

Audio

The
Authoritative
Magazine
About
High Fidelity

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**PHASE TESTING IN
PHONO CARTRIDGES**

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SNEAK PREVIEW!!!

**SHARP DX-3
COMPACT DISC
PLAYER**

**VISIT TO THE
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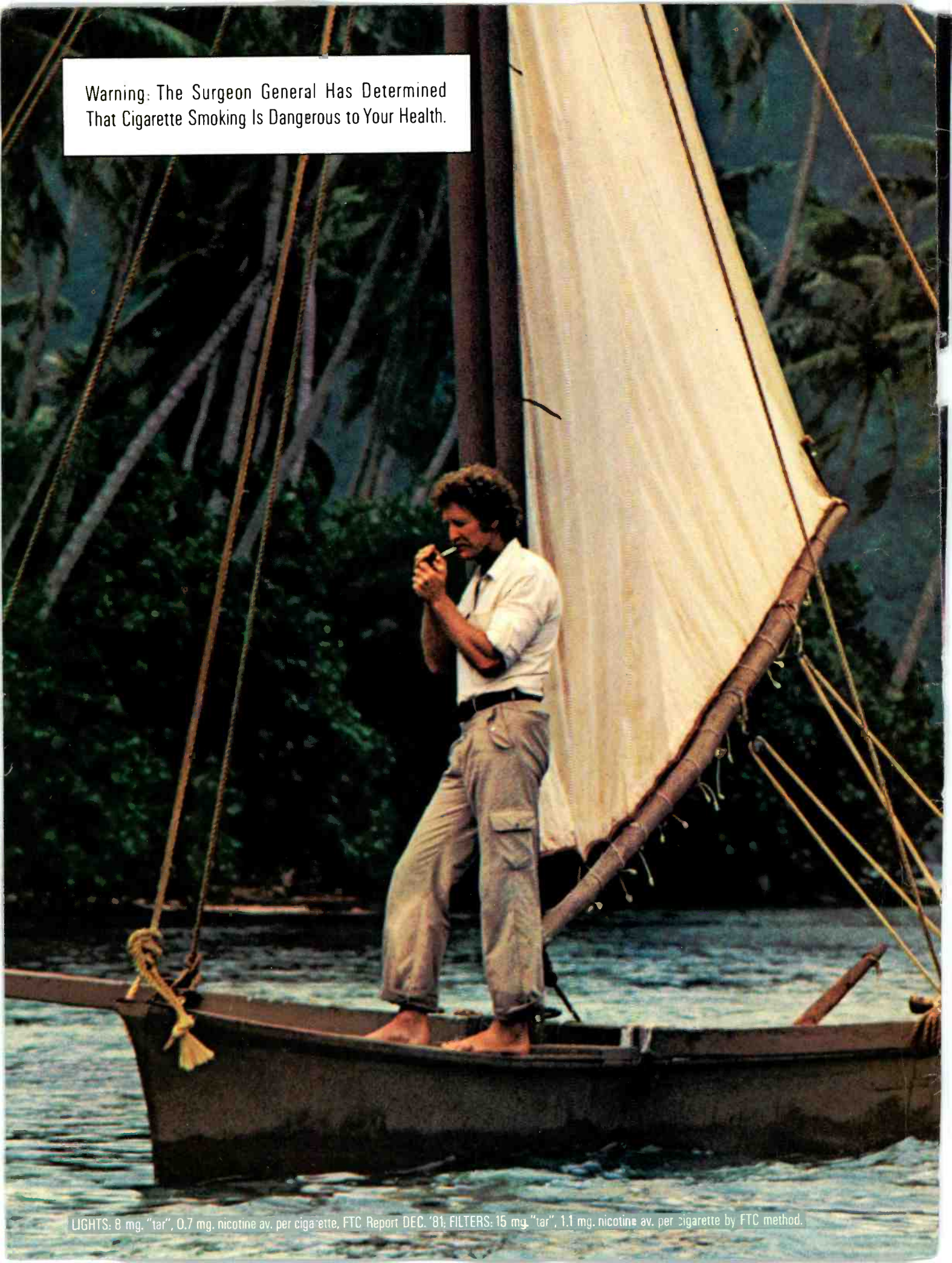


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Audio

MARCH 1983

VOL. 67, NO. 3

Where to reserve seventh row, center. Forever.



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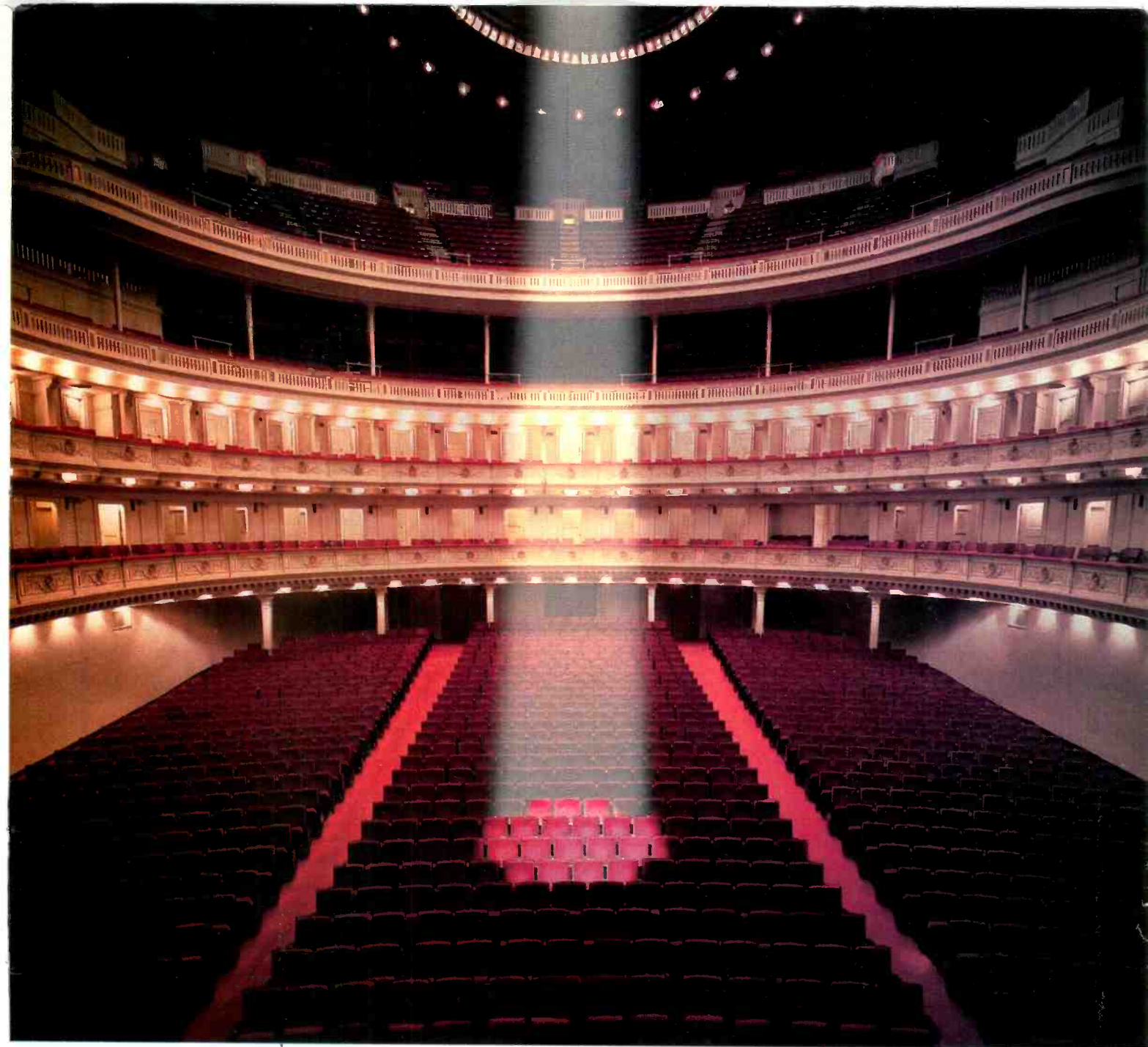
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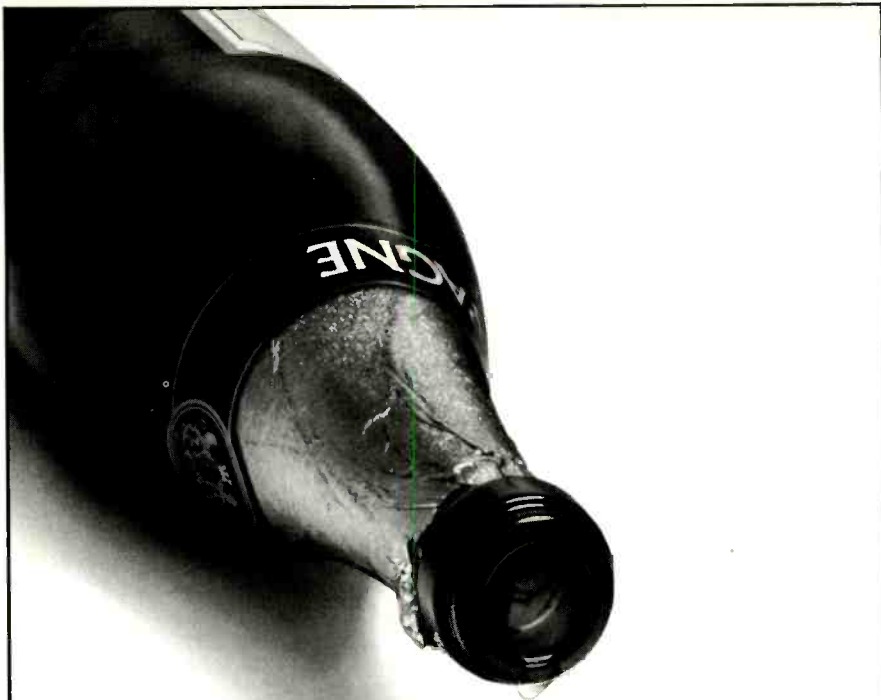
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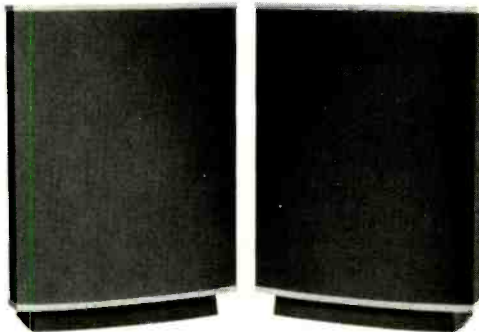


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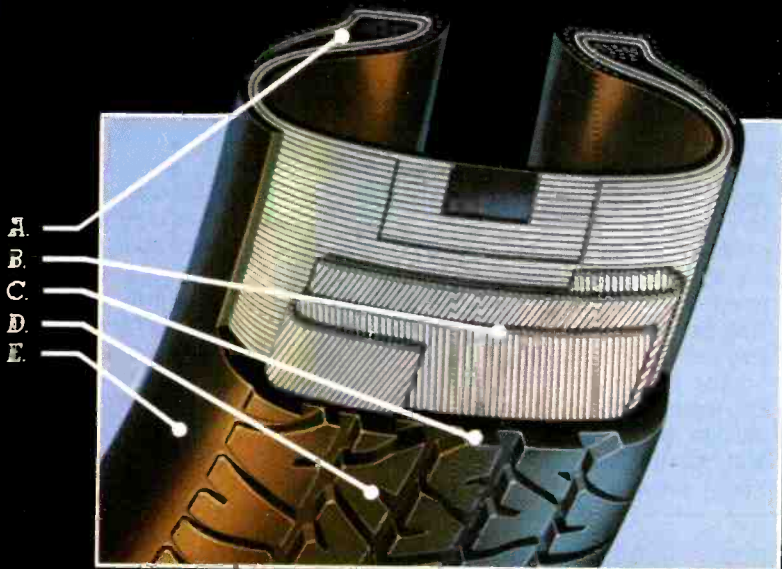
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TALKIES, STEREO STYLE

I think maybe I'll stay with pure audio, two-channel, for awhile longer. My first experience with homemade hi-fi stereo sound wedded directly to the TV image was, shall I say, soul shaking. It was David (me) and Goliath, but David didn't win. I'm not discouraged! There's a gleam in my eye, and I'll be back. Meanwhile, I've played around with some of the fanciest equipment, a brand-new VCR equipped with—yes—two discrete channels of audio. And a video camera to match.

My thought was simple and, I think, a valid one. Hi-fi stereo and color video pictures are at last getting together for the consumer. Terrific idea but why limit it? As noted last month, there is more to come, much, much more. All in due time, but do you think I'm going to wait? I wanted to try for myself, insofar as I could, ahead of time. All you really need, my argument went, would be one of the new VCRs that will take down any two-channel audio you want, instead of the obstinate mono of all previous equipment. And, if you want to make your own, not merely copy things off the professional tube, you'll need a set of mikes and that camera.

Well, it's one thing to limit yourself to ready-made professional offerings and quite another to get out there and do your own, as anybody ought to know, including me. You very quickly learn respect for the pros, the people who provide us with most of our vaunted hi-fi sound, ready to play, and those who produce the home TV image. You don't just transfer all that technique to the home consumer area with a couple of snaps of the finger. Hobbyist stuff is a lot trickier than we sometimes think.

Yet the old human spirit won't be kept down and "hobbyism" usually gets there, eventually, if with modifications. Thus it becomes "commercial" again and again. In every area of this sort there is a steady outflow from the professional into home hobby, a sort of leakage. The line between the two is never really sharp. The better the pro stuff gets, the more are the amateurs inspired. And so, as it specializes and adapts, do-it-yourself becomes an enormous market with its own ever-so-definite demands on the designers and manufacturers. From the very first Kodak Brownie right up to instant Po-

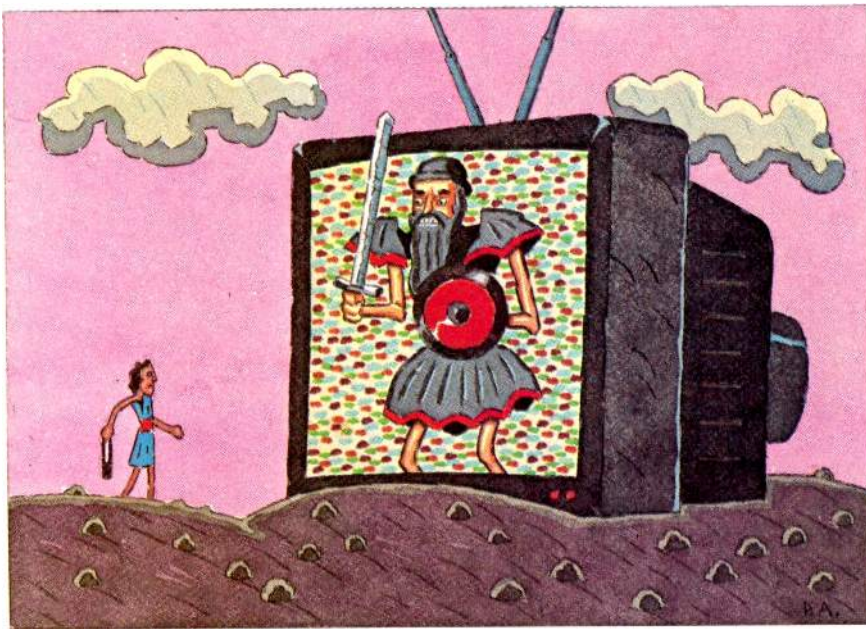


Illustration: Philip Anderson

laroid, from Edison's cylinder to Philips' cassettes, we on the outside have horned right in on technology to demand equipment that we can use.

I do see it coming. First, "home" video pictures with home sound attached, versatile, with those dual audio channels, apt for all sorts of marvelous new things, once that revolutionary Phase III gets started: Micro miniaturization of video components, the elimination of the Tube, a whole new age of video technology. Hitachi already has its video camera without a tube and talks busily in its ads of cameras the size of cigarette packs. Just go on from there—that's what I mean.

So I borrowed an Akai VS-7U video-cassette recorder, VHS and stereo capable. Also a video camera, the VC-X2, a little five-pounder (tiny as compared with studio pro cameras). With enthusiasm, I set about making for myself a few futuristic examples of ATV, home pictures combined with home hi-fi. Phew! Did I soon begin to sweat.

Yes, in the end I got a few shaky home-type "movies" of self and friends—like so many home films the very first time you try. I was embarrassed at myself—I thought I knew how to take movies, but this was something else again. No, video is not merely an electronic version of old-fashioned film! Wish I could go into details—later,

later. But what matters is this: Yes, we *talked*, visibly and audibly, right there on my giant 19-inch monitor. With instant playback, faster than Polaroid. Shaky or no, my friends were astonished and delighted to see and hear themselves too. The potential was obvious! This could be far ahead of anything that ever previously moved and talked via recording, consumer-style.

But it's still today, and by the time I got all this to working, more or less, I had accumulated maybe 200 pounds of decidedly non-portable gear and a roomful of cables. Reminded me of my first experiments with "home" stereo recording, long before the audio cassette. The nearest I got to the great outdoors, where most consumer pictures are made, was the steps of my front porch via extension cables. No matter. I got the feel of what is in the future. Yes, I know there are portable VCRs, including JVC's little five-pounder. Steps along the way. But it'll take more than that to open up this new entertainment in commercial form. I got the essentials out of the strictly indoor VS-7U, and so can you, even if it won't fit into a hip pocket.

Note that these experiments were towards "movies," pictures with sound added. How about the opposite—our familiar hi-fi recording in stereo, but with pictures? A different emphasis but

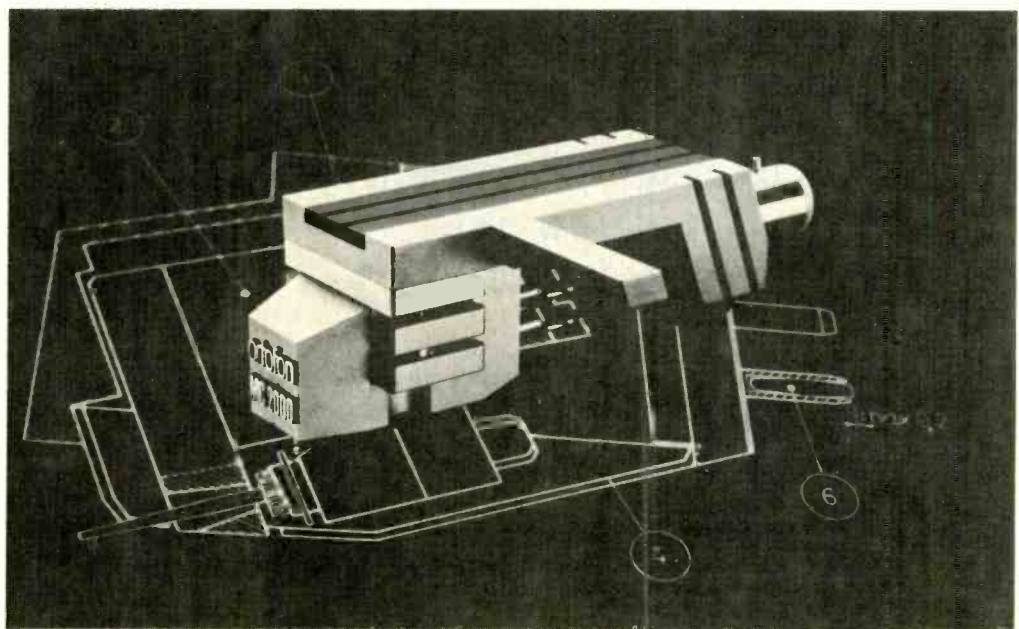


Every so often, a new development contributes so decisively to performance, that it re-defines the state-of-the-art. Such a development has taken place in the laboratories and listening rooms of Ortofon in Denmark.

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"I thought I knew how to take movies, but this was something else again. Video is not merely an electronic version of film!"

just as promising. Music. Take down your local orchestra or pop group or opera in hi-fi stereo sound, and also in pictures. An all-new idea, never feasible before (at least in the home-based consumer world). With stereo, the sky's the theoretical limit. Keep in mind our

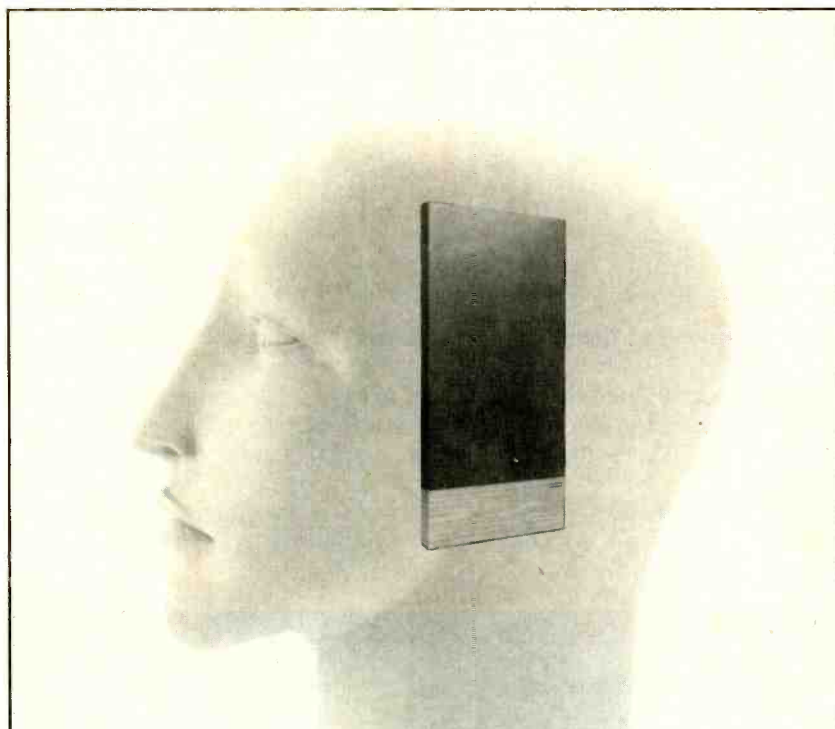
present top-grade stereo cassette recorders. Do you think a rough equivalent with video would be any less popular? Big potential, I say. Just a few li'l problems to be solved before we get down to Walkman size.

When you do add video to your hi-fi

recording, you will have some new things to learn, of course. The two elements have to match and that isn't so easy. As I've already found, you run right into the inevitable "simulcast" problems, namely, a wide spread of sound in the stereo playback and a narrow spread in the picture. Not necessarily contradictory, if you are careful how you do your recording. You must stress ambience in your stereo music, rather than too-discrete directionality. Don't get too close! A close-up singer, heard way over to one side, will be seen just away from the center of the tube. When the sound source moves yards, the picture moves inches. This can be crazy and you'll have to give it a thought. Avoid, avoid. But with less obvious directionality and more ambience—this can be a splendid sound—you will have no trouble with the sound-sight combination.

On the other hand, if you are into people and people talking—the "home movie" approach, again, I found that an exaggerated sonic separation offers some surprising new effects in an oddly literal way, as you record (and photograph) people. What you do is to extend your working "stage" far off to the left and right beyond the tube itself. The sides are audio only. The center brings the people into view. It's amazing! You can have conversations between people off to one side, invisible, and people in the picture. Audio ghosts, you might say. Your folks can walk casually on and off the tube, or stand just outside it, even stick a hand into sight or peer around the edge of the TV display. Tell me where *that* has ever been done before! The tube in this case is like a window in a wall. But the wall is transparent to sound.

Note that the video makers today, as might be expected in Phase II of audio/video equipment consolidation, are emphasizing stereo pairs of loudspeakers that sit right next to the tube itself on each side. Good for TV mono sound, natch. Not very good for stereo. Not at all good, indeed, unless you move up so close that the picture hurts. You will be wise to keep your options—use your speakers freely in wide and narrow spacing, according to need, leaving plenty of room. For those new "offstage" effects, the wide spacing is far more dramatic. Also, of



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The human ear is a marvelous listening mechanism. Its full-range, single element diaphragm lets you detect all the subtle details of a fine musical performance. Unfortunately, the ear can also detect the weaknesses and defects of fine music poorly reproduced by an inferior speaker.

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"The better the pro stuff gets, the more the amateurs are inspired. So do-it-yourself becomes enormous, with its own demands on designers."

course, for ambient music, though again you must watch out for the directional disparities.

As to mike settings, my camera was a mono model. Evidently the two-channel idea is going to be slower to reach this area. The VCR operates in mono too with all standard TV, and with this mono camera. Necessary at this point. There's a built-in mike on the camera, electret, extendable forward on one side. You can plug in another, of your own (watch out for loud raster buzzing if it gets too near the camera tube), but the signal's still mono, feeding the VCR's left channel. For stereo, you must plug the right-channel mike into the VCR's right mike input; for the left, you can use the camera mike, or plug a second mike into the camera or the VCR's left-channel mike input.

Rather to my surprise, the "binaural" setup, two mikes close together with some solid object between—the camera, a head, even a block of wood or plastic—gave surprisingly useful loudspeaker directionality to my pictures. It might be the best way for many home purposes. Especially speech. But don't get too far away, and keep the room sound dead—or go outdoors. In this sort of speech recording, ambience merely means off-mike, an amateurish voice quality. Maybe Bob Carver and Sound Concepts and JVC could help here with their respective binaural-for-loudspeaker circuits? As we all know, the techniques for good voice sound do not match those for camera placement—especially with a prodigious zoom such as the one Akai has on its VC-X2 video camera. You've seen the TV reporters stick their mikes into people's faces. That's the pro way, or via lapel mikes, mikes overhead but unseen, and so on. So get close for people, more distant for music.

All of this, of course, is really for the future, or assuming that you can experiment with present two-channel equipment as I did. And assuming muscles and patience in the hooking up. We do have a way to go before we have home-recorded video "movies" with equipment expressly designed for the purpose. That is for Phase III when video goes truly miniature—or maybe gigantic, wall to wall. But you can fuss with it now, as soon as you can get hold of two channels. And camera. 

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First, a few words about our straight line tracking system – Linatrack®. Under the guidance of a sensitive infrared-interrupt servo circuit, Linatrack® guides the ultra-short (1¼" long) low mass tonearm straight across the radius of the disc, thus eliminating tracking error. Linatrack® mounts most popular cartridges, and the entire tonearm module swings aside for quick record changing.

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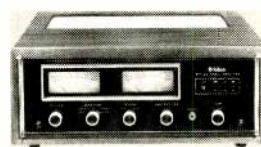
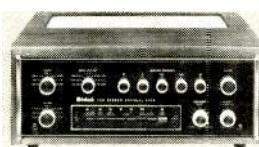
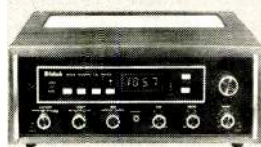
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EDWARD TATNALL CANBY

WINNING STRINGS



Schubert: String Quintet in C. The Albeni Quartet; Thomas Ignoi, second cello.

Vanguard Bach Guild HM 79 SD, \$5.98.

Sound: B + Surfaces: B – Recording: A –

The earlier releases in Vanguard's large music history series, decked out with uniform flowered tapestry covers, were mostly reissues from the label's well-known earlier catalog, notably the numerous Alfred Deller recordings. Many of these are now somewhat dated, not in the engineering but in the performing style for older music. Things have changed mightily in Renaissance and Baroque performance in the intervening years. Lately, however, Vanguard has moved on, using the same series covers and at the same low price for newly released imported tapes made within the last few years, virtually up to the present. This one is 1975. The new material is splendid, no less.

Here we find absolutely first-rate Schubert playing, a sort very rare even among the famous virtuoso groups. The music is from that fabulous last year of Schubert's life, 1828, the year of numerous, absolutely hair-raising

works of incredible length and tension, often with a well-nigh eerie power. These players, with the extra cello, have a masterful understanding of that power, the vast dramatic lengths, the strange, weird harmonies, the hypnotic pulsing rhythms—it's all there. After a few hearings (or one, if you know the music), you'll find your hair on end. This was one of earth's towering musical minds.

Though the recording is older than that of the companion Mozart Quartets in the series (HM 80/1/2), the sound seems somewhat cleaner and, oddly, the Schubert surfaces are considerably better than the Mozart. Quality control at work?

Mozart: The Six String Quartets ("Haydn"). Chilingirian Quartet.

Vanguard Bach Guild HM 80/1/2 SD, three discs, \$17.94.

Sound: B Recording: A Surfaces: C

So you really think the "name-brand" string quartets are best? Indeed, they are brilliant, virtuoso; they "project" like mad. But do not be fooled. There are literally hundreds of string quartets, world over, who can do as well or better for recordings. This quartet is a prize example.

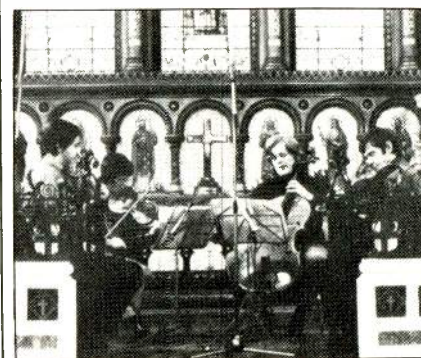
These six Mozart quartets were dedicated to Mozart's newly found older friend, Haydn; the interplay between those two composers, each on each, has been the wonder of the musical world these 200 years. Here is a quartet (the players, that is), unknown to me by name, which does the six in wonderful fashion. Their playing is stylish, easy, relaxed, yet disciplined—but most of all it is somehow friendly. None of that taut, tense achiever stuff here, as in so many top-flite groups! You sense immediately that these four musicians simply enjoy the music and the playing of it. So will you. They are really good.

The first violin, to be sure, could be a bit stronger—his role is always the leader and this one doesn't put out much leadership. But the others make up for it. And an unusual sound, at least in recordings, is a very clear viola, quite prominent, where usually the viola is lost in the shuffle. Interesting. Microphoning? The player? Who knows. I enjoyed hearing that cold-in-the-head viola sound throughout.

As for the sound itself, not more than average in cleanliness, but the recording is lovely. The performances are in an English church, and for those with any sort of rear ambience reproduction—whether "four-channel," delay line or whatever (I have both)—the frequent short pauses in the music provoke a lovely transferral of the reverb from front directly to back. It almost can be heard going past you. Very nice indeed.

All this is a part of Vanguard's older-tapes program, at a now-low price, though these recordings are evidently only two years or so old.

P.S. Not good surfaces—pops, ticks, stuck-on dirt. Check yours.





