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Authoritative
Magazine
About
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Audio

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BUILD A
PHONE AMP



BETA HI-FI

**BETTER AUDIO
FOR VIDEO**

TESTED

**KOSS CM-1030
SPEAKER SYSTEM**

**KYOCERA R-851
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MAY 1983

VOL. 67, NO. 5



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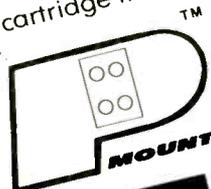


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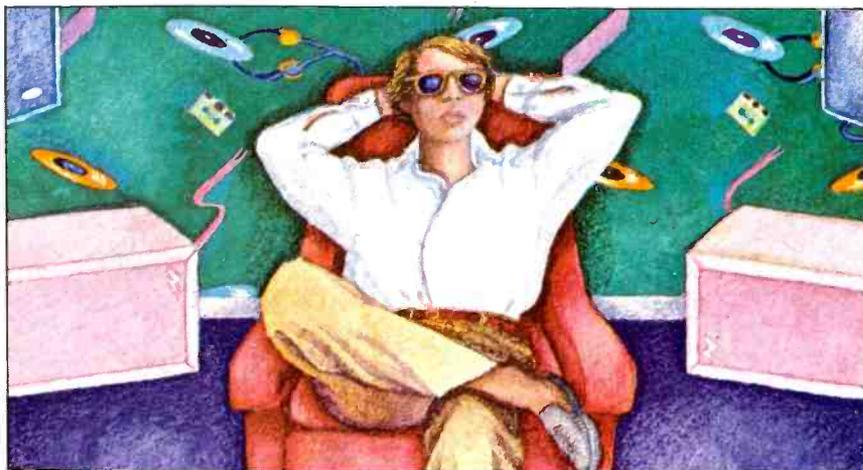
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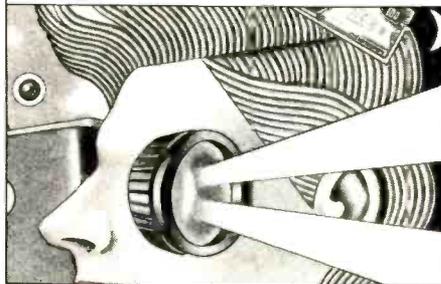
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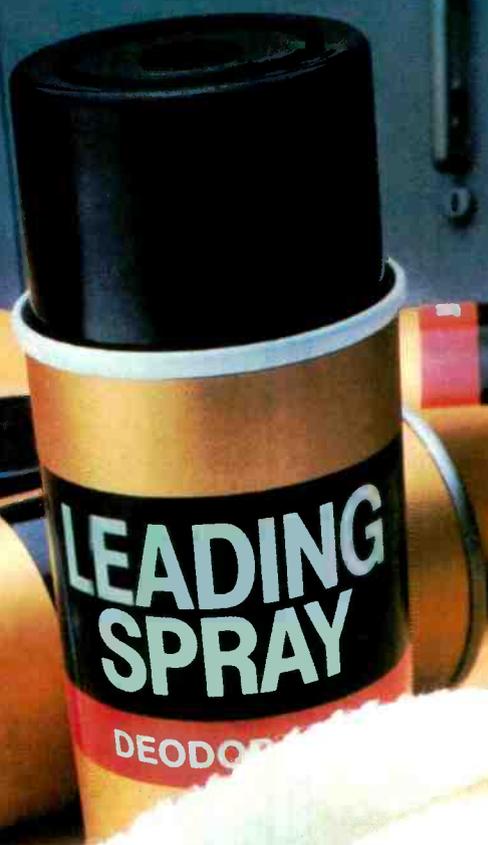


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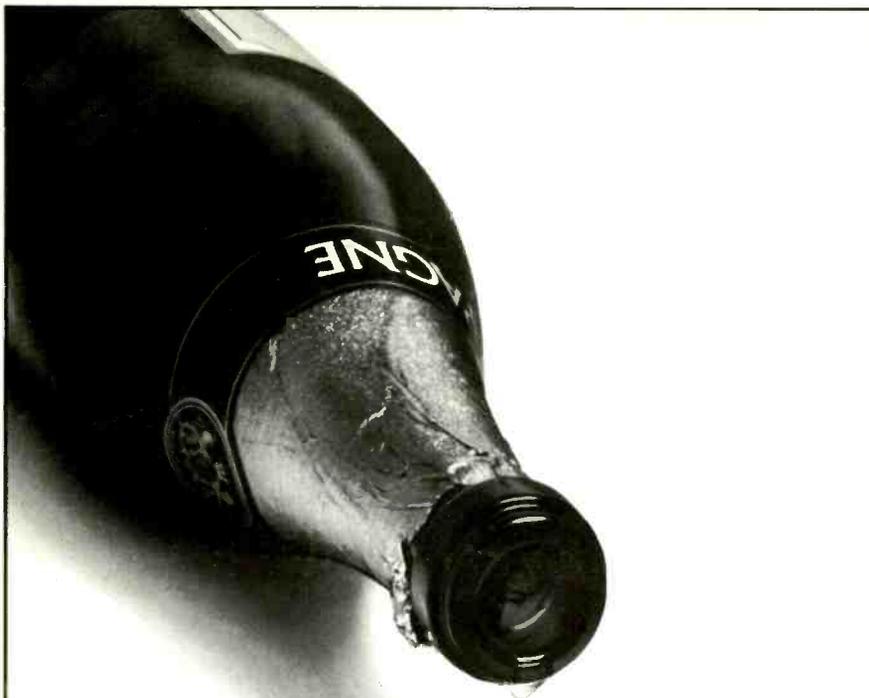
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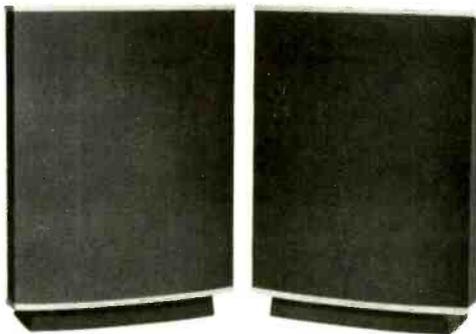
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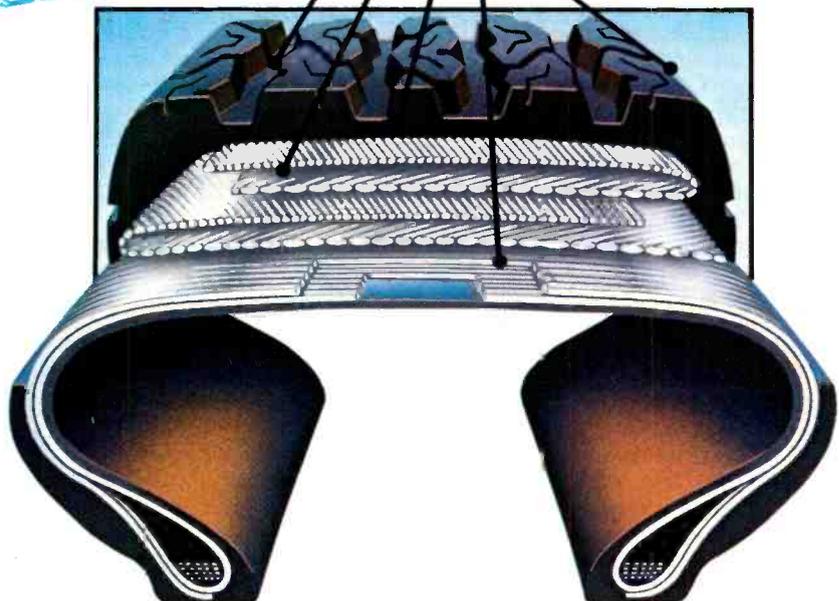




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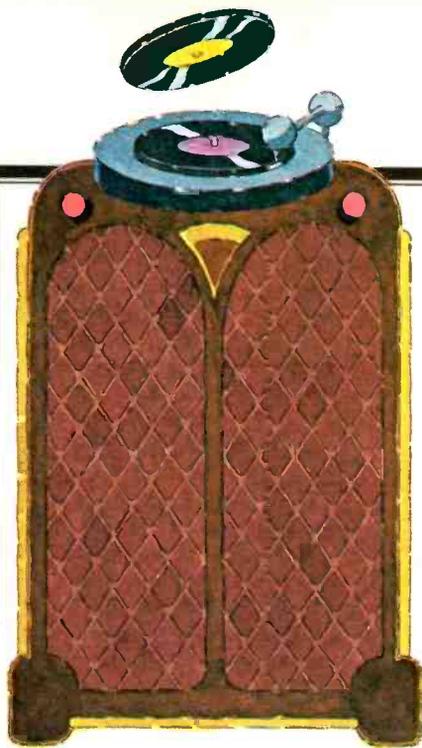
CARNEGIE & CACTUS

Installation IV of my on-again, off-again hi-fi autobiography appeared, I see, well over a year ago in the February 1982 issue. I keep forgetting, the time lag keeps widening. Pretty soon it'll be a half-century if I don't get going. So herewith Installation V; you'll find the first three segments back in 1980, in the January, May and December issues of that year.

There are two incongruous appeals, I hope, in this reminiscent material. The first, I trust, is for the younger readers who, hard to believe, actually do not know much about our Early Days. Well, I was there and I enjoyed every bit, so why not tell about it? Second, of course, is for you elderly souls, of my own ilk; there will be nostalgia and humorous memories. The things we took for granted seem so quaint now. And yet—yes, that's the way they were, all right. So here goes.

You'll recall (IV) my experience as a young college music instructor with that remarkable proto-hi-fi monster machine, the Carnegie Phonograph by Federal Telegraph, size of a small elephant—the working part of a gift that included some thousand or so 78-rpm records presented back in the mid-'30s to worthy colleges and schools with music programs. If you will think how soon this came after the very start of modern electrical recording, you will understand the impact it had and its importance in music teaching.

Music education for the "amateur"—we called it Music Appreciation (a term I have always detested)—was then barely beginning to use recorded music. A few years before, there hadn't been any, except those famous bits of opera à la Caruso and, of course, millions of corny two-minute ballads, joke recitations, tear-jerkers, and jazz discs, all of which were awful from the point of view of a Professor of Music. But the buildup, especially in European recording, was very rapid. By the middle 1930s, most of the standard classic repertory had been recorded—there was one recording of almost everything you could name, and even a few duplications here and there. It was on this remarkable new foundation that the Carnegie people built their happy idea of an all-out musical gift to the world of Education.



Classroom music was still a thing that was talked about, lectured upon, and then played on a piano—whether it was a symphony, an opera, a chorus or a string quartet. Every classroom had the required piano, and all teachers of music were supposed to be able to play the Beethoven Fifth or a Palestrina Mass or "Tristan und Isolde" in some vaguely convincing manner so that, just maybe, the students might actually recognize it in the flesh, the live performance. The very latest innovation in teaching method was the new small phonograph which began to appear in every music classroom, right next to the usual piano, and, in the Music Library, off in an obscure corner near the reference books, a reluctant shelf of very breakable 78s. All this, I assure you, was considered unpleasantly radical by most of the music personnel, including the librarian. It was roughly as jolting as the appearance of

a woman Professor in an all-male college. A good many years had to go by before the school and college teachers came around to thinking that maybe records could be moderately useful, since the students really seemed to appreciate them. But the transition was not easy. For most older teachers, it was canned music even before James Petrillo invented that term—was it for *this* that they had spent much of a lifetime training in piano technique for the propagation of the musical faith?

For those of us who were of student age, there were no qualms at all. The generous (relatively) collections of records that now came to our ears in our classes, no matter how badly displayed, were the very wave of the future, the latest thing in technology. It was precisely like the computer terminals and electronic music labs of today—we could afford a few records and a modest player in our rooms or homes, but the Music Department had all this munificence, this profusion of recorded sound, real music! And we could even borrow it, sometimes. Just as today you can go to school, music or otherwise, and play with the big computer stuff. But it was really hell for the old professors, trained in the traditions of the 19th century, when artists were purely artists, not mechanics and electricians.

Machinery, any machinery, was still anathema to the artistic soul. You must understand that artists, any sort, were the 19th century's only holdouts (or so they felt) against the crassness and crudity of the Industrial Age. They were aesthetes, they had Finer Sensibilities, they could not bear to think of such things as locomotives and steam engines. Or automobiles. Oh yes, one could learn to cope, to a practical degree. Life required it. But please, do not expect us to *approve!* And so in this early period of the electric record player, these scrupulously trained teacher-artists ran their phonographs about the way they ran their cars in those final days of the horse. They got where they were going, but teeth-gnashing mayhem was committed en route. More or less deliberately, one sensed.

The artists, and almost all "intellectuals," avoided any sort of feeling for the merely mechanical, as somehow unworthy of those Finer Sensibilities they felt they possessed. Or, of course, that one's parents and teachers said we *should* possess. It was right and proper to hate the machine, or to master it and make fun of it.

Even my amiable mother (no musician, but a music lover and an artistic soul) fell for this line of thought. She and her closest woman friend jointly bought a Model T Ford when my father went off to WWI, and they happily went

Illustration: Philip Anderson

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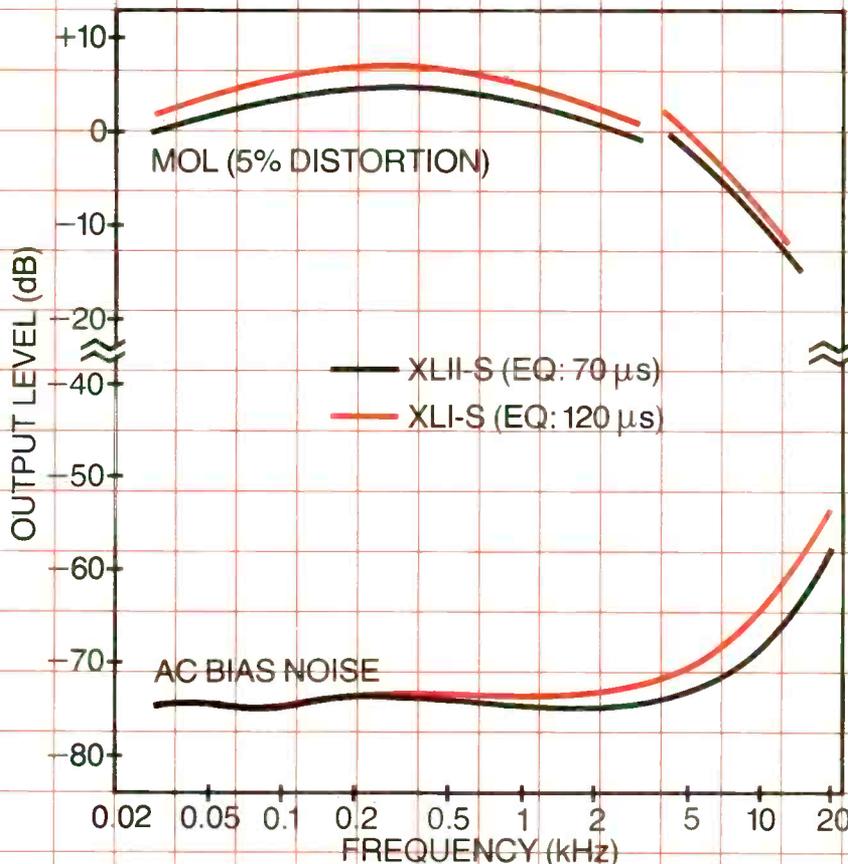
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bouncing around the Connecticut countryside, dirt roads and all, learning to drive backwards up a hill when the low-gear band gave out, putting aside the old gray mare (named Martha) for good. They hadn't the faintest idea, though, what they were doing with that large and potentially dangerous machine—it was all a lark. Two artistic souls on a plebeian holiday.

