), he was off into deeply felt personal expressions of the Fantasia type. Mozart and even Haydn also wrote them on occasion, but the C.P.E. Fantasias extend over more than 35 years, for the clavichord or the harpsichord, and then for the early piano, which we now call the fortepiano.

Huguette Dreyfus is basically a harpsichordist in the French tradition. Of the three works with violin on her Denon CD, the first (very late—1787) is played with fortepiano, and the other two (much earlier) are with harpsichord. Her fortepiano playing, as often happens with harpsichordists, tends to be jumpy and nervous; the fortepiano keys, with their potential for both soft and loud, feel very different from the click action of harpsichord keys. The violin part, though "required," is of only nominal importance and is so played, quite correctly, by Eduard Melkus. The work with the fortepiano is a Fantasia, C.P.E.'s very last, and both quite long and remarkably soul-searching, with premonitions of death.

In contrast, Evelyn Garvey is an extraordinary artist on her fortepiano, which is an American-made replica of a Viennese Walter piano in a Mozart house in Salzburg. It seems to me an extraordinarily fine instrumental "recreation"—strong, beautifully balanced, fleet, and yet with an immense range of tone color, from the strident metal of louder high notes and the twang of the low bass to the gentlest

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Only one moderate fault in this recording, and that is a matter of programming. The pauses between the 18 works—works written dozens of years apart—are so short that you will completely miss most of them and, instead, hear a synthetic and false mega-Fantasia, all in one piece. *Much* longer pauses are needed, but, at 62:36 for the music, I assume it was impossible. And after all, this is a complete set, so you can't omit anything. So be it. Gorgeous analog recording. You can't do better in digital. *Edward Tatnall Canby*

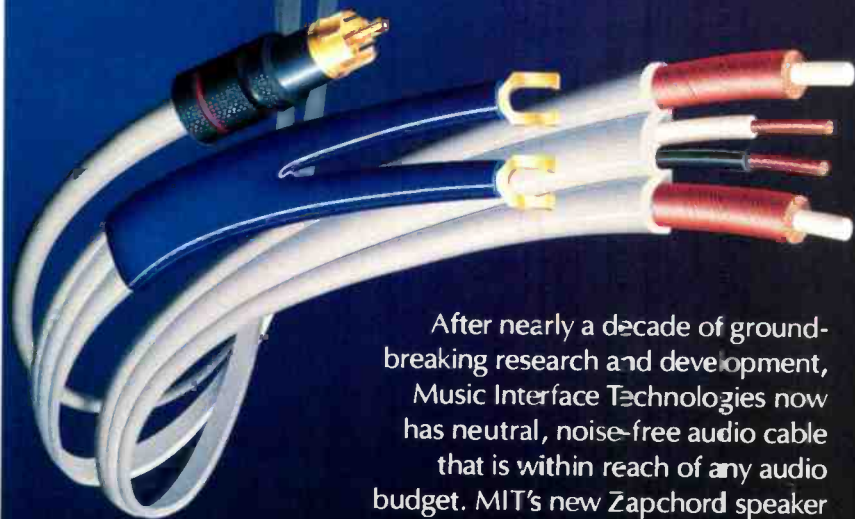
**A Touch of Romance.** Angel Romero, guitar.  
**Telarc CD-80213**, CD; DDD; 61:00.

Florid embellishment of familiar melodies, sprinkled here and there with adventuresome liberties, one eye cocked toward the popular heart—this is what the title, *A Touch of Romance*, conjures. If such is your expectation, Angel Romero's latest album will not disappoint. But in anticipating a chestnut toast, look forward, as well, to some very impressive guitar playing.

Romero, like so many guitarists nowadays, has chosen an unpromisingly conservative program with selections by Sanz, Barrios, Albéniz, a suite by his father Celedonio, and the ubiquitous anonymous "Romance" (or "Romanza"). What saves it is the execution—crystal-clear articulation full of expressive rubato, sweet dolce, and rapid-fire ornamentation which concentrates on the Romantic effect. For example, his arrangement of tunes for Sanz's familiar "Suite Espagnole" contains many of his own variations. Also of note is the "Romance," with its digitally overdubbed second part composed by Romero and actually transcribed from a version Romero wrote for Doc Severinsen's trumpet and orchestra! If a restrained side is shown at all, it's in the readings of Barrios' "Choro da Saudade," "Un Sueño en la Floresta," and "Aire de Zamba," which beg to be pushed farther in a Romantic direction than Romero chooses. His interpretation of his father's "Suite Andaluza" also favors the classical rather than flamenco elements. (His playing of the "Leyenda" is impeccable, but heaven help us, no more of this tune for a decade or so, please!)

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*Simple Gifts* enables you to make direct comparisons between studio-recorded and live versions of folk songs, an intriguing proposition.

Guitar fans should relish the exceptional control Angel Romero wields over his instrument, with every sound and nuance captured perfectly. No transformers or signal processors (compressors, limiters, or equalizers) were used throughout the entire recording chain, and full technical infor-

mation is provided. Truly jaded fanatics, however, might wonder whether the excellent performance justifies sitting through yet another "Canarios" when so much worthwhile old and new guitar music with *A Touch of Romance* is waiting to be recorded.

