

The  
Authoritative  
Magazine  
About  
High Fidelity

# Audio

JANUARY 1983 • \$1.50 • ©06030

**WE TEST 11 FM  
OUTDOOR ANTENNAS**

**EXCLUSIVE!!**

**HITACHI'S  
DIGITAL AUDIO  
DISC PLAYER**

**REVIEWS:**

**PARASOUND  
EQ1210  
EQUALIZER**

**H/K'S T60  
TURNTABLE**



**FIRST LOOK!!**



**VECTOR RESEARCH  
VCX-800 CASSETTE  
RECORDER:  
WORTH \$1000?**



# The Most Unique Part Of Mitsubishi Component TV Is In The Lower Right-Hand Corner Of The Screen.

Mitsubishi is pleased to present its remarkable new component TV system.

In some ways, it's just what you'd expect in state-of-the-art component TV:

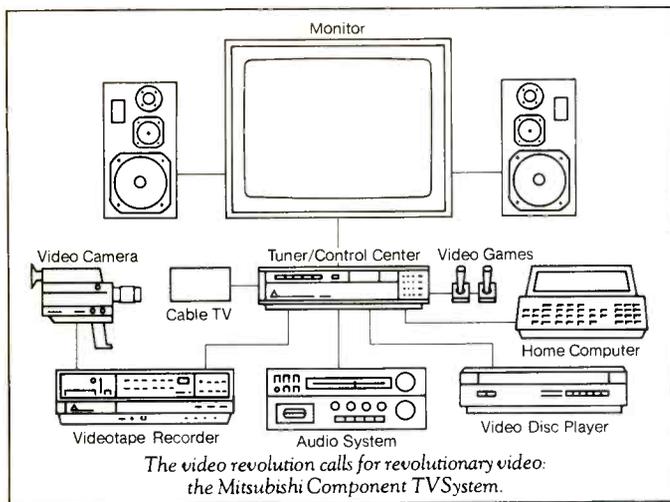
There's a frequency-synthesized tuner/

control center with multiple video inputs for your VCR, video disc player, video game console, home computer or any of the other video wonders looming on the horizon.

Electronic mode selection allows you to



switch instantly from one program source to another — at the control center itself or from



your favorite chair via the wireless remote.

The 25-inch (diagonal) professional-quality monitor features an Automatic Picture Latitude Circuit and a comb filter that yield 330 lines of resolution (versus the normal 280) for a crisper, sharper over-the-air picture. Or a stunning 400 lines of resolution from direct tape or disc input, achieved by bypassing the picture-degrading RF signal conversion process.

A pair of big, beautiful, high-fidelity speakers deliver sound that's actually as good as the picture. Even stereo, from stereo video discs, videotapes and FM simulcasts.

In short, Mitsubishi component TV offers the picture and sound upgrade that results when individual components aren't compromised by the need to fit them all into one box.

But there's something more. Something you won't find in any other company's TV, component or otherwise.

Our exclusive, patented Diamond Vision™ picture tube.

## UP TO 40% WIDER COLOR RANGE WITH DIAMOND VISION.

Diamond Vision is the most important picture tube innovation in years.

It was developed initially to eliminate

image-fading sun glare on our outdoor electronic scoreboards. And was based on the proven fact that certain chemicals absorb certain colors in the light spectrum. The result was a combination of chemicals mixed with the glass to absorb the offending light.

In adapting this principle to our home screens, we added other color-absorbing chemicals to eliminate the undesirable light elements emitted by the phosphors of the picture tube. Then painstakingly re-engineered the phosphors themselves to match the new screen's transmission characteristics.

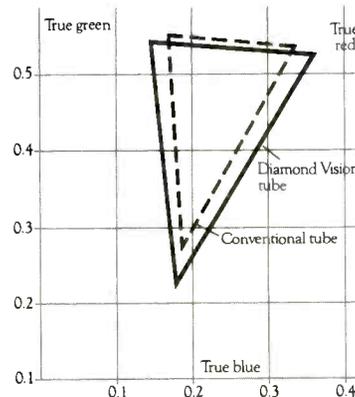
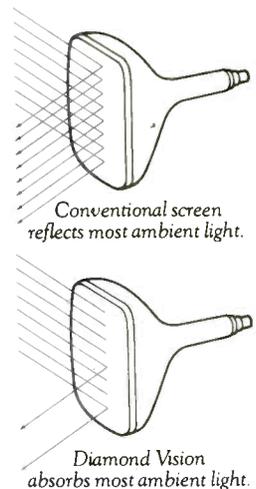
The result is not only a picture relatively unaffected by ambient light, but a significantly improved picture overall. Brightness. Contrast. Color fidelity.

And compared to conventional picture tubes, the color reproduction range is 15% to 40% wider, depending on the amount of ambient light present.

So when you shop for a component TV system, look for that little "Diamond Vision" sign in the lower right hand corner of the screen. It tells you a lot about what's inside.

And there's another sure sign just below that. Something that speaks even more eloquently about how that system is built.

It's just one word.  
Mitsubishi.



Comparison of the color range reproduced by Diamond Vision and conventional TV tubes under ambient light.

# MITSUBISHI

Even If You Can't Have The Best Of Everything,  
You Can Have The Best Of Something.

Mitsubishi Electric Sales America, Inc. 3030 Victoria St., Rancho Dominguez, CA 90221. Available at specialty houses nationwide. Specifications are subject to change without notice.

**From now on,  
no matter what  
type of cartridge  
you need... you  
can  
use**



**1) The high performance  
Samarium Cobalt  
Cartridges that Stanton  
is famous for.**

**981HZS, 980HZS, 881S, 880S**

Its patented moving stylus system features the exclusive Stereohedron Diamond mounted in an ultra-low mass Samarium Cobalt armature (0.2 mg) that enables the 981HZS to track at the highest levels found in the newest high tech records used in all kinds of professional applications around the world.

**Comprehensive  
literature  
now available**



**2) The revolutionary  
low impedance  
Samarium Cobalt Concept  
— "a step beyond the  
moving coil"**

**981LZS, 980LZS, 885LZS, 785LZE**

A moving magnet cartridge that because of its unique design works directly into the moving coil input of most receivers and integrated amplifiers and provides extended frequency response well beyond 50kHz. It offers the best features of the moving coil with the technical soundness of the Stanton Samarium Cobalt design concept.

**Send for  
Comprehensive  
literature**



Stanton Magnetics Inc.  
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Please send me

- 981HZS High Performance Literature
- 980LZS Low Impedance Literature

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# Audio

JANUARY 1983

VOL. 66, NO. 1



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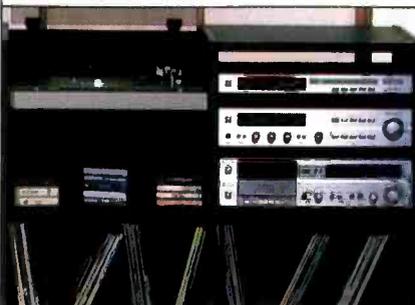
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The Cover Equipment: Hitachi DA-1000 digital audio disc player; inset, Vector Research VCX-800 cassette deck. The Cover Photographer: Carl Zapp; inset by the CBS Photo Studio.

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# HOW CAN SANSUI CLAIM THE WORLD'S ONLY DISTORTION-FREE RECEIVER? SIMPLE. WITH SUPER FEEDFORWARD DC AMP.

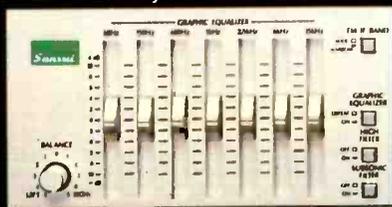
Creating technological breakthroughs is nothing new to Sansui. One of our most recent innovations, the unique Super Feedforward DC power amplifier system routs all types of distortion—harmonic, intermodulation, transient intermodulation, switching—you name it.

And it's the reason we can claim that Sansui's new top-of-the-line, 120-watt\* Z-9000 receiver is truly distortion-free.

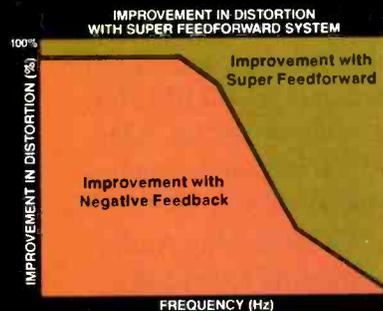
Simply stated, the Sansui Super Feedforward circuit is the perfect marriage between negative feedback and feedforward. As a result, you're never bothered by any type of distortion. You hear precisely what's on the records, tapes and broadcasts. Nothing added, nothing lost—just pure music.

## 7-band graphic equalizer for greater tone control.

Unlike receivers with conventional two or three tone controls, the Z-9000 provides total flexibility with a state-of-



the-art 7-band graphic equalizer that helps balance the sound in your listening room.



## Digital Quartz-PLL tuning is more precise.

While Super Feedforward alone is enough to outperform most receivers, the Z-9000 adds the pinpoint accuracy of drift-free digital Quartz-PLL tuning. To make sure it's as easy to use as it is precise, there's microprocessor-controlled pushbutton pre-selection of eight FM and eight AM stations. Plus automatic scanning to recall each preset station at the previously programmed volume level. Each time you touch the tuning button you can scan or go up and down the FM and AM bands, bringing in perfectly tuned stations even when they're a hairline away from each other.

## Extras add more pleasure to your listening.

The Z-9000 is loaded with high technology refinements that let you experiment with sound the way no other receiver can.

The built-in reverb unit with its own display can make your finest tapes and recordings sound even more magnificent by adding natural depth, extra brilliance and sound realism. The exclusive quartz/timer clock with three independent memory functions can be programmed to wake you up, lull you to sleep, and tape a broadcast in your absence. There are also high and sub-sonic filters and a preamp that handles both moving magnet and moving coil cartridges.

If the new distortion-free Sansui Z-9000 sounds too good to be true, satisfy yourself with an audition at your audio specialist. Or write today for additional details.



SANSUI ELECTRONICS CORPORATION  
Lyndhurst, NJ 07071; Gardena, CA 90248  
Sansui Electric Co., Ltd., Tokyo, Japan

\*120 watts per channel minimum RMS into 8 ohms, 20Hz to 20kHz, with no more than 0.005% total harmonic distortion.

Putting more pleasure in sound

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# Audio

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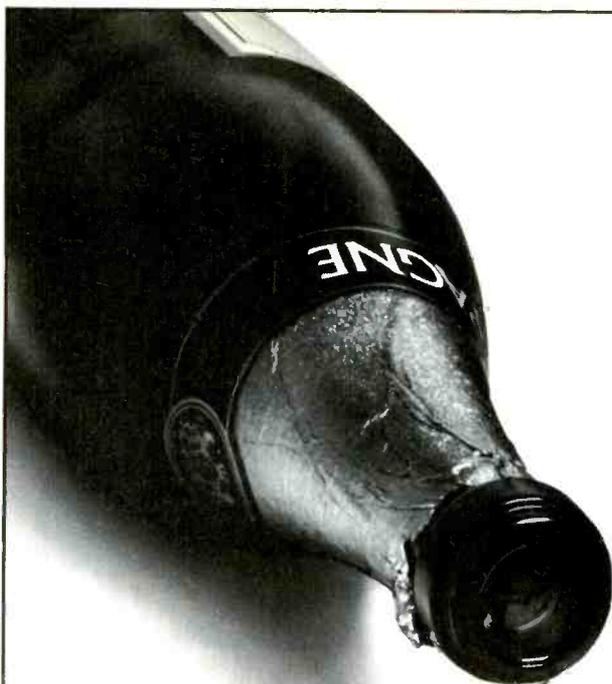
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## No hangover!

Hangover—a rather loose term to describe the stored energy resonance in a loudspeaker, the principal cause of coloration that immediately tells you you're listening to a loudspeaker.

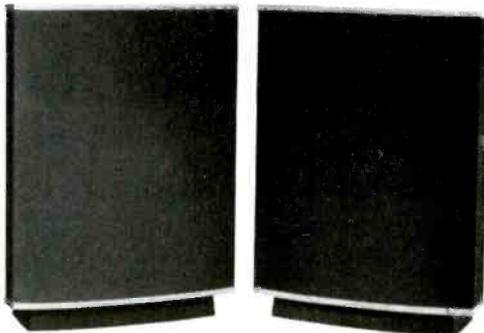
Take it away and there's a new world—the loudspeakers have nothing more to say—instead there's just the orchestra and the magic of the music.

If music is an important part of your life, then a pair of ESL-63 loudspeakers could be the best investment you've ever made.

Perhaps even something to celebrate about.

For further details and the name and address of your nearest QUAD ESL-63 retailer, write: QUAD, 425 Sherman Avenue, Palo Alto, CA 94306.

In Canada: May Audio Marketing Ltee, Ltd., Longueuil, Quebec J4G 1P8



**QUAD**  
for the closest approach  
to the original sound

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## The Nakamichi DRAGON The Most Incredible Creature Of The Decade

**Dragon**—the first deck to reproduce every cassette with exquisite clarity and definition. Dragon's revolutionary NAAC (Nakamichi Auto Azimuth Correction) system determines the actual recorded azimuth and continuously manipulates the *play-back* head into perfect alignment *without* special test tones—*automatically*—on every cassette. Restored are the missing highs that have made pre-recorded cassettes (and many home-recorded ones!) inferior to phonograph records. Gone is the dullness caused by noise-reduction systems that don't receive all the high-frequency energy that was recorded. Move into the future with a deck that's already there!

**Dragon**—Nakamichi's first auto-reverse deck. Not until we created NAAC to correct the playback-azimuth error that occurs when tape is reproduced in the reverse direction would we put our name on an auto-reverse deck.

**Dragon**—the world's first deck to reproduce in *both* directions with equal perfection, the first auto-reverse deck to employ Asymmetrical Dual Capstans, each directly driven by its own Super Linear Torque DD Motor electronically locked to a precision quartz-crystal reference for amazingly low flutter.

**Dragon**—with a full complement of "traditional" Nakamichi features and such new innovations as switchable subsonic filters to prevent tape overload when recording a warped record and an Auto Rec Pause that triggers automatically whenever a 10-second program break is detected!

**Dragon**—another Nakamichi miracle! See it now at your Nakamichi dealer.



Nakamichi U.S.A. Corporation, 1101 Colorado Avenue, Santa Monica, CA 90401

# WHAT YOUR EAR IS A BRAIN.



*This tiny microprocessor is the latest innovation in Pioneer's best components. It can improve the way you listen to your music. And it can also improve your music.*

## THE SX-8 RECEIVER: DON'T TURN THAT DIAL.

How smart is smart?

For starters, the brain inside the SX-8 allows us to use push button controls, eliminating noise and distortion caused by mechanical dials.

Not that there's anything wrong with the one you've got.

We just had something a little smaller in mind. More like the one you see here.

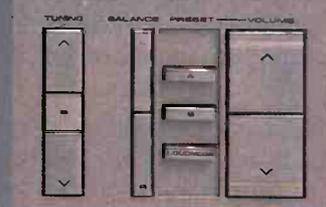
Technically, it's called a microprocessor or computer chip.

But we like to think of it as a little brain. Because when it's built into our Pioneer receivers, tape decks and turntables, they become more.

They become smart.

And when it comes to getting the most music out of your music, smart components have a lot of advantages over dumb ones.

So all you hear is crisp, clean music. Just the way it was recorded. The brain also willingly takes over the chores you used to do yourself.



*All-electronic receiver operation does away with knobs and dials. Volume, station and bass and treble levels can be easily monitored thanks to L.E.D. readouts.*

Just push a button to raise or lower volume or tone, change stations, even check the time. Push the Scan Tuning button and the receiver automatically scans every station, playing five seconds of each one.

Then, simply touch the Memory button. Your station, volume, and tone settings will

# RS NEED

be instantly stored in the memory. Ready to be recalled just as fast.

## THE CT-9R TAPE DECK: SMART ENOUGH TO FIND NOTHING.

If you've ever done even a small amount of cassette recording, you've gone through the not-so-convenient fast forward/stop/play/reverse/stop/play procedure of trying to find the blank area where your last recording left off and the next one can begin.

The CT-9R, on the other hand, has a button marked Blank Search. Give it a push and it will find the area that's long enough to tape on, back up to the last recorded piece, leave a four second space and stop, ready to record.

Automatically.

And, as if that weren't enough, the CT-9R also has one of the world's fastest Automatic Bias Level Equalization systems. In plain English, that means that it takes just eight seconds for Auto B.L.E. to analyze the tape being used (no easy task with over 200 different tapes on the market) and then adjust the deck for optimum performance with that tape. Improving



*The real-time counter reads out the amount of tape left in meaningful minutes and seconds instead of meaningless inches.*

the quality of your recordings faster than you can say "wow and flutter."

## THE PL-88F TURNTABLE: IT WON'T PLAY WHAT YOU DON'T LIKE.

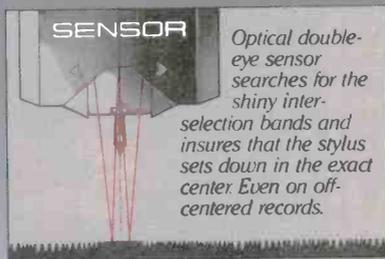
In the history of recorded music, there has probably been one, maybe two people who like every cut on a

record. If you're not one of them, you'll take an immediate liking to the new PL-88F.

It's front loading, stackable and, best of all, it's fully programmable.

Punch in up to eight cuts per side in any order that makes your ears happy. The turntable will automatically skip the ones that don't.

And when you're recording from records to cassettes you'll appreciate the tape deck synchro that automatically



*Optical double-eye sensor searches for the shiny inter-selection bands and insures that the stylus sets down in the exact center. Even on off-centered records.*

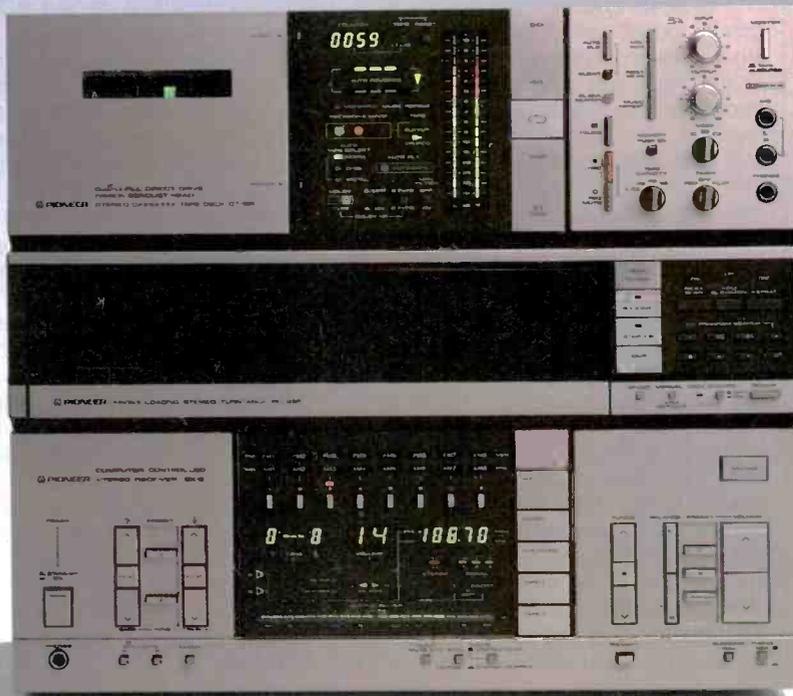
places any Pioneer Auto Reverse tape deck into the pause mode when the turntable tone arm lifts off the record. Leaving you free for more important things.

Like listening to music.

The Pioneer CT-9R tape deck, SX-8 receiver and PL-88F turntable. Proof that to get the quality of music you buy quality components for, you don't need a lot of knowledge.

You just need a little brain.

**PIONEER**  
Because the music matters.



## HAPPILY EVER AFTER?

**E**verybody 'round here knows about the big wedding of technologies and equipment going on today. That huge, blowsy, successful achiever, "King TV with the cracked voice," better known as Video, is tying the knot—until death do us part—with a dainty, refined little thing called Hi-Fi. She's older but she speaks pretty. That's us! And just as a married man imposes his name on his spouse, as though she were only an ampersand (&), so video is now busy innovating in its own name all sorts of big ideas borrowed straight from the blushing bride.

**COMPONENTS!** Where have I heard that before? The idea is not TV's, but ours, and already 40-odd years old, though you'd hardly guess it from the video ads. **STEREO!** Coming, coming, but is it an innovation? It was, a quarter-century ago in audio. And **DISCS!** Now you can build a whole library of Great Works to play right in your own living room. Zowie, what an idea! It dates from slightly before 1900, at which time it was indeed innovative. Never imagined before. Brand-new. In these areas, present-day video is just borrowing, adapting, not innovating. Maybe we're going to have to do the innovating, we who now are in audio.

Can you really imagine the first-time thrill of hearing a real, intelligible voice coming out of a machine, actually making sense and offering entertainment? That's what the phonograph did for people in the 1890s and on into the first age of recorded opera. This was real innovation, living up to the potential of a wholly new array of equipment. Can you remember, as I do, some 30 years ago, the slow realization that stereo, the spread of sound to right and left—much distrusted at first—was really going to work? We could not possibly have imagined the effect in earlier mono days. I lived as long with mono as I have since lived with stereo; I should know.

And high fidelity. That hi-fi componentry, too, was a genuine new thing which those of us who had simply owned radio-phonographs of various kinds could not have envisioned beforehand. Hi-fi, the very idea of a play of quality between a recording and its reproduction, was certainly new for the intelligent consumer and it hit me like a

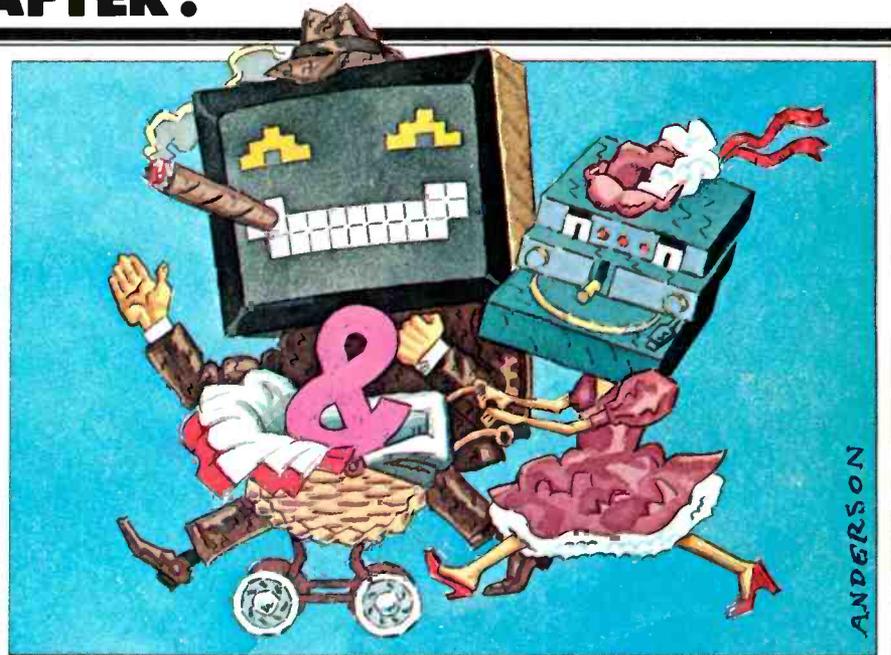


Illustration: Philip Anderson

thunderbolt. It still retains that vitality because it is still real.

These were some of the genuine shock treatments that audio, minus pictures, has been able to give to the public. It's a good record, you'll admit.

The days of TV's shock treatments are mostly over. The business got bigger faster than it moved forward; its innovations have been slow and pretty safe. Too big! The genius of TV is ever so clearly in its engineering. Its weakness is in its software, the whole enormous, expensive, commercialized, rigidly mediocre day-to-day mass of it. There are miracles of TV programming, here and there, superb documentaries, great dramas, acres of news, Emmy awards, sports. None of these can make up for the dead weight of the rest. It won't go away. It can't. The air, the cables, must be kept full.

Is this for us, for our hi-fi business, to join? Are we to be dragged down into mediocrity?

The video genius is in its incredibly capable machinery, the ever-blossoming hardware and the possibilities that it opens up for real innovation. In pure engineering, video is supreme and the video engineers are already into a New Age as anybody can see. Just wait until the ancient tube at last shrinks to zero size and gives way to compact image processing, tubeless, for fewer demands on space and, in the end,

what with the usual inflow of integrated circuits and microprocessors on chips, also micro in cost for the viewer. If we are given half a chance—by politics, economics, war—without question we will soon have a TV, a video, that is so much more versatile than ours today that you wouldn't believe it—now, that is. (You'll take it for granted then.)

But what's going to be done with all this marvelous stuff? Who's going to do it? It's likely we'll have to. Those of us who have come up through audio, through the sound media minus pictures. Our program people, our recording people, pop and classical alike. Television won't help! It's muscle-bound. It's bogged down in weight lifting. It's the Mr. America of entertainment. In comparison, we in hi-fi are flyweights and maybe the better for it.

In current TV, as is, I note only two areas of video programming where things are being done that really are new, unimaginable before. I'll risk the brickbats and describe them. One, without the slightest doubt, is current TV sports. That area is alive and moving! Sports casting on TV is genuinely out of nothing that has come before, unless with a mild bow to old-time radio. And like all real innovation, the stuff is incredibly effective, so much so (as we all know) that by comparison the "original," the living sport itself on the spot, is already an inferior mes-

# MAXELL IS PLEASED TO PRESENT AN EVEN HIGHER PERFORMANCE TAPE.



If you're familiar with Maxell UD-XL tapes you probably find it hard to believe that any tape could give you higher performance.

But hearing is believing. And while we can't play our newest tape for you right here on this page, we can replay the comments of Audio Video Magazine.

"Those who thought it was impossible to improve on Maxell's UD-XL II were mistaken. The 1981 tape of the year award goes to Maxell XL II-S."

How does high bias XL II-S and our normal bias equivalent XL I-S give you such high performance? By engineering smaller and more uniformly shaped epitaxial oxide particles we were able to pack more into a given area of tape. Resulting in a higher maximum output level, improved signal-to-noise ratio and better frequency response.

To keep the particles from rubbing off on your recording heads Maxell XL-S also has an improved binder system. And to eliminate tape deformation, XL-S comes with our unique Quin-Lok Clamp/Hub Assembly to hold the leader firmly in place.

Of course, Maxell XL II-S and XL I-S carry a little higher price tag than lesser cassettes.

We think you'll find it a small price to pay for higher performance.



## IT'S WORTH IT.

Maxell Corporation of America, 60 Oxford Drive, Mooresville, N. J. 07074

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# Dynavector's Moving Coil



## is Now Affordable.

You can now experience the superb musicality of Dynavector's moving coil cartridge at a reasonable price and without the additional expense of a step-up device.

The DV10X3 is a high output cartridge (no step-up device required) that embodies all the design advantages of Dynavector's moving coil technology, including low mass for wider dynamic range, precision wound silver coils for lower distortion and powerful Samarium cobalt magnets for increased product life.

With our DV10X3, you can hear the improvement—*honest music reproduction without coloration.*

The big surprise is that this new DV10X3 retails for only \$150.

We know that once you listen to the DV10X3, you'll be sold on Dynavector. Write or call for information or visit your audio specialist.

# Dynavector

World leader in moving-coil cartridges

Dynavector Systems USA  
1721 Newport Circle  
Santa Ana, CA 92705  
(714) 549-7204

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"The video genius is in its incredibly capable machinery and the possibilities it opens up for real innovation."

sage, often bewildering—especially to the uninitiated. On TV, all is clear! Unheard-of techniques do the trick—the instant slow-motion replay, for instance, or the marvelous use of the zoom, so that the viewer is, you might say, weightless and disembodied, all over the field, seeing everything. Can you imagine describing this to a baseball fan of 1899?

Here we can admire the mesh of technology and its actual dramatic use, perfectly at one. That's real. It's innovative. But (sigh) is audio of any importance? Will even our best hi-fi make any vital difference? Nope. It's all video.

The other really innovative TV area, shared with the movies (more and more these work cheek to jowl together) is the incredible, often foolish but absolutely unheard-of art of computer animation, combined of course with assorted space wars, which was recently brought to a focus in the Disney *Tron*. Say no more! This is a thing that video can do and superbly, in all its entertainment forms, in games, arcades and computers, via broadcast and cable and cassette and, maybe, even disc. And do it as never before imagined. I won't say much about artistic values at this point, but basic innovations like these tend to grow fast on their own enormous potential. Compare the earliest motion-picture dramas with the profound works of art that came later, even before sound was added to a silent medium.

But what part can state-of-the-art audio play in *this* area? Sigh again. A lot of beeps, blips and electronic howls? It's video stuff, through and through.

Oh, so you think there are other areas of present TV that are truly innovative? Well, go a bit further. There's plenty of fine entertainment, of course. But is it really new, alive for the future, or just borrowed from the past? I love good films but they aren't as good on TV as on the screen, though much more convenient. I am always impressed by TV news coverage—it's amazing. But I do not think that a picture of an anchorperson reading news across a big desk is exactly a profound innovation, compared with radio news. (They had to put the person *somewhere* in the picture.) Again, the news is all engineering, that instant as-

sembling of info and pictures from everywhere, the ubiquitous satellite. That, decidedly, is real and new in our time. The news does project a few mild "firsts," like those windows at the back through which newscasters in distant places seem to talk to us. That's clever and useful engineering, not to be imagined in TV's earlier days. So with other news tricks, but mildly.

What's so innovative about the talk show? Maybe its length—not much else. If they moved the guests from the left couch to the right, I suppose *that* would be innovation. I did a talk-show (dead-center mono) in 1943.

So is hi-fi going to get very far in the video news and the talk shows? Well, we can always install stereo.

We have to be careful about this business of mediocrity in programming and lo-fi standards on the technical side. They are often rigidly unamenable to change and for good reason—simply because they work as is.

In audio we have never felt that the sound of TV even rates the term "audio." Pretty sad. Still mono. If it *is* audio, then it ranks with the feeblest, including ancient P.A. systems in churches, ball parks and maybe the New York subway. Most audio professionals will agree and many are all hepped up and missionary about it—we'll fix things up for *good* TV sound!

I take a different tack. I've always felt that present TV sound is exactly right for its purpose. Otherwise why does it satisfy the millions? No, it's not because we have no choice! No, not because people are clods with tin ears. They are right because 98% of the present TV message gets through quite adequately via the present sound system. That's why. We can use better fi (at reasonable cost) but we do not really need it.

The TV message, as is, consists almost entirely of the speaking voice. It is no accident that nature shaped our hearing to maximize the understanding of speech, and vice versa: The telephone has grown up on this principle. Hi-fi on the phone would do no harm but we don't need it either. No bass required. We supply it within the ear. Just enough midrange to distinguish the sibilant S from the fricative F, though we did fine without even that for many years.

# Perfect Timing



## So you won't miss the music you're after.

The song you're recording is building to a big finish. Unfortunately, your tape may finish before the band does.

The Onkyo TA-2055 takes the guesswork out of making perfect cassette recordings. It features a Real Time Counter that displays the consumed or remaining time on the tape, so you can plan your music selections down to the second. Creating your own tapes takes a lot of effort, and the TA-2055 insures that time is on your side.

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flattest frequency response a tape can produce. Dolby B & C Noise Reduction systems are standard, and a microcomputer controlled direct-drive 3-motor transport guarantees smoothness and reliability, in recording or playback.

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# ONKYO

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"Present TV sound is exactly right for its purpose. Otherwise, why does it satisfy the millions?"

People will indeed accept improvements of this sort if they are handed to them on a platter. But they really aren't much interested, and they are right. *The messages get through as is!* That's what really matters.

Same for color. Color is lovely but people still don't much object to purple

or green faces on the tube. Just look around you. Too much effort to get up and fuss with the controls—not worth the effort because the TV message gets through anyway.

You don't argue about these things. You can't. No matter how high your standards. Stereo, for instance. For TV

speech, for most video fare now, it would be a very marginal improvement and sometimes a liability. (The canny Japanese use it largely for two-language channels.) [But also for stereo—even baseball games.—*I.B.*] Who cares about directionality and ambience via the little TV box, or even the smallish projection screen? Too much separation and you confuse. (And bollix up the mono reception.) As of the whole of TV—why bother? TV is not organized for little minorities who like classical concerts and such. And after all, do you ever notice that the TV sound in your favorite bar comes from the other side of the room, or behind you, far from the picture? Who cares? Doesn't bother the message a bit.

On the other hand, certain forms of distortion are immediately serious. Audio noise, static, garbled voices, signal interference (that's why we have FM). Video snow, ghosts, rollings and shearings. These hit people right in the plexus, because they do interfere with the message in a big way.

Finally, music. Music is still the mainstay of hi-fi. There's music on video too, but it is characterized in four very unpalatable ways. First, it is still mono, as of audio around 1957, but the sound is good 1932. Can we go for that? Second, music is statistically unimportant; speech is the overwhelming audio message on TV. In our hi-fi, speech is almost nonexistent. Third, video music is by its very nature *inherently background*. The picture always hits harder. Even the most urgent efforts in high-minded classical music still leave the picture very much ahead, the music secondary.

And fourth, in contrast to the enormous diversity of available sound in our hi-fi, present video music is irrevocably limited to strict big-time stuff. It has to be. Can't be helped. Inherent in the present TV setup, except for a bit of PBS now and then.

Yes, it's a dismal picture—for us. *Where* can we fit in? It's going to be a very incompatible marriage, right down the line point by point. *Unless* we join the video engineers (the innovators) and get away from this monster, TV, to create some genuinely *new* entertainments that combine sound and sight. Like nothing ever before. This, or we die.

A



## Only the very best retailers carry this sign.

The only valid and fair method of evaluating audio components involves assessing their performance in circumstances which approach a domestic environment. This implies that only one pair of loudspeakers can be in the room at any time.

The presence of any other transducer, no matter how small,

will significantly degrade the performance of any audio system.

The best retailers realize that modern equipment demands higher standards of demonstration than the familiar wall of speakers on wobbly stands.

The best retailers employ only single-speaker dem-rooms.



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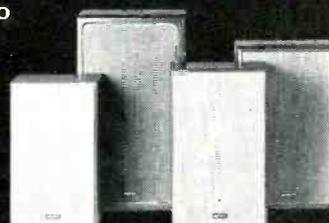
ADVENT

# The one thing we never change.

During the last fifteen years, we've made a lot of improvements on our Advent speakers. 137 to be exact. We've redesigned woofers and tweeters. Crossover networks and phase plates. Cabinets and mounting hardware. Even screws. But there's one thing we haven't changed. That's the value. The ability of an Advent speaker to out-perform many speakers that cost more. How? By making changes that sound good not just look good. While other speaker companies have spent their time adding all manner of dials, knobs and wild grilles, we've quietly gone about the business of perfecting the two-way speaker.

For example, our newest change is the Advent "Direct Report" tweeter. It is a parabolic rather than hemispheric design. And the special phase plate for the tweeter has been tapered to improve dispersion. Stereo Review liked it as much as we did. They said, "We cannot recall ever having measured a front-radiating dome tweeter whose dispersion equaled that of the new Advent design."

We think you'll agree with Stereo Review. The new tweeter is indeed exceptional. The change substantially improved the sound quality. But it hasn't substantially changed the price. You see, value has always been a part of the Advent legend. And that's something we haven't changed... never will.