Almost immediately upon at last entering the Big City, they drove that Model T straight into a trolley car, somehow wedging it irretrievably between that and another trolley coming the other direction, just like the famous Keystone Kop movie. Nobody was hurt; they didn't drive very fast in Model T Fords. So we got an early Chevrolet and, a bit later, my mother committed the ultimate artistic boo-boo; one morning she gaily backed the Chevrolet out of our new garage and forgot to open the door first. Such a splintering crash you never heard. Artistic license, shall we say?

You may now, with this bit of background, go back to February of last year and read my account of the Professor and the Carnegie Phonograph, the elephant machine, or rather the home-made local substitute the Physics people built for him. Same story! There were only two ways the artist could react—either he took on the mechanical monsters in fear and trembling, hating and despising, or just had a good time, like my mother—in neither case knowing, nor wanting to know, anything at all about the machinery's real operation.

Yeah, I was an artistic soul, too. I still am. But oddly enough I was also a mechanical/electrical soul. I loved trolley cars, I was devoted to trains and fascinated by subways, to my literary father's infinite disgust. That's why I am here.

The Carnegie Set, as we sometimes called it, was a lifetime influence on me as you may easily understand. Such an unbelievable abundance! And as already mentioned, by the sheerest coincidence I encountered it twice, in my first and only two jobs teaching Music Appreciation. When I arrived for my very first working day ever, I walked into an office piled to the ceiling with huge packing boxes, every one of them filled with RECORDS. And it was

my first duty to get those things out of the boxes and into some order on the waiting shelves. So within days I found myself automatic “curator” of the new record collection, and its librarian and indexer as well. Quite simply, nobody else was interested, and wasn't it nice to have an enthusiastic youth who would do all the heavy work?

While the pros and the instructors stayed away in droves, I struggled; after a week or so the Boss came in cautiously, but only to ask for a couple of records he might get to use, “Would I find them please?” No card indexes for *him*. So now I was the stock boy. I pawed through a dozen half-unloaded boxes before I found what he wanted, by a sort of intuition, I guess. I was inundated with discs, flooded, snowed under; they were everywhere, in total confusion. Maybe Carnegie had packed them in some sort of order (singles only, in thin paper jackets, no albums at all) but I didn't discover it—or more likely, I just unpacked so enthusiastically that I never even noticed.

But this was getting to be too much. Somehow, I had to *make* order. Do you think I knew anything about cataloging? My own little collection was still in the loose-pile stage and no problem. I had not the slightest idea how to go about shelving a thousand records.

Leave that be, since I've told of my eventual catalog system in a series written here a few years ago. Anyhow, with a bit of prompting and a lot of help from our undergraduate hired office boy (now a big wheel in the AMA), I did work out a way to do it which was unique, in that you could use the file cards we typed up or, alternatively, go directly to the shelves in that small cubbyhole office and read a coded label on every disc—if you could remember the code. B15 v1C. Bach Violin Concerto. I still remember a lot of the composers' “ID” numbers. Years later I discovered that this was merely a Canby variation on the universal Dewey Decimal System, still used in many libraries. Somebody must have set me on the right track.

Then we opened for the general university public, who could borrow our magnificent Carnegie records for themselves if they had the right credentials. This was heaven! There I sat, presiding over the goodies and meet-

ing everybody I could ever want to know who loved music and enjoyed records in that university. The most significant consequence, as I've said, was my growing acquaintance with the Physics and Math people in the graduate school, prolific record borrowers, and thus my introduction by them to the very earliest beginnings of component hi-fi.

If you think lending out LPs is a hazardous business, consider the lordly 12-inch shellac 78, incredibly breakable, crackable, hideously gougeable and scratchable by steel needles topped with five or six ounces of pick-up. They did very well, those records, as long as you left them in the stacks. Or avoided stepping on them or accidentally sitting on one—or dropping it. But to lend was to destroy, as we quickly found. I have a vague feeling that we could order replacements through the Carnegie people, who dealt in large volume and even had their own special pressings. I do know that we cracked and broke discs right and left, and the damage was probably done as often by our own faculty members as by the very conscientious outside borrowers.

So—we set up rules. Just like today! But how different. Some of those rules were bizarre, as I think of them now. But they helped, they really made the difference. At the expense of fi, to put it mildly. We required, for instance, that all borrowers use wooden stylus points. . . .

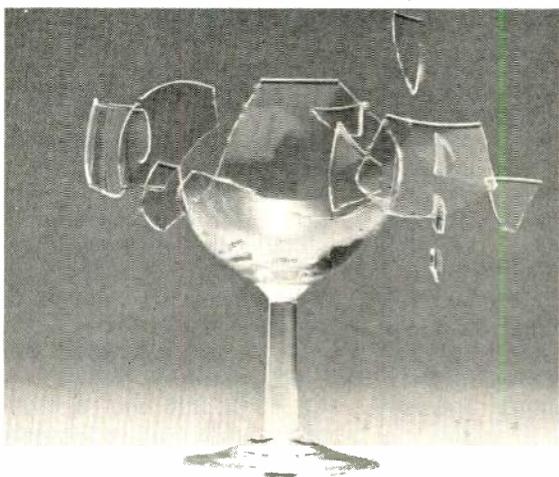
You think I'm joking? Not at all. The rule actually said “cactus or fibre” but these were merely hard wood in two formats. Those things were widely used in the 1930 period, especially by the real highbrow connoisseurs. They did indeed preserve your precious records, though not from breakage or cracking. With a wooden needle screwed in place, you *could not* gouge a hole, nor make a scratch.

So long as the disc stayed in one piece, there was nothing those gorgeous styli could do to harm it, except to leave a thick sludge of powdered sawdust in the grooves. So—what if the highs extended upwards to, maybe, 1,000 cycles, 1 kHz? What if the point disintegrated after half a side? The record was preserved! That was the real point. 

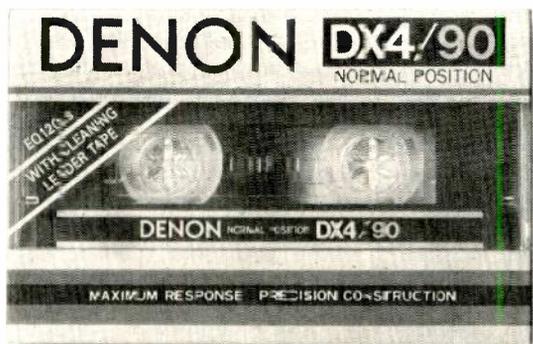
Have you ever heard a cassette sound like real music?



You've had your hair blown,



your glasses shattered...



now listen to real music.

TO MAKE A CASSETTE SOUND LIKE MUSIC, YOU'VE GOT TO KNOW WHAT MUSIC SOUNDS LIKE.

Other than making tape, most cassette manufacturers have nothing to do with music. Denon, on the other hand, has been in the *music* business for well over seventy years. Denon professional equipment can be found in almost every single Japanese radio station and recording studio. Denon is the company credited with the development of the PCM recording process, a development which has already revolutionized the entire recording industry. And, when it comes to tape, Denon has been making it for over twenty-five years.

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BERT WHYTE

DISC & DATA

At the WCES in January, video-disc activities were minimal. Pioneer was not exhibiting their LaserVision players, having held a special press conference in New York before the WCES, heavily concentrating on their vastly improved software situation. JVC's "suspension" of their VHD program caused a lot of comment, pro and con, and though a spring introduction date has been set for Japan, there are no new U.S. plans. Perhaps part of their decision was prompted by the resurgence of the laserdisc system, and surely by the improving market for the RCA CED SelectaVision disc system. After a very shaky start in 1981, the CED system has gathered considerable momentum, and sales in 1982 were double those of the introductory year. The advent of the stereo players has helped sales considerably, according to RCA. They expect even better sales when they introduce an advanced CED player in the fall of 1983. Not only will the new player feature stereo, but it will have interactive random access capabilities as well. That is quite an achievement, for initially there was much criticism that the CED system, which employs a groove/stylus format, was rather archaic and could not be expected to perform all the manipulative functions of the laserdisc, let alone provide stereo and random access. RCA isn't saying how the random access function will work, other than that it will search out specific segments of video information from the CED video-discs. The new player is as yet unpriced.

According to EIA figures, projection TV sales substantially increased in 1982. There wasn't much in the way of new projection TV systems at the WCES, except for the new Novabeam models from the ever-venturesome Henry Kloss. The new Model One-A is available with a 6½- or 10-foot screen. It features updated electronics and a cable-ready, 105-channel tuning system with wireless infrared remote control. There is also a component version of the Model One-A without the off-the-air tuner. Instead it has, as standard equipment, a separate video control center containing all operator controls, including power on/off, convergence and audio/video input for two program

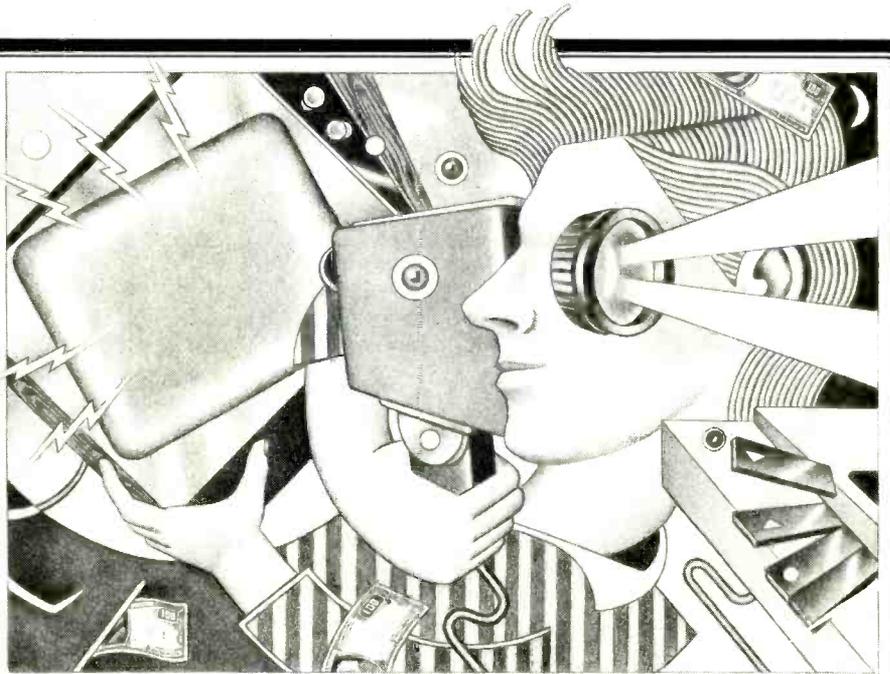


Illustration: Michael Emerson

sources. Kloss also introduced their Model T-1, a 105-channel TV tuner with infrared remote control and multiplex output as well as normal audio/video outputs. This \$219 unit is intended for use with the monitor versions of the Model One-A and the new, compact Novabeam Model Two, but it can also be used with any component video monitor. The Model Two portable system, which can project a 64-inch diagonal picture on any white wall or flat screen, is now in production and is priced at \$2,200.

Another EIA statistic claims a very significant increase in the sales of color video cameras. Apparently, more and more people are becoming videophiles and are demanding more sophisticated equipment in every aspect of video. It is no surprise that color video cameras are currently a hot item. One standout model at the WCES was Sony's HVC-2800.

Derived from Sony's professional ENG (electronic news gathering) cameras, the HVC-2800 is the first consumer camera to use the Sony SMF Tricon pickup tube. Previously incorporated only in professional cameras, Sony claims this tube affords exceptional resolution, high color accuracy and consistent color purity. Another plus is that the Tricon design uses a Saticon photoconductive layer, which affords higher sensitivity and lower im-

age lag. In fact, image lag is reduced about 80% and light levels of only 20 lux can be accepted, meaning less need for supplementary lighting.

The HVC-2800 is fitted with an f/1.4 variable speed 8:1 power-zoom lens. Macro-focusing facilities are provided for extreme close-ups. For audio recording situations where the built-in omnidirectional microphone is inappropriate, a superdirectional cardioid mike is furnished.

The HVC-2800 has a 1½-inch, black-and-white detachable electronic viewfinder, in which all critical operating parameters are displayed. A new one-touch automatic white-balance system adjusts the camera's built-in filters to changing light conditions. The camera also features electronic fade-in/fade-out and, though it weighs only 6 pounds, has a professional shoulder-mount harness. Essentially, this HVC-2800 is for the serious videophile. There are no frills such as automatic diaphragm or auto focusing, for the emphasis is on maximum quality in the basic parameters of resolution, color purity, and color consistency. The price of the HVC-2800 is \$1,350.

The Fosgate Research Model 101A has a foot in both the audio and video camps. Jim Fosgate calls it, quite properly, the "Tate Two Surround Stereo System." The result of 10 years of cumulative research by CBS Labs,

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"One EIA statistic claims a very significant increase in sales of color video cameras; a standout at WCES was Sony's new HVC-2800."



Tate Audio, Jim Fosgate and others, it is covered by five patents, with others pending. The 101A will play video source material, stereo material in surround or ambience mode, and SQ quadrasonic source material. I won't go into all this unit can do, but will point out its application in video playback. As I am sure most of you are aware, since the advent of VCRs capable of stereo playback with Dolby B noise reduction, several hundred videocassettes of movies with Dolby B stereo encoding have been released. Many of these videocassettes contain the Dolby surround-sound encoding originally intended for the motion picture theater presentation. The Model 101A has a "Cinema" position on its selector switch, which activates the Tate surround circuits in quite the same manner as those used in the original theater decoders. If you hook the 101A to your front stereo system (usually via tape loop) and feed its output through another stereo amplifier to a pair of speakers behind your listening position, you will perceive the Dolby surround-sound information. All the spectacular audio effects in *Star Wars* and other sci-fi movies are vividly re-created. The amplifiers and speakers used for movie surround sound can be modest in power and size and still provide these exciting sonic augmentations. The Fosgate Research Model 101A has a remote control for easy and accurate control of the entire sound field, including Dolby surround sound. An extremely versatile unit, the 101A should find many uses in some of the new video technology, such as Beta Hi-Fi, and others now under development. Price of this 101A is \$579 with remote control.

Jensen also demonstrated Dolby surround-sound effects, using their component video system and a Tate unit from Wesley Ruggles (who owns the Tate patents and licenses them to

Jim Fosgate). And speaking of Jensen's component video system, it has one of the most modern and strikingly beautiful enclosures. Conceived by Design Presentations of Skokie, Ill., the unit is 8 feet long, 38 inches high and 26 inches deep. It features a black polyester mirror finish, with metallic silver trim and a chrome pedestal base. The doors enclosing the Jensen 25-inch video monitor, tuner, control center, VCR and stereo speakers can be slid into pockets when the components are in use. No price given, but it certainly won't be cheap!