*Michael Wright*

**Simple Gifts.** Benjamin Luxon, Bill Crofut, and various artists.

**Omega OCD-3003**, CD; DDD and ADD; 72:28.

Crofut and Luxon—American folk singer and British opera singer, respectively—obviously take great pleasure in the folk music they toss back and forth in a sort of short course in comparative ethnomusicology. They do it very well, and audiences love it—whether at their concerts or on disc.

This CD offers a direct comparison between the two. The first half, approximately, is from a digital tape recorded live at Tanglewood during the summer of 1986. The second is from an analog studio tape and duplicates the previous *Simple Gifts* LP. Much as I like the music, I find the live/canned comparison even more engrossing.

"Canned" because the second half has difficulty sounding convincing after you've heard the first half, whose verve and pulse make the occasional audience noise or minor tongue-twist unimportant. An ad-lib correction in "Devil's Wife" actually adds to the enjoyment. If you have wide-range speakers, the very low-frequency stage noise may convince you that someone's trundling an office safe through the next room, but even that adds to the sense of liveness.

I'm sure many listeners will prefer the polish and the absence of extraneous noise in the studio job, which was begun at the BBC and added to by overdubbing in this country—perhaps over years, though Crofut's engaging notes aren't specific on this point. He particularly comments on the "simplicity" of the studio version, though overall that's one of my reasons for preferring the live one. Luxon's excellent, unaccompanied "She Moved Through the Fair" on the analog half is offset, in this respect, by the overdone jangliness of the "Old Paint/The Carter" track.

The bottom line, however, is that stage and studio are essentially two different media and require that the material be rethought for each. Technically, the Tanglewood tape is the better—if you ignore the extraneous noise. The studio job is a shade gritty in some of the voice tracks, and the stereo imaging leaves me unconvinced, but it's still entirely satisfactory. *Robert Long*

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## DUDE'S BACK



**Back on the Block:** Quincy Jones  
**Qwest/Warner Bros. 26020**, CD;  
 DDD; 57:54.

Sound: A                      Performance: A

Arriving amidst a publicity paper trail guaranteed to offend conservationists everywhere, Quincy Jones' *Back on the Block* is on the streets and in the stores. Try not to get distracted by the hoopla surrounding Jones' first album since *The Dude* in 1981. Brush aside the hype, and get good and serious with *Back on the Block*—you'll be rewarded.

This is much more than just a new collection of songs. You'll find a trip through time here. A voyage into the evolution of American music. Not that Jones has recorded a National Geographic Society-style spoken-word record capable of boring you into a coma. No way! What we've got is a gathering of wildly diverse talents, many of them masters of their musical niches.

Yo, check it out! Rappers Kool Moe Dee and Big Daddy Kane introducing Miles Davis, Ella Fitzgerald, James Moody, Sarah Vaughan, and others in a boiling update of Joe Zawinul's "Birdland." Chaka Khan and a supremely relaxed Ray Charles melding

styles to create a dance hit, "I'll Be Good to You." R&B meets African tribal chants; a cappella song meets the computer.

Quincy Jones, of course, is the man in the control tower for this flight. *Back on the Block* exemplifies why "Q" has become our most respected producer. He is a man who can set the stage with his arrangements and then get out of the way, letting the musicians take over. The ultimate musical conduit. Only someone open to, and expert in, all musical styles would have been capable of writing the arrangements necessary for such a dizzying variety of music (yes, Gillespie's on board, too).

The arrangements are a big reason why *Block* is also so sonically sharp. It would have been impossible to record, edit, and mix this mélange into a cohesive package without precise, clean arrangements. Still, few engineers could have handled the job as well as Bruce Swedien, who has worked with Jones for years on sessions for artists from Count Basie to Michael Jackson. Swedien records using what he's dubbed Acusonics—essentially, his own left/right stereo miking technique, intended to capture the true sound field heard in the studio. The effect can be moving, especially with vocal

choirs—listen to *Block's* "The Places You Find Love."

There's no way around it: *Back on the Block* is a cornucopia of talent and great music. It took Quincy Jones a long time to deliver, but the wait was worth it.

Hector G. La Torre

**You Can't Do That On Stage Any-more, Vol. 3:** Frank Zappa

**Rykodisc 10085 and 10086**, two CDs;  
 ADD or DDD; 1:06:33 and 1:08:36.

Sound: B—                      Performance: C

*You Can't Do That On Stage Any-more, Vol. 3* continues to chronicle the odd appeal of Frank Zappa, who seems perennially caught between the roles of social satirist and composer/improviser. Culling from live recordings, in this case from 1971 through 1984, Zappa freely mixes 'n' matches, combining three or four different performances in any given piece, and a couple of different bands as well.

Since Zappa's scathing 1960s barbs, *We're Only in It for the Money*, *Absolutely Free*, and *Freak Out*, his humor has continually reveled in locker-room humor for a mostly male audience. It's all sung in a pseudo doo-wop style that's tiresome in its monotonous harmonies.