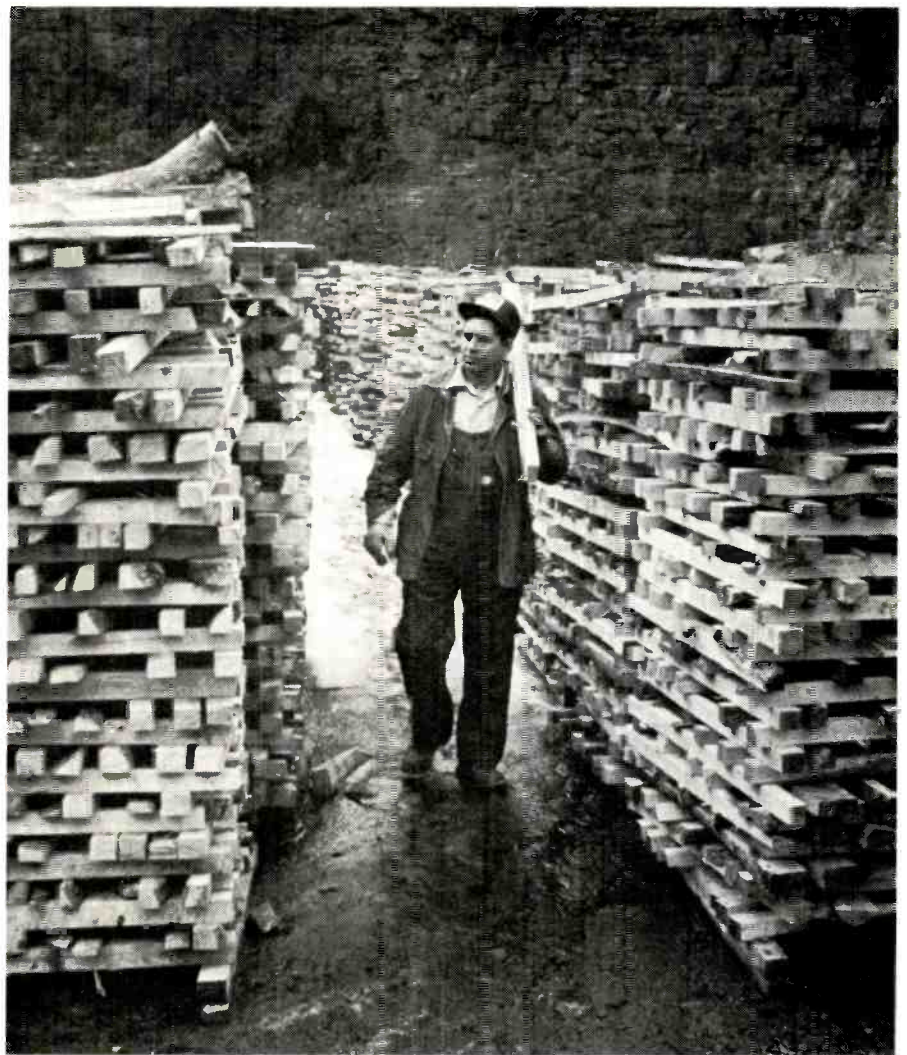
Salieri: "Il giorno Onomastico"; Sinfonia; Variations on "La Follia." London Symphony, Zoltan Pesko. **CBS 37229.**

Doubtless the profit motive raises its tiny head here, thanks to recent publicity concerning Mozart and Salieri, who is said to have poisoned Mozart in Vienna, where Salieri was the top musical dog. (False.) Nevertheless, this is an unusually interesting disc, beautifully and enthusiastically played by my favorite British orchestra, the London Symphony.

Violent contrast. The first two works date from the 1770s in Vienna, when Mozart was entering his twenties; the style is of that period, more of Gluck (who was Salieri's early patron) than Mozart or Haydn. It must be said that, at least at this early time, Salieri's instrumental music was nice but superficial. Pleasant listening, just the same.

But tacked onto these works come the really quite extraordinary Variations on the familiar "La Follia" theme, composed much later, not far from 1815, when Salieri was the teacher of such noted Romantics as Beethoven, Liszt and Schubert. Accordingly, his style of composing is radically altered—now it's the big sound of the 19th century. And the "La Follia" Variations are brilliantly executed, with all the tricks of the new Romantic orchestration, including even a harp solo and numerous violin solo segments. It is an impressive piece.

Grand, big sound—is it from British engineers? The record is licensed through an Italian label.



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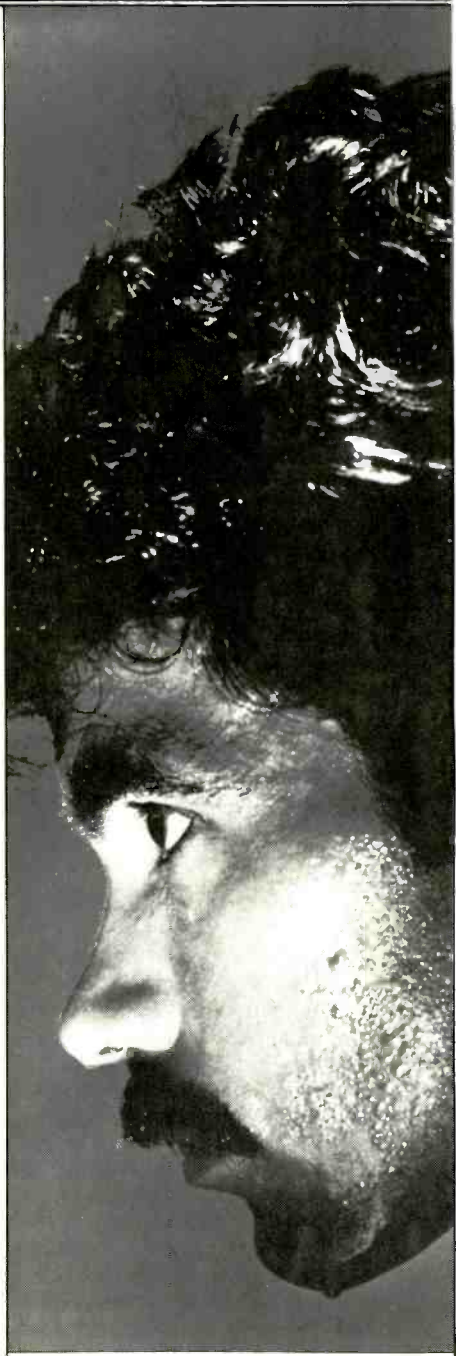
ROCK/POP RECORDINGS

MICHAEL TEARSON
JON & SALLY TIVEN

WALK ON H₂O



Daryl Hall



John Oates

H₂O: Daryl Hall & John Oates
RCA AFL-4383, \$8.98.

Sound: B Performance: B+

It is surprising with a band as talented as the one Hall & Oates have assembled that there is such reliance

upon machines and player-substitutes on H₂O. Of course, you'd expect these guys to jump on the rhythm box/synth trend, but as far as the technological side of things go, they're a few steps behind even The Human League. They were, however, quick to hire away XTC's excellent engineer/producer Hugh Padgham to do the mixing. Despite these vacillations away from their successful formula, H₂O eventually triumphs—but it's a case of material struggling to overcome the bonds of somewhat inhuman arrangements.

On a Hall & Oates album there's seldom a lack of strong compositions, given the duo's mastery of hit-single chord sequences and lead vocalist Hall's outstanding "white boy does R & B" pipes. The success or failure of their work depends on the treatment of the material, and here they seem to be fumbling for a new light in which their considerable talents might shine. First the flops. On "Crime Pays," the futuristic synth setting and use of drum machine, instead of the real skins of their resident rhythm whiz Mickey Curry, simply don't work with a singer whose soul stylings demand a warm backdrop. Oates' chance to shine as sole writer and lead vocalist results in the amusing tune "Italian Girls," on which he does a convincing Jerry Vale impersonation—cute, but surely not the new direction for the group.

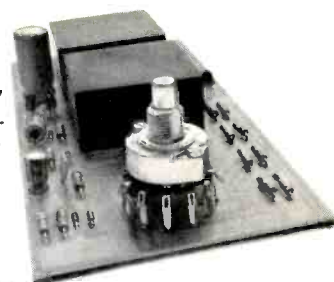
The rest of the album is surer going, with "Man Eater" getting things off on a Motown groove (if Squeeze can get away with "Black Coffee in Bed," Daryl & John are allowed to liberate the beat from "You Can't Hurry Love"). H₂O rocks out on a few numbers: The block chords and a super-distorted guitar sound give "Family Man" a healthy kick in the pants, while the Carlos Almar-styled rhythm guitar provides "The Art of Heartbreak" its considerable drive. And let us not forget ace sax man Charlie DeChant whose work on the latter track only makes us wish there had been more use of him.


Clearly, this is not a band of soloists, despite the Olympian abilities of all the players. From song lyrics and arrangements to overall production, you could say that Hall & Oates' only sin is that of moderation. We long for some rough edges in their work, a few instrumental or compositional excesses from which

to glean an expanded impression of the group's personality; all we see is a twosome trying to produce records which are more pristine and less human. Hopefully, the next Hall & Oates record will put the accent more upon the soul and less upon the blue-eyed part of their idiom. *Jon & Sally Tiven*

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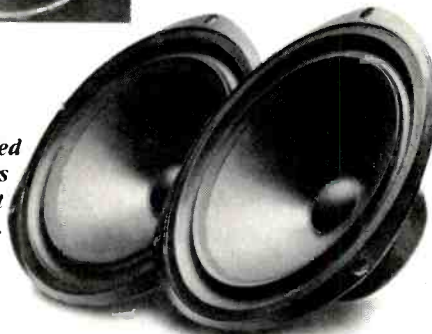


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"The queen of heavy metal and the high princess of R & B are victims of their material."



Pat Benatar



Diana Ross

Signals: Rush
Mercury SRM-1-40631, \$8.98.

Sound: B- Performance: C+

The most interesting aspect of Rush's latest is how relaxed Geddy Lee's singing is. For a change, he doesn't sound as if he'd just been kicked hard below the belt, and as a result the songs appear uncommonly melodic and flowing for this Canadian power/art rock trio. Perhaps they are mellowing a bit with advancing age.

Granted, their songs remain lyrically ponderous, unemotional and tedious tracts about the trials of modern life. But the increased raw listenability is a real saving grace.

Their production style is clean and finely detailed, particularly for Neil Peart's drums, but really nothing extraordinary. *Michael Tearson*

Get Nervous: Pat Benatar
Chrysalis CHR 1396, \$8.98.

Sound: B Performance: B-

Silk Electric: Diana Ross
RCA AFL1-4384, \$8.98.

Sound: B Performance: B+

The queen of heavy metal and the high princess of R & B are both victims of their material. In Benatar's case, the outside compositions are only slightly better than her band's songs, making for an album with no great highs or lows, just mediocrity hyped to the fullest bombast. Ross fares far better with a variety of musical styles—her "Fool for Your Love" outdoes Benatar at her own idiom—but the songs themselves

still aren't up to the artistry level of the singing. The world is still waiting for Diana Ross to put out an album that's as solid as her singles, which set high standards for all other Diana Ross performances.

On the other hand, the world would be shocked if Pat Benatar put out a record that could stand above her "state of the this is art?" albums, which barely go beyond standard. She rarely varies her delivery, and although her husband/arranger/guitarist/producer Neil Geraldo may have mastered the ability to get on the airwaves, that's about all he's mastered. He hasn't furthered the art of rock guitar one iota, still owing much to teacher Rick Derringer. When it comes to being a man behind the throne, he can't touch Jimmy Page. Instead of creating a new sound, they merely tap whatever is current and ape it—although audiences haven't seemed to tire of it yet.

Jon & Sally Tiven

T-Bird Rhythm: The Fabulous Thunderbirds

Chrysalis CHR 1395, \$8.98.

Sound: B+ Performance: A

If you thought that Nick Lowe's production touches might somehow hamper The Fabulous Thunderbirds' magical approach, sit back easy: Mr. Lowe's standard tacky drum sound and generally shrill EQ are nowhere to be found. This disc doesn't stray too far from the sound of the previous three Fab T-Birds albums, except that it's even better! Of course, Nick Lowe fans are probably dismayed that there

are no new nicked Lowe tunes. His musical ability is not in evidence (except for a wee bit of organ on one track, we suspect), and the best white blues band in the world—or at least Texas—remains intact.

The T-Birds have made a simple, even bare approach to arrangements into their signature sound. Guitarist Jimmie Vaughan doesn't show off much, though his occasional instrumentals are always memorable. One of his stylistic idiosyncrasies is to play abbreviated forms of traditional rockabilly or blues licks, a sort of musical in-joke that complements the usually humorous lyrics. It's interesting to note that while vocalist Kim Wilson's self-penned "Can't Tear It Up Enuff" is one of the strongest cuts on the album, The T-Birds depend, for the main part, on outside material. Interpretation is right up Wilson's alley, with a commanding bass register and penchant for humorous inflection. Unlike 99% of the records out today, *T-Bird Rhythm* conveys tons of personality with a modicum of instrumentation and production. Armed with an ace guitarist given to an antique treble tone and a frontman ready to sing his do-rag off on every track, The T-Birds have created an album that makes them more than just keepers of the flame—they are a personable and remarkable blues entity.

Jon & Sally Tiven

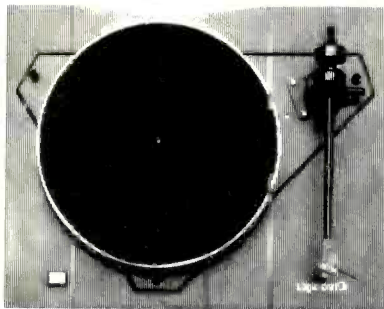
Love Over Gold: Dire Straits
Warner Bros. 23728-1, \$8.98.

Sound: B Performance: D+

Love Over Gold isn't nearly the album that Dire Straits' previous album *Making Movies* is. Leader Mark Knopfler's guitar lines remain distinctively snaky and seductive, but his songs this time are not very distinguished. The element of human drama that ran through *Making Movies* is all but absent here. Even when it is apparent, as in "Telegraph Hill," it gets buried under lengthy and unfocused instrumental noodling—very much less involving than the urgent playing of "Tunnel of Love" and "Skate Away" on *Movies*.

The special magnetism that Dire Straits first demonstrated on "Sultans of Swing" and refined on *Making Movies* is missing from *Love Over Gold*. Maybe next time. . . . Michael Tearson

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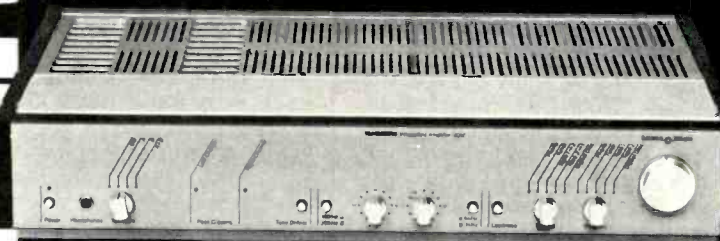
As a result, it is possible to reproduce the signals pressed into the record with utmost accuracy.

Logic 

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Subsonic Energy

Q. What damage do subsonics cause to bass drivers? When will this damage most likely occur?

My equalizer's filter cuts off sound at the rate of 18 dB per octave below 20 Hz. Will this be sufficient?—Bob Connelly, Green Bay, Wisc.

A. There is no real answer to the questions you have asked. Much depends on the amount of subsonic energy which is present and on the power-handling capacity of the bass drivers. Bass drivers are made to handle power and should "expect" a certain amount of such subsonic energy.

I would think that your 18 dB roll-off below 20 Hz would be sufficient to remove any possibility of damage, except where there is a case of acoustic feedback at frequencies above the 20 Hz we have just discussed.

Laterally Cut Discs

Q. I have read that a mono switch on a preamplifier is best set to the mono position when playing laterally cut mono records, to cancel vertically modulated components. What are "laterally cut" records? And will the mono records now being produced benefit from being played this way?—Paul Tomatani, Honolulu, Hawaii

A. All of today's mono records, and most of yesterday's, are laterally cut; that is, the groove is modulated from side to side, rather than up and down. Stereo records are cut with monophonic information common to both channels, modulating the groove laterally, while stereo difference information is a vertical modulation.

Setting the preamp switch to mono will clean up some mono records—and even some noisy stereo ones, if you don't mind hearing them in mono. It will only help, however, if the noise is in the vertical components, such as vertical rumble (in the recording or the playback turntable) or stylus motions due to "pinch effect." The mono switch will also clean up noisy FM stereo broadcasts, though it's better to switch to mono at the tuner, where possible.

Old Edison discs and cylinders (and, I think, Pathé discs) were cut with vertical modulation, as were some radio transcriptions on 16-inch discs. If you collect these, you can play them with a modern stereo cartridge by wir-

ing its two channels together out of phase—the exact opposite of the connection made by a preamp's mono switch.

Outer Groove Record Noise

Q. I notice that, when playing phonograph records, a "roaring" noise occurs somewhat before the start of the program. I am puzzled because, when I hear recordings over my tuner, there is absolute quiet.—Victor Ogorodnick, Narrowsburg, N.Y.

A. Phonograph records tend to be noisy at their unmodulated outer edges. Most of this noise has to do with problems in molding the raised area at the outer edge, sometimes known as the "groove guard." If you could start playing your discs at the point just prior to the start of the program, this noise would not usually be heard (except where modulation begins too early or where the raised area extends too far into the disc).

That's how the broadcasters do it (though they do it primarily to have the selection start right after it's announced, without "dead air"). And some stations play tape recordings of their records rather than the records themselves; this allows the edge noise to be edited out and prevents subsequent wear on the records.

"Bad Vibrations" Again

I recently moved from the comforts of a semi-soundproof home to a very "hard," reflective apartment. My Thorens TD160 MKIIB turntable does not "like" its new location. After setting up my SME Type II tonearm (fitted with a Shure V15 Type IV cartridge), I got acoustic feedback when the volume control was advanced a very small amount. The frequency of the feedback was in the range of 30 to 40 Hz.

My turntable sat on a base, suspended from the ceiling, to prevent "bumps" from heavy footsteps and direct vibrations from stands, tables, etc. There was quite a pronounced bass resonance.

I attempted to stop the "bad vibes" by adding weight to the base, by surrounding the base with soft materials, and even by putting cord and foam under the feet of the table. No luck! In a last-ditch effort, I bought a tube of silicon rubber and proceeded to line

the entire inside of the table, with the exception of wires and moving parts. Success at last!!! No feedback!!! Sound is great, with the volume control well advanced. The turntable now sits 3½ feet from a loudspeaker. The undesired bass resonance is also completely gone.—Victor Wasend, Vancouver, B.C., Canada

I try to answer all questions, but it is also very nice to receive comments of this kind. Information of this sort broadens our knowledge. I wish, therefore, to thank all of you who have taken the time and effort to share your problem-solving experiences.

Mixing Buss

Q. Please explain what a buss is, as applied to recording gear.—Christopher Berry, New York, N.Y.

A. A buss is any electrical line used by several different circuits at once. Recording mixers usually have several signal busses. At a minimum, there will be one such mixing buss for each output channel, and all inputs assigned to that channel will feed that buss. There may also be effects busses (feeding signals to echo or delay systems), equalizers and other signal processors whose outputs are fed into the output buss. Monitor busses control which signals within the console feed each monitor speaker. Busses are also used for ground and power.

Load Impedance and Amplifier Power Output

Q. Why does an amplifier put out more power into a lower impedance?—Bob Robinson, Warrensville Heights, Ohio

A. The lower the impedance of a load, the more power that can be supplied by an amplifier feeding that load. This is true because the lower the load impedance, the closer to an impedance match that load becomes. We never match loads to the output stage of an amplifier. If we did, the amplifier would attempt to supply more power than could be dissipated as heat, and the amplifier would be destroyed. **A**

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



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Graphic Realism

Q. *I notice that reviews of cassette decks specify the frequency response curves at -20 dB, and of course the high-end response always looks good on the graphs. But is this realistic? Everyone knows that we tape at levels typically around 0 dB, and I am sure the high-end response will then droop.*—Alfred Chiesa, Springfield, Mass.

A. It is true that when tested by a series of constant level audio signals, a cassette deck will ordinarily show treble droop if the recording level is in the vicinity of 0 dB (such droop is less with metal tape and when noise reduction is employed). However, in most music and other program material, the relative amplitude of the high frequencies is substantially lower than the amplitude of the mid-frequencies. Hence, one can usually record on cassette at 0 dB level, particularly from FM or disc, without noticing treble loss. Of course there are exceptions, particularly when recording live material with strong transients, such as guitar. But these are exceptions for most people, and in such cases one can reduce the recording level to preserve the high frequencies, albeit at the cost of reducing the signal-to-noise ratio, too. Considering the very high S/N ratios achievable today (thanks to advanced noise-reduction systems), sacrificing a few dB of S/N usually entails little if any reduction in listening pleasure.

Tape Deck Mis-Phasing

Q. *I feed a mono source into both channels of a stereo tape recorder; in playback, both outputs are combined and fed into another unit with mono input. When the playback signals are combined, the sound seems to lose its original quality and level. Even if I bring the level up, there is a loss of quality. If I disconnect either playback channel, the sound regains its original quality. Any help will be appreciated.*—Cicero LaHatte, Jr., Vicksburg, Miss.

A. There is a probability that your tape deck's output signals are somewhat out of phase with each other, resulting in partial cancellation. Even though there is no phase problem when the mono signal enters the deck, phase differences occur at the output owing to characteristics of the heads

and perhaps to the electronic circuitry. Conceivably, there is a gross wiring error in your deck which has changed phase of one of the channels by 180° from which it should be. This would, of course, produce gross cancellation when the outputs are combined. It seems that your best course is to use just one channel of your deck for mono recording until you can get it fixed.

Bias Percentages

Q. *Why is bias measured in percent? To wit, I have seen that Type I tape requires 100% bias; Type II, 150%; Type III, 250%.*—H. P. Kornick Sanford, Fla.

A. Type I tape (ferric oxide of the low-noise, high output type) provides a reference standard for the amount of bias required, and therefore is arbitrarily rated as requiring 100% bias. The actual amount of bias current fed to the head would depend on the bias frequency, on the head construction, and on the deck maker's judgment as to the trade-off he wishes to make between extended treble response (requiring reduced bias) and other performance characteristics, namely low distortion and low noise (requiring more bias). If Type I tape requires a certain amount of bias current in a given deck, Type II would require about 50% more than Type I and Type IV would require about 2½ times as much as Type I.

Format Fuddlement

Q. *I am going to buy a tape deck and am oscillating between cassette and open-reel units. In my opinion, one can get better reproduction at a high tape speed than at a lower speed. So, at the same price, should I buy a cassette or open-reel deck?*—George Nour, Reading, Pa.

A. There is no definite answer to your question. It depends upon your personal needs and expectations.

Owing to improvements in tape, in deck electronics, in heads, and in mechanical design and construction, a high-quality cassette deck is capable of truly high-fidelity performance: Wide and flat response extending to 15 kHz or better, low distortion, high signal-to-noise ratio, low wow and flutter, and accurate speed.

In fact, those improvements have been given most prominently to cas-

sette decks, both because cassette's slower speed (1⅞ versus 3¾ to 15 ips) puts it in greater need of these benefits and because there is more demand for cassette decks. This has helped narrow the gap between the formats.

Open-reel's advantages of greater high-frequency headroom (ability to record high frequencies at higher levels without tape-saturation distortion) and easier editing are more significant in live recording than when taping off the air or copying phono discs. Cassette's chief advantages are low tape cost, convenient loading, compactness (especially for tape storage) and a plethora of convenience features such as automatic tape-selection programming on some decks.

Listen for yourself, to see how much difference you can hear, and how significant those differences are to you.

High-Speed Cueing and Head Wear

Q. *A friend of mine refuses to use the cue feature on his cassette deck—that is, he never fast-forwards the tape while the deck is in play mode. He claims that running the tape at fast speed while it's in contact with the heads will wear out the heads. If I cue my tapes a lot, am I decreasing the life of my tape heads?*—Garth Whetzel, Sharon, Pa.

A. Yes, cueing the tape past the heads at fast speed will accelerate head wear. However, depending on the type of head, it may outlast the rest of the cassette deck. This is particularly true of ferrite heads, which are claimed to have lifetimes of at least 20,000 hours and up to as much as 150,000 hours in a cassette deck at normal operating speed of 1⅞ ips. Allowing for a reduction owing to cueing, they should still have a very long period of serviceability. With other types of heads, there might be a problem, but probably not for a long time.

[I believe there are some decks which hold the tape a minute distance from the heads during high-speed cue, which would eliminate the problem altogether.—I.B.] **A**

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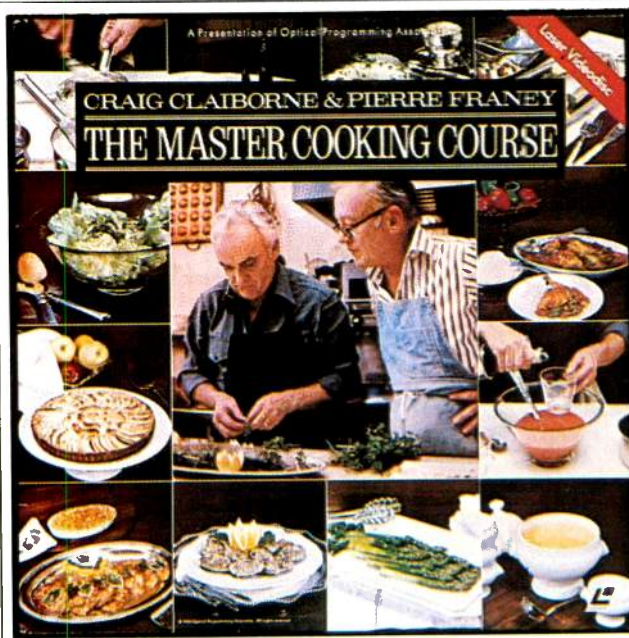
COOKING WITH LASER(DISC)S

Last month I reviewed the new Pioneer LD-1100 LaserDisc player and its greatly improved software. Gone are the glitches that plagued the early LaserDiscs. Instead, we have operas and ballets and classical music concerts that are visually enchanting, with a quantum leap forward in the audio portion through the successful implementation of CX noise reduction for the stereo sound.

While one freely admits that feature films constitute the bulk of LaserDisc viewing, it is nice to have classical material available. No matter how avid a movie buff might be, how many times can a film be viewed? The operas, ballets and classical-music LaserDiscs are really analogous to phonograph records in that great music endures. You may have listened to Beethoven's Fifth Symphony 190 times, but you can listen for the 191st time and the music is just as timeless, just as fresh, and just as enjoyable (maybe more so, because with familiarity comes understanding) as your first encounter with this masterpiece.

Since writing the last column, I attended a Pioneer press conference showcasing the LaserDisc. Pioneer didn't present anything new in the way of equipment, but they revealed very ambitious plans for all kinds of new software. Cultural programming was given a high priority, and we were told that the music-oriented discs were among the best sellers—not "blockbusters" like some movies, but for day-in, day-out consistency. And because of the degree of picture control (from freeze frame, step frame, variable slow motion, indexing and frame search) that is possible with the LaserDisc, educational subjects are particularly well suited to this format.

The latest buzzword among media types in the video world is "interactive." This describes a LaserDisc in whose material the viewer can actively participate. Intelligent use of the special LaserDisc controls can involve the viewer so deeply that the educational process is greatly accelerated. Inter-



active LaserDiscs will be prominently featured in Pioneer's software program. One of the first titles in this category is a model of its kind, *The Master Cooking Course* by Craig Claiborne and Pierre Franey. These gentlemen are familiar to readers of the *New York Times* Sunday magazine section, where they have been discoursing on food and presenting fascinating recipes for many years. Craig Claiborne has been restaurant reviewer and food writer for the *Times* for over 25 years. Pierre Franey was head chef of the legendary Le Pavillon, long considered the finest restaurant in America. He's also an old acquaintance, for reasons I'll get to shortly.

But first, the disc. It is just fabulous. Pierre and Craig are each on one of the LaserDisc's two, independent audio tracks. Pierre goes through the actual preparation of each dish on one track, while Craig gives supplemental comments and anecdotes on the other. Four menus are presented, with complete visual guides for preparing each dish. In addition to the food preparation, there are sections on such things as knife sharpening and other handy tips. The Pioneer 1100's special effects permit the most thorough study of how Pierre prepares the various dishes. For example, he shows how to separate egg yolks from egg whites by breaking an egg into the palm of his

hand, with his fingers separated just enough so that the whites slither through his fingers, while the yolk remains intact on them. I pushed the "Still" button to check just how far apart he kept his fingers, then used "Slow Motion" to watch the whole process. In watching Pierre chop vegetables or cut up a chicken for Poulet Portugaise, I used "Slow Motion," "Still" and "Step Frame." If I didn't quite understand a point, I'd simply press the "3X Fast" reverse button and go over the scene again. This LaserDisc is tied into the random-access system through the remote control. Thus, if I want to take another look at Pierre preparing Hollandaise Sauce, I press the "Search" button

on the remote control, punch in number 31033 on the keyboard, press "Search" again, and in seconds I am watching how Pierre whips up this luscious sauce. The menus are well chosen and balanced. The dishes are not particularly complex, but this is all to the good for those not experienced in preparing haute cuisine. The Mousse de Poisson and Steak au Poivre were staples at Le Pavillon, which sadly has been only a memory for many years. All in all, with the expertise of Pierre and Craig, and the extraordinary teaching methods possible with this LaserDisc, you too can concoct a Mousse au Chocolat that is truly sinful!

How do I know how good Pierre's cooking is? Not just from the disc, I assure you. You might, however, say I know Pierre from the movies, even though he wasn't in them.

Let's set the scene by going back to 1953. Television was already giving movies a bad time, and many theaters were closing. In an effort to rekindle public interest in motion pictures, 20th Century-Fox introduced the Cinema-scope process. This featured a huge, wide-aspect-ratio movie screen and three-channel stereophonic sound (four-channel when special effects were used, as in the "thunder" from the rear in the Crucifixion scene of *Ben Hur*). Sound quality was quite good when everything was working right, as

Dolby® HX Professional

Dolby HX Professional is a program-adaptive bias technique which can significantly improve the quality of cassette recordings. High-level high frequencies can be recorded more accurately, without sacrificing signal-to-noise ratio, while such side effects of tape saturation as distortion are reduced. For both the home recordist and the duplicator of pre-recorded cassettes, Dolby HX Professional improves the performance of good conventional tapes to match that of costlier, more exotic formulations.