Finally, General Electric gave a foretaste of some far-out future video developments. How about digital TV? Essentially, the GE digital system samples the horizontal lines 14 million times per second for color and brightness information. This information is converted to binary code, the familiar 1s and 0s of computer language. This constantly monitored information is processed by a computer which instantly regulates any variance in color and brightness. Other advantages of digital TV are two channels on screen at once (picture within a picture), freeze frame and frame storage, teletext and videotext displays, picture resolution enhancement, video noise elimination, automatic ghost cancellation, and direct processing of digital audio. The chassis of GE's digital TV uses just seven VLSI (Very Large Scale Integrated) silicon chips!

The digital TV ties right in with GE's new high-resolution picture tube, which has twice as many lines of resolution as the best CRTs currently in use. A fine-grain dot screen is used, rather than the normal slot design in today's TV sets.

Combine all this advanced video technology with direct satellite broadcasting, and one wonders how we ever put up with the horse-and-buggy picture quality of our current TV sets! **A**

The KEF Standard Series Loudspeakers

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Compact two-way system; 19 litre enclosure

Sensitivity: 87 dB spl/W/m

3rd order bass loading for extended bass, higher efficiency

Ferrofluid-cooled HF voice coil for higher power handling capacity and better reliability

8 ohm impedance; 50W program rating

18½ (H) x 11 (W) x 8½ (D) inches; \$300, a pair

CARINA

Two-way system; 33 litre enclosure

Sensitivity: 89 dB spl/W/m

Centre-mounted HF driver between twin LF drivers for symmetrical horizontal and vertical directional distribution

Improved power handling; increased efficiency

8 ohm impedance; 80W program rating

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CARLTON

Floor-standing two-way system; 44 litre enclosure

Sensitivity: 86 dB spl/W/m

Bass radiator and bass loading for extended bass and higher efficiency

8 ohm impedance; 100W program rating

Extreme-cone LF/MF driver; dome radiator HF driver

*4th order crossover network
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BERT WHYTE

FETS IN THE FIRE

A number of interesting new preamplifiers were introduced in Las Vegas at the Winter Consumer Electronics Show. At last, there is a production model of the long-anticipated John Curl preamplifier from Dennesen. Designated the Dennesen JC-80, it is an all-FET unit in a complementary push-pull Class-A topology, all d.c.-coupled and with a zero-feedback input stage. Each stage is separately regulated, with no interstage coupling capacitors. The RIAA section is passive and there is switchable R and C cartridge loading as well as sufficient gain for "straight-in" amplification for most moving-coil cartridges. All signal switching is accomplished by hermetically sealed gold-on-gold relays. One especially useful feature, found on few preamps, is a switch for absolute phase—of particular importance with PCM processors and CD (DAD) players, which usually have a 180° phase reversal. John Curl has chosen to use high precision potentiometers, of the sliding fader type used in studio mixing consoles, as level controls. The JC-80 is claimed to have an extremely wide open-loop bandwidth and to be "virtually unsewable." Price is expected to be about \$3,500. John Curl is noted for his design of the Mark Levinson JC-2 preamp and his pioneering work with Matti Ojala on TIM (transient intermodulation distortion). He is a man of remarkable talents, and I can hardly wait for some hands-on experience with the JC-80.

Another FET preamplifier is the Nova CPA-100 which, quite coincidentally, has an absolute phase switch—as does the Dennesen JC-80. (Start of a trend?) This \$1,600 unit features a high phono overload (300 mV rms at 1 kHz) and an open-loop bandwidth exceeding 200 kHz for each amplifier stage. The large power supply uses a toroidal transformer, and each of the eight amplifiers in the unit has an independent wide-band regulator. The TIM is said to be virtually unmeasurable, and SMPTE and harmonic distortion are claimed to be under 0.01% at 1 V output. An optional battery-powered head amplifier is available for \$300.

Still another FET preamp is the Acoustat Trans Nova, though it was introduced last summer. Its main design feature is a new type of RIAA

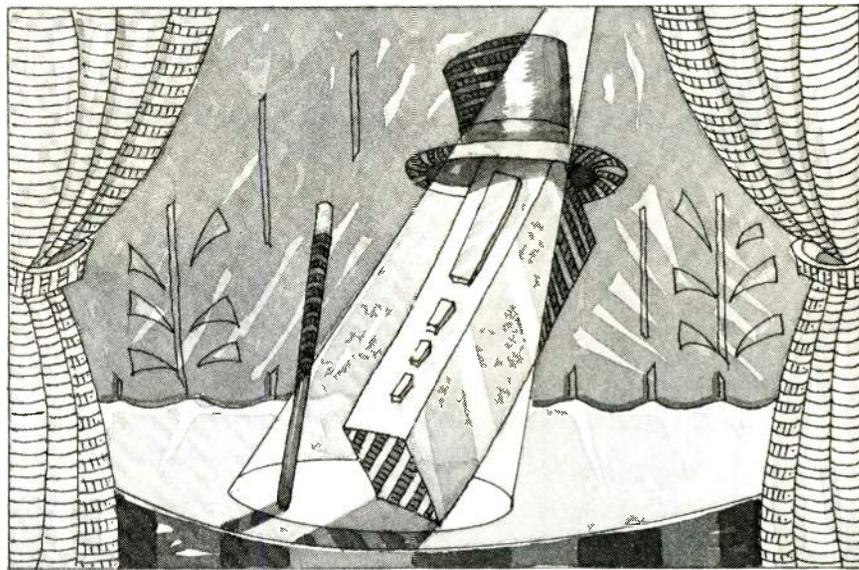


Illustration: Michael A. Donato

phono stage which Acoustat calls "Achromatic," as it is "neither active nor passive" but "combines the advantages of both." The firm says that with this new arrangement virtually all later stage noise disappears.

Acoustat also states that with this new phono circuit, their Trans Nova preamp has more gain, less noise and more headroom than any previous preamp. They further claim that even the lowest output moving-coil cartridges can be used without any step-up device. Switchable phono loading is provided, as are such amenities as two tape monitors, external processing loop, passive high filter and loudness compensation. Price is \$850.

Perreux introduced the SM-2 preamplifier as a companion for their 2150B and 1150B amplifiers. The big feature on this unit is a phono overload of over 1 V, and it is claimed that an output of over 25 V with no measurable distortion can be achieved. Perhaps we are seeing the beginning of another trend, for the SM-2 is also claimed to handle the lowest output moving-coil cartridges "straight in," without head amps or stepup transformers. Price of the SM-2 is \$990.

Lastly, Jim Fosgate of Fosgate Research has come up with a specialized preamplifier, the Model DC-301. Using Class-A circuitry throughout, with a regulated power supply, the unit uses his patented active equalizer along with National Semiconductor DNR

noise reduction. The equalizer can provide boost of up to 15 dB at 20 Hz and up to 5 dB at 20 kHz. One of the few preamps to offer DNR, it can provide an improvement in signal-to-noise ratio of up to 14 dB. Both the equalizer and the DNR can be bypassed. Price not yet determined.

As usual with loudspeakers in any CES, "hope springs eternal" in the speaker designer's breast. They are all looking for a magic formula that will produce a high-volume, high-profit speaker. Alas, for the most part we have legions of walnut boxes, all seemingly cast from the same mold, and all sounding about the same—which is to say, not very convincing in the reproduction of music. The other side of the coin is the exotic speaker designs that appear at every CES. They usually share the common attributes of imposing size and weight and stratospheric price tags. Some try to abrogate the laws of physics. There are those, however, that represent good design based on solid scientific rationale, and some of these speakers can be mighty impressive transducers.

A case in point is the VMPS Wide Range Ribbon speaker system. The brainchild of Brian Cheney, the clever chap who owns VMPS, this is something of a breakthrough in ribbon speaker technology. Ribbons have always been highly regarded for their ultra-fast transient response and low distortion. They are equally well-known

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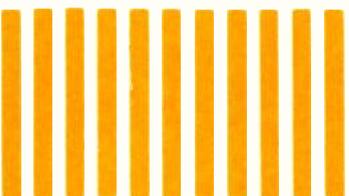
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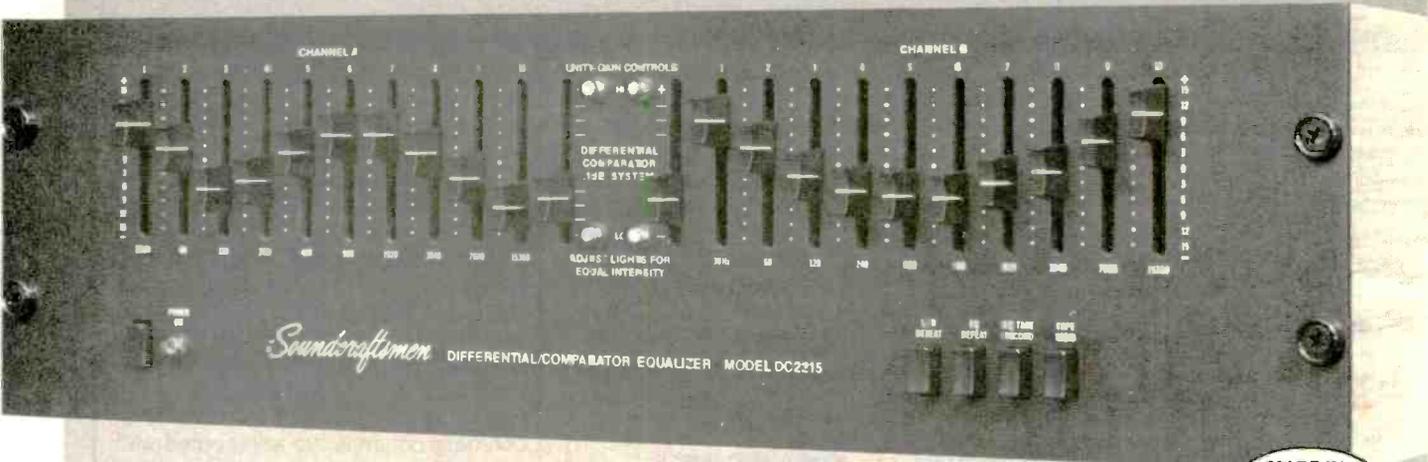


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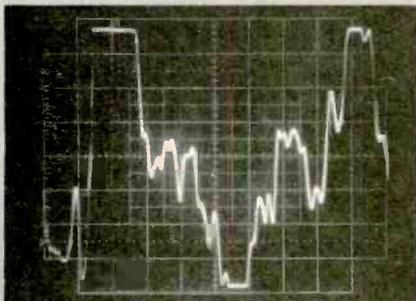
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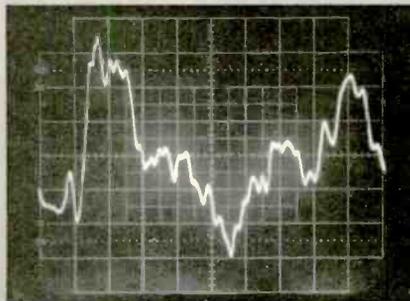
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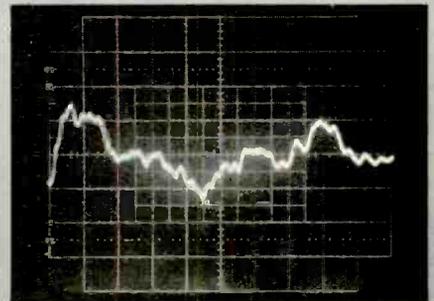
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"Both the Nova CPA-100 and the Dennesen JC-80 preamps have phase reversal switches. Is this the start of a trend?"

for their lack of durability and poor power handling. The result up to now has been a minimal use of ribbons in speakers, except in some tweeter applications.

Essentially, Brian has taken a 130-inch-long, 5/16-inch-wide, flat aluminum-alloy ribbon and bonded it to a

gossamer-like polyester backing film, less than a third of a millimeter thick. The ribbon/film is bent into a side-by-side configuration and clamped non-compliantly between parallel rows of over 100 bar magnets of extremely high intensity. In this way, the ribbon cannot "flap" in response to low fre-

quencies or high levels. The ribbon is driven uniformly over its entire surface in a push-pull manner. With over 41 square inches of radiating surface, the ribbon can handle over 300 watts rms between its crossover points of 300 Hz and 15 kHz. A "super-tweeter" ribbon 3/16-inch wide and 2¼ inches long carries on to 50 kHz (so your dog can share in the fun). From 300 Hz down, 8- and 12-inch polypropylene dynamic cone woofers and a bottom-firing, slot-loaded 15-inch subwoofer provide response to 22 Hz. The 6½-foot-tall ribbon/bass columns are augmented with special Space Boxes flanking satellite/subwoofer systems with integral electronic crossovers and their own drive unit designed by John Curl. The Space Boxes are meant to be placed 2 to 10 feet behind and somewhat to the sides of the main columns, and are said to provide "spectacular" front-to-back depth of sound field. There is a great deal more to these ribbon loudspeakers, but it would require pages to fully document this new technology. Sensitivity of the system is 94 dB SPL (1 W/meter) with an awesome output of 128 dB SPL for 5% THD. The -3 dB frequency response with Space Boxes is 19 Hz to 50 kHz. Brian was going to bring these extraordinary new speakers to my home for extensive listening tests. Unfortunately, the blizzard of '83 hit New York, it took poor Brian 26 hours to get from San Francisco, and to top it all, the trucker could not deliver the preshipped speakers! Ah, well, we have rescheduled the whole thing for April, when the weather should be more cooperative. As you might expect in such an elaborate loudspeaker, the price has been set at \$5,995 the pair, including the Space Boxes.

Another loudspeaker which elicited much favorable comment is from, of all places, Italy! Apparently the ESB (Electroacoustic Systems Building) company occupies much the same place among loudspeaker manufacturers there as JBL does in the U.S. In any case, they appear to have very modern facilities, including a large anechoic chamber. The ESB 7/05 is their top-of-the-line loudspeaker. It stands 68 inches H x 18½ inches W x 14½ inches D and is actually a two-cabinet design. The lower unit contains a 12-inch cone woofer with free air resonance of 16

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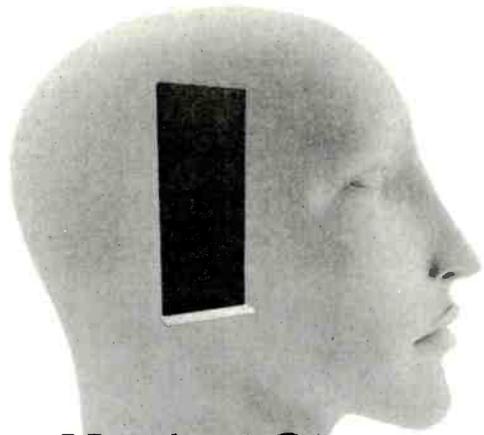
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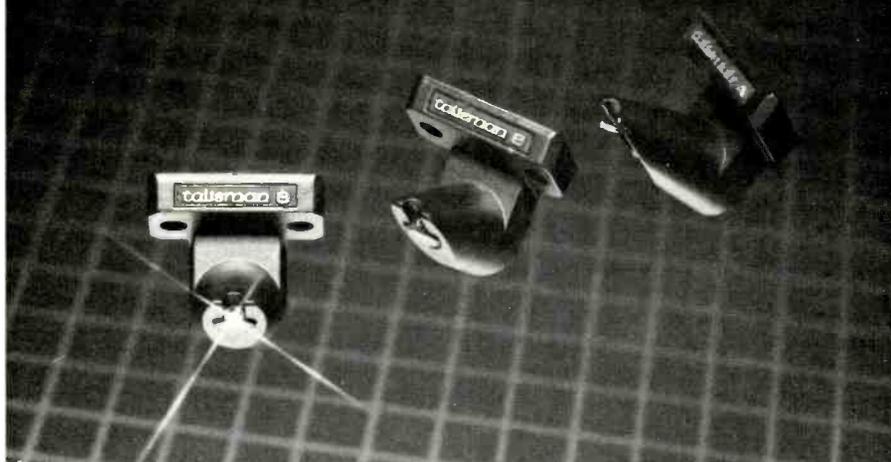
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"Exotic speaker designs appear at every CES. They usually share imposing size and stratospheric price."