For the location of the Advent dealer nearest you, call toll free 800-323-1566. [In Illinois call 800-942-0502.]

# ADVENT

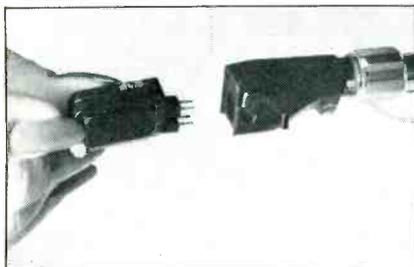
## The legend continues.

ADVENT

ADVENT

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## PLUG-IN PLAUDITS



Shure pickup and Technics P-Mount adaptor.

### Goodbye, Screws and Washers?

You can probably measure how long you've been reading *Audio* by how many tiny screws, nuts, washers, weights and spacers have accumulated from the phono cartridges you've mounted. You may not need all that hardware much longer, though.

The ideal has always been a plug-in cartridge which would snap into perfect alignment with the arm, no tools or screws or alignment gauges needed. But cartridge makers have resisted standardizing on such a mount.

At least, they did till Technics started selling rafts of linear-tracking turntables with plug-in Technics cartridges. With no other way to sell cartridges for these tables, the cartridge makers soon came up with plug-in cartridges of their own. Audio-Technica, Empire, Nagatronics, Ortofon, Pickering, Shure and Stanton are already joining the fold, and there will doubtless be others soon.

### Printer's Devilry

We try to filter out the typos, and we usually succeed. But there are occasional beauties that we really wish we could leave in, for sharp-eyed readers to enjoy. For example, the typesetter's change of a "2- $\mu$ F" capacitor to a "2-MF" one. That would turn a common capacitor, about the size of an infant's fingernail, into a rip-snorter the size of a 70-story building, 350 feet in diameter!

Even that is based on new technology, which allows 1-F capacitors (built only for display, nobody uses them) to be a mere eight inches long by three inches in diameter. At one time, says Sprague Electric, a 1-F capacitor would have filled a small room.

So far, only Technics turntables (including some new models with conventionally pivoted arms) and Radio Shack's new LAB-2000 linear-tracking model can use these cartridges. But, with so many cartridges available, other arm and turntable makers will probably adopt the system, too. Technics has encouraged this by giving it a generic name, "P-Mount," so other turntable makers won't have to call their products "Technics-compatible." So far, there have been no takers.

P-Mount cartridges all have the same mass (6 g), as well as the same dimensions, so you won't have to rebalance your arm if you swap cartridges. What happens when a new, lighter generation of cartridges arrives? Technics' Sid Silver doubts that will happen before digital discs take over. If it does, though, one could simply offer lower-mass arms with snap-on counterweights to handle earlier P-Mount cartridges.

My only reservation is to wonder whether the mounting system is really rigid enough. It seems to be, but we have not yet run a P-mount arm and cartridge through a formal test. To keep the system rigid, the cartridge is held in by a screw, not just snapped in place, so you'll still need a screwdriver, at least, when mounting cartridges. That's a bit more work than interchanging headshells with premounted cartridges, but it also helps eliminate the headshell's mass.

### Piezo Film

Piezo-electric films have been used in commercially made speakers (Pioneer's HPM tweeters, for example). If you'd like to try building your own piezo speakers, you may have trouble finding the special films and information on how to use them. Here's a source: Piezo Film Group, Pennwalt Research Chemicals, P.O. Box C, King of Prussia, Pa. 19406. Their tech data book on Kynar™ Piezo Film lists microphones, pickups and headphones as other possible applications. Minimum order is \$35 worth, which will get you about 200 square centimeters (31 square inches) worth, in a variety of sizes and thicknesses.

### Components vs. Systems?

One-brand rack systems first appeared as a merchandising ploy—regular components, matched in style, size and performance, but sold as one system rather than separately. A rack cabinet tied the pieces together visually and kept the system compact. (The idea is neither new nor Japanese—Stromberg-Carlson had similar systems in the '50s, but with console-shaped racks.)

This limited the choice of components to the ones which fit the rack (which rather pleased the buyers who'd rather not face too many choices). However, it may also have been the first step toward locking system-buyers into one brand or system. Many systems now offer unified remote controls that won't work with other brands. Some have automatic selectors, where starting the turntable automatically switches the preamp to phono, while tuning in a station switches the preamp to FM. Schneider's Direct Contact System components plug together without cables (as will Aiwa's V-1000 and a forthcoming Technics system)—though you can also hook up other components using the normal jacks and cables.

These are real conveniences. But they do limit your choice. And they needn't, if the industry had chosen common control and connection interfaces. But standard interfaces would make these special features less of a competitive advantage, so don't hold your breath.

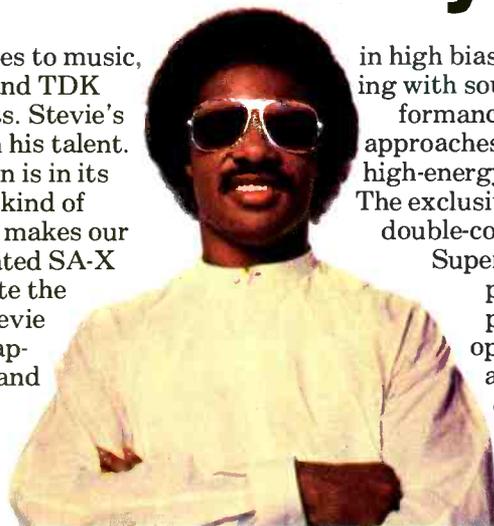


Illustration: Philip Anderson



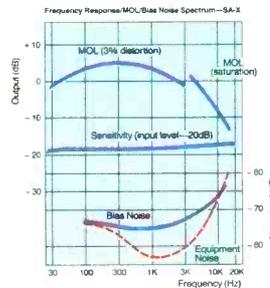
# Stevie's cassette is SA-X for all the keys he plays in.

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in high bias recording with sound performance which approaches that of high-energy metal. The exclusive TDK double-coating of Super Avilyn particles provides

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the sorrow, the vitality that makes jazz great.  
It gives me a tremendous feeling to know  
this collection is being done, and  
I'm delighted to be a part of it."*

—Dave Brubeck

A collection that only the Institute of Jazz Studies could assemble:

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From the world's largest jazz archive *The Greatest Jazz Recordings of All Time* is the culmination of years of work carried on at the Institute's headquarters at Rutgers University—by a staff of authorities unique in all the world.

As they set about making their selections, no resource was denied them. They considered countless recordings, beginning with the Institute's own archive of more than 60,000 records. In addition, they received the support of all the great jazz labels, whose vaults hold the master recordings essential for this collection.

#### The most comprehensive collection ever assembled

As a result, this will be the first collection to capture the all-time best of

jazz, as it flourished in each generation. The greatest music from the *golden age*—the dazzling trumpet solos of Louis Armstrong, the biting elegance of Bix Beiderbecke's cornet, and the vital, vibrant piano styles of Fats Waller.

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The best of *bop* and *cool jazz*—with alto sax artists ranging from the fiery Charlie Parker to the impeccably graceful Paul Desmond . . . trumpeters Dizzy Gillespie and Miles Davis . . . the Oscar Peterson Trio . . . Milt Jackson, with the Modern Jazz Quartet.

And the great musicians who are bringing jazz to more people than ever *today*—including George Benson, Herbie Hancock and Chick Corea.

#### A collection you could never assemble in any other way

This is a collection that could not be duplicated by any individual. For it draws upon a wealth of rare recordings which belong to the Jazz Institute—including important material just uncovered in the last few years.

Some of these recordings, such as Teddy Wilson's solo piano version of 'Somebody Loves Me,' have actually never been issued before. Others have been unavailable for decades—such as Art Tatum's 'Chloe.' And among the most fascinating of all are the previously unreleased studio "takes" of well-known numbers like 'Benny's Bugle' by Charlie Christian and 'I Can't Get Started' by Bunny Berigan.

And all the *classics and hits* of jazz will be here. Unforgettable performances of 'St. James Infirmary' by Jack Teagarden, 'China Boy' by Eddie Condon, and 'Star Dust' by Lionel Hampton.

#### The superior sound of proof-quality records

The sound quality of each record will be a revelation. For every vintage recording will first undergo a painstaking restoration. Each will be electronically "cleaned," groove by groove . . . bring-

ing you closer to the actual performance than was previously possible.

Furthermore, the Institute of Jazz Studies has appointed The Franklin Mint Record Society, one of America's leading producers of high-quality records, to press the records for this collection. And they will use a special vinyl compound containing its own anti-static element. In addition, each record will be pressed in an atmosphere controlled "clean room." The result—a pressing of superior fidelity that is also more durable and resistant to dust. A record of true *proof-quality*.

The records will be issued in hard-bound albums. Each album will hold a set of four 12" long-playing records. And each will present a specially conceived *program of selections*, which brings together related performances in a way unique to this collection. Accompanying each album will be an expert commentary, written under the supervision of Institute Director Dan Morgenstern.

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rediscovering jazz: realizing anew what a vital musical form it is. If you have a love for jazz . . . whether you follow it avidly or remember it with nostalgia . . . this is an opportunity not to be missed.

The collection is available *only* by subscription. Albums will be shipped at the rate of one every other month, and the price of \$10.75 for each proof-quality record will be *guaranteed* throughout your subscription period.

To subscribe now, mail the accompanying application to The Franklin Mint Record Society, Franklin Center, PA 19091, by February 28, 1983.



Louis Armstrong, Stan Getz: Photos by Robert Parent; Ella Fitzgerald: Photo by Raymond Ross; Lionel Hampton, Dave Brubeck: David Redfern/Retna Ltd.; Benny Goodman: Rex Features Ltd.; King Oliver's Creole Jazz Band: Courtesy of the Tulane University Jazz Archive.

## Selectable Phono Capacitance

*Q. I am aware that a phono cartridge requires a particular value of capacitance for optimal response; mine requires 200 to 300 pF. My receiver has a load-capacitance selector, with a choice of 100/250/450 pF; obviously I have set the selector at 250 pF. I am curious, however, to know if the 250-pF load is in addition to that of the tone-arm wiring and interconnecting cables, or does the 250-pF load take into consideration the arm wiring and cables? If it does not, I would change the capacitance load to 100 pF.—Bill Landiuk, Calgary, Alberta*

A. The load-selector switch on your receiver is designed to provide capacitance in addition to any other capacitance which may be present. Unless you have relatively low capacitance cable, you should find that by switching to the 100-pF setting, you have better highs with less peakiness.

## Tuner and Turntable Volume Difference

*Q. My tuner is two or three "notches" louder than my turntable. Is there something wrong?—Glenn L. Brass, New York, N.Y.*

A. There is no problem with your tuner producing more volume than your turntable. The difference in volume between these two sources will vary, depending on the volume of the recording being played and upon the voltage produced by your particular phonograph cartridge. Years ago, equipment was supplied with level controls for each input so that these loudness differences could be taken into account.

## Relating Response to Bandwidth

*Q. Please explain the difference between frequency response and power bandwidth in an amplifier.—John Potter, Oakdale, N.Y.*

A. Frequency response refers to the measured amplitude or output of a device over various frequencies. In other words, if a range of frequencies is fed into the gear at equal amplitudes, the output of the unit will contain these frequencies at equal amplitudes throughout the measured frequency range—if the unit is perfect. Such a system is said to have a flat frequency response.

Amplifiers usually have a wider frequency response at low output levels than at or near their maximum rated power. Therefore, amplifier specifications may show both low-level frequency response (usually at 1 watt output) and the bandwidth over which the amplifier can deliver its full power.

For example, an amplifier putting out 1 watt might have a bandwidth from 25 Hz to 20 kHz. The same amplifier at 10 watts might have a bandwidth of only 30 Hz to 17 kHz.

## Noisy Volume Control

*Q. When I adjust the volume control of my receiver up or down, there is a static sound coming through my speakers. This occurs whether the program source is FM, AM, phono or tape. I have bypassed all of my music enhancers, thereby narrowing the discrepancy down to the control itself. After I adjust volume, the static sound stops. Can I correct this problem at home, or must I take my receiver to a repair shop?—Donald F. Bullock, APO San Francisco*

A. The problem with your volume control is that it is either internally oxidized or worn out. Most likely it is oxidized, which sounds terrible, but is simple to cure if you can obtain contact cleaner, sold for cleaning volume controls. First take the receiver apart and look at the control. Often there is a small opening around each of the two terminal lugs (to which the wires are connected). Squirt the contact cleaner into both of these openings, but be careful to use this cleaner sparingly.

If there are no openings around the lugs, remove the volume control knob and tip the unit so that the control shaft faces up. Try to squirt some cleaner where the shaft enters the body of the control.

In either of these cleaning methods, after the cleaner has been sprayed into the control, rotate the shaft up and down a few times so that the cleaner will be dispersed over the sliding contact surfaces within the control. Keep the amplifier turned off during this process.

In cases where the problem is not severe, noise can be reduced or eliminated for a time merely by rotating the control rapidly a few times, without using any cleaner.

If none of the above helps, the control may require replacement. There is also another, though rare, possibility. A coupling capacitor associated with the control may be leaky, thereby putting d.c. voltage on the control. In this event, the capacitor must be replaced.

## Low-Frequency Filters

*Q. I own a preamplifier with a filter that inserts a 12 dB per octave roll-off below 15 Hz in the phono preamplifier section. My speakers' low-frequency response is flat to 44 Hz. I hear no difference with the filter engaged or disengaged and assume this is because the filter operates far below my ability to hear such low frequencies. Is this correct?—Steven T. Johnson, Rushville, Nebr.*

A. Because your speakers are not designed to reproduce frequencies flat below 44 Hz, their bass response would be so far down at 15 Hz that you would not hear a difference with the filter switched in or out. You might, however, notice some cone movements with the filter out and less with it switched in. This would be most noticeable at high volume levels, on a quiet passage of a disc.

I recommend that you leave the filter switched in, which will avoid problems in the event that the tonearm is dropped. A transient produced under such conditions would probably result in damage to your speakers as well as to your amplifier.

## Speaker Doubling

*Q. Please explain "doubling" in reference to loudspeakers.—James D. Gibbs, Cedar Rapids, Iowa*

A. Doubling is basically harmonic distortion, and it occurs when a speaker is fed a signal lower than it can reproduce, though it will sometimes occur with high-power signals. Instead of the fundamental tone, the speaker produces its second harmonic, that is, a tone double the original frequency, hence the name. The reason doubling occurs with high-power signals is that harmonic distortion rises with increasing input level. 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.**

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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FILTERS: 15 mg. "tar", 1.1 mg. nicotine av. per cigarette by FTC method.



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BERT WHYTE

## SNAPSHOT VIDEO

**A**ny survey of the video recorder market reveals the steady growth of portable VCR equipment. Nearly every supplier has a portable model and, as you would expect, color video cameras are proliferating very rapidly. Some of the portable VCRs are quite compact and relatively lightweight, but none of them quite reach the dimensions and weight that would make them attractive alternatives to Super-8 movie cameras.

Technicolor's mini VCR system, using quarter-inch tape cassettes hardly larger than audio cassettes, was a step in the right direction. Since I reviewed the system in the January 1982 issue of *Audio*, nothing much more seems to have happened with it, probably due to its picture quality—fairly good for the format, but not in the same league with the larger, half-inch VHS and Beta portable VCRs.

Rumors continue that a number of Japanese companies have quarter-inch videocassette systems under development, including some which combine camera and recorder in a single, ultra-compact lightweight package. However, none have surfaced yet.

However, on June 1st of 1982, JVC held a press conference and surprised everyone by introducing the HR-C3U super compact, lightweight videocassette recorder and their newly developed VHS compact videocassette. The system employs standard half-inch VHS tape in a special, small cassette; JVC evidently feels that this format is necessary to ensure good picture quality. The company signed up about 10 licensees for the VHS-C, and Maxell, Fuji, TDK and Scotch (and of course JVC) indicated they would make the TC-20 videocassettes, which afford 20 minutes of recording.

Now, some six months later, the VHS-C system is just beginning to reach the market. JVC has its HR-C3U compact VCR and Sharp is marketing its VC-220 VHS-C videocassette recorder. Thus, it is time to take a closer look at the JVC HR-C3U, and before long I expect to have some hands-on experience with it.

In the case of the HR-C3U, "compact" means a really small VCR, one measuring 7.2 in. W x 3 in. H x 8 in. D, plus a half-inch more depth with the battery pack attached. Without the bat-

*The smallest VCR so far, JVC's HR-C3U is still compatible with normal VHS videocassette recorders.*



tery pack, the VCR weighs only 4.4 pounds; with the battery pack, it tips the scale at just 5.3 pounds. The TC-20 videocassette is about the size of a deck of playing cards.

For all its compact size, the HR-C3U has many features. The recording drum has a newly developed brushless, quartz-locked, direct-drive motor, and there is a new direct-drive capstan motor. The mechanism has been simplified and its performance improved through the use of four motors. Automatic back-space editing prevents picture breakup between successive recordings. A full-function, wired remote control is provided. An LCD display is used for tape counting and real-time indication of remaining tape length. Forward and reverse shuttle search functions help locate particular tape segments. Recorder controls are light-touch pushbuttons with microprocessor-based full-logic operation. Audio dubbing facilities are provided, as is a recording standby-mode lock, and there is automatic rewind at the end of a tape. The HR-C3U can be powered by rechargeable nickel-cadmium battery pack, household a.c., or car battery. One of the unique features is "automatic quick review" that permits viewing the last seconds of recording in the camera's viewfinder.

The HR-C3U has a full complement of controls on the front panel, which also includes a headphone jack and microphone jack. The all-important camera input is conveniently on the front panel as well. On the right side of the unit is an audio dubbing connector, an r.f. output connector so that the unit can be hooked up for viewing through a TV set, and a video output connec-

tor. Apparently there is no video input connector, which means that the HR-C3U cannot be used to record digital audio with a processor like the Sony PCM-F1. [One could probably rig an adaptor for the camera jack.—I.B.] An optional \$28.00 C-P1U cassette adaptor holds the TC-20 cassette for playback or recording in a standard VHS videocassette recorder. The HR-C3U is furnished with quite a few accessories—the remote control, battery pack and charger, carrying case, shoulder strap, and TC-20 videocassette—and lists for \$850. Optional accessories include high-capacity battery pack, high-output battery charger, car-battery adaptor, a.c. power pack, and recording and tuner cables.

Early next year (perhaps at the WCES in Las Vegas) JVC plans to announce a companion compact camera for the HR-C3U. Designated the GZ-S3U, it weighs 2.7 pounds, features a 6:1 f/1.2 power-zoom lens, electronic viewfinder, auto/manual iris, and a half-inch Saticon pickup tube. Price will probably be around \$725.

JVC has evidently done considerable research for technical improvements to their special Super HG TC-20 videocassette tape. This tape is said to have super-fine magnetic particles, very evenly dispersed, with high packing density and unidirectional particle orientation. A special back-coating has been used for more stable tape transport, allowing the magnetic surface to be polished to a previously impractical degree of smoothness. It is claimed this affords a significantly better color signal-to-noise ratio, with stable color output and reduced modulation noise. The TC-20 cassette also has a special



## MERIDIAN TAKES HIGH FIDELITY BEYOND THE MUNDANE

Meridian is a unique line of audio components produced by Boothroyd Stuart Limited of London, one of the most prestigious design teams in the world. Now in America, Meridian signals the arrival of a new, beautiful and unconventional approach to high-fidelity.

Meridian products are designed to create an utterly believable musical experience in your home. Meridian's quest for excellence, demands engineering of the utmost sophistication, but excessive complexity of no redeeming benefit to the user is carefully avoided. Meridian form is always dictated by function, and yet, the components never fail to blend gracefully into the most tasteful home settings.

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the striking results of new, fundamental research into the physical and psycho-acoustic factors which affect the musical realism of reproduced sound. The Meridian M10 is the new "big brother" to the highly acclaimed M2 and M3 systems. Each M10 contains seven active drivers, one passive radiator, and four direct-drive power amplifiers. The built-in active crossovers are linear phase high-order networks with an unusual 190 Hz mid-to-bass division and time delay compensation for the tweeter. The system is uniquely configured to assure virtual point source "man-like" sound propagation. The Meridian M10 InterActive Loudspeaker will astonish you with its clean and powerful bass, wide dynamic range, extremely low coloration, and finely detailed multi-dimensional rendition of complex program.

Meridian products have received rave reviews from hard-to-impress audio critics around the world. Find out why. Write for more information, review reprints, and the name of the authorized Meridian dealer nearest you.

### MERIDIAN AUDIO OF AMERICA

A division of Misobanke International Inc.

Dept. AU-782, P.O. Box 653, Buffalo, NY 14240

Models shown: Preamplifier/Control Unit 101, FM Tuner 104, InterActive Loudspeaker M10

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"For all its compact size, JVC's HR-C3U has many features, including a full-function, wired remote control."

"Dustatic" anti-static leader, and the cassette housing itself is more carefully molded and mechanical parts held to closer tolerances. All this is in aid of maximum resolution and picture quality which of course, is absolutely vital if the HR-C3U is to be considered a viable alternative to Super-8 movies.

Not until high-definition, 1,125-line video is achieved can the high resolution and sparkling detail of Kodachrome movie film be challenged. However, what I saw at the demonstration of the HR-C3U system at the JVC press conference was awfully good. Good enough in fact, for many people,

especially considering the cost differential between videocassette and Super-8 movies. The cost of Super-8 film and developing for one hour is a whopping \$187! At the anticipated *list* price of \$20 each (much cheaper at discount stores), three TC-20 cassettes will give you the same hour of viewing for \$60. Add to this the fact that with the HR-C3U there is instant playback—no waiting days for developing of film, and if one desires, the cassette can be erased and used again and again. My own feeling is that JVC should introduce a simple auto-focus/auto-exposure camera; this plus the other advantages of the HR-C3U should really grab the attention of Super-8 devotees.

Every time I have talked to videotape service technicians, they have deplored the use of the typical abrasive video head cleaners on the market. They use wet cleaning on the head drums because they know how to disassemble the VCR to gain access to the drum. Now there are two "wet" cleaners which are very easy to use. Teac makes a VHS-only VCL-20 cleaning cassette, which has an orange-colored reservoir in the upper left corner of the cassette. Five or six drops of the supplied cleaning fluid (highly volatile, it smells like carbon tetrachloride) are placed in the reservoir and the cassette placed in play mode. After the tape stops, the cleaning tape is re-wound for its next use. This fluid seemed to do a good job when I used it, and a 15-cc bottle costs \$19.95.

Koss Corp. has come out with a unique wet video-head cleaner available in both VHS and Beta formats. The Koss V.I.P. (Video Improvement Process) features a special videocassette that is "loaded" with pre-moistened cleaning cartridges. The cassette is run through the play cycle and then the cartridge is removed from the cassette shell and discarded. The cartridges are hermetically sealed, and three are furnished with the original cassette package at \$19.99. Replacement cartridges are three for \$3.99. This is a very effective system and its disposable feature assures no post-cleaning contamination. Clean recording-head drums are very important in digital recording, and the Koss V.I.P. cleaner helps prevent dropouts. 

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## PHILADELICACIES



Eugene Ormandy

**Dvořák: Symphony No. 8.** The Philadelphia Orchestra, Eugene Ormandy. **RCA ARL1-4264, \$9.98**  
**Mussorgsky-Ravel: Pictures at an Exhibition; Stravinsky: Firebird (Suite 1919).** The Philadelphia Orchestra, Riccardo Muti. **Mobile Fidelity MFSL 1-520, \$17.00.**

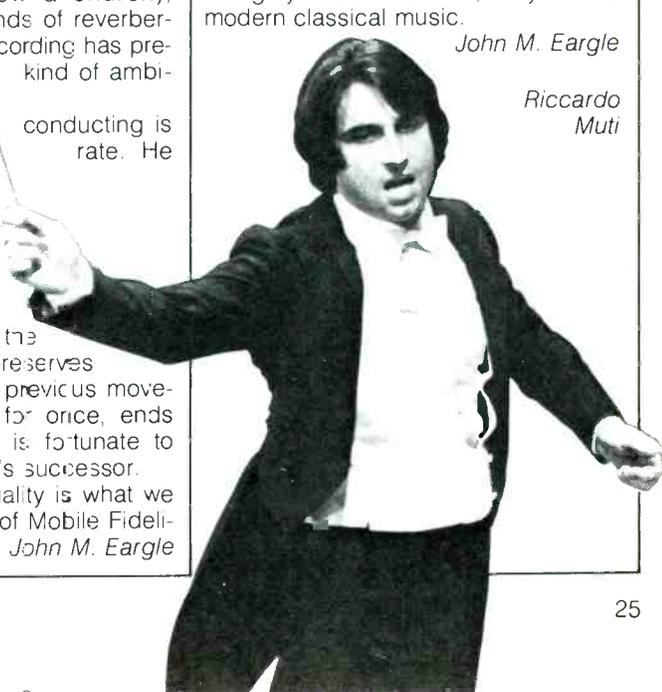
RCA's recording of the Dvořák is a good example of intelligent multi-miking; one senses that there is a main microphone array, with accent microphones mixed in at reduced levels only to limn inner voices. One is not aware of gain riding per se, and imaging remains stable throughout. The high end on both strings and brass is quite natural, and the overall dynamic range is wide. With these fine sonics, Ormandy emphasizes lyric elements over rhythmic ones, and in the balance, the performance is low-keyed and lacking in briskness. With only occasional minor ticks and pops, the pressing is a good example of domestic record production.

Mobile Fidelity's reissue of Angel's Mussorgsky-Stravinsky album presents Angel-EMI's first recordings of the Philadelphia Orchestra made a few years ago. The opening trumpet state-

ment of "Pictures" had me running to my test records so I could determine if, in fact, there was something wrong with my system! There is an annoying, high-frequency "sizzle" in this recording that conventional tone controls can only partly correct. Once you adjust to it, however, you will surely enjoy the superb playing and the rich perspectives of the recording. Made in Philadelphia's Old Met (now a church), with its 2.5 seconds of reverberation time, the recording has precisely the right kind of ambience for this music.

Riccardo Muti's absolutely first-keeps tempos moving without sounding brisk or hurried, and there is a comfortable feeling of tight control at all times. The transition into the "Great Gate at Kiev" preserves the momentum of the previous movement and the work, for once, ends logically. Philadelphia is fortunate to have him as Ormandy's successor.

Record pressing quality is what we have come to expect of Mobile Fidelity—excellent.



John M. Eargle

Riccardo Muti

**Joseph Schwantner: "Afternoons of Infinity" and Witold Lutoslawski: "Livre pour Orchestre."** The Eastman Philharmonia, David Efron. **Mercury Golden Imports SRI 75141, \$6.98.**

Most discophiles think of the Mercury Golden Import series as the vehicle for Dutch transfers and pressings of the famous Mercury stereo catalog of the late '50s and '60s. It is not generally realized that the series occasionally introduces a new recording, and this one is noteworthy in several respects.

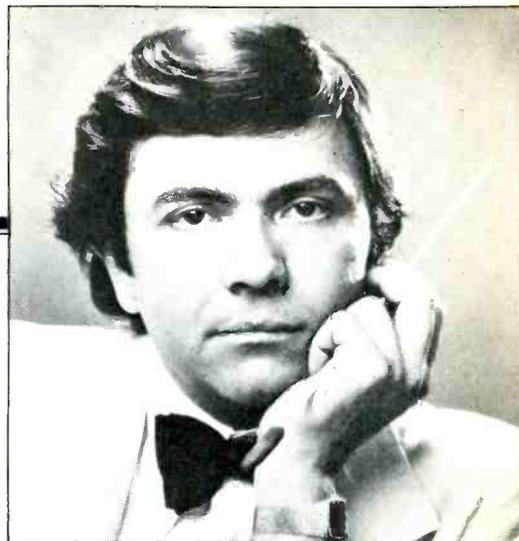
The music is compelling. The Schwantner piece skillfully melds instrumental timbres with voices of the orchestral players, exotic percussion instruments, and even tuned goblets played by rubbing their rims. The Lutoslawski work is more traditional in its sonic resources, but it is likely to be somewhat more inaccessible, at least on first hearing.

The Eastman Philharmonia demonstrates that the Eastman School of Music in Rochester is just as capable as it was during the Fennell/Symphonic Wind Ensemble era of the '50s and '60s of turning out thoroughly professional performances good enough for record making.

The recording quality is excellent; both pieces were recorded on the Eastman premises, making good use of the school's complete and modern recording facility.

Highly recommended, if you like modern classical music.

"The sumptuousness of the sound belies the small size of the Los Angeles Chamber Orchestra."



Gerard Schwarz

an excellent backdrop for the assembled musicians.

Douglas Davis' cello in "Silent Woods" has not been given the usual spotlight solo treatment; instead, the instrument seems to come from the orchestra itself and is heard in a more natural perspective with the rest of the ensemble.

The "Notturmo" begins on a tentative, brooding note and uses a harmonic palette rare for Dvořák. The work develops in a more traditional manner, however, and we are left with the comforting feeling that the work was in fact written by Dvořák.

The package is the usual complete and handsome one we have come to expect of Delos, and the notes are extremely well written. If you are a bit tired of the symphonies of Dvořák, try this record. You are sure to find it a genuine pleasure. *John M. Eargle*

**Marche Slav and Other Russian Favorites.** The Saint Louis Symphony Orchestra, Leonard Slatkin.

**Telarc Digital DG-10072, \$14.95.**

This collection of Russian bon bons includes, in addition to Tchaikovsky's "Marche Slav," Rimsky-Korsakov's "Russian Easter Overture," Glinka's "Ruslan & Ludmilla Overture," Borodin's "In the Steppes of Central Asia," and Gliere's "Russian Sailor's Dance."

Like most of the Saint Louis recordings on Telarc, this one has good ambience and a fine sense of fore-aft spatial relationships. As in so many Telarcs, the bass drum is a bit overblown, but for demonstration purposes this may be entirely okay.

Slatkin leads his ensemble through characteristically idiomatic performances of these works, and the playing is first-rate. The Rimsky-Korsakov overture, easily the best piece of mu-

**Dvořák: Serenade, Op. 22; Waldesruhe, for cello and orchestra; Notturmo.** The Los Angeles Chamber Orchestra. Gerard Schwarz.  
**Delos DMS 3011, digital, \$17.98.**

This disc contains some of Dvořák's loveliest and most unusual writing. The

"Serenade" is the familiar work here, and Schwarz leads his group in a performance which balances rhythmic precision with melodic flow. The sumptuousness of the sound belies the small size of the ensemble, and the acoustics of medium-size Bridges Hall of Music at Claremont College provide

## Revox B791

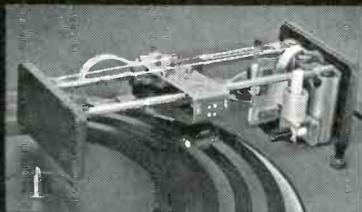
### The Straight Line on Precision Engineering

First, a few words about our straight line tracking system. It's called Linatrack®, and it utilizes a low mass, incredibly short tonearm that's barely 134' from pivot to stylus tip. Tracking error is eliminated as Linatrack®, guided by an accurate infrared-interrupt servo circuit, moves straight across the radius of the disk. The tonearm mounts most popular cartridges, and the entire Linatrack® module pivots aside for quick record changing.

Precision engineering is at the heart of the B791. A quartz-regulated, Hal-effect direct drive motor assures absolute speed stability with no cogging effects. Even the vari-speed is quartz locked, with a front panel display to show both the nominal speed and the exact percentage of speed deviation.

The Revox B791 is solid, substantial, meticulously assembled, and handsomely finished. It is designed for maximum user convenience, exceptional reliability, and sonic accuracy. It is not inexpensive.

That's the straight line. Hear the full sound at your nearest Revox dealer.



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# BASF Chrome. The world's quietest tape is like no tape at all.

Today, only one high bias tape is able to combine outstanding sensitivity in the critical high frequency range with the lowest background noise of any oxide tape in the world.

That tape is BASF's Professional II.

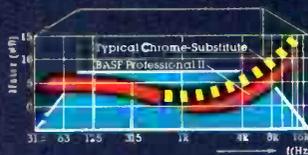
Professional II is like no other tape because it's made like no other tape. While ordinary high bias tapes are made from modified

particles of ferric oxide, Professional II is made of pure chromium dioxide. These perfectly shaped and uniformly sized particles provide a magnetic medium that not only delivers an absolute minimum of background noise, but outstanding high frequencies as well.

Like all BASF tapes, Professional II comes encased in the new ultra-precision cassette shell for perfect alignment, smooth, even

movement and consistent high fidelity reproduction.

With Professional II, you'll hear all of the music and more of the tape. And isn't that what you want in a tape?



The difference in noise level between PRO II and ordinary high bias tape is greatest where the human ear is most sensitive (2-6 kHz).

## GUARANTEE OF A LIFETIME

All BASF tape cassettes come with a lifetime guarantee. Should any BASF cassette ever fail — except for abuse or mishandling — simply return it to BASF for a free replacement.

## Mobile Fidelity Sound Lab.

BASF Professional II is so superior it was chosen by Mobile Fidelity Sound Lab for their Original Master Recording™ High Fidelity Cassettes. These state-of-the-art prerecorded cassettes are duplicated in real time (1:1) from the original recording studio master tapes of some of the most prominent recording artists of our time.



# CHROME



# BASF

For the best recordings you'll ever make.



"Leonard Slatkin leads his ensemble through characteristically idiomatic performances."

... sic in this collection, is given a resounding performance. "Marche Slav" comes across as a sort of small-scale "1812 Overture," even to the same hymn finale, albeit without cannons!

The new Telarc packaging has done away with the plush double-fold albums with their rich notes and photo-

graphs. Doubtless, it is a result of current economic conditions, but the single album which remains is beautifully done, with excellent notes.

*John M. Eargle*

**Widor: Symphony No. 4 for Organ.**  
John Rose, organist.  
**Towerhill T-1014, \$8.98.**

Towerhill is a small, Los Angeles-based classical label whose catalog consists largely of organ music. This record, fourth in a series devoted to the French romantics, was recorded on a 1971 Austin instrument in the chapel of Trinity College in Hartford, Connecticut. The instrument is well suited to the French literature, and the chapel itself is appropriately reverberant.

John Rose is an intelligent player who approaches this music with respect and conviction. His tempos are sensible, and the war-horse toccata finale is accorded a measured, sane approach which is far more satisfying than the breakneck-speed performances one usually hears.

Most readers of this column may never have heard of Widor, and they probably think of Saint-Saens when "organ symphony" is mentioned. Actually, the symphonies of Widor, and those of Vierne as well, might better be called suites. The fact that they were written for the large French Cavaillé-Coll organs of the last half of the 19th century, with their rich array of timbres, doubtless suggested their being called symphonies.