The problem of self-bias

Even when a cassette deck is adjusted for the nominally optimum bias for a given tape, performance is nevertheless compromised under some signal conditions.

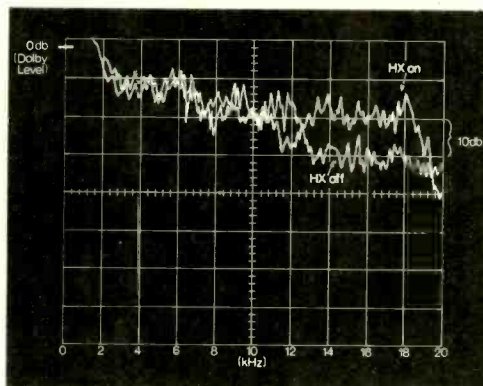
In particular, music which is rich in high frequencies has what's called a self-biasing effect. The musical high frequencies act in and of themselves as recording bias on the tape, effectively adding to the external bias supplied by the recorder's bias oscillator. The net result under such signal conditions is momentarily too much effective bias, which leads to the familiar symptoms of tape saturation. The highest frequencies don't get recorded at all, and considerable IM distortion is generated at lower frequencies.

How Dolby HX Professional deals with the problem

Dolby HX Professional is a special circuit which constantly monitors the total effective bias — a combination of bias from the recorder's oscillator and self-bias contributed by the musical signal — while the recording is being made. If it senses the total bias

increasing beyond the optimum level as a result of high frequencies in the music, it instantly compensates for the increase by lowering the bias from the recorder's oscillator, thus keeping the total effective bias constant. Even on music with a great deal of high-frequency energy, the tape remains

optimally biased, and so tape saturation and its side effects are significantly reduced. The improvement in high-frequency headroom can be 6 dB or more, depending on the particular tape formulation.



Spectral analyses of two high-speed (32times) cassette recordings of the same selection of rock music show the highest levels accumulated over time at each frequency. Both recordings were made on conventional iron oxide tape of the type favored for commercial cassette duplicating; in this example, the high-frequency headroom improvement provided by Dolby HX Professional is as much as 10 dB.

Improve both the cassettes you make and those you buy

Dolby HX Professional, which was developed by Bang & Olufsen with the assistance of Dolby Laboratories, is provided along with Dolby noise

reduction in home cassette deck models from Aiwa, B&O and Harman-Kardon. Just as important, Dolby HX Professional can be applied to high-speed cassette duplication, where its ability to improve good conventional tape formulations is economically, as well as sonically, significant. The first commercial duplicating facility has now been equipped, and the first pre-recorded cassettes made with Dolby HX Professional (as well as Dolby noise reduction) are expected in the near future.

For further information, including a complete technical explanation of Dolby HX Professional, contact Dolby Laboratories at the address below.



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"Pierre Franey shows how to separate egg yolks from whites. On the LaserDisc, you actually see the whites slither through his fingers."

the projector had magnetic heads and the film used magnetic tape stripes, rather than an optical system. Ironically, the three-channel stereophonic sound was the first commercial use of this format since Bell Labs and Leopold Stokowski proved its superiority in their famous 1933 experiments.

Although Cinemascope was well received by the public, the process soon ran into problems. The wear on the film's magnetic stripes was high, and the projectionists neglected to properly clean the oxide from the magnetic heads. Then it proved too difficult to use stereo sound in shooting a film because of the constantly changing visual and audio perspectives. The producers therefore went back to mono sound, and it was incongruous to see an actor on the extreme left of a wide Cinemascope screen, and another actor on the extreme right, with both of their disembodied voices obviously coming from the loudspeaker behind the center of the screen.

By this time I was associated with the late C. Robert Fine (see obituary in this issue), one of the greatest recording engineers in the world and a pioneer in many aspects of audio technology. Bob and I were mutual friends of Sherman Fairchild (whose father was one of the founders of IBM), and Sherman was a large stockholder in 20th Century. He told us about the Cinemascope problems. Bob analyzed the situation and came up with an elegant solution: He invented Perspectasound, a form of pseudo-stereo particularly well-suited to the wide screen.

In Cinemascope, lateral directivity was of primary importance, because of the wide screen. Bob's Perspectasound system added this lateral directivity to monophonically-recorded soundtracks. This required a return to Cinemascope's original three-speaker sound system. During the "post-mixing" process, the film was projected. Then, using a special mixing console with panning pots, the lateral "action" was created by directing the various voices and sounds from the appropriate speakers. The film's final optical soundtrack was still monophonic, but it also contained low-frequency cue signals (at 5, 10, and 15 Hz), proportional to the positions of the console's left, right and center output pots.

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J&R MUSIC WORLD

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TECHNICS SA-926 (Receiver 65W)	PIONEER SE-5
TECHNICS SB-10 (Turntable)	SENNHEISER MD-470
TECHNICS SL-6 (Turntable)	SONY MD-7 (Micro)
TECHNICS PSM-276 Casette Deck	
TECHNICS PSM-275 Casette Deck	
PIONEER PL-4 (Turntable)	
PIONEER SX-5 (Receiver 30W)	
PIONEER PL-88 (Turntable)	
PIONEER CT-5 Casette Deck	
PIONEER CT-8 (Casette Deck)	
AKAI CSF-71 Casette Deck	
AKAI CX-71 Casette Deck	
SONY STB-V80 (Receiver 40W)	
SONY PSX-800 (Turntable)	
TEAC V2-EX Casette Deck	
TEAC V66-C Casette Deck	
MARANTZ SR-7100 (Receiver 65W)	
WINEGUARD FM-4400 (Electric Antenna)	

CARTRIDGES	EQ/MIXERS
SHURE V-15 TYPE V	SHURE V5 (15 Band EQ)
SHURE V5PHE	ADC 55-50 (10 Band EQ)
SHURE M95ED	NUMARK EQ-2 (10 Band EQ)
	AUDIOSOURCE EQ-1 (10 Band)
	CLJ PMX-9000 (EQ Mixer)

KEYBOARDS	STEREO-TO-GO
CASIO CT-701	SONY WALKMAN 4 (Cass Stereo)
CASIO CT-601	SONY WALKMAN 3 (Cass Stereo)
CASIO VL-10 (with Calc)	SANYO MC-2 (AM/FM Cass Stereo)
CASIO PT-30	SANYO MC-30 (AM/FM Cass Stereo)
CASIO MT-55	SANYO MC-160 (Cass Ster. Dolby)
	AIWA MSP-02 (Cass Ster/Auto Rev)
	AIWA HS-02 (Cass Ster/Auto Rev)
	TECHNICS SAC-07 (SBF 7 port Stereo)
	TOSHIBA KTR-1 (FM/Cass Ster/Rec)
	TOSHIBA KTR-3 (FM/Cass Stereo)
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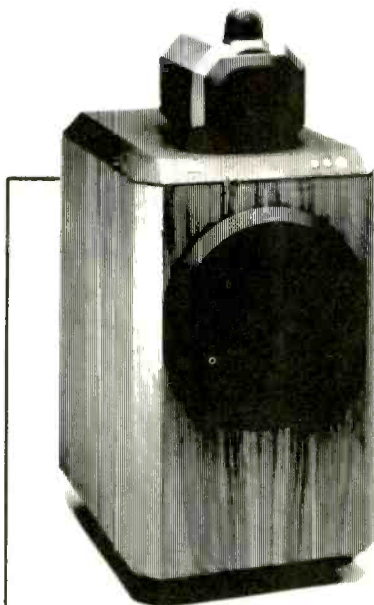
"The latest buzzword among media types in the video world is 'interactive'—material the viewer can actively participate in."

In the theater, when the cue tones passed the film gate, special filters sensed them and used them to control the appropriate amplifiers and speakers. Thus, in *The Bad and the Beautiful*, Lana Turner is on the left of the wide screen and when she yells and throws a bottle at Kirk Douglas on the far right of the screen, you hear her voice properly from the left loudspeaker and the bottle smashing realistically against the wall behind Douglas, with the sound coming from the right loudspeaker. And so the directed lateral action is heard from the three speakers across the width of the screen.

We were given a print of *High Noon*, demonstrated Perspectasound, and sold it to Arthur Loew, head of the Loew theater chain. I became General Manager of the new Fine Sound Division of Loew's/MGM. We set up elaborate studio facilities, including a big Cinemascope screen on the two-story top floor of 711 Fifth Avenue in New York City. From day one of our occupancy, we were driven mad by the most mouth-watering, tantalizing aromas of grand cuisine filtering up the elevator shaft. Yep, you guessed it: Le Pavillon was the friendly neighborhood restaurant on the ground floor.

Thus we knew Pierre Franey and his fabulous cuisine, and his autocratic boss Henri Soulé. Unfortunately, even in those days, Le Pavillon's prices did not encourage frequent dining, but we had our share of Pierre's inspired creations. We post-mixed many films at 711, and there was a constant stream of movie moguls and film celebrities who, needless to say, often dropped in to Le Pavillon when they were visiting us. To use a well-worn but apt cliché, "those were the days!" I hope I haven't digressed too much, but I thought you would be amused by the story, as well as interested in some of Bob Fine's activities.

Incidentally, another old friend, Jac Holzman, has produced an interactive LaserDisc. Jac was an early enthusiast of binaural recording, and a former vice-president of WEA (Warner/Elektra/Asylum) and founder of Elektra. But his disc isn't about sound or music. It's *The Creative Camera*, a primer on single-lens reflex photography. It looks to be a splendid production, too. At some future date, I'll report on it. 



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A ROSE BY ANY (ANTI-) ALIAS

As I noted last month in my report on the 72nd AES Convention in Anaheim, digital audio was the star of the show. In addition to the digital equipment I covered last month, there were other interesting new digital items.

The dbx Model 7000 delta modulation digital audio processor I reported on in my January column caused quite a stir at its demonstration. A number of pop music recordings were played; in general, they had all the usual desirable digital attributes. The dynamic range of a recording of the Boston Symphony Orchestra was especially impressive. There were many favorable comments on the availability of a professional-quality 16-bit digital processor for \$5,000, but I also heard reservations in respect to the editing capabilities of the unit.

Although there were a number of digital compact disc players around the show, the only demonstration I heard was in the TAD (professional speaker division of Pioneer) room. They were using the neat-looking Pioneer CD player, and as I entered, I was greeted with a blast of raucous rock music. With one exception (JVC with some beautiful harpsichord music), at all the digital demos—with equipment capable of 90 dB dynamic range—"rinky-dink" pop music was being played, with a dynamic range of 10 dB at best. C'mon, fellas, what's the point? [Gee, Bert, even the worst of rock manages 20 dB or better, and the best has real, if not quite classical, dynamics.—*I.B. and E.P.*] In any case,

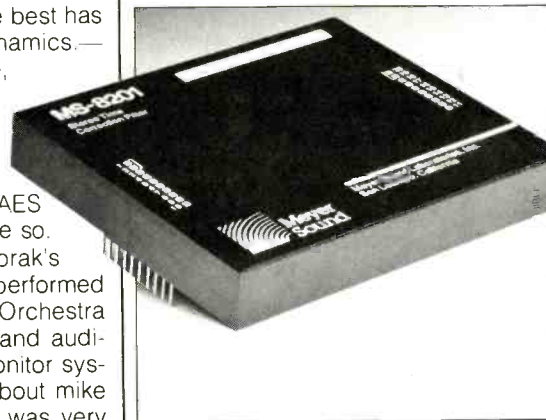
I knew there were some classical CD discs at the TAD room because Bart Locanthi, their erudite consultant (and head of the AES digital committee) had told me so. After some rummaging, Dvorak's New World (9th) Symphony performed by the Czech Philharmonic Orchestra was played on the CD unit and auditioned through TAD's big monitor system. I had some quibbles about mike placement, but in general it was very clean, dead quiet, and with such impressively wide dynamic range that one of the assembled "rock types" exclaimed, "Gee, that's almost too much!" In all fairness, however, I must say that I recently have been able to

play some digital tapes of pop/rock persuasion that have actually made some tentative approaches to wide dynamic range. In the right creative hands, digital audio could revolutionize pop music recording.

A development that could have significant effect on digital recording and playback was the subject of a paper by John Meyer. John is the brilliant young engineer who designed the high-power speakers used for special effects in the film *Apocalypse Now*, and he currently manufactures high-power, phase-corrected speakers for monitoring and sound reinforcement. John was also my colleague in my Crystal Clear direct-to-disc and digital recordings, being the designer of the special low-noise preamps for use with the Bruel & Kjaer 4133 instrumentation microphones I used. (At the convention, B & K introduced their own preamp for the 4133.) John's paper, "Time Correction of Anti-Aliasing Filters Used in Digital Audio Systems," details studies he has made of a number of digital audio processors which exhibit high-frequency phase anomalies, due mainly to their anti-aliasing filters. John found that these processors exhibit a total delay which is the product of two components: A linear, pure delay resulting primarily from the data conversion process, and a nonlinear, frequency-dependent delay pri-

marily due to the anti-aliasing filter. He points out that the phase shift starts around 5 kHz, and reaches 50° by 12 kHz, 100° by 15 kHz and 175° by 17 kHz! John freely admits that the audibility of high-frequency phase shift is a controversial subject. He notes, however, that there seems to be general agreement that "pure delay"—delay which is not frequency-dependent—does not change the perceived character of a sound. On the other hand, he states that we seem to be sensitive to frequency-dependent time distortion. John feels those who proclaim that digital recordings have a different high-frequency sound are reacting to this phase distortion.

On the basis of his studies, John has produced an analog all-pass stereo correction filter with complementary circuit group-delay characteristics, the Meyer Sound MS-8201. It is supplied as a 3 × 4 inch epoxy module for printed circuit mounting. Each channel is completely independent, with provision for separate power supplies for each channel. Power required is ±15 volts a.c. The unit has an active, balanced input, with a maximum output level of +18 dBV into 10 kilohms. The MS-8201 can be used in digital recording and playback. John has found that most digital processors are 180° phase-inverted. Even without the MS-8201 filter, I can personally attest that if



The Meyer Sound MS-8201 stereo time correction filter.



The Studer A810 pro/broadcast tape recorder.

you reverse the leads on *both* of your speakers, you'll hear marked improvement in respect to imaging, depth, stage width and projection.

The MS-8201 is adaptable to different digital processors and recorders. Trim pots adjust the filter's delay to match the phase characteristics of the unit it's being used with, and it can be set up to correct the phase inversion of some digital units. How does the MS-8201 work? The corrected system behaves as a pure delay line, with constant delay to 18 kHz. In practical terms there is no phase shift up to 15 kHz and only 10° shift at 17 kHz. As to the audible effects on digital sound, an early report is very positive from Peter McGrath, who operates Sound Components in Coral Gables, Florida, and whose engineering skills are evident on his fine piano recordings. He states that with the MS-8201, recordings made on his Sony PCM-F1 have more precise and stable imaging, better depth and, most especially, smoother high-frequency response. In short, Peter is very enthusiastic about this device. John Meyer supplied an MS-8201 to Dave Fletcher, the head of Sumiko, importer of Supex and Grace phono cartridges. Dave packaged the MS-8201 in a neat cabinet with power supply and RCA input and output jacks. Dave tells me the filter not only corrects digital processors, but works equally well on compact digital disc players, and even on digitally mastered analog phonograph records! Perhaps there is some slight alteration due to the phasing in the cutter head, but evidently the phase shift characteristics of the digital master are transferred to the lacquer and subsequently to the LP. Dave claims the filter makes digital/analog records tolerable to those people who are always complaining about "edgy digital string sound." The MS-8201 is available from Meyer Sound in San Leandro, California for \$485. Dave has indicated that he may market the MS-8201 in a package similar to the unit he assembled.

Last month I mentioned that Studer had introduced a new analog tape recorder, the Model A810. One is tempted to say that perhaps this unit is Studer's "last hurrah" in analog tape recorders before digital becomes the "standard" recording technology. It

would be hard to imagine an analog tape recorder with improvements beyond those Studer has incorporated in the A810. It is a recorder of great complexity with a staggering array of features and it literally would take a half-dozen columns to fully describe. The A810 is 19-inch mountable in rack,

console or portable case. Any two speeds between 3¾ and 30 ips can be selected. Its servo-controlled capstan motor has capacitive speed-sensing and microprocessor quartz reference, while its electronically-controlled tape tension has servo-controlled spooling motors. The tape counter op-

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"It would be hard to imagine an analog tape recorder with improvements beyond those Studer has incorporated in the A810."

erates in real time for all tape speeds. In the electronics section, record and playback amplifiers are phase corrected. There is an elaborate microprocessor control keyboard for many functions, with such exotic amenities as an integrated test system which automatically monitors main functions. SMPTE

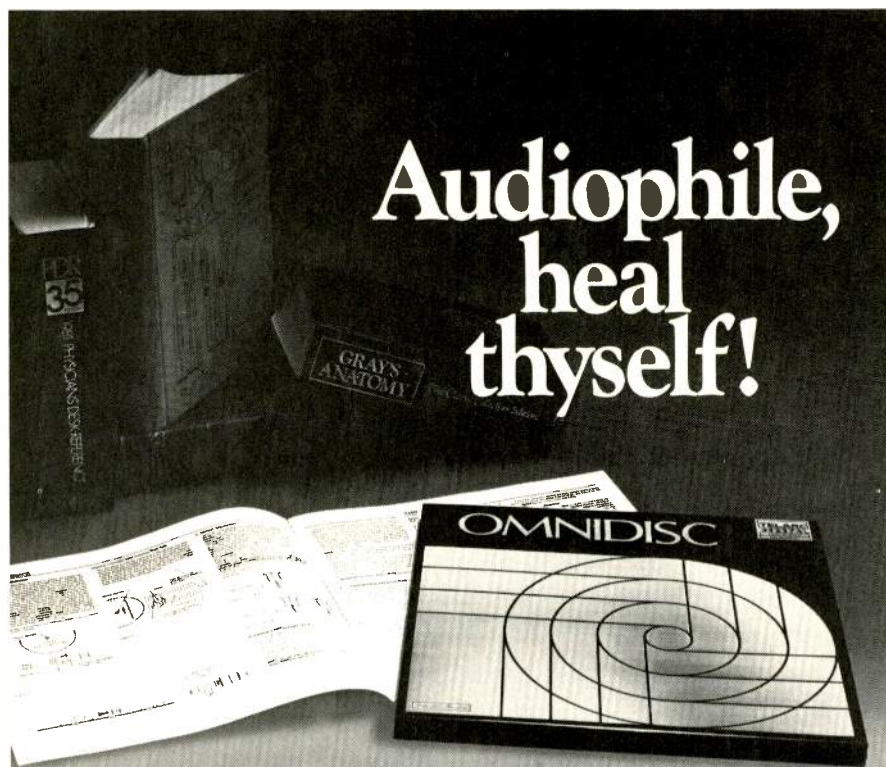
intertrack time code recording is optional. There is an audio-frequency test generator with five frequencies. Remote control is very complete, including remote calibration of the recorder!

Digital technology gets into even this analog machine. Audio parameters are entered via keyboard. All adjustments

are made via 8-bit A/D converters, with 256-step adjustment ranges. Such parameters as treble and bass correction, level and bias are read out on the tape-counter LCD. A nonvolatile electronic memory retains the calibration parameters even when the recorder has been switched off. I could go on and on, for this is just the tip of the iceberg. The basic A810 is expected to sell in the \$6,000+ area.

At Gotham Audio (celebrating their 25th year), owner Steve Temmer introduced me to Horst Redlich, Technical Director of Teldec. As most audiophiles know, Teldec (jointly owned by Telefunken and Decca) has become very well-known for its audiophile-quality premium pressings. Herr Redlich and I discussed the fabulous new Teldec Direct Metal Mastering, a process first shown to me by Arthur Haddy, former Technical Director of Decca Records, in his London studios in 1976. Although it was applied only to videodisc technology at the time, Arthur indicated that someday audio discs would be cut in a similar manner. Essentially, by means of a special Neumann lathe and cutter head, a copper-plated disc is used for disc mastering instead of the usual lacquer blank. The result is the creation of a direct-cut mother. The whole thing is a clever, complex and rewarding new technology. I have auditioned some DMM pressings, and they have no trace of surface noise, nor any ticks or pops or any other kind of noise! Like cavalry ever coming to the rescue, new technology has given the venerable phonograph record a new lease on life.

As usual, there were many other interesting items at the convention which must go unheralded, while others are significant enough to deserve separate, in-depth reports. In this category is Crown International's Tecron TEF System Ten. TEF is the acronym for "time, energy, frequency" measurement techniques, based on TDS—time-delay spectrometry—invented by *Audio Senior Editor* and speaker tester, Richard C. Heyser. The Tecron TEF System Ten is a dedicated instrument for this technology. It does a great deal more than the assemblage of instruments heretofore needed for these measurements, and is available at a substantially lower cost. **A**



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Cordia also comes with Mitsubishi's advanced ELC (Electronic Control) auto-

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\$7,849*
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**24/24
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Under its 1983 Limited Warranty, Mitsubishi Motors will replace or repair most components of the Power Train, which prove to be defective, for 24 months or 24,000 miles, whichever comes first. See your Mitsubishi Motors Dealer for details.



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struts— for agile road handling— lets you know you're driving a sporty car. And Cordia's 4+4 Transmission, on L & LS, gives you your choice of two driving modes.

Cordia also comes with Mitsubishi's advanced ELC (Electronic Control) auto-

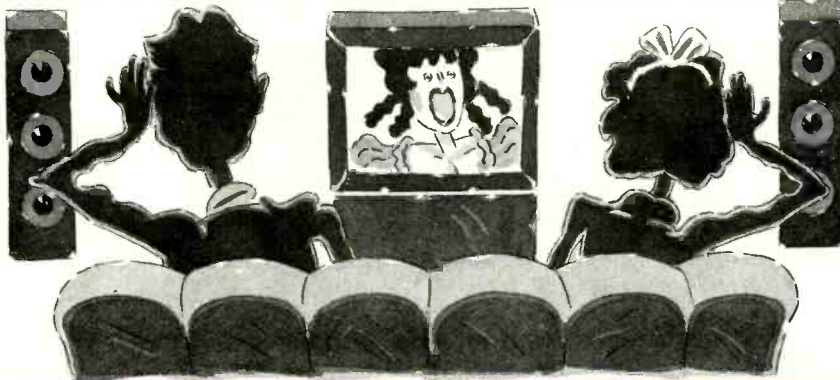
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takes you where
you've never
been before.**



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WIDE SCREEN SOUND

Illustration: Philip Anderson



Video Speaker Spacing

Stereo TV is coming. Stereo videocassette and videodisc are here. And pictures of the new, component TV systems all show them with two speakers . . . nestled next to the screen, too close for "proper" stereo.

It's not so puzzling when you know the reason, as Jensen demonstrated to me recently. Speakers spread the usual six feet or more apart give good sound perspective when the sound is the main focus of interest. But give that sound a visual focus, from a central video screen, and the sound can seem too separated; your ears and eyes are working with two separate spatial perspectives. Speakers nearer the screen merge those perspectives for you—although the sound becomes more spacious

when you add two more speakers, at more normal stereo width.

A single, center-fill speaker could also work with a standard stereo pair, says Jensen, if made for video use. (TV speakers are magnetically shielded, so as not to disturb the color picture when near the screen.) It should be no more than two feet from the screen, I'm told. And though some component TV tuners (such as Jensen's) have outputs for two pairs of speakers, none that I know of are set up for center fill.

It struck me for a moment that a pair of speakers near the screen might work well with side speakers connected to an audio delay line. And so it would . . . for interior shots. You don't expect reverberation in exterior shots, however, and it would probably sound disturbing if you got it.

Beethoven Rolled Over

Bruno Walter's recording of Beethoven's Sixth Symphony was the disc that first sold me on stereo. I wore out the original Columbia release (MS 6012), then replaced it a few years ago with the Odyssey repressing (Y33924). Now it's out in a new pressing, as part of Columbia's "Great Performances" reissue series (36720); remixed and remastered from original tapes, using the Dolby system—greater dynamic range and higher signal-to-noise ratio, says the jacket.

The sound strikes me as very slightly improved in the new version—a little cleaner, a little more focused spatially, the strings a little more open and less metallic. The tape hiss is slightly diminished, but still faintly audible in quiet passages, and the bass is still a trifle tubby. The stereo is still lush but undifferentiated—on the other hand, it was that lushness which originally convinced me that a second amp and speaker might be worth my while.

The remastering, then, hasn't accomplished all that much. But the performance (joyful and romantic) does as much as ever. It's still my favorite *Pastorale* in stereo (my overall favorite, by Furtwängler, is only available in mono, alas).

The packaging, however, is a little chintzy—thin cardboard that began to tear at the top as soon as I first opened it. And I do wish that either the Odyssey or Great Performances reissues had duplicated the very pastoral photo of a farmer plowing which decorated the original.

Quotes Without Comment

"There are people—like myself—who got their first system with the idea in mind of making a collection of all of Beethoven's sonatas as played and interpreted by pianists who have made history, and then find out that their system sounds well only when it plays the Pink Floyds as pressed . . . by Mobile Fidelity, while the only way to really understand the Waldstein sonata is to study the piano and play it by oneself. It's a fact that a good high-fidelity system's food is not all the records that you might want to buy for their own sake, but is rather those records, and only those, that sound well on it."—Marino Mariani, in *Audio Visione* (Italy)

Local Audio

We are considering adding a column of dates and places of audio-related functions, such as meetings of local audio societies or AES sections. So if you know of any local audio clubs or societies, please send us their names, mailing addresses and meeting schedules (e.g., third Thursday in Town Hall). If you know of any regularly scheduled radio or TV shows about audio, please tell us their names, times, stations and moderators. We'd also be interested in "radio-row" shopping centers, where electronics stores cluster together. (We already know of New York's West 45th St. and Canal St., and Tokyo's Akihabara.)

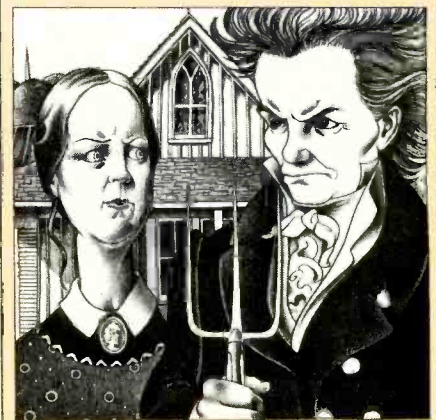


Illustration: Rick Tulka

The purpose of a turntable is to remain quiet. It should contribute no noise or vibration to the sounds picked up by the cartridge.

That's why our new T-Series turntables all use belt drive.

The belt drive provides acoustic isolation from motor vibrations. It literally separates the motor from the platter and spindle. This avoids the noise problems inherent in direct drive, where the motor is connected directly to the platter.

A belt design, of course, requires more careful engineering to achieve a constant platter speed. But we considered it well worth the effort.

In fact, we went to great lengths to make the T-Series among the finest turntables you can buy. Doing so required using massive platters; wooden bases that provide isolation from room vibrations; as well as disc stabilizers and vibration-absorbent platter mats.*

We also used low-mass tone arms to handle warped records, and capacitance trim to electrically match your cartridge and receiver.

And even though Harman Kardon's new T-Series delivers features found only on the world's most expensive turntables, we haven't made ours expensive. Harman Kardon turntables start at less than \$200. You can see them at quality audio retailers. But you certainly won't be able to hear them.

*Available on T40 and T60 models.



*Belt drive
is essential to
isolate the platter
from
motor vibrations*

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JAPAN FAIR

The Art Advances

GENE PITTS, EDITOR

It was the best of Fairs, it was the worst of Fairs — there was a whole new technology, there was much new standard gear, but it was noisy, and crowded, and hot. But, most importantly, it was the first public showing of the Compact Disc, which is hailed by some as the most important development since stereo.

In the places where I have lived, save for some few very cheap hotel rooms, there have always been telephones, ones with the double-letter code for exchanges such as L Ongacre and ROgers Park. There have not always been television sets, there still isn't a color set—nor a computer nor a videodisc player. Thus change.

We are, in these few past and coming months, seeing what I believe is the largest change in audio technology of the last decade—the biggest apparently since the compact cassette (and again, at least partially, from Philips)—go sliding past with all the inevitable finality of a cold air front. Thus change.

It was warm, humid, and overcast during the five days, beginning October 27th, I spent at Tokyo's Harumi Exhibition Grounds where the 31st All-Japan Audio Fair was held in conjunction with the 1982 Japan Electronics Show. I'm told that more than 300,000 people went through the turnstiles, where the featured attractions were

Compact Disc players carrying more than 20 brand names. Some of these players share common parts; indeed, several are made on an OEM basis, so that the actual makers presently number about 15.

Let me recite the brands: Aiwa, Aurex by Toshiba, Denon (Nippon Columbia), Diatone by Mitsubishi, Hitachi, JVC, Kyocera, Nippon Marantz (Philips), Matsushita (the parent of Technics, whose player we reviewed last month), NEC, Onkyo, Otto by Sanyo, Pioneer, Sansui, Sharp (whose player is reviewed elsewhere in this issue), Sony (whose player we discussed in November and January), TEAC, Trio-Kenwood, and Yamaha. Prototypes were also shown by Akai, Alpine-Luxman, and Harman/Kardon Japan. Polygram had a rather large booth with some 270 CD albums on display from companies such as London, Deutsche Grammophon, Casablanca, RSO, Polydor, Archiv, and Philips. There was no obvious duplication of titles. At the





Large balloons and a billboard announcing the 31st All-Japan Audio Fair were located in the mall at Tokyo's Herumi Exhibition Grounds (left, above). CBS/Sony headquarters in the Ichigaya section of Tokyo (right).



time of the Fair, CBS/Sony had announced over 75 titles as being available in Japan, but a moderate portion would be suitable for that market only. At a meeting at the Denon studio and office complex in Tokyo's Akasaka district, 10 more titles and a sampler were shown, and Toshiba/EMI has announced release of 10 discs in the format. It appears to me that about 50% of all announced titles are of classical music.

Perhaps more significantly for the United States, CBS Records will market Compact Discs imported from their CBS/Sony subsidiary in Japan. Indeed, you may already have seen these discs, as the program was to begin, says the press release, "during the first quarter of 1983." In addition, there is to be a pressing facility established by CBS Records in the U.S. by the end of 1984. Inasmuch as some 1,200 CBS employees were laid off at the Terre Haute operation, it's to be hoped that location would be near the

top of a list of potential sites for the CD plant. I saw M & K's Ken Kreisel at the Fair, and he told me that he is trying to make his the first American firm to re-release a Compact Disc. Indeed, he may have done so by the time you read this. RCA has plans to release discs in Europe beginning in March; Vanguard has listed 10 titles for CD release and has been doing a good deal of digital recording recently. AudioSource intends to import some 100 titles which will carry \$23.98 to \$25.98 prices; 17 titles will be included in the initial release. Thus change.