Hz, a rear-mounted passive radiator and a control unit for low-, mid-, and high-frequency response contouring. In the upper cabinet an 8-inch low mid-range cone driver is mounted, along with a 2-inch upper midrange dome and a 1-inch dome tweeter. Crossover points are 500 Hz, 1.6 kHz, and 6 kHz. The upper cabinet has a sloping front for phase alignment of the drivers. In each speaker the 8-inch cone driver and the 2- and 1-inch domes are mounted on a baffle board that is set at a certain angle along with a "reflector" panel. These mirror-image baffle/reflector panels afford what ESB calls "Distributed Spectrum Radiation" which is claimed to form such a wide and deep soundstage that good stereo imaging is not confined to the central sweet seat. Frequency response is quoted as 25 Hz to 20 kHz with the lower 3 dB point at 35 Hz. With an efficiency of 89 dB SPL (1 watt/meter), the 7/05 is said to be capable of handling 400 watts rms into 8 ohms. Obviously, this loudspeaker should have no trouble with digital program sources. A pair will cost \$4,500.

After years of building full-range electrostatic loudspeakers, Acoustat has produced their first hybrid electrostatic/dynamic driver system, the Model Two/MH. Standing 6 feet tall with a width of 20 inches and a depth of 3½ inches, the electrostatic portion covers the range from 100 Hz to 20 kHz. Placed behind the electrostatic panels is the woofer enclosure, which measures 21 x 18 x 13 inches. Of sealed-box design, a 10-inch, down-firing woofer covers the range from 100 Hz down to 28 Hz. Acoustat claims a frequency response of 28 Hz to 20 kHz, ±3 dB, for their Model Two/MH. The system is said to produce sound pressure levels of 110 dB at 18 feet in a 14 x 22 foot room on program peaks. A minimum of 60 watts is required to drive the system. Acoustat feels that since most of the frequency spectrum is covered by their electrostat elements, the major advantages of pure electrostatic speakers is retained. They evidently expect the Two/MH to be a sales leader at \$1,195 per pair.

As usual, one could fill every page in *Audio* with new product information from WCES, but space dictates only a survey of the highlights.





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Nautilus NR 38, \$16.98.

Sound: A+ Performance: A+

What can one say about a flawless album remastered so that each little gem on it has the clarity it deserves? The original Sire pressing was choppy, to say the least, and Ms. Hynde's delivery was hard to decipher in places, as precision was somehow abandoned for the sake of attack. Nautilus has rescued the tapes and given them the treatment, thus clarifying the little production goodies that a zillion listenings never turned up before. Things like the keyboard and harmonies on "Kid," the lyrics and harmonized vocal on "The Phone Call," and the neat dynamics of "Space Invader" are readily apparent rather than hidden in the track. Some groups would be subject to shame and embarrassment if their debut albums were resurrected thusly, but The Pretenders' initial outing stands the test of time and the sonic magnifying glass. This version is an absolute must for all fans of the group. What's more, their

second album suffered from an even shriller mastering job, and although some of the songs weren't up to snuff, a Nautilus job on that one might give many critics a good reason for a second opinion on that much maligned LP.

As for this record, the rhythm section (Martin Chambers and Pete Farndon) are given the bottom that they so well deserve, and the precision of their playing is more readily apparent than the original album demonstrated. James Honeyman Scott's guitar solos have far more impact as well, as each note is put on vinyl the way it was originally played. Classic licks like the ones in "Kid" and "Tattooed Love Boys" carry more musical weight this time around, and his reputation as one of rock's premier axemen is given even more credibility.

No question about it, this record is one of the hardest to take off our turntable. It's difficult to argue with quality reproduction of an album which created an aesthetic that all successors—or pretenders to the throne, if you will—can't help being compared to.

Jon & Sally Tiven

Wow/Grape Jam: Moby Grape
San Francisco Sound SFS 0401K/M,
\$20.98.

Moby Grape
San Francisco Sound SFS 04805,
\$15.98.

Sound: B Performance: B

San Francisco Sound is a new audiophile label started by record producer Matthew Katz, whereby he re-releases records he was responsible for in the late '60s and recuts them to today's standards. Unfortunately, the state of the art of rock recordings (particularly in American studios) was extremely primitive back then, and although the records do sound substantially better than the originals, they hardly have a modern sound. The rhythm section is buried throughout, and they hadn't figured out back then how to record with separation and not have it sound like the vocals were done in one room and the instruments in another. On a strictly sonic level, these records present a peculiar approach that doesn't really travel comfortably through the time barrier.

But on a whole other level, it's a joy to have these records available once again. Moby Grape was a highly underrated California rock band, probably the only West Coast group whose songs from that era can still stand as timeless rock—not all of them, but certainly "Hey Grandma," "Changes," and "Murder in my Heart for the Judge." Jimmy Page and Robert Plant liked "Never" off the *Grape Jam* LP so much they recorded their own version titled "Since I've Been Loving You" but failed to give credit to the writer. In fact, most of *Grape Jam* makes it by today's standards far better than the other, more heavily produced albums of this series, and it contains some of the best music to boot—the talent in this group derived from the wailing guitar of Jerry Miller and Bob Mosley's soulful singing, both of which are toned down on the other records.

Regarding the overall job being done by Katz, he seems to be on the case so far as the record itself is concerned. He could be a little more careful in providing plastic sleeves (the records come in the typical paper jobbies), and songwriting credits have been left off the records completely.



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*Source: Ward's Automotive Reports, Specialty Subcompact Segment, October, 1982.

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"The ensemble-playing on *Tanuki's Night Out* is unbelievably precise, and the intonation, at all dynamic levels, is just about perfect."

The best news is that Bob Mosley is back in the studio recording new material for this label under superior sonic conditions, and this will be the true test of the capabilities of San Francisco Sound as a viable collector's label. Meanwhile, it's very nice to have these obscure rock classics back in print again, especially since they actually sound superior to their first incarnations.

Jon & Sally Tiven

Candy-O: The Cars
Nautilus NR-49, \$15.98.

Sound: A Performance: B

Not the best album by this group, but there are some fine performances here ("Double Life" stands out as a sleeper track). The remastering process brings out some things that you'd certainly miss on the original. Roy Thomas Baker's production seems to have been tailored to the mastering process of the regular version, as some semi-glitches slip out that certainly seemed to slide by all right on the record first time around (such as some overdub tom fills that are a touch too upfront). But this is actually one of those albums that seemed a little ordinary before and, with this added definition, makes a lot more sense. When you hear *Candy-O* the way it sounded in the recording studio—or closer to it, anyway—its strength is more readily apparent.

Jon & Sally Tiven

Fresh Aire 4: Mannheim Steamroller
American Gramophone AG 370,
\$16.00 (206 South 44th St., Omaha, Neb. 68131).
Daydreams: Ron Cooley
American Gramophone AG 368,
\$16.00.

American Gramophone (sic) is an Omaha-based audiophile label whose products are more likely to be found in high-end audio stores than in record shops. They are probably best known for the "Fresh Aire" albums featuring the group Mannheim Steamroller. A few years ago, the "Toccata" from their third album was one of the hits at high-end demos at the Consumer Electronics Shows in Chicago and Las Vegas.

Fresh Aire 4 continues in the same vein as its predecessors. Mannheim

Streamroller presents a happy fusion of synthesizers and acoustical instruments, borrowing from styles as far back as the Baroque. The "Toccata in G" harks back to the more successful earlier "Toccata." It includes an overdubbed Aeolian-Skinner pipe organ, along with the group's more traditional resources. Other works make use of dream-like images, wind chimes, gliding synthesizers, and the like. Harpsichord and recorder are never very far away, and they underscore the neo-Baroque basic flavor of the playing.

While it may be too much of a good thing to play their albums all the way through, I found it a joy to revel in the lovely sounds and absolutely clean re-

Tanuki's Night Out: Toshiko Akiyoshi-Lew Tabakin Big Band
Jazz America Marketing JAM 006,
\$8.98 (1737 De Sales St., N.W., Washington, D.C. 20036).

Quoting from the album notes, "If the Akiyoshi-Tabakin Big Band were a race car, it would be the favorite to win any world class Grand Prix—a finely tuned, well-oiled machine that masters the fastest jazz track at any speed." How true! The ensemble-playing on this disc is unbelievably precise, and the intonation, at all dynamic levels, is just about perfect. The excellent engineering keeps musical balances in line, with extremely natural timbres.



Toshiko Akiyoshi-Lew Tabakin Big Band

ording. Some of this stuff is made to order for high-end component demonstration.

Cooley is the lead guitarist of Mannheim Steamroller, and *Daydreams* features him as a soloist. Not surprisingly, many of the performers on this disc are from the same group, but generally this production makes use of more instrumental resources, and the flavor is decidedly non-Baroque. All of the nice things I can say about the "Fresh Aire" series apply to this record just as well.

Sound Recorders Inc. in Omaha deserves credit for original recording and subsequent transfer to disc. To my ears, they have maintained standards as high as any in the industry.

John M. Eargle

The album contains works written by Tabakin and arranged by his wife Akiyoshi. Many soloists are acknowledged, but it is Tabakin who is featured, with his tenor sax and flute. While many big bands can play precisely during high-tension, fast and loud passages, their downfall is usually intonation in softer, slower passages where the sax players double on a variety of woodwinds and the brass play softly with mutes. There is no problem here; the players have all the secure intonation one could want, and balances are right on target. Listen for this in "Falling Petal," which shows why Tabakin is the world's first jazz flutist in *Downbeat's* Critic's Poll.

A sure winner for the big-band enthusiast!

John M. Eargle

EDWARD TATNALL CANBY

PUTTING ON HIS TOP HAT



Gershwin on Broadway. Michael Tilson Thomas, Buffalo Philharmonic.
CBS HM 44582, half-speed mastered.

Sound: A Recording: A Surfaces: A -

Stravinsky: Petrouchka (1947 version); Scherzo à la Russe. Michael Tilson Thomas, Philharmonia Orch.
CBS IM 38281.

Sound: A - Recording: A - Surfaces: B

Michael Tilson Thomas has now moved on from the white jeans and Adidas of his sprightly earlier conducting years, but he is the same accomplished yet very cool musician. Our first contact with him was as one of two pianists who played four-hand Stravinsky—incredibly accurate, hard as nails. There is some of that left, for better or worse depending.

The Gershwin album is a reissue in the half-speed series, presumably also available in the original release, though you would do better to latch onto the new one. The cover, Broadway theater-type marquee, seems to promise one of those high-flying beautiful-music albums, à la film score or Muzak—but far from it. This is an interesting, matter-of-factly literal portrayal of six Gershwin show overtures, not in any way blown up to sensation size, just the original show sound, as of people entering the theater and shuffling about, finding their seats and so on. I

found it fascinating, since these six overtures, for whatever they are worth, are very rarely heard—and yet the tunes they feature are world famous and for most of us (even classical minds like mine) instantly recognizable.

Somehow, CBS has added a bonus in the recorded sound—it is not the usual vast concert hall reverberation but precisely, exactly, the sound of a moderate sized Broadway theater of the pre-electronic age, with the smallish semi-jazz orchestra in the pit. Uncanny! To be sure, it could have been a mere accident, this sound, just the way it came out in the available recording spot. No matter—it works, and I have never heard better. Rather dead (though one senses a longish reverb time in the background) and very theater-like. Exactly what the music needs. With a big spectacular-type treatment it would sound merely corny. These are not in any way great overtures. Instead, they are simply routine openers in the prevailing style of the day, only half listened to by the assembling audience, yet planting the main tunes of each show in their minds, for later recognition.

Paradoxically, the effect is so very authentic to the original intention that after each of six works we feel a curious anticlimax—the curtain should sweep back and the show go on! It doesn't. That's the recorded medium.

Tilson Thomas is good here because he indulges in no histrionics at all, just lets Gershwin speak in his own terms, his own notes. Far too often, the composer is blown up and overdramatized to the point of banality.

The overtures are, in order, "Oh, Kay!," "Funny Face," "Girl Crazy," "Strike Up the Band," "Of Thee I Sing," and "Let 'Em Eat Cake." And be sure to notice the superb bass drum, in every one.

As for "Petrouchka," note that there are currently around 20 versions listed in Schwann and, of course, as many more in the past—going back to the first I ever heard, Leopold Stokowski on 78s. That's the complete ballet; there are still more in the shorter suite form. Thomas may be the latest, but in this immense array of musical talent, I find his version pretty thoroughly second-rate. It is cool—that's the trouble. It just plods along, following all the notes and the stage directions, with a certain let's-get-this-over-with feeling. "Petrouchka" is a lot better than that. Much higher voltage needed, please.

The 1981 Allegro Bell Choir. Union Church of Hinsdale, Ill.

Vol. III, \$8.00. (Available from Union Church of Hinsdale, 137 South Garfield St., Hinsdale, Ill. 60521.)

Sound: A - Recording: A - Surfaces: B+

Very pretty record to look at and also to listen to. If you haven't yet heard hand bells, out of good olde England, then you'd better. I heard my first live performance in Oregon last year, the vast and enormous L.A. bell ringers who subdivide into many performing groups that travel all over—typically California, if I may say so. It's a wonderful show, I can tell you, since the entire little-boy-little-girl (mostly) ensemble is a sort of living keyboard, each person a single note (bell) or, among the older teen-age patriarchs, maybe as many as three bells, artfully juggled like so many not-so-dumbbells. Such concentration! It's almost inhuman, but clearly this is precisely suited to that age group's highest abilities, and it is a pleasure to see the intense and exacting precision with which kids, young and older, do these musical gymnastics.

Listening? Just lovely, though the



Nina Lechuk

music is not exactly of earthshaking importance. Side one is Christmas carols, with all the old familiars, and side two is decked with assorted virtuoso items, including "Maple Leaf Rag." Joplin would turn in his grave—not that he hasn't turned plenty already these days.

Such lovely bell harmonics for recording. Engineers' paradise.

Schumann: Fantasia in C; Liszt: Song transcriptions of Schubert and Schumann, Rhapsody Espagnole.

Nina Lechuk, piano.

Telarc DG 10075.

Sound: A Recording; B+ Surfaces: A –

If you know the big recent Russian male virtuosos, on piano, violin and so on, you will here experience the same sound in feminine form. It's good. We very seldom produce this sort of pianism in the West.