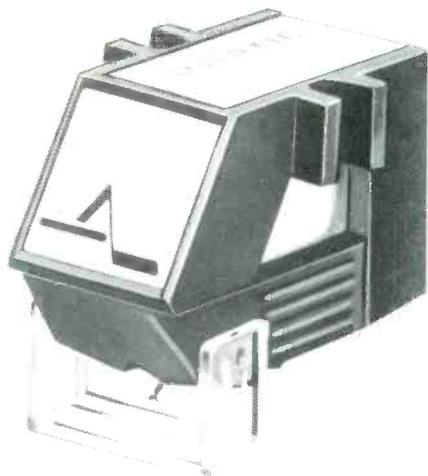
The recording perspective is mid-hall rather than close-up, meaning that the flatter the playback system, the more natural the result. The 32-foot bottom end on this recording is one of the most extended and natural I have heard in a long time. The "Untersatz" has plenty of fundamental and has not been filtered in any way. Listen for the low C at the end of the fourth movement. What you will hear is the octave of the 16-Hz fundamental. Now, look at your woofers. You will see very clearly a 16-Hz fundamental, the kind of thing that rarely shows up in organ records, just begging for a subwoofer that goes down that low! Excellent demonstration material it is.

The transfer is excellent, and the processing quality is quite good.

*John M. Eargle*

**"... the new Astatic Cartridge (a moving flux design) sounded as good, if not better than the Dynavector Diamond."**

*The Audiophile Society Minutes\**



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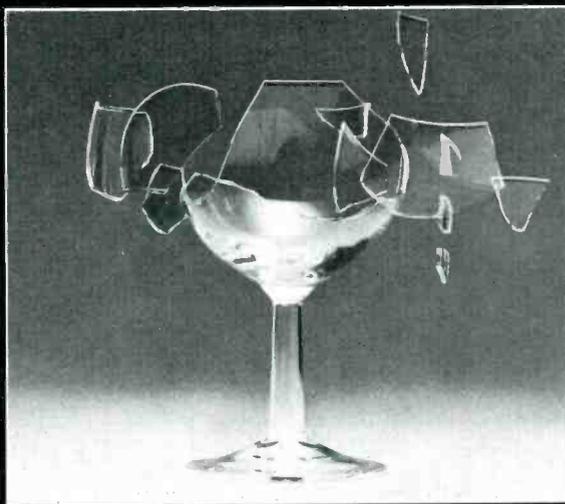
\*Publication of The Audiophile Society  
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**You've had your hair blown...**



**your glasses shattered...**

## **Have you ever heard a cassette sound like real music?**

### **DENON'S 70 YEARS OF EXPERIENCE RECORDING LIVE MUSIC.**

It shouldn't be surprising that most tape manufacturers describe their products in terms that have little to do with real music. After all, they are basically industrialists and marketers.

Denon, on the other hand, is in the music business and has been for over 70 years. Our vast range of recording experience includes supplying professional equipment to most of Japan's recording studios and radio stations; the recording and distribution of the world famous Denon PCM record library (using the digital process which we developed) and over 14 years specifically devoted to the manufacturing of cassette tape.

Denon DX Series Cassette Tape is not someone else's product that we place our name on to capitalize on Denon's success in other categories. We manufacture every single element of our DX-Tape from the dual coatings (each designed for a specific portion of the bandwidth) and the precision half-shells (which exceed the I.E.C. specifications by 300%) to the non-abrasive, self-cleaning leader provided on each and every DX cassette.

### **CASSETTE TAPES, LIKE COMPONENTS, CAN MEASURE ALIKE AND STILL SOUND DIFFERENT.**

Serious audiophiles know that components with identical specifications can sound noticeably different. Conventional measurement techniques do not explain this phenomenon, so words such as "musical" are often used to describe sound that possesses the "life-like" characteristics of real music.

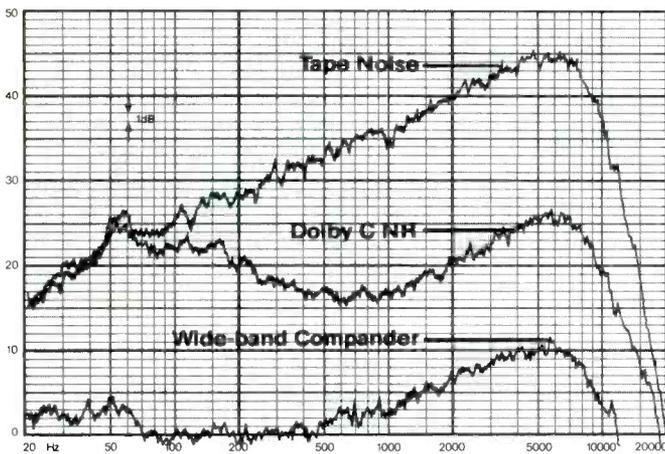
### **DYNAMIC DISTORTION: THE FIRST TRUE MEASUREMENT OF TAPE SOUND QUALITY.**

The reason conventional tape testing measurements do not tell the whole performance story is that they are based on single test tones rather than complex musical signals. Denon, on the other hand, adopted a means for measuring Dynamic Distortion, the distortion created on the tape by actual music signals. By specifically developing formulations to reduce Dynamic Distortion, Denon was able to significantly improve DX-Tape's ability to accurately recreate the sound of *real music*.

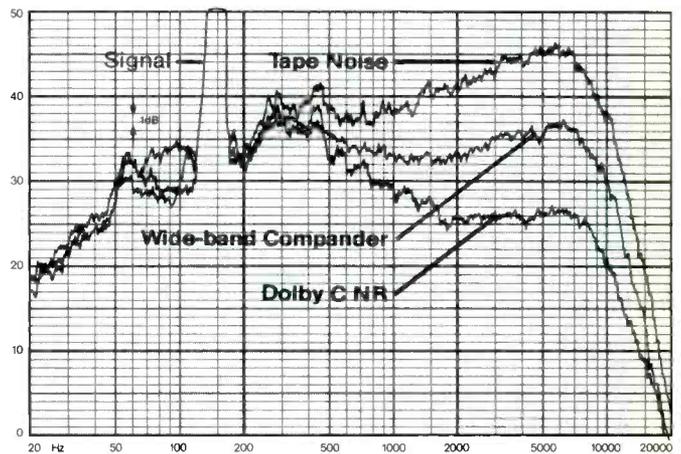
Thus, by satisfying conventional "static" and Dynamic Distortion parameters, every formulation of Denon DX-Tape including normal (DX-1, DX-3), FeCr (DX-5), Chrome (DX-7), and Metal (DXM) delivers the type of satisfying *musical* performance that is making Denon DX-Tape the first true "audiophile's" cassette.



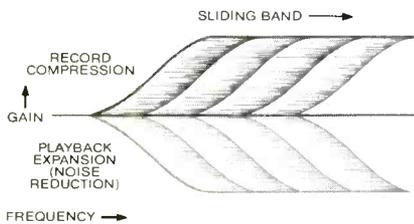
# There's More to Noise Reduction Than Silence.



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



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



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

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

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

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

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

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

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

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



Dolby Laboratories Licensing Corp.,  
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Telephone (415) 392-0300. Telex 34409.

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# DIRECTORY ADDENDA

**E**very year, we first query and then hound, nag, plead and urgently remind the manufacturers whose products should be in our Annual Equipment Directory (October) and Car Stereo Directory (July). And every year we get a pretty good response—over 3,000 products in October, almost 1,000 in July, and about 200 more in November's Son of Directory section.

Nonetheless, some of our questionnaires get lost in the mail, or on the desks of people who have gone on vacation or departed altogether. Companies move and their mail takes weeks to catch up with them, new companies are born, imported product lines switch importers, and so on. Sooner or later, though, the information reaches us. And here it is. *I.B.*



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# ANNUAL EQUIPMENT DIRECTORY

## AMPLIFIERS

MANUFACTURER	Model	Unit Type: Integrated = I, Kit = K, Tube = T, Mono = M, Stereo = S, Moving Coil Input = MC	Cont. Avg. Watts Channel into 8 Ohms	Power Bandwidth, Hz to kHz	Rated THD, %	Rated IHF IM, %	Class of Output Operation	Phono S/N, dB for 0.5 v Output at 1 kHz	MM Phono S/N, dB for 0.5 v Output at 1 kHz	MM Phono Overload, mV	High Level Sensitivity, mV	Tone Controls?	Phono Input Capacitance, pF	Moving Coil Input?	Does Unit Invert Phase?	Weight, Lbs.	Price, \$	Notes
JRM	Power Tower	B M	†	10-20 +0, -1	0.02	0.02	AB				80	††	M, L	1.5	No		2000.00	†(2) 45 & (2) 180; ††(2) 2.2 V & (2) 1.1 V; will drive 2-ohm speakers.
MARK LEVINSON	ML-2	B M	25	20-20	0.1	0.1	A				50	860		1.0	Sel.	84	6300.00	
	ML-3	B	200	20-20	0.2	0.2	AB2				15	1.3V		2.0	No	140	5250.00	
	ML-9	B	100	20-20	0.2	0.2	AB2				15	1.5V		2.5	No	65	2785.00	
	ML-11	B	50	20-20	0.5	0.5	AB2				15	633		1.0	No	36	1700.00	
MICRO-TRAK	10P	B	10	20-20	0.5		AB								No	6	229.00	
ONKYO	M-5060	B	120	20-20	0.005	0.005	AB						M		No	39.2	795.95	
	M-5090	B	200	20-20	0.01	0.01	AB					M		No	68.3	1799.95		
	A-65	I	100	20-20	0.015	0.015	AB	80	2.5	250	150		L	Yes	34.2	649.95		
	A-45	I	70	20-20	0.018	0.018	AB	80	2.5	200	150		L	No	21.6	449.95		
	A-35	I	55	20-20	0.02	0.02	AB	80	2.5	180	150		L	No	19.4	329.95		
	A-25	I	40	20-20	0.04	0.04	AB	75	2.5	180	150		M	No	14.3	234.95		
	A-15	I	30	20-20	0.08	0.08	AB	75	2.5	150	150		M	No	14.1	179.95		
PHASE LINEAR	DRS 900	B	150	10-80	0.015	0.009	AB+				100	800	M	4.8	No	38	1095.00	900 watts peak.
	DRS 400	B	50	10-80	0.015	0.009	AB+				100	500	L	6.0	No	21	695.00	400 watts peak.
	DRS 250	I/MC	50	10-80	0.015	0.009	AB+	79	0.625	150	100	150	L	6.0	No	23	975.00	As above.
SONTEK	P-1	B/K	75	20-20	0.1	0.1	AB				55	560		2.0	No			Toroidal transformer.
	B-1	I/K	100	10-20	0.1	0.1	AB					56		2.0	No		400.00	As above, with x-over for subwoofer.

## PREAMPLIFIERS

MANUFACTURER	Model	Unit Type: Kit = K, Tube = T, Mono = M, Stereo = S, Moving Coil Only = MC	Frequency Response, Hz to kHz, ±dB	Maximum Output, V	THD, %	IHF IM Distortion, %	Number of Tape Loops	MM Phono Sensitivity, mV for 0.5 v Output at 1 kHz	MM Phono S/N, dB	MM Phono Overload, mV	High Level Sensitivity, mV	Tone Controls?	Phono Input Capacitance, pF	Moving Coil Input?	Does Unit Invert Phase?	Weight, Lbs.	Price, \$	Notes	
																			MM Phono Sensitivity, mV for 0.5 v Output at 1 kHz
MARK LEVINSON	ML-6A	M	20-20 ±0, -1		0.01	0.01	0		86		No	Sel.	Sel.	Yes	No	18	6300.00	External power.	
	ML-7		20-20 ±0, -1		0.01	0.01	2		86		No	Sel.	Sel.	Yes	No	21	4725.00	As above.	
	ML-10		20-20 ±0, -1		0.02	0.02	1		86		No	Sel.	Sel.	Yes	No	18	2785.00		
	ML-12		20-20 ±0, -1		0.05	0.05	1		86		No	Sel.	Sel.	Yes	No	14	1200.00	For use with ML-11 amp only.	
MICRO-TRAK	6410	P/M	20-20 ±1	10	0.05	0.05	2	100	70		No	5	47k	No	No	2	194.00		
	6411	P	20-20 ±1	10	0.05	0.05	2	100	70		No	5	47k	No	No	2	229.00	Model 6411-CX, with CX circuitry, \$325.00.	
ONKYO	P-3060		0.8-170 +0, -3	20	0.004	0.004	2	2.5	330	82	150	Yes	Sel.	Sel.	Yes	Yes	15.8	549.95	
	P-3090		0.8-170 +0, -3	13	0.004	0.004	2	2.5	380	82	150	Yes	Sel.	Sel.	Yes	Yes	23.1	1249.95	
PHASE LINEAR	P 3800		10-100 +0, -3	10	0.003	0.002	2	0.625	200	85	150	Yes	Sel.	47k	Yes	Varies	14	750.00	
	P 3600		10-100 +0, -3	10	0.003	0.002	2	0.625	150	80	150	Yes	Sel.	47k	Yes	Varies	11	450.00	
PHOENIX SYSTEMS	P-10-MM	K	16-100 +0, -3	8	0.01	0.01	0	5	150	85	1V	No	100	47k	No	Sel.	5	99.00	IEC/RIAA selectable.
	P-10-MC	K	16-100 +0, -3	8	0.01	0.01	0	0.17	5	88	1V	No	200	Yes	Sel.	5	99.00	As above.	
SONTEK	C-1	K	4-100 +0, -3	10	0.005	0.01	1	0.80	185		80	Yes	Sel.	Sel.	No			Toroidal transformer.	

# TUNERS

MANUFACTURER	Model	F/D	Amp Section										Tuner Section				
			Unit Type: FM Only = F, Digitally Synthesized = D	Mono IHF Sensitivity, dbi	Stereo IHF Sensitivity, dbi	Capture Ratio, db	Alt. Chan. Selectivity, db, Wide/Narrow	Signal Strength for 50-dB Listening, dbi, Mono/Stereo	Number of Memory Presets	Separation, db, 1 KHz	Separation, db, 10 KHz	THD, %, Mono/Stereo, 1 KHz, 100% Modulation	THD, %, Mono/Stereo, 6 KHz, 100% Modulation	Maximum S/N, db, Mono/Stereo	Switchable De-emphasis?	Net Weight, Lbs.	Price, \$
CARVER	TX-11	F/D	11.3	16.3	1.0	90/35	16.1/21	16	45	36				82/85	No	11¼	549.00
NIKKO AUDIO	NT-500	D	10.8		1.5	60	14.7/36.1	0	45	35	0.1/0.2		75/65	No	9.9	180.00	
	NT-700	D	11.2		1.5	60	14.7/36.1	12	45	35	0.1/0.2		75/68	No	9.5	280.00	
	NT-990	D	11.2		1.5	60	14.8/40	12	50	40	0.1/0.2		75/65	Yes	9.9	320.00	
	Gamma 20	F/D	5.2		1.5	70	13.2/36	6	55	30	0.08/0.12		75/68	Yes	11	400.00	
	Gamma 40	F	5.2		1.0	80	13.2/36	0	55	45	0.02/0.04		86/78	Yes	13.2	450.00	
ONKYO	T-9060	F/D	10.3	17.2	1.0	80	14.7/36.1	14	45		0.05/0.13		81/73	Yes	12.3	489.95	
	T-35	D	9.8	17.2	1.0	80	14.7/36.1	14	40		0.08/0.15		80/72	Yes	8.4	379.95	
	T-25	D	10.8	17.2	1.5	60	16.1/36.1	12	40		0.15/0.25		73/65	No	7.5	249.95	
	T-15	D	11.2	17.2	1.5	55	18.3/39.2		40		0.15/0.4		70/63	No	8.4	139.95	
PHASE LINEAR	T 5200	D	10.8	25.0	1.0/2.5	40/85	15/37	12	55	48	0.03/0.05	0.03/0.1	90/85	No	11	495.00	
SEQUERRA	Model 1 Broadcast Analyzer	F	5.0	15.0	0.70	130/94	7.5/20.0		53	40	0.85/0.15	0.06/0.15	70/79	Yes	48	4500.00 w/Spectrum, Multipath & Vector Analyzer	

# RECEIVERS

MANUFACTURER	Model	F/D	Amp Section										Tuner Section					
			Unit Type: FM Only = F, Digitally Synthesized = D, CX Circuitry = C	Avg. Watts/Channel into 8 Ohms	THD, %	IHF IM, %	Rated Power Bandwidth, Hz to KHz	MM Phone S/N, db, A: Wild, Fe: 5 mV, per IHF A-202	MM Phone S/N, db, A: Wild, Fe: 5 mV, per IHF A-202	Dynamic Headroom, mv	Number of Memory Presets	IHF Sensitivity, dbi, Mono/Stereo	Capture Ratio, db	Mono Signal Strength for 50-dB Listening, dbi	Stereo Signal Strength for 50-dB Listening, dbi	THD, %, 100% Modulation, 1 KHz, Mono/Stereo	All Chan Select, db, Wide/Narrow I.F. Bandwidth	Max. S/N, db, Mono/Stereo
NIKKO AUDIO	NR-320	D	28	0.08	0.08	15-30	75	140	0	11.2/	1.5	13.2	35.2	0.1/0.2	55	70/75	12.8	240.00
	NR-700	D	40	0.04	0.04	10-35	75	150	12	11.2/	1.5	14.7	20.3	0.2/0.3	60	70/60	18.7	400.00
	NR-800	D	50	0.04	0.04	10-35	80	150	12	11.2/	1.5	14.7	20.3	0.2/0.3	60	70/60	19.8	480.00
	NR-1000	D	65	0.03	0.03	10-50	88	150	12	10.9/	1.5	14.7	15.5	0.1/0.2	60	70/60	22.4	550.00
	NR-520	D	30	0.05	0.05	15-35	75	100	12	11.2/	1.5	14.0	20.0	0.1/0.2	60	75/65	13.7	300.00
ONKYO	TX-61	D/C	60	0.025	0.025	20-20	76	200	16	10.3/17.2	1.3	14.7	37.2	0.12/0.2	70	75/70	28.6	539.95
	TX-51	D/C	43	0.04	0.04	20-20	76	180	16	10.8/18.3	1.5	17.2	37.2	0.15/0.25	60	72/67	20.9	399.95
	TX-41	D	33	0.06	0.06	20-20	75	110	16	11.2/19.2	1.5	17.2	37.2	0.15/0.3	55	71/66	17	299.95
	TX-31	D	45	0.04	0.04	20-20	75	180	16	11.2/19.2	1.5	17.2	37.2	0.15/0.3	60	72/66	18.7	349.95
	TX-21	D	30	0.06	0.06	20-20	75	110	16	12/19.2	1.5	18.3	39.2	0.2/0.4	55	71/66	14.5	249.95
	TX-11	D	20	0.08	0.08	40-20	73	100	16	13.2/19.2	1.8	19.2	41.0	0.3/0.5	50	70/65	12.8	199.95

# TURNTABLES

MANUFACTURER	Model	Wow & Flutter, %, 33 1/3 rpm, DIN 45-507	Rumble, -db, DIN 45-539-B	Motor Type	Drive System	Speed Accuracy, ±%										Straight-Line Tracking Arm?	Controls Outside Dustcover?	Prior Stylus Distance, Inches	Multi-Play, No. of Discs	Auto Cue = C, Auto Return = R, Programmable Play = P	Max. Tracking Error, Degrees/Inch	Anti-Skating Adjustment?	Recommended Tracking Force Range, Grams	Total Cable Capacitance, pF	Damped Cuing?	Dimensions, Inches, Incl. Dustcover	Price, \$
						Speed Inaccuracy, ±%	Speed Adjustment Range, ±%	Speed Accuracy, ±%																			
NIKKO AUDIO	NP-500 NP-800	0.08 0.035		4-Pole Sync. F.G. D.C. Servo	Belt Direct	0 6	No Strobe	No No	Yes Yes	8½ 8½	No No	C/R C/R		Yes Yes				Yes Yes	16½ x 14¼ x 5¼ 16½ x 14¼ x 5¼		120.00 200.00						
ONKYO	CP-1000A	0.08	62	A.C. Sync. D.C. Servo	Belt Direct	3	LED	No	Yes	8¼	No	R		Yes				Yes	16½ x 5½ x 15½		124.95						
	CP-1017A	0.028	70	D.C. Servo	Direct	3	LED	No	Yes	8¼	No	R		Yes				Yes	16½ x 5½ x 15		159.95						
	CP-1027F	0.028	72	D.C. Servo	Direct	3	LED	No	Yes	8¼	No	C/R		Yes				Yes	16½ x 5½ x 15		185.95						
	CP-1028R	0.028	72	D.C. Servo	Direct	3	LED	No	Yes	8¼	No	C/R/P		Yes				Yes	16½ x 5½ x 14¾		259.95						
	PL-33	0.027	72	D.C. Servo	Direct	3	LED	No	Yes	8¼	No	C/R		Yes				Yes	13 x 5 x 13¼		289.95						
	CP-1130F	0.025	72	D.C. Servo	Direct	3	LED	No	Yes	8¼	No	C/R		Yes				Yes	16½ x 5½ x 15		249.95						
CP-1150F	0.025	75	D.C. Servo	Direct	6	LED	No	Yes	8¼	No	C/R		Yes				Yes	16½ x 5½ x 15		329.95							
CP-1260F	0.025	75	D.C. Servo	Direct	6	LED	No	Yes	9¾	No	C/R		Yes				Yes	18½ x 6¾ x 16½		359.95							
PHASE LINEAR	8000 A	0.013	78	Quartz PLL Hall	Direct	0.002	No	LED	No	Yes	7½	No	C/R	0.2	No	0.5-4	180	Yes	19½ x 6½ x 17½		650.00						

# LOUDSPEAKERS

MANUFACTURER	Model	Enclosure or System Type	Woofer Diameter, Inches	Midrange Diameter, Inches	Midrange Type	Tweeter Diameter, Inches	Tweeter Type	Separate Level Control W. Woofer, W = Woofers, T = Tweeter, ST = Superwoofer	Acoustic Freq. Response, Hz to kHz, ±dB	SPL/1 Watt/1 Meter, dB	Recommended Min. Amp. Pwr., Watts	Crossover Frequencies, Hz	Impedance Ohms, Nominal/Minimum	Dimensions, Inches	Finish	Grille Color and Material	Weight, Lbs.	Price, \$
AUDIOQUEST	AQ Little Guy	Inf. Baf.	6½			2	Cone	T		86	15			17 x 10 x 8	Oak	Brown Cloth		450.00
	AQ Big Guy	Inf. Baf.	8			(2)2	Cones			90	15			38 x 11 x 12	Oak	Brown Cloth		650.00
AVID AUDIO	60ab	Ac. Sus.	6½			1	Dome		70-20 +0, -3	87	15	3.5k	8	14 x 8¾ x 8	Wood Vinyl	Brown Cloth	11	210.00
	80ab	Ac. Sus.	8			1	Dome		53-20 +0, -3	88	15	3k	8	19½ x 12 x 8¾	Wood Vinyl	Brown Cloth	18	270.00
	102ab	Ac. Sus.	10			1	Dome		43-20 +0, -3	89	15	2.5k	8	25 x 15 x 10½	Wood Vinyl	Brown Cloth	35	378.00
	232ab	Bass Ref.	10	4½	Cone	1	Dome		40-20 +0, -3	90	15	650,5k	8	28 x 15 x 10¾	Wood Vinyl	Brown Cloth	42	550.00
JRM	Transparency Sat. Tower	Vented, Triamped	(16)5	4	Horn/Lens	1½	Ring	W, M, T	150-20 ±3		100, (2)7k	150, 800, 7k	Sel.	50 x 14½ x 8	Opt.	Opt.		1200.00
	Transparency Subwoofer	Vented Subwoofer	18					W	24-150 ±3		150	150	8.5	24 x 36 x 24				450.00
PENTAGRAM	P-10	Pas. Rad.	10	2	Dome		Leaf Rbn.	No	24-20 ±1	90	35	450, 5.5k	7.5	34½ x 25½ x 23½	Opt.	Black Cloth	85	1600.00
SONTEK	W-1	Subwoofer	(2)15						30-250			Sel.	4	21½ x 21½ x 32	Oak			350.00

# TONEARMS

MANUFACTURER	Model	Overall Length, Inches	Pivot-Stylus Distance, Inches	Cueing?	Straight-Line Tracking Arm?	Removable Headshell = HS, Changeable Arm Tube = CA	Maximum Tracking Error, Degrees/Inch	Anti-Skating Adjustment?	Adjustable Vertical Tracking Angle?	Recommended Tracking Force, Grams	Total Cable Capacitance, pF	Cartridge Weight Range, Grams	Vertical Bearing Type	Lateral Bearing Type	Price, \$	Notes
MICRO-TRAK	303	12½	8¾	No	No	HS	2, 1¼	†	Yes	½-10	50	0-12			137.00	†Fluid type anti-skate.
	306	14%	10%	No	No	HS		†	Yes	½-10	50	0-12			166.00	

# HEADPHONES

MANUFACTURER	Model	Operating Principle	Frequency Range, Hz to kHz	Impedance, Ohms	Sensitivity, dB SPL for 1 mV Input	Maximum Input, mV	THD at 95 dB SPL, %	Cord Length, Feet	Cord Style: Flat = F, Coiled = C	Weight, Ounces	Circumaural = C, supra-aural = S	Adjustable Headband?	Individual Volume Controls?	Cover Material on Ear Cup	Price, \$	Notes	
ONKYO	HP-L1	Dyn.	20-20	32	96	100		5	F	0.9					29.95		
	HP-L2	Dyn.	20-20	32	101	100		†	F	1.0					39.95	†4.9.8.	
	HP-L3	Dyn.	20-20	32	103	100		†	F	1.2					49.95		
SIGNET	TK11	Dyn.	30-20	4-16	93 @ 1 kHz		0.6†	4.9	F	1.9	S	Yes	No	Foam		†At 110 dB SPL; mini plug.	
	TK20	Dyn.	25-20	4-16	100 @ 1 kHz		0.5†	4.9	F	1.6	S	Yes	No	Foam		As above, folding headband.	
	TK33	ES	10-22.5	4-16	††		0.1†	8.2	F	7.4	S	Yes	No	Vinyl		††100 dB for 1 V; matching impedance adaptor.	
	TK22	Dyn.	20-20	4-16	96 @ 1 kHz		0.4†	11.5	F	7.2	S	Yes	No	Knit			
SONY	MDR-E22	Dyn.	20-20	25	95	1V		¾	F	½		†		No	None	24.95	†Fits in ear; mini plug.
	MDR-E252	Dyn.	20-20	18	108	1V		¾	F	1.0		†	No	None	29.95	As above.	
	MDR-20T	Dyn.	20-20	25	100	1V		½	F	¾		Yes	No	Foam	19.95	Phone/mini plug.	
	MDR-30T	Dyn.	18-20	25	100	1V		½	F	¾		Yes	No	Foam	29.95	As above.	
	MDR-A30L	Dyn.	18-20	25	100	1V		¾	F	1		Yes	No	Foam	34.95	As above; folding headband.	
	MDR-40T	Dyn.	18-22	55	101	1V		½	F	1		Yes	No	Foam	39.95	Phone/mini plug.	
	MDR-50T	Dyn.	18-22	55	101	1V		½	F	1.6		Yes	No	Foam	49.45	As above.	
	MDR-70T	Dyn.	16-22	55	101	1V		½	F	1.6		Yes	No	Foam	64.95	As above.	
	MDR-80T	Dyn.	16-24	45	106	1V		½	F	2.1		Yes	No	Foam	84.95	As above.	

# PHONO CARTRIDGES

MANUFACTURER	Model	Frequency Response, Hz to kHz, ±dB	Stylus Type		Price: Mono Iron Mt. Induced Magnet IM, Moving Coil MC, Moving Magnet = MM	With Individual Response Curve?	Channel Separation, 1 kHz, dB	Output, mV, 1 kHz, dB	Recommended Tracking Force, Grams	Recommended Load Resistance, Ohms	Stylus Type—See Code	Stylus Radius (Radius), Mils	Stylus Replacement: User = U, Factory = F	Compliance, μm/mN, Vertical/Lateral	Weight, Grams	Price, \$	Replacement Stylus Price, \$
			C—Conical	S—Spherical													
AUDIOQUEST	AQ 404	10-50	MC	Yes	25		2	47k				F	8/8	6	225.00	112.50	
	AQ 505	10-50	MC	Yes	25		2	0.23				F	8/8	6	225.00	112.50	
	AQ 808	10-50	MC	Yes	25		2	2.5				F	8/8	6	450.00	225.00	
	AQ 909	10-50	MC	Yes	25		2	0.23		X		F	8/8	6	450.00	225.00	
GROOV-DANCER	IM+	15-40	IM	No	20		2	47k	100	E		U	7/7	5.5	85.00	40.00	
	MC+	15-35	MC	No	25		2	47k		E		U	8/8	4	135.00	67.50	

# OPEN-REEL TAPE DECKS

MANUFACTURER	Model	Speeds—See Letter Code	Maximum Reel Size, Inches	Number of Heads	Number of Tracks	Number of Channels	Number of Motors	Drive Motor Type	Drive to Capstan	Freq. Resp. Hz, kHz, ±dB, with Best Tape at Highest Speed	Wow & Flutter, Wtd. Peak, %	S/N, dB	Output Level at 0 VU, mV	Noise Reduction: Dolby B = B, Dolby C = C, dbx = D	Mike Input, Ω, Ohms	Record Level Indicator(s), Type and Quantity	EE Tape Capable?	Dimensions, Inches	Weight, Lbs.	Price, \$	Notes
MARK LEVINSON	ML-3	†	12½	3	2	2	3	A.C. Servo Sync.	30-25 ± 1.5	0.04	385	No	No					25 x 21.8 x 10.8	120	14,000.	†15-30 ips; built on Studer A80RC transport.
	ML-5A	†	12½	3	2	2	3	A.C. Servo Sync.	30-25 ± 1.5	0.04	385	No	No					25 x 21.8 x 10.8	120	25,000.	Extensive modification of A80RC transport, completely phase coherent.

# CASSETTE DECKS

MANUFACTURER	Model	Frequency Response with Best Tape, Hz to kHz, ±dB	Number of Heads	Wow & Flutter, Wtd. Peak, %	S/N with Noise Reduction, dB	Noise Reduction Circuit: Dolby B = B, Dolby C = C, dbx = D	Continuously Adjustable Bias?	No. Preset Bias/EO Positions	Mike-Line Mixing	Variable Pitch Control, %	Random Access Music Search?	Peak Level Indicators?	Dimensions, Inches	Weight, Lbs.	Price, \$	Notes
NIKKO AUDI	ND-700 II	30-18 ± 3	2	2	0.055	91	B/D	No	3	No	No	No	17¼ x 4¾ x 11¼	10.3	320.00	One-touch record system.
	ND-620	30-18 ± 3	2	2	0.045	72	B	No	3	No	No	No	17¼ x 4¾ x 10¾	8.6	240.00	
	ND-800	30-20 ± 3	2	2	0.05	72	B	No	3	No	No	No	17¼ x 4¾ x 11¼	11	380.00	
	ND-1000	30-20 ± 3	3	3	0.05	72	B	No	3	No	Yes	Yes	17¼ x 4¾ x 11¼	11	580.00	
	ND-520	30-18 ± 3	2	2	0.05	72	B	No	3	No	No	Yes	17¾ x 4¾ x 11	8.2	200.00	
ONKYO	TA-2070	20-19 ± 3	3	3	0.021	80	B/C	Yes	3	2		Yes	17½ x 3⅞ x 15¾	20.9	699.95	†Dolby HX.
	TA-2060	20-19 ± 3	3	3	0.04	70	B†	Yes	3	2		Yes	16½ x 4¾ x 13	14.3	469.95	
	TA-2055	20-18 ± 3	2	2	0.035	80	B/C	Yes	3	2		Yes	16½ x 3⅞ x 14¾	14.8	359.95	
	TA-2035	30-17 ± 3	2	2	0.045	80	B/C	Yes	Auto	2		Yes	16½ x 3⅞ x 10¾	9.9	299.95	
	TA-2025	30-16 ± 3	2	2	0.045	70	B		3	2	Yes	Yes	16½ x 3⅞ x 10¾	9.9	254.95	
	TA-2015	30-16 ± 3	2	2	0.060	78	B/C		3	2		Yes	16½ x 4⅞ x 10¾	10.1	209.95	
	TA-W88	30-16 ± 3	2	2	0.06	68	B		3	2		Yes	16½ x 4¾ x 10¾	14.3	379.95	

# MICROPHONES

MANUFACTURER	Model	Directional Pattern	Operating Principle	Case Material	Most Common Use	Actual Impedance, 1 kHz, Ohms	Operating Range, Hz to kHz	Open-Circuit Sens., 1 kHz, dB, re: 1 Volt/1 μbar	Mike Connector Type	Cable Length, Feet	Connector Type on Equipment End of Cable	Dimension, inches, Length x Diameter	Weight, Ounces	Mounting Method	Wide Speech = W, On Off Switch = S, Switched Low or Proximity Filter = F	Price, \$	Notes
CROWN	3LVR	PZM	Elect.	Carbon Fiber	Studio	150	76	(2) A3F	10	(2) TA4F	2½ x ½		Tie Clip		399.00	Fail-safe pair.	

# MICROPHONES

MANUFACTURER	Model	Directional Pattern	Operating Principle	Case Material	Most Common Use	Actual Impedance	Operating Range - 1 Mhz. Ohms	Operating Range - Hz to Mhz	Open-Circuit Sens. - 1 Mhz. - dB re: 1 Volt/1 uBar	Mike Connector Type	Cable Length, Feet	Connector Type on Equipment	Dimension - Inches: Length x Diameter	Weight - Ounces	Mounting Method	Wind Screen = W, On/off Switch = S, Switched Low or Proximity Filter = F	Price, \$	Notes
SDNY	F-V2A	Card.	Dyn.	Alum.	Speech	600	100-12		Att.	9 1/2	†	5 1/2 x 1 1/4	3	Desk			21.95	†Phone/mini plug.
	F-V3T	Card.	Dyn.	Alum.	Speech	600	100-12		Att.	9 1/2	†	7 1/4 x 2 1/8	6.4	Desk			29.95	
	F-V4T	Card.	Dyn.	Alum.	Vocal	600	90-13		Att.	17	†	7 1/4 x 1 1/8	4	Desk			39.95	
	F-99T	Stereo	Dyn.	Alum.	Vocal/Instr.	Low	80-12		Att.	17	†						39.95	
	F-V7ET	Card.	Dyn.	Alum.	Vocal	500	100-12		Att.	17	†	8 1/4 x 1 1/8	4	Desk			59.95	
	ECM-16T	Card.	Dyn.	Alum.	Speech	Low	50-13	56††	Att.	6	†	5/8 x 3/8	1.8	Tie Clip	WS		39.95	††At 1 V/10 microbars.
	ECM-150	Omni	Elect.	Alum.	Speech	250	40-13		Att.	6 1/2	†	5/8 x 3/8	2.8	Tie Clip			65.00	
	ECM-220T	Card.	Elect.	Alum.	Instr. Gen.	600	50-14		Att.	17	†	1 x 4 x 3	7.5	5/8 x 27 Sel.	S		49.95	Opt. remote.
	ECM-929LT	Var. Stereo.	Elect.	Alum.	Gen.	Low	70-15		Att.	4 1/2	†		2.9		S		85.00	
	ECM-939T	Var. Stereo.	Elect.	Alum.	Gen.	Low	50-15	57.6††	Att.	6	†	5 x 5/8	2.6	5/8 x 27 Sel.	WS		115.00	As above, with stand.
ECM-23F	Card.	Elect.	Alum.	Gen. Video/Speech	250	20-20	56††	XLR-3	20		XLR-3	7 1/2 x 1 1/4	6.7	5/8 x 27 WF		115.00		
ECM-Z300	Var.	Elect.	Alum.		Low											150.00		

# EQUALIZERS

MANUFACTURER	Model	No. of Channels	No. of Bands	Bandwidth, Octaves	Boost/Cut Range, ±dB	Switched Tape EQ?	Unity Gain Control?	Rated Output, rms V	THD at Rated Output, %	S/N, dB, at Rated Output, A, W/O	Variable Center Frequencies?	Pink Noise Generator?	With Calibrated Mikes?	Dimensions, Inches	Weight, Lbs.	Price, \$	Notes
NIKKO AUDIO	EQ-20	2	10	1/3	12	Yes	Yes	1	0.007	100	No	No	No	19 x 3 3/8 x 9 1/8	11	300.00	
	EQ-500	2	6		12	Yes	No	1	0.01	100	No	No	No	17 1/4 x 3 3/4 x 13	9.2	200.00	
DNKYO	EQ-08	1	10	1	12	Yes	No	1.5	0.01	100	No	No	No	16 1/2 x 3 1/8 x 10 1/4	6.8	179.95	
PHOENIX SYSTEMS	P-94-S	2	2	1.6-2	20	No	No	8	0.01	100	Yes	Yes	No	11 x 2 3/8 x 5 3/4	3.3	99.00	Kit, "Q" volume compensation.