But as a longtime, devoted Zappa-ophile friend of mine insists: Sure the humor is juvenile, but listen to the music, the odd meters and the solos. And that's all true. Zappa takes a haunting, slow-motion, note-bending solo on "Zoot Allures" that makes you realize he's got other emotions besides rage and juvenile sarcasm. These moods are very much in evidence on "King Kong." Here Zappa combines two different bands, from 1971 and 1982, at four different locations. It's a tour de force of sudden tempo shifts that moves through reggae, free jazz, and dirty blues. Zappa's solos are vicious excursions with uncanny structure and form, the kind of solos that make people say, "Shut up and play yer guitar." "King Kong," however, also points to the slick professionalism of Zappa's 1980s groups, compared to the more open, anarchic spirit of his earlier ensembles.

But, of course, there remain lines like "My car is fast, my teeth are shiny, tell all the girls they can kiss my hiney,"

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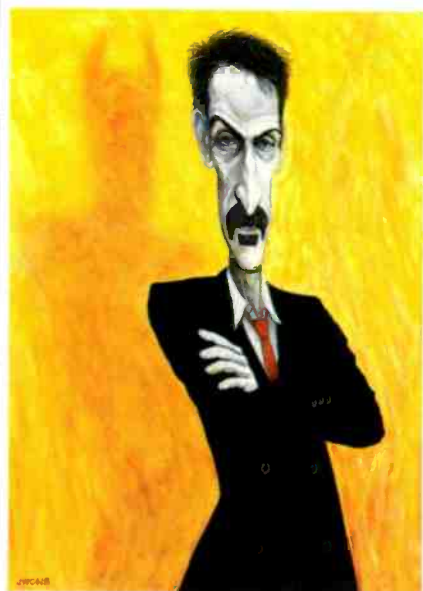
Robbie Shakespeare, KRS-One, and Sly Dunbar

from "Bobby Brown Goes Down." So, is this the guy we want testifying before Congress against censorship in rock? Definitely! Zappa will be the first and last to defend our right to not listen.

Given the various formats of this record and the rampant intersplicing of performances, Zappa maintains an audio integrity throughout, with good dynamic range, stereo separation, and effects. He also allows quite a few amplifier buzzes and hums, in the interest of history.

People probably think the title means you can't bring this kind of outrage and off-color farce to the stage anymore. But in these days of computer-programmed pop and freeze-dried performances tied more to lighting effects and smoke bombs than to music, Zappa is really recalling when performances were spontaneous and live.

John Diliberto



**Silent Assassin:** Sly & Robbie  
Island 91277, CD; DDD; 60:28.

Sound: B Performance: B

Rap music has gone from sensation to international institution, but Sly Dunbar and Robbie Shakespeare, rhythm section *extraordinaire*, aren't just jumping onto the bandwagon with this album—they're rushing to the rescue. They sidestep the pitfalls of the Sideman Syndrome by doing what they do best—play drums and bass—rather than trying to promote their other tal-

ents. By doing so, they give rap music a vital boost.

Rap needs a strong backbone, a solid, unassuming rhythmic framework against which the staccato vocals can play. On most rap records it's little more than an electronically generated pulse, functional but colorless. Sly and Robbie, heavyweight rhythmatsists, use real bass, real drums, and keyboards, horns, and guitars to bring the rappers' rhythmic backdrop alive, turning it into a dynamic and supple presence with which the voices spar and dance. They've enlisted five top rappers and a super-producer, KRS-One. A rapper himself (and sometime Harvard lecturer), KRS-One (a.k.a. Kris Parker) is also a founder of the Stop the Violence Movement, a coalition of artists that fights crime and illiteracy.

The lyrics on *Silent Assassin*, composed by the performers, tackle these issues with candor, optimism, and, often, wry sophistication. The songs all show the fruitlessness of violence; going deeper, they suggest how the system itself must be changed in order to work things out.

Susan Borey

**Transverse City:** Warren Zevon  
Virgin 91068, LP.

Sound: B+ Performance: C-

A few years ago, in a review of Warren Zevon's concert videocassette, I facetiously said he was better when he was a drunk. I've always sort of hated myself for that—being tongue-in-cheek about a horrible disease—and while I'm happy, of course, that the enormously talented Zevon has cleaned up his habits, I'm rather sorry he's cleaned up his demons. Because *Transverse City* is even more mediocre than 1987's supposed comeback album, *Sentimental Hygiene*. Somebody get this man to a Fassbinder movie, quick!

From someone who's found rage, pity, and humor in the hearts of mercenaries, zoo gorillas, Mexican lovers, and London werewolves, Zevon's latest concerns and insights are trite. Under the supposed thematic umbrella of

yet one more cyberpunk future (cf. *Blade Runner* and TV's *Max Headroom*), he tells us we're a consumerist society that gets into traffic jams every day at 5 p.m. And that computers are in the home and workplace. So what? Now what?

Structurally, the 10 songs don't have the tortured grace of Zevon's best writing. Virtually all the songs rely on endlessly repeated choruses. That beloved jaunty insouciance is gone. And despite the rare case where Zevon's lyrics and music are as biting as in the old days ("Splendid Isolation"), both here are too often thin and hackneyed. My C- rating would have been even lower, except that the playing itself (by the likes of Neil Young, David Gilmour, and Jerry Garcia) is so slick and lush. Happily, Zevon's voice still rumbles like a grumpy god's, and his vocal range, while noticeably smaller than in such masterpieces as *Warren Zevon*, *Excitable Boy*, *Bad Luck Streak in Dancing School*, and *Stand in the Fire*, still is adequate for the job. But then, Zevon doesn't ask it for much; on some songs, particularly "Networking," he sounds bored, enervated.