During a two-hour trip through Akihabara, an area of Tokyo where there are many audio shops, I purchased 12 Compact Discs from a store with a display holding about double that number. As I was about to pay for my initial collection, which ranged in price from 3,500 to 3,900 yen, a sales assistant brought out from a back room about 20 additional discs, mostly from Polygram. (Yen/dollar exchange is

"We are seeing the largest change in audio technology go sliding past with all the inevitable finality of a cold air front."



Several computer systems were set up to generate music, either by reading magnetic stripes or by keyboard commands, as with these systems from NEC (left). Sony's CDP-5000 Compact Disc Player is intended for pro use and can locate by track, time or frame (below).



presently about 245 yen to the dollar.) While I was reselecting discs for purchase, a Japanese man carrying a Sony machine came into the store and made straight for the display. I am told that only the Sony was available during the Fair period, though many other brands were to begin sale as of December 1st.

While I had expected the Compact Disc to be the big news of the Japan Audio Fair, I was not fully prepared for the crowds which congregated around the booths showing players. I spoke with representatives of several firms, each of whom expressed satisfaction at the reception of the CD player. Aiwa's Mr. Kohjimoto told me that their player would be shown at the Winter CES in Las Vegas, but as with most other firms, plans for marketing in the U.S. were not at all clear. Several makers thought that they would have demonstrations at selected dealerships or at hi-fi shows, but none had any specific dates to offer.

Aiwa was giving away tapes of music by Gimmi and the Pinks, a punk rock group, made at the Fair using Aiwa's WX-11 dual-well cassette deck, which features a four-gap record head and double-speed dubbing for a resulting dub efficiency four times normal. Recording a live group is a fairly usual promotion device at the Fair, and apparently there is somewhat greater

opportunity for live recording in Japanese clubs, theaters, and concerts than in the U.S.

Aiwa's DX-1000 CD player was priced at 168,000 yen, which is a hot price point and the same as Sony's. The top price I saw at the Fair was 248,000 yen for the Mitsubishi. Mr. Kohjimoto said he felt that 300 discs were not enough to make the CD system popular; at least 2,000 would be needed. He did, however, point out one interesting use for the CD player, in clubs "because of the disc's durability and the ease of access to songs via programming."

Club use brings to mind *karaoke*, a sort of evening sport endemic to Japan, where a group of fellows go out to a bar and have as their primary entertainment songs sung by one or another of the group. CBS/Sony has already released several Compact Discs for *karaoke* use, which consist of background vocals and music, and there were products from about a dozen makers at the Fair aimed at this market. One such item is a digital vocalizer, that is, a black box which can change both the pitch and the beat of the accompanying music, making the *karaoke-san* sound like a superstar. Yamaha's Music Printer combines an electronic keyboard with a melody and chord printout and the expected variations of pitch and beat. And here I

thought listening to records was a passive sport.

Besides the CD players, several Pulse Code Modulation (PCM) processors and decks were shown. Of particular interest were the decks extending the technology away from VCR-based recorders. For example, Technics showed both standard and microcassette PCM decks, JVC displayed a prototype deck using a standard cassette, Alpine had a stand-alone processor and a deck using a standard cassette for 1983 introduction with prices of 200,000 to 250,000 yen, and Sansui's Tricode processor has special error-correction circuitry to make possible recording at the slower VCR speeds with no loss of fidelity.

In the Electronics Show section there was one portion devoted almost entirely to combinations of video and computer, which the Japanese apparently see as working hand in hand. National's HA Home Automation system, for example, combines an image synthesizer, system command via an outside telephone, security/home protection, and finger-to-screen image processing/computing, among other things. Sanyo had in operation a voice-controlled videodisc search system, while for me the most impressive display was Aniputer's. Controlled by three pushbuttons and a joystick, the Aniputer's action on the screen is like a

“There were more than 20 Compact Disc players shown at the Fair, along with several PCM units using standard cassettes.”

combination of watercolor brush and finely chiseled variable-size rubber stamp. NEC's exhibit had a quartet of young ladies playing computers (keyboards?) from music displayed on their monitors.

Other interesting items at the Fair included the Micro Ridge stylus from Namiki, which supplied many of Japan's cartridge makers with the Shibata-cut diamonds when CD-4 was in vogue. The Micro Ridge appears, from engineering drawings, to start out much like a line-contact stylus, then it has two V-shaped cuts made on it, one going from front towards the back and the second from back to front. This extra cutting results in a sort of lip which works the groove; frequency response is claimed as being absolutely flat from 20 Hz to beyond 30 kHz at a 138-mm groove radius.

Aside from their CD player demonstration, Sony had two eye-catchers. The Studiolab personal playing room is a soundproof booth, which comes in three sizes from 2.25 up to 3.5 square yards. Prices range from \$1,900 To \$2,700. I spent about five minutes in one to get away from the noise of the Fair; almost as good as *shiatsu* massage. Sony's Heliplayer PS-Q7 turntable exposes fully three-quarters of the disc it sandwiches, as its top surface

measures only 8½ by 9¼ inches. The unit is priced at 35,000 yen, and we will see a near relative from Audio-Technica in their Mister Disc, at \$169.95, for the C-cell powered unit which has a headphone output.

An interesting departure from Lux was the Basic A522 belt-drive turntable, a kit (!) with a price tag that translates to about \$90, less tonearm. If I read the Japanese flyer correctly, the wow and flutter spec is 0.04% and rumble is -70 dB, DIN-B. Even at double the price, this would seem to be a natural base for one of the quality separate tonearms such as are available from Souther, Sumiko, Signet, or Stax.

High-end car stereo units were displayed by Hitachi and Sansui, while Nakamichi also plans to introduce their TD-1200 mobile tuner/cassette deck early in 1983. Both Hitachi and Sansui have rows of fairly large LEDs for power output levels; sexy.

Truly massive amplifiers were again seen at the Fair, and some idea of what I mean by "massive" can be gained by consideration of not one but two power cords, both of them polarized for 220 volts! As my daddy used to say, it would have taken two men, four mules, three dogs and a long lever. . . .

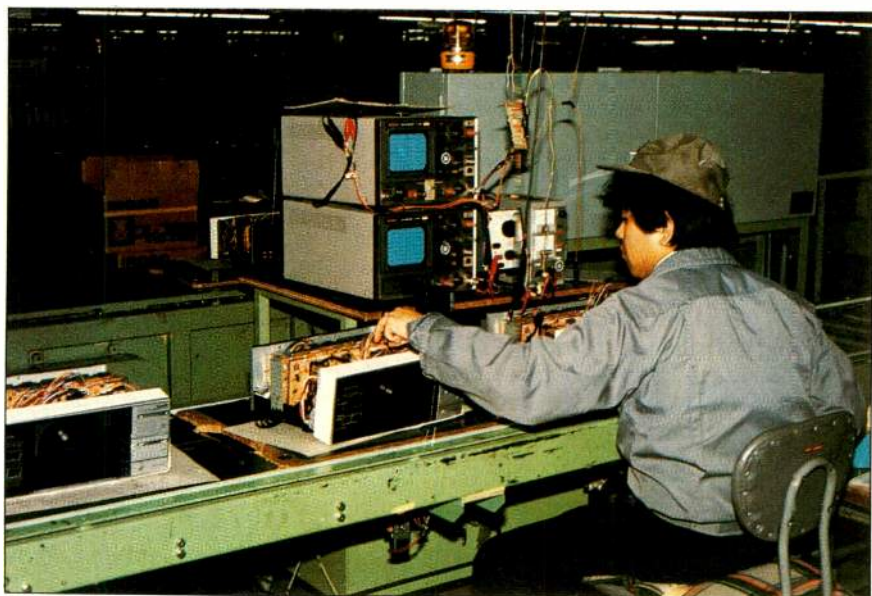
During my visit in the company of some dealers and reps to the Denon facility, where they have been engaged in digital recording since 1972,



A flashy car stereo system carrying Hitachi's Lo-D brand name.

Mr. Anazawa told me that they have produced some five generations of pro-grade digital recorders; the DN-035ED is their latest. They have some 600 digital recordings in the can and expect that 30% to 40% will find their way to release as Compact Discs. I received a copy of their sampler at a demonstration of their CD player, where Mr. Anazawa discussed the CD standard and production techniques at some length. Mastering of the disc is the most difficult part right now, and only one or two masters can be made per day. Times of up to 75 minutes can be gotten on the disc, which is single-

Part of Polygram's display, which included some 270 CD album covers (below). An adjustment stage on Hitachi's CD player line (right).



"Future developments for the CD system, according to a Sony spokesman, will be in reducing price and simplifying operation."

Audio-Technica
Mister Disc



Nakamichi
TD-1200

see their CD player facility and, thus, special thanks to Keita Kawahara, who made many arrangements for me, and to Messrs. Hayakawa, Hiroayma, Minobe, Sato, Takahashi, Takeda, Yamamoto, and Yoshida, for their hospitality. As it turned out, Hitachi's CD player line is still fairly new, since it was started up only last September 10th; there are roughly 50 to 60 people on this line, many of whom are on temporary loan from the engineering department. Each section of the laser servo is adjusted in two steps, first onto the disc and back and forth, and then each trim screw is locked with glue. The disc motor is brushless, much like the turntable types from which the design was adapted.

After touring several areas of the plant besides the CD line, I spent the best part of an hour listening to Hitachi's player in head-to-head A/B comparisons, using the same disc, with another player. I preferred the sound of the Hitachi in this audition, though I must point out that it was not run under blind conditions and that the ancillary equipment was not familiar to me. In any case, either CD player's specific sound would not have been recognizable after, say, an hour's lapse; the differences were that small.

One of the most interesting conversations I had during the trip was with Mr. Hiroshi Kanai, who is coordinating Compact Disc operations for CBS/Sony. His background has been with CBS/Sony's Family Club, a Japanese version of Columbia House. Events are proceeding at such a rapid pace for him, both in the European and Japanese markets, that he has had little time to plan for the American introduction. In addition to a soft market for standard discs, Japanese record firms have also had to deal with stores which rent discs, virtually all of which are copied onto tape. Over 1,000 rental operations have sprung up during the last year, and some of them even provide rental gear for on-premises recording.

Mr. Kanai feels that basically this is a poor introduction time for the CD system, as he is not at all certain that the market can expand to include the Compact Disc, and he finds that many software people are pessimistic. Playing the "what if" game, he notes that

sided according to the Sony/Philips standard. Yields, as might be expected, are low relative to analog disc rates, but they are going up. One interesting aspect of the mastering is that the music portion of the signal is on U-Matic tape, while the timing or address codes are on floppy disc. Mr. Anazawa stressed the need for clean air for plating and pressing; normal air has approximately 1½ million particles per cubic foot, while the CD facility requires fewer than 100 per cubic foot.

We later went to NHK's FM station JOAU, where we found professional CD players from both Denon and from Sony. Aside from a keypad for calling up exact sections of a disc, I felt that the most impressive feature of these pro CD players was their speed of access; slow access by some of the consumer players has been annoying to me. Other features are a bigger motor and built-in speaker.

I also paid a visit to Mr. A. Suzuki, Sony's digital maven, at the company's Tokyo headquarters in Shinagawa-ku. He feels that the Compact Disc is the Fourth Source of signal for the music system. I mentioned that we had detected small but consistent differences between the different players, and he said that this could well be so. However, he stressed that it is the final analog section which determines the

overall "sound" of the player, rather than the D/A section. It is important, too, he said, that the error correction be adequate. Sonic differences, he felt, were in the frequency response. (In my own listening tests, I find the differences to be at the level of the differences between two good preamps or amps. What is most striking, after the total absence of surface noise, is the ease with which one discovers what the recording engineer has been doing—or not doing.)

Asked what might be expected in the way of future developments for the CD system, Mr. Suzuki said that the main two things Sony was working on were reducing the price and simplifying the operation. "Timing is a key factor, especially with high-grade equipment," he told me, "but there are possibilities in LSI research." Sony is actively investigating a recordable disc but they are very concerned about keeping the power (and therefore danger) of the laser diode low. As a practical matter, this means a lot of research into materials, not to mention determining the proper layering of the disc.

I was fortunate to be able to arrange a visit to Hitachi's Toyokawa-shi plant, where they make CD players. While the firm is very well-known for its semiconductor operation, it has also been involved with the various technologies required for CD players for some years. I was therefore very pleased to

"In the opinion of Hiroshi Kanai, the public's attitude towards music has changed since introduction of cassettes—and not for the better."

an average-good sale is 10,000 albums and 5,000 cassettes; adding 3,000 Compact Discs will, in the opinion of many software people, simply squeeze current sales, not generate new ones. If this scenario is true, then there will simply be a further slowdown at standard record and tape producing facilities, which will still be required.

I asked Mr. Kanai about his reaction to statements by some in the hi-fi field that slumping record sales are largely because of poor quality discs and music. Mr. Kanai replied that while such arguments might seem reasonable to the consumer, the pressing-quality argument doesn't really apply since higher quality records would simply improve the quality of home-brew recordings. Judgment of the quality of music being made these days is pretty much an individual thing, he feels. However, Mr. Kanai stressed that making a compilation from one's own records is quite different in character from copying from a friend's record or from FM. The difference basically is that one supports the musician, while the other does not. He points out that even professional compilations of "greatest hits" never quite have the character of the originals and that they never sell very well. This leads him to feel that the art of the producer and engineer in sequencing, fade downs, etc. is not truly appreciated.

Perhaps the most interesting point Mr. Kanai made was that there has been a fairly obvious change in the public's attitude towards music since the introduction of the cassette—and it is not for the better. He pointed out that he has seen literally hundreds of cassettes out on the street, trashed, and that one never sees LPs treated in such a fashion. I was forced to reply that there is always a market for LPs in second-hand stores or at yard sales,

but I have rarely, if ever, seen cassettes sold in such a manner. It appears that the disposable society has descended on the music field.

Some interesting details: CBS/Sony began CD production in July 1982. They presently have four machines and are planning more eventually. The pressing cycle is 17 seconds versus 25 for a standard analog disc. While there presently is a shortage of capacity during start-up, by the end of 1983 there is an anticipated annual capacity of 2,000,000 Compact Discs.

I also had dinner with Har Tendeloo, who is Director of the Group Technical Staff Bureau for Polygram. Such a title makes one diffident, but you will never meet a more charming or gracious man—or a better source of information about the Compact Disc. Turns out that CBS/Sony and Polygram are using different pressing methods. Injection pressing, used by CBS/Sony, has dust particles as its main problem, while the injection/compression combination method used by Polygram has air bubble inclusion as its toughest. Not that either problem is insurmountable, mind you, but it is interesting that two different problems were encountered in achieving acceptable production rates. Insofar as player difficulties go, Tendeloo felt that proper tracking was the toughest, particularly for the single-beam systems. He also told me that the Philips design, which will be marketed in this country by Magnavox, uses a sampling frequency four times that required by the Standard. This technique makes error correction and filter design much simpler, I surmise, resulting in a very stable output signal. They have a dozen presses but output is a different story, what with European working conditions.

And now to answer the inevitable question: What was the best sound at

the Fair? To my ears, that from the Fostex GX-2020 Regular Phase speaker system, which was playing jazz. This satellite and subwoofer system has 6 x 12 inch ES tweeter panels, 12 x 24 inch midrange ES panels, and 10-inch cone woofers, all in a pair of mirror-image units, together with an FW-800 30-inch cone in a monster subwoofer. The approximate size of this subwoofer was 5 x 3½ x 3½ feet. The source was a Sony CD player. Very clean!

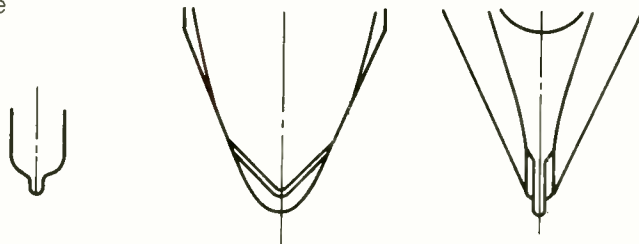
Best sound away from the Fair was at the apartment of Mr. Hiyashi, the genial head of Stax Kogyo, where I auditioned the firm's new and quite spectacular ESTA4U. Unlike conventional electrostatic speakers, this one doesn't require extra polarizing power to operate; further, its relatively small size (15.7 x 17.7 x 3.5 inches) makes it easy to place. While such a small size obviously requires a subwoofer for realistic bass, the ESTA4U's clarity, definition, openness and accurate resolution were exemplary. Sensitivity is fairly low at 80 dB SPL (1 watt/meter), but maximum power handling is 100 watts so that fairly decent peak SPLs can be achieved. Listen if you have a chance.

The Best Badge Award goes to Aurex (Toshiba) for a 3-inch round number which flashed two messages by means of a lenticular screen. Best Tee Shirt to Shonan for C-MOS, making it into an acronym for Contact of Mountain, Ocean, and Sky.

In the place where I now live, there is a new and very good television component system, purchased in the week since I began this article, and a small computer, given me in the same period by one of the Contributing Editors who has graduated to a larger system and who, I believe and hope, will continue to expand his mind as he has expanded mine during the years we have worked together on this idea called *Audio Magazine*. I had a chance to purchase at very large discount one of the leading makes of CD players. Had I not been intent on replacing the 16-year-old black/white set, which buzzed loudly and intermittently and apparently without cause, and on paying an insurance premium, I would have bought that CD player. In any case, such a player will be the next addition of any magnitude to my audio system. Thus change.

A

Namiki Micro Ridge stylus, which will be sold on Signet's TK10ML cartridge.



PHASE THE PHONO CARTRIDGE

KEVIN BYRNE

The question of a component with impressive specifications and less impressive performance remains, despite the increasing sophistication of laboratory measuring instrumentation, a puzzle. The belief that such a blind spot exists in phono cartridge measurements led the technical staff at Ortofon of Denmark to construct a test procedure to measure the phase response of phono cartridges and correlate these findings with the other parameters that are normally measured.

The impetus for this work stemmed from earlier listening evaluations of phono cartridges that had resulted in a clear preference for moving-coil designs over moving-magnet or moving-iron types. This was true despite the fact that test data, including amplitude response, trackability, separation, and harmonic distortion, did not point out any reason for the listeners' preference of the moving-coil design. The conclusion was that, while the conventional parameters were clearly important tools in predicting audible performance, they did not fully quantify all of the sonic differences among phono cartridge designs.

It is not generally realized by the audiophile that what he calls frequency response really has two parts: Amplitude versus frequency response and phase versus frequency response. With electronics it is convenient to forget the phase response because it is generally linear, and therefore of no consequence, at the frequencies of interest. (We'll leave aside filters for the purposes of this article.) When we consider transducers such as phono cartridges, however, phase does play a part, because it is not linear in such devices. We therefore made a mathe-

Kevin Byrne is Product Manager for Ortofon, Plainview, N.Y. 11803.

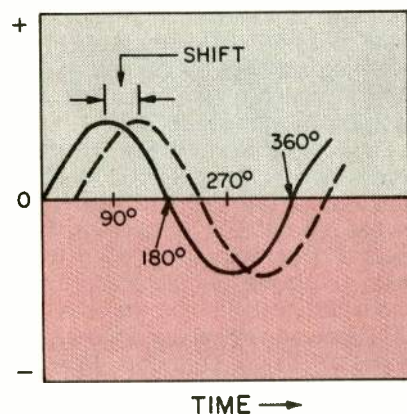


Fig. 1—Phase shift.

mathematical model, which we calibrated by measuring a cartridge that was the basis for the model. While the model is too lengthy to describe here, it was covered in a paper presented at the 71st Audio Engineering Society Convention in Montreux (Preprint No. 1866). Using measurements made with a B & K accelerometer for the phase response and with a conventional test record for the amplitude response, we were able to compare our model with actual test data and thus validate it.

It is probably valuable at this point to go through some definitions and explanations. The phono cartridge's *moving system* is defined as the parts which vibrate in accordance with the modulations of a record groove. These parts include the stylus, cantilever, and the moving parts of the voltage-generating system. All of these, taken together, have a *resonant frequency*, which (in simple terms) is the frequency at which the moving system likes to vibrate. The *natural resonance* is the frequency at which such a moving system is operating at its highest efficiency. In phono cartridge terms, that means the frequency at which the cartridge delivers the most output signal voltage at constant input from the record groove.

The *voltage-generating system* is made up of all parts of the cartridge which are designed to convert the mechanical energy produced by groove modulations into the electrical energy which is the output of the cartridge. These parts may include the coils, the magnet assembly or a magnetic shunt, and the pole pieces.

In a moving-coil design, the coil is part of the moving system, vibrating in a fixed magnetic field to produce the electrical signal. In a moving-magnet design, the magnet structure or magnetic shunt material vibrates such that its magnetic field passes through a fixed set of coils.

Phase in Moving-Coil Cartridges

Typically, the undamped moving-coil cartridge has an amplitude response which begins to rise in the 5 to 6 kHz region, climbs to about +8 dB at 20 kHz, and peaks at about 15 to 18 dB at 25 to 28 kHz. This undamped cartridge also has a large amount of phase shift, up to +180°, centered around the resonant frequency. This can be thought of as time distortion with respect to frequency or as a difference in the rate of rise or fall from what is expected from the calibrated model.

While the undamped moving-coil cartridge has only about 10° to 15° of phase shift at 20 kHz, with negligible amounts below 15 kHz, the amplitude response has a substantial error, which results in a very bright, subjective sound. The most usual method of reducing this rising high-end amplitude is to damp it with a suspension or rubber suspension donut.

Phase in Fixed-Coil Cartridges

Both the moving-magnet and the moving-iron types have moving systems with somewhat larger effective mass than moving-coil designs, and therefore their mechanical resonance points are at lower frequencies, ordinarily *within* the audible band. To ob-

TESTING IN CARTRIDGES

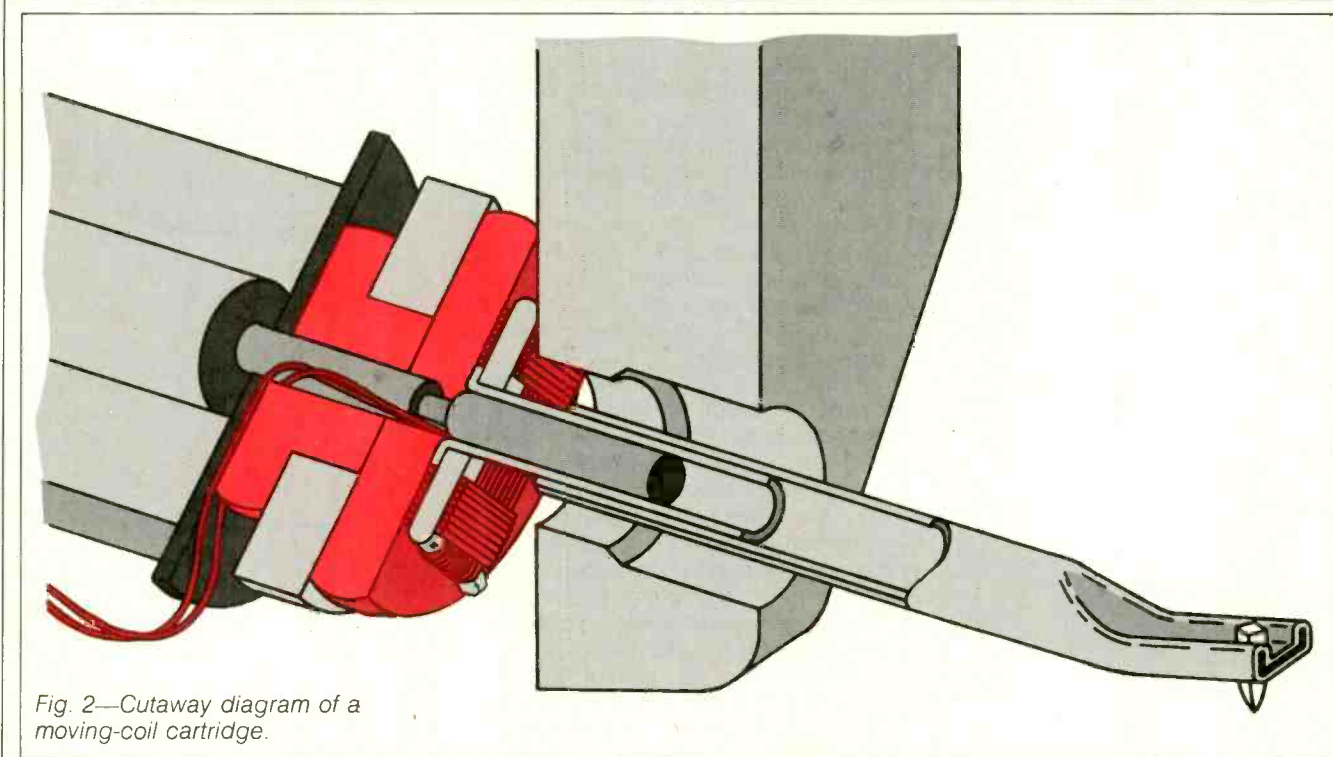


Fig. 2—Cutaway diagram of a moving-coil cartridge.

tain acceptable amplitude response, designers of fixed-coil cartridges have primarily used severe damping, a technique that increases the phase shift. As a result, these designs exhibit phase errors several times greater than those of a properly damped moving-coil design.

Fixed-coil cartridges also exhibit phase shift because of electrical resonance (at frequencies typically within the audible band) due to the self-inductance of the 2,000 to 3,500 turns of wire in these coils. The usual method used to damp this resonance is to load down the cartridge's output with a specific amount of capacitance in the cables between cartridge and preamp. Such capacitive loading also adds to the amount of phase shift, just as mechanical damping does.

Figure 3 shows the amplitude and

phase response measurements for five different fixed-coil cartridges of different brands and types. Figure 4 shows the same two responses for four Ortofon MC200 moving-coil cartridges, each with a different amount of damping. In Fig. 3, there is little variation in amplitude response, only ± 1.5 dB between 5 and 20 kHz, but phase responses vary from a shift of $+30^\circ$ at 10 kHz to $+80^\circ$ at 10 kHz. The worst-case example of the moving-coil types showed a shift of only $+20^\circ$ at 10 kHz.

Listening Tests

In order to verify our theory about the audible effects of phase shift, we conducted extensive listening tests with the four MC200 cartridges measured for Fig. 4. These cartridges ran the gamut, from one which was totally undamped, with a rapidly rising frequen-

cy response characteristic, reaching $+7$ dB at 20 kHz, to a heavily damped version which was ruler-flat in response, -0.3 dB at 20 kHz. The other two cartridges were moderately damped, with response peaks of $+3.8$ dB at 20 kHz and $+1.9$ dB at 20 kHz respectively. The sonic differences among the sample cartridges were easily apparent. The locations of instruments, the overall sensation of depth and height, and the total width of the image all varied from sample to sample.

The totally undamped cartridge, which had the least amount of phase shift, produced the widest, deepest, and most stable image. The feeling of realism with this cartridge was unsurpassed. Unfortunately, its "bright" character could not be overlooked. Overall balance was not correct, par-

"It is indeed possible to measure phase shift in phono cartridges, and this parameter directly relates to the sound produced by the cartridge."

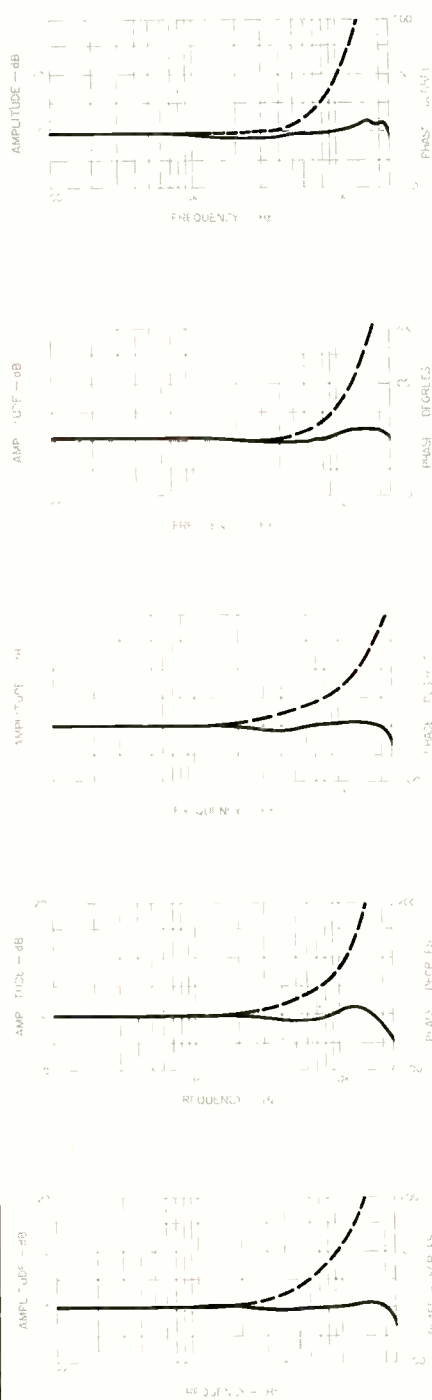


Fig. 3—Amplitude and phase response (dashed line) of five fixed-coil cartridges.

ticularly with respect to female vocals, stringed instruments, and some of the percussion.

The second cartridge, which had the least amount of added damping, presented a sound stage which was slightly narrower and slightly taller, and which had a bit less depth. Localization and placement of instruments, however, remained very close to the undamped version's. Most importantly, the audible effect of any variation from absolute flat frequency response was minimal, and the feeling that the cartridge was too bright disappeared.

The third cartridge, with slightly more damping, sounded extremely similar to the second. Some shrinking of depth was detected on the vocal material, and very complex string passages exhibited slightly less definition of the instruments.

The fourth cartridge, which had the flattest amplitude response, was the least satisfying. The overall sound field had little depth; what depth existed was confined to center-stage information. Any difference in the locations of instruments placed in the same side of the stage was gone. Whereas the undamped cartridge presented a sound field which seemed made up of numerous instruments placed in front of the listener, the sound field of the most damped cartridge seemed to have only three sound sources—left channel, right channel, and center channel.