# NOISE-REDUCTION UNITS

MANUFACTURER	Model	NR Type	Function: Coded Loop = C, Open Loop = O, Transient = T	Application: Tape Rec. = R, Phono = P, FM = F, Video = V, Universal = U	Simultaneous Encode/Decode?	Degree of Noise Reduction, dB @ Hz	Record = R, Play = P, Both = RP	THD, %	Frequency Response, Hz to 10 KHz, ±dB	Price, \$	Notes
MICRO-TRAK	CX11P	CX	C	P	No		P	0.05	20-20 ±1	325.00	

# CAR STEREO DIRECTORY

# CAR RADIOS/TAPE PLAYERS

MANUFACTURER	Model	Price, \$	Stereos (S) Mono (M), or 4 Channel (4)	FM Sensitivity, ±V (For 30-dB Quieting)	Selectivity, dB	Preamp Output?	Average Watts/Channel, per IEC P-202	Amplifier S/N Ratio, dB	% THD at Rated Output	Loud/Distance Switch?	Total Number of Presets	Separate Tone Controls?	Cassette (C), 8-Track (8)	Auto Reverse?	Noise Reduction Circuit? See Code	Bias EQ Switch?	Fast Tape Speeds?	In-Dash (I), Under-Dash (U), Convertible (C)	Dimensions, Inches
CLARION (Continued)	PE959A MK II	729.00	S	12	70	Yes	Ext.		Auto	10	Yes	C	Yes	B	Yes	I		7 x 2 1/8 x 7 1/4	

# CAR RADIOS/TAPE PLAYERS

MANUFACTURER	Model	Price, \$	Stereo (S), Mono (M), or 4-Channel (4)	FM Sensitivity, $\mu$ V (For 30-dB Quieting)	Selectivity, dB	Preamplifier?	Average Watts/Channel, per IHP A-202	Amplifier S/N Ratio, dB	% THD at Rated Output	Local/Distance Switch?	Total Number of Presets	Separate Tone Controls?	Cassette (C), 8-Track (8)	Auto Reverses?	Noise Reduction Circuit?	Bias/EQ Switch?	Fast Tape Speeds?	In-Dash (I), Under-Dash (U), Convertible (C)	Dimensions, Inches		
																				NR Code A = dbx B = Dolby C = National Semi.	
CLARION (Continued)	9300T	409.00	S	12	70	Yes	Ext.													7 1/4 x 2 x 5 1/2	
	7500R	329.00	S	12	70	No	12	5.0	Auto	10	Yes	C	Yes	B	Yes					7 1/4 x 2 3/4 x 5 1/2	
	5700R	309.00	S	12	70	No	3.2	5.0	Auto	10	Yes	C	No		Yes					7 1/4 x 2 x 5 1/2	
	5550R	229.00	S	12	70		6	5.0	Auto	10	Yes	C	No		Yes					7 x 1 1/4 x 5 1/2	
	5500R	229.00	S	12	70		6	5.0	Auto	5	Yes	C	No		Yes					7 1/4 x 2 x 5 1/2	
	5300R	229.00	S	12	70		6	5.0	Auto	0	Yes	C		B	Yes					7 1/4 x 2 x 5 1/2	
	5150R	179.00	S	12	65		6	5.0	Auto	0	Yes	C			Yes						6 3/4 x 1 1/4 x 5 1/2
	5100R	179.00	S	12	65		6	5.0	Yes	0	Yes	C	No		Yes						7 1/4 x 2 x 5 1/2
	3700R	169.00	S	13	65		6	5.0	Yes	5	Yes	C	No		No						7 1/4 x 2 x 5 1/2
	3550R	159.00	S	13	65		6	5.0	Yes	0	Yes	C	Yes		No						6 3/4 x 1 1/4 x 5 1/2
	3500R	159.00	S	13	65		6	5.0	Yes	0	Yes	C	Yes		No						7 1/4 x 2 x 5 1/2
	3150R	109.00	S	13	65		6	5.0	Yes	0	Yes	C	No		No						6 3/4 x 1 1/4 x 5 1/2
	3100R	109.00	S	13	65		6	5.0	Yes	0	Yes	C	No		No						7 1/4 x 2 x 5 1/2
	2500R	299.00	S	12	70		6	5.0	Yes	5	Yes	C	Yes	B	No						7 1/4 x 3 1/4 x 5 1/2
	2100R	139.00	S	13	65		6	5.0	Yes	0	Yes	C	No		No						7 1/4 x 3 1/4 x 5 1/2
CRAIG	S611	99.95	S	3.8 @ 50dB	50	No	4	65	1.5	Yes	0	Yes	B	No	No	No	No	I		6 1/2 x 1 3/4 x 4 3/4	
	T500	99.95	S	5.8 @ 50dB	60	No	3.5	65	1	Yes	0	Yes	C	No	No	No	Yes	I		6 1/4 x 1 3/4 x 4 3/4	
	T501	129.95	S	3.8 @ 50dB	60	No	4	60	1.0	Yes	0	Yes	C	Yes	No	No	Yes	I		6 3/4 x 1 3/4 x 4 3/4	
	T530	189.95	S	2.8 @ 50dB	60	No	4	60	2.0	Yes	5	Yes	C	Yes	No	No	Yes	I		6 1/4 x 1 3/4 x 4 3/4	
	T531	189.95	S	6.5 @ 50dB	70	Yes	4	64	1.0	Yes	5	Yes	C	Yes	No	No	Yes	I		6 1/4 x 2 x 4 3/4	
	T560	279.95	S	3.3 @ 50dB	65	Yes	4	60	2.0	Yes	0	Yes	C	Yes	B	Yes	Yes	I		6 1/4 x 1 3/4 x 4 3/4	
	T610	154.95	S	9.4 @ 50dB	60	No	4	60	1.0	Yes	0	Yes	C	No	No	No	Yes	I		7 1/2 x 2 x 5 1/4	
	T614	154.95	S	6.3 @ 50dB	60	Yes	4	60	1.0	Yes	0	Yes	C	Yes	No	No	Yes	I		7 1/2 x 2 x 5 1/2	
	T617	149.95	S	4.4 @ 50dB	60	No	4	60	1.0	Yes	0	Yes	C	Yes	No	No	Yes	I		7 1/2 x 1 3/4 x 5 1/2	
	T618	189.95	S	3.4 @ 50dB	60	Yes	4	60	1.0	Yes	0	Yes	C	Yes	No	No	Yes	I		7 1/2 x 1 3/4 x 5 1/2	
	T619	279.95	S	5.0 @ 50dB	65	Yes	8	56	1.5	Yes	0	Yes	C	Yes	B	Yes	Yes	I		7 1/2 x 2 x 5 1/2	
	T622	89.95	S	5.8 @ 50dB	60	No	3.5	65	1.2	Yes	0	Yes	C	No	No	Yes	Yes	I		7 x 1 3/4 x 4 1/2	
	T623	79.95	S	5.0 @ 50dB	60	No	4	55	5	Yes	0	Yes	C	No	No	No	Yes	I		7 x 1 3/4 x 4 3/4	
	T624	129.95	S	3.0 @ 50dB	60	No	4	60	0.8	Yes	0	Yes	C	Yes	No	No	Yes	I		7 1/2 x 1 3/4 x 4 3/4	
	T640	169.95	S	2.9 @ 50dB	60	No	4	60	2.0	Yes	5	Yes	C	Yes	No	No	Yes	I		7 1/2 x 2 x 5 1/2	
	T641	219.95	S	4.5 @ 50dB	60	Yes	4	60	1.5	Yes	5	Yes	C	Yes	No	No	Yes	I		7 1/2 x 2 x 5 1/2	
	T687	599.95	S	5.0 @ 50dB	60	Yes	12.5	50	0.1	Yes	10	Yes	C	Yes	B	Yes	Yes	I		7 1/4 x 2 3/4 x 5	
	T690	299.95	S	8.7 @ 50dB	65	Yes	12	64	0.9	Yes	5	Yes	C	Yes	B	Yes	Yes	I		7 1/2 x 2 x 6	
	T691	189.95	S	6.8 @ 50dB	65	No	12	60	2.1	Yes	0	Yes	C	No	No	No	Yes	I		7 x 1 3/4 x 5 1/2	
T692	249.95	S	6.8 @ 50dB	65	Yes	12	60	2.1	Yes	0	Yes	C	Yes	B	No	Yes	I		7 x 1 3/4 x 5 1/2		
T693	449.95	S	2.3 @ 50dB	50	Yes	12	55	1.5	Yes	12	Yes	C	Yes	B	Yes	Yes	I		7 1/2 x 2 x 6		

# CAR SPEAKERS

MANUFACTURER	Model	Price, \$ (If Sold Individually)	Price, \$ (If Sold in Pairs)	Recommended Max. Power, Watts	Woofer Size, Inches	Impedance, Ohms	Frequency Response, Hz to kHz, $\pm$ dB	Whizzer (W), 2-Way (2), 3-Way (3), 4-Way (4)	Five Mount (F), Six Mount (S), Composite (C)	Dimensions, Inches	Notes
ALTEC LANSING	TK-1	79.95	4C				5k-18k $\pm$ 4		S	3 1/2 Dia.	Front-mount control.
	SK-1	112.95	80	5/4	4	100-10 $\pm$ 5		S	5 1/2 Dia.		
	SW-1	239.95	40	6 x 9	1k	30-150 Hz $\pm$ 4		C	6 1/2 x 9 3/8		
	AL-1	389.95	80	6 x 9	4/1k	30-18 $\pm$ 5	3	S	Five Pieces		
	6 x 9-4A Duplex	169.95	100	6 x 9	4	80-18 $\pm$ 6	2	S	6 1/2 x 9 3/8		
	6 x 9-4B Super Duplex	239.95	150	6 x 9	4	60-18 $\pm$ 5	2	S	7 1/8 x 9 3/8		
6 x 9-4C Duplex II	119.95	100	6 x 9	4	90-16 $\pm$ 6	2	S	7 1/4 x 9 3/8			
SK-2 Duplex	119.95	100	5 1/4	4	100-18 $\pm$ 6	2	C	5 3/4 Dia.			
B & W	LM-1 DM	265.00		4	8/6	80-16 $\pm$ 4	2			9 1/2 x 6 x 7 3/4	
CLARION	SD5000	189.00	60	6 x 9	4	70-20 $\pm$ 6	3	S	6 x 9 x 3	Omnidirectional, twin direct-radiating midrange and tweeter.	
	SD1000	179.00	120	6 x 9	4	45-20 $\pm$ 6	3	F	6 x 9 x 3 1/4		
	SK107	79.00	63	7	4	30-2 $\pm$ 6		F	7 x 3		
	SK99B	139.00	25	5	8	80-20 $\pm$ 6	3	F	6 x 9 x 2		
	SD980	119.00	80	6 x 9	4	70-20 $\pm$ 6	3	F	6 x 9 x 3 1/4		
	SD970	89.00	60	6 x 9	4	65-16 $\pm$ 6	2	F	6 x 9 x 3 1/4		
(Continued)	SD630	99.00	60	6 1/2	4	70-18 $\pm$ 6	3	F	6 1/2 x 2 3/4		

# CAR SPEAKERS

MANUFACTURER	Model	Price, \$ (If Sold Individually)	Price \$ (If Sold in Pairs)	Recommended Max. Power Watts	Woofer Size, Inches	Impedance, Ohms	Frequency Response, Hz to kHz, ±dB	Whizzer (W) 2-Way (2), 3-Way (3), 4-Way (4)	Flush Mount (F) Surface Mount (S) Convertible (C)	Dimensions, Inches	Notes
CLARION (Continued)	SD620	69.00	40	6 1/2	4	90-17 ± 6	2	F	F	6 1/2 x 2 1/4	
	SD610	39.00	40	6 1/2	4	80-18 ± 6	2	F	F	6 1/2 x 2 1/4	
	SD520	59.00	30	5	4	90-18 ± 6	2	F	F	5 x 1 3/4	
	SD500	39.00	30	5	4	200-10 ± 6	2	F	F	5 x 1 3/4	
	SD420	59.00	30	4	4	130-18 ± 6	2	F	F	4 x 1 7/8	
	SD410	39.00	30	4	4	120-20 ± 6	2	F	F	4 x 1 7/8	
	SD310	19.00	20	3 1/2	4	150-12 ± 6	2	F	F	3 1/2 x 1 5/8	
CRAIG	V240	29.95	25	20	4	80-15		F	F	4 3/8 x 10 1/8	
	V251	59.95	25	6 x 9	4	60-17 ± 6	3	F	F	6 3/8 x 9 1/4	
	V300A	25.95	15	3 1/2	6	130-80 ± 6		F	F	3 1/2 Dia.	
	V301	39.95	15	4	6	120-20		F	F	4 Dia.	
	V302	39.95	15	5 1/2	6	110-13.5 ± 8		F	F	5 1/2 Dia.	
	V305	49.95	25	6 1/2	8	70-17 ± 9		F	F	6 1/4 Dia.	
	V322	55.95	20	4	6	120-20 ± 8	2	F	F	4 1/8 Dia.	
	V323	59.95	25	6 1/2	6	70-21.5 ± 9	2	F	F	6 1/4 Dia.	
	V341	37.95	15	4 x 6	6	100-21 ± 6		F	F	4 x 6	
	V351	84.95	25	6 x 9	6	60-22 ± 10	3	F	F	6 3/8 x 9 1/4	
	V360	49.95	25	4 x 10	8	70-21 ± 5	2	F	F	4 3/8 x 10 1/8	
	V363	69.95	25	6 x 9	6	60-23 ± 9	2	F	F	6 3/8 x 9 3/8	
	V380	55.95	20	6	6	170-9.3 ± 8		S	F	9 1/4 x 7 1/2 x 6	
	V104	25.95	8	4	4	130-15 ± 6		F	F	4 1/4 x 4 1/8	
	V105	29.95	8	6 1/2	4	70-17 ± 10		S	C	6 1/4 Dia.	
	V180	28.95	7	3 x 5	4	140-15		S	C	7 x 3 1/2 x 4	
	V191	35.95	10	5 1/4	4	†		S	C	6 1/8 x 6 1/2 x 4 3/4	
	V203	37.95	10	6 1/2	6	80-17.5 ± 8		F	F	6 1/4 Dia.	

†Surface, 250 Hz to 16 kHz, ± 6 dB; flush, 95 Hz to 16 kHz, ± 6 dB.

# CAR EQUALIZERS & AMPLIFIERS

MANUFACTURER	Model	Price, \$	Amp	Amp-EQ-Equalizer: Both = Both, Pre = Preamp	Number of EQ Bands	Separable Controls for Each Stereo Channel?	Boost/Cut Range, ±dB	S/N Ratio, dB	Watts into 4 Ohms, per IHR A-202	% THD at Rated Output, per IHR A-202	Dimensions, Inches	Notes
CLARION	400A	59.00	Amp		No		75	13.5	1.0	4 3/4 x 1 1/2 x 6 3/8		
	800A	109.00	Amp		No		75	27	1.0	5 1/2 x 1 1/2 x 6 3/8		
	1800A	289.00	Amp		No		80	15	1.0	7 3/8 x 2 3/4 x 11 3/8		
	500E	49.00	EQ	5	No	12	80			4 3/4 x 1 3/4 x 2 5/8		
	100EQ84	89.00	Both	5	No	12	75	15	1.0	5 1/2 x 1 7/8 x 5 1/8		
	300EQ83	189.00	Both	5	No	12	75	33	1.0	6 3/8 x 1 7/8 x 6 3/8		
CRAIG	V507	79.95	Both	7	No	12	80	15	5.0	5 7/8 x 1 1/4 x 4 1/4		
	R501	49.95	Amp				75	15	3.0	6 7/8 x 1 7/8 x 4 1/8		
	R502	89.95	Amp				75	25	1.0	8 1/2 x 2 3/8 x 5 3/8		
	R510	149.95	Amp				75	30	1.0	8 3/4 x 3 1/8 x 6 3/4		
	R511	199.95	Amp				75	50	1.0	10 x 3 x 6 3/4		
	R550	99.95	EQ	5		12	75		0.03	6 1/4 x 1 3/4 x 4 3/4		
	R551	169.95	EQ	7	No	12	75		0.03	6 1/4 x 1 3/4 x 4 3/4		

## All styli are not created equal.



When you select a phono cartridge, the cost will be strongly influenced by which stylus design you choose. Least expensive is the UniRadial (spherical or conical). A simple design, simply made. Or you can opt for better high frequency tracing with a BiRadial (elliptical) tip. Its more complex shape takes longer to make, so costs more. Best performance comes with a Line Contact (Shibata) tip whose shape permits the best high frequency tracing, yet whose long, narrow bearing face reduces groove pressure for longer record and stylus life. Add a positively-indexed square shank, plus laser-beam alignment of micro-polished surfaces and you have the finest stylus design available today. Make your choice with Audio-Technica. You'll hear the difference.



Enter No. 31 on Reader Service Card

# HOW COULD A CASSETTE DECK WITH TWO HEADS BE SO HARD TO GET?



The Kyocera D-801 Cassette Deck is hard to get because so much more is built into it. For example, it has five circuit boards where most decks have only one or two. But that's only the beginning.

## It more than meets the ultimate tape deck challenge.

The challenge is to move tape across the heads at as nearly a constant speed as possible. Variations in speed, of course, come out in your speakers or headphones as wow and flutter.

Many decks claim a wow and flutter figure of 0.05% WRMS—trouble is, speed variations of 0.05% are clearly audible with piano music (one of the most revealing tests you can give a cassette deck—try it on the D-801 and marvel!).

The D-801 by Kyocera comes through with a remarkably low wow and flutter figure of 0.02% WRMS—and that is derived from a unique, three-motor, dual capstan drive mechanism. Two capstans are driven by a direct drive motor. A beltless/clutchless simple DC motor drives the feed and takeup reels, while a third motor is used as a head-position assist drive (it greatly prolongs head-to-tape azimuth accuracy). The dual capstan system provides that sensationally accurate tape travel, maintaining proper tension between capstans to eliminate external shock source modulating noise.

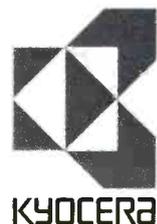
## It more than meets the needs of the audio perfectionist.

The D-801 goes above and beyond even the fussiest audiophile's needs with 3-position bias/equalization selection (with fine bias adjustment), 400 Hz calibration tone, Automatic Program Mute Recording, automatic search, and electronic 4 digit display, including counter, elapsed time and time remaining functions.

The D-801's noise reduction systems were built for the audio purist. It has *two*—Dolby\* B & C—Dolby B for music material of limited dynamic range, Dolby C for music of the widest dynamic range, so noise reduction can be tailored to program material.

Finally, the specs everyone wants: frequency response of 30-20,000 Hz  $\pm$  3 dB using metal or CrO<sub>2</sub> tape, and a S/N ratio of 78 dB with metal tape in Dolby C NR mode.

If you have any trouble finding a Kyocera dealer, contact: Cybernet International Inc., 7 Powder Horn Drive, Warren, NJ 07060 (201) 560-0060.



\*Dolby is a registered trademark of Dolby Laboratories, Inc.

Enter No. 33 on Reader Service Card

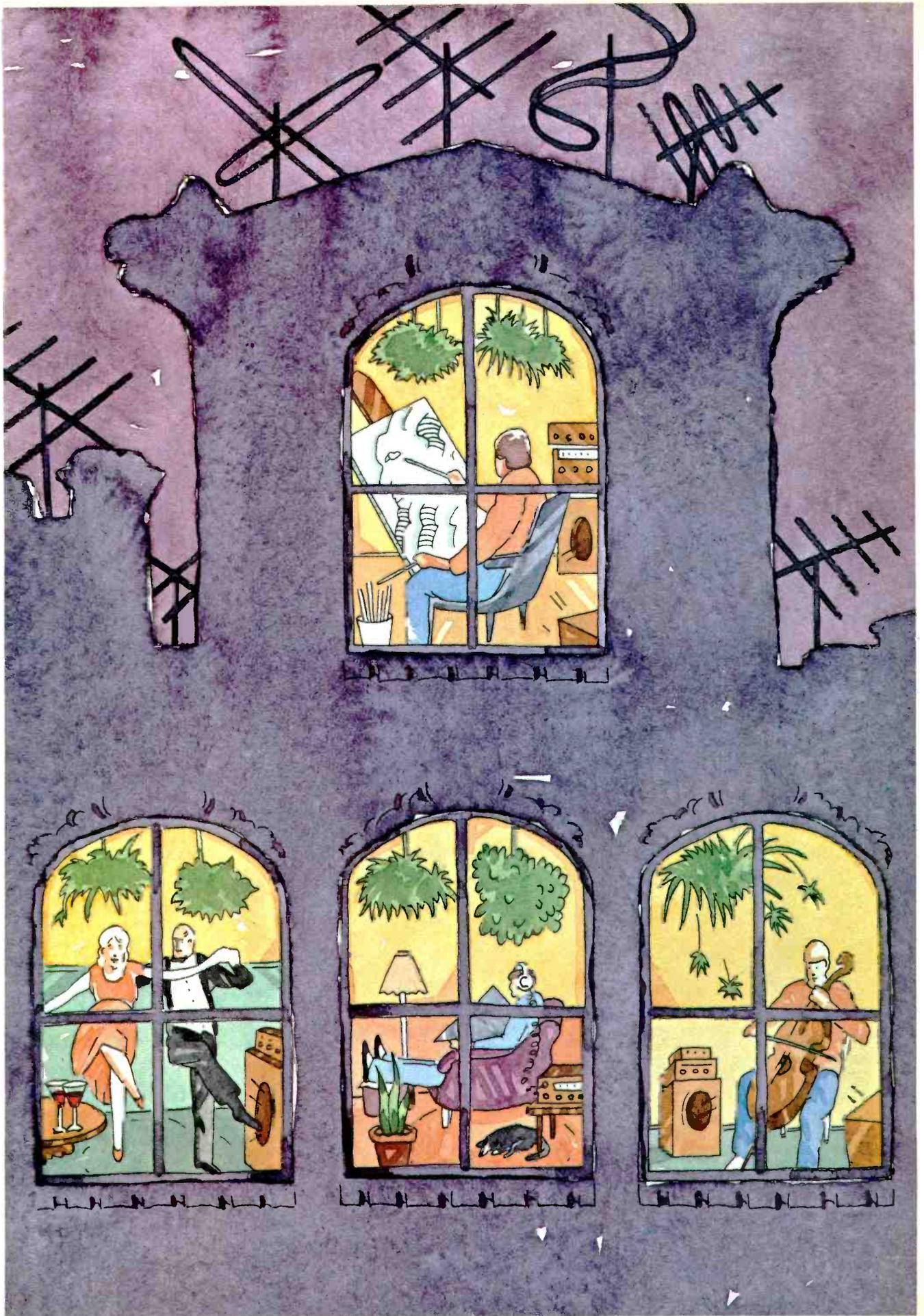


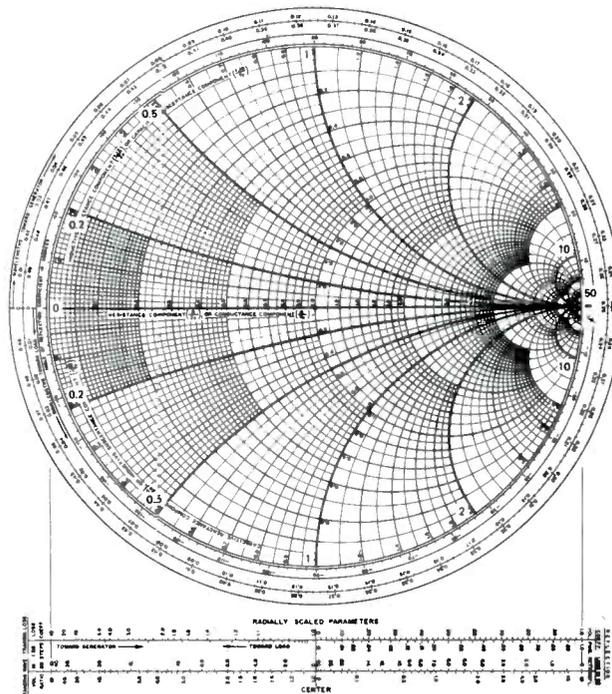
Illustration: Michael A. Donato

# 11 OUTDOOR FM ANTENNAS ANALYZED

LEONARD FELDMAN

**A** number of years ago, the Editors of *Audio* asked me to test and evaluate a half dozen or so of then-popular outdoor FM antennas. To this day, my neighbors look at me with raised eyebrows, no doubt convinced that I am either slightly eccentric or awfully hard to please: During that testing period I hired the services of an antenna installer who would climb up to my chimney top every two or three days, remove the FM antenna that had been painstakingly mounted there a few days before, and proceed to mount a new one in its place. This went on for the better part of a whole month!

When the present Editor asked me to do another survey and test of FM antennas, my first reaction was, "Thanks, but no thanks!" Cold weather was approaching, and I wasn't ready for more of those neighborly stares. Happily, I learned that the actual testing, this time, would be done in Stamford, Connecticut, by the prestigious CBS Technology Center and under the supervision of Frank Barr, Manager of their Product Evaluation Laboratory. My job would simply be to interpret and explain the data. Having worked with Frank Barr on a variety of other test projects, I agreed.



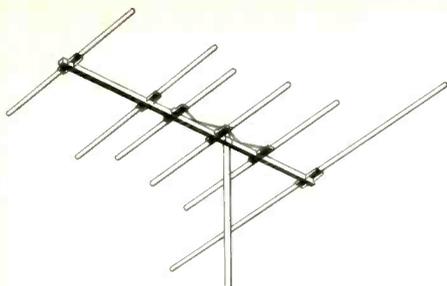
*The reference Smith chart shows the relative predominance of resistive, capacitive and inductive components in an antenna's impedance. Resistances fall on the horizontal line, inductive reactances above and capacitive reactances below.*

Testing outdoor antennas meaningfully is not simple, as I learned from discussions with Mr. Barr. Furthermore, as is obvious from the "specifications" listed (and not listed) in Table I, most manufacturers of antennas provide only the most meager data regarding their products; the tester is left on his own to come up with tests and numbers that enable proper evaluation of antenna performance under given reception conditions.

## The Test Site and Setup

The test site was the CBS Technology Center, some 35 miles from most of the FM transmitting antennas in mid-Manhattan, New York. A source antenna was mounted on the roof of the laboratory. The antennas under

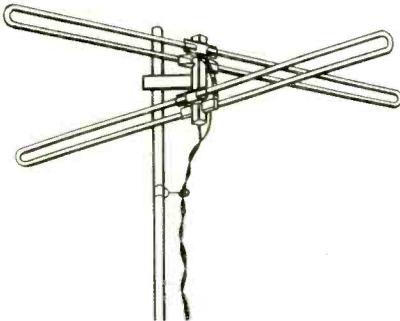
test were mounted on top of a testing tower approximately 75 feet above ground level and about 400 feet away from the source antenna. The dynamic range of the test facility was in excess of 50 dB. The average radiation uniformity across any given antenna under test was approximately 1 dB. Transmissions of the test signals were done only during the normal vertical blanking period of the nearest TV station in order to prevent interference with any FM or TV station in the vicinity.



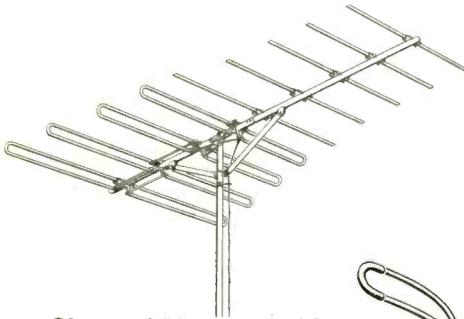
**Antennacraft GFM-6**



**Antennacraft GFM-10**



**Antennacraft GFM-SS**



**Channel Master 4408**



**Channel Master 4405**



**Finco FM-4G**

**Antenna Characteristics**

As a general rule, when you see an antenna that has many rods or elements, you can assume that it is highly directional. That is, it is more sensitive to signals arriving perpendicular to its active elements than it is to signals coming in from other angles, or even

from the opposite direction. Such directionality is desirable in an FM antenna for at least two reasons. First, antennas that are highly directional also have high "gain." Gain, when referring to an FM antenna, must always be related to a standard reference antenna whose gain is arbitrarily said to be 0

*Table I—Manufacturer's specifications and measured test data. A +j value for impedance represents inductive reactance, while a -j value represents capacitive reactance. No specs are given by Radio Shack; the balance list impedance at 300 ohms, except for Winegard's CH-6060 which is listed as 75/300 ohms.*

Make & Model	No. of Elements	Gain—dB		Beamwidth—Deg.		F/B Ratio—dB	
		Spec	Test	Spec	Test	Spec	Test
Antennacraft GFM-6	6	6.4	+5	75	72	16	19
Antennacraft GFM-10	10	8.1	+9	66	64	17	16
Antennacraft GFM-SS	2	-3.0	-3	Omni	—	Omni	—
Channel Master 4408	9	9.5	+12.5	No Spec	47	No Spec	16
Channel Master 4405	1	0	0	Omni	—	Omni	—
Finco FM-4G	6	6.8-9.6	+8.5	42	71	17	14.5
Finco FMT	2	0	-1.5	Omni	—	Omni	—
Radio Shack 15-1638A	10	No Spec	+5.5	No Spec	60	No Spec	17
Radio Shack 15-1639	2	No Spec	-3.5	Omni	—	Omni	—
Winegard CH-6060	6	No Spec	+8	No Spec	66	No Spec	17.5
Winegard TV-6011	2	No Spec	0	Omni	—	Omni	—

dB. In these tests, the reference antenna was a simple, standard half-wave dipole, cut to a length which is resonant at the frequency of the received signal with which it is tested. Rabbit ears and the flat twin-lead antennas provided with FM tuners and receivers are the most common dipoles.

Six of the antennas tested are multi-element, directional types, and these would be expected to have gain well above 0 dB. The remaining five are so-called omnidirectional types, and these might be expected to show 0-dB gain values or even slightly negative gain. The measurement of gain was made from the frontal or main lobe (0°) of the polar plots taken for each antenna and reproduced here. For example, a gain of 6 dB as listed in Table I (summary of test data) means that the particular antenna delivers twice the voltage or four times the power (in dBf) compared to a standard half-wave dipole. The higher the gain and directionality of the antenna, the longer and narrower the front lobe becomes.

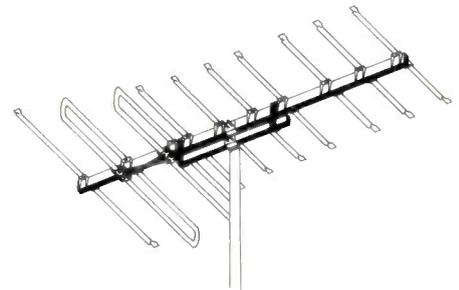
#### Directivity and Beamwidth

While antenna gain is certainly an important parameter to be considered in judging an FM antenna, it is assuredly not the only one. The polar patterns plotted by CBS Technology Center for the 11 antennas provide us with other useful information. For the six directional antennas, measurements of beamwidth and front-to-back ratio were also made. Beamwidth is the antenna's front radiation angle, which is defined by the half-power points (-3 dB). If this angle is too great, the antenna is insufficiently directional, and it may have trouble rejecting reflected signals. If the beamwidth is too narrow, you may have trouble locating the precise position that gives the best reception on one station, possibly sacrificing some quality on other stations. The six highly directional antennas tested are designed to be used in weak signal areas but may also be suited for close-in reception conditions where problems such as multipath reflections and co-channel or adjacent channel interference exist.

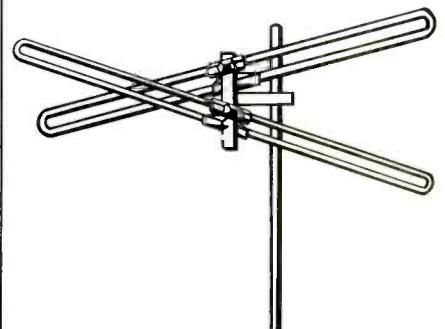
Omnidirectional antennas, though always much lower in gain and lacking any significant directionality, may still be the best choice in certain situations. For example, if you live in an area which is relatively free of multipath problems, receives strong signals, but receives them from many points on the compass, a low-cost omnidirectional antenna may suffice. If, on the other hand, you have multipath problems, weak-signal conditions and station sig-



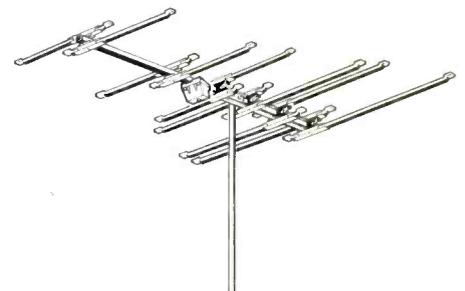
**Finco FMT**



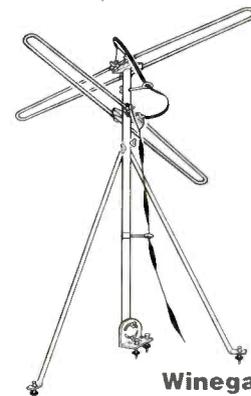
**Radio Shack 15-1638A**



**Radio Shack 15-1639**



**Winegard CH-6060**



**Winegard TV-6011**

#### Impedance

MHz	VSWR	Price—\$
88 250 +j75	1.4	27.00
98 225 -j15	1.4	
108 540 +j165	2.0	
88 375 +j90	1.4	47.00
98 175 +j35	1.8	
108 675 -j300	2.8	
88 115 +j60	2.8	19.00
98 250 -j270	2.5	
108 360 +j120	1.5	
88 360 +j25	1.2	78.95
98 210 +j120	1.8	
108 180 -j90	1.9	
88 210 +j180	1.9	22.40
98 330 -j30	1.2	
108 210 -j60	1.5	
88 210 -j90	2.2	50.10
98 420 j0	1.4	
108 165 -j115	2.1	
88 180 -j50	1.8	25.90
98 315 -j180	1.8	
108 375 +j120	1.5	
88 315 +j115	1.4	30.00
98 150 j0	2.0	
108 750 -j300	3.0	
88 105 +j75	3.0	12.00
98 255 -j225	2.2	
108 360 +j90	1.4	
88 170 +j115	4.0	44.75
98 115 +j40	1.7	
108 240 +j185	2.1	
88 205 -j30	1.5	34.75
98 360 -j165	1.8	
108 345 +j180	1.8	

## **“Using a good FM antenna is probably the single most significant improvement you can make for good FM reception.”**

nals arriving from many points on the compass, your only solution may be to select a directional antenna and add a powered rotator.