Given the two years since his previous album—time enough to polish, rewrite, throw out—*Transverse City* is disappointing. Zevon long ago proved himself one of our most talented poet-musicians, but I think he's in danger of becoming the Orson Welles of rock.

Frank Lovece



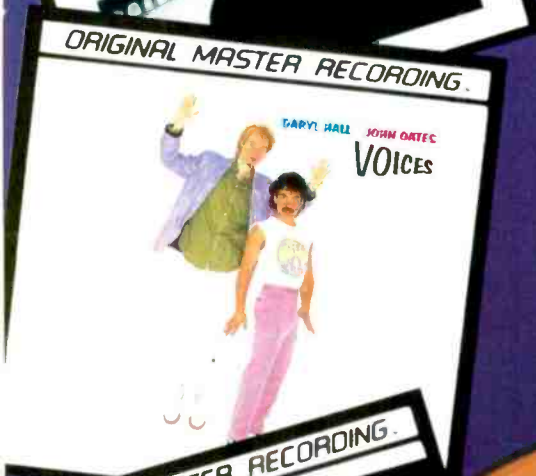
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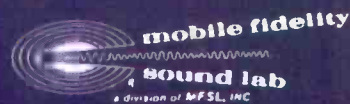
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*Acadie* is one of those uncommon, mood-establishing albums; playing it, I kept going to the window to see if rain was falling.

**Acadie:** Daniel Lanois  
**Opal/Warner Bros. 25969, CD; AAD;**  
 41:21.

**Sound:** B -                      **Performance:** B -

You've got to give engineer/producer Daniel Lanois credit on at least two fronts: First, for having the guts to

make an album of (mostly) self-penned music, leaving himself open to criticism for not "sticking to his job," and second, for making the most of the opportunity and actually coming across with the goods. This is a highly entertaining, unusually atmospheric set of 12 songs.

*Acadie* is Daniel Lanois' maiden voyage as an artist. (He's gained his fame as the producer/engineer for the Neville's, U2, and Bob Dylan, among others.) It's an album steeped in the culture of North America's Acadian region, a tradition—dig out your history books—long established in Louisiana, where it was gumbified and gave birth to Cajun music.

Sung in French and English, and often using prose-style lyrics placed into musical beds (as opposed to lyrics written specifically as pop songs), *Acadie* falls very much outside the normal standards for a popular release. It's one of those uncommon albums which seem to change the atmosphere in your listening room—every time I listened to it, I found myself going to the window to check if it was raining. The lyrics build a sad, blue, almost dreary mood by combining religious images with tough workaday settings. Even the uptempo tunes come off as dark and introspective.

The music strongly supports the lyrics. Brian Eno (Opal is his label) programmed the keyboard patches (sounds), an integral part of the music's blue mood. Also lending support are U2's Adam Clayton and Larry Mullen, some Neville's (including Aaron, singing lead on "Amazing Grace"), and engineer/multi-instrumentalist Malcolm Burn, among others. Listeners will notice the U2 influence on "Where the Hawkwind Kills" and "St. Ann's Gold," with their sparse, open sound (and slightly histrionic vocals).

Despite what you might expect, Lanois and co-engineers Burn and Mark Howard didn't strive for an ultra-impressive sonic statement. This probably would have been impossible anyway; *Acadie* was recorded in snippets over several years at studios (and on portable recorders) in England, Ireland, Canada, and the U.S. Nonetheless, the album manages to convey a unified image, and Lanois deserves credit for keeping it from becoming disorientingly diverse. While certainly self-indulgent (as, perhaps, any highly personal musical effort of this nature needs to be), *Acadie* is well-crafted and original. It may reach only a small audience, but it will provide that audience with a lot of interesting listening.

Hector G. La Torre

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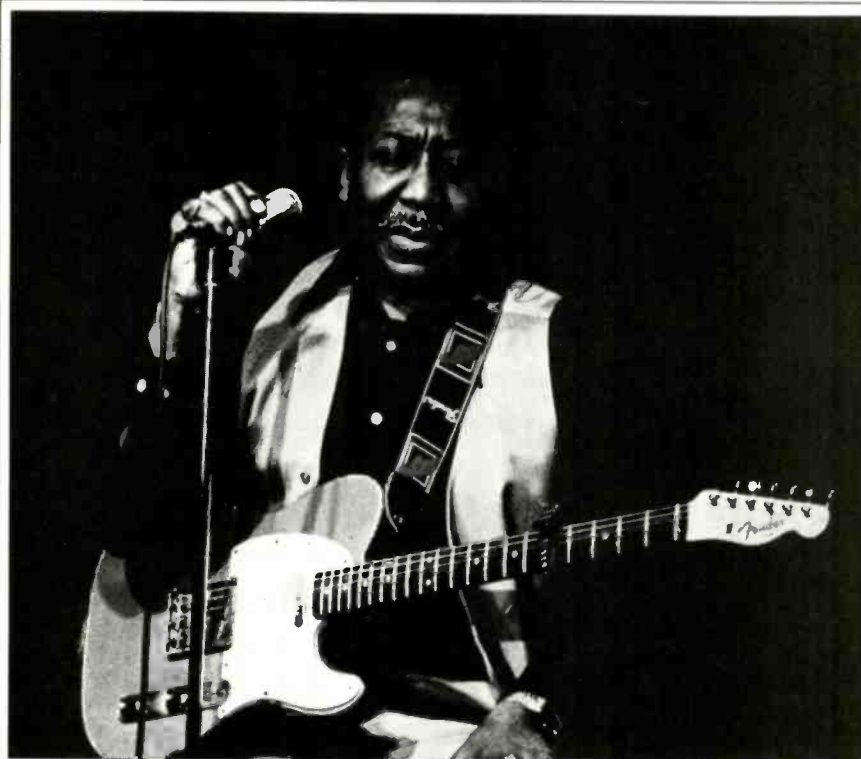
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## THAT'S SPELLED M-A-N