It is important to note that all four cartridges exhibit amplitude responses which are essentially flat throughout all but a very small portion of the audible range. With the exception of the totally undamped version, which begins to show amplitude variations of +2 dB at 10 kHz and +5 dB at 15 kHz, the audible differences due to amplitude-response variations were negligible. The audible effects of these phase variations appeared to be a reduction of depth of the sound stage, a lack of image stability, poor localization of sounds, and, in some instances, an image originating from above the loudspeakers and remaining limited in width to the outside perimeter of the speaker setup.

Our conclusions from these measurement studies and listening tests are that it is indeed possible to measure phase shift in phono cartridges,

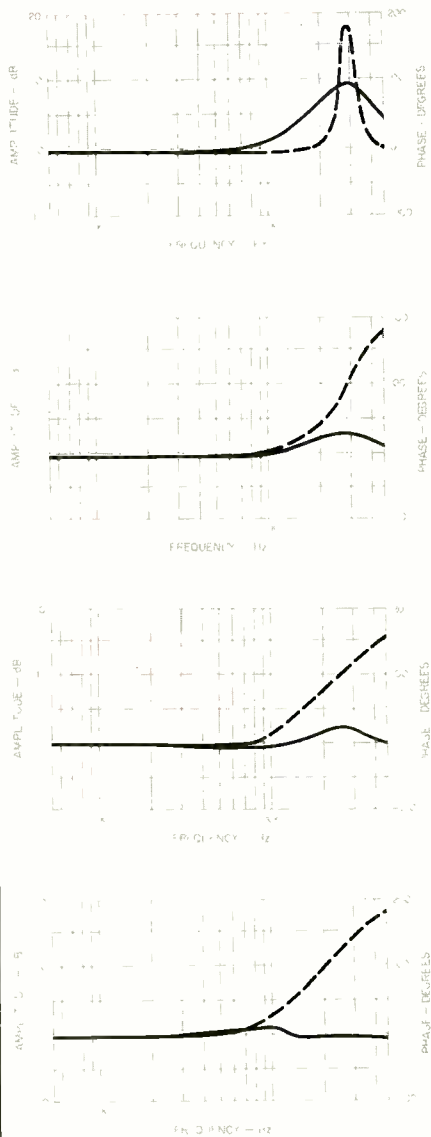


Fig. 4—Amplitude and phase response (dashed line) of four moving-coil cartridges with various amounts of damping.

and that this parameter directly relates to the sound produced by the cartridge. We are therefore trying to design cartridges which have both a flat amplitude response and relatively little phase shift. Our investigations at this time show that the moving-coil cartridge will typically exhibit less phase shift than a fixed-coil type, while its amplitude response is fairly easy to keep reasonably flat or balanced. **A**



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with features and refinements that let you transfer every nuance of sound onto tape—and actually monitor it while you're recording. The unique combination of the precision,



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ONE-BRAND SYSTEMS

AIWA S.P.A.N. V-1000G



Photograph: Susanne Buckler

The initials in this system's name stand for "Synchro Performance Audio Network," a unique interconnection method which lets the V-1000G's components act together like a single unit. However, you *must* use only the components offered, with the possible exception of the turntable and the definite exception of the optional speakers. (In my tests, I did not use Aiwa's speakers and recommend using something larger and of higher quality for best sound.) Interconnection is extremely simple: With the glass rack accompanying the "G" system or the wood rack of the less expensive V-1000X, one just places the components in position and plugs them into prewired connectors in the rack's back plate. Additional cables are supplied for those who do not wish to use a rack.

Even without the rack, however, the lengths of the cables supplied are such that you *must* stack the components as shown in the owner's manual, unless you buy longer cables with the appropriate DIN plugs (not all identical). Ordinarily, however, the Model LX-100, linear-tracking turntable goes on top; the Model MX-100 amplifier (which also acts as the system's control center) goes just below it. Below that will be the Model TX-100 frequency-synthesized tuner, resting atop the Model FX-100 Dolby B/C-equipped cassette deck. (All components have "footprints" slightly larger than a record jacket's, just under 13 inches on each side.) Even the various a.c. power cords must be hooked up a specific way in order for the interactive features of the system to work properly. Once all the connections are made, the only

"spare" inputs available are a pair of "AUX" terminals. There is no provision for tape monitoring or the addition of any sort of signal processing equipment (dbx decoder, equalizer, etc.). Neither is there any circuit interruption point between the preamp-control section of the integrated amplifier and the power amplifier section.

There are, of course, operating advantages to this arrangement. The amplifier's program source selectors for "Phono," "AUX," and "Tuner" are paralleled on the cassette deck, so you can select a source for taping without reaching back up to the amp. If you go into "Record" mode when the system is set for "Phono," the tape deck goes into "Record Pause" mode, automatically starting the tape when the tone-arm comes to rest on the first groove of the spinning record. These neat tricks,

and more, are all made possible by those extra wires inside the supplied interconnecting cables.

The MX-100 integrated amplifier has an accurate LED power-output indicator referenced to 8-ohm loads. Next to it is a corresponding volume-level indicator which is necessary because volume levels are altered by means of up/down keypads rather than a rotary level

control. Several other indicators inform the user about amplifier status, including a "Tone" indicator, since the bass and treble controls of this unit can be bypassed if desired. A DSL ("Dynamic Super Loudness") switch boosts bass below 100 Hz for rooms or speakers requiring it, but boost diminishes as the level control is advanced for speaker protection. The amplifier is

equipped with a microphone input jack and an associated volume control, for mixing live mike sounds with other program sources when listening or recording. There is also a jack for a remote control, as yet unavailable. The MX-100 delivered a full 60 watts per channel for its rated distortion, even at the audio frequency extremes of 20 Hz and 20 kHz.

Aside from its excellent frequency-synthesized tuning circuitry, the TX-100 tuner features a real-time digital clock display and timer which can be programmed to turn on the tuner and thereby the entire system. It is the tuner's line cord that is connected to a wall socket, with all other line cords connected to its convenience outlets or to convenience outlets on the amplifier. Power will switch off automatically, about 64 minutes after a timed start, or after a front-panel sleep-timer button is pressed. As for its operation as a tuner, sensitivity was just average (an outdoor antenna is recommended), but distortion was surprisingly low and stereo FM separation was excellent. There are memory presets for six FM and six AM stations.

Perhaps the most outstanding component of this system is the turntable, Mocal LX-100. Its tangential-tracking tonearm is equipped with an Ortofon VMS-type cartridge of extremely low mass. Thanks to the front-loading system (records are slipped in from the front, after a "Load" button causes a drawer-like ejection of the entire turntable tray mechanism), no clearance for lifting the dust cover is needed. Such operations as lowering or raising the tonearm are controlled from the front panel. Record size is automatically detected by the tonearm. My only criticism of the system had to do with a slight rise in the cartridge's bass response which, combined with an equally small one in the amplifier's response, added up to +3.1 dB. Of course, slight counterclockwise rotation of the bass control easily compensates for this response error. Wow and flutter and distortion were very low, and separation was excellent using this turntable/cartridge combination. I found it easy to cue the tonearm very accurately using the "Backward" and "Forward" tonearm guidance buttons

Continued on page 72

ONE-BRAND SYSTEM RATINGS

Manufacturer: Aiwa America **Model:** S.P.A.N. V-1000G
Company Address: 35 Oxford Dr., Moonachie, N.J. 07074.
Cabinet Dimensions: 14⁷/₁₆ in. W x 34¹¹/₁₆ in. H x 14¹⁵/₁₆ in. D.
Price: \$1,340.00 with glass rack. For literature, circle No. 98.

Component & Specification	Claimed	Measured	Rating
<i>Power Amp Section (MX-100)</i>			
Power/Channel, watts	50	60	♪♪♪
Rated THD, %	0.05	0.02	♪♪♪
<i>Preamp/Control Section (MX-100)</i>			
Freq. Response, Phono, ±dB	RIAA, ±0.2	RIAA, ±1.2	♪♪
Phono S/N, dB	78.0	83.0	♪♪♪
<i>FM Tuner Section (TX-100)</i>			
50-dB Quieting, Stereo, dBf	N/A	38.0	♪♪
S/N, Stereo, dB	77.0	72.5	♪♪
THD, Stereo, 1 kHz, %	0.15	0.04	♪♪♪
Separation, 1 kHz, dB	50.0	48.0	♪♪♪
Alt. Channel Selectivity, dB	70.0	72.0	♪♪
<i>Turntable/Cartridge Section (LX-100)</i>			
Frequency Resp., Hz-kHz, ±dB	20-20	+3.1dB @ 20 Hz	♪♪
Separation, 1 kHz, dB	N/A	30	♪♪
Rumble, DIN B, dB	75.0	72.0	♪♪
Wow & Flutter, % wtd. rms	0.03	0.03	♪♪
<i>Cassette Recorder Section (FX-100)</i>			
Freq. Resp., Hz-kHz, ±3 dB			
Normal Tape	20-16	20-17	♪♪
Chrome Tape	20-17	20-19	♪♪
Metal Tape	20-18	20-20	♪♪
S/N, Best Tape, dB (with NR)	73.0	71.0	♪♪
Wow & Flutter, % wtd. rms	0.09	0.05	♪♪

Rating System

♪ = Poor; ♪♪ = Good; ♪♪♪ = Very Good; ♪♪♪♪ = Excellent; ♪♪♪♪♪ = Superb.

General Comments

Power Amplifier: Sound quality very good, power output conservatively rated. Phono equalization slightly off in bass region. Good switching arrangement between components. **Turntable & Cartridge:** Properly matched to each other, but cartridge response further accentuates extra bass boost. If replacing, choose a high-output moving-magnet cartridge. **Tuner:** Well designed and easy to use, with special features not normally found on separate tuner components. **Cassette Deck:** Exhibited excellent frequency response and good Dolby C tracking. Excellent interface with the amplifier and with the rest of the system.

Overall Comment: While this system makes good use of the fact that it is sold as a complete music system, it also sacrifices some features that are found in separate components, such as a tape monitor loop. On the whole, however, Aiwa manages to cram a great deal of audio performance into a very small space at a very attractive price. A fine system for small apartments, second homes, and the like.

Overall Rating: ♪♪♪

1

SHARP DX-3 COMPACT DIGITAL AUDIO DISC PLAYER

Manufacturer's Specifications

Frequency Response: 5 Hz to 20 kHz,
±0.5 dB.

Dynamic Range: 90 dB.

S/N Ratio: 90 dB.

Total Harmonic Distortion: 0.01%.

Wow and Flutter: Unmeasurable.

Line Output Level: High, 3.0 volts;
low, 600 mV.

Output Impedance: High, 600 ohms;
low, 3.75 kilohms.

Power Consumption: 40 watts.

Dimensions: 13 in. (33 cm) W × 5 $\frac{1}{8}$
in. (15 cm) H × 9-7/16 in. (24 cm) D.

Weight: 16 $\frac{1}{2}$ lbs. (7 $\frac{1}{2}$ kg.)

Price: Not established.

Company Address: 10 Sharp Plaza,
Paramus, N.J. 07652.

For literature, circle No. 90

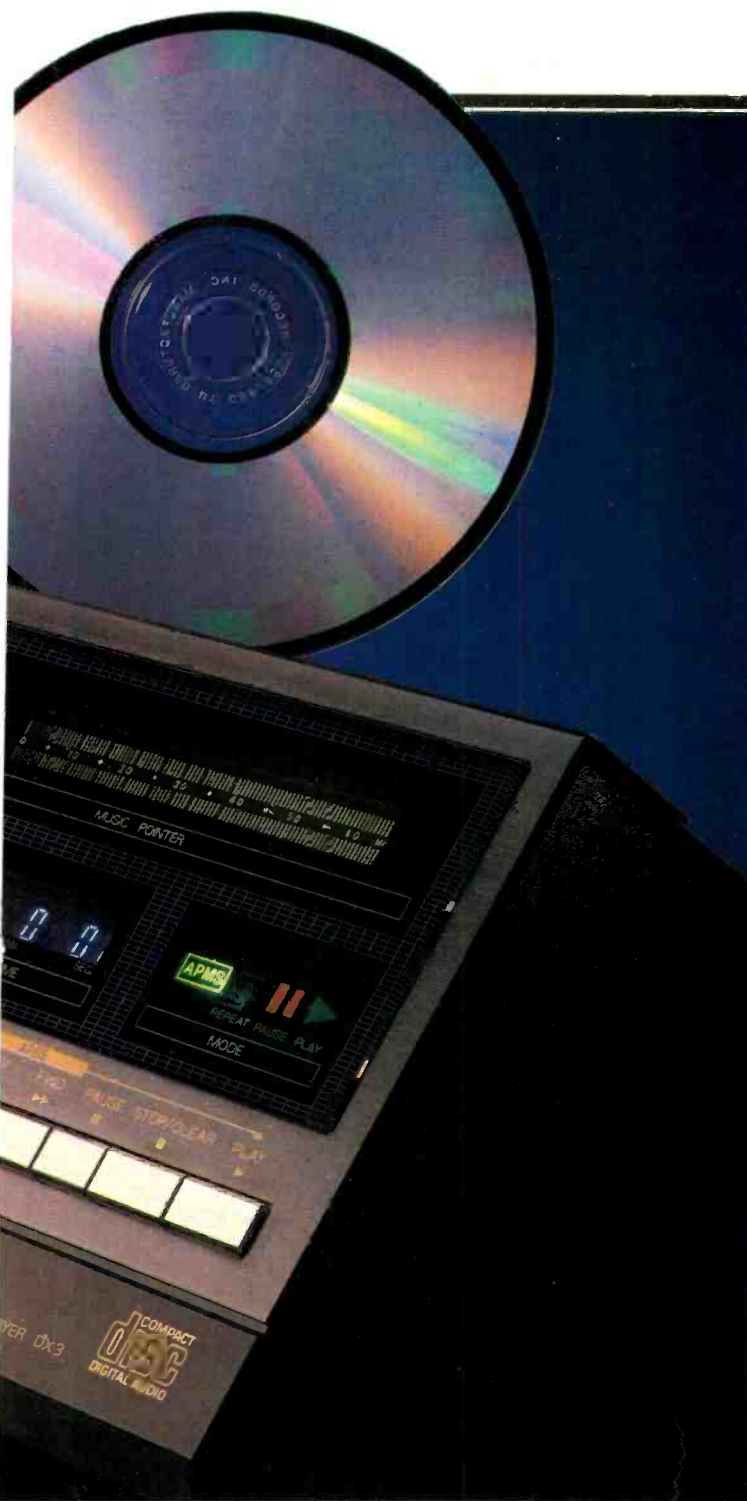


Photograph: Robert Lewis

CD players are becoming familiar items in my lab. The latest one sent for evaluation was the Sharp DX-3. Physically more compact than the Technics SL-P10 tested last month, it is about the same size as the Hitachi unit evaluated two months ago and somewhat larger than the Sony CDP-101, the first CD player I tested.

In terms of configuration, the DX-3 is a front-loading player, much like the Technics and Hitachi units. Once it is

switched on, depressing an eject button at the lower left of the front panel causes a hinged compartment to swing open. While the two other CD players employing this type of loading scheme had well-defined slots into which to drop a compact disc to be played, the Sharp unit seemed to have no well-defined location for the disc. Following instructions in the owner's manual, I casually dropped the disc inside the compartment, letting it fall where it might, and observing



only that the proper (label) side faced me. Still following instructions contained in the manual, I lightly touched the "door." Much to my surprise it began to close, at the same time automatically orienting the disc onto the spindle and changing the mode of the music-program display.

When the DX-3 is first turned on, the music-program display looks like a tape deck's bar-graph level meter, only calibrated from 0 to 60 minutes. A few seconds after the

disc is loaded, the display changes to show one vertical bar for each selection on the disc, spaced in proportion to each selection's approximate length. When the disc plays, the bar corresponding to the present location of the laser servo on the disc flickers, while the bars preceding it glow. Other bar patterns show which selections, if any, are stored in the APMS (Automatic Programmable Music Selector) memory.

Two more digital displays are to the right of the disc compartment. The first of these shows the track number being played, while the second display shows the time, in minutes and seconds, which have elapsed since the beginning of that track.

Pushbutton controls along the lower right section of the front panel include "Repeat," "Reverse," "Forward," "Pause" and "Stop/Clear." The "Reverse" and "Forward" buttons are used to perform what Sharp calls a "monitor search." When either of these buttons is depressed, play is interrupted and the laser pickup moves forward or backwards to other tracks. It is here, however, that I raise an objection to this machine's control arrangement: There is no way to listen to a given selection from its mid-point. If you depress the "Reverse" button, you will hear the current selection repeated from its beginning. The separate "Repeat" button is used to repeat-play an entire disc, over and over again, until that button is depressed a second time or the "Stop/Clear" button is touched. The "Repeat" button can also be used in conjunction with the APMS to have only certain selections repeated.

Operation of the APMS feature involves the use of the four remaining small pushbuttons on the front panel. These are labeled "Memory," "Up," "Down" and "Clear." Operating much like the station preset memory systems found on recent FM/AM tuners, these buttons allow you to "program in" the track numbers you want to hear, in any order. The "Up" and "Down" buttons advance the track number display so that it shows the track you want. Depressing the "Memory" button retains that track number, and as many as 20 tracks can be programmed in this way. If a disc contains more than 20 tracks, APMS will not advance the pickup beyond the 20th track, though the "Forward" button will advance the pickup to all tracks. (I found this out pretty quickly, since the digital test disc I use contains 39 tracks, all of which are needed to test a CD player.) To the right of the track and time displays are indicator lights which tell the user, symbolically, that the player is in play, pause, repeat, or APMS mode.

The rear of the DX-3 has two sets of output jacks. One pair of terminals provides an output of around 0.5 volt and has a source impedance of 3.75 kilohms (at 1 kHz). The other set provides an output of nearly 3.0 volts, and a source impedance of only 600 ohms. Recommended load impedance in either case is 10 kilohms or greater. Other than this choice of outputs, there is no level control facility on the DX-3.

Sharp provided no circuit or design details concerning this CD player which, I understand, is one of several prototypes that have been brought to the U.S. well in advance of actual market introductions here. (The units are becoming available in Japan.) It should be noted, however, that of the four CD players I have tested, this is the only one that arrived in its proper finalized shipping carton and accompa-

"In direct head-to-head comparisons, I could not detect any difference between the Sharp and a previously tested unit."

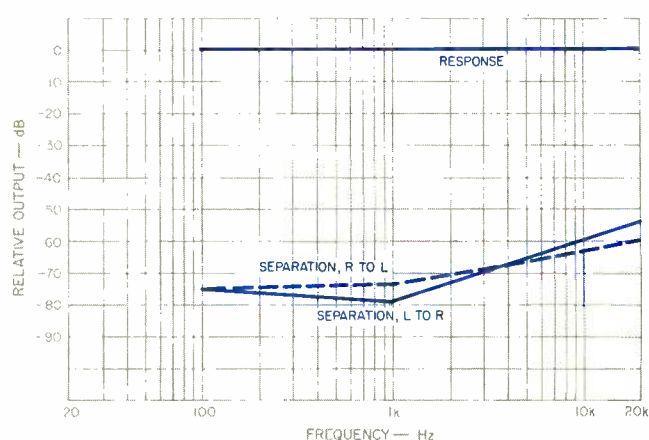


Fig. 1—Frequency response and channel separation.

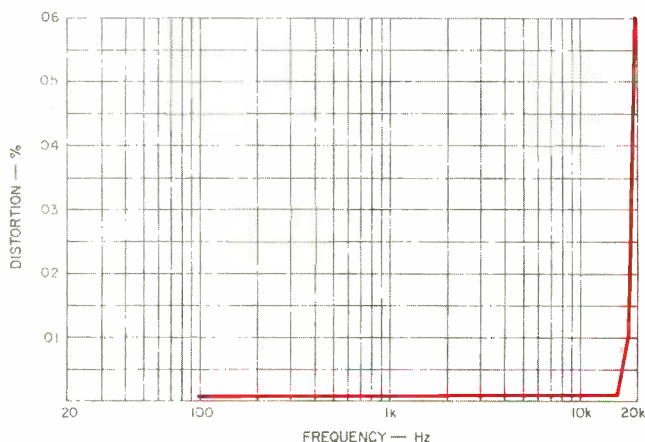


Fig. 2—Harmonic distortion vs. frequency, at 0 dB level.

nied by an actual published owner's manual, written in no fewer than seven languages! Clearly, Sharp is serious about bringing this product to market worldwide.

Measurements

Using the same test disc (Sony YEDS 2) which I used in my earlier tests of CD players, I repeated all the tests for the Sharp DX-3. Frequency response was flat within 0.1 dB from 100 Hz (the lowest spot frequency in the test disc) to 20 kHz. Stereo separation between channels measured 79 dB at mid-frequencies, decreasing to 75.5 dB at the bass test frequency and to between 54.5 and 60 dB (depending upon the channel measured) at the 20-kHz test frequency. These results are plotted in Fig. 1.

Harmonic distortion versus frequency, at 0 dB (maximum output) level, is plotted in Fig. 2. It ranged from an extremely low 0.005% at low frequencies, to a rather high 0.6% at 20 kHz. In fact, observing the nature of the "distortion" at 20 kHz on a scope, I concluded that this high reading was not really harmonic distortion at all, but rather a form of "beats" (probably against the sampling frequency or a subharmonic of it), not unlike the spurious outputs seen when measuring high-frequency distortion in the stereo mode of FM tuners. It would appear that even with CD players, you can't have everything. Note that the frequency response for the DX-3 was actually flatter at the high end than that of any CD player measured to date. This suggests that Sharp's anti-aliasing filter may be tuned to a somewhat higher frequency. The result is the higher order of apparent distortion (or spurious signal content) observed at 18 and 20 kHz.

The Sony test disc contains 1-kHz test tones at levels ranging from 0 dB (maximum digital recording level) down to -90 dB. These are used to check linearity of the playback system. The DX-3 was absolutely linear down to more than -60 dB. Where I should have read -80 dB, I read an output of -78.4 dB, but even this "error" was probably not caused by any departure from linearity but by the contribution of hum and/or noise supplied by the test-bench setup.

Signal-to-noise ratio, A-weighted, measured 93.5 dB. Without any weighting network, S/N measured 91.0 dB below reference output (maximum) level. The SMPTE-IM distortion measured a rather high 0.67% at 0 dB output level but settled down to a negligible 0.05% at an output level of -10 dB. Using the twin-tone signals available on the test disc (19 and 20 kHz, at 0 and -10 dB levels), I measured a CCIF-IM distortion of only 0.002% at both record levels.

Standards for the CD audio disc call for specific values of de-emphasis to be built into the disc players. Three test tones contained in the test disc are used to verify the accuracy of this de-emphasis characteristic, and final lab measurements involved these test tones. Precise readings are supposed to be -0.37, -4.53, and -9.04 dB at 1, 5, and 10 kHz respectively. For the DX-3 I measured -0.4, -5.0, and -9.7 dB.

Use and Listening Tests

Having retained the few musical CD discs which were loaned to me for last month's review, I was able to compare the sonic performance of the Sharp with that of a previously tested player I'd also retained. In terms of sound quality, I could not detect any difference between the two units.

All of the programming and display features of the Sharp DX-3 worked perfectly and with reliable repeatability. I have already noted the fact that it is not possible to play a given track from its mid-point (other CD players tested so far can be instructed to start playing from any point on the disc). If this doesn't pose a problem for you, then the Sharp DX-3 can be ranked right up there with the previously tested Technics and Sony players. Much will depend, of course, upon what the final pricing of this unit (or, for that matter, the earlier tested units) will be. We won't know that until the first production units reach U.S. dealers' shelves. As for myself, having now had many, many hours "at the controls" of compact digital disc players, I can hardly wait to share my enthusiasm with the rest of you music lovers out there.

Leonard Feldman

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Shure Brothers Inc., 222 Hartrey Ave., Evanston, IL 60204



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CROWN PZM-30GP PRESSURE ZONE MICROPHONE

Manufacturer's Specifications

Active Element: Pressure calibrated electret condenser.

Frequency Response: 50 Hz to 15 kHz.

Polar Pattern: Hemispherical.

Electrical Impedance: 150 ohms balanced with PA-18B (active) or PX-18B (transformer) power supplies. (Crown recommends PX-18B for use with consumer recorders having unbalanced inputs.)

Normal Loading Impedance: 1 kilohm (150-ohm unloaded input).

Total Harmonic Distortion: 3% at 150 dB SPL (maximum input level).

Noise Level: Less than 26 dB equivalent input SPL.

Sensitivity: Open circuit voltage, -76 dB, re: 1 volt per microbar (-56 dB, re: 1 V/Pa).

Power Source(s): PA-18B or PX-18B power supplies operate from two internal 9-V batteries (MN1604) or external phantom power, 15 to 48 V d.c.

Dimensions: Microphone, 5 × 6 × 3/4 inches; power supply, 5 × 1 7/8 × 1 1/4 inches.

Supplied Accessories: 5 1/2-foot cable from mike to power supply, PA-18B or PX-18B power supply (user's choice), windscreen, plastic storage case.

Price: Model PZM-30GPG, gold finish, or Model PZM-30GPB, black finish, \$349.00.

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



The regular *Audio* reader has been introduced to the Pressure Zone Microphone via Ed Canby's columns in the October and November, 1981 issues. This review presents both measured data on a specific PZM model and information on how this new professional tool can be utilized in amateur recording and sound work.

The PZM design is simple, but unique: An electret micro-

phone element is positioned upside down, about 1 mm from a metal backing plate; it and its associated connector are held in position by a conductive plastic housing filled with flexible potting compound. The element is actually an electret cartridge, complete with miniature amplifier, developed and produced by a manufacturer of hearing-aid microphones. These amazing devices are manufactured in high

enough volume to be low in cost, but Crown indicates that they must be carefully tested and selected to meet the PZM's rigid performance specifications; this is reflected in the relatively high selling price.

The idea behind the PZM goes back at least to the mid-'60s, when RCA's acoustic laboratories and independent soundmen experimented with microphones placed on or near the floor. This allows the direct sound wave from the performer to reach the microphone at the same time as the sound reflected off the floor. Logically, this should eliminate "comb-filter" effects, multiple dips and peaks caused by phase interference between the direct and reflected sounds. Later, microphone manufacturers designed special gadgets to position mikes close to the floor, such as E-V's "mike mouse."

Meanwhile, a number of West Coast audio engineers, including *Audio's* Ed Long, were inventing and experimenting with PZMs. The results were good, and Crown International now manufactures these microphones.

Of what interest is the PZM to the audiophile? The literature promises better quality music and vocal recordings. The improvement is said to be very significant as compared to conventional microphones on floor stands or mikes "flown" above the sources of sound. Those of us who do not like to carry mike stands (which may weigh more than a modern cassette recorder), or risk life and limb in "flying" our mikes, will appreciate the simplicity of PZMs. They fit in small boxes, weigh next to nothing, and can be rapidly set up by placing them on the floor or a wall. Since their bass response is proportional to the size of the plane they're mounted on, they should be backed up with mounting planes when they are "flown"; if transparent Plexiglas panes are used, the microphones remain relatively inconspicuous.

The PZM-30GP tested here is the general-purpose model, available in gold (30GPG) or black (30GPB). Six other models are listed in *Audio's* October 1982 Annual Equipment Directory. These include miniature versions, versions on tie clips, and for mounting on musical instruments, lecterns or conference tables. The PZM-30GP (and the smaller PZM-6LP with attached cable) have responses with "presence humps" at 10 kHz, to counteract high-frequency attenuation in the air.

Two power-supply options are available, the PA-18B active circuitry power supply and the PX-18B transformer power supply. Both provide for either "phantom" powering (18 to 48 volts, preferably 48 volts) through the audio cable, or for power from built-in, 9-volt alkaline batteries (When used with batteries, these supplies should be switched to "Phantom" when packing up, to prevent battery drain.) For this review, the PX-18B was selected because its audio output can be connected directly to unbalanced inputs of typical open-reel and cassette recorders.

Measurements

Figure 1 shows a family of impedance curves. The output impedance of the PZM-30GPG with the PX-18B power supply is much lower than its 150-ohm rating at 1 kHz, but rises above 150 ohms at 20 kHz. This would seem to indicate high leakage inductance in the transformer, and the inductive termination of the microphone line could encourage

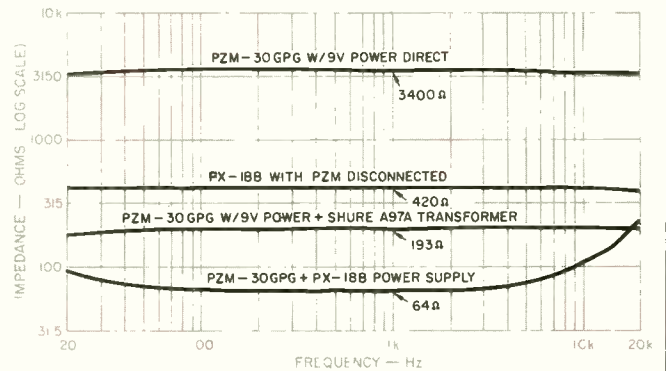


Fig. 1—Impedances for various combinations of PZM microphones and power supplies.

radio frequency interference (r.f.i.). When the PZM is disconnected, the PX-18B has a curve like a 420-ohm resistor. With a simple battery power supply, the direct PZM impedance is 3,400 ohms resistive. Adding the Shure A97A transformer yields 200 ohms resistive, an ideal termination for a long microphone line.

How does one test a PZM's frequency response? Ideally, the PZM would be placed on a large outdoor parking lot, with the sound source suspended overhead. Baffle surfaces of practical size introduce dips and peaks into the response, due to reflections from their edges. Crown uses Time-Delay Spectrometry (as in Dick Heyser's speaker reviews for this magazine), which discriminates against room and baffle reflections. Because I wanted to eliminate these reflections only in one test, I devised a simple method where the unique properties of my laboratory sound source were used to accomplish this objective. The sound source (see *Audio*, April 1977) has a 2-inch aluminum piston suspended by nylon threads. The "far field" (according to accepted practice) begins at a distance of 4 inches. I discovered that the PZM, mounted on an easily handled 2 x 2 foot baffle, exhibited a smooth frequency response curve at 6 inches from the source. This is because the edge reflection path is more than 2 feet, and the reflection SPL is therefore about 12 dB less than the direct SPL. Thus, the reflection dip at 700 to 800 Hz is seen to be only 1 or 2 dB (Fig. 2). I call this the "Pseudo-Infinite-Baffle" frequency response. The curves of Fig. 2 are in good agreement with Crown's published curves and fall within the tolerance envelope. Without the windscreen, the 30GPG high-frequency response is at the extreme of tolerance, but falls to nominal with the screen. The GPB unit as received did not have a foam damper under the cartridge, as did the GPG. Crown sent me some foam pieces which damped the 10-kHz response, so it is well matched to the 30GPG. This damper is not glued in place; if you see light in the slot under the cartridge, the foam has fallen out and the high-frequency response is likely to be out of tolerance.