The Russians, as should be clear to everyone, never moved away from the

high Romantic period and in many ways are still there—most notably in performing of all sorts. When after WWI the West plunged into dissonance, jazz, the brittle and sardonic sounds of the '20s, the Russians removed themselves and as far as possible ignored all such developments, including their own men—Stravinsky, Prokofiev. Only in very recent years has all this music suddenly appeared over there. But we, in our turn, worked through the snazzy, jazzy dissonance and into the "neo-classical"—and then back to Romantic, among the very young. Neo-Romantic is the better term. Our young people have turned back to the big works of the 19th century, but with what a difference! The ongoing tradition is broken; these Western young-

sters play it differently. Dreamily, ever-so-slow, mystically, but often missing the solid, hard shapes beneath.

In the East the grand tradition has never died and there is a remarkable continuity—hence, without a doubt, the popularity of Russian performers in the West today. And never mind the political reasons—beside the point.

Listen to Nina Lechuk, out of the Soviet Union, and you will very soon hear what I mean. Schumann was meat and drink to the older Romantics, but the new young people flounder. Not she! This is the easiest, most happily persuasive and listenable big Schumann I've heard in a long time, effortlessly shaped in the large, miraculously easy and unconcerned in the details. Only a handful of Westerners, a few older pianists and a few of the young, can come anywhere near it. Lechuk's big Liszt is scintillating but a bit bangy—but when isn't Liszt that way? The slow song transcriptions are lovely.

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MICHAEL TEARSON
JON & SALLY TIVEN

BLUER THAN BLUE

Money and Cigarettes: Eric Clapton
Warner/Duck 23773-1, \$8.98.

Sound: B+ Performance: B+

The Yardbirds
Epic FE 38455, \$8.98.

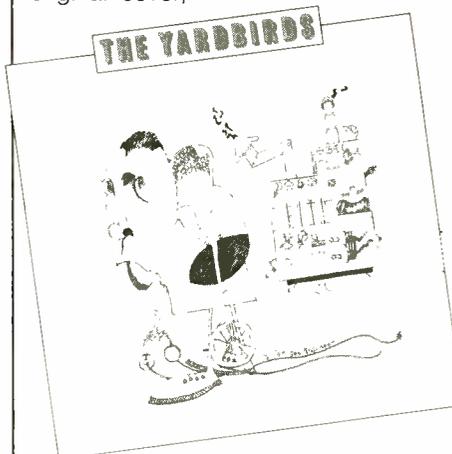
Sound: B Performance: A+

Although plagued by a series of lame countrified albums, Eric Clapton's latest record seems to indicate a return to his strength—blues guitar. Clapton's difficulty stems from the fact that he is a player first and everything else comes second. This is compounded by his periods of musical barrenness. Most of his solo albums are wholly dismissible, but bad records haven't stopped him from charting hits, due to the enormous respect he earned during his "hot" years. This is not to say that Clapton's latest is mind-blowing, but both the playing and the general direction of the music seem to have more fire than the Clapton of the past five years.

Unfortunately, the vocals still sound steeped in the middle-age, blown-out-rockstar tones that have dominated his previous records, and the atrocious single "I've Got a Rock 'n' Roll Heart" mars the purism of this blues-based LP. Clapton's original tunes are pretty well-conceived and rocking for a geezer who's made as many comebacks as he has. On *Money and Cigarettes*, he plays much more guitar than he's done previously. This time he's enlisted Ry Cooder as a supportive guitarist and not as a co-lead player, and the combination works quite well, especially teamed with bassist Duck Dunn. Clapton tends to pick less-than-driving

rhythms, and American session drummer Roger Hawkins emulates the drumming of Jim Gordon (who teamed with Clapton in Derek & The Dominoes) rather than propel the tunes. It would be nice to see Eric teamed with a blues producer like Don Nix or an English-style mixmaster like Andy Johns instead of staying in the American groove established by Tom Dowd.

As you may or may not recall, Clapton first appeared before the public in a group called The Yardbirds, and left before getting a chance to really shine. He claimed that he was more interested in pure blues, so he teamed with John Mayall and made an album called *Bluesbreakers*, a classic text of Clapton's most influential licks. But the album *The Yardbirds* made after his exit was also an incredible piece of music, and Epic has seen fit to reissue it, packaged in a close simulation of its original cover,

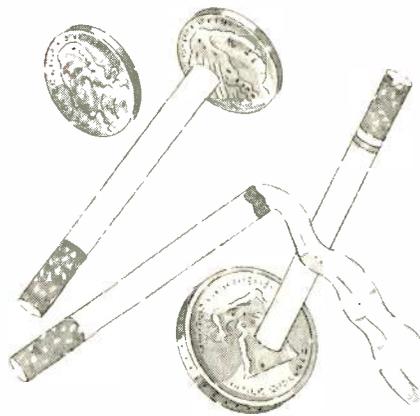


nearly 20 years later. This record company seems to have gotten wiser in the interim—witness the adding of the two tracks they deleted from the U.K. version ("The Nazz Are Blue" and "Rack My Mind") as well as supplementing the material with two tracks which never appeared before on a regular Yardbirds album (not counting their *Greatest Hits*), "Happenings Ten Years Time Ago" and "Psycho Daisies."

Perhaps to Eric's ears this music may have sounded a wee bit commercial, but these extravaganzas still rate as some of the most experimental and avant-garde creations ever put to disc. Indian-derived licks, Gregorian chants, distortion, feedback, and the explosive

debut of a young guitarist named Jeff Beck made *The Yardbirds* a record that has stood the test of time. This makes it the reissue of the year.

Jon & Sally Tiven



Money and Cigarettes: Eric Clapton
Warner/Duck 23773-1, \$8.98.

Sound: B+ Performance: B

It's real hard to work up raw enthusiasm over Eric Clapton's albums. He certainly hardly ever seems to. They are just easy-going little affairs that are real easy to listen to but not real deep. On his good ones, though, the songs somehow work an effortless magic that can be captivating.

Money and Cigarettes is a good one. It is a really upbeat, cheery album, even the blues ("Everybody Oughta Make a Change," "Crosscut Saw"). Clapton's new originals are a comfortable homey bunch that let the band rip off some snappy licks. "The Shape You're In" and "Ain't Going Down" are pleasant cookers, while "Pretty Girl" is this album's "Wonderful Tonight."

Speaking of the band, what a stellar group! Clapton shares guitar space with both Ry Cooder and Albert Lee (who doubles on keys), while Donald "Duck" Dunn and Roger Hawkins admirably fill out the rhythm section. Tom Dowd, Clapton's regular producer, does his usually excellent job.

Money and Cigarettes is a surprisingly satisfying album for Eric Clapton, who has been known to make some very dull ones. This one is bouncy and fun, his best since 1977's *Slowhand*.

Michael Tearson

The Roches



Keep On Doing: The Roches
Warner Bros. 23725-1, \$8.98.

Sound: B Performance: B-

Keep On Doing rebounds The Roches from the sleazy and trashy image they cultivated on their second album, *Nurds*, back to the pristine yet complex nature of their debut. Additionally, they have regained the services of their first producer, and Robert Fripp's return seems largely responsible for this album's artistic success. His iciness restrains the three sisters from their hammier instincts while keeping intact the cerebral nature of their work. He drapes their voices in wonderful ways full of stereo surprises. Best of all, their material, too, has

rebounded from *Nurds'* sophomore jinx. Their own songs are sometimes difficult to connect with, but the challenge is invigorating.

Since The Roches defy easy categorization, you aren't likely to hear them on the radio, but don't let that stop you from listening to them. *Michael Tearson*

The Distance: Bob Seger & The Silver Bullet Band
Capitol ST-12254, \$8.98.

Sound: B Performance: B

It's about time this guy sacked his drummer and took in some outside help to produce a record, but all the changes here are the most obvious and superficial. Hiring Springsteen's engineer surely isn't going to push Seger in a new and interesting direction, and using the L.A. sessionaires and some ex-Eagles to fill in for his departed mates only makes for a more polished record, not a more potent one. Seger's like an old vitamin that's been sittin' too long and now has lost its vitality. While he goes through all the motions, and this record sounds a lot better than his last two, overall *The Distance* is merely a formula album.

Unless writing songs is a tremendous chore for Seger—there were twice as many songs taped as ended up on vinyl—one must question the massive effort to just play it safe.

Perhaps Seger has good reason to be so musically conservative; after struggling for seven or eight albums, he suddenly comes up with a winning formula and hits it big enough to shock the musical senses into submission. But if you listen to *Night Moves* and *The Distance*, there's virtually no musical progression. When you go back to his earlier and less popular albums, e.g. *Beautiful Loser*, what you hear seems a lot closer to the soul of a human being. We'll say this is Bob Seger's best album in five years, but somewhere locked in this guy is absolute greatness. What he delivers on his records is considerably less, even though it sounds pretty good.

Jon & Sally Tiven

gimmicks, taking uncluttered aim at the heart of the song.

The recorded sound, too, is basic and uncluttered. The voices could have been mixed a bit more up front, but this is just a minor quibble with an attractive debut. *Michael Tearson*

I Advance Masked: Andy Summers & Robert Fripp
A&M SP 4913, \$8.98.

Sound: B Performance: B-

Is this supposed to be the hip Chester & Lester? There was much of merit in the meeting of great fingers Chet Atkins and Les Paul, and their album also projected personality and warmth, neither of which is in great abundance on *I Advance Masked*. Fripp takes himself so seriously that all of his projects are heavier than they are weighty, while Andy Summers (of The Police) seems introverted after having been the glue between Sting and Stewart Copeland. The only presence Summers has here is as a drone, a rhythm player, or a Fripperton. If you weren't aware that this isn't just a Fripp solo LP, you wouldn't jump up and yell, "That sounds just like Andy Summers!"

This is not to degrade the quality of the playing and/or the music, which is technically fairly tricky—a combination of clean chordings, fast runs which are transposed from key to key (rather than improvised upon) with each chord change, and swooping textures. But as

Bob Seger

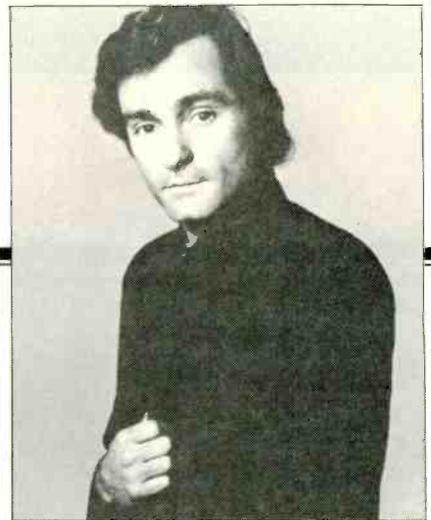


Chronic Town: REM
IRS SP 70502, \$5.99.

Sound: B- Performance: B+

REM, hailing from that hotbed of new music, Athens, Ga., has made one of the most unlikely and charming records of the past year. Their five-song EP virtually resurrects the folk-rock sound of The Byrds for the '80s, shimmering 12-string guitars and all. Their songwriting is arresting, fascinating. They play it straight and without many

"Marty Balin's problems center on ordinary material and a style that sounds like corporate rock of 1977."



Marty Balin

Lucky: Marty Balin
EMI America ST-17088, \$8.98.

Sound: B Performance: C-

Marty Balin, founder of Jefferson Airplane, still has his trademark, that clear tenor voice of yore. His previous solo album was just awful. This one's not nearly as bad. It is a perfectly average, L.A. pop album with lots of the usual suspects behind the instruments and Val Garay's usual glossy production. The problems center on material that is ordinary enough to be totally forgettable and on a style that sounds like corporate rock from 1977.

Michael Tearson

Last Date: Emmylou Harris
Warner Bros. 23740-1, \$8.98.

Sound: B Performance: B+

Emmylou Harris' latest release is her first live album, and it is quite revealing. In concert, Emmylou emerges as a tougher, stronger, less compulsively polite singer than she does in studio performances; she's more willing to take chances. Even though there are some warts visible in the performances, *Last Date* is a charming, unassuming album that is over too soon.

Emmylou's choice of material here (all songs not previously recorded on her solo albums) is pretty conservative. There are country standards like "I'm Moving On," "So Sad (To Watch Good Love Go Bad)" and "It's Not Love (But It's Not Bad)" plus four songs from the Gram Parsons songbag (one of which she recorded with him). Two moderate surprises, and pleasant successes, are Neil Young's "Long May You Run" and Bruce Springsteen's "Racing in the Streets."

Recording quality is adequate, although very warm and cheery.

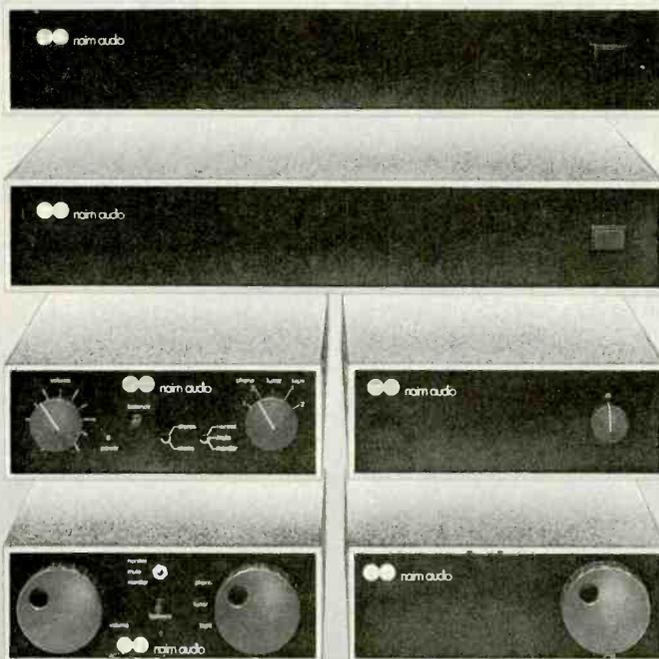
Michael Tearson

far as being a revolutionary album, if you threw on an overdub of Billy Cobham, it wouldn't sound much different from John McLaughlin's Mahavishnu Orchestra of 10 years ago. The songs all sound vaguely familiar ("Hardy Country" could easily be mistaken for a reworking of "Girl from Ipanema's" first

four bars), as if they've been playing the same scales too long. This is a pleasant album, admittedly, but more for background's sake than intent listening. Improvisation would have been far more welcome than this too well-thought-out collection.

Jon & Sally Tiven

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Nicolette Larson

All Dressed Up and No Place to Go:

Nicolette Larson

Warner Bros. BSK 3678, \$8.98.

Sound: C+

Performance: D+

This album has a lot of problems: The arrangements are flat, listless, and directionless. The players are all the right guys in the right place, but they just can't make this one fly. Some touches, particularly the LA backing vocals, are wrong-headed and just plain distracting, however pretty.

Nicolette is a fine singer—this much is made clear by her backing work, especially what she has done with Neil Young. But she just doesn't sound interested in most of these songs. She breathes some life into "Nathan Jones," Lowell George's "Two Trains" and her own song with producer Andrew Gold, "I Want You So Bad." And when she gets onto her home turf in the countryish "Love, Sweet, Love," a post-Little Feat song by Paul Barrère, she is infectiously alive and brings the best out of everybody. The rest of the time she gets the words and the tunes right but isn't really listening to what they are saying.

This is good dinner music.