**The Chess Box:** Muddy Waters  
**Chess/MCA CH6-80002**, six LPs.

Sound: B Performance: A

He could have been a character in one of his songs. McKinley Morganfield's rise from sweating west-Mississippi tractor driver to Muddy Waters, King of the Chicago Blues, was a feat no less heroic than the tall-tale exploits of the mojo men and hoochie-coochie boys he sang about for 40 years.

This six-record package starts in the '40s, with Muddy just another deep-South emigrant to the Windy City. His music, steeped in the rich Delta tradition of Son House and Robert Johnson, was readily appreciated by other homesick Southerners, who bought out the first pressing of 1948's rural-sounding "I Can't Be Satisfied" in 24 hours.

When Chess Records refused to record Muddy's new amplified group for fear of jeopardizing his downhome sound, he surreptitiously recorded for a rival label; the success of "Rollin' and Tumblin'" on Parkway helped bring Muddy's band into the studio.

The band seemed to feature nothing but legends-in-the-making: Little Walter (breaking new ground with a revolu-

tionary amplified harp style), Big Walter, or James Cotton on blues harp; Otis Spann on piano; Muddy, Jimmy Rogers, Pat Hare, or Luther Tucker on guitar; Francey Clay on drums, and usually Willie Dixon on bass. So began Muddy's golden string: "She Moves Me," "Long Distance Call," "Baby Please Don't Go," "Hoochie Coochie Man," and other songs that now form the bedrock of the blues. Muddy's boastful, virile singing was the zenith of the declamatory Delta style. When he sings "Someday baby you ain't gonna trouble . . . poor me . . . anymore," you can't miss the menace in his growls that suggests the offending female would be lucky to be banished from merely *his* life. As his band's work progressively became more explosive, so did Muddy's vocals. No matter that his ferocious attack obliterates portions of "Don't Go No Further"—he could be shouting almost anything with equal effect. When the band responded with back-of-the-barroom yells, as on "Mannish Boy," Chicago blues was in its glory.

When Chuck Berry begged Maybeline to be true in 1955, the classic bluesmen's days were numbered.

Muddy faced the onslaught of rock 'n' roll with a series of experiments: *Folk Singer*, a satisfactory acoustic attempt to woo the growing folk-revivalist audience; *Muddy, Brass & The Blues*, represented here by a single, hornless track, and *Fathers and Sons*, which successfully paired Muddy with his enthusiastic students Paul Butterfield and Mike Bloomfield. Justly relegated to liner-note footnotes are such embarrassing capitulations to pop trends as *Electric Mud* and *After the Rain*, as well as Muddy's matchups with other fading (and equally uncomfortable) giants on *Super Blues* and *The Super Blues Band*.

*The Chess Box* represents the sort of well-designed, well-packaged compilation that too often eluded the prior owners of the Chess catalog. The combination of classics and 23 rare and unreleased performances ensures that this will be the Muddy Waters album that will find its way into collections around the world. Roy Greenberg

**The Best Of, Vol. 2:** Little Walter  
**Chess/MCA 9292**, LP.

Sound: B Performance: A

If you've ever heard anyone blow blues harmonica, you've heard the legacy of Little Walter Jacobs. His breathtaking creativity has made his influence inescapable; not just his songs, but his riffs, even his attitude, are quoted by a generation of harp men. Walter's refusal to accept the harmonica's secondary role in blues bands led him to redefine the instrument's role, and the blues was reshaped in the process.

Little Walter amplified his harp not merely to be heard over the din of other electric instruments, but to develop an aggressive technique and fat, buzz-saw tone that elevated the harp to lead instrument. His bands, anchored by former jazz drummer Fred Below, favored a lilting, skipping rhythm more typical of, say, jump-blues star Louis Jordan than of Walter's own Chicago contemporaries. Walter's sidemen included the cream of Chess Records: Pianist Otis Spann (his mate in Muddy Waters' band) and such first-rate guitarists as Robert Jr. Lockwood, Luther Tucker, Freddie Robinson, and Louis and David Myers.

Photograph: ©David Gahr



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The Evans album sings, the Petrucciani doesn't—sort of. Michel Petrucciani is a very strong pianist, but on this date he wanders.