The last characteristic which can be determined from the polar plots is called front-to-back ratio. It is the ratio between the signal gain of the front lobe and the gain of the signal coming in from the rear (180°). Although all antennas also have some lobes to the sides and rear, those with the smallest back lobes are likely to have the best rejection of signals coming from the back of the antenna. This is especially important if you happen to be located between the two transmitters, each off in a different direction.

### **Antenna Impedance**

If you've ever examined the rear panel of an FM tuner or receiver, you have probably seen the notation "300 ohms" next to the two screw terminals to which the antenna down-lead is connected. Many tuners also incorporate coaxial connectors which bear the notation "75 ohms." These numbers refer to the input impedance of the r.f. circuitry of the FM set. Ideally, there should be a perfect match between your antenna, its down-lead or cable, and the input impedance of your FM receiver or tuner. All of the antennas tested for this report have a nominal impedance rating of 300 ohms, with the exception of the Winegard CH-6060. The CH-6060 is basically a 75-ohm unit, but it is supplied with a matching transformer that can be set for either 75 or 300 ohms. If your FM tuner or receiver is equipped only with a 75-ohm input terminal, it is possible to use a 300-to-75 ohm transformer device which, in theory at least, maintains a correct match between the antenna and the circuits to which it is connected.

When a proper match is maintained between antenna and FM tuner, maximum power transfer takes place between the two. In practice, such a perfect match is seldom achieved. The impedance of an antenna is hardly ever exactly its nominal value (300 or 75 ohms), and even if it is, it is not likely that this value will be maintained over the entire tuning range (in this case, from 88 to 108 MHz). Furthermore, an ideal antenna would have an imped-

ance which is purely resistive, whereas in actual practice an antenna's impedance is usually partly resistive and partly reactive (inductive or capacitive).

Mismatches in impedance cause some of the signal energy received to be reflected back up the transmission line, to the antenna. If the antenna is totally resistive, it absorbs this reflected energy. But if, as in most cases, there are reactive components in the antenna's impedance, some of the reflected wave bounces back yet again towards the tuner or receiver. Such reflections can cause various forms of distortion in the received audio program, most of which sound like multipath distortion.

While deviations from the purely resistive ideal make for a less-than-perfect antenna, performance degradation (even with relatively large mismatches and rather highly reactive components) is not as great as you might think. So, while the a.c. impedances shown in the test results of Table I seem, in many cases, to be far from the "ideal," note that both resistive and reactive components normally vary rather widely over the FM frequency band, and at some frequency the overall impedance may be closer to the ideal value of 300 ohms, and purely resistive at that.

Although Table I lists only the impedances observed at 88, 98, and 108 MHz for the 11 antennas tested, these values were obtained using a display known as a Smith chart. A detailed photostatic view of the Smith chart is shown for reference along with Smith chart 'scope readings for each of the 11 antennas measured. The bright dots in each 'scope photo show the impedance value for the identified frequencies. A purely resistive value will appear as a bright dot along the display's horizontal center line. An impedance dot in the upper hemisphere of the display indicates an inductive reactance. Dots appearing below center indicate the capacitive reactance. An antenna having a purely resistive impedance of exactly 300 ohms would produce a dot lying exactly on the horizontal axis, where the numeral 1.0 is seen in the reference Smith chart. Note, for example, that the Finco (Finney Co.) FM-4G comes close to this

ideal at a frequency of 98 MHz, at least insofar as its being purely resistive. The Channel Master 4405, at 98 MHz, also comes very close to the ideal value of 300 ohms (resistive) with minimal capacitive reactance which would have negligible effect. In Table I under "Impedance," the first number in each measurement tells the resistive component, while the number following the letter "j" depicts the reactive component. A "+j" means inductive reactance while a "-j" means capacitive reactance.

The Voltage Standing Wave Ratio (VSWR), also tabulated in Table I, is the ratio of the highest and lowest voltages in a transmission line and is a function of the impedance match between the antenna and the FM receiver. Under ideal conditions, the VSWR would have a value of 1.0. All of the FM antennas tested exhibit values greater than 1.0, showing that some portion of the electromagnetic energy is being reflected instead of being delivered with maximum efficiency to the antenna. I should stress that "perfection" in antenna design is never completely achieved, particularly when an antenna has to cover a wide range of frequencies.

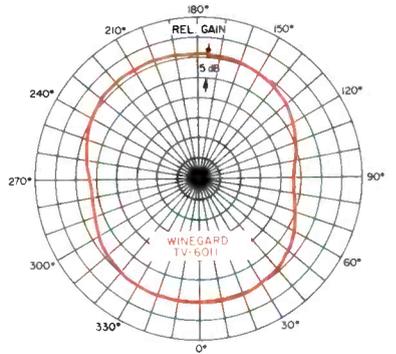
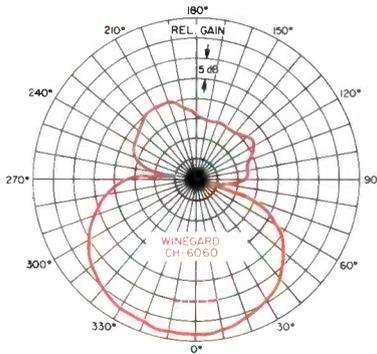
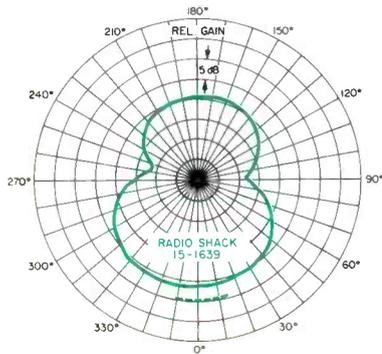
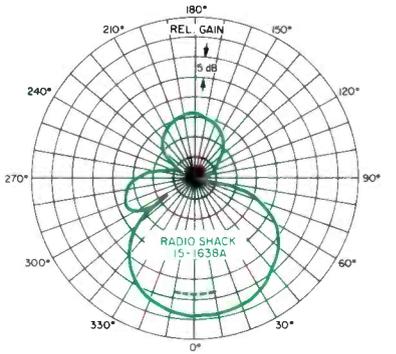
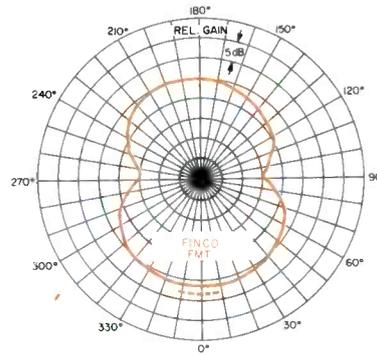
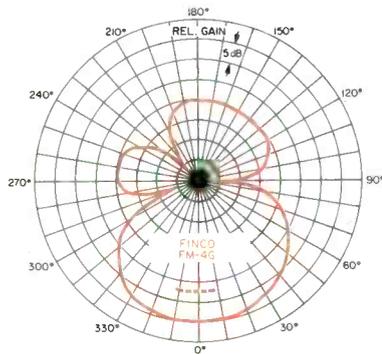
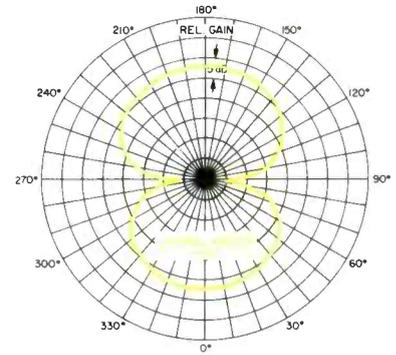
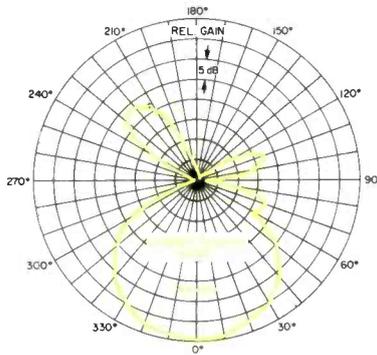
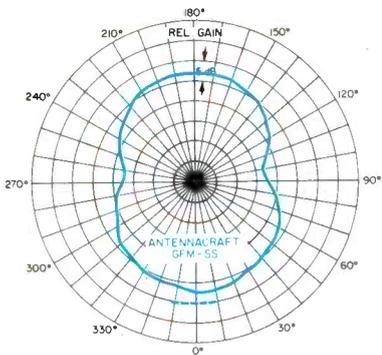
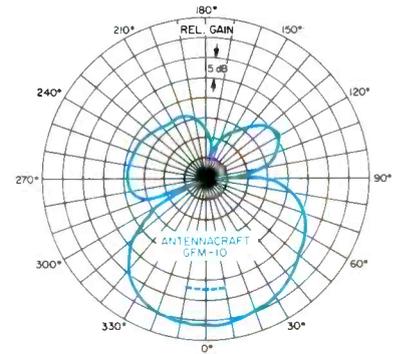
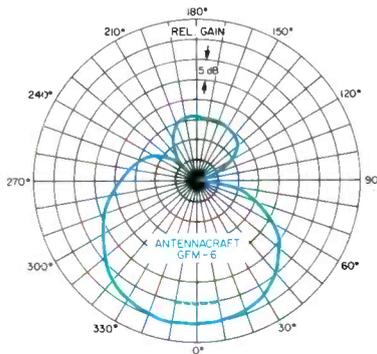
### **Test Results**

The results obtained by CBS Technology Center and summarized in Table I pretty well speak for themselves. Clearly, when it comes to antennas for FM there is no such thing as a single "best" model for everyone, since qualities that are important in a particular geographic location will be less important in another.

The highest gain was exhibited by the Channel Master 4408 (12.5 dB), with the Antennacraft GFM-10, Finco FM-4G and Winegard CH-6060 next in line. Those seeking a narrow-beamwidth (highly directional) antenna may also want to choose the Channel Master 4408, though the Radio Shack 15-1638A, the Antennacraft GFM-10 and the Winegard CH-6060 all did quite well in this regard. If high front-to-back ratio is what you need, the six-element GFM-6 by Antennacraft did very well (a high 19 dB), followed closely by the Winegard CH-6060 and the Radio Shack 15-1638A (17.5 and 17 dB respectively).

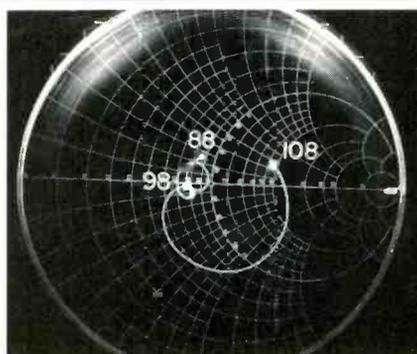
**“As a general rule of thumb, antennas with many rods or elements are considered highly directional.”**

*Polar patterns for 11 tested antennas. The dashed lines indicate the gain of a reference dipole, for comparison.*

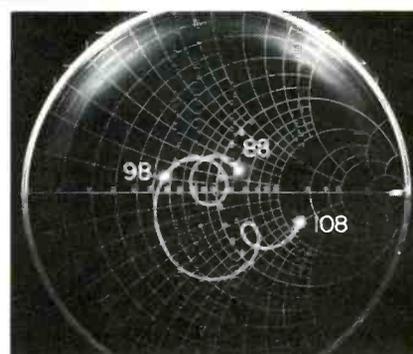


**“While gain is certainly an important parameter in judging an FM antenna, it is not the only one.”**

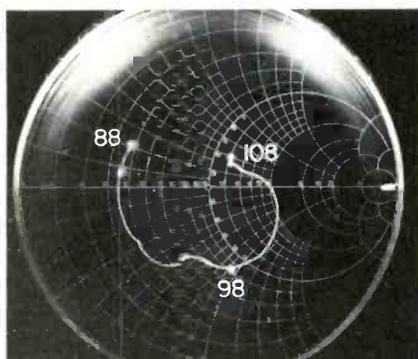
Smith charts for the 11 antennas tested. Numbers shown are FM frequencies in MHz.



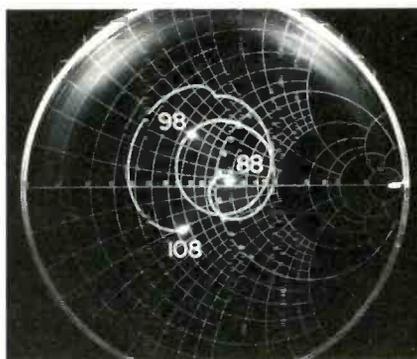
**Antennacraft GFM-6**



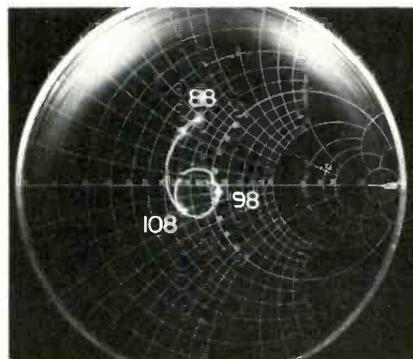
**Antennacraft GFM-10**



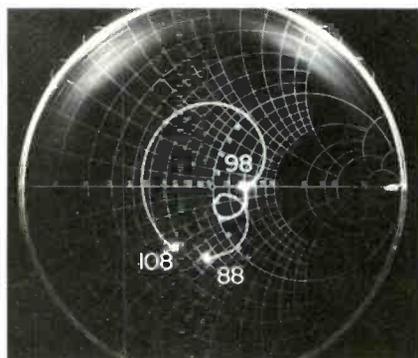
**Antennacraft GFM-SS**



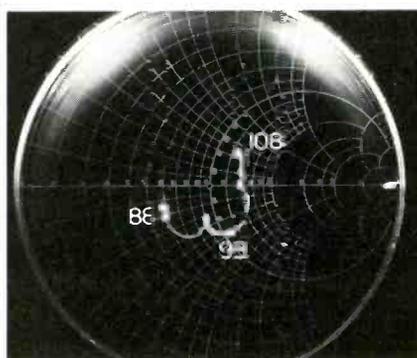
**Channel Master 4408**



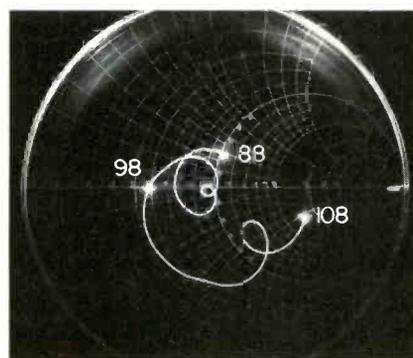
**Channel Master 4405**



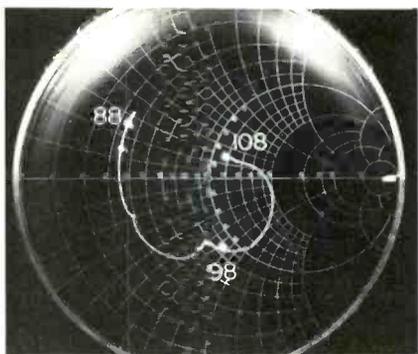
**Finco FM-4G**



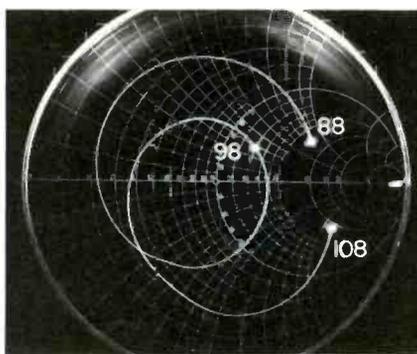
**Finco FMT**



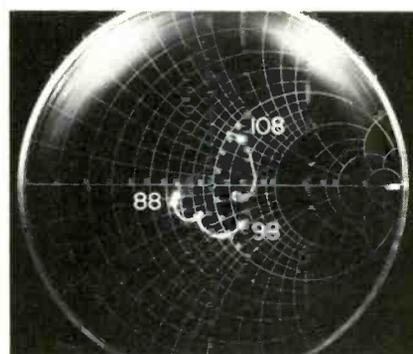
**Radio Shack 15-1638A**



**Radio Shack 15-1639**



**Winegard CH-6060**



**Winegard TV-6011**

**“If you have multipath and weak signals from many directions, you may need both a directional antenna and a rotator.”**

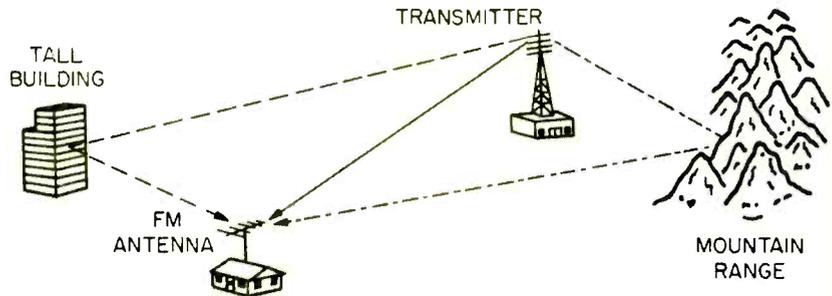
# ANTENNA TYPES AND TERMS

Antenna performance is always rated relative to the performance of a reference dipole. You may never see such an antenna on a rooftop, but if you did, it would look like a flattened-out Channel Master 4405 or like one of the crossbars on the other omnidirectional antennas shown. Rabbit ears and the flat, twin-lead antennas provided with FM tuners and receivers are the most common dipoles.

A reference dipole's directivity also resembles that of the Channel Master 4405 except that the dipole's figure-8 pattern is narrower, with less side pickup.

Omnidirectional antennas should theoretically be equally sensitive in all directions. In practice, their patterns usually range from the fat figure-8 of the 4405 to the pinched-in circle of the Winegard TV-6011.

Directional antennas come in several types (yagi, log periodic, et al.) which almost invariably consist of several parallel elements, one behind the other. While they are usually far more sensitive in their forward direction than any other, plots of their directivity usually show some sensitivity to the back or sides. Directional antennas tend to have



*How multipath occurs. Note that the signal being broadcast by the transmitter will arrive at the home antenna by three different paths.*

more obviously asymmetrical directivity plots, too.

Directivity is needed both to concentrate an antenna's sensitivity in one direction for weak-signal pickup, and to exclude unwanted signals. In fringe areas where the listener lives roughly halfway between two stations sharing the same frequency, such signals may include co-channel interference. Unwanted stations may also include strong stations on a frequency near that of the desired one, especially if the tuner's selectivity is poor.

Directional antennas are also frequently used to reduce

multipath pickup, where the incoming signal is accompanied by signal reflections (see illustration). Since reflections follow longer paths than the direct signal, they are delayed. A mixture of direct and delayed signals can cause distortion on FM, equivalent to "ghosts" on television. A directional antenna can exclude these delayed signals to pick up only the direct signal. In some situations, a directional antenna can be aimed to exclude a direct signal accompanied by several reflections. Instead, it should be aimed to pick up a reflection coming in alone from someplace else.

—Ivan Berger

As for antennas with "best" impedance characteristics and lowest voltage standing wave ratios, no clear winner emerges since, as I said, these characteristics vary widely with frequency of the signal being received by the particular antenna. I did note that VSWRs for the Channel Master 4408 and 4405, the Finco FMT, and the Winegard TV-6011 did not exceed 2.0 at any of the frequencies at which they were tested.

## General Conclusions

Using a good FM antenna is probably the single most significant improvement you can make for good FM reception. As pointed out by the CBS

Technology Center, this fact is often overlooked by many, who insist upon using the ribbon-wire dipole supplied by the manufacturers of most tuners and receivers.

The six directional antennas tested were designed to be used in weak signal areas or, as stated earlier, in areas having reception problems attributable to signal reflections. If you are trying to receive very distant signals or plan to use one antenna for more than one set (an arrangement which obviously reduces signal strength available to each set), one of these antennas would be a good choice. Mounting should be on a separate mast, away from other antennas

and power lines, and, if need be, an antenna rotator should be used.

The remaining five antennas tested are omnidirectional. Compared with a standard dipole, these units have very little gain and often even a loss. They should only be used in strong signal areas which are free of multipath and r.f. interference. No rotator is needed, and an omnidirectional antenna can generally be mounted on an existing TV antenna mast, although a distance of at least four feet should be maintained between it and any other antenna already on that mast. In addition, any antenna installation should be kept well away from any power line as a safety precaution.

## SCOTT SLIMCOM 650SL



Photograph: Susanne Buckler

**A**s I studied the literature in preparing for this analysis of H. H. Scott's highest priced one-brand system (one of six Slimcom systems ranging in price from just under \$1,000.00 to \$2,160.00), I looked forward to being able to test and report on a superb package. I was overjoyed to see that Scott had elected to use components in their assembled one-brand systems which are identical to those they sell as separates. I presumed, therefore, that the system would be as good as or better than the sum of its excellent parts.

Unfortunately, not *all* those parts are up to the quality I would have expected from the venerable Scott company

(one of the true pioneers of high-fidelity components). As a result, the sum of those parts doesn't come off that well. It only pays to buy a packaged system when its individual components are superb, or when the system price is substantially lower than that of its component parts, or when the system provides facilities not available from individual components.

For example, some one-brand systems offer remote control. A few also have components which interact, so that the turntable can cue the tape deck or so that selection of an FM station on the tuner will automatically set the amplifier's selector to FM. You won't find such extra features here.

That's not to say the components of the Slimcom 650SL don't go well together. They are all of the same basic width (about 17 inches) and look good when stacked one above the other. Visual displays, such as the power level on the integrated amplifier and the record-level indicators on the cassette deck, are of the same color and design. Panel finish and touch buttons on all of the units are similar, even on the turntable (which is mounted atop the supplied rack-type, wood-finished cabinet). This lends an attractive, cohesive look to the entire system.

The 458A integrated amplifier delivered in excess of 72 watts per channel into 8-ohm loads at its rated harmonic

distortion of 0.03%. A most interesting calibration scheme for the power-output LEDs is used: At low signal levels, the maximum scale for the LEDs is 1 watt. When that level is exceeded, the range automatically changes to a maximum of 100 watts full-scale. Separate bass, midrange and treble tone controls are provided, as are subsonic and high-cut filters, two tape monitor cir-

cuits (with comprehensive tape copy facilities) and a loudness control. A pleasant surprise on a unit in this price category is the presence of a phono-input stage which will, at the touch of a switch, accommodate a moving-coil phono cartridge.

The slim 558T tuner offers seven AM and seven FM station presets and effective, frequency-synthesized tuning.

In addition, the now-familiar tuning modes such as automatic (tuning stops when usable signals are encountered) and up-down manual are also included. A high-blend circuit can be switched in to reduce noise during weak-signal stereo reception, with some reduction in treble stereo separation. While stereo quieting, signal-to-noise ratios and distortion levels essentially met or exceeded published specifications, stereo separation at 1 kHz fell far short of the claimed 50 dB, measuring only 35 dB. Clearly, more careful alignment of the multiplex decoder section would have brought the separation within spec. Indicating displays of this tuner include frequency readout, preset station frequency, tuning, stereo, signal strength, and "memory" (which lights up when the tuner is ready to preset or "memorize" a station frequency).

The unidentifiable moving-magnet cartridge supplied with the PS68C turntable came properly mounted in a tonearm shell, thereby eliminating the most difficult chore (for most neophytes) of the installation sequence. The rest of the turntable setup was easily accomplished with this relatively simple and straightforward semi-automatic direct-drive unit. Rumble was actually a bit lower (62 dB, DIN B) than claimed by Scott, but I had difficulty substantiating their wow-and-flutter figure of 0.035%. It is quite possible that eccentricities of the test record and/or the center spindle of the table may have contributed to the somewhat higher reading (which was, nevertheless, still acceptably low). My criticism is of the nondescript cartridge rather than the turntable itself. Though well-damped at the high-frequency end of the spectrum, it did exhibit deviations from flat response, amounting to about 1.5 dB above reference level and 1.7 dB below reference level. I felt, too, that a tracking requirement of 2 grams was a bit on the heavy side and would recommend substitution of a higher quality cartridge. The turntable and tonearm can certainly handle a better pickup than the one supplied, without encountering any difficulties.

Although I used premium-grade cassette tapes (TDK AD, SA and MA for the three major generic tape types),

*Continued on page 71*

## ONE-BRAND SYSTEM RATINGS

**Manufacturer:** H. H. Scott **Model:** Slimcom 650SL  
**Company Address:** 20 Commerce Way, Woburn, Mass. 01888.  
**Cabinet Dimensions:** 37 in. W x 32 in. H x 18 in. D.  
**Price:** \$2,160.00. For literature, circle No. 98.

Component & Specification	Claimed	Measured	Rating
<i>Power Amp Section (458A)</i>			
Power/Channel, watts	65	72.6	♪♪♪
Rated THD, %	0.03	0.01	♪♪♪
<i>Preamp/Control Section (458A)</i>			
Freq. Response, Phono, ±dB	RIAA, ±0.5	RIAA, +0, -1.5	♪♪
Phono S/N, dB	80	79.5	♪♪
<i>FM Tuner Section (558T)</i>			
50-dB Quieting, Stereo, dB	37.0	37.0	♪♪♪
S/N, Stereo, dB	72.0	71.0	♪♪
THD, Stereo, 1 kHz, %	0.2	0.11	♪♪
Separation, 1 kHz, dB	50.0	35.0	♪
Alt. Channel Selectivity, dB	60.0	60.0	♪♪
<i>Turntable/Cartridge Section (PS68C)</i>			
Frequency Resp., Hz-kHz, ±dB	N/A	20-20, +1.4, -1.7	♪
Separation, 1 kHz, dB	N/A	20.5	♪
Rumble, DIN B, dB	-60	-62	♪
Wow & Flutter, % wtd. rms	0.035	0.05	♪
<i>Cassette Recorder Section (638DM)</i>			
Freq. Resp., Hz-kHz, ±3 dB			
Normal Tape	25-16	26-14.5	♪
Chrome Tape	25-17	25-14.5	♪
Metal Tape	25-17	25-16.0	♪
S/N, Best Tape, dB (with NR)	66	67.5	♪
Wow & Flutter, % wtd. rms	0.045	0.065	♪

### Rating System

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

### General Comments

**Power Amplifier:** Sound quality acceptable, with adequate power reserve for matching speakers. Phono equalization not accurate at high frequencies. **Turntable & Cartridge:** Reasonably well-matched to each other, but heavy tracking requirement for cartridge and further deviations from flat response detracts from low-noise and otherwise good performance of turntable. **Tuner:** Well-designed and easy to tune, but misalignment caused poor separation readings in lab tests. **Cassette Deck:** Should have done better in frequency response with the premium tapes I used, but did offer good S/N ratio and accurate Dolby tracking.

**Overall Comment:** There is little that distinguishes the components of this system from equivalent separates; therefore, there is no particular advantage in opting for the entire package. I would recommend the integrated amplifier, tuner and turntable (providing you upgrade the cartridge), but there are better cassette decks available at its price.

**Overall Rating:** ♪♪½

# 1

## HITACHI DA-1000 DIGITAL AUDIO DISC PLAYER

### Manufacturer's Specifications

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

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

**S/N Ratio:** More than 90 dB.

**Channel Separation:** More than 60 dB.

**Distortion:** 0.03%.

**Wow and Flutter:** Not measurable.

**Line Output Level:** 1.4 volts for 0-dB record level.

**Power Consumption:** 24 watts.

**Dimensions:** 12.6 in. (32 cm) W  $\times$  5.7 (14.5 cm) H  $\times$  9.2 in. (23.4 cm) D.

**Weight:** 12.32 lbs. (5.54 kg).

**Price:** Not determined.

**Company Address:** 401 West Artesia Blvd., Compton, Cal. 90220.

For literature, circle No. 90

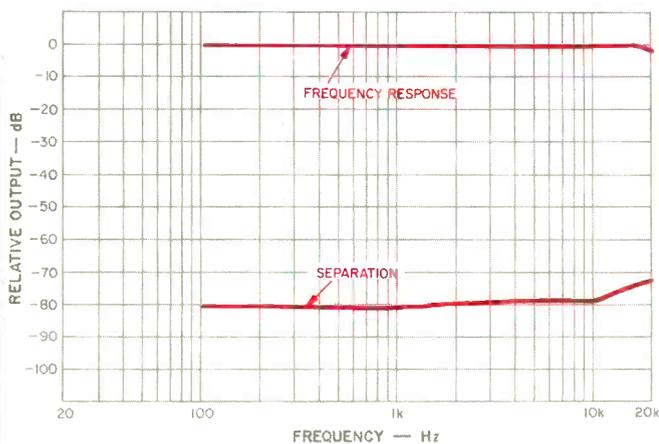


Fig. 1—Frequency response and channel separation.

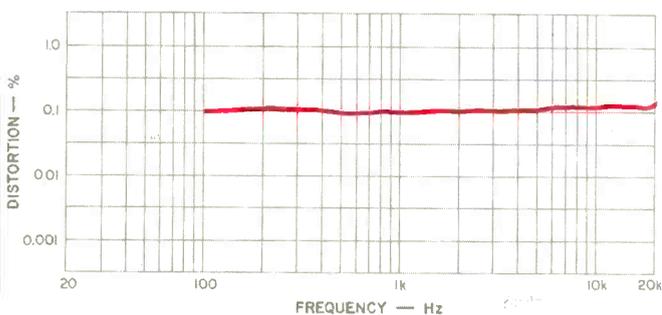


Fig. 2—Distortion vs. frequency.



I must confess that when I was asked to test and evaluate a second digital audio disc player only a few weeks after having tested the Sony CDP-101 (for the November 1982 issue of *Audio*, with a follow-up elsewhere in this issue), I suspected that the project would result in identical measurements and even identical product descriptions. Nothing could have been further from the truth. I am happy to inform my colleagues who test and evaluate audio products that their futures are secure. Digital audio players are *not* all peas in a pod. They are, in fact, as different from each other as are analog audio products. As it turns out, these first two DAD players differ not only in features and physical configuration, but in measured performance characteristics as well. If I had to sum up my conclusions about each, I'd say that the Hitachi has the edge on convenience features, but not as far as pure, measured performance is concerned.

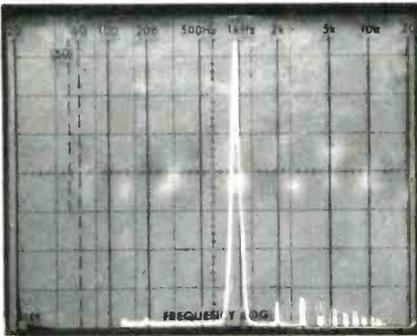
The Hitachi DA-1000 is configured somewhat like a cassette deck, in that digital discs are loaded into the machine via a swing-down door. A slot at the top of this door accepts the disc, which should be inserted with its label facing you. Slight downward pressure on the disc itself activates a

motor mechanism which both "swallows" the disc and closes the hinged door. With no further directions from the user, the disc (which is now upright, its label towards the user) then spins briefly so that the laser pickup can read the disc's coded "Table of Contents."

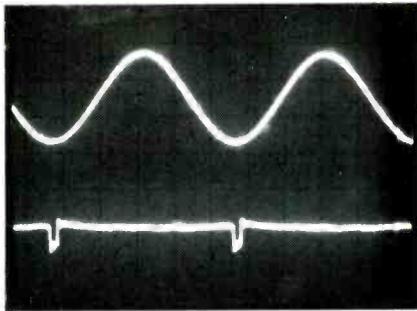
The left section of the panel is dedicated to several illuminated displays and to the power on/off switch. One of these displays tells the number of individual selections on the disc, as well as the number of the selection currently being played. Thus, a few seconds after the measurement test record is inserted in the machine, this display tells us that there are 39 separate "bands" or selections on the record, as indeed there are. (See my description of the test disc in the Sony CDP-101 "Equipment Profile" postscript in this issue.) Another display, below the "Program/Play" display, indicates volume level supplied to the phone jack and to the variable-level output jacks at the rear of the unit. A real-time counter display indicates elapsed time since the beginning of the selection being played or, during programming of the desired selection, the total time of the selections being called for. Still another display, the "Location Indica-



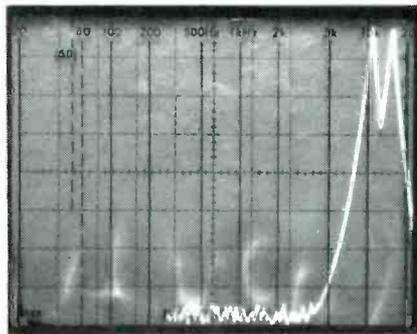
“Fast-forward and fast-backward are more like a tape deck’s auto search than tape fast-forward and fast-rewind.”



**Fig. 3—**  
THD analysis  
of a 1-kHz  
test signal.



**Fig. 4—**  
Distortion  
components  
(lower trace)  
during playback  
of high-level  
1-kHz test signal;  
the output signal  
is represented  
by the upper  
trace.



**Fig. 5—**  
Twin-tone IM  
measurement  
discloses no  
visible IM com-  
ponents, but  
noise level is  
within dynamic  
range of the  
spectrum  
analyzer display.

tor,” shows how far into the disc you are, using a moving-LED spot on a scale calibrated in five-minute increments from 0 to 60 minutes (the approximate total playing time per side of a DAD disc).

The right-hand portion of the DA-1000’s front panel contains buttons for programming, volume “Up” and “Down,” play, stop, and door open/close as well as a stereo phone jack. In addition, there are two rocker bars in this area, one of which handles fast-forward/fast-replay functions, the other pause and “Memory Stop.” These last-named functions are so versatile that it was necessary to read the preliminary English translation of the owner’s manual to understand all of the functions they perform. Take the fast-forward/fast-backward button, for example: When fast-forward is pressed, the laser pickup advances only to the beginning of

the next selection and then begins to play it. Depressing fast-backwards once brings the pickup back to the start of the selection currently being heard, while depressing it a second time moves the pickup back to the start of the previous selection. In this, it is less like a tape recorder’s fast-forward and fast-rewind than like a cassette deck’s auto search function.

The remaining controls are for programming and volume adjustment. Random-access programming is accomplished by depressing the “Program” touch button, followed by the number of the selection you want to hear first; this process is repeated until you have programmed all preferences in desired order. To make programming a little less tedious, touch buttons labeled “1” and “10” are provided. Thus, if you want to hear selection number 22, you would touch the “10” button two times and the “1” button twice; the number “22” will then appear in the indicator at the left end of the panel. A “Clear” button erases previous programming and a “Call” button permits you to see on the display what you’ve programmed. A “Repeat” button, if depressed when there is no preprogramming entered, will simply cause the disc to be played over again. If it is depressed when a random-access program has been entered, it will cause repeat play of only those bands that have been selected.

When in stop mode, pressing the “Call” button displays the play time of all selections on the disc. In play mode, pressing “Call” displays the play time from the start of the disc to the current play position. With so many displays and indications available (I’ve probably left some out) and so much information to be gathered about each disc, one wonders when the user will have time to listen to some music!

The rear panel of the DA-1000 is much more simply configured. It is equipped only with a pair of fixed output jacks and a pair of variable output jacks whose output signal level, like that of the headphone jack, is controlled by the volume control buttons.