Michael Tearson

Ten Years Live: The Nighthawks Chesapeake CR-LP 101, \$8.00.

Sound: B

Performance: A

The Nighthawks—Jimmy Thackaray on guitar, Mark Wenner on harmonicas and tattoos, Pete Ragusa on drums and Jan Zukowski on bass—are based in Washington, D.C. Last year, they recorded a series of nights at Washington's Bayou to celebrate their tenth anniversary as a working group, which itself is no small feat. In addition, they had a slew of new, original material they wanted to record and they decid-

"Nicolette Larson gets the words and the tunes right, but she doesn't really listen to what they are saying."

ed to capture the energy of live performances in front of their rabid home-team crowds.

In a concert situation, the Nighthawks are a special treat, and they hadn't done a live album in six years. You just can't help having a good time with the Hawks. What puts them over

the top is the superlative sense of roll that goes into their mix of blues, rockabilly, and soul. It makes your head swim, while your feet tap the beat.

Ten Years Live is first-rate all the way. So are The Nighthawks. Don't you dare miss them when they come to your town.

Michael Tearson

Elegantly simple. In 1971 this man introduced the first planar magnetic loudspeaker to American audiophiles. Now, with four models priced from \$475 per pair and up, Magneplanars are still the ONLY full-range planar magnetic speakers on the market. With over 45,000 pairs sold, Magneplanars are recognized worldwide as an elegantly simple, cost-effective approach to accurate music reproduction. Although there have been speakers that do some things better, never has there been any that do more things right—especially for the price.

And now, Jim Winey, in recognizing the performance advantage of true ribbon tweeters for esoteric audio, has developed a superior true ribbon tweeter that interfaces synergistically with Magneplanars. As with Magneplanars, this patented* ribbon tweeter is an elegantly simple device. However, this simplicity is deceiving, for it accomplishes all of the following:



- Direct drive (no transformer) • Low mass ribbon (only 2.5 microns thick) • Bi-polar operation (no rear cavity or loading) • Response to 50 kHz • Near perfect dispersion (360 degrees to 25 kHz) • Line source (ideal interface with Magneplanars) • Affordable

MAGNEPAN

1645 9th Street
White Bear Lake, MN 55110

*Pat. No. 4,319,096

ABERCROMBIE & FITCH



MEET MITSUBISHI MONTERO,
THE URBAN GORILLA.

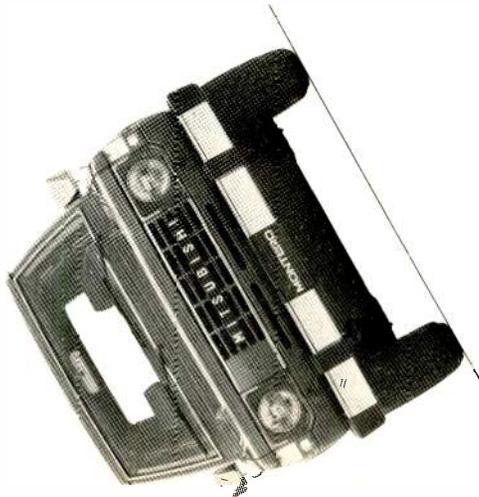
Behold: a rugged off-road 4-wheel drive beast that acts civilized on the road.

Shift our new Montero into 2-wheel drive and it cruises around town like a sporty car. It's roomy, seats four comfortably. And it's loaded with creature comforts.

But more about the beauty later. First, let's examine the beast.

WHERE DOES A GORILLA GO? JUST ABOUT ANYWHERE IT WANTS TO.

Mud, snow, hills or gullies. You name it, the Montero tames it.



In its 4-wheel drive mode, there's a low gear that will haul you up a hill. And a high gear for quick and nimble going in sticky snow or loose dirt.

Super low gearing provides Montero with super climbing ability. And its wide track, allows it to traverse steep terrain.

Town or country, this animal goes just about anywhere.

YOU NEED A GORILLA BECAUSE IT'S A JUNGLE OUT THERE.

From steel top to solid box-type frame and protective steel skid plates, the Montero is well built, like a gorilla.

Gutsy 2.6 liter, 105 horsepower MCA-Jet engine is the biggest 4-cylinder power-plant we offer. So it won't back down in the backwoods.

Yet, it's smooth and quiet in the concrete jungles. Because unique Dual Engine Stabilizers reduce vibrations.

Beefy independent front suspension with torsion bars smooths out unbeaten paths. Or roads that have gone to potholes.

And the power-assisted front discs will stop a gorilla in its tracks.



GOT THINGS TO CARRY? GET A GORILLA.

Fold down the rear seat and the Montero becomes a beast of burden. Sporty front bucket seats recline, and the passenger seat tilts forward for easy rear seat access. Cargo tie-downs come standard, to secure everything you need to go on a

camping trip. Or haul everything back from a shopping spree.



EVERY GIRL NEEDS A GORILLA.

Although it manhandles most anything, the Montero is easily woman handled, thanks to variable assist power steering.

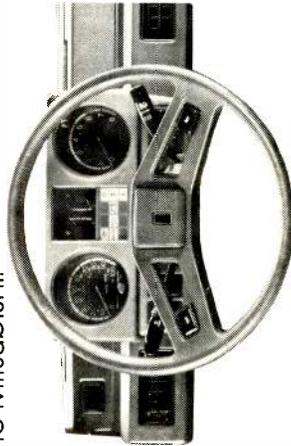
Easy to see out of. Thanks to a high top and tinted glass.

Easy to shift. Thanks to a sporty 5-speed manual over-drive transmission.

Easy to ride in. Thanks to a driver's seat that "floats" on a shock absorber.

And it's easy to look at. Thanks to a nifty two-tone paint job and 15-inch stylish spoke-type wheels with all terrain radial tires.

And it's all standard. Thanks to Mitsubishi.



CIVILIZED INSTRUMENTATION.

ALL THESE STANDARD FEATURES MAKE IT QUITE AN ANIMAL.

Every gorilla comes loaded with standard features like: 2.6 liter, 105 horsepower MCA-Jet engine.

5-speed manual overdrive transmission.

Independent front suspension with torsion bars.

Variable assist power steering.

Manual free-wheeling hubs.

Protective skid plates.

Driver's suspension seat.

15" styled spoke-type wheels with all terrain radial tires.

4-passenger seating plus big cargo area.

Plus dozens more standard features for only \$9,229*.

YOU CAN EVEN BEEF UP A GORILLA.

We offer the Sport Option Group with limited slip differential, automatic free-wheeling hubs, headlamp washers, rear wiper/washer, accent stripe and an AM/FM/MPX cassette radio with four speakers. That's a lot of gorilla for only \$721* more. You might say you'll go ape over it.

For your nearest dealer, call (800) 447-4700.

*Manufacturer's suggested retail price. Actual prices set by dealers. Taxes, license, freight, options and other dealer charges extra. Prices may change without notice.

Limited availability in California until September, 1983.



ACHIEVE MITSUBISHI MONTERO. IT TAKES YOU WHERE YOU'VE NEVER BEEN BEFORE.



Sony Underwater Video System

Videotape your vacation on the coral reefs: Sony's Marine Pack protects an SL-2000 portable Betamax and Tricon HVC-2800 color camera down to 200-

foot depths. The MPK-60 case has an underwater microphone and exterior controls for the recorder. Price: \$3,000.00 for marine pack alone; \$5,400.00 with SL-2000 and HVC-2800. For literature, circle No. 100



Electronic Specialists TV Antenna Filter

Model TVFM-HP is a compact, easy to install filter that will significantly reduce or eliminate CB, ham or other interference entering through a television antenna. Price: \$16.75.

For literature, circle No. 102

Acoustical Physics Speaker

The Acoustic Image Model II has a 10-inch, polypropylene, acoustic-suspension woofer; a gradual-slope crossover at 3.5 kHz, and a time-corrected, 1-inch soft-dome tweeter. The system, rated from 28 Hz to 22 kHz, ± 2 dB, is available assembled, as a kit with cabinets, or as a kit without cabinets. Prices: Assembled, \$600.00 per pair; kit with cabinets, \$400.00 per pair; kit with only drivers, crossover, hardware and instructions, \$225.00 per pair. For literature, write to Acoustical Physics Laboratories, 151 6th St., Atlanta, Ga. 30313.



Audiovox Car Stereo

The Hi-Comp HCC-1200 has Dolby noise reduction, auto reverse, a digital display with clock, night

illumination, and 12-station electronic memory. Price: \$450.00, with built-in power amplifier. For literature, circle No. 101



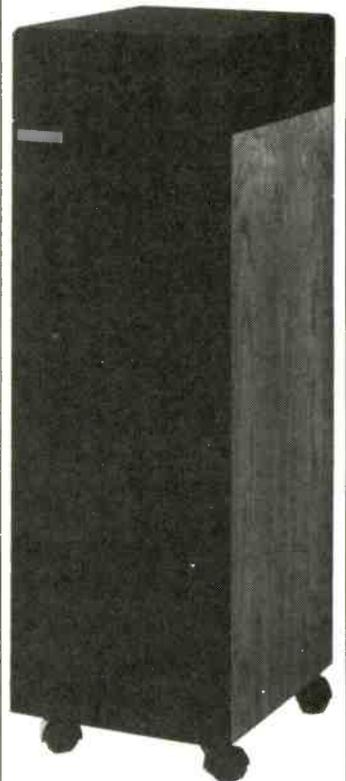
Canton Car Speaker

The Pullman auto speaker spreads over a yard (37½ inches) across a

car's rear deck to achieve larger enclosure volume without bulking so high as to obscure the driver's rear view. Mounting bolts can be located anywhere beneath the case. Drivers

include two 4½-inch woofers, a 1-inch midrange and a ¾-inch dome tweeter for each channel. Recommended power is 5 to 80 W, and response is 45 Hz to 30 kHz. Price: \$400.00.

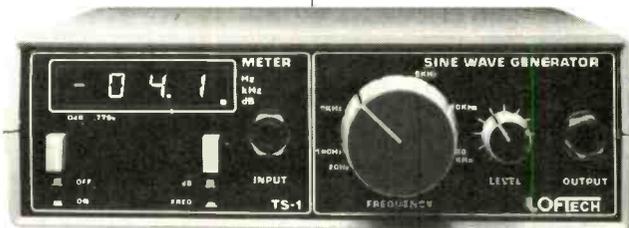
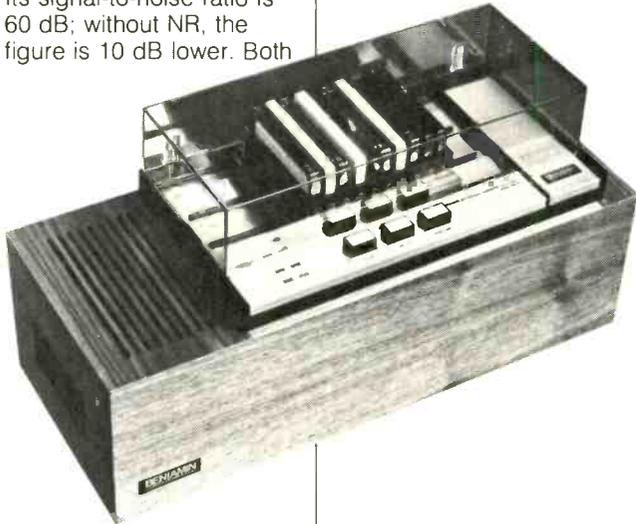
For literature, circle No. 103



**Benjamin Automatic
Cassette Changer**

The latest version of the RAC-10 MK II cassette changer is the MK II DNR, with DNR noise reduction. Its signal-to-noise ratio is 60 dB; without NR, the figure is 10 dB lower. Both

versions hold up to 10 cassettes at one time, and have 0.3% wow and flutter. Prices: With DNR, \$900.00; without NR, \$850.00. For literature, circle No. 104



LofTech Test Unit

The TS-1 combines a compact audio oscillator,

frequency counter and dB meter for such purposes as level calibration and

**Acoustic Design Group
Speaker System**

Probably the first satellite/subwoofer system with a bookshelf-sized subwoofer, the Triad system is rated at 25 Hz to 20 kHz. Putting the entire system on one shelf permits true "Time Alignment," according to the manufacturer. An IC in the woofer limits cone excursion. Price: \$499.95 per system.

For literature, circle No. 105



TEAC VCL-20



**TEAC
Video Head Cleaner**

The VCL-20 is a wet-type video head cleaner in a VHS videocassette shell. Price: \$19.95.

For literature, circle No. 106

frequency-response checks. The oscillator covers 10 Hz to 30 kHz, with 0.5% THD, and the counter reads from 1 Hz to 99.99 kHz. The dB meter's range is -50 to +24 dB, in one range, with 0 reference adjustable from -10 to +8 dBV. Price: \$299.00. For literature, circle No. 107

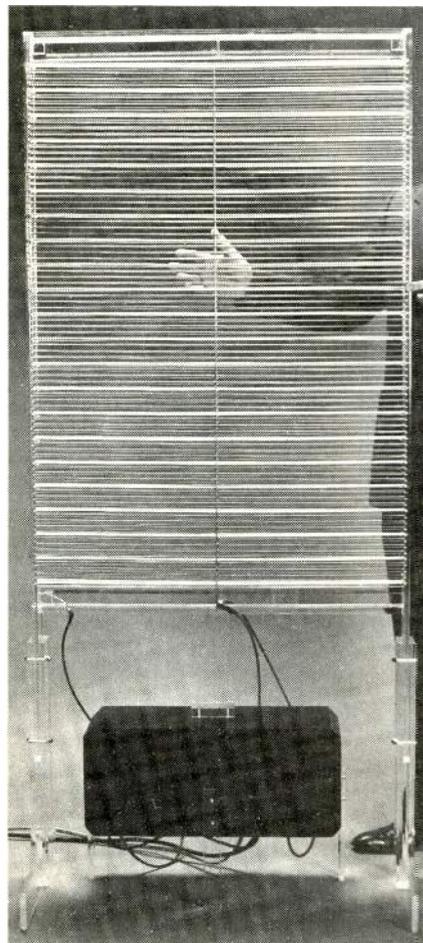
**Avel-Lindberg
Toroidal Transformers**

Toroidal transformers, with low interference radiation, are available in a budget range from Avel-Lindberg's Cotswold Division, at prices from \$21.00 (30 VA) to \$69.67 (530 VA), including



mounting hardware. Most have 110-V primaries, and dual secondaries from 6 + 6 V to 50 + 50 V are available. For literature, circle No. 108

THE IONIC MAN

**Transparent Sound Source**

The large, opaque object in the photo is designer Nelson Pass of Threshold. The large, transparent object is his new "ion cloud panel" loudspeaker.

In principle, it could be considered

an electrostatic speaker with a diaphragm of air—at least, in this version. For the speaker to work, the air must be ionized so the electrostatic forces from the two control grids will be able to attract it.

This is by no means a production model, merely "the first embodiment of such a system to reach a level of performance sufficient to enable public showing," in the words of the press release; "still an engineering toy," in Pass's own words.

When I heard it at CES, the toy had a few problems yet to be worked out. One was limited dynamic range. Using Threshold's S 500 amplifier, which delivers about a kilowatt per channel on transient peaks, it was far from loud. Another problem was that it generated ozone, which is not good stuff to breathe; after five days of demonstrations, Pass became so sensitized to it that he couldn't even run the copy machine or take static-charged laundry from the dryer (he's since recovered). To minimize ozone production, the panel used high-voltage r.f. energy to ionize the air—which could cause radio or TV interference.