“How does one test a PZM’s frequency response? Ideally, with the PZM on a large, outdoor parking lot and the sound source suspended overhead.”

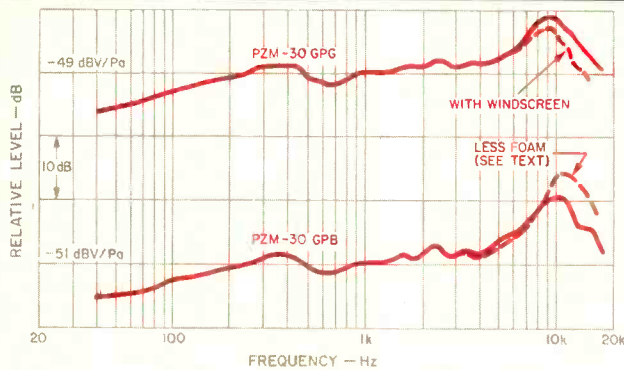


Fig. 2—Pseudo-infinite-baffle frequency responses.

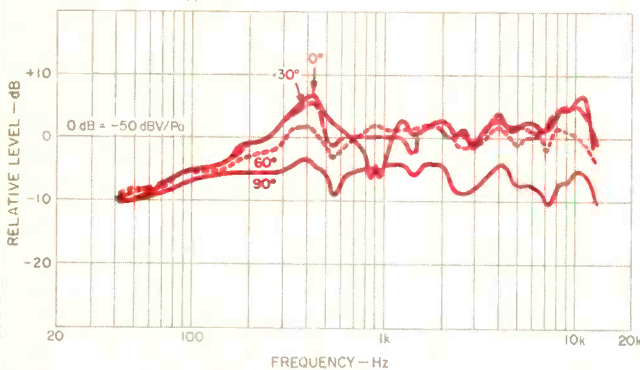


Fig. 3—Directional frequency responses of PZM-30GPG on 2 x 2 foot baffle.

My reference for all tests was the free-field sound pressure level, which is the SPL in free space at the PZM element location, with no microphone or baffle present. The measured output level values are thus 6 dB higher than Crown’s data, because the pressure-doubling at the baffle increases the PZM output level by 6 dB. This also results in the measured noise level (in equivalent SPL) being 6 dB lower than specifications. Crown could justifiably claim the PZMs to be 6 dB “better” by adopting my computation scheme, which, I believe, more strictly conforms to EIA standards for microphone testing.

I wanted to verify Crown’s claim that, on a baffle, the PZM’s directional pattern is perfectly hemispherical at all frequencies. Crown recommended a 4-foot-square baffle for the test.

Ron Streicher, a West Coast recording engineer, had challenged me to find the 6 dB step in the PZM’s low-frequency response, which varies with baffle size. The baffle cutoff frequency for a square baffle is given by the formula $f = 283/D$, where D is the length of one baffle side, in feet

(see Table I). At the cutoff frequency the baffle’s pressure-doubling effect vanishes, and the PZM’s output level drops by 6 dB (for square baffles; for rectangular ones, 3 dB for each side’s cutoff frequency), remaining at this level down to the capsule’s cutoff frequency. To be measurable, the baffle cutoff must be well above the capsule cutoff frequency. A 2 x 2 foot baffle is suitably sized for this test. (Obviously, a PZM will perform rather poorly on baffles smaller than 2 feet on a side.)

I cut the required baffles from half-inch plywood, mounting each in turn on a pipe stand, outdoors, at six feet from my large, spherical sound source (*Audio*, September 1978). A distance of 8 feet is more appropriate for testing a microphone on a 4-foot baffle, but 6 feet was used, to be in agreement with previous tests using this source.

Comparing Figs. 3 and 4, the decrease in low-frequency response is steeper at the small baffle’s 142-Hz cutoff frequency than with the larger baffle because the larger one, being rectangular, has different cutoffs for each side. Edge reflection dips are seen at 450 Hz for the 4-foot, and 900 Hz for the 2-foot, in exact ratio to the size of the baffles. Curiously, these dips smoothed out at 30° to 90° off-axis. However, the response at 0° and 30° with the small baffle is decidedly more ragged than with the 4-foot baffle. Considering the entire hemisphere, the 2-foot baffle is actually not very inferior to the 4-foot, except for the loss in bass response. At 90°, the responses with either baffle drop 6 dB in level (pressure doubling vanishes) but remain uniform.

The results of these tests do confirm, in my opinion, that the PZM directional pattern is hemispherical over its useful frequency range. Since the 90° responses are attenuated by 6 dB, and a PZM (on a large baffle) has no 180° response, the PZM seems to resemble a unidirectional microphone. This may account for the reports by users that a PZM has long “reach.” The 10-kHz hump in the high-frequency response of Fig. 2 is not so pronounced in the real-world baffle curves of Figs. 3 and 4, so the 30GP’s response is probably appropriate to many practical applications. Without a baffle, response rose very steeply across the entire audio frequency range, so the PZM is not to be used this way.

Next, I devised tests to investigate the “comb-filter” effect which the PZM is said to eliminate. The 2-inch sound source, which is quite omnidirectional, was placed 8 feet away from the PZM, which was on the hard floor of my 14 x 25 foot listening room. (It would be better to conduct such a test on the floor of a large stage, since the PZM eliminates reflections only from the surface upon which it is placed.) Three kinds of conventional microphones were in turn placed on a tripod stand 5 feet above the PZM, and then positioned on the floor near the PZM. The source was driven by a pure tone, and the microphone outputs recorded on a strip chart. A Nakamichi CM-700 with omni- and unidirectional capsules plus an RCA 44-BX (figure-8 pattern) served as the three conventional microphones. Inspection of the resulting strip charts showed that *none* of the conventional microphones exhibited as smooth a curve as the PZM. The “comb filter” showed up as a series of holes in the response curves in the region of 200 to 1,000 Hz. I even tried the omni mike head-down, 1 mm from the floor. This did not eliminate

"The PZMs on the floor beat conventional mikes on a guitar solo. The ceiling PZMs sounded best on the symphony. The conventional mikes were never superior."

the "comb filter," so it seems that there is no way to equal PZM performance with conventional commercial microphones. I did not try laboratory condenser microphones, because their noise level is too high for practical use in voice or music applications.

The self-noise testing of the PZM-30GPG with the PX-18B showed overall levels of 19 dB (A weighted), or 28 dB in a flat 15-kHz bandwidth. Figure 6 shows the spectrum, which is a falling-with-frequency curve. The manufacturer's specification of 26 dB is presumably A weighted, and in my frame of reference would be stated as 20 dB. The "hiss" level of the PZM was so low that my readings had to be corrected for amplifier noise in the region of 5 to 15 kHz. Some recorder preamps will probably be noisier than the PZM. Many Japanese recorders are designed for 600-ohm microphones; a 150 to 600 ohm line matching transformer should be used to obtain optimum S/N with them.

PZMs are unusual in that the 5-foot cable run from mike to power supply is not low impedance, and could be subject to noise interference from electrical appliances, motors, fluorescent lights, computers and radio transmitters. At the time of these tests, I had two PZM-30GPGs obtained some time ago by *Audio*, and two PZM-30GPGs plus two PZM-31S mikes just purchased from a local Crown dealer. These showed a mixed bag of manufacturing variations that could cause noise problems. The cables included 3- and 2-wire shielded varieties, and these were wired in three different ways. I rewired all of the older ones to equal the newer, 2-wire shielded cables. In each cable, I connected the female connector shell to pin 1 (shield), leaving the male connector shell ungrounded. This assured that the PZM plates would be grounded to the pin 1 shield circuit, but would *not* be connected to the chassis of the PX-18B. This alludes to two more problems: Three of six PZM plates were not grounded to pin 1. (All new ones are supposed to be grounded.) The PX-18B supply, with a standard 3-pin microphone input connector, causes the PZM plate and PX-18B chassis to have a voltage difference of 9 volts. Murphy's Law requires that someone will someday short the two together, burn out a battery, and make a very noisy tape recording. I recommend that Crown use 4-pin connectors and 3-wire shielded cable to prevent this. The existing cables were tested for r.f.i. by laying them on a wooden bench at 1 meter from, and parallel to, a quarter-wavelength antenna which was driven by a 1-watt aircraft transmitter at 122.9 MHz. The carrier was amplitude-modulated by voice. The older, 3-wire cables, which were foil-shielded and supposedly r.f. proof, picked up intense r.f.i. The new 2-wire cables were free of r.f.i. Neither cable picked up r.f.i. when used with a conventional low-impedance microphone. If Crown changes to 4-pin connectors and 3-wire shielded cable, I hope that they will select a cable which is r.f. proof and is more flexible than the stiff, foil-shielded type.

Use and Listening Tests

My first listening test was at a press event sponsored by Crown. Dr. Clay Barclay, Crown's Promotion Manager, set up an 8-track recorder plus a stereo playback system in a mobile home. Selected members of the audio press were driven from New York City to Wilmington, Delaware in this

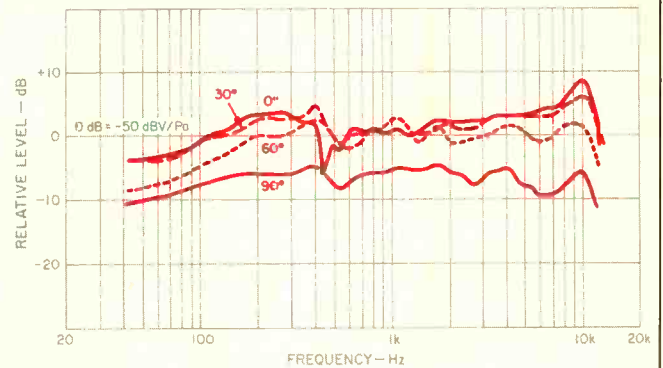


Fig. 4—Directional frequency responses of PZM-30GPG on 4 x 3½ foot baffle.



Fig. 5—Artificial Voice used for PZM talk test.

vehicle. After the press left to eat dinner with the Music Director of the Delaware Symphony, Dr. Barclay spliced the wiring of the motor home to microphone cables coming from the Grand Opera House. When we returned from dinner to the motor home, we were able to compare three pairs of PZMs to two pairs of conventional condenser microphones while the orchestra played a concert. Two PZMs were on the floor of the stage, two on a disc overhead, and two on a false ceiling over the orchestra. The conventional mikes were "flown" in front of the stage. The PZMs on the floor sounded best during a piece with a guitar solo. The ceiling PZMs had the best sound on the Brahms Fourth Symphony. The conventional mikes never sounded superior to the PZMs. The disc-mounted PZMs usually sounded better than the conventional mikes, but poorer than the other PZMs. Although Dr. Barclay put on a fine demonstration, there were two flaws: The press could not sit in the house to sample the live sound, and, because the conventional mikes were clustered in one location, we had to accept Dr. Barclay's opinions that this was the best placement.

"I hope amateur recordists discover that PZMs are the best way to get maximum audio quality with a minimum of effort."

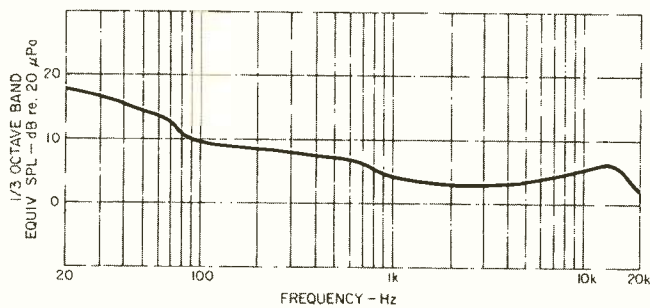


Fig. 6—Noise of PZM-30GPG with PX-18B power supply.

Table I—Baffle dimensions and cutoff frequencies for PZM.

Baffle Dimensions, Feet	Baffle Cutoff Freq., Hz
4 × 4	71
2 × 2	142
1 × 1	283
0.5 × 0.5	566

My first hands-on tryout of the PZM in an on-site recording occurred during the Christmas season of 1981 at "Glencairn," the home of the late Mr. and Mrs. Raymond Pitcairn in Bryn Athyn, Pa. Each year since the residence was completed in 1939, a "Christmas Sing" is held in the Great Hall. This is a large room with an 80-foot-high ceiling, and up to 800 townspeople attend. Members of the Philadelphia Orchestra's brass section play in a smaller room which is joined to the Great Hall by a large stone archway. The building has hand-cut stone walls, with teak floors and woodwork. The PZMs were placed about 8 feet apart on the stone floor of the archway. They did not sound as good when taped to the (very rough) stone walls of the arch. For comparison, RCA KB-2A "Paintbrush" velocity microphones were "flown" about 20 feet above the PZMs. Each set of mikes were then connected to identical Tandberg cassette recorders.

Lachlan Pitcairn, son of Raymond Pitcairn and an accomplished amateur musician, supervised the recordings. He had previously selected the conventional microphone type and placement. For this "Sing," however, the contrast in setup labor was great: The PZMs were taped to the floor, with power supplies hidden in a niche and short cable running along the floor to the recorder. The "flown" mikes required some human acrobatics, plus long cable runs and balancing transformers at the Tandbergs to eliminate noise and r.f.i.

The PZM and conventional recordings sounded almost identical in the low and midrange frequencies, including the same mix of direct and reverberant sound. The PZMs sounded brighter in the highs, but the velocity mikes had falling response above 5 kHz. I found it surprising that the microphones placed on the floor could sound similar to those overhead.

Since PZMs are also used for vocal and speech pickup, I was interested in how they would compare to conventional mikes with a speech source. A person is not a very consistent source and would tire before the tests could be completed. I was therefore fortunate to have on loan a model of the Artificial Voice (Fig. 5) developed by Dr. H. F. Olson at RCA Laboratories, and described in the *Journal of the Acoustical Society of America* (June 1966). This source duplicates the directivity pattern of a human voice from 63 Hz to 12 kHz and has uniform frequency response, ± 3 dB, over this range. The Voice was driven from a tape recording which was dubbed from many plays of a carefully recorded tape loop. The phonetically balanced sentence, "Joe took father's shoe bench out, she was waiting at my lawn," spoken by me, was played back at a level of 65 dB at 1 meter, which is normal speech level. (It was rather disturbing to hear my own voice mirrored exactly by the aluminum-headed dummy!) The PZM was placed on the floor 10 feet away from the Voice, and the conventional microphone placed on a tripod 5 feet above the PZM. The mikes were then laid on the floor, near the PZM and pointing at the Voice. First, the Nakamichi CM-700 microphone was used on the tripod with an omni capsule: The PZM audio sounded much less reverberant, as if the Voice were close-miked. The PZM thus exhibited long "reach," like a directional mike. Compared to the CM-700 with a cardioid capsule on the tripod, the PZM sounded similarly low in room reverberation, but crisper, more intelligible, and less boomy. Similar results were obtained with the omni and cardioid mikes on the floor, most closely approximating the PZM's sound when the cardioid was on the floor, set to its "Lo-Cut" position. This eliminated the boominess, but the PZM was still more crisp.

The PZM, placed on a floor, can equal or outperform conventional microphones mounted on floor stands or "flown." The simplified placement and easy portability of PZMs can be a boon to the amateur recordist or those involved in amateur theater productions. PZMs should be placed on large-area surfaces for critical recordings; 2 x 2 foot baffles will suffice for less critical work. The PZM should therefore not be placed on smaller baffles or be used by itself.

I think that the PZM is good enough to be a first choice in any application where it can be properly set up. Of course, the PZM is not suited to all situations, and rather than misuse it, I would opt for conventional microphones where necessary.

Although this review specifically pertains to the 30GP, the 6LP is similar. My tests of the 31S and 6S revealed that they have flatter low- and high-frequency response than the 30GP. They might be better for classical recordings, if properly located in a room which is free of low-frequency noise. The 6LP and 6S models are very small and best for use with miniature cassette recorders.

I hope that amateur recordists will discover that PZMs are the best way to obtain maximum audio quality with a minimum of effort. Crown publishes much information on how professional sound people use PZMs; these publications can be of great value to the amateur. I also hope that readers will develop some unique ways to use PZMs and will tell us about them.

Jon R. Sank

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If you need some help in finding that one Kyocera dealer in twenty, contact: Cybernet International, Inc., 7 Powder Horn Drive, Warren, NJ 07060 (201) 560-0060.



*85 watts RMS per channel, both channels driven, at 8 Ohms with no more than 0.015% THD from 20-20,000 Hz.

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3

NAD 4150 AM/FM TUNER

Manufacturer's Specifications

Usable Sensitivity: Mono, 5.0 dBf.

Fifty-dB Quieting Sensitivity: Mono, 13.0 dBf; stereo, 35 dBf.

S/N: Mono, 82 dB; stereo, 80 dB.

Stereo Separation: 50 dB at 1 kHz; 40 dB at 10 kHz.

Alternate Channel Selectivity: 65 dB.

AM Suppression: 70 dB.

Capture Ratio: 0.5 dB.

THD: Mono, 0.08% at 1 kHz, 0.10% at 6 kHz; stereo, 0.10% at 1 kHz, 0.2% at 6 kHz.

Dimensions: 16-9/16 in. (42.1 cm) W × 3 in. (7.6 cm) H × 10 in. (25.4 cm) D.

Weight: 8.7 lbs. (3.95 kg).

Price: \$338.00.

Company Address: 675 Canton St., Norwood, Mass. 02062.

For literature, circle No. 92



I first became aware of the talents of Larry Schotz when, more than six years ago, he appeared at the door of my lab with a Sherwood Micro-CPU 100 digital tuner. He had designed that tuner for Sherwood and later sold a similar unit under the name of Draco Labs. I remember my frustration at not being able to verify all of the claimed specifications for that remarkable product because it was then so far ahead of both its time and my test equipment. Mr. Schotz now runs his own laboratory, LS Research, Inc., in Thiensville, Wisconsin, and NAD is among his well-known clients. The NAD 4150 tuner is his brainchild, and, to my mind, it represents one of the finest achievements in FM and r.f. circuitry design that I have ever seen. There's so much that's new about the circuitry that it would take several reports this size to do it full

justice. So, let's get the physical details out of the way first, and then I'll try to discuss at least the highlights of this, the most sensitive tuner I have ever measured.

The all-black front panel of the 4150 has relatively few controls and switches protruding from its surface. At the left are a power on/off button, a mono/stereo mode switch, and an FM (interstation) mute switch. A display area provides digital readout of AM or FM frequencies and shows signal strength (in the form of from one to five LED indicator "bars") and tuning indication. The tuning indicator consists of an illuminated LED bar, flanked by pointer arrows which illuminate only when using the FM band and tell you tuning direction for correctly centering an incoming channel. The arrow disappears when perfect tuning is achieved.

A stereo indicator light is located just to the right of the display area, as are the memory preset buttons, which store five AM and five FM station frequencies. When you turn the 4150 on, a last-station memory tunes to the station you were listening to before turning it off. All memories hold their contents for two weeks with the tuner unplugged, with no batteries needed for this feature.

The "Up" and "Down" tuning buttons at the right of the panel can be used for manual or automatic tuning. In manual mode, touching each button raises or lowers the tuned-in frequency in increments of 100 kHz for FM, 10 kHz for AM; holding the buttons down causes a rapid increase or decrease in frequency. For automatic tuning, depress the "Search" button before tuning, and the 4150 will search out and lock onto the next usable AM or FM signal.

The rear panel of the NAD 4150 is equipped with the usual 75- and 300-ohm FM antenna terminals, an external AM antenna terminal, a loopstick AM antenna mounted with a ball-joint for easy orientation, a pair of output jacks, and an output level control.

Circuit Highlights

The most outstanding circuit innovation of the 4150 is the Schotz variable-bandwidth PLL detector. I'll discuss that in some detail shortly, but the rest of the tuner's circuitry is worth a brief description as well. The front-end consists of six varactor-tuned stages, and all r.f. amplifiers and the mixer use low-noise J-FETs. The first and second r.f. amplifiers are configured in a cascode arrangement to minimize Miller effect. The third r.f. amplifier is a grounded gate circuit for improved noise performance and signal-handling ability. Schotz told me that he measured r.f. IM of -85 dB and that, because the dynamic range of this front-end is a very high 120 dB, there is no need for any a.g.c.

First and second stages of the i.f. amplifier utilize J-FETs too, which helps to achieve an adjacent channel selectivity of greater than 20 dB. The J-FETs also help to maintain better phase linearity throughout the i.f. amplifier, which results in lower distortion.

Figure 1 illustrates the dramatic improvement in capture ratio achieved by the Schotz detector. Since low capture ratio is directly related to minimization of multipath distortion problems, FM listeners who have been suffering with such problems are most likely to benefit from the new circuit, as are those who receive weak signals because they live in remote areas or must use indoor antennas.

The heart of the Schotz detector is a discrete phase-locked loop (PLL) detector circuit. Figure 2 compares the FM demodulation curve of this PLL detector with that of a conventional ratio or quadrature detector. The latter types have a so-called S-curve, only a small section of which is linear. The PLL detector's "S-curve" is more Z-shaped than S-shaped, and it is inherently linear over its entire operating range. With the PLL detector, tuning away from dead center of channel has no effect upon linearity until the tuning goes so far off-center that distortion rises steeply (and obviously). Figure 3 shows how distortion varies with tuning accuracy for a PLL detector and a conventional ratio detector.

Previous FM tuners have always used detectors with a wide, fixed bandwidth. While this provides optimum perfor-

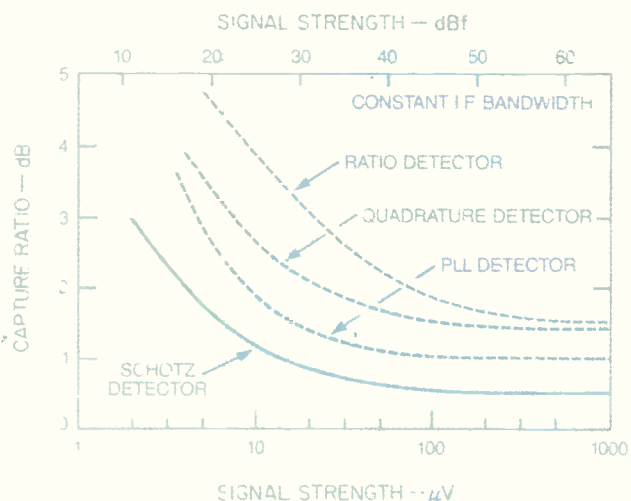


Fig. 1—Capture ratio vs. signal strength for Schotz and conventional FM detectors.

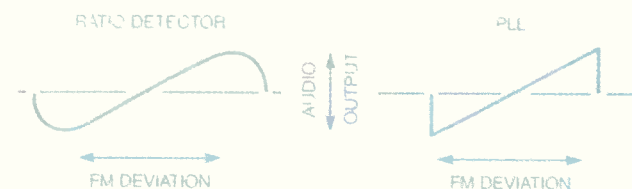


Fig. 2—Detection "S-curves" for ratio and PLL detectors.

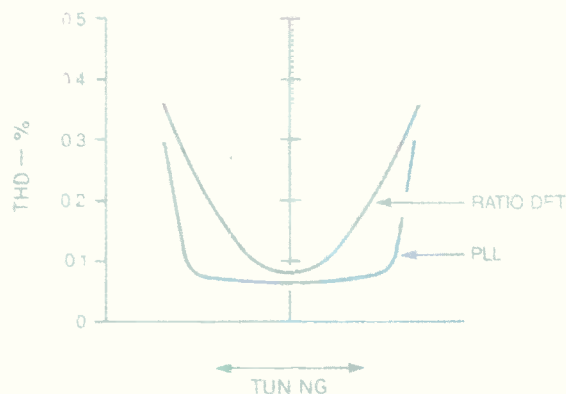


Fig. 3—Tuning error vs. distortion for PLL and ratio detectors; tuning is far less critical with PLL.

"I measured a monophonic usable sensitivity of 6.8 dBf—the lowest figure I have obtained for any tuner, ever!"

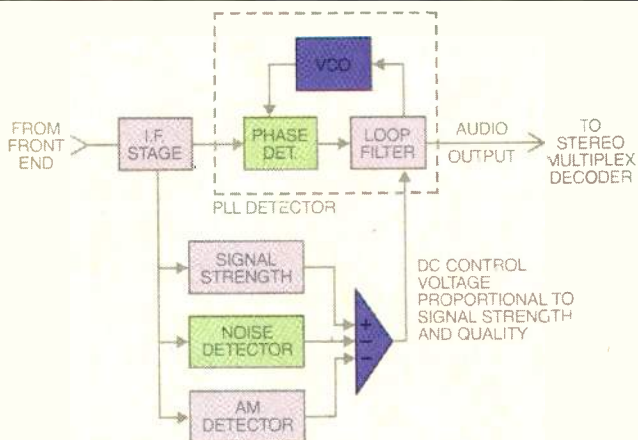


Fig. 4—Block diagram of Schotz detector system used in NAD 4150.

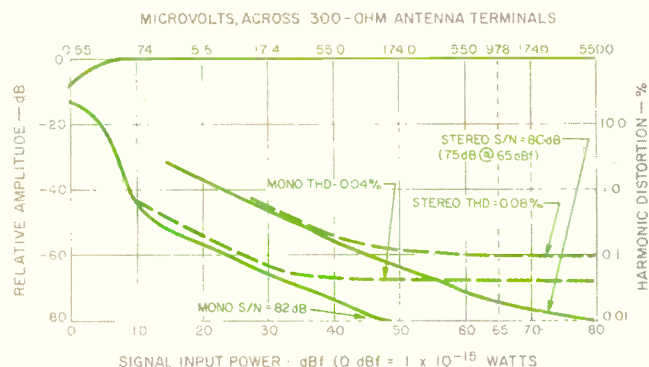


Fig. 5—FM mono and stereo quieting and distortion characteristics.

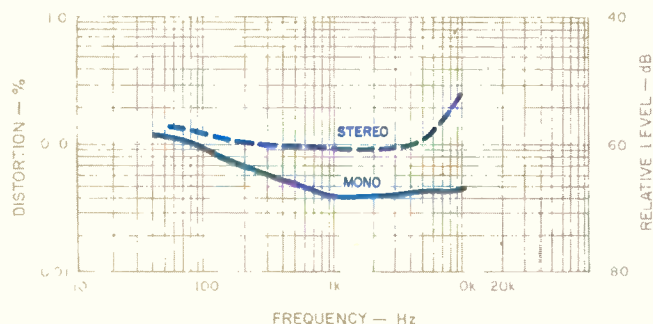


Fig. 6—Harmonic distortion vs. frequency.

performance and lowest distortion with strong signals, it limits usable sensitivity and noise performance when weaker signals are encountered. The Schotz detector alleviates this problem by automatically narrowing its own bandwidth at low signal levels, so that it responds only to the portion of the FM deviation that is within the bandwidth of the i.f. stage. By ignoring the wider FM deviations in the i.f. "skirts," it also rejects associated noise and distortion.

Figure 4 shows how the Schotz circuit works. The elements within the dotted line make up the phase-locked loop detector. They include a voltage-controlled oscillator, a phase detector which determines when the V.C.O. signal is precisely locked in phase with the incoming FM signal, and a loop filter which controls the V.C.O.'s frequency. Where this differs from conventional PLL detectors is that the operating bandwidth of its loop filter (and therefore of the entire detector) is variable.

Three additional detectors are connected to the i.f. stages. One senses signal strength, the second responds to the noise level, and the third responds to the amplitude-modulation content (which bears a direct relationship to multipath interference). The three outputs of these sensing detectors are combined to form a d.c. control voltage, proportional to the signal quality. This voltage controls the bandwidth of the PLL detector. When an incoming signal is weak, noisy or full of multipath interference, the detector's bandwidth narrows to clean up the sound. When the signal is strong and free from interference, the Schotz detector has the same bandwidth as other detector circuits.

Measurements

I measured a monophonic usable sensitivity of 6.8 dBf (1.2 μ V across 300 ohms) on the sample NAD 4150. This is the lowest figure I have obtained for any tuner, ever! Only 12 dBf of signal input was required to achieve 50-dB quieting in mono, while in stereo the same level of quieting was achieved with a signal input of only 33.2 dBf (25 μ V across 300 ohms). Stereo threshold was set at around 16 dBf, which therefore constitutes usable sensitivity in stereo as well. Signal-to-noise ratio in mono was 82 dB, exactly as claimed, with an input signal of 65 dBf. Increasing the signal strength to 85 dBf yielded another dB of S/N (83 dB). At that signal level, stereo S/N measured 80 dB, as claimed, while at the more usual measuring level of 65 dBf it was 75 dB.

Distortion at mid-frequencies was far better than claimed, measuring 0.04% in mono and 0.08% in stereo. These results, as a function of signal-input level, as well as the quieting characteristics of the tuner in mono and stereo, are shown in the graphs of Fig. 5. Distortion figures were equally impressive at the frequency extremes of 100 Hz and 6 kHz, where I measured 0.09% and 0.045% respectively in mono and 0.12% and 0.09% in stereo. Plots of harmonic distortion versus frequency are shown in Fig. 6.

This is the first tuner I have ever measured which exhibited absolutely flat frequency response (within 0.1 dB) all the way out to the highest FM audio frequency of 15 kHz. Even more remarkable was the separation characteristic of the multiplex decoder section: As shown in Fig. 7, the separation is also very nearly uniform from one extreme of the audio frequency band to the other! At 1 kHz, I measured a

“When an incoming signal is weak, noisy or full of multipath, the detector’s bandwidth narrows to clean up the sound.”

separation of 51 dB, at 100 Hz it was 45 dB, while at 10 kHz, where separation usually tends to decrease substantially, separation was actually 49 dB. What’s more, the separation on both channels was the same!

Figure 8 is an analysis of crosstalk distortion products for a 5-kHz modulating signal. In this ‘scope photo, frequencies are *linearly* displayed (as opposed to the log-frequency, 20 Hz to 20 kHz sweep in Fig. 7) from 0 Hz to 50 kHz. The tall spike at the left represents the desired (left-channel) 5-kHz output signal when the left channel is modulated to 100%. The shorter spike within the tall one is the 5-kHz output observed from the right channel. Other spikes to the right represent harmonic-distortion and subcarrier components present at the right-channel output jack.