### Measurements

I subjected the Hitachi DA-1000 player to all the tests on the Sony test disc. Frequency response was almost ruler-flat, as shown in Fig. 1, though there was a fraction of a dB of rise at around 16 Hz and a dip amounting to just short of 1 dB at 20 kHz. These slight deviations from perfectly flat response would seem to indicate that the anti-aliasing, sharp cutoff filter in this particular sample may not have been optimally tuned, but the deviations are certainly negligible from a listener’s point of view.

Separation, though superb (and 20 dB better than Hitachi specifies), was not as high as the other player’s. It hovered around the 80 dB level, decreasing to just over 70 dB at the 20-kHz test frequency. This still exceeds the modest claim of 60 dB made by Hitachi and surpasses by far anything that has yet been achieved with an analog disc or tape.

Total harmonic distortion at 0 dB (maximum output) level for this unit was considerably higher than I measured for the Sony player and was, in fact, considerably higher than the 0.03% claimed by Hitachi. A graphic plot of harmonic distortion versus frequency, using the test frequencies available on the test record, is shown in Fig. 2.

**“Dynamic range is less than claimed—but still 20 to 25 dB better than even the best analog LP discs.”**

I was somewhat perplexed by this relatively high (though audibly insignificant) THD level, the more so because the competing unit had exhibited distortion levels that were at least an order of magnitude lower. Applying the 1-kHz test signal (at 0 dB) to spectral analysis, I confirmed that the problem was, indeed, common garden-variety THD and not noise or other nonharmonically related residual signals, as can be seen in Fig. 3. To the right of the desired 1-kHz “spike” we see a rather large number of harmonic components, all the way up to a tenth harmonic. Higher order components may also be present but may be too low in level to be discerned with this spectrum analyzer’s limited 80 dB of dynamic range. Investigating further, I checked the output waveform and the distortion component waveform (as derived from a distortion analyzer) on a dual-trace scope, Fig. 4. The lower trace shows the distortion components found in the output signal, which is depicted by the upper trace. The problem looks almost the same as clipping, so I suspected that perhaps what Sony considers to be “0 dB level” might be higher than that for the Hitachi unit. I therefore repeated the distortion measurements at a -10 dB signal level, which is also available on the test disc. Distortion remained virtually the same: 0.1%.

SMPTE IM, also measured using the same test disc, was 0.06% at 0 dB level and 0.16% at -10 dB recording level. If there were any IM components generated by the twin-tone (19 and 20 kHz) test signals, they remained buried beneath the noise floor observable in the spectrum analyzer display of Fig. 5.

As for that noise floor, I measured it as being 83 dB below reference maximum output level when no weighting was applied and as 87 dB below when using an A-weighted network. This falls somewhat short of the 90 dB of dynamic range claimed for the DA-1000, but again, it is around 20 to 25 dB better than the dynamic range available from even the best analog LP records.

De-emphasis built into the DA-1000 was within around 0.2 dB of the values required, judging from the three available test frequencies on the test disc. While precise readings of -0.37, -4.53 and -9.04 dB are prescribed at 1, 5 and 10 kHz, I measured attenuations of -0.4, -4.8, and -8.8 dB at those frequencies respectively.

### Use and Listening Tests

In my first tests of a digital audio disc player, most of the musical listening was confined to Polygram DADs. For testing the Hitachi DA-1000, I was also able to add a CBS-Sony DAD release to the collection. The new disc, cataloged as 38DC 1, is a recording of Beethoven’s Fifth Symphony plus Schubert’s Eighth (“Unfinished”) Symphony, both conducted by Lorin Maazel with the Vienna Philharmonic Orchestra. Of interest was its price, printed right on the back page of the little pamphlet packaged with the disc. (It’s legal in Japan for manufacturers to set retail prices for their wares, though retailers can still discount those prices if they like, and many do.) The price read 3800 yen which, when converted at a rate of around 260 yen to the dollar (current rate as this is being written), works out to \$14.62. Not bad for an “audiophile” record such as this, wouldn’t you say? Although most of the information contained in the pamphlet is

in Japanese, the recording data section is in English and indicates that the Beethoven was recorded in Nagoya, Japan on November 5, 1980, and the Schubert work about a week later, on November 13, 1980, at Hitomi Memorial Hall in Tokyo. I mention this only to convey the important fact that these were live recordings mastered digitally, and not simply re-recordings of analog master tapes in digital format.

Though the Hitachi DA-1000’s measurements were no match for the other player’s, its sound quality when playing discs was superb. It is hard to correlate musical loudness levels with single test-tone levels, but it did seem to me that the test record tended to push things a bit, and that most of the musical discs I played had peak levels recorded at somewhat lower absolute levels. I do not know whether this was done deliberately to prevent accidental overrecording (a veritable catastrophe in the case of digital records) or is simply a random thing.

From time to time, the Hitachi DA-1000 did not respond correctly to my programming commands when I tried to program sequential bands on the test record in a particular order. In one case the laser pickup began playing the wrong selection; in several other cases, especially when I called for a high-numbered selection, the player began to spin the disc, seemed to search for the required band, and then gave up and stopped. It may well be this was because the test record had so many (39) separate “selections.” The failure to program correctly never occurred with any of the musical records which I played on the machine.

All of this in no way detracts from the excellent quality of music reproduction which I heard and which was virtually indistinguishable from the quality of sound obtained from the Sony unit. I get the feeling that Hitachi’s engineers concentrated more on displays and front-panel features. If that doesn’t add anything to the price, fine. But if the DA-1000 ends up costing significantly more than the competition without sounding better (and in fact, measuring somewhat poorer), then it is up to the individual as to whether the bells and whistles are worth the extra money.

*Leonard Feldman*

*Editor’s Note:* This DA-1000 was a late pre-production unit, built by hand instead of on the line, and its measurements may possibly not be up to those of actual production samples. We will test a production unit as soon as possible, and will report on any differences we find.—E.P.

*Two recent Compact Disc releases.*



## 2

## AUDIO-TECHNICA AT666EX DISC STABILIZER

### Manufacturer's Specifications Stabilizer Plate

**Diameter:** 11.81 in. (300 mm).  
**Thickness:** 0.374 in. (9.5 mm).  
**Weight:** 3.087 lbs. (1.4 kg).  
**Basic Material:** Duraluminum.

### Suction Unit (AT661)

**Power Source:** Two C batteries, 3 volts d.c.  
**Current Drain:** 500 mA, loaded.  
**Low-Voltage Operational Limit:** 1.64 volts.  
**Time Required to Obtain Suction:** 7 seconds or less (110-cc capacity load).  
**Obtainable Vacuum:** 400 mm Hg or better.

**Limiters Operation Vacuum:** Over 350 mm Hg (3 volts d.c.).

### General Specifications

**Dimensions:** 2.79 in. (71 mm) W × 1.61 in. (41 mm) H × 5.16 in. (131 mm) D.

**Weight:** 6 oz. (168 grams) without batteries.

**Supplied Accessories:** Spindle adaptor, turntable platter spacer, record compressor, cleaning leather, suction nozzle, two C batteries.

**Price:** \$295.00.

**Company Address:** 1221 Commerce Dr., Stow, Ohio 44224.  
For literature, circle No. 91



During the Consumer Electronics Show held in Las Vegas in January 1982, Jon Kelly, President of Audio-Technica U.S., demonstrated a prototype of a vacuum record-clamping device that replaces the turntable mat and converts the turntable to a vacuum-platter turntable, clamping the record in place for over an hour. This item was, indeed, unique!

A vacuum-suction system is used to flatten out all record warps, usually of the "dish" or "pinch" type, on a 12-inch (30 cm) record. At the same time, it firmly bonds the vinyl record to the vacuum platter, thus eliminating the ever-present problem of vinyl resonance. In the prototype shown at the CES, the vacuum was created with a hand-operated vacuum pump. I was of the opinion that this type of vacuum pump would, after a while, become a nuisance such that the Disc Stabilizer would not be used except by the most avid audiophile. Apparently, many people were in agree-

ment because it wasn't long before I was informed that the vacuum pump would be battery operated.

During the summer CES, held in Chicago last June, Audio-Technica introduced the modified version with the battery-operated vacuum pump. With this innovation, the AT666EX Disc Stabilizer can be used to modernize most direct-drive turntables and possibly any belt-driven turntable currently available. Some older spring-suspension turntables may require a heavier type of suspension spring capable of handling the additional three-pound weight. Further, the turntable manufacturer should be asked if the bearings can withstand the device's three pounds; I am quite certain, for example, that the Linn Sondek's can't.

Vacuum-platter turntables are not a new idea, inasmuch as they have been around for a few decades. Their primary use is to hold (bond) the acetate record blank (lacquer)

firmly to the cutting lathe turntable when a master disc is being cut. About three or four years ago Luxman introduced their PD-555 turntable with a vacuum-suction system that is excellent, but the price is almost \$3,000. Subsequently, Luxman produced at least three additional turntable models utilizing the vacuum-suction system, but still employing a manual vacuum pump and still fairly expensive. I understand that the Michell Gyrodec is a vacuum-suction turntable utilizing a bellows-type vacuum pump (looking somewhat like a concertina bellows) that is placed over the center pin when drawing the vacuum. Thorens recently announced that they were introducing a new turntable (TD226) with their VCM vacuum system, but here again the price is beyond the reach of most audiophiles. Undoubtedly, there will be a number of others soon.

The Audio-Technica AT666EX Disc Stabilizer is a precision-machined, duraluminum vacuum-platter turntable accessory. It has thin, rather flat, rubber seals located around the outer edge, just inside the bead on the record surface, and at the inner area just before the raised label area. The pliable, thin rubber gaskets are 7.5 mm wide. The outer diameter of the outer gasket is 297 mm, and the outer diameter of the inner gasket is 120 mm. When a record is placed on this vacuum platter and held down evenly across the entire record surface with a record compressor or heavy turntable mat, an air-filled chamber is formed. The vacuum platter has channels going from the formed air-filled chamber to a suction (vacuum) outlet tube on the vacuum platter rim. The vacuum pump attaches here when drawing a vacuum. On the opposite side of the vacuum platter rim is a small, hand-turnable relief valve. It breaks the vacuum, allowing the record to be removed from the vacuum platter.

After the battery-operated pump creates a sufficient vacuum by removal of air from the chamber formed by the record and vacuum platter, the pump automatically stops. The gaskets, which have a tacky feel, firmly attach themselves to the record rim and label, permitting no air to enter the formed chamber. In turn, the record is immediately pulled (sucked) flat against the vacuum platter surface, effectively eliminating the warps. When the vacuum is drawn, atmospheric pressure exerts a force of about 551 lbs. (250 kg) on the record surface, forming a solid bond between the vinyl and the metal vacuum platter and making the record effectively a part of the vacuum platter.

After using the AT666EX over a long period of time, it may well be advisable to replace the rubber gaskets in order to keep the device in a mint-like condition. Those who have more than one turntable can purchase, separately, additional stabilizer plates.

A word of caution—the rubber sealing gaskets and the record surface contacting these gaskets must be scrupulously clean if the vacuum is to be maintained for at least 30 minutes. The average length of an LP record is about 27 minutes, with a rare record lasting 33 minutes.

The advantage of a vacuum clamp system is that it eliminates record warp, distortion, and resonance problems associated with the usual manner of playing records. Feedback, both acoustic and stylus, is usually the cause of disc resonance that results in an increase in distortion and sound-smearing. The same sort of distortion and sound-

smearing can also occur in the absence of acoustic feedback but in the presence of stylus feedback.

### Test Procedures and Results

All tests were performed under the following conditions: Constant ambient temperature and humidity at 75° F, 67% humidity; constant ambient temperature at 84° F, 70% humidity, and constant ambient temperature at 66° F, 70% humidity. Each temperature change required that all elements remain at that temperature and humidity for a period of three to four hours.

Records used in the tests were cleaned with the Disc-washer record-cleaning system. The rubber gaskets of the Disc Stabilizer were cleaned in various ways, e.g., with a dampened and wrung-out cleaning leather (chamois), Scotch tape, 25% to 50% ethyl alcohol, pure white cake soap, and a plastic kitchen sponge. Again, a word of caution: The only 25% to 50% alcohol permissible for use in cleaning the rubber gaskets is ethyl alcohol (also known as ethanol, grain alcohol or grain spirits). Neither methyl alcohol (also known as methanol, carbinol or wood alcohol) nor isopropyl alcohol (rubbing alcohol) should be used as they frequently contain other ingredients (e.g., lanolin) which are harmful to rubber. A trade secret—if ethyl alcohol is not available, 100-proof (*not* 80 proof) vodka (e.g., Smirnoff or Wolfschmidt) may be used inasmuch as it is 50% ethyl alcohol and has no additives, such as flavoring agents. Stolichnaya vodka is not acceptable because it contains a flavoring agent. If you wish to use a 25% alcohol solution, dilute the acceptable vodka 1:1, one ounce of distilled or mineral-free water and one ounce of vodka.

The Technics SP-10 Mk II direct-drive turntable was used in these tests in combination with the Audio-Technica AT666EX Disc Stabilizer. Where necessary, the Luxman PD-555 vacuum turntable was used as the control.

The records used in testing had an average mild warp, and one record was very warped.

To get the platter and rubber gaskets clean enough for my lab tests I experimented with a number of procedures. In the first of these, I dampened the cleaning leather in water, thoroughly wrung it out, and then applied the chamois to both the platter and rubber gaskets. A second technique involved using a 50% alcohol-dampened, lint-free cloth to wipe both platter and rubber gaskets. A third and more thorough method was to take a plastic kitchen sponge dampened with plain tap water, lightly rubbed on a cake of white soap, and then applied to the metal platter and rubber gaskets. The soap was then removed with a tap-water dampened plastic sponge, and the entire platter and the rubber gaskets wiped with a 50% alcohol-dampened, lint-free cloth.

After any cleaning procedure, if some lint and dust remain on the tacky rubber gasket, the adhesive side of Scotch tape (or Audio-Technica's AT6104 Dust Cleaner) should be dabbed, not rubbed, over the entire area of the rubber gasket to remove the foreign matter. The record areas that will be in contact with the rubber gaskets should be dabbed with Scotch tape to remove any foreign matter.

The absence (zero warp) or presence of warp was visually checked with the aid of a tonearm and cartridge combi-

**“The rubber sealing gaskets and the record must be scrupulously clean if the vacuum is to be maintained.”**

nation. The check points were about ½ inch beyond the record edge, in the middle of the record, and about ⅛ inch from the run-out groove.

The record compressor was used at all times to press the record evenly against the Disc Stabilizer when establishing the vacuum seal. Using the electric pump, the vacuum seal was established within five to six seconds.

Due to the nature of this study, I requested two additional Disc Stabilizers so that initially each device would undergo only one cleaning test.

When using the first cleaning procedure (the damp chamois) under any of the temperature and humidity conditions, the vacuum seal did not hold well and warp was visible for 12 to 15 minutes after establishing the vacuum seal and zero visual warp. However, the record could be played reasonably satisfactorily under these conditions since only the outer edge showed the presence of warp, and the stylus was already playing the middle of the record. Therefore, the sound was not affected too much by the visible presence of some edge warp. Because the rubber gaskets are tacky, they continue to adhere to the record, and about 25% of the vacuum remains. An increase of the ambient temperature to 84° F only prolonged the time required to establish the vacuum but did not appear to have any effect on the length of time the vacuum held. A decrease in ambient temperature to 66° F did not appear to have any visible effect on the test or the length of time the vacuum held. From the temperature studies, I concluded that the AT666EX is not temperature sensitive.

When using the badly warped record in these tests, there was some difficulty in establishing a vacuum seal. When the vacuum was established, the normally raised edge of the warp area was flattened, but the usual condition of the record called for a part of the record to be raised (i.e. warped). Accordingly, this created a strongly positive upward force that continuously worked against the vacuum seal and in about 9 or 10 minutes broke the vacuum seal.

All the test results following the second cleaning procedure were, in general, quite similar to those of the first cleaning procedure. However, when the third and more extensive cleaning procedure was used, the vacuum seal held for 27 minutes. Apparently, records that are badly warped cannot be flattened for the entire playing time. This record was checked on the control device, the Luxman PD-555, where the problem was not encountered.

Because of the problems associated with the first two cleaning procedures, I concluded that the Disc Stabilizer and the rubber gaskets were contaminated during the manufacturing and/or assembly period and needed a more thorough cleaning. Consequently, I cleaned the entire Disc Stabilizer using the third cleaning technique.

The test results were dramatic. A vacuum seal was established at zero warp that held for a period of two hours and 20 minutes, although a moderate amount of warp was visible across the entire record at the end of the time period. The badly warped record stayed reasonably flat for over one hour, starting with zero warp. The average warped record was held flat for proper playing with just a barely perceptible warp seen at the outer edge on some records at 25 to 30 minutes. Most of the mildly warped records

remained flattened for more than 30 minutes, long enough to eliminate the problems caused by warp during play.

After using either of the first two cleaning procedures on the Disc Stabilizer, I conducted a number of experiments at an ambient temperature of 75° F, 67% humidity. Using an average, mildly warped record, I established a vacuum seal and zero warp, then reattached the vacuum hose to the Disc Stabilizer and turned the vacuum pump to the “On” position. On the average of about once every 5.9 seconds, the vacuum pump started to draw a vacuum for less than a half second, reestablishing the original vacuum. This action was observed for 30 minutes at a time for a total of four hours. Under these conditions it became evident that a small leak developed 4½ minutes after the original vacuum was drawn and verified for zero warp. When the 30-minute time period had elapsed, the constant action of the vacuum pump maintained the vacuum despite the leak. When the vacuum was permitted to leak, the experiment ended within 15 minutes.

When the third cleaning procedure was used this phenomenon did not occur. With the pump attached as above, the vacuum seal held from 25 to 30 minutes before the vacuum pump was activated to reestablish the original vacuum. This test was repeated four times with reasonably similar results.

It should be mentioned that the more extensive third cleaning procedure was needed only once—when the Disc Stabilizer was first used. Thereafter, use of the dampened cleaning leather appeared sufficient. The Scotch tape process was used at all times to remove any possible lint or dirt that was not picked up by the cleaning leather. Of course, at some time in the future when the Disc Stabilizer has become soiled, it may again be necessary to clean the entire Disc Stabilizer, using the third technique.

#### **Use and Listening Tests**

Having spent quite a number of hours listening to records played on the Luxman PD-555 vacuum turntable during the past couple of years, I had a reasonably good aural reference point when listening to records played with the aid of the Audio-Technica AT666EX Disc Stabilizer. In my opinion, it is incontrovertible that a vacuum-turntable system, in combination with a good tonearm and cartridge, dramatically improves the sound output from any record. For proof, it is necessary only to play a record on the Luxman PD-555 vacuum turntable with and without the vacuum-clamping device and then repeat the process using the Audio-Technica AT666EX Disc Stabilizer. The results are truly amazing.

Aurally, the AT666EX was practically identical to the Luxman control system, with clean sound, particularly in the treble and upper midrange. It was a bit difficult to identify the turntable when playing a record under “blind” conditions, the Technics SP-10 Mk II turntable fitted with an Audio-Technica AT666EX or the Luxman PD-555 with its own built-in vacuum-clamping device.

In conclusion, I find the Audio-Technica AT666EX Disc Stabilizer to be a superb and effective vacuum record-clamping device. I recommend it without reservation, particularly to the audiophile who has almost everything.

*B. V. Pisha*

# You'll be sold on our DRS 900 amplifier after just one peak.

Our new DRS™ 900 amplifier will bring you as close as you can get to concert hall sound without buying a ticket. How? Power and lots of it. And after all, who knows more about high power amplifiers than Phase Linear? We became known for them back in the days

when everyone's idea of good stereo was loud stereo.

If you could blow the windows out of your home, you had a good stereo.

And nothing could blow out windows like an amplifier from Phase

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get pure sound reproduction out of a low power amplifier. You need lots of power... power for

purity. Advances in recording technology like direct-to-disc and digital audio disc recordings require enormous amounts of peak power. Without it, the amplifier simply clips the peaks leaving you without the full musical experience. For example, accurately reproducing the final cannon shot from a digitally recorded version of

Tchaikovsky's 1812 Overture can require 900 watts of peak power! And that's at reasonable volume levels. That much power is needed because the dynamic range (the ratio of the loudest note to the residual noise) of a digital audio disc is about four times that of a conventional record.

Our DRS 900 handled the previously mentioned cannon shot. No clipping, no distortion. Yet, the DRS 900 is conservatively rated at 150 watts per channel RMS (see specifications). You see, efficient power is the key. The DRS 900 has a dual voltage power supply. It operates at an efficient 150

watt capability. Then, when the music approaches a peak requiring more dynamic headroom (more power to keep it from clipping), the

secondary supply kicks in, instantly providing up to 900 watts of peak power per channel. A conventional 150 watt amplifier has a peak power rating of

just about 300 watts.

Keep that in mind the next time you're comparing amplifiers. Don't go by RMS alone. You have to compare dynamic headroom, too. When you do, you'll be sold on our DRS 900.

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8833. Or write us at 4134 N. United Parkway, Schiller Park, IL 60176. Oh, and remember to give us your address so we can send you a copy of "The Phase Linear Report: Power for Purity." It's an exciting analysis of audio amplification in the eighties. We think it should be required reading for anyone serious about audio.

#### DRS 900 SPECIFICATIONS

150 Watts per channel continuous output power, minimum RMS into 8 ohms, with no more than .015% total harmonic distortion, 20-20kHz. 900 Watts peak per-channel momentary output power into 8 ohms with no more than .02% THD, 20-20kHz.



## Power for Purity™

Enter No. 23 on Reader Service Card

## 3

## HARMAN/ KARDON T60 TURNTABLE

### Turntable

#### Manufacturer's Specifications

**Speeds:** 33 $\frac{1}{3}$  and 45 rpm, variable control.

**Motor Type:** Servo-controlled d.c., quartz lock f.g. generator.

**Drive Type:** Belt.

**Wow & Flutter:** 0.035% wtd. rms.

**Rumble:** -67 dB, DIN B.

**Pitch Range:**  $\pm$ 3%.

**Features:** Disc stabilizer, capacitance trim switch (+100, +200 pF), auto lift, detachable gold-tipped phono cables.

### Tonearm

**Type:** Low-mass, straight, statically balanced.

**Stylus Overhang:** 18 mm.

**Offset Angle:** 25.5°.

**Effective Length:** 8.9 in. (226 mm).

**Tracking Error:**  $\pm$ 2°.

**Recommended Tracking Force Range:** 0 to 3 grams.

**Phono Capacitance:** 100/200/300 pF.

### General Specifications

**Dimensions:** 17.3 in. (44.0 cm) W  $\times$  5.8 in. (14.8 cm) H  $\times$  15.7 in. (37.2 cm) D.

**Weight:** 17.6 lbs. (8.0 kg)

**Price:** \$399.95.

**Company Address:** 240 Crossways Park West, Woodbury, N.Y. 11797.  
For literature, circle No. 92



Harman/Kardon's new T60 turntable is a sleek, low-profile design with some rather interesting features. Unlike most models in this particular price range, it does not use a direct-drive system; the makers have opted for a d.c. servo-

controlled motor with a belt drive. The belt—which is a flat nylon ribbon—drives a 3.3-lb. platter having an extra deep polished edge. A flat, rubber mat adds about 12 oz., and I was pleased to note that there are no ribs or holes to



weight carbon fiber, has a single screw fixing. Both arm and motor are mounted on a counterweighted subchassis which is suspended on three "dash-pots." This subchassis is made from diecast aluminum, and the floating suspension puts the center of gravity at the platter spindle. The unit comes complete with a disc stabilizer which has a diameter of  $2\frac{3}{4}$  inches, weighs  $1\frac{1}{4}$  lbs., and has strobe markings on the top. Another uncommon feature of the T60 is a three-position capacitance trim switch which can add 100 or 200 pF to the phono cartridge's load.

The cue lift lever is located just in front of the arm base, next to the anti-skating dial, while all the other controls are situated at the front. Reading from left to right, they are: Variable speed control, quartz-lock switch, speed-selector switches, trim control, and auto/manual switch. Operation is not fully automatic, as the arm is only lifted at the end of a record.

The base is constructed from heavy chipboard with an attractive, smooth, silver finish and an aluminum control panel, and the unit stands on four large, adjustable feet. Output connection—gold-plated RCA-type phono sockets—are at the rear, together with a ground terminal. Gold-plated plugs are used on the low-capacitance connecting cables.

#### Measurements

For test purposes, an ADC ZLM cartridge was mounted on the shell, and alignment was set with the neat plastic gauge supplied. This gauge has the overhang template on it as well as "zero error" tracking points at 66.04 and 120.90 mm from the center spindle. The offset angle is  $25.5^\circ$ , which puts the maximum tracking error at approximately  $+2^\circ$  and  $-1.2^\circ$ . Tracking force was set to 1.5 grams for most tests and the anti-skating dial just over that figure. As a matter of interest, the ADC ZLM was able to track most records quite happily at 0.8 gram in this arm, and similar results were had with the Shure V15 Type V. Arm-cartridge resonance was a trifle low at 6.5 Hz, but the rise was only 3 dB.

Wow and flutter measured a low 0.03% (DIN 45-507), and rumble was  $-59$  dB. Using the Thorens "Rumpel-Messkoppler," the figure increased to

66 dB (ARRL). Arm friction was very low indeed in both vertical and horizontal modes, and there was no trace of sideplay. Tracking force calibration was within 5% from 1 to 2 grams, and the anti-skating adjustment gave very good matching. Speed was well within the tolerances of the test record at 0.1% fast, and the variable control gave a range of  $+3.4\%$  and  $-4.4\%$ , measured with the quartz lock switched off.

Speed was not affected when the disc stabilizer was placed on the platter—although the natural oscillation period of the suspension system changed, with the amplitude decreasing and the decay time increasing. This weight is not as effective in dealing with warped records as larger edge clamps or vacuum systems, but it does "bond" most records to the platter quite well and certainly performs a useful function. As for the capacitance trim control, this is definitely a worthwhile refinement since there are a few cartridges out there which need loads of 400 pF or so for best results.

#### Use and Listening Tests

In operation, the T60's arm is moved manually to the required position, and the cue lever is used to lower the stylus gently into the groove. If the "Lift" button is set to "Manual," the motor will not stop at the end of play and the stylus will remain in the run-out groove. In the "Auto" mode, the motor will stop and the arm will lift—it will not return to its rest position. The cueing device works well, with a minimum of backlash, but it is not accessible when the dust cover is closed.

Predictably, the T60 is reasonably free from acoustic feedback, and the base can be knocked quite hard before any mistracking occurs. Like other Harman/Kardon products, the T60 is notable for clean, "no nonsense" styling, and the performance level attained by its well-designed arm makes use with a top-quality phono cartridge necessary.

*George W. Tillett*

cause resonances. The arm is a low-mass type (only 8 grams) constructed from tubular aluminum and measuring 8.9 inches from pivot to stylus. Micro-race bearings are employed, and the headshell, which is made from light-

*George Tillett, a former editor of this magazine, died in an accident on Saturday, October 30, 1982. Reflections will appear in our next issue.*

# 4

## VECTOR RESEARCH VCX-800 CASSETTE DECK

### Manufacturer's Specifications

**Frequency Response:** 25 Hz to 17 kHz, to 19 kHz with CrO<sub>2</sub> tape, to 21 kHz with metal tape.

**Signal/Noise Ratio:** 65 dBA.

**Separation:** 33 dB.

**Crosstalk:** Down 63 dB.

**Erasure:** 65 dB.

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

**Output Level:** Line, 700 mV; head-  
phone, 150 mV at 8 ohms.

**Flutter:** 0.03% wtd. rms.

**Wind Times:** 120 seconds for C-60.

**Dimensions:** 17-5/16 in. (440 mm) W  
× 5 1/8 in. (143 mm) H × 14 5/8 in.  
(371 mm) D.

**Weight:** 21.6 lbs. (9.7 kg).

**Price:** \$1,000.00.

**Company Address:** 20600 Nordhoff  
St., Chatsworth, Cal. 91311.

For literature, circle No. 93



The Vector Research VCX-800 cassette deck offers the major features of most premium-priced decks (such as Dolby B and C, remaining tape-time counter, and tape calibration facilities) plus a few small but exclusive features of definite interest.

One of the major features is the VCX-800's microprocessor-controlled "Compucounter." Press a light-touch button to set it for your tape's length (C-45, C-60 or C-90) and a few seconds after starting play or record from any point on the tape, it will display remaining tape time in fluorescent digits. If the user forgets to enter the tape length, the Compu-counter will light a "Correct" LED and set itself. Where timing is not needed, pressing "C-90" and "Lock" gives an uncalibrated time readout.

The Compucounter has two tape-position memories which can be set with the "Save 1" and "Save 2" buttons during play or record, or set to any tape time with the 10-digit keypad when the transport is stopped. The display shows each entry as it is being made, and the "Save" entries can be displayed at any time by pressing "Memory Read."

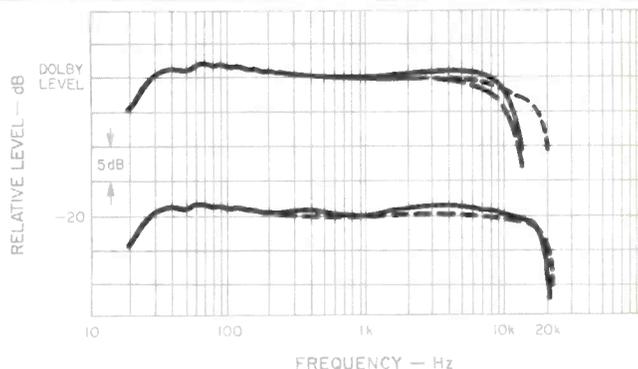
Pressing "Search" winds the tape to the first memory position, then returns to whichever mode (play or stop) the deck was in when it was pressed. The auto rewind and play buttons can set up combinations of automatic rewinding, stopping or playing, as desired, including continuous cycling between the two memory locations. These start and stop entries can be removed with a push of the "Save Clear" button. The scheme is convenient and flexible.

Light-touch rectangular buttons control the transport functions, with LED status indicators for all except "Stop." Pressing the "Record" button puts the deck in record-pause mode; recording begins when "Pause" is pushed. Flying-start recording is not possible: Pushing "Record" while holding down "Play" still just puts the deck into record-pause mode.

A push of "Record Mute" records four seconds of silence on the tape, then puts the deck in record-pause mode; holding the button down lengthens the muting period—a good scheme.

The row of push-in/push-out switches at the bottom center of the front panel include the "Monitor" ("Source/Tape") and five noise-reduction controls. The latter include "NR In/Out," "Dolby NR B/C," "Dolby System FM In/Out" (for decoding FM broadcasts from an external tuner or receiver), "Dolby System NR-HX In/Out" and "MPX Filter In/Out." The switches are logically interlocked: When "Dolby System FM" is pressed, the "Dolby NR B/C" selector is automatically set to Dolby B, since no station broadcasts with Dolby C. When "Dolby System NR-HX" is engaged, the Dolby FM circuit is defeated to prepare the deck for recording. This happens regardless of the physical switch settings—good human engineering.

The three-position ("Fe/Co/Metal") rotary tape-select switch has a large bar knob. The input and output level controls have good-size knobs, with friction coupling between the two sections of the former. The horizontal bargraph meters have 20 segments for each channel (orange up to zero and red above) and a switchable peak-hold function with settings for "Auto" (held for a second or so)



**Fig. 1—Record-playback responses using Maxell UD-XL I tape with Dolby C NR (solid line), with HX added (short dash), and without NR (long dash).**

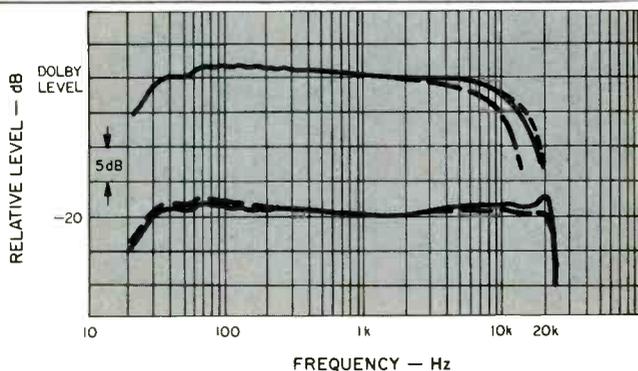
and "Manual" (held until released or exceeded). Further left is the test section, with center-detented "Rec Cal" and "Bias Adjust" trim pots. "Test In" inserts a 400-Hz tone into the left channel and a 400-Hz to 15-kHz swept sine wave into the right channel. "Rec Cal" is adjusted for zero indication with the "Monitor" switch in "Tape" position, and bias is adjusted for flat response over the range of the sweep (also indicated at zero, although actual test levels are lower). A "Test Monitor" switch allows feeding the test signals out through the line out and headphone jacks. A bright red indicator between the bar graphs reminds the user when test mode is being used. The combination makes for an excellent tape-to-deck matching scheme.

Also on the front panel are the mike phone jacks (left only, for mono), the headphone jack, and, to the left of the cassette compartment, the power and timer switches and the eject button. On the back panel are the line in/out phono jacks, the Dolby FM calibration pots, sockets for an optional remote control and for control by the timer in the Vector Research VRX-9500 receiver, and a fuse-holder. (The receiver also has dbx encoding and decoding.) The VCX-800 showed a number of fairly large p.c. boards, with very good to excellent soldering. Many of the interconnections were made with multi-pin plugs, though some wirewrap and direct soldering were also used. Adjustments were labelled, as were all components with the exception of the resistors (so, read the color coding). The drive ran very quietly, and the two-motor, dual-capstan design was quite impressive. The power transformer was large, and there were two fuses in clips. The chassis construction was rugged and rigid.

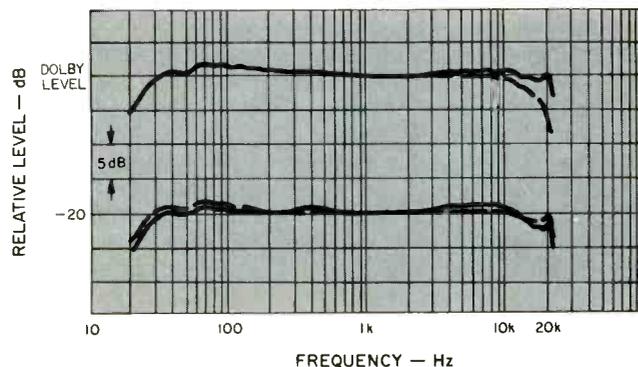
#### Measurements

The playback responses were excellent at both equalizations, with most points within less than a dB of flat. Playback level indications were correct within the resolution of the meter segments. Reference tapes for the deck were TDK AD, SA and MA, but excellent results were obtained from many tapes with the aid of the "Rec Cal" and "Bias Adjust"

"If the user forgets to enter the tape length, the remaining-time counter sets itself."



**Fig. 2—Record-playback responses using TDK SA tape with Dolby C NR (solid line), with HX added (short dash), and without NR (long dash).**



**Fig. 3—Record-playback responses using Memorex Metal IV tape with Dolby C NR (solid line), with HX added (short dash), and without NR (long dash).**

trim pots. Each tape was set up using the built-in test scheme. Dolby tracking could be checked by switching Dolby NR in and out. Mistracking was indicated by any large level variations in the right-channel (swept sine wave) signal after initial setup without NR. Maxell UD-XL I, TDK SA and Memorex Metal IV were selected for the testing to follow, but BASF Professional I Super, Maxell UD-XL II-S and TDK MA could have been chosen just as well.