The album's title is a bit of a misnomer; almost everything Walter cut ranks with his best work. All the tracks are standouts, but the previously unreleased 1952 "Boogie" demands the most attention. Inexplicably unreleased during Walter's lifetime, the instrumental is an uninterrupted flow of brilliance. Walter once said he sang in order to catch his breath, but don't let his modesty fool you: As "Key to the Highway" shows, he was a sensitive singer.

Bargain-priced for a minimal sum that will make older collectors weep into their wallets, this set is indispensable.

Roy Greenberg

**The Solo Sessions, Vol. 1:** Bill Evans  
Milestone 9170, LP.

Sound: A — Performance: A

**Music:** Michel Petrucciani  
Blue Note 92563, CD: AAD: 42:22.

Sound: A — Performance: B

The teacher and (at least to an extent) the disciple arrive with albums made a quarter-century apart. Producer Orrin Keepnews has reissued a solo piano date from January 1963 by the late Bill Evans (issued originally as part of Riverside's Bill Evans boxed set); pianist-turned multi-keyboardist Michel Petrucciani, meanwhile, offers us a concoction of small-group, acoustic material and larger band, more commercial-sounding extravaganzas. *Music* attempts to fuse Petrucciani with electric basses, synthesizers, and Hammond B-3 organ.

Plainly and simply: The Evans sings, the Petrucciani doesn't—sort of. To compare is almost unfair; this is some of the most moving, gut-wrenching Evans you'll ever hear. Bill Evans' elegance may be unparalleled in jazz history. His single-note playing on Miles Davis' "Nardis" is everything Keith Jarrett has tried to be and everything George Winston wishes to be. The entire album, which includes Evans' readings of "What Kind of Fool Am I?" "When I Fall in Love," the "Love Theme" from *Spartacus*, and "Everything Happens to Me," is exquisite, if not extraordinary.

While Evans moves with purpose and resolve, Petrucciani doesn't. There's no doubt that Petrucciani is one of the strongest pianists around, but this date seems to wander in comparison with his previous albums—say,

his trio effort with Wayne Shorter. Petrucciani dabbles in South Americanisms on "Brazilian Suite No. 2"; on "Looking Up," he reminds one of early Steps Ahead. "Memories of Paris" is an austere, romantic ballad with a strong bridge; "Play Me," a funky blues, borders on the sophomoric (especially for Petrucciani). The two added CD cuts, "Happy Birthday Mr. K" and "Thinking of Wayne," come last. That's no accident, I fear; they're the album's most adventurous offerings, the former a straight-ahead acoustic trio plus percussion, the latter a mostly electric sextet arrangement with Petrucciani doubling on Steinway and synthesizer and Joe Lovano shining on soprano sax.

Bill Evans' playing and ideas seem effortless, flowing freely from song to song. With Petrucciani's *Music*, while many of the pieces have bright moments, they don't add up.

Jon W. Poses

**Stardust and Much More:** Hoagy Carmichael

RCA Bluebird 8333, CD: AAD: 67:14.

Sound: B — Performance: A

As a student and fan of 20th-century American popular song, I've always had an especially warm place in my heart for Hoagy Carmichael. And not just for that ultimate chestnut "Stardust." Through all his songs run threads of romance and a laconic humor that's as purely American as his Indiana boyhood.

This new Bluebird collection contains 19 recordings from 1927 to 1934, plus two unissued 1960 takes of "Stardust," one sung and one recited, each to Hoagy's solo piano. Six of the old cuts are also solo performances, including a 1934 "Stardust." The rest are hot orchestra takes, including "Washboard Blues" and "Rocking Chair" (two takes each), "Georgia on My Mind," "Lazy Bones," and "Judy." This collection is a primer of a great American songman's work.

It's been processed with the No-Noise system. Since six of the selections also appeared on RCA's 1979 "Legendary Performer" Carmichael set, sonic comparisons are easy to make. The new set clearly has a more vibrant, detailed, punchy sound, but it



Bill Evans

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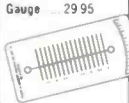
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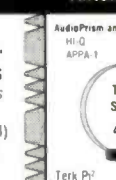
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suming the work would be sober and academic, maybe even didactic. Well, forget about that, because *Shadows* is, in common parlance, all-the-way live. In fact, the finale is arguably the best work this Fort Worth native has ever done.

*Shadows'* subtext is the northward migration of black Americans during the half-century following the Emancipation Proclamation. From the start, with Don Preston's jaunty, jangly piano on "Sippi Strut," Carter's octet captures the sense of expectation and momentum. There are moments on *Shadows* when the music hurtles through a chaotic jumble of emotions, styles, and sounds, like a train rushing headlong to some unknown destiny.

Just as Carter's lyrics sparkle with the glitter and allure of big-city streets and fortune, the octet bristles with virtuoso performances. At times, Carter's riffing, twisting clarinet lines and Bobby Bradford's dry, crackling trumpet bring to mind the darting duets of Ornette Coleman and Don Cherry. Soloists such as trombonist Benny Powell, whose muted snorts and guffaws evoke the territory bands of the Southwest, and bass clarinetist/flutist Marty Ehrlich, whose swooping, tumbling lines seem an abstraction of a street-corner crooner, echo the moaned, song-sermon-like vocals of Terry Jenoure. On "52nd Street Stomp," Carter augments the octet with three gospel singers and an organist for some bracing harmonies.