Capture ratio measured 1.5 dB at 45 dBf but, remarkably, at the lower signal level of 25 dBf (where capture ratio usually deteriorates on other tuners), capture ratio on this tuner actually improved to 0.9 dB. I measured an alternate-channel selectivity of 79 dB and AM rejection of 70 dB at 65 dBf input-signal strength. Spurious, i.f. and image rejection were all above 100 dB (the limits of the test setup), but Larry Schotz tells me he was able to measure in excess of 130 dB for all three of these parameters. I’m willing to take his word for it! SCA rejection, an important parameter that all too many tuner designers tend to neglect, measured a superb 79 dB, while 19- and 38-kHz subcarrier product rejection was a very satisfactory 71 dB. You won’t have to activate any MPX filters on your cassette deck if you record programs with *this* tuner.

While I didn’t spend too much time measuring the AM performance of the NAD 4150 tuner (the company doesn’t even list any specifications for AM), I did run the usual frequency response plot, which is reproduced as Fig. 9.

Use and Listening Tests

To put it simply, Larry Schotz has outdone himself this time. That old Sherwood tuner, mentioned at the beginning of this report, originally sold for around \$2,000.00! But this NAD tuner designed by Schotz carries a suggested retail price of just over \$300 and outperforms his earlier unit by a wide margin. Tuning is easier than on most tuners I’ve worked with, and the difference was even more apparent when dealing with signals having marginal levels. I picked up, with usable quality, at least eight stations that are normally so full of noise and distortion that I don’t even log them as receivable in my location.

The 4150’s variable-bandwidth detector feature seems to eliminate the need for the variable bandwidth i.f. stages found in much more expensive tuners and receivers, and that obviously reduces cost. Schotz was right about the relaxed center-tuning requirements too. Given a fairly strong signal, I was able to detune the 4150 by a full 100 kHz in FM without detecting any change in sound quality, noise or distortion. Try that on a tuner having a conventional detector circuit, and the sibilance and raspy peaks would make you leap from your armchair to retune (or turn off) the set.

I deliberately made some A-B comparisons between the 4150 and a conventional tuner costing about \$600.00, tuning each to stations known to produce multipath distortion in my location. To make matters worse, I even rotated my

Fig. 7—
Frequency response and stereo separation.

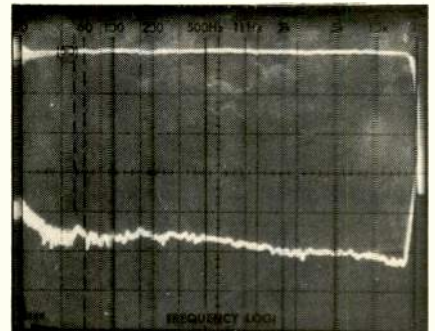


Fig. 8—
Crosstalk and distortion products with 5-kHz modulating signal.

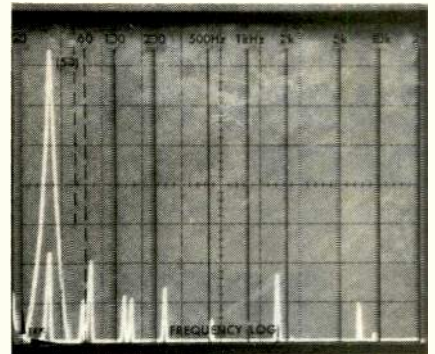
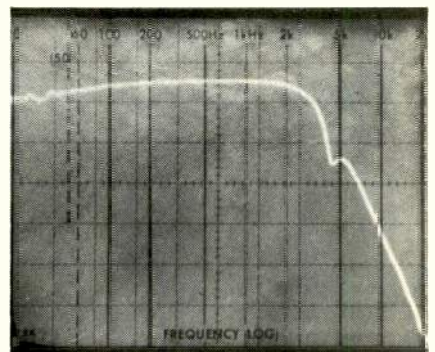


Fig. 9—
Frequency response, AM section.



outdoor antenna to emphasize the problem. I’m not going to tell you that the NAD 4150 totally eliminated the problem, but it very definitely reduced it to tolerable levels. The familiar raspy outbursts so characteristic of multipath-signal reflections occurred with great regularity on “Brand X” and only were audible during occasional extremes of modulation with the NAD 4150.

I’ve always had a great deal of respect for Larry Schotz’s work in r.f. design. I felt that his design efforts were always pure in concept, devoid of gimmicks, and represented the state of the art. The NAD 4150 helps to reinforce my high opinion of this behind-the-scenes inventor, and I look forward to his next breakthrough. As for NAD, they deserve a great deal of credit for having turned to the right designer when they wanted an outstanding tuner. *Leonard Feldman*

4

REVOX B710 MKII CASSETTE DECK

Manufacturer's Specifications

Frequency Response: 30 Hz to 18 kHz, to 20 kHz with chrome or metal tape.

Harmonic Distortion: 0.8%.

S/N Ratio: 72 dBA with Dolby C NR.

Separation: 40 dB.

Input Sensitivity: Mike, 0.35 mV; line, 35 mV.

Output Level: Line, 775 mV; head-phone, 2.45 V.

Flutter: 0.1% wtd. peak.

Wind Times: 65 seconds for C-90.

Dimensions: 17.8 in. (452 mm) W x 6 in. (151 mm) H x 13.8 in. (352 mm) D.

Weight: 22.9 lbs. (10.4 kg).

Price: \$1,995.00.

Company Address: 1425 Elm Hill Pike, Nashville, Tenn. 37210.
For literature, circle No. 93



Studer Revox makes a limited number of products for the audiophile market, but they are all of very high quality. It is always of interest, therefore, when they introduce a new model, such as the B710 MKII stereo cassette deck. It has microprocessor control (including a built-in timer), three heads mounted on a high-stability common base, four-motor direct drive, and other goodies which I will cover later. The cassette holder and drive assembly dominate the front panel with their size and rugged looks. The dual capstans draw attention because they are of much larger diameter than those on other decks. Also unusual and noteworthy is the light and sensor assembly to detect clear leader for automatic cueing right at the start of the actual oxide.

The transport control buttons are the standard ones, and the logic allows direct changing between most modes, including "punch-in" flying-start recording (shifting to "Rec" while in "Play") by pressing both "Rec" and "Play" at once. There is no pause function in "Play," but there is one in "Rec," where it's needed. The counter display above shows either four bright LED-type digits for tape location or, with a push of the "Mode" switch, local time. Counter, memory, time and timer settings are controlled with the adjacent buttons for "Zero" and "Run-Up" (which set and find the zero positions on the tape), while the timer's "Set," "Start," "Stop" and "Clear" buttons are behind a swing-down panel at the top. There are also slide switches for timer mode

("Play/Off/Rec") and the multiplex filter, as well as four interlocked pushbutton switches for tape selection (IEC Types I, II, and IV or auto-selection from sensing holes in the cassette shell).

When the B710 MKII is placed in record mode, a red indicator appears at the very right of the "Counter/Time" display, just above the "Rec" button. Below the transport buttons are the large-handed toggle switches for "Power," "Monitor," and "Dolby-NR" ("On/Off") and ("C-Type/B-Type"). If the power switch is in the "Standby" position, the clock continues to function, and the time can be read out by pushing "Mode." When the Dolby-mode switch is on, a Dolby double-D symbol is illuminated at the right end of the horizontal LED-type "Peak-Reading Meter." If the multiplex filter is on, "MPX" appears just above the Dolby symbol, and if the tape selector is set to "Auto," there is an "IEC" just below it.

The "Peak-Reading Meter" covers a wide range, from "-30" to "+8" for each channel. Meter resolution is very good, with 24 bars for each channel and with separate thresholds for each bar. The dual-concentric level pots for both mike and line inputs allow for complete mike/line mixing. There is a fair amount of friction between sections, but the large, well-knurled knobs make interchannel balancing quite easy. There are phone jacks for left and right mikes and for headphones. (A single mike in the left jack sends a mono signal to both channels.) The separate headphone volume control does not affect the outgoing line level—a considerable convenience at times. The large, white lettering on the gray background makes for excellent legibility under any normal lighting.

The connections on the back panel are under a fairly deep overhang of the chassis, so they're a bit hard to see from the front. There are the expected line in/out phono jacks, plus sockets for a remote control and for power-on connections to a Revox receiver, especially useful with the built-in timer. The screw-type fuseholder and a line-voltage selector are potentially helpful if you move overseas.

Access to the interior was gained by removing the metal top cover. The attention that Revox gives to detail was indicated by the cover's smooth, gentle curve which ensures firm seating at all points when installed. The soldering on the several p.c. boards was excellent, with no flux residue. Most of the inter-card connections were made with multipin cables. All of the ICs were in sockets, for easier service replacement. None of the parts or adjustments were labelled, however, so internal work would best be left to those with the necessary servicing information. The four-motor transport assembly caught my attention with its rugged and rigid construction, large flywheels, lack of pulleys and belts, and damped head-gate solenoid. The drive system was very quiet in all operating modes.

Measurements

The playback responses were very good for 120- μ S, but showed some high-end roll-off (-3 dB) for 70- μ S EQ. Playback level indications were exact within the resolution of the bar-graph meters. Play speed was about 0.25% fast, very satisfactory. This Revox deck was supplied with TDK AD, SA-X and MA cassettes, and they were used for the normal

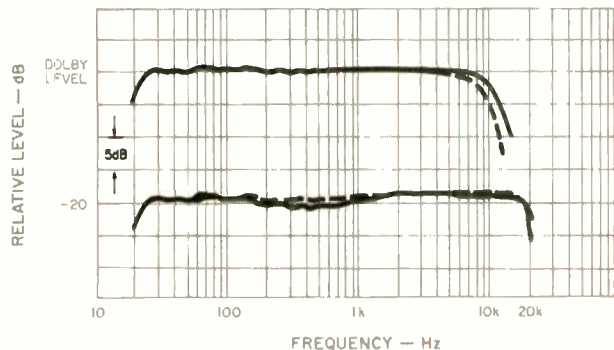


Fig. 1—Swept-frequency responses with and without (dashed line) Dolby C NR using TDK AD tape.

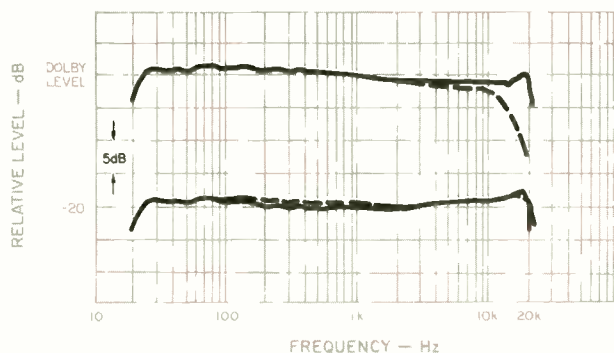


Fig. 2—Swept-frequency responses with and without (dashed line) Dolby C NR using TDK SA-X tape.

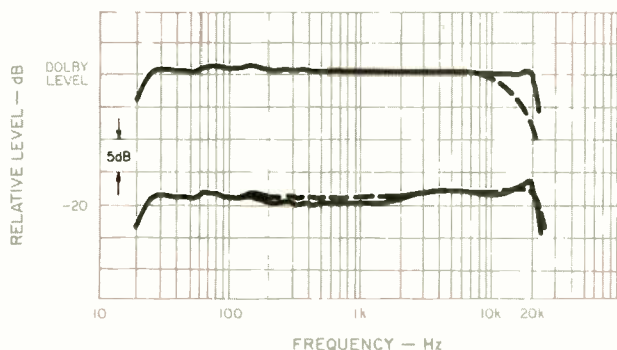


Fig. 3—Swept-frequency responses with and without (dashed line) Dolby C NR using TDK MA tape.

"The benefits of Dolby C were especially noteworthy, yielding response that would do many decks proud at levels 20 dB lower."

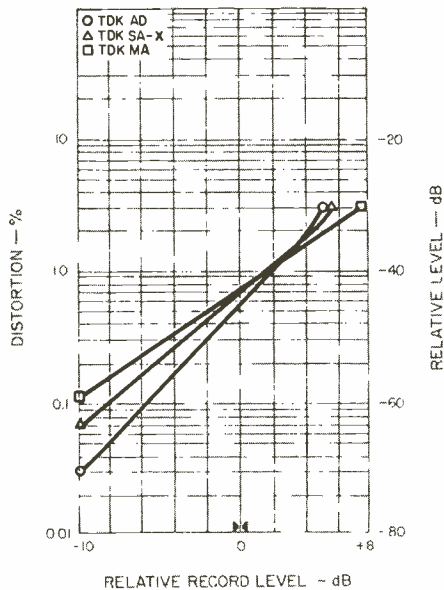


Fig. 4—Third-harmonic distortion vs. level at 315 Hz with Dolby C NR.

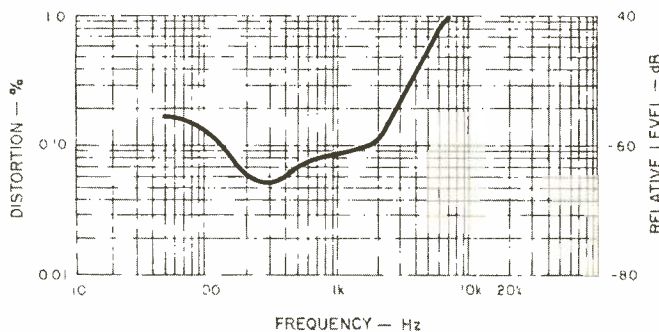


Fig. 5—Third-harmonic distortion vs. frequency with Dolby C NR at 10 dB below Dolby level using TDK SA tape.

test program. Other tapes that were well-matched to the B710's internal sensitivity and bias settings were BASF Professional I Super and Metal IV, JVC ME-P, Maxell UD XL I and XL II-S, Memorex HBII and TDK MA-R. Swept-frequency responses were obtained for the three supplied tapes at Dolby level and 20 dB below that both with and without Dolby C NR. As Figs. 1 to 3 and Table I show, all of

the responses were quite flat and well extended. The benefits of Dolby C at higher levels were especially noteworthy with SA-X and MA tapes, yielding response that would do many decks proud at levels 20 dB lower. Dolby tracking was excellent with SA-X, and good with the other tapes. In running the swept responses, some leak-through from the inputs to the outputs at the highest frequencies was noted. A check with pink noise at maximum meter level proved that the coupling was a testing oddity and definitely not detectable with music-type signals.

Playback of a recorded 10-kHz tone had about 30° of phase error between tracks and a total jitter of 10°, better than most decks overall. The multiplex filter was 1 dB down at 16.0 kHz and a good 32.8 dB at 19.00 kHz. Bias in the output during record was very low in level. Separation between tracks at 1 kHz was a very good 47 dB, and crosstalk at the same frequency was an outstanding -87 dB. Erasure of metal tape at 100 Hz was a good 62 dB.

The third-harmonic distortion was a very linear function (in dB) from -10 dB to the HDL₃ = 3% limits (Fig. 4) for all three tapes. Notice the very low figures at -10 dB for both SA-X and AD tapes. The SA-X tape was also used for tests of HDL₃ versus frequency from 50 Hz to 7 kHz, with Dolby C NR, at 10 dB below Dolby level. The results from 50 Hz to 2 kHz were excellent (Fig. 5), but the sharp rise above 2 kHz was a little unexpected.

The signal-to-noise ratios (Table II) were measured at Dolby level and at the 3% limit points, both with and without Dolby C NR and with both IEC A and CCIR/ARM weightings. The perceptive reader may notice that the difference between a Dolby-level ratio and a 3%-point ratio is less than the level difference shown in Fig. 4. The discrepancy is the result of compression in the recording; Fig. 4 shows the difference in incoming *record* levels, but Table II reflects the compression revealed in *playback*. (Please note that this is a characteristic of all recorders, even though rarely reported.) A further point is that the 3% points are higher with Dolby NR than without—another plus for noise reduction. The results are all excellent, and there is no doubt about the considerable advantage Dolby C provides over Dolby B in lowering noise.

The input sensitivities were 0.64 mV for mike and 64 mV for line, both higher than the specification and by exactly the same ratio (64:35). In some cases, it would be advantageous to have the specified sensitivities. The overload points were 40 dB higher, as specified: Mike at 65 mV and line at 6.4 V. The output clipped at a level equivalent to +15.1 dB relative to meter zero. The line input impedance was close to 200 kilohms over much of the band, falling to about 25 kilohms at 20 kHz—still plenty high enough. The line input pot sections tracked within a dB from maximum down 60 dB, which is outstanding. The mike pot sections tracked to the same limit for 45 dB, quite acceptable. The line outputs were right on the specification of 775 mV for meter zero, falling to about 747 mV with a 10-kilohm load. The maximum headphone output was a very high 2.61 V, even with an 8-ohm load. That was far more than enough for all of the phones tried, and it was necessary to turn the headphone volume control down for normal use. The line output impedance was close to 400 ohms (low and good)

“Wind times were just 68 seconds for a C-90, a shorter time than many decks need for C-60 cassettes.”

across the band, but increased somewhat when the output level-set pots were turned down to their maximum attenuation of 28 dB. The output polarity was reversed in both “Source” and “Tape” modes.

Tests with a 5-kHz tone burst demonstrated that the B710’s meters were truly peak reading, meeting the require-

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

Tape Type	With Dolby C NR				Without Dolby NR			
	Dolby Lvl		–20 dB		Dolby Lvl		–20 dB	
	Hz	kHz	Hz	kHz	Hz	kHz	Hz	kHz
TDK AD	20	10.1	20	20.0	20	8.8	20	21.0
TDK SA-X	20	20.2	20	20.3	19	11.0	19	21.2
TDK MA	20	20.8	18	23.1	20	13.4	20	24.0

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

Tape Type	IEC A Wtd. (dBA)				CCIR/ARM (dB)			
	W/Dolby C NR		Without NR		W/Dolby C NR		Without NR	
	At DL	HD=3%	At DL	HD=3%	At DL	HD=3%	At DL	HD=3%
TKD AD	68.2	72.4	54.5	58.2	71.4	75.6	52.3	56.0
TDK SA-X	69.3	73.9	55.1	59.1	71.6	76.0	52.5	56.5
TDK MA	68.0	74.4	53.1	58.6	69.8	76.2	50.5	56.0

ments of IEC Standard 268-10 both for response and decay time. A full zero response was reached with a 20-mS burst. The frequency response was 3 dB down at 6.6 Hz and 25.9 kHz. Calibration of the scales was excellent over the entire range from “–30” to “+8.” It is a rarity to find 24 separate thresholds so accurate, and the deck’s meters were definitely superior in that regard. The high brightness of the segments made for easy reading over a range of lighting levels.

Playback of a 3-kHz tone recorded with 120-V line power had no detectable change in speed over a range from 110 to 130 V, one indicator of good transport design. Over a considerable period of time, any speed variations were less than the minimum readable, 0.02%. Throughout the length of a C-90 cassette, maximum flutter was 0.038% wtd. rms and 0.07% wtd. peak, both excellent figures. Wind times were just 68 seconds for a C-90 cassette, a shorter time than many decks need for C-60s. This fast wind, however, was very smooth and quiet (constant-speed, according to Revox), and the stops were soft and shock-free. The times for run-out to stop, changing winding directions and going from wind to play were all less than a second.

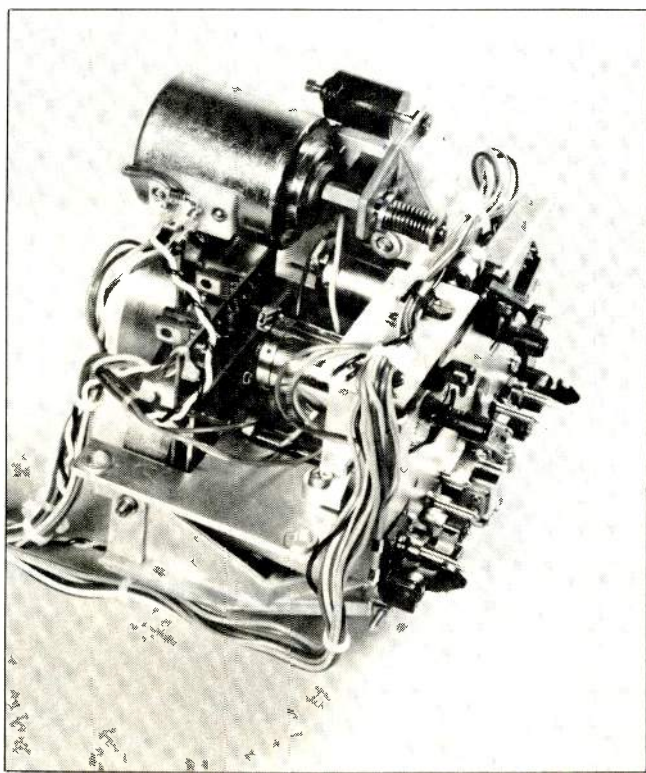
Use and Listening Tests

The instruction manual has 14 pages each of English, French and German. There are many excellent illustrations, well integrated into the fairly lucid text, although I would have preferred more detail in the discussion of memory functions. The block schematic is very good and a most welcome inclusion. The design of the cassette drive, which projects out from the front panel, made for very easy loading/unloading and provided excellent access for all maintenance tasks. All of the controls and switches were com-

pletely reliable throughout the testing. I found it a little frustrating that I could not set “Start” (the timer’s control behind the swing-down panel which zeroes the counter) while in record or play mode, because this caused the deck to stop. I would also like to have been able to rewind past “Start,” but pushing the rewind button again caused the B710 to go into play. Having the clock function built in was nice, and the timer scheme worked fine.

The listening tests utilized pink noise for the Dolby tracking tests, as usual, and the discs included Mobile Fidelity’s *Romantic Russia* with Georg Solti and the London Symphony Orchestra and Chorus. The biggest effect noted in any of the switching was the great improvement in the high end at higher levels with SA-X tape when Dolby C was switched in; there were changes with the other tapes, but less obvious. At times, there were small variations in the playback compared to the original, but they were fleeting, and the sound quality was always excellent. Dolby C NR was used for these tests, and its low-noise character was apparent in a number of very quiet passages.

The Revox B710 MKII does not have a sophisticated array of microprocessor-controlled functions such as music-selection programming, intro-search, etc., but it does have a solid list of good things for its premium price. These include excellent response, low distortion, very low noise, full mike/line mixing, excellent peak-responding meters and an outstanding transport drive system. All in all, the B710 MKII impresses me as one deck that will deliver excellent performance for many years to come. *Howard A. Roberson*



5

ACOUSTAT TRANS-NOVA TWIN-200 POWER AMPLIFIER

Manufacturer's Specifications

Power Output: 200 watts per channel, 8 ohms, 20 Hz to 20 kHz; 325 watts per channel, 4 ohms, 20 Hz to 20 kHz.

THD: 0.1%.

SMPTE-IM Distortion: 0.1%.

Damping Factor: Greater than 1,000 at all frequencies below 1 kHz; greater than 100 at 20 kHz.

Slew Rate: 165 V/ μ S.

Input Impedance: 47 kilohms.

Input Sensitivity: 1.3 volts.

Output Impedance: Forward driven, 0 to 1 kHz, 40 milliohms at 20 kHz; 200 milliohms at 50 kHz.

Power Consumption: 100 watts idling, 750 watts at rated power.

Dimensions: 17 in. (43.18 cm) W x 5 in. (12.7 cm) H x 14 in. (35.56 cm) D.

Weight: 40 lbs. (18 kg).

Price: \$1,095.00.

Company Address: 3101 Southwest First Terr., Fort Lauderdale, Fla. 33315.

For literature, circle No. 94



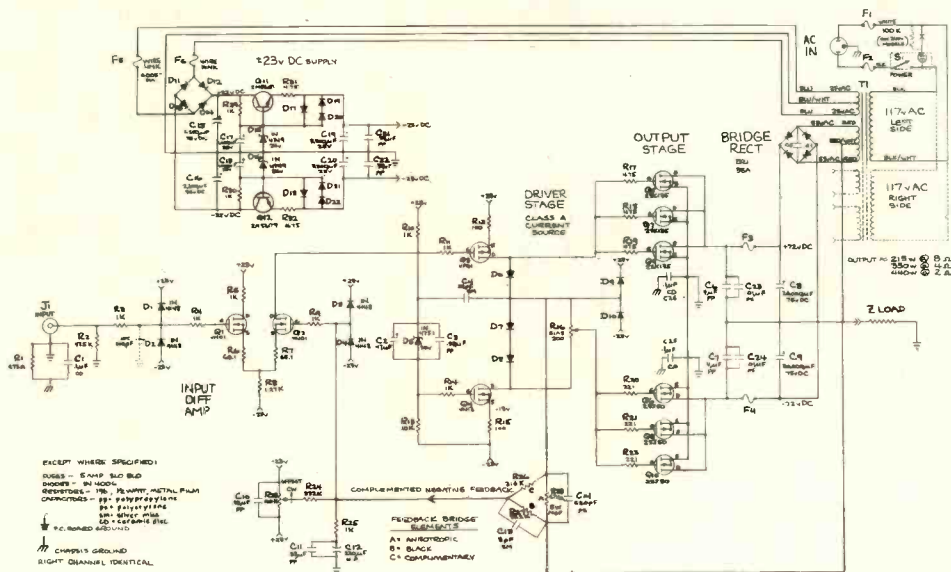


Fig. 1—Schematic diagram of one channel, Acoustat TNT-200 amplifier.

The search for the perfect power amplifying circuit goes on. This time it's Acoustat Corporation, which claims to have come up with the long sought-after answer in the Trans-Nova Twin-200 power amp. Trans-Nova is an acronym for "Trans-conductance Nodal Voltage Amplifier." Most power amplifier output stages are typically configured either as voltage followers or as transconductance stages (common in tube-type amplifiers). When Acoustat decided to design an amplifier employing MOS-FETs as power output devices, they found that neither of these basic configurations was well suited to such ICs.

The follower type of circuit is not ideally suited to the power MOS-FET because it does not allow use of either full positive-to-negative supply-voltage dynamic range or gain-bandwidth product. The transconductance stage is also not ideally suited to the power MOS-FET, since pure transconductance-mode operation of an output stage requires large amounts of multistage or long-loop negative feedback.

So Acoustat came up with a third alternative, which they call an anisotropic output configuration (anisotropic: Having different properties in different directions). A schematic diagram of one channel is shown in Fig. 1. The circuit departs from the usual bipolar amplifier design approach of having a voltage-gain stage driving a current-gain output stage. Instead, it uses voltage-to-current conversion followed by current-to-voltage conversion. In this arrangement, the first stage is called a transconductance stage ($g_m = I/E$), while the second stage is called a transresistance stage ($r_m = E/I$). The first stage has near-infinite generator impedance (and therefore zero damping); the voltage errors of the second power stage are totally returned to the first stage's input gates, to create an output characteristic equivalent to a unity-gain stage. In fact, while the output stage has every desirable property of a no-gain stage (low distortion and noise with high damping and speed), it also exhibits full open-loop voltage gain of around 20 dB into 8 ohms together with full rated power, headroom and speed.

A second important circuit innovation in the TNT-200 is called Complemented Feedback. According to its inventors, this is an improvement on classic negative feedback; it looks at signal error inside the classical feedback loop, as well as outside it, and then further refines the feedback signal to cancel output-stage distortion and impedance. In the circuit diagram of Fig. 1, the feedback circuit elements identified with the letter "A" represent Acoustat's anisotropic feedback elements. The RC network identified with the letter "B" represents the conventional feedback elements based upon the famous H. S. Black patent (1937). The complemented negative-feedback element "C" creates an intra-loop error-return path that results in "infinite" error gain without the problems of instability described by Bode and Nyquist.

This circuit design eliminates any need for current-limiting protection against load faults. Neither are inductors needed in the output path to insure stability (and possibly cause sonic aberrations with certain unusual loads). As is evident from the schematic diagram, only FETs are used in the signal path. The bipolar devices identified as Q11 and Q12 are merely part of the 23-V d.c. supply regulating circuit.

So much for the theory. Now let's have a look at the amplifier itself. The front panel is totally devoid of any controls, with the exception of its rocker-type power on/off switch. A rather prominent nameplate identifies the maker and the product. As for the rear panel, most of it is taken up with a massive heat sink, but there is just enough room at either end to accommodate color-coded, five-way output binding posts and an input jack for each channel. This sort of channel isolation is carried on inside the chassis as well, with completely separate modules housing the parts for each channel. Six fuses are located internally (four d.c. supply-voltage line fuses and two a.c. line fuses). The TNT-200 uses four completely separated bilateral power supplies and a twin-core, quasi-toroidal power transformer with parallel primaries.

"When Acoustat found the basic power amp output configurations weren't suited for MOS-FETs, they devised the anisotropic output configuration."

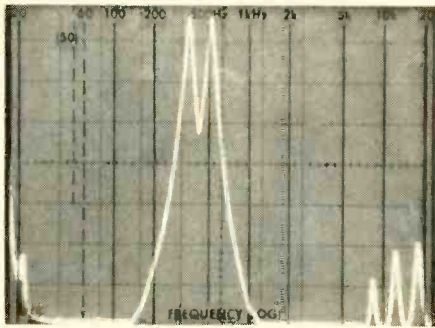


Fig. 2—Twin-tone (9 and 10 kHz) test signal displayed on spectrum analyzer for calculation of CCIF IM and IHF IM.

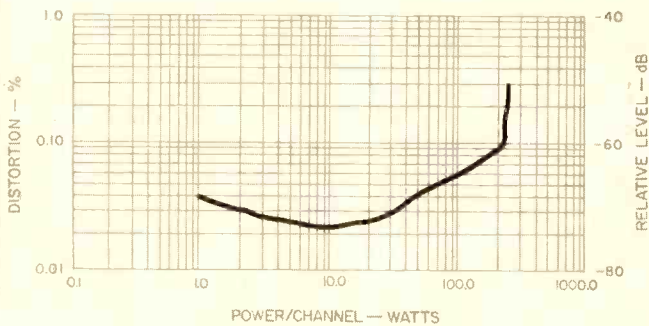


Fig. 3—Power output per channel vs. harmonic distortion, 1-kHz test signal, 8-ohm loads.