Figures 1 to 3 show the record/playback responses with the three tapes selected, at Dolby level and 20 dB below that, both with and without Dolby C NR. Headroom extension (HX) NR was also added for the Dolby level tests with Maxell UD-XL I and TDK SA. All of the responses were very good, and the Dolby tracking was generally excellent, as shown. Dolby HX was most effective with the Type I tape, but there was some improvement with SA also. All of the responses had a rise of 1 to 2 dB around 70 Hz. The measured 3 dB down points are listed in Table I; as expect-

ed, the best of the good results go with the metal tape. The built-in 400-Hz (419-Hz actual) test oscillator used for record calibration had less than 0.3% distortion, much less than most such built-in sources. Sweep range was actually from 526 Hz to 14.5 kHz, plenty close enough to the nominal 400-Hz/15-kHz specification. The "Rec Cal" pot had a range of -8 to +6.5 dB with UD-XL I tape. The bias trim pot could set the response at 10 kHz anywhere from -4.5 to +3 dB relative to that at the detent position. Tests showed these pots could match the great majority of tapes.

With a 10-kHz test tone, there was 20° phase discrepancy between tracks and a total of 20° jitter, better than most decks. The multiplex filter was 3 dB down at 15.9 kHz and a good 32.5 dB down at 19.00 kHz. There was no bias observed in the output in record mode. At 1 kHz, separation was a good 40 dB, and crosstalk was down more than 83 dB, an outstanding figure. Erasure of metal tape at 100 Hz was 64 dB—a very good result.

**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
Maxell UD-XL I	22	10.3	22	18.0	22	8.7	22	18.7
TDK SA	24	9.9	23	21.0	24	6.4	22	21.1
Memorex Metal IV	22	21.0	22	20.8	22	14.8	20	21.0

**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%
Maxell UD-XL I	66.3	71.5	51.6	56.3	67.8	73.0	49.4	54.1
TDK SA	69.1	71.9	54.8	56.3	70.4	73.2	52.0	53.5
Memorex Metal IV	68.3	73.8	53.5	58.3	70.0	75.5	51.4	56.2

The third-harmonic distortion was measured at 315 Hz in Dolby C mode for all three tapes, from 10 dB below Dolby level to the points where HDL<sub>3</sub> = 3% (Fig. 4). The figures for metal tape were certainly very good, and those for UD-XL I were even better. For Memorex Metal IV, HDL<sub>3</sub> vs. frequency was determined from 50 Hz to 6 kHz at -10 dB (Fig. 5). The distortion is quite low in the mid-band, with the expected rises at the frequency extremes.

The signal-to-noise ratios were checked with both IEC A and CCIR/ARM weightings, with and without Dolby C NR and with reference to both Dolby level and the 3% distortion points. The results in Table II demonstrate quite clearly the lower noise benefits of Dolby C NR, with excellent ratios for all three tapes.

The input sensitivities were 0.13 mV for mike and 44 mV for line, both notably lower (more sensitive) than specification. The overload points were at 25 mV for mike and 6.9 V for line, high enough for normal usage. The input-level pot sections tracked within a dB for about 45 dB down from maximum, fairly good. The input impedance was close to 90 kilohms over most of the band, falling to a very acceptable 25 kilohms at 20 kHz. Output clipping appeared at a level equivalent to +14.3 dB relative to meter zero. The line output was within the meter-segment resolution of the 700-mV specification. It fell to about 630 mV with a 10-kilohm

"All of the responses were very good, and the Dolby tracking was generally excellent."

load, indicative of the 1-kilohm output impedance. The multi-detented input and output pots had "steps" of 1 to 1.5 dB but were actually continuous and could be set at in-between points. The output polarity was the same as the input in "Source," but it was reversed in playback.

The bar-graph meters were faster than VU types, requiring close to 100 mS duration of the test-tone burst for zero indication. The decay time for 20 dB was about 300 mS, making a reasonable combination with the fairly fast response. The -3 dB response points were at 24 Hz and 21 kHz. Meter calibration was accurate above "-10" and below "+5," but beyond those levels the errors were a dB or greater. For example, "-20" was at -17 dB, and "+8" was at +6.2 dB actual, but the important near-zero thresholds were all accurate. Up to zero, the segments were orange and a somewhat dull red above that; meter reading was easier in dimmer light. It should be noted that the regular maximum indications were held: There was no faster-than-normal response with peak hold.

Playback of a 3-kHz tone recorded at 120 V line power showed no variation in speed (frequency) with the power supply anywhere from 110 to 130 V. Flutter checks over the length of a cassette revealed consistent performance at every point, with figures of 0.04% wtd. rms and 0.068% wtd. peak. The wtd. rms result was slightly above specification, but the results are excellent just the same, and another cassette might very well have given lower figures. Speed variations over a period of time were less than 0.03%. Wind times averaged 115 seconds, better than specification, but much longer than most decks. Run-out to stop, changing wind direction, or going from wind to play all took a second or less. There was a wait of approximately two seconds after insertion of a cassette before the VCX-800 would initiate any mode. That was caused by the worthwhile loose-loop take-up system, which always did its thing first.

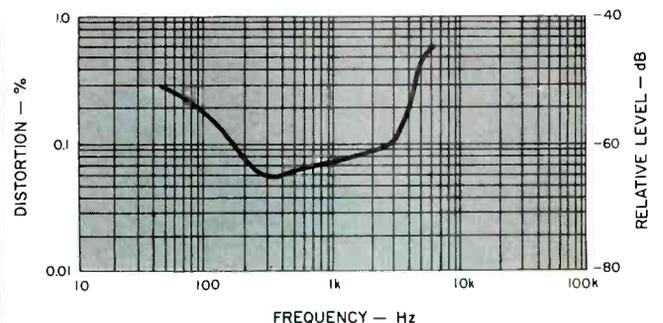
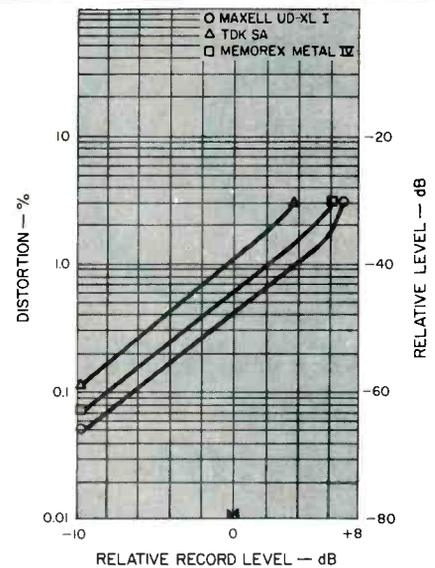
### Use and Listening Tests

Vector Research provides instructions in two forms: A 14-page manual and a two-page hard-paper operation reference guide that is very handy for keeping next to the deck. The manual has good text, including the maintenance instructions, and very good diagrams on various auto-wind/play actions. There are several detailed schematics covering all of the circuit cards.

Tape loading/unloading was easy and direct. Access for maintenance tasks was fairly good, but definitely improved when the door cover was removed. All of the controls and switches were completely reliable throughout the testing. Interchannel level adjustments were a bit fussy because of the high friction, which would have been less of a problem if the knobs were knurled. Different features of the deck kept showing their conveniences. The readout of remaining time was one of the most helpful for this user. The test scheme worked very well, and adjustments could be made within a few seconds to match most tapes and to ensure good Dolby tracking. Metering was easy in general, and "Peak Hold" was of obvious benefit. No record or pause noises were detected: There were low-level stop clunks, heard in tape noise (with Dolby C).

The listening tests included pink noise and high-quality

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



**Fig. 5—Third-harmonic distortion vs. frequency with Dolby C NR, at 10 dB below Dolby level, using Memorex Metal IV tape.**

discs such as Umbrella's "Big Band Jazz" with Rob McConnell and the Boss Brass. There was excellent Dolby tracking in all cases, with only the very slightest subtle shifts at times. With some of the sources, there was some improvement when HX was added. Dolby C showed its definite low-noise superiority in quiet portions of the best discs. A slight emphasis could be noted in the bass on a number of occasions, but the playback was still very close to the original.

The VCX-800 would not be the best choice for someone who records just miscellaneous pop selections and likes to play them in a specific order. This deck does not have a selection program scheme, and its wind times are on the high side. However, the unit is most worthy of comparison to other decks in its price range: It offers excellent performance in general, an accurate and convenient remaining-time readout, an excellent test matching system, and other automatic features—to say nothing of Dolby B and C, as well as HX and FM Dolby decoding. *Howard A. Roberson*

# 5

## POSTSCRIPT: SONY CDP-101 DIGITAL AUDIO DISC PLAYER

**Manufacturer's Specifications\***  
**Frequency Response:** 5 Hz to 20 kHz,  
 ±0.5 dB.  
**S/N Ratio:** Greater than 90 dB.  
**Channel Separation:** Greater than 90  
 dB at 1 kHz.  
**Harmonic Distortion:** 0.004% at 1  
 kHz.

**Company Address:** Sony Dr., Park  
 Ridge, N.J. 07656.  
 For literature, circle No. 94

\* For complete list of specifications,  
 see November 1982 issue, page 43.



Here is a "better-late-than-never" effort to quantify the performance of the remarkable Sony CDP-101 DAD player which I tested for the November 1982 issue of *Audio*. If you read that report, you will recall that right up to press time I had hoped to have a definitive test record with which to measure the

performance of the new digital disc player in an objective manner. At last, the people at Sony (co-inventors with Philips of the Compact Digital Disc player system) came up with the first such disc that I know of and loaned me a copy. And of course, that gave me a good excuse to borrow back the DAD

player, along with a couple of new Compact Digital Discs I hadn't auditioned before.

### Contents of the Test Disc

The Sony Test Disc (catalog number YEDS 2) is entitled "Test C.D. Type 1 for Signal Performance Check." It con-

tains a total of 39 separate bands or test signals and, like all digital discs, also has an encoded "Table of Contents" listing the number and length of these selections.

Band 1 is a 1-kHz, reference-level signal recorded at 0 dB level on both channels. (Recall that "0 dB" in this digital disc system is the highest recordable level available.) Unlike analog tape or disc recording, there is no available headroom beyond 0 dB.

Bands 2 through 11 contain spot frequencies of 100 Hz, 200 Hz, 500 Hz, 1 kHz, 5 kHz, 7 kHz, 10 kHz, 16 kHz, 18 kHz and 20 kHz, all recorded at the same 0 dB level and on both channels. These bands are used to check playback frequency response, THD versus frequency, and the presence of any modulation noise.

Bands 12 through 20 contain 1-kHz test signals on both channels, recorded at progressively lower and lower signal levels, beginning at 0 dB and followed by levels of -1, -3, -6, -10, -20, -60, -80, and -90 dB. These signals are used to check linearity of the player as well as THD versus level.

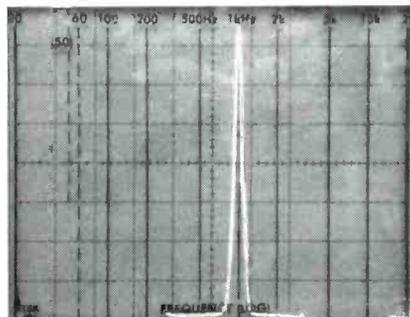
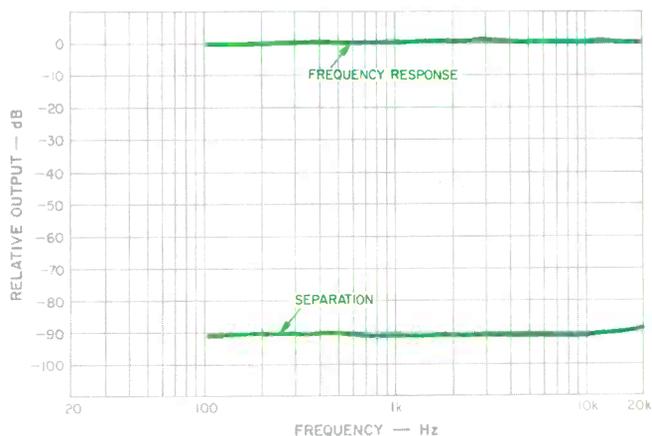
Band 2 is the digital equivalent of a "silent groove" analog recording and is used to check the player's signal-to-noise ratio.

Bands 22 and 23 contain a two-tone, SMPTE-type IM test signal (400 Hz and 7 kHz in a 4:1 ratio) at levels of 0 and -10 dB, while Bands 24 and 25 contain 19 and 20 kHz twin tones recorded at 0 and -10 dB levels.

Bands 26 through 33 contain frequencies of 100 Hz, 1 kHz, 10 kHz and 20 kHz at 0 dB level, recorded first on the left channel and then on the right. These signals are used to measure the system's channel separation capability. Bands 34 and 35 contain square-wave signals at 100 Hz and 1 kHz for transient response measurement.

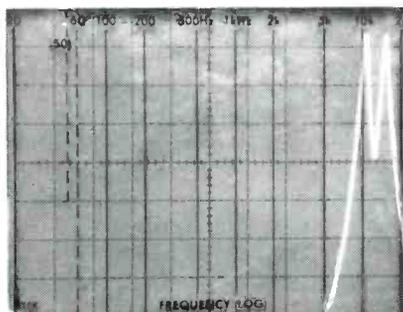
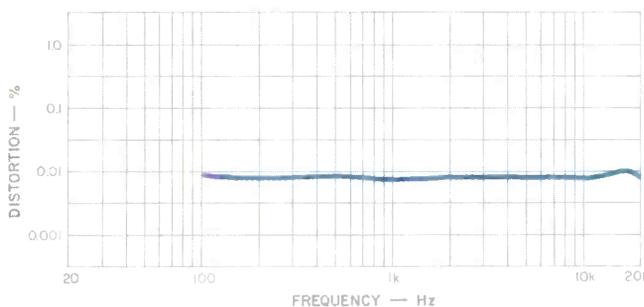
The standards developed for the Compact Digital Disc incorporate pre-emphasis and de-emphasis characteristics involving time constants of 50 and 15  $\mu$ s. To test whether players have correct de-emphasis characteristics, bands 36 through 38 contain test frequencies of 1, 5, and 16 kHz, recorded so that during playback they should reproduce levels of -0.37, -4.53, and -9.04 dB respectively.

**Fig. 1—**  
**Frequency response and separation.**

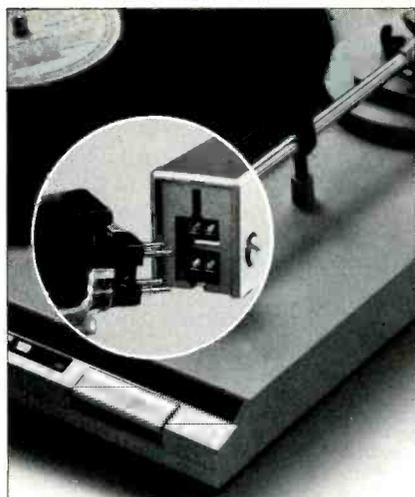


**Fig. 2—**THD for a 1-kHz test tone at 0 dB level was too low to be measured on a spectrum analyzer with a range of 80 dB. There was also no evidence of modulation noise on the Sony CDP-101.

**Fig. 3—**  
**Distortion vs. frequency.**



**Fig. 4—**Twin-tone IM test signal was reproduced with no evidence of modulation products within the audio range.



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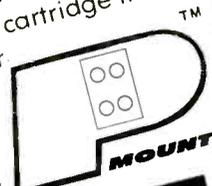


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**“There is no evidence of modulation noise or harmonic distortion within the analyzer’s range.”**

Finally, band 39 of the test record concludes with an extended 1-kHz reference test tone, again recorded at 0 dB level. This last tone runs for a full 14 minutes and 56 seconds, providing ample time for anyone to run through other desired single-tone, mid-frequency testing. All of the other bands give even the slowest moving lab tester plenty of time in which to make measurements. Bands 1 through 11 run for 1 minute and 56 seconds each; bands 12 through 38 run for 56 seconds each. Total recorded time on the Sony test disc is 61 minutes and 24 seconds—and all of that on one side of a disc which measures only 4¾ inches in diameter!

#### Measurements

Figure 1 is a point-by-point plot of playback frequency response (upper curve) and channel separation for the Sony CDP-101 player. Since the lowest test frequency on the test disc was 100 Hz, it was not possible to plot response or separation below that point. Having listened to a good deal of program material in my earlier tests and again in this re-test, I have no reason to suspect that response or separation would deteriorate in any way at still lower bass frequencies.

As for the separation plot shown, it should be more accurately described as a residual noise plot, since I saw no evidence of the discrete spot test frequencies on the 'scope when making these measurements. The readings of -90 dB or better really consisted of residual noise from the analog electronic circuitry of the player and whatever minute amounts of quantization noise might have been generated by the digital playback circuitry itself.

In an attempt to see if any modulation noise could be detected when playing back a steady tone, I fed the output of the player to a spectrum analyzer while playing the 1-kHz reference-level signal on the test disc. Results are shown in the spectrum analyzer 'scope photo of Fig. 2. There is no evidence of modulation noise or of harmonic distortion with the analyzer's 80 dB of dynamic range (-80 dB translates to a percentage of 0.01%).

Figure 3 is a plot of harmonic distortion versus frequency for as many test frequencies as were provided on the

Sony test disc. Total harmonic distortion remained consistently below 0.01% for the 0 dB level at which these test signals were recorded. Recognizing that THD of a digital recorded signal tends to rise rather than fall at lower signal levels, I also measured the THD for a 1-kHz signal at levels of -10 and -20 dB. As expected, THD did rise somewhat, to an insignificant 0.01% at -10 dB record level and to -0.025% at -20 dB. Linearity remained accurate within 0.1 dB all the way from 0 dB record level down to -80 dB!

SMPTE IM followed much the same pattern as THD. At 0 dB record level, I measured an IM of 0.0075%, while at a -10 dB level, the IM number increased to 0.02%. At this point I think I should remind you that we're talking about a disc recording and player, and not an amplifier or preamplifier!

I went through the motions of plotting twin-tone IM on the spectrum analyzer, from 20 Hz to 20 kHz. As shown in Fig. 4, no IM products showed up across the sweep. Only the two test tones themselves are evident at the right-hand side of the screen.

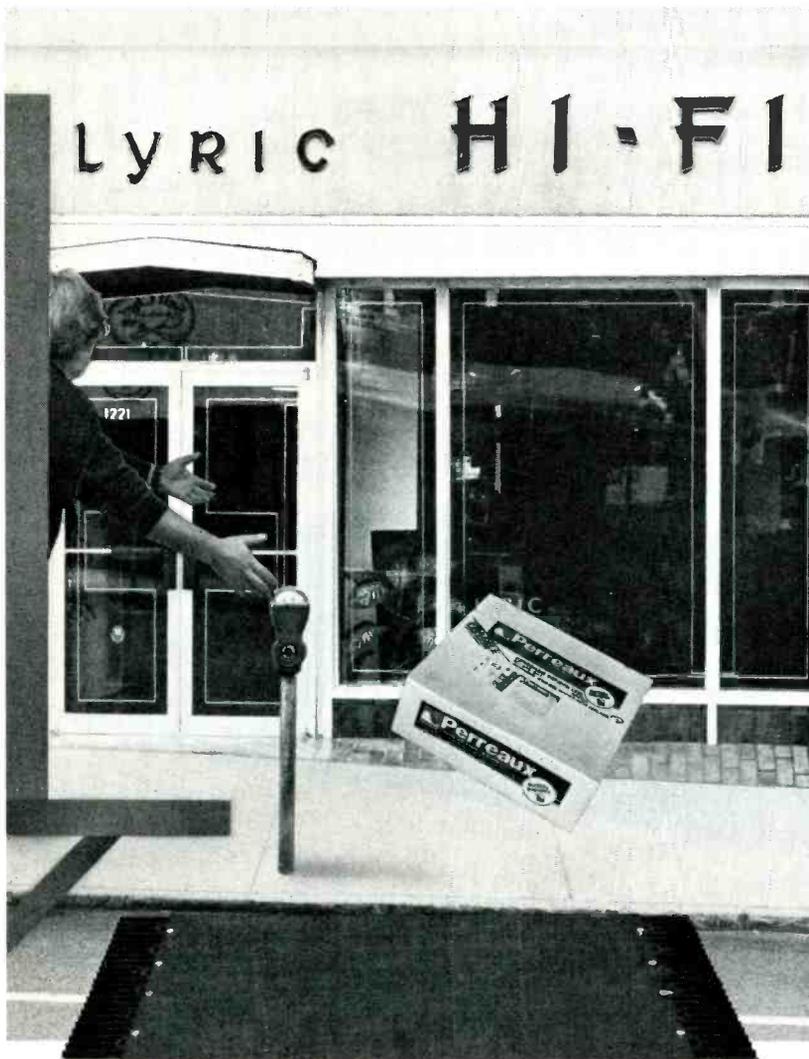
**“The separation plot would be more accurately described as a residual noise plot. I saw none of the discrete test frequencies.”**

Signal-to-noise measured 91.0 dB, unweighted, increasing to 95.5 dB when an A-weighting network was inserted in the measurement path. De-emphasis was accurate to within 0.1 dB (I measured -9.1 dB at 10 kHz, as against a specified -9.04 dB, for example), but who's to say whether my dB meter is more accurate than Sony's test disc and/or player when we're splitting such hairs?

It's always nice to get lab confirmation of what our ears tell us. In this case, the delayed arrival of the Sony test disc served a good purpose for this reviewer. The enthusiasm that I expressed in the November issue for the Sony CDP-101 player and for digital audio discs in general has not been contradicted in any way by the lab test measurements. It's nice to know that my hearing is still reasonably acute!

*Leonard Feldman*

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6

## PARASOUND EQf210 GRAPHIC EQUALIZER

### Manufacturer's Specifications

**Frequency Response:** 5 Hz to 100 kHz,  $\pm 0.5$  dB.

**Control Range:**  $\pm 12$  dB.

**Harmonic Distortion:** 0.01%.

**Signal-to-Noise Ratio:** 100 dB.

**Input Impedance:** Greater than 50 kilohms.

**Output Impedance:** 600 ohms.

**Dimensions:** 19 in. (483 mm) W x 3 in. (76 mm) H x 8 in. (203 mm) D.

**Weight:** 5½ lbs. (2.5 kg).

**Price:** \$249.95.

**Company Address:** 680 Beach St., San Francisco, Cal. 94109.

For literature, circle No. 95



The Parasound EQf210 is one of the most recent additions to the growing number of stereo graphic equalizers. It is in the most common form, having 10 filter sections with octave spacing from 30 Hz to 16 kHz. There are separate sets of vertical slider adjustments for each channel, with a range of  $\pm 12$  dB cut and boost. Each of the sliders has detents not only at the zero position, but at each of five boost and cut steps. There is no doubt about the value of a detent at the zero position, but there was some question on the desirability of detents at other positions. As the manufacturer states, the extra detents facilitate resetting to those positions, but a question on the ease of exact adjustment led to some special tests (reported later).

Between the two sets of filter controls is the "Level-Match" slider for matching EQ-in and EQ-out levels. This is a worthwhile feature to include, even though there is no means (such as LEDs) to indicate that the levels are matched

before switching. Four pushbutton switches control power, "EQ" (to equalize the line output or the feed to a tape recorder), "Monitor" (to connect a recorder's outputs to the equalizer's line outputs) and "Bypass" (of the equalizer filters). There are useful LED indicators above each switch; red is a good choice for "Monitor" and "EQ" since confusion could cause errors and unwanted results. All of the panel designations are white on a black background, quite easily read in any normal lighting.

On the back panel are the expected stereo phono-jack sets for line in and out and tape recorder in and out. It was a pleasant surprise to see some extra niceties: A second set of line-out jacks for equalizing another signal path, an unswitched a.c. convenience outlet, and a grounding post. Examination of the interior of the Parasound unit revealed quality parts and good workmanship with very good soldering on the medium-size p.c. board. It was disappointing,

however, that the board material is phenolic, rather than the superior glass epoxy. All components are clearly identified, and interconnections are made with direct soldering. As the manufacturer states, the front panel is 19 inches wide, and it can be drilled for rack mounting for high-fidelity use; its construction did not seem rugged enough for professional applications.

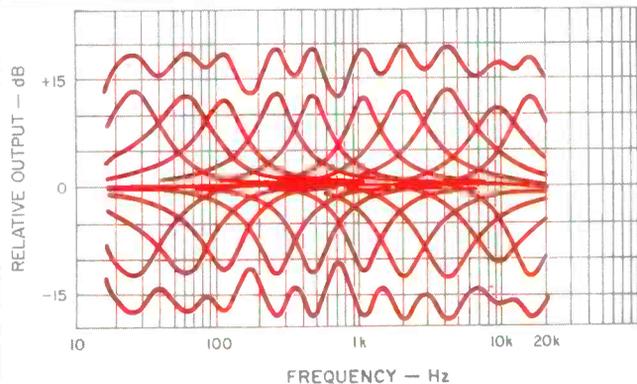
### Measurements

The frequency response of the EQ210 was very wide, whether EQ was in or out. Flatness was maintained within  $\pm 0.2$  dB to 100 kHz, with the  $-3$  dB point somewhere around 500 kHz. At the low end, the  $-1$  dB point was at 2 Hz with EQ out and at 6.2 Hz with EQ in. The  $-3$  dB points weren't reached until less than 1 Hz without EQ and 3.9 Hz with EQ. This flatness of response is certainly to be applauded, but there is some doubt on the desirability of such extended response to nonmusical energy.

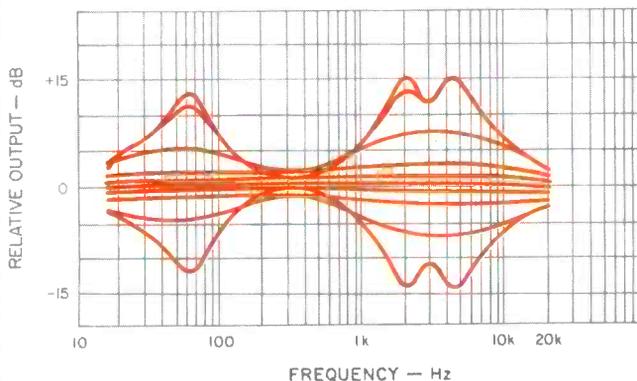
The best match for levels, EQ-in to EQ-out, came with the "Level-Match" slider at its maximum, all the way up. At that point, with all filter sliders at zero, the match was within 0.1 dB, and at its minimum position, the EQ signal path was turned off. Thus, the control had more than enough range to reduce the effect of any amount of boosting, but there is no provision for level matching if the equalization, overall, is more cut than boost.

The designated center frequencies of the filters are not the accepted ISO standards, but the discrepancies were not significant. The actual measured centers were of more interest, and, as Fig. 1 shows, the centers did not have the desired even spacing across the band. A couple of the centers were off by 12%, which is on the high side, especially since some of the adjacent filters deviated in opposite directions, increasing the unevenness of the spacing. The maximum boost and cut values were close to 12 dB or more, although the range of the 8-kHz filter was about  $\pm 11$  dB. The uneven spacing and some differences in filter shape contributed to the large deviations in the response with all filters at maximum boost and cut. This result is not that significant, though, as such settings would not occur in normal use. Octave bandwidths ( $Q=1.4$ ) were obtained with boosts of about 8.5 dB, and a  $Q$  of 1.0 was reached with a boost of 7.3 dB. It was difficult to get these bandwidth measurements because of the difficulty of setting filters between detents.

A closer examination was given to the effects of setting filters to their detented positions. On the average, the detented slider steps produced successive changes of  $\pm 0.6$ ,  $\pm 1.4$ ,  $\pm 5.1$ ,  $\pm 11.3$ , and  $\pm 12.3$  dB. The changes we might expect per step for five-step controls would be about 2.5 dB each, but the measured changes were 0.6, 0.8, 3.7, 6.2 and 1.0 dB. Figure 2 shows the swept responses with the 60-Hz and 2- and 4-kHz filters set at each detent from maximum cut to maximum boost. The responses actually stayed quite flat for the first two steps away from zero, so the result was quite different from what the slider settings suggested. With the third step there was a considerable change, and even more so with the fourth step. The fifth step produced a change at two points but not at four others, as shown. Attempts were made to make a series of boosts,

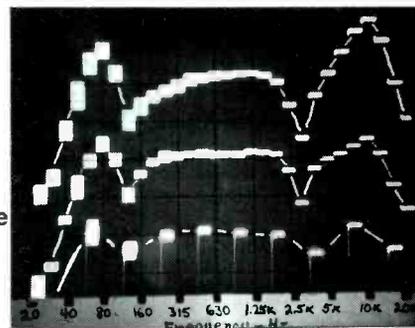


**Fig. 1—Swept-frequency responses with each filter at maximum boost and cut, and with all filters at maximum boost and cut.**



**Fig. 2—Swept-frequency responses with 60-Hz, 2-kHz and 4-kHz filters set successively at each detented step from “-12” to “+1.”**

**Fig. 3—One-third octave RTA display of simulated loudspeaker response (top), response after adjusting EQ (middle), and equalized response with 1-octave RTA display (bottom). Vertical scale, 5 dB/div.**



"The EQf210 can do a very good job of smoothing response, but care may be needed if settings are made between off-zero detents."

and cuts to get specific dB changes in response, such as -3.5 dB at 60 Hz. This and other between-detent settings were difficult to make and required considerable patience.

A fast check of the output impedance indicated it was less than 100 ohms across the band, showing substantially no loading effect from a 10-kilohm load. The input impedance was 50 kilohms or more over most of the audio band. As expected, this value fell with increasing frequency, but it was still a very satisfactory figure of 17 kilohms at 20 kHz. The maximum output voltage varied from 6.9 to 7.5 V, varying with the particular combination of boost and match-gain settings. Introducing cut reduced the maximum limits by the same amount as the cut. During the course of some of these checks, it was noted that the unit generated a high-frequency oscillation (176 to 195 kHz) when all filters were at maximum boost. The oscillation did not disappear until all filters were pulled down one step and three were pulled down to the third step. There would never be a logical reason to have all channels boosted like that, but the condition did increase my doubts about the desirability of the extended high-frequency response. The polarity of the output was the same as the input, whether EQ was in or out.

The mid-band distortion was typically about 0.0045% within its normal voltage limits. At the frequency extremes, the distortion rose to about 0.03%, which is still quite good. Slew-rate limiting did not become obvious until 90 kHz at

more than 1 V. The signal-to-noise ratios were 94 dBA and 90 dB CCIR/ARM weighted, both with a 0.5-V reference level. (For a 1-V reference, increase both figures by 6.)

### Use and Listening Tests

The four-page instructions give few details on making interconnections, and there are no illustrations as guidelines. The text is clearly written, however, with comments on the musical spectrum and some discussion on system equalizing and tape-recorder usage. There are good cautions on the possible negative effects from excessive boosts at the frequency extremes. Figure 3 shows a simulated loudspeaker response (top) and the results (middle) from using the EQf210 to smooth it. The equivalent octave-band RTA display is shown also (bottom). The improvements made are considerable and very worthwhile. The away-from-zero detents, however, made small adjustments quite difficult; results would have been better without them.

The Parasound equalizer has low distortion and very low noise, and it has good connection and switching facilities. Excessive boosts should be avoided with equalizers in general, but particularly with the EQf210 to ensure that high-frequency oscillations cannot possibly occur. The unit can do a very good job of smoothing sound system responses, but care may be needed if settings must be made between off-zero detents.

Howard A. Roberson



# talisman

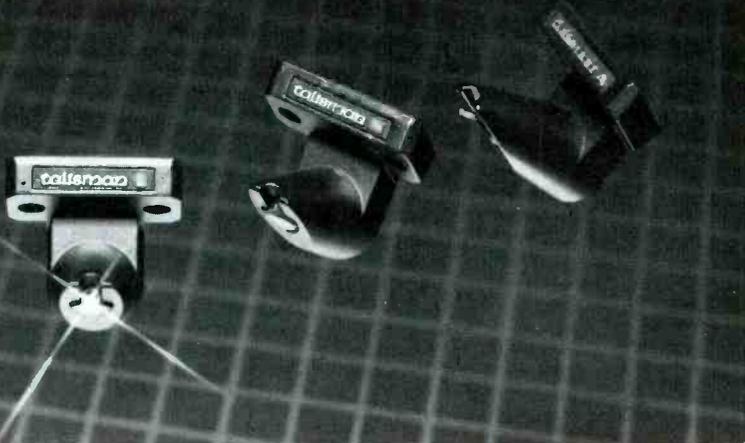
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**ONE-BRAND: SCOTT 650SL**

*Continued from page 49*

the two-head 638DM was unable to deliver its claimed frequency response for any one of the samples. It came closest to reaching its rated 17 kHz (for a -3 dB roll-off) with the metal-particle formulation. Clearly, the 19-kHz filter built into the deck is insufficiently steep and therefore begins to roll off response well before the 19-kHz null point where maximum attenuation is needed. Dolby B noise reduction

tracked well on the deck, and using TDK SA tape I measured a very good 67.5 dB of S/N, referenced to the 3% distortion point, when Dolby B NR was used. Wow and flutter, at 0.065% wtd. rms, was somewhat higher than claimed but was inaudible with most taped program material.

I did not test the 197BII speakers, which are three-way types with 15-inch, air-suspension woofers.

I have always had great respect for the Scott name and, indeed, there is nothing that is actually bad-sounding

about this rather expensive system of theirs. On the other hand, there's nothing really outstanding about it. Scott's "suggested retail value" for the system—the sum of the list prices for components and cabinet—is \$2,160, but dealers get a lower price when buying the system as a whole, and they're free to pass that savings on. That being the case, it could be a bargain. But I think that if I wanted Scott components, I would pick and choose among them rather than settle for the Slimcom package as it comes. *Leonard Feldman*

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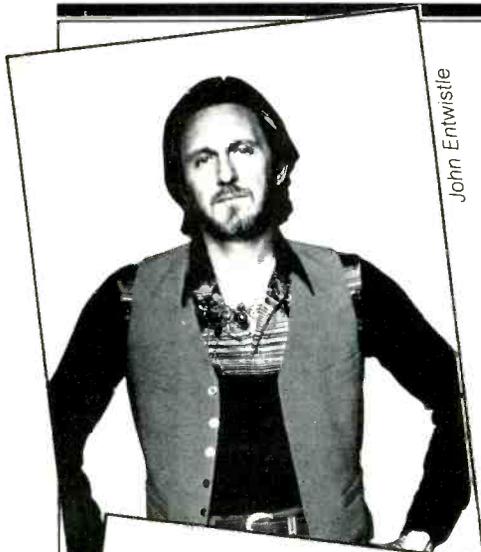
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Vice President and General Manager

# ROCK/POP RECORDINGS

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## WHODUNNIT!



John Entwistle



Kenny Jones



Roger Daltrey

**It's Hard:** The Who  
**Warner Bros. 23731-1, \$8.98.**

Sound: A — Performance: B —

I'm finding it's hard to get excited about this new Who album. It is meticulously crafted with superb sound and clarity plus exquisite separation in the Quiex II early pressings. However, this clarity does not necessarily work in The Who's favor. It gives them a rather too-proper appearance, but then "My Generation" was a long time ago. So, too, for that matter were *Tommy* and *Quadrophenia*.