The ozone and r.f. problems have now been solved, Pass tells me. The

final version will use argon gas instead of air, and therefore can use d.c. instead of r.f. to ionize it. Argon was chosen because it's inert, comparatively low in cost (it's a byproduct of oxygen separation), and because its mass is high enough for a reasonable transfer of momentum between it and the surrounding air. ("Air itself would be the perfect match," Pass says, "but for the ozone problem.") The argon does leak out into the air, but slowly. Nevertheless, says Pass, "It will cost at least a couple of bucks per hour to run."

Like all large, flat-panel speakers, it beams high frequencies instead of evenly dispersing them. "But that's because we made it flat," says Threshold's Rene Besne. "We could make it any curve we like, even S-shaped. Our next version will be curved."

That next version, to be shown at the Summer CES, may even be a preproduction prototype. Comments Besne: "It has about a 50% chance of becoming a production item—if you call the Hill Plasmatronics or the Infinity IRS production models. We should know by June what's actually entailed in making it. If it's producible, we could be making one or two pairs per month by early next year."

The ion cloud's price would probably be in the range of about \$10,000 per pair. Worth it? The sound of the early prototype I heard was rather good, if bass-shy, with good transient response and low distortion, and with the strong imaging typical of bipolar speakers. In other words, pretty transparent.

Coda

One of the nicest people in the world has gone further away, so that we will not see him again soon. "Music has given my life meaning, and made my dreams immortal"; these were the words on the front of the card telling of the death, last November 10th, of Etsuro Nakamichi, whose vision and dedication of quality literally raised the performance of the cassette medium by orders of magnitude. We will not see his like again soon.

—E.P.

**Digital Facilities:
Foreigners are Faster**

You can't have digital recordings—even "digital" analog discs—without digital master tapes. The number of facilities capable of making such masters, or of renting and leasing mastering equipment to others, is increasing—but most of that increase is abroad.

According to a survey taken by the RIAA in October of last year, the number of digital recording facilities in the United States had

grown by 10%, from 30 to 33, since June of 1982. But overseas, the number had grown from 21 to 50 in the same period. Fourteen of those are in Japan, three in Canada, one in Mexico, and the other 32 in Europe (13 in Germany, 11 in England, 5 in France, 1 each in Hungary, Czechoslovakia and Sweden). This may well be related to the fact that it had long been known that the Compact Disc would be made available in Europe and Japan months before its introduction here.

WHY PUT TWO FILTERS INTO ONE GREAT COMPACT DISC PLAYER?



Kyocera goes to double lengths to make sure there's no distortion in its DA-01 Compact Disc Player. It's got both digital and analog filters—so nobody hears distortion.

The advantage of digital and analog filtering systems.

Modern technology has made analog filters pretty effective. But there can be a problem—analog filters by themselves render limited performance. By combining an analog filter with a digital filter, and precisely applying both types in just the right way, the limitations found with analog filters are not there anymore. Thanks to the unique use of these filters, and an impressive array of very advanced circuitry, the Kyocera CD Player provides accurate, crystal-clear, life-like sound.

The awesome specs that only digital can provide.

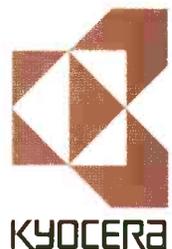
Needless to say, the Kyocera DA-01 comes through with some specs that are mind-boggling: A full 90 dB dynamic range... flat frequency response from 20-20,000 Hz... quiet 90 dB S/N ratio... and total isolation 90 dB channel separation.

And, just in case you didn't realize it, with the fabulous disc player system, as provided in Kyocera's DA-01 Player, there is no contact between disc and playback head. No tics, clicks, pops, scratches or record wear. And the DA-01 plugs right into your present audio system—Kyocera or others—just like a conventional turntable.

Easy to use, but total control of every function.

The DA-01 is easier to use than a modern cassette deck—slide the compact disc into the disc compartment, shut the door and hit the play button. With the DA-01's feather-touch controls, you can play the whole thing (60 minutes a side)...repeat a track...scan...pause...skip...advance...index...and program up to 24 different segments with an electronic memory. A functional LED digital panel tells you program running time and just where the optical scanner is on the disc.

Admittedly, our DA-01's are carried only by selected dealers. If you have trouble finding one, contact: Cybernet International, Inc., 7 Powder Horn Drive, Warren, NJ 07060 (201) 560-0060.



FLY WITH THE EAGLES

EAGLE



Eagle ST's low-profile stance is pure Goodyear — derived from our legendary racing Eagles. Its surefooted tread pattern is a direct steal from our two-time IMSA RS champion radials.

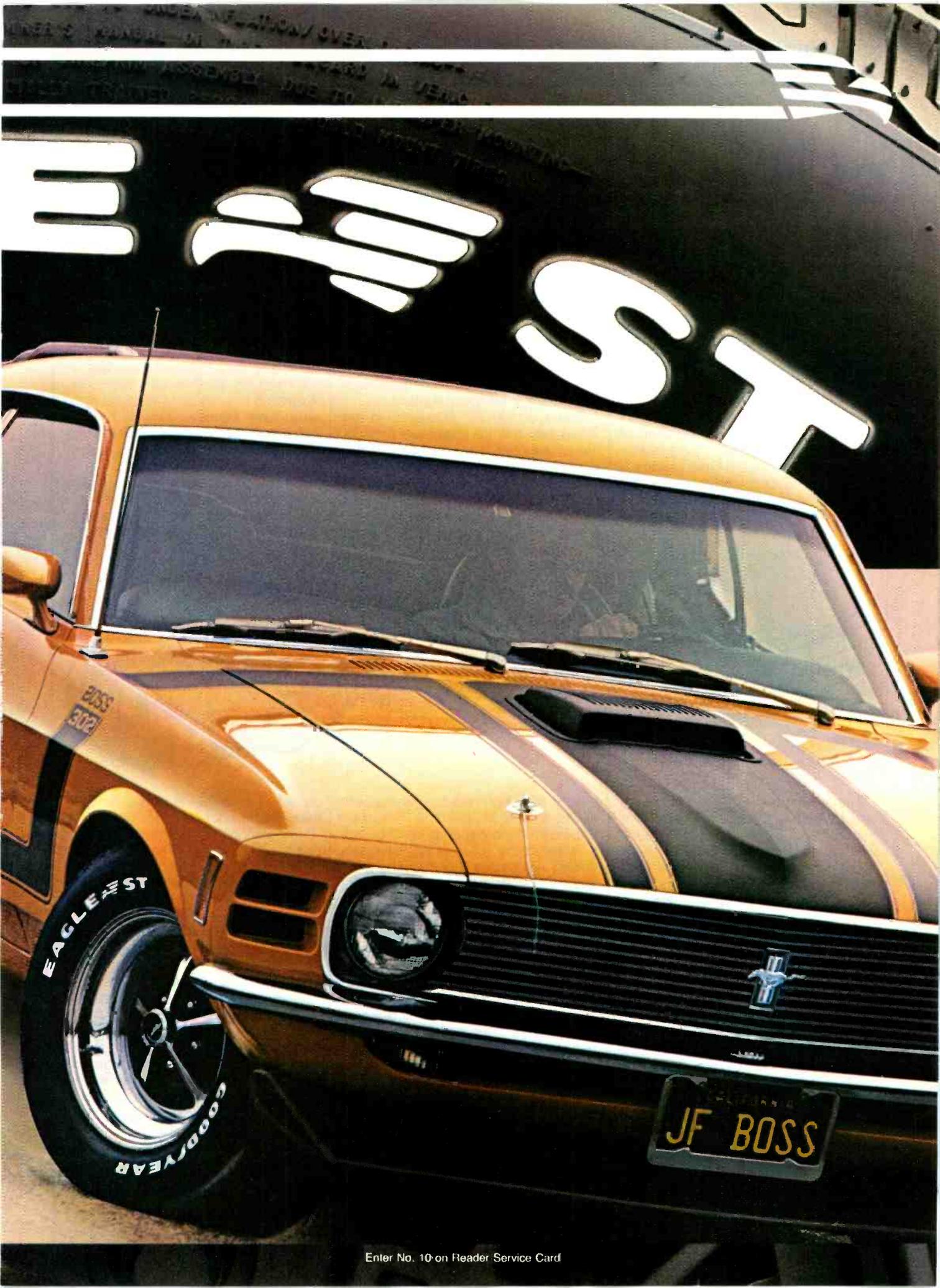
As for the classic white-letter styling, it doesn't make Eagle ST go faster, but when you have a tire with this much of a competition heritage, why keep it a secret?

One last thing: Once you start leaving the competition in the tracks of your Eagle ST radials, do the charitable thing.

Tell 'em they can get a set of Eagles for their car. In the Eagles' Nest at your Goodyear retailer.

GOODYEAR
QUALITY AND INNOVATION

***Make the Boss look good.
Eagle ST.***



Enter No. 10 on Reader Service Card

IVAN BERGER

AM, AMAS, AMAT

As I mentioned in "Roadsigns" last month, Delco has picked Motorola's AM stereo system. That doesn't ensure you'll get it in your next GM car, only that Delco recommends it to the GM car divisions, who will probably offer it as an '84 option. It may be available in the fourth quarter of this year.

That this information is in "Roadsigns," rather than elsewhere in the magazine, is because 70% of adult AM listening takes place in automobiles, or so says Motorola. Forty percent of those listeners, also according to Motorola, are hearing it on Delco radios—one reason Delco's adoption of the Motorola system for receivers should substantially encourage broadcasters to adopt it, too.

for the sake of broadcasters, the receiver industry and the public." After further testing, Harris stayed with the 55-Hz pilot tone.

Meanwhile, Motorola is considering seven bids from other broadcast equipment companies to make the transmitter exciters which stations need to convert to the system. Such exciters will cost about \$10,000 each for any of the systems—comparatively small change for many stations.

Home equipment should be in the stores late this fall. Because production of the necessary ICs has just begun, an absolute maximum of 500,000 Motorola-system receivers could be out by Christmas, but Motorola doubts that will happen. Stereo AM/FM receivers will cost about \$12 to \$15 more

"unless you open up to at least 3 kHz. You need separation at those frequencies to hear the stereo effect at all."

In theory, that should be no challenge. Everything else in the audio chain has response well beyond that. But in practice, even component high-fidelity tuners and receivers fall woefully short in AM response, as readers of our "Equipment Profiles" know well.

It need not be that way, of course. Illustrating how well AM sections once were done, Payne comments that his Fisher 90T has, in its AM section, three i.f. bandwidth settings, high-frequency roll-offs, and low-end roll-offs.

But the limited frequency response in today's AM gear has prompted a pre-emphasis war from the stations. Since AM tuners have poor high-fre-



Illustration: Robert Zimmerman

The system is already being broadcast by WJR in Detroit, WIRE in Indianapolis and KZLA in Los Angeles, where car-stereo engineers can check it out for themselves. Motorola feels that the Kahn and Harris systems' early lead among broadcasters is because those companies already make broadcast equipment, so the stations know them. But, says Motorola, "About 85% of AM broadcasters have no loyalty, yet, to any stereo system."

The Motorola and Harris systems are compatible, to some extent. So Harris recently considered lowering their pilot tone from 55 to 25 Hz, the same as the Motorola system's, for "practical compatibility." Roger Burns of Harris says, "We felt that such a conciliatory gesture on our part could be the catalyst to get AM stereo going. We were wrong."

David Hershberger, inventor of the Harris system, adds, "While we knew 55 Hz was a superior pilot frequency, we were willing to make a compromise

apiece than equivalent receivers with stereo on only the FM side. The exact price difference depends on "how sophisticated the receiver is," says Motorola's AM Stereo Broadcasting Manager, Chris Payne. "Making the AM better adds some cost, too."

In the long run, making the AM better by improving AM broadcasting and reception may be AM stereo's biggest benefit. "In home systems," says Oscar Kusisto, a consultant to Motorola, "AM has been treated as a very low form of life. . . . Engineers and manufacturers are surprised by how good AM can be."

Says Payne, "AM can give 15-kHz responses, 60 dB S/N. The typical AM transmitter, now, is flat to 14k and has 65 dB of S/N. Broadcasters gripe that, for years, they've been able to transmit better than the customers can hear."

For stereo, receiver frequency response will have to improve. "You get nothing out of stereo," says Payne,

quency response, stations increase their high-frequency pre-emphasis. "Some stations," says Payne, "pre-emphasize to extremes. They adjust it to sound good on the program director's radio. As a result, wideband AM radios may sound tinny till the stations cut back on this boost."

Just as in FM, some pre-emphasis is actually desirable, to cut high-frequency noise for the listener—but only with matching de-emphasis at the receiver. The only way to assure such a match is to standardize; Payne is "94% confident that we'll have a de facto standard by the end of 1983."

Wider band AM equipment won't be that hard to make. "Earlier receivers" says Payne, "had L-C i.f. filters, which were expensive. Now, ceramic filters can be better—have sharper cutoffs—for less. To improve a Technics receiver's AM section to 6 kHz, we only had to replace one IC." To widen bandwidth much beyond that, though,

would require addition of sharp, preferably notch-type, 10-kHz whistle filters.

Cutting corners is not the only reason why AM receiver makers have been rolling off the high end for decades, ever since FM became dominant. The other major reason is interference: FM is comparatively immune to static and, thanks to the capture effect, to interference from other stations on the same frequency (which is also limited by FM's smaller range).

AM has much longer range (a major reason for its popularity in cars) but is far more vulnerable both to static and co-channel interference, especially at night. "No competition to FM in that," says Payne. "But tests show that in the car, you frequently can't hear the difference between FM and good AM." (The best AM I've heard in cars recently sounded like FM, all right—but with the tweeters blown.)

Under some reception conditions, AM actually has advantages. "Long before the signal degrades enough to drop out, in FM you get multipath distortion of 10% or more. Not so in AM," says Payne.

Sensitivity is still an issue, though. Typical AM sensitivity is 300 $\mu\text{V}/\text{meter}$ —a figure representing signal strength reaching the built-in antenna, not that reaching the antenna terminals of the set. Theoretically, this should suffice, as the FCC requires a signal strength of 25 mV (not μV) per meter in a station's market area, with a minimum of 500 $\mu\text{V}/\text{meter}$ at the farthest reaches of its FCC-defined, daytime coverage area.

Even home listeners, however, routinely try to catch stations outside their immediate area. And in the car, where you could be 50 miles farther from the station by the time a program ends, more sensitivity is vital. According to Motorola, current Delco products measure "under 10 μV sensitivity at the antenna inputs (maybe 50 $\mu\text{V}/\text{meter}$, with a whip antenna)."

Sensitivity is not, however, the be-all and end-all in AM that it has sometimes been made out to be in FM specification wars. "You'll probably be limited by interference before you hit the tuner's noise floor," says Payne. "In the past 10 years, AM radios have had almost no design attention paid to interference rejection." Adds Kusisto,

"Noise cancellation helps, but it's expensive—and, in New York City, almost hopeless."