*Shadows* is the type of rich orchestral work whose brilliant mosaic reveals more and more detail on repeated hearings. This doesn't mean it is cluttered. On the contrary, *Shadows* is propulsive. It chortles through "Spats" on the energy of Andrew Cyrille's percussive brushwork, wobbles majestically through the blues of "City Streets" atop Fred Hopkins' hammering bass, and soars through the boppish anthem "Hymn to Freedom." Carter has so perfectly balanced the solo statement with the ensemble's contrapuntal lines, cacophony with sweet harmony, and jaggedness with elegant swing, that *Shadows on a Wall* has to be considered not only his tour de force, but one of the most startling jazz albums released in the past 12 months.

Don Palmer

is also harsher and harder edged. I'm not entirely sure if that's better. Despite the electronically reprocessed stereo of the earlier release and its cooler mastered sound, it still sounds warmer. In its defense, *Stardust and Much More* has as much clarity and detail as you could hope for. At a relatively soft and comfortable listening level, No-Noise's harshness is, essentially, negated.

Michael Tearson

**Chicago/The Blues/Today! Vols. 1, 2 & 3:** Various artists

**Vanguard VMD-79216, VMD-79217, VMD-79218,** three CDS; AAD; 45:27; 45:17; 40:21.

Sound: A Performance: A

Crack open the champagne, blues lovers—Vanguard has just released the Chicago blues collector, digitally remastered for CD: The three-volume *Chicago/The Blues/Today!* Originally released in 1966, these records, produced by Sam Charters, capture some of Chi-town's best electric blues artists in their prime, preserving an invaluable slice of American music history.

Volume One leads off with The Junior Wells Chicago Blues Band (with a hot young Buddy Guy on guitar). J. B. Hutto and His Hawks are funkier, driven by Hutto's slide guitar and more countrified singing. Otis Spann, one of the Windy City's best ivory tinklers,



John Carter

boogie-woogies with only drum accompaniment through instrumental and vocal numbers.

Volume Two brings The James Cotton Blues Quartet center stage, as the now-ubiquitous vocalist/harpist propels his quartet over a strong shuffle beat. The Otis Rush Blues Band plays in a much jazzier mode, with Rush's mellow guitar tone and style sounding much like B. B. King's. Homesick James and His Dusters career with James Williamson's nasty slide guitar through rave-ups of "Set a Date" (with Willie Dixon on bass) and Robert Johnson's "Dust My Broom."

Volume Three highlights work by three more obscure bands, all featuring the harp work of legend Walter Horton: Johnny Young's South Side Blues Band (including some rare blues mandolin on "Stealin' Back"), The Johnny Shines Blues Band, and Big Walter Horton's Blues Harp Band with Memphis Charlie (this last notable for a harmonica duet between Horton and Charlie Musselwhite).

The transfer to CD of these classic performances is very clean, with very little noise. The original recordings were not great in terms of spatial depth and remain a little compressed sonically. Still, *Chicago/The Blues/Today!* puts you in the front row down at Theresa's Lounge (without the smoke and the crowd), in the days when blues ruled, and that's a heady experience. Essential listening.

Michael Wright

**Shadows on a Wall:** John Carter  
**Gramavision 79422,** CD; AAD; 53:29.

Sound: A Performance: A

*Shadows on a Wall* is the fifth and last section of composer/clarinetist John Carter's suite *Roots and Folklore: Episodes in the Development of American Folk Music*. With a title like that, most anyone could be forgiven for as-