The Peter Townshend songs on the album feel like more of the same batch that went into his recent *Chinese Eyes* solo album. As on *Who Are You* and *Face Dances*, the songs that rock hardest and toughest are from John Entwistle.

*It's Hard* is clearly aimed at The Who's new generation of fans, the video game generation pictured on the cover, the kids who know The Who firsthand only from stadium shows and movies. Townshend is old enough to have kids of fan age, and he has been adroit enough to notice and to keep on evolving. Indeed, the album's final track, "Eminence Front," is the most striking departure from The Who's traditional sound as it gives more than a slight nod towards the modern beat. Me, I'm still finding it hard to get very excited.

Michael Tearson

**All the Best Cowboys Have Chinese Eyes:** Pete Townshend  
**Atco SD 38-149, \$8.98.**

Sound: B — Performance: B —

Pete Townshend's newest solo album, while beautifully recorded by the Chris Thomas/Bill Price team, is a bit of a nag. And the reason why cuts directly to the heart of the songs that Townshend has been writing. Ever since *Tommy*, there's been very little humor in his work although until that time it was essential.

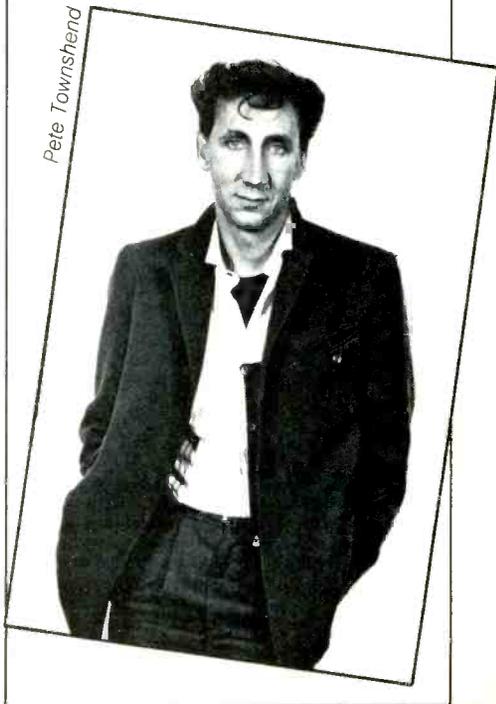
Thus you now expect a new Who or Townshend album to be a rather dour if spiritual affair, and *Chinese Eyes* is no exception. It contains both infuriatingly didactic and gloriously eloquent moments, as Townshend again spends most of his musical time rumi-

nating on the riddle of the aging rocker. "The Sea Refuses No River," "Stop Hurting People," and "Uniforms" all suffer from lyrics that resist efforts to sing them, let alone read them. "Communication" goes even further, crossing the line to unintelligibility.

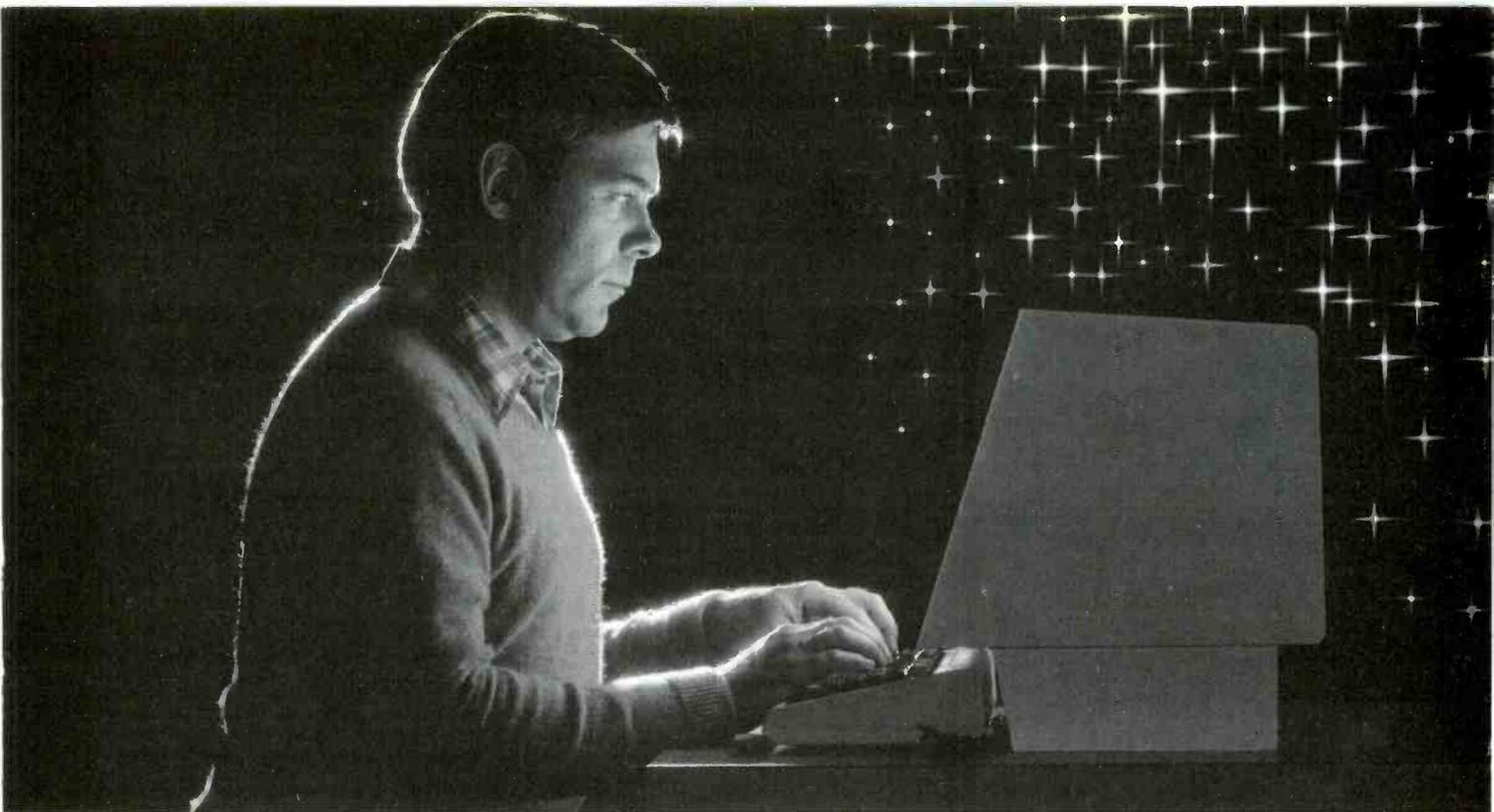
But his ode to his lady, "Face Dances Part Two," has a gloriously bright melody that makes the words better than they are. And "North Country Girl," a traditional ancestor to Bob Dylan's "Girl from the North Country," is spare and joyous. "North Country Girl," looking back to a love left behind, sets up the album's final songs, which redeem the record. "Somebody Saved Me" could have turned out precious, even embarrassing, but the ever-boldness of Townshend carries it, and that song leads to the introspective and retrospective "Slit Skirts."

Musically, *Chinese Eyes* holds no surprises. The textures and musical concepts indigenous to Townshend are so firmly established that it would take a Herculean effort for him not to sound something like a more refined version of The Who on his solo efforts. Curiously, I'm beginning to get the idea that his solo projects are beginning to mean more to him than the continued existence of The Who.

Michael Tearson



Pete Townshend



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Captain Beefheart & The Magic Band

**Ice Cream for Crow:** Captain Beefheart & The Magic Band  
**Virgin/Epic PBL 38274, \$8.98.**

Sound: B+ Performance: A-

Don Van Vliet (a.k.a. Captain Beefheart) is one of those artists who make records with absolutely no regard for current trends, commercial potential, or his audience. You can choose to call him a visionary or a lunatic, but on *Ice Cream for Crow* he covers the entire territory between the two. It's easily his best album in 10 years, but that doesn't guarantee any wider audience than he's had in the past. Still, given the general effect New Wave music has of opening people's ears to more experimental efforts, with this album

Beefheart could find himself closer to the mainstream record-buying public. If one of his earliest supporters/rippers-off, Frank Zappa, can have a hit single in 1982, there's no telling what the present holds for this guy.

Beefheart's musical base is the blues, with which he takes considerable liberties, courtesy of jazz rhythms and an original lyrical approach. Witnesseth: "The past sure is tense/ They're heading up for the main event/ All those people seem to be hell-bent/ See those people up on top of the fence/ And the man down there/ Selling knot holes through the fence/ The little shoe generation man." Well, what do you expect from someone who lives in a motor home in the middle of the Mo-

jave desert with his wife and mother? *Ice Cream for Crow* has been likened to *Clear Spot*, the definitive blues album of the '70s, and there are many similarities—a lot of his albums between then and now were not nearly so Delta bluesy in nature as this one. Much credit for this must be given to Beefheart's guitarist and manager Gary Lucas, who seems to have helped Van Vliet immensely in recovering and consolidating his vision. Lucas' playing (right channel, Walkman-iacs) is crisp and somewhat reminiscent of Ry Cooder, the original guitarist in His Magic Band.

Beefheart fans should be most delighted with this one. Although it isn't the kind of album you'd recommend for background music at parties, traditional discos or Joan Jett fans, avant-garde jazzers and New Wavers into the music of Richard Hell and Elvis Costello (two avowed fans of the Captain) might want to check this record out with a sober ear. *Jon & Sally Tiven*



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Eye to Eye

**Eye to Eye**

**Warner Bros. Automatic BSK 3570,**  
\$8.98.

Sound: B+

Performance: B

Eye to Eye has a sound we're very likely to hear a lot more of as the '80s unfold. They are a very sophisticated brew, very jazzy and high-tech sounding, very sharp lyrics. With a kinky, post rock and roll beat.

The core is the duo of English keyboardist Julian Marshall and American vocalist Deborah Berg. They wear their heroes on their sleeves. Berg's vocals and overdub techniques have clarity and odd accents reminiscent of Joni Mitchell. Rhythms and weirdness resemble Talking Heads' *Remain in Light* stripped down by the jazzy politeness of latter day Steely Dan. Having the Dan's producer Gary Katz on hand, with his access to the top studio technicians on both coasts, should ensure that quality.

Katz has given *Eye to Eye* a shimmering, detailed, pulsing sound punctuated with lots of quirky little keyboard effects. A sturdy drum sound anchors the album, allowing Marshall space to float free. Berg's vocals are more technical than emotional. Enunciation is a very strong point for her. The whole presentation insists on a vivid "This Is Art" stamp.

Their lyrics are deliciously worded reflections on life in the '80s. Most take on new twists on the age-old themes of commitment and love. Some are more political. The best, "Life in Motion," is about all of the above: Life, love, war, hunger. It is a nervous, kaleidoscopic tic of a song.

With superb craftsmanship in its conception and articulation, *Eye to Eye* is an album that you might find slight at first and then find growing on you.

Michael Tearson

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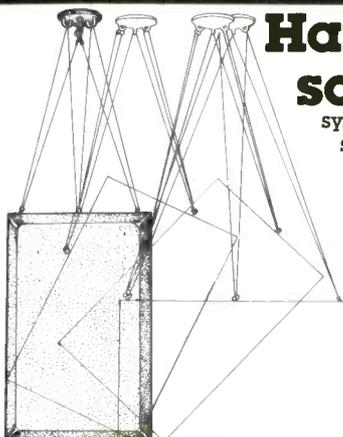
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BERT WHYTE

## △ DIGITAL AT DBX

As I write this, the 72nd Audio Engineering Society Convention will be getting underway in a few days. Thus, it will be "autumn in Anaheim," as the convention holds forth at the Disneyland Convention Center. This will be the first of the "new era" AES conventions. Up to now, there has been an AES convention in an overseas location in March, a May convention in Los Angeles, and—"autumn in New York"—a fall convention at the Waldorf. Under a new AES policy, there is one overseas convention and one convention alternating between the East and West Coasts in this country each year. This 72nd AES Convention in Anaheim will be followed by the 73rd in Amsterdam in March 1983, and the 74th at the Waldorf in New York in late October 1983. Obviously, under this setup there will be an interval of two years between conventions on the West Coast and the East Coast. Considering the rapid developments in audio technology, some feel this is too long a period. Time will tell.

As I have noted before, digital audio is "hot" these days, and you can be certain there will be many new developments in digital audio at the AES Convention. We can expect second- and even third-generation PCM digital recorders. There are sure to be various models of the Compact DAD (digital audio disc), especially since the DAD was officially launched in Tokyo late in September.

Among all the PCM digital recorders at this convention will be a surprise package from dbx. This enterprising company, heretofore associated with noise-reduction equipment, will be unveiling their new Model 700 digital audio processor. The real eyebrow-raiser here is that instead of the ubiquitous PCM (pulse-code modulation) used in current digital processors, the dbx 700 uses delta modulation.

In delta modulation, the numbers produced by the system's A/D (analog-to-digital) converter represent *differences* between successive sampled voltages, rather than a PCM adaptor's instantaneous voltage of the input signal at each point of time. Delta modulation is not new; about 10 years ago I reviewed the Delta T digital delay system in *Audio*. (Incidentally, Barry Blesser, one of our foremost digital ex-



The dbx 700 digital processor uses delta modulation, not PCM.

perts and outgoing President of the AES, was a codeveloper of this system.) I believe the manufacturing company evolved into Lexicon, well-known for their PCM digital delay systems.

There are some inherent disadvantages in delta modulation which up to now have precluded its use in digital audio recording. Dynamic range was limited, noise modulation problems ("breathing") were present, and the noise floor exhibited distinct tonal characteristics. On the plus side, delta modulation has inherently less sensitivity to bit errors. Its anti-aliasing filters are simple, easy to build and have small phase shifts, as compared to the complex filters and large phase shifts of PCM equipment.

Some years ago, delta modulation was improved by what was known as Adaptive Delta Modulation (ADM). In the words of Robert Adams, Senior Project Engineer of dbx, "In ADM, the digital number produced by the A/D converter is allowed to represent varying differences (step sizes) between successive samples. When the input signal changes quickly, the step size becomes larger, producing a digital output which tracks the input. When the input signal changes slowly, the

step size is adjusted ('adapted') to be smaller, to more accurately reproduce the waveforms. By adjusting the step size to suit the input signal, ADM extends the dynamic range of delta modulation." This ADM is a definite improvement over conventional delta modulation, but still is not good enough for serious recording.

Stimulated by the possibility of a low-cost, professional digital processor, Mr. Adams and his team of engineers set out to resolve the problems of ADM. They succeeded in the development of two innovative circuits which essentially give their delta modulation processor performance equal to that of a 16-bit PCM processor. Mr. Adams describes the dbx Companded Predictive Delta Modulation (CPDM) circuits thusly: "The analog-to-digital conversion process in the dbx Model 700 differs from that used in ADM in two important respects. First, in ADM, step size is varied to follow the signal. The dbx converter uses a precision compander in which the signal itself is varied with a voltage-controlled amplifier to avoid overloading a fixed delta modulator. Second, the dbx delta modulator uses a 'linear-predictive filter,' which relies on the recent history

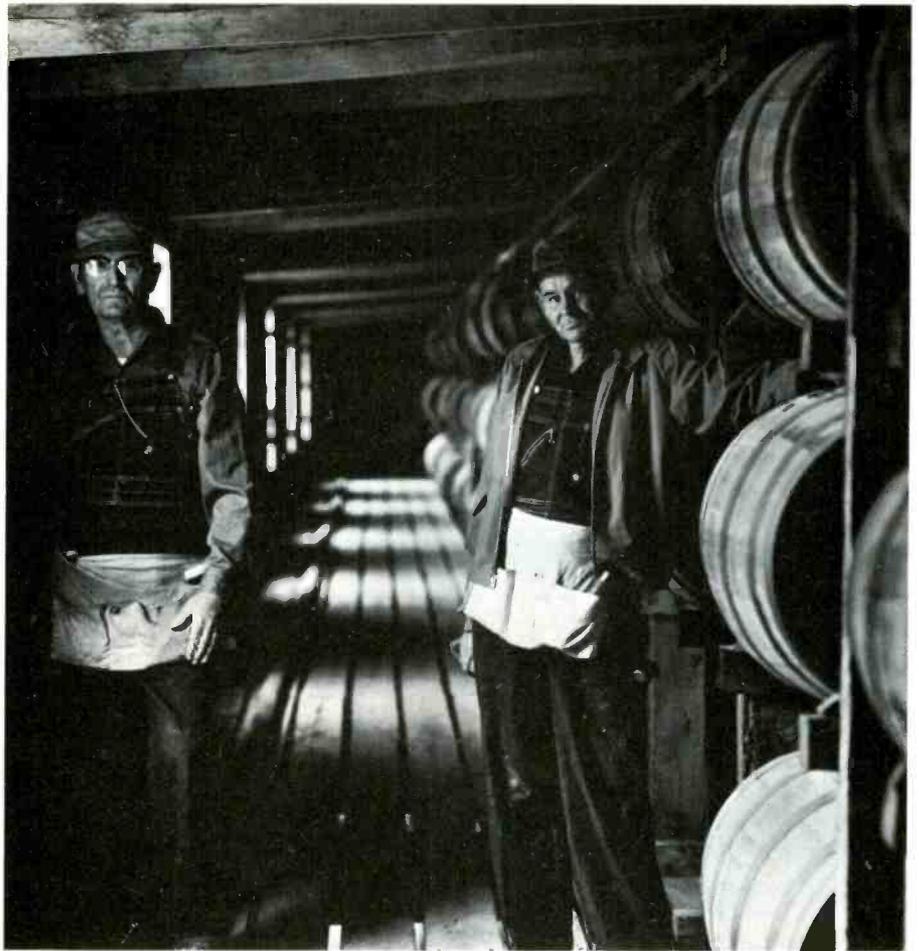
of the audio signal to predict its future. These two differences result in substantial improvements in performance."

The use of a fixed step-size, non-adaptive delta modulator is particularly important. For example, "dither noise" (a white noise added to the signal in order to mask quantization noise) cannot be used in ADM. However, in the dbx 700, dither noise can be added at the input of the fixed delta modulator to eliminate the noise floor anomalies (audible tonal effects) that plague ADM. In addition, the use of the linear predictive filter can increase the dynamic range of a fixed delta modulator by more than 10 dB, which is enough to eliminate all possibility (so it is claimed) of audible noise modulation.

The dbx Model 700 is meant to be used with professional U-matic helical-scan video recorders, although consumer VHS and Beta video recorders can be used as well. Because of the video format, the dbx 700 is furnished with a memory that has 16K bits of RAM (random access memory) storage for wow and flutter absorption, data interleaving and de-interleaving, and video requirements. As Robert Adams points out, the A/D converter produces a steady stream of bits during record. Since the video format has several areas where data cannot be recorded, the memory is asked to store the data bits during these times. Of the 16K memory, 8K is assigned for data interleaving (time scrambling) and 4K for storing data during the video-synch intervals.

During playback, the memory must supply the D/A converter with a steady stream of data while receiving the data from the VCR. Since the VCR has wow and flutter, this causes variations in the bit rate sent to the memory. The memory absorbs these variations with the last 4K bits of storage, and the result is a claim of very low flutter (less than 0.01%) in the decoded signal.

According to Adams, his error-correction system works "by adding one extra parity bit for every three data bits. The parity bits are mathematically derived from the data bits so that any bit errors on playback will produce a unique error pattern in the received parity bits. This error pattern is decoded to find exactly which bits are in



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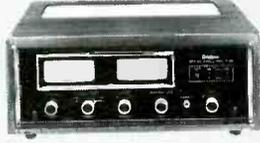
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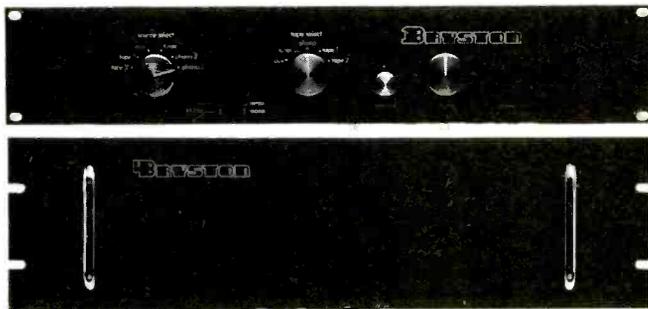
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"Inherent disadvantages in delta modulation up to now precluded its use in digital recording."

error, and the offending bits are then corrected. This correction circuit works in conjunction with the memory interleaving in such a way that a long burst error is presented to it as a series of short errors separated by good data." The dbx Model 700's error-correction circuit is claimed to be so good that it will completely correct dropout or burst errors up to 1,024 bits long, even if they occur as frequently as 240 times per second. An LED flashes when a bit is being corrected, which also gives the user some information about the videotape quality.

The dbx 700 is a two-channel system, with frequency response claimed to be 10 Hz to 20 kHz, ±0.5 dB. Dynamic range is quoted at a breathtaking 110 dB! Total harmonic distortion is said to be less than 0.03% at 1 kHz, 1 volt rms, with wow and flutter less than 0.01% unweighted. Sampling rate is quoted in a rather odd fashion as "700k bits/sec." Some quick work on a calculator will show that this would be roughly equivalent to 16 bits at 44.056k/S in the PCM world.

The new dbx unit is rack-mountable and measures 5¼ in. H x 19 in. W x 11½ in. D. It weighs in at 20 pounds, and construction is totally modular. There is a metering system of two columns of 30 LEDs switchable for three separate functions. A microphone preamp is optional. The front panel has input, output, and microphone preamp modules with appropriate controls. The price is "less than \$5,000" which certainly qualifies it as the lowest priced professional digital processor on the market. Needless to say, the 700 is an exciting development.

It must be noted that dbx has said nothing about editing facilities for this unit. There is some talk about a fixed-head transport on which "razor-blade" editing would be possible. A consumer model of the processor is said to be in the works, and I would hazard a guess that it will cost between \$1,000 and \$1,500. Here, the lack of editing facilities would place it in the same class as other consumer digital processors on the market, so this would not be a drawback.

In any case, the dbx 700 digital processor breaks some new ground with its delta modulation, and it will be interesting to see the reactions. A

## Dolby B through Dolby C

*Q. Can I play Dolby B-encoded cassette tapes through Dolby C decoding?—Ward Audio, Kahului, Hawaii*

A. I don't see why you would, since Dolby C decoders and tape decks with Dolby C tend to have Dolby B as well. If you try it, however, the main result of the mismatch will be a drop in treble response roughly equal to that produced when playing non-Dolby tapes through a Dolby B decoder.

A more common problem is having to play Dolby C tapes through a Dolby B decoder. This will emphasize the treble, much as playing Dolby B tapes with no decoder does.

Either way, there will also be other, mild response irregularities, because Dolby C processing covers a wider range than Dolby B. No harm will be done to either tape, tape deck or decoder, of course.

## FM Hiss Frequency

*Q. I have heard a lot about using FM interstation hiss to test the ability of a tape deck to give faithful audio reproduction. Approximately what frequency is this hiss?—Rob Canaday, Northwood, Ohio*

A. In a stereo tuner, FM hiss consists of all frequencies that the electronics are capable of reproducing up to nearly 19 kHz. On most tuners, a very sharp filter is used to remove the 19-kHz pilot signal, after it has served its purpose for stereo, so as not to interfere with operation of a tape deck.

Thus, there are an infinite number of frequencies from about 0 Hz to 19 kHz in the FM hiss you hear. However, these frequencies are not of equal amplitude. At the low end, below 20 Hz or so, tuners tend to be limited in their response, producing a dropoff. Between, say, 20 Hz and 19 kHz, the tuner's de-emphasis circuit produces declining amplitude as frequency rises. In the case of standard 75- $\mu$ S de-emphasis, the decline begins (3 dB down) at 2,122 Hz and approaches a drop of 6 dB per octave. In the case of Dolby 25- $\mu$ S de-emphasis, the decline begins at 6,366 Hz.

Thus, referring to 75- $\mu$ S de-emphasis, there is essentially equal noise energy per unit bandwidth—say, 1-Hz bandwidth—from about 20 to 2,122 Hz, and declining energy per unit

bandwidth above 2,122 Hz. However, as we go up the audio spectrum, there are twice as many unit bandwidths in each octave. Hence, the amount of noise energy doubles with each successive octave up to 2,122 Hz, with equal noise energy per octave thereafter. The total effect is to impart a hissy character to the FM noise since the lower octaves contain less noise energy. In the case of 25- $\mu$ S de-emphasis, noise energy doubles with each octave up to 6,366 Hz so that FM noise becomes even brighter.

## Premature Peaking

*Q. My cassette deck has peak indicators in addition to VU meters for setting recording level. During recording, the peak indicators start flashing while the VU meters are registering a level of -4 dB. I checked this on FM interstation hiss. When I record music, the VU level is usually about -10 dB when the peak indicators start flashing. This makes the meters useless as far as I'm concerned. I obtain good results by using the peak indicators, so I conclude that the meters are improperly set. Can the meters be recalibrated so that they show 0 VU on peaks, and would it be possible for me to do this?—Dan Zimmert, Saint Marys, Pa.*

A. Peak-indicator LEDs read peak program levels; most tape-recorder meters (including all true VU meters) read average program levels, which are always lower. The difference between peak and average is greater on musical program material than on essentially steady-state test signals such as FM interstation noise. Therefore, there is no way you can get average- and peak-reading indicators to read identically on all types of program material, though you could have the meters recalibrated to match the LEDs on one specific type of signal.

The VU readings are by no means "useless"; recording engineers in this country used only VU indications, without supplementary peak indicators, for decades. However, it does put you in the unfortunate position of the man with two watches, who's never quite as sure what time it is as he was when he had only one.

Both indicators can be useful, though. If you want to aim for minimum distortion, use the peak-reading LEDs

as your guide to maximum permissible recording levels, and your meters as a guide to permissible minimums. If you want to record for best signal-to-noise ratio, use your meters' zero indication as your permissible maximum under most conditions, recording a bit above that point on program material where the LEDs never flash and a bit below that point on material where the LEDs flash often.

## Why Monitor?

*Q. My preamplifier contains a switch for tape monitoring. What, then, are the advantages of a three-head cassette deck with monitoring features on the deck itself?—Merrill German, Baltimore, Md.*

A. True monitoring signifies that while a tape is being recorded, one can also hear the tape playback with only a fraction of a second delay, owing to the distance between the record and playback heads. This is possible only if the deck has separate record and playback head gaps and electronics. If the same head is used for both record and playback, it is impossible to record and play simultaneously.

In the case of a three-head deck, the tape monitor switch enables you to listen either to the signal fed into the deck for recording, or to the playback signal from the tape. Preamps generally offer a similar switching arrangement. Monitoring through your speakers requires that both the tape deck's and preamp's monitor switches be set to monitor position. Accessories which preempt the tape jacks, such as equalizers, frequently have their own monitor jacks and switches. With headphones plugged into the deck, you can monitor without using the preamplifier's monitor switch.

The purpose of tape monitoring is to assure the recordist that the quality of the signal on the tape is satisfactory, and to facilitate adjustments if it is not. Otherwise, one may discover only in playback, and all too late, that the recording is not satisfactory.  $\Delta$

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

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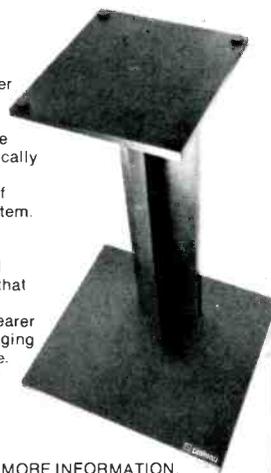
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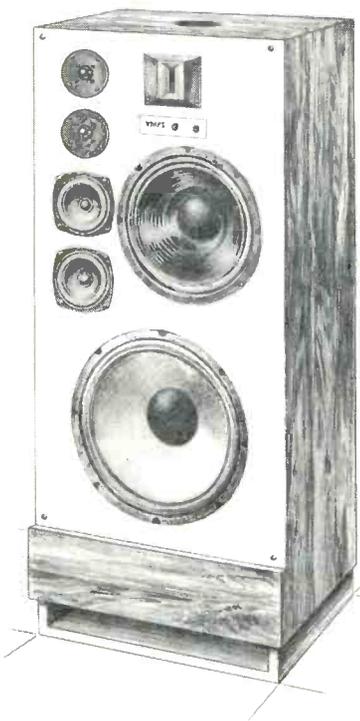


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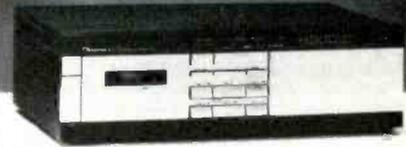
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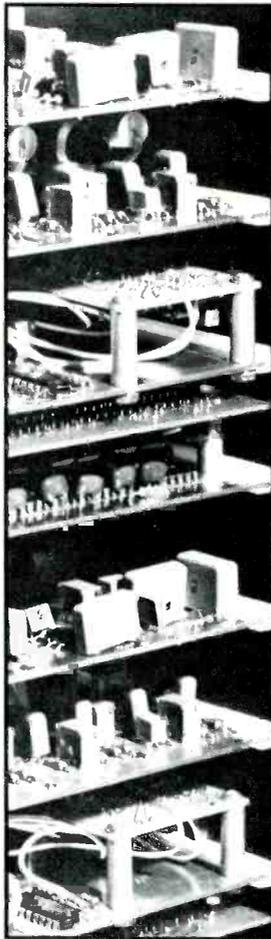
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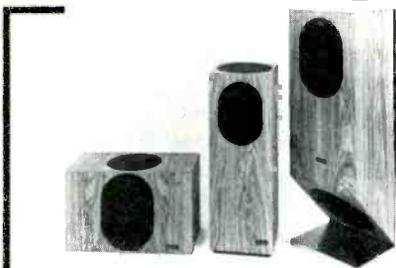
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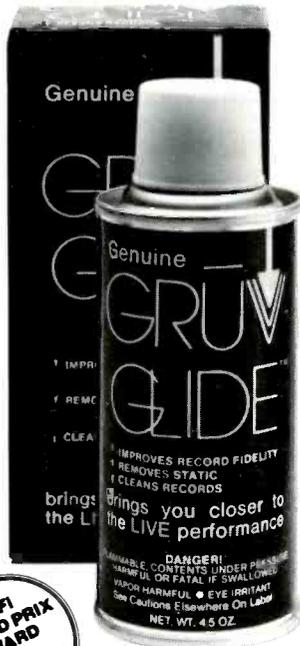
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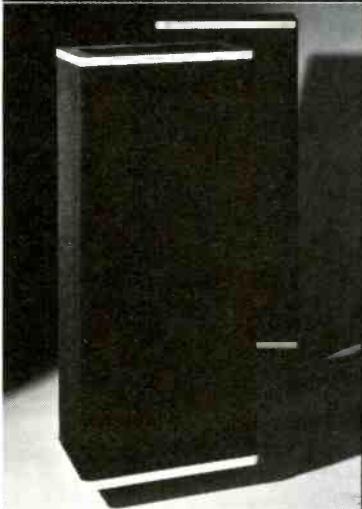
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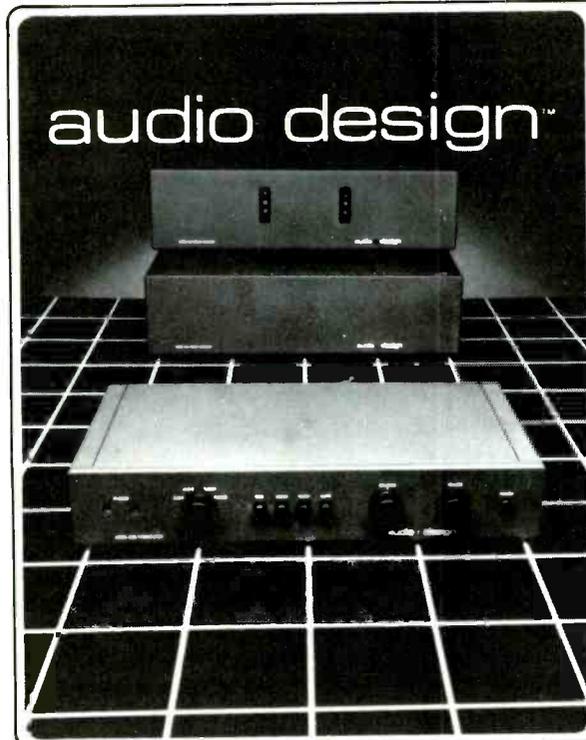
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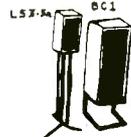
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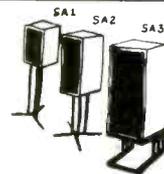
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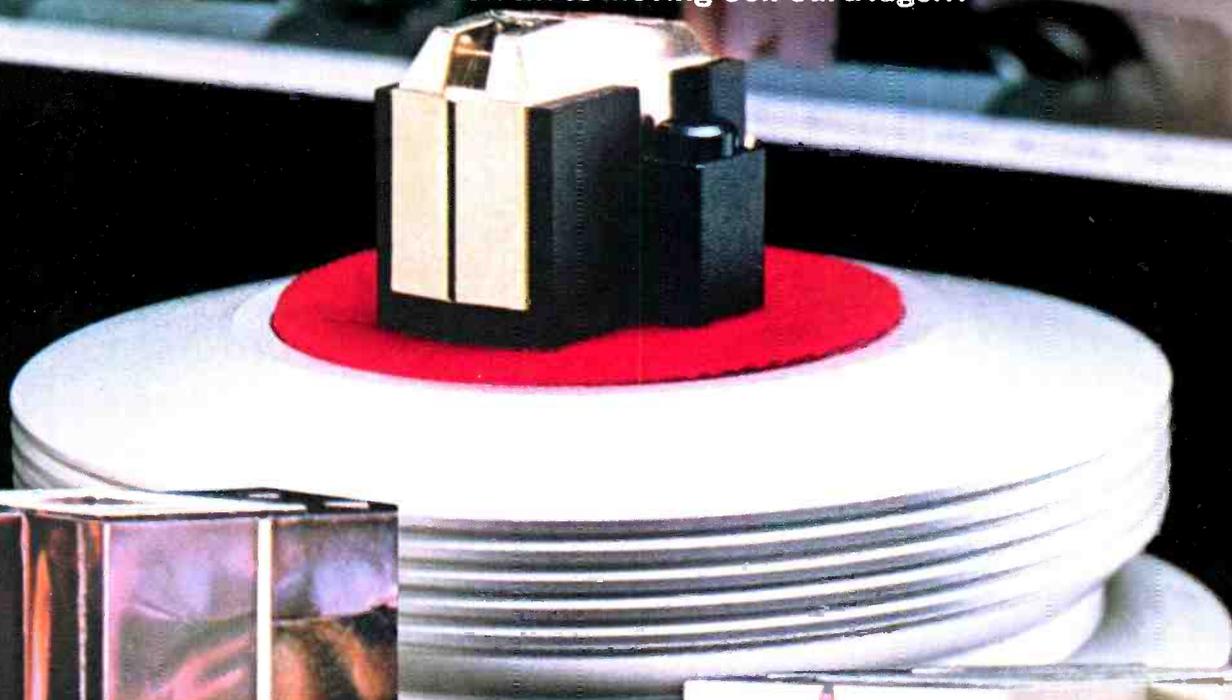
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