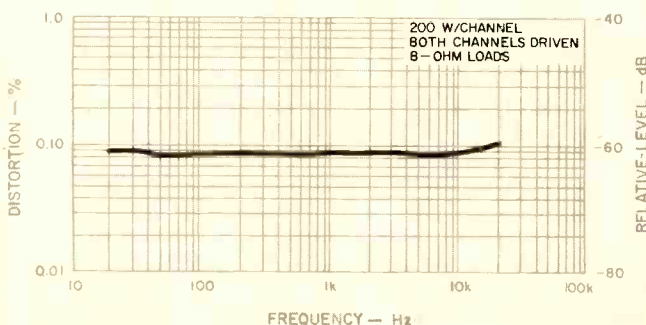


Fig. 4—Harmonic distortion vs. frequency.

Measurements

The TNT-200 delivered just over 200 watts per channel over the entire range of audio frequencies from 20 Hz to 20 kHz for its rated harmonic distortion level of 0.1%. SMPTE-IM distortion was a bit higher than claimed, rising to a nonetheless inaudible 0.2% for rated output into 8-ohm loads, but CCIF IM and IHF IM, calculated from the spectrum analysis of Fig. 2 (linear sweep from 0 Hz to 20 kHz), were 0.046% and 0.149% respectively. Dynamic headroom measured 1.4 dB, while IHF slew factor was greater than 5. Damping factor was obviously higher than I was able to measure in the bench setup, even though I used short, 14-gauge connecting wire from the amplifier's output terminals to the input terminals of the test instruments.

IHF input sensitivity (for 1-watt output) measured 100 millivolts; sensitivity for rated output was 1.4 volts. Frequency response extended from 4 Hz to 135 kHz between -1 dB cutoff points, and from 2 Hz to 400 kHz for a -3 dB cutoff. Signal-to-noise ratio, referenced to rated output, measured 109 dB (A-weighted). Figure 3 is a plot of harmonic distortion versus power output, for a 1-kHz signal driving an 8-ohm load. When the load was switched to 4 ohms, maximum power output per channel was 325 watts, as claimed. I lowered the load impedance to 2 ohms briefly, and under those load conditions the amplifier was able to deliver in excess of 400 watts per channel to the load. A 1- μ F capacitor, paralleled across the 8-ohm resistive load on each channel, did not result in any instability. Figure 4 is a plot of harmonic distortion versus frequency for the 8-ohm load condition.

Use and Listening Tests

I am not prepared to say that the sound of the Acoustat TNT-200 is markedly superior to that of several other high-grade power amplifiers I have listened to in recent months. I did note an effortlessness in the way the amplifier delivered power to a variety of loads, and an almost complete transparency of sound which characterizes several previously favored amplifiers. It has been said that FETs behave more like tubes than do bipolar devices, and indeed that is true. Since I never became emotionally involved in the debate over "tube sound versus transistor sound," as have some of my colleagues, I can't honestly say the sound of the Acoustat TNT-200 replicates that of any tube amplifier of yesteryear. Nor would I want it to. The Acoustat's sound merits serious consideration and auditioning in its own right. It's a clean and robust sound that appeals to me.

With an amplifier capable of producing this level of power, it's important to consider some qualities which are not sonically related, such as long-term reliability. The fact that Acoustat offers a limited 5-year warranty is an encouraging sign. Perusal of the components in this sturdily built amplifier gave further evidence that it is not likely to require frequent service. I suspect the reason for the relatively high cost of the TNT-200 is the high cost of those MOS-FETs and the rest of its bill of materials. Perhaps, in time, amplifiers built this way will come down in price as more and more serious listeners begin to appreciate the virtues they offer and stop measuring amplifiers on a watts-per-dollar basis.

Leonard Feldman

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TECHNICS RS-M275X CASSETTE DECK

Manufacturer's Specifications

Frequency Response: 20 Hz to 17 kHz, to 18 kHz with CrO₂ tape, to 19 kHz with metal tape.

Signal/Noise Ratio: 68 dB CCIR/ARM with Dolby B NR, 76 dB with Dolby C NR, 92 dBA with dbx NR.

Input Sensitivity: Mike, 0.25, mV; line, 60 mV.

Output Level: Line, 700 mV; head-phone, 130 mV at 8 ohms.

Flutter: 0.03% wtd. rms, 0.07% wtd. peak.

Wind Times: 90 seconds for C-60.

Dimensions: 16 $\frac{7}{8}$ in. (430 mm) W × 3 $\frac{7}{8}$ in. (98 mm) H × 12 $\frac{7}{8}$ in. (326 mm) D.

Weight: 14.1 lbs. (6.4 kg).

Price: \$600.00.

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

For literature, circle No. 95



The Technics RS-M275X deck provides a number of helpful conveniences, but the most interesting feature for many will be the inclusion of dbx noise reduction. This method offers a reduction of up to 30 dB of tape noise and expanded headroom and achieves a signal-to-noise ratio of more than 90 dBA. The dbx logo in the center of the front panel indicates the importance that Technics gives to this feature. The user is not restricted to dbx NR, however, and the five-position noise-reduction switch has provision for Dolby B,

Dolby C, dbx/tape and dbx/disc NR (as well as off, of course). The dbx/disc setting lets the deck serve as a dbx disc decoder, and lets you simultaneously tape the undecoded signal from the disc, for dbx playback later (with dbx/tape). However, you can't decode for both play and recording. Status lights remind the user of the switch setting, and the one for dbx/disc is a warning red, calling attention to the fact that this is not a normal recording or playback mode.

The knobs for the NR switch and the bias-adjust and output-level pots are small, but the bar design makes adjustment easy. The medium-size knobs of the dual-section, input-level control have a good design for interchannel level adjustments, and the friction coupling makes for simple setting of levels for both channels. The peak-responding, horizontal bar-graph level meters have 18 segments for each channel: Blue-white from "-40" to "0," orange for "+2" to "+8," and red for "+10," "+12" and "+18." A parallel set of red reference bars are illuminated only with dbx NR, indicating that such high recording levels are acceptable only when using dbx NR encoding, with its 2:1 compression. The meters also have a short peak-hold at any level of -20 dB or above, an aid to setting accurate levels.

The logic-controlled tape-motion switches are actuated by large, light-touch plates, with indicators for "Rec," "Pause," "Play" and "Stop." The use of "Rec Mute" automatically switches the counter/time display to a minute-second readout giving the duration of muting, second by second—a useful scheme. "Tape/Time" allows switching between the normal three-digit counter and a time-remaining mode. The latter function can be set to count down in minutes and seconds for any standard-length cassette from C-30 (15:00 start time) to C-120 (60:00), provided, of course, that record or play starts at the beginning of the cassette. The "Set" button is also used in conjunction with "Music Select," which results in the display of two zeros, to set the number of selections that will be *skipped* in "Intro Search" mode. "Intro Search" fast-winds to the start of each selection in turn, playing 10 seconds before winding to the next piece; this is useful when the location of desired selections is uncertain. "Memory Repeat" calls for the deck to go automatically into play when rewound to "000." An indicator at the top of the counter/timer readout shows when this mode is active.

"Eject" tilts the cassette carrier out smoothly for loading and unloading. The door/cover snaps off for improved access for maintenance tasks. The timer and power switches and the phone jacks for headphones and left- and right-channel microphones complete the front-panel facilities. The line-in/line-out phono jacks are on the rear panel. As was expected, the Technics deck contained quite a bit of circuitry with several p.c. boards, including a large, horizontal one which also served as the motherboard for three medium-size vertical cards. The cards appeared to be phenolic-type material, rather than the more desirable, and higher cost, glass-epoxy type. The soldering was excellent, the parts were clearly identified, and adjustments were also labeled with their functions. Intercard connections were made primarily with the use of multi-pin plugs. The three-motor, direct-drive transport was very quiet in operation. The main chassis and frame unit was of molded, ribbed plastic. By itself, the unit was fairly rigid, but stiffness was considerably improved with the steel top and side cover in place.

Measurements

The playback responses were quite good at both 70- μ S and 120- μ S equalizations, although response was more than 2 dB down at both ends with 70- μ S EQ. The bias adjust

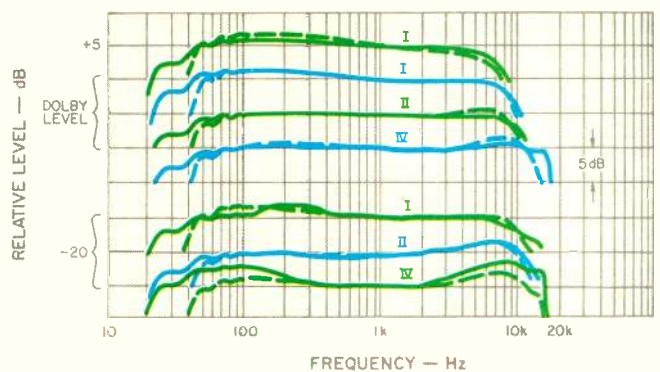


Fig. 1—Frequency response with Dolby C and with dbx NR (dashed line) using Type I (Denon DX3),

Type II (Scotch Master II) and Type IV (TDK MA) tapes.

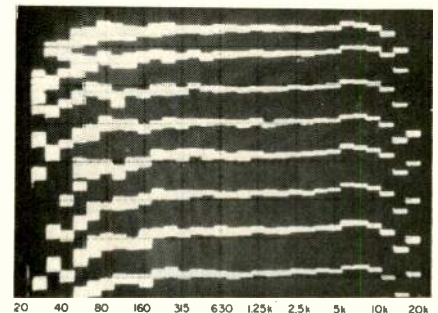


Fig. 2—Record/playback responses with TDK MA tape using pink noise at 0, +5, +10 and +15 dB

re: Dolby level. Top four with Dolby C NR, bottom four with dbx. (Vertical scale: 5 dB/div.)

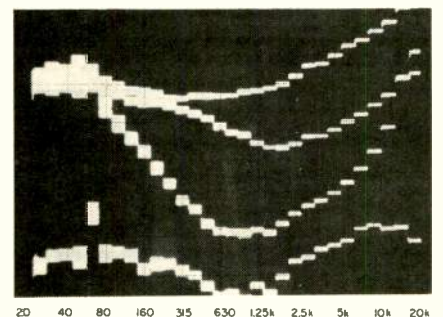


Fig. 3—Relative noise levels in third-octave bands for Scotch Master II with, from top, no NR,

Dolby B, Dolby C, and dbx. (Vertical scale: 5 dB/div.)

“ ‘Intro Search’ fast-winds to the start of each selection, plays 10 seconds, and winds to the next; useful when locations are uncertain.”

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

Tape Type	With Dolby C NR				With dbx NR			
	Dolby Lvl		–20 dB		Dolby Lvl		–20 dB	
	Hz	kHz	Hz	kHz	Hz	kHz	Hz	kHz
Denon DX3	23	9.2	24	14.1	45	13.8	45	14.7
Scotch Master II	25	11.0	24	13.2	45	15.0	45	16.0
TDK MA	25	16.7	21	16.6	45	17.2	45	17.8

Table II—Miscellaneous record/playback characteristics.

Noise Reduction	Erasure At 100 Hz	Sep. At 1 kHz	Crosstalk At 1 kHz	10-kHz A/B Phase Error	Jitter	MPX Filter At 19.00 kHz
Dolby C	75 dB	54 dB	–100 dB	5°	50°	–39.8 dB
dbx	96 dB	62 dB	–120 dB			

Table III—400-Hz HDL₃ vs. record level (0 dB = 200 nWb/m).

Tape Type	NR	Record Level						HDL ₃ = 3%
		–12	–8	–4	0	+4	+8	
Denon DX3	Dolby C		0.09	0.17	0.4	1.4		+6.5 dB
	dbx		0.09	0.13	0.18	0.3	0.5	+17 dB
Scotch Master II	Dolby C	0.09	0.14	0.26	0.65	1.9		+6.0 dB
	dbx	0.18	0.22	0.30	0.45	0.68	1.0	+17 dB
TDK MA	Dolby C	0.07	0.17	0.37	1.0	2.5		+4.8 dB
	dbx	0.23	0.28	0.34	0.5	0.7	1.1	+17 dB

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

Tape Type	IEC A Wtd. (dBA)				CCIR/ARM (dB)			
	W/Dolby C NR		W/dbx NR		W/Dolby C NR		W/dbx NR	
	@ DL	HD=3%	@ DL	HD=3%	@ DL	HD=3%	@ DL	HD=3%
Denon DX3	67.2	72.6	79.1	96.1	67.0	72.4	74.3	91.3
Scotch Master II	69.7	75.3	79.6	96.6	68.2	73.8	75.2	92.2
TDK MA	69.3	73.4	81.3	98.3	68.1	72.2	77.1	94.1

Table V—HDL₃ vs. frequency at 10 dB below Dolby level.

Tape Type	NR	Frequency (Hz)						
		50	100	400	1k	2k	4k	5k
Scotch Master II	Dolby C	0.21	0.30	0.11	0.12	0.08	0.21	0.32
	dbx	0.6	1.4	0.20	0.26	0.19	0.32	0.45

Table VI—Input and output characteristics at 1 kHz.

Input	Level			Imp., Kilohms	Output	Level			Imp., Ohms	Clip (Re: Meter 0)
	Sens.	Overload				Open Ckt.	Loaded			
Line	55 mV	17.5 V		50	Line	636 mV	588 mV	955		+20 dB
Mike	0.27 mV	74 mV		1.1	Hdphn.	674 mV	114 mV	38		

pot made it possible to get flat responses with most tapes without NR, but the lack of means to adjust record sensitivity reduced the number of tapes that had good noise-reduction tracking. Matching was quite good with BASF Professional I Super, Professional II and Metal IV, Denon DXM, Fuji FR-I and FR-II, JVC ME, Maxell XL II-S, Sony UCX-S and TDK D, AD, and SA. The results appeared best with Denon DX3, Scotch Master II and TDK MA, and these tapes were used for the detailed testing that followed.

Swept-frequency record/playback responses were plotted (Fig. 1) for the three tapes at Dolby level and 20 dB below that both with Dolby C and dbx NR. With the Type I Denon DX3, responses were also run at 5 dB above Dolby level. In general, the responses were quite good between 60 Hz and 10 kHz or more, but the boosts with TDK MA and Dolby C NR at low and high frequencies were greater than desirable. At the frequency extremes, points were reached where there were fast roll-offs in the dbx responses. (In private communications, it was learned that the low-frequency roll-off was caused by a high corner frequency on the coupling network after the dbx circuit. At the time of writing, a decision had not been made on if, or what, corrective action might be taken. The roll-offs at the high end were caused by the dbx system's operating on the sweeping single tone as the response deviated from flat. As the dbx scheme operates on broadband level sensing, the responses are best checked with broadband signals such as pink noise.) Table I lists the results for the three tapes with the two NR schemes, using the swept sine wave for Dolby C and pink noise for dbx. (It should be noted that the sine wave is more of a challenge to high-frequency headroom than is pink noise for the same meter level.) Not listed are the figures without NR, which met specification.

Figure 2 shows the record/playback responses with pink noise with the record levels increased in 5 dB steps from meter zero to +15 dB. The bottom set of four were made with dbx NR, and good tracking and lack of compression are obvious. In the top set of four, made with Dolby C NR, there is about 0.5 dB compression at +5 dB, 1 dB compression at +10 and almost 3 dB compression at +15 dB. The anti-saturation scheme of Dolby C NR prevents high-end roll-off, but the dbx NR is clearly more resistant to high-level compression. Table II lists some miscellaneous record/playback characteristics, and they are all excellent except for somewhat high phase jitter at 10 kHz. Take note of the fact that dbx NR improved the erasure, crosstalk and separation performance—the result of the 1:2 expansion in playback decoding.

Table III shows the HDL₃ values for the three tapes, with both NR schemes, over a range of recording levels. The points at which the third harmonic level reached 3% are also shown. The distortion was quite low with Dolby C NR, especially with the Denon tape. With dbx NR, the measured distortion was higher at low record levels (Scotch Master II and TDK MA), but much lower at high record levels—both results of the 2:1 encoding (and the 1:2 decoding). The HDL₃ points with dbx NR appeared to go as much with output clipping effects as with tape-saturation limits. The signal-to-noise ratios with Dolby C and dbx NR were measured with both IEC A and CCIR/ARM weightings with refer-

"The bias adjust pot made it possible to get flat responses with most tapes without NR, but it was harder to get good noise-reduction tracking."

ence to both Dolby level and the 3% points. Table IV lists the excellent figures for all conditions, and the results of over 90 dB with dbx NR are certainly worthy of particular attention. Table V shows that at medium levels (-10 dB) with Scotch Master II, the distortion across the band, though low, was roughly two times greater with dbx NR than it was with Dolby C NR. Figure 3 shows the tape noise spectrum in third-octave bands (top to bottom) without NR, with Dolby B, with Dolby C and with dbx NR. The successive reduction in noise levels is very apparent, perhaps made more so by the use of a 'scope setting of 5 dB/division for a total "window" of just 40 dB.

Table VI lists the basic input and output characteristics of the Technics deck, all very good and substantially to specification. The input and output pot sections tracked within a dB for at least 45 dB down from maximum, quite good overall. The output polarity was the same as the input in record mode, but reversed in playback. The thresholds of the bar-graph level meters were accurate from "-10" to "+18," but "-40" did not turn on until -29 dB actual. The Dolby symbol appeared to be lined up with "+2," but the standard play level was closer to "+4." The dynamic response to a 5-kHz tone burst was slower than IEC standards, but did reach meter zero with just 15-mS duration. Return time for 20 dB was about 0.5 second, a bit fast, but the 1-second peak holds seemed helpful. The frequency response was 3 dB down at a rather high 72 Hz and at a normal 25.6 kHz.

Tape motion was very steady in all respects. Flutter was just slightly over the specified 0.03% wtd. rms (0.034%) and weighted peak flutter was only 0.05%, less than the 0.07% specification. The tape speed vs. time appeared to vary less than 0.01%, and there was no measurable change in playing speed with any line voltage from 110 to 130 V. Wind times for a C-60 were 84 seconds—within specification, but slower than most decks. Reaching a full stop from fast wind or changing modes required 1 second or less, though reaching a full stop from play took about 4 seconds. It was not possible to go directly into record from play mode (flying-start recording). This may represent a limitation in

technique for some users, and I like the feature when it is included on a tape deck.

Use and Listening Tests

I judged the owner's manual one of the better ones I've seen lately. The text was very good, with the illustrations well tied to the discussion. Operational steps were shown in conjunction with call-outs on a front-panel layout, a good scheme. Two criticisms: There could have been more detail on setting levels in the various modes, and the listing of possible tapes includes some that would not perform too well with noise reduction.

With the door cover removed, access for maintenance tasks was one of the best seen to date. The controls and switches were all completely reliable, with the exception of the "Stop" status light which went out in the last hours of testing. A number of the convenience functions were utilized quite regularly, especially the remaining tape-time display, "Intro Search" and "Memory Repeat." Timer start checked out just fine. There were no record or pause clicks even detected, and the stop noise was just a soft clunk down into tape noise.

The listening tests used discs, a number of them dbx-encoded. A couple of these discs were played using the deck's decoder, and it sounded like an exact match to a separate dbx 128 decoder. Record levels were set quickly and accurately with the bar-graph meters, benefiting from the peak holds as expected. Much of the reproduction was certainly very good, but there were some differences observed. For example, the results with dbx were very impressive, tape playback showed as little noise as the original disc with very little modulation, and high record levels were certainly quite possible. Instrumental sound seemed to be very slightly pointed, however, and Dolby C NR matched the original better in this respect. In a recording of Strauss' *Also Sprach Zarathustra*, the dbx NR playback did not keep the impact of the low organ tones, although the sound was still quite impressive. All in all, the Technics RS-M275X offers very good to outstanding performance in all areas—with Dolby B, Dolby C and dbx NR. *Howard A. Roberson*

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It is with great sorrow that I note the passing of Bob Fine, a dear friend, former associate and one of the world's great recording engineers.

Bob was a pioneer in so many areas of audio technology. In 1949, when recording Albert Schweitzer playing the organ in his home in Alsace, Fine discovered the virtues of the Telefunken U-47 condenser microphone. After bringing it back to the U.S., Bob developed his famous "point source" omni-pattern monophonic technique, which resulted in the first Mercury "Olympian" Series recording. With the U-47 hung in exactly the right focal point in Orchestra Hall, Bob made a landmark recording of Rafael Kubelik conducting the Chicago Symphony Orchestra in the Mussorgsky/Ravel "Pictures at an Exhibition." The Olympian Series expanded to include many orchestras. Collectively, they are considered as being among the finest recordings of symphonic music ever made.

Bob Fine had heard of my stereo

recording experiments, and in 1951 invited me to join him in recording the Eastman Rochester Wind Ensemble in Rochester, New York. We established an immediate rapport and made a very successful recording of Morton Gould's "Latin America Symphonette" with Fred Fennell conducting. Bob used his mono technique, while I used a pair of U-47s in the omni pattern. He was pleased with the stereo and, with his usual vision, recognized stereo would soon be a factor on the market. We made a series of memorable recordings with the Chicago, Detroit and Minneapolis Symphony Orchestras. In 1953, I joined Bob as General Manager of his company in New York. I've detailed Bob's invention of Perspecta-sound in my "VideoScenes" column in this issue.

Bob Fine did some early work on videodiscs, and his life-long interest in acoustics is reflected in the legacy of great recordings he left for us to treasure and enjoy.

Bert Whyte

ONE-BRAND: AIWA V-1000G

Continued from page 43

on the front panel. The linear-tracking arm delivered its advantages without imposing any new friction-related problems.

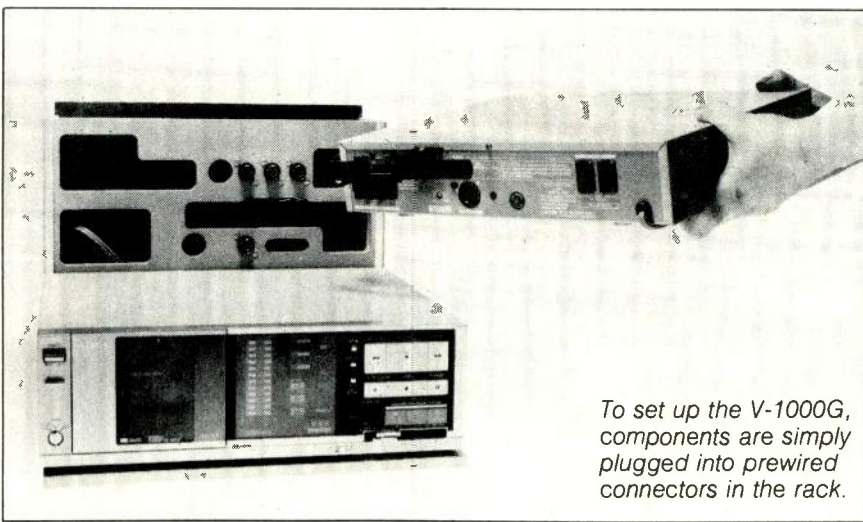
Aiwa very wisely elected *not* to build a permanent MPX filter into their Model FX-100 cassette deck. As a result, using premium tape, frequency response proved to be better than claimed for all generic types of tape tested. Of course, it's only because Aiwa had control of the design of the matching tuner that they were able to omit this type of filter; the tuner hasn't got enough unwanted subcarrier product output to cause problems here. Wow and flutter was far lower than claimed. Signal-to-noise fell a bit short of claims, but an actual S/N of 71 dB, using Dolby C (which tracked very well in the record/play cycle on this deck), is nothing to complain about. The deck has a music-sensing feature (to detect silence between taped selections) and a vernier bias adjust which, for some strange reason, is only operative with normal bias tapes. Perhaps this is because normal ferric oxide tapes show the greatest variations in bias require-

ments, but Type II tapes could benefit, too. Here, again, another advantage of one-brand system design is in evidence. You can have this deck record (or play) at a predetermined time, using its "Timer" button and the clock-timer on the tuner. This would require an external separate timer in a conventional component system, if it could be done at all.

By keeping the size somewhat larger

than that of the "mini" components Aiwa and others promoted some time ago, the price of this system has been kept within bounds. In my opinion, it represents excellent value. For anyone who wants convenience and simplicity of operation, and isn't too worried about later add-ons and embellishments, I wouldn't hesitate to recommend the Aiwa V-1000G.

Leonard Feldman



To set up the V-1000G, components are simply plugged into prewired connectors in the rack.

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CT-8R	\$365
CT-9R	\$432

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ADS RECEIVED AFTER THE CLOSING DATE WILL BE HELD FOR THE NEXT ISSUE UNLESS OTHERWISE STATED.

BLIND ADS—Audio box numbers may be used at \$5.00 extra for handling and postage.

GENERAL INFORMATION—Ad copy must be type-written or printed legibly. The publisher, in his sole discretion, reserves the right to reject any ad copy he deems inappropriate. **ALL ADVERTISERS MUST SUPPLY:** Complete name, Company name, Full Street address (P.O. Box numbers are insufficient) and telephone number. Classified **LINE ADS** are not acknowledged and do not carry Reader Service Card Numbers. **AGENCY DISCOUNTS** do not apply to line advertising. **FREQUENCY DISCOUNTS** not fulfilled will be short rated accordingly. For any additional information contact Laura J. Lo Vecchio, Classified Adv. Mgr., 1515 Broadway, New York, NY 10036 . . . Direct Dial (212) 719-6338.

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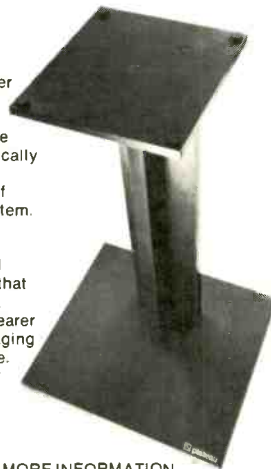
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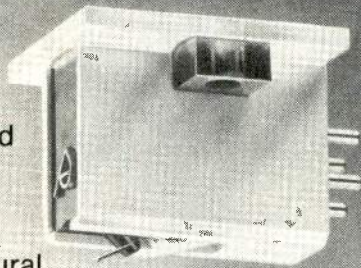
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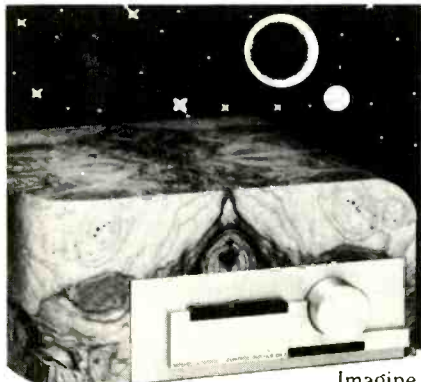
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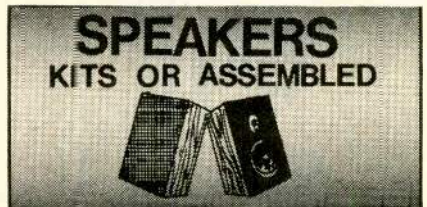
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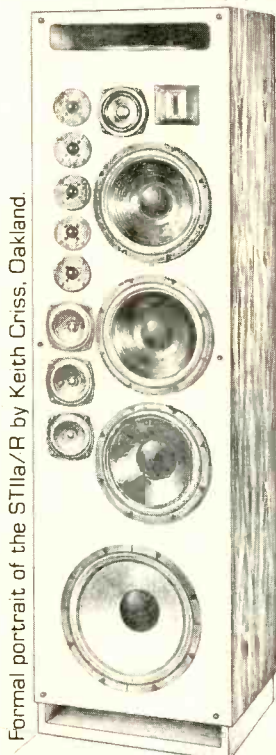
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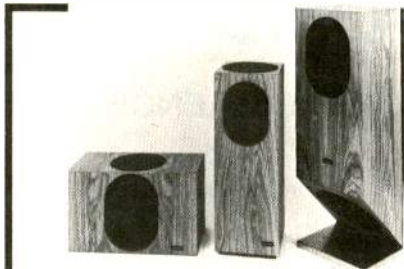
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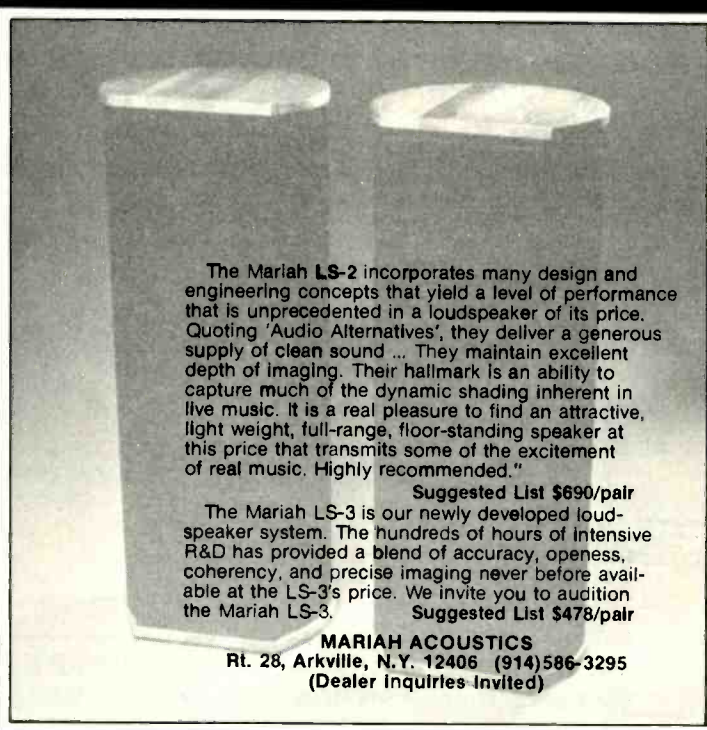
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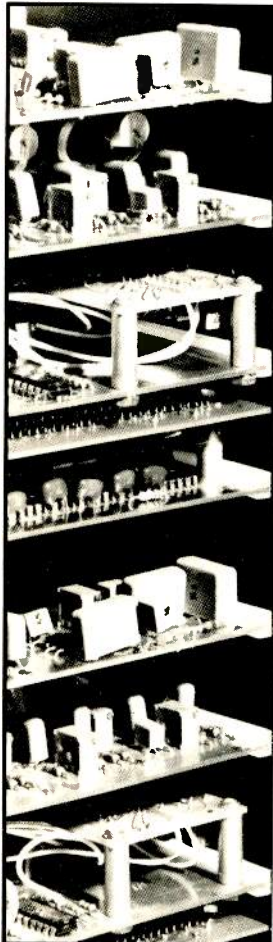
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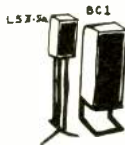
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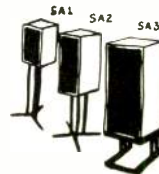
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