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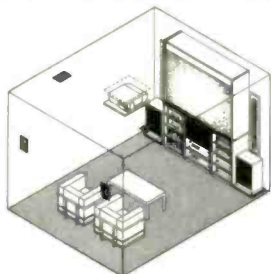
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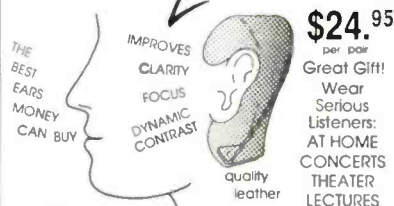
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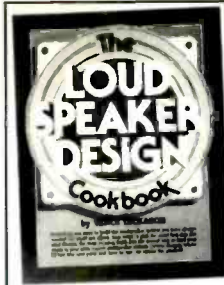
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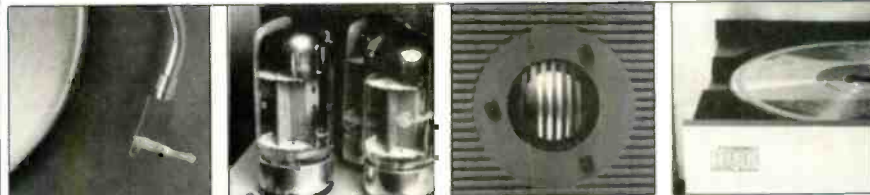
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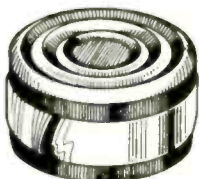
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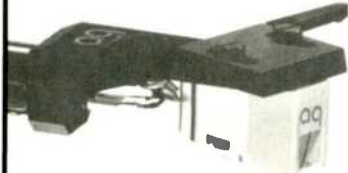
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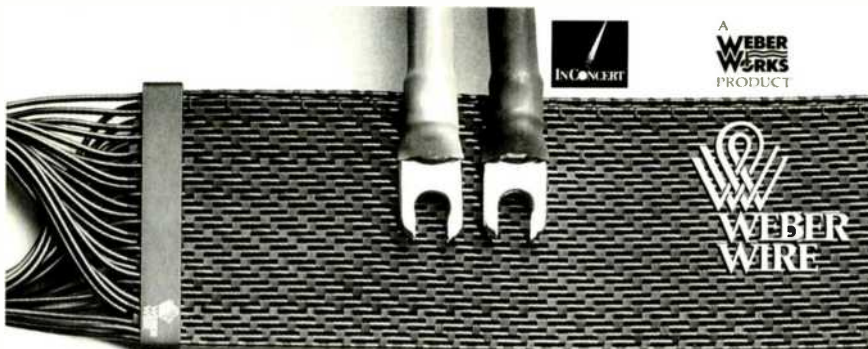
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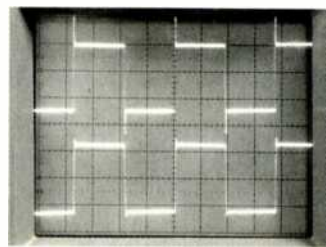
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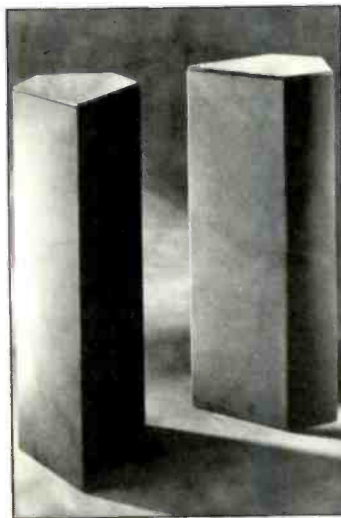
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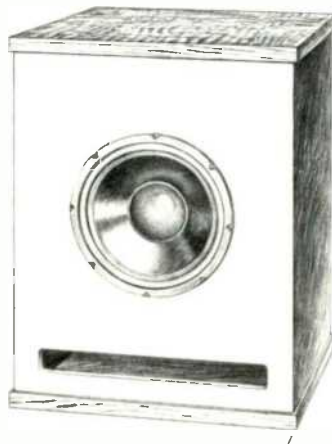
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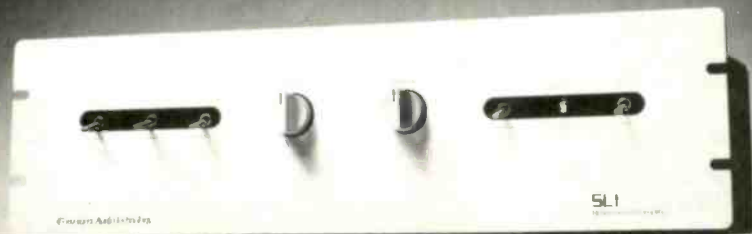
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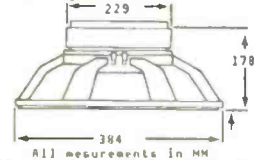
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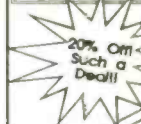
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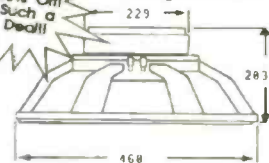


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Q's	.36	.30
VB/F3	200Lt./48Hz	90Lt./63Hz
Magnet Wgt.	4.9 lbs	
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Sledgehammer 18 Inch



All measurements in MM

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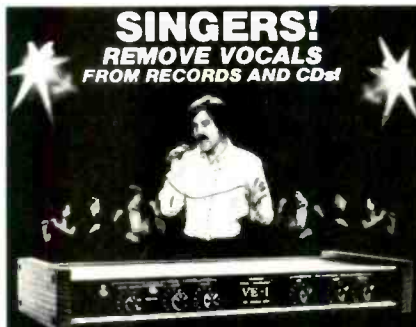
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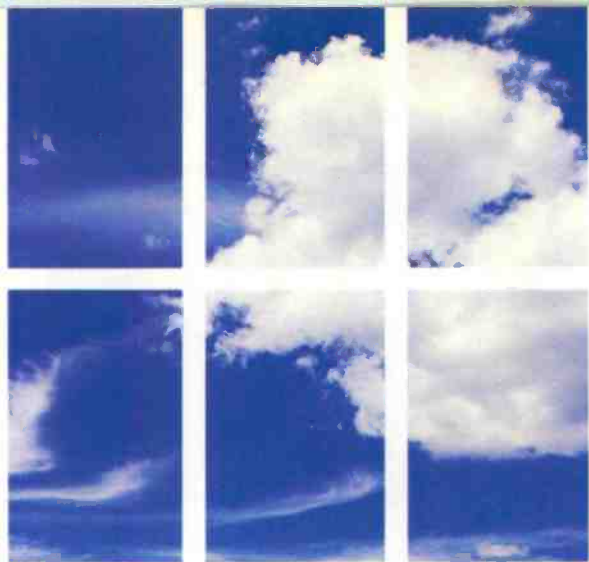
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