You can probably expect some confusion when the receiver makers first start trumpeting their AM specifications, for, says Payne, "There are no really current AM test standards. There

are old IRE standards, but they were last rechecked in 1951—and not revised at that time. For stereo, there are no AM standards." Still, when those specs gain prominence, it will probably bear out Payne's hopeful prediction: "Now the good engineers will be assigned back to AM." 

If you love music, make it last



If you've run out of patience with those highly-promoted record and stylus "cleaners", it's time you made the move to LAST. Originally developed for the record archives of institutions, LAST record and stylus care products are now available to everyone.

LAST power cleaner cleans records like no other product on the market. It even removes mold release—the potentially damaging material left in the groove by the manufacturing process.

LAST record preservative actually penetrates the record groove to a depth of ten molecular layers, protecting the groove from the constant, complex movements of the stylus—for 200 plays!

LAST stylus cleaner removes the most tenacious accumulations on the stylus while protecting the adhesive holding the diamond tip and the cantilever suspension.

STYLAST is molecularly engineered to lower friction by filling in the hollows on the surface of every diamond, reduce vibration effects by creating a liquid cushion for the moving stylus, and protect the elastomer holding the cantilever to the cartridge and the adhesive holding the diamond to the cantilever.

Of course, you love music! That's why you should make it LAST. LAST is at finer dealers everywhere.

LAST

LAST • 122 Dupont Street, Plainview, New York 11803. Tel. 516-349-9180

Going to the Well

Q. I am constantly dubbing cassettes, and have been thinking of buying one of the new, double-well cassette decks. However, I have been told that it is better to have two decks. Please advise.—Jonathan Edwards, Boston, Mass.

A. When dubbing, the principal advantage of the double-well deck lies in its compactness and economy. The advantage of separate decks—if you spend enough—lies in the ability to achieve utmost quality. [And in having one working deck if the other breaks down.—I.B.] Whether you should get a double-well deck depends on the quality of dubbings you seek. It may serve your purposes quite well, and at a fair or considerable savings in cost over separate decks. The only way to know is to try. Check the quality of the dubbings you get on a double-well deck in an audio showroom. Better, if you can arrange for a short home-trial period, do so.

S/N vs. Frequency Response

Q. I am planning to buy a cassette deck but am confused about the specifications of the decks involved. Exactly what are frequency response and signal-to-noise ratio, and how should I compare decks in these respects? For example, one deck may have better frequency response but poorer signal-to-noise ratio than another, or vice versa. My question is, which is better?—Roy Wong, Oakland, Cal.

A. Frequency response refers to the range of audio frequencies that an audio component can reproduce. Usually, 1 kHz is taken as a reference, and the component is evaluated in terms of its ability to reproduce the various frequencies in the audio range as well as it reproduces the 1-kHz signal. Ideally, if all frequencies are fed to the component at equal amplitude, the component (unless its purpose is to deliberately alter frequency response) should reproduce them all at equal amplitude. In practice, within the audio range there will be a slight variation. Ordinarily a component is considered excellent if all audio frequencies are reproduced within 1 dB of reproduction at 1 kHz.

As we approach the very low and the very high frequencies, a cassette deck's response tends to fall off. While

some persons, particularly the young, may have exceptional hearing extending beyond 20 kHz, for most adults the upper limit of consequence is about 15 kHz or quite possibly less. The lower limit of consequence from the point of view of program material content is generally about 40 Hz, or possibly 30 Hz. If a cassette deck has quite flat (equal amplitude) response in the range of 40 Hz to 15 kHz with no more than a loss of 3 dB at these extremes, it is capable of substantially faithful response and deserving of the adjective high fidelity.

Signal-to-noise ratio (S/N) refers to the relationship between the amplitude of the audio signal (customarily measured in the region of 315 Hz now; formerly measured in the range of 333 to 1,000 Hz) and the noise produced by the tape and tape electronics. Once S/N exceeds 60 dB, noise tends to be reasonably inaudible unless the program material is played at quite loud levels, and then chiefly during quiet passages. With the aid of Dolby B noise reduction, S/N can rise to about the mid-60s in terms of dB; with the aid of Dolby C noise reduction, to the mid-70s; with dbx, to something like 85 to 90 dB. There is some tendency for frequency response to be less flat when such noise-reduction devices are used, but the extent to which this happens depends on the care with which a particular deck is designed and aligned.

It is difficult for me to tell you the extent to which one should be willing to trade off frequency response for S/N. This is a personal decision. Fortunately, today one can find many cassette decks that provide both good response and high S/N. I think your decision should be made on the basis of listening, equipment reviews, and price.

Direct Drive vs. Belt Capstans

Q. Are direct-drive capstans superior to conventional belt-drive capstans?—Alfred Chiesa, Springfield, Mass.

A. I have no basis for preferring one drive system over the other; some direct-drive decks are superior to some belt-drive ones, and vice versa.

As in turntables, belt drives, if properly done, can damp out vibrations and

minute speed variations from the motor. However, belt systems can also be subject to wow and flutter owing to variations in belt thickness and elasticity. Direct-drive systems are more prone to "cogging"—very brief changes in motor speed due to changes in the magnetic field turning the rotor. Newer motors are less subject to cogging, and it is partially smoothed out by the flywheel.

Price and Performance

Q. I would like to transfer records to 7½ or 15 ips, quarter-track tape, and am considering a 10½-inch open-reel deck. Would my best choice be a medium-priced deck coupled with a dbx noise-reduction unit or a deck in the Revox class without dbx?—Thomas Kerchner, Allentown, Pa.

A. If signal-to-noise ratio is your chief consideration, you might do better with a medium-priced deck and dbx. But keep in mind that a high-priced deck would tend to be superior with regard to such important considerations as distortion, frequency response (wide and smooth), speed accuracy and stability, crosstalk between channels, reliability, operating features, etc. Also, tapes made with dbx noise reduction won't sound right when played back on decks without it; if others will play your tapes, this could be an important factor.

Still, today's medium-priced decks perform as well as or better than yesterday's high-priced ones. Accordingly, the only respect in which improved performance is noticeable might be signal-to-noise ratio. If so, the combination purchase may be your best choice.

Bias and EQ

Q. What is record equalization? How does it relate to record bias and playback equalization?—H. P. Kornick, Sanford, Fla.

A. Depending on tape formulation (Type I, Type II, etc.) and on tape speed, there are industry standards as to the amount of playback equalization—largely bass boost—which the

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.

deck manufacturer must provide. Bias current is usually chosen so that (in the deck manufacturer's judgment) it will achieve an optimum balance of the conflicting requirements of extended treble, low distortion, and low noise. Record equalization then must be adjusted to achieve flat record/playback in conjunction with standard playback equalization. For a given tape and tape speed, record equalization—largely treble boost—tends to differ somewhat from one deck to another. But playback equalization remains the same (or it should). An increase in bias current reduces treble response, requiring greater treble boost in recording. Conversely, a decrease in bias current requires less record equalization. Changes in bias do not affect playback equalization.

Mikes and Cables

Q. Is an omnidirectional, dynamic mike with a 1-kilohm impedance suited to my deck, which has a low-impedance (200 to 600 ohm) input? Also, since I want to use it for recording lectures and conferences, how should I best arrange an extension cord for the mike? Some local hi-fi stores have said to use simple, two-lead speaker wire, and some have said I should get shielded cable. I have seen braid shield and wrap shield, 20-gauge and 22-gauge, high- and low-impedance cable. What should I get? Should I minimize the number of connections, using one 25-foot cable instead of the more flexible arrangement of two cables each half that length? Is there any danger of signal loss in a run of 25 feet?—Chris Joyner, Beallsville, Ohio

A. The impedance mismatch between the mike and your deck is probably slight enough to cause no noticeable problems, but try it at home before you try a serious recording. However, its being omnidirectional may present problems if you're trying to record the voices of those on the podium while excluding the sounds of the audience, unless you could mount the microphone right on the lectern. Even there, a cardioid might well be preferable [especially one with a bass-cut switch to eliminate "boom" in close talking—/B.]; it would certainly be preferable elsewhere. If the podium voices are amplified, the omnidirec-

tional mike will tend to pick up the speakers as well as the direct sound.

Your cable should definitely be shielded. There is a more or less standard microphone cable with a braid shield, having a satisfactorily low capacitance of about 25 μ F per foot. This cable is available at most audio stores

and should serve your purposes well, with no noticeable signal loss for runs up to 50 feet or more.

It is usually desirable to minimize the number of connections, because each one introduces the possibility of a poor connection, which can cause noise, hum, loss of sound, etc. 



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Power Output, One Channel Driven

Q. Why does an amplifier deliver more power with one channel driven than with both channels driven?—Bob Robinson, Warrensville Heights, Ohio

A. An amplifier will produce more power with just one channel driven because the power supply is, under such conditions, not required to deliver as much current as when both channels are driven. The output voltage of the power supply will therefore be higher. This has to do with what is known as the "regulation" of the power supply. The better the power supply is regulated, the less the discrepancy between what happens with one channel driven and what happens in terms of power output with both channels driven.

FM "Drop-Out"

Q. I have an FM tuner connected to a rhombic antenna with a leg length of 8 feet. I am using coaxial cable for the lead-in, but with this setup, multipath distortion is very bad.

When receiving close, strong signals, the sound will cut out and the signal-strength LEDs do not illuminate when a lot of bass is present. When there is less bass, these LEDs remain lit, and the signal remains audible. This only happens, however, when the muting is turned on.

The stereo indicator also flickers when a strong bass signal is received. This happens regardless of the muting setting.

What would cause these problems?—Mark Cuddeback, Park Falls, Wisc.

A. I cannot say for sure just what is wrong with your reception. It may be that the timing capacitor associated with the muting circuit has opened. This would mean that if signal strength changed, as it momentarily does with deviation from the center of the carrier during modulation, the set could cut out. Because bass produces the widest swings in the frequency of the carrier, it would happen during loud bass rather than with other kinds of program signals.

It is possible that the tuner is not aligned as it should be or that the muting action is too strong. There may be an internal adjustment you can make, but to determine this or to perform any alignment, I suggest you obtain a ser-

vice manual or send the equipment to a qualified technician for adjustment and checking.

The fact that the stereo indicator fluctuates independently of muting setting could indicate that the muting circuit is not the problem. It may also be that there are several difficulties.

All of the symptoms you have described could also relate to severe multipath problems. In that event, orient your antenna to minimize this.

If the tuner is literally cutting out, then it's unlikely to be simple tuner overload. I've never seen overload make that happen, though it may cause distortion and other problems.

FM DX Update

In a discussion of FM reception some months ago, I mentioned the address of the WTFDA (Worldwide TV FM DX Association). This organization is still in operation. Because of reader interest, I am happy to give you their new address: P.O. Box 97, Calumet City, Ill. 60409.—J.G.

Record Destruction, or, One for the Books

Q. For a long time now, I have noticed a problem with some "non-audiophile" turntables and phonographs. Using a new stylus ruins my records.

I found by switching back that any of the old needles which originally gave me no problem, still gave me none. If I play part of a record with a new needle and play the rest of the disc with one of the "old" ones, I can hear where the "new" needle left off. It sounds as if the grooves are being eaten away. Playing a disc a few times with a new needle can cause it to look and sound like a worn 45-rpm record. This problem is limited to just 45-rpm records—not 33 $\frac{1}{3}$ albums or 78-rpm records.

In addition, these records cannot be stacked. Attempts to play one 45 on top of another only results in "slipping."

Can you determine the cause of this problem?—Iric Fox, Bay Shore, N.Y.

A. I believe that all of your problems result from the tracking force being too great. Over the years the force has gradually increased. The new stylus, with its smaller tip radius, exerts more pressure on the disc's surface than the worn one does. The ultimate result of

this is that a great amount of record wear is produced.

See if you can reduce tracking force to tolerable levels. Look for a spring which may have stretched. Remove one or two turns, reattach the spring, and measure tracking force.

The fact that 45-rpm discs are the ones mostly affected by your system is the result of the turntable not running "true." This results in the tonearm's rising and falling as the height of the table changes. Add this to too high a tracking force, and wear will be accentuated. Because the force exerted by the turntable to force the tonearm upward is greater at 45 than at 33 $\frac{1}{3}$ rpm, a greater amount of record wear can be noticed at that speed.

At first glance one would think that record wear would be even more serious when playing 78-rpm discs than when playing 45-rpm discs. The only reason why this is not the case is that the tip radius of the stylus is larger than that used for 33 $\frac{1}{3}$ -rpm discs. Therefore, the contact pressure on the disc is less, so wear is less severe than it would be if the stylus was not different. It may be, too, that the record wear of the 78s is not as noticeable because they are made of a different material than 33 $\frac{1}{3}$ -rpm discs.

Recommended Crossover Frequency

Q. What is meant by "recommended crossover frequency" for loudspeakers?—Richard Roy, Dalhousie, N.B., Canada

A. To begin with, it means that the speaker in question leaves you the option of selecting a crossover frequency, either because the speaker is a separate driver or because it's part of a system which has separate input terminals for each driver so that you can bypass its internal crossover if you wish.

The response curves of the drivers in a multi-speaker system do not butt together like beads on a string, but overlap. The crossover network and the natural roll-offs of each driver deter-

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mine the frequency at which response crosses over from one driver to the next—that is, where each driver is producing half the output.

You should at least consider using the frequency the manufacturer recommends. Shifting the crossover point can have undesirable consequences.

Raising a midrange-woofer crossover point, for instance, may make the woofers operate at frequencies where its response is uneven, or where it is rolling off so quickly that there will be a dip in response until the midrange starts coming in. Lowering the tweeter/midrange crossover point may also ex-

pose peaks and dips in the tweeter response, or force it to handle frequencies so low as to damage it. (Tweeters tend to be delicate, because of the need for low moving mass at high frequencies.)

Hi-Fi and Stereo History

Q. When did high fidelity and stereo come into use on records?—Lee Kihm, San Diego, Cal.

A. For "high fidelity," there is no single date, as its growth has been a continuous evolution rather than a revolution. Then, too, the sound that one era considers state-of-the-art "high fidelity" may be considered obsolete in later days. The phrase "high fidelity" dates back to at least the '30s and possibly the '20s. If you can locate some of Stokowski's recordings of the late '20s and early '30s, you will probably be surprised at hearing high frequencies out to about 8 kHz on some of them, assuming the discs are still in good condition. I have heard a few Edison cylinders whose high end extends out to nearly 5 kHz—remarkable, when you consider that no microphones or electrical amplifiers were used.

It is possible to date some important milestones along the route to high fidelity, however. Electrical recording first appeared in the mid-'20s. The use of negative feedback around the cutter head was first done, I believe, by London Decca during World War II. Some of the 78s produced toward the end of the war were incredibly well recorded and certainly qualify as high fidelity. About that time, some radio transcriptions and 78s were pressed on vinyl, which provided a much better signal-to-noise ratio than shellac.

In 1948, Columbia Records introduced the LP record, using a slower turntable speed (33 $\frac{1}{3}$ rpm, a speed previously attempted by Vitaphone for synchronized movie soundtrack discs and by RCA for commercial records) and a thinner groove and stylus. Adding to this the London feedback techniques plus the use of vinyl as the base material yielded an improvement in signal-to-noise ratio and fidelity.

Stereophonic disc recording, as we know it today, was proposed back about 1931, but did not actually arrive on the market until about 1957. **A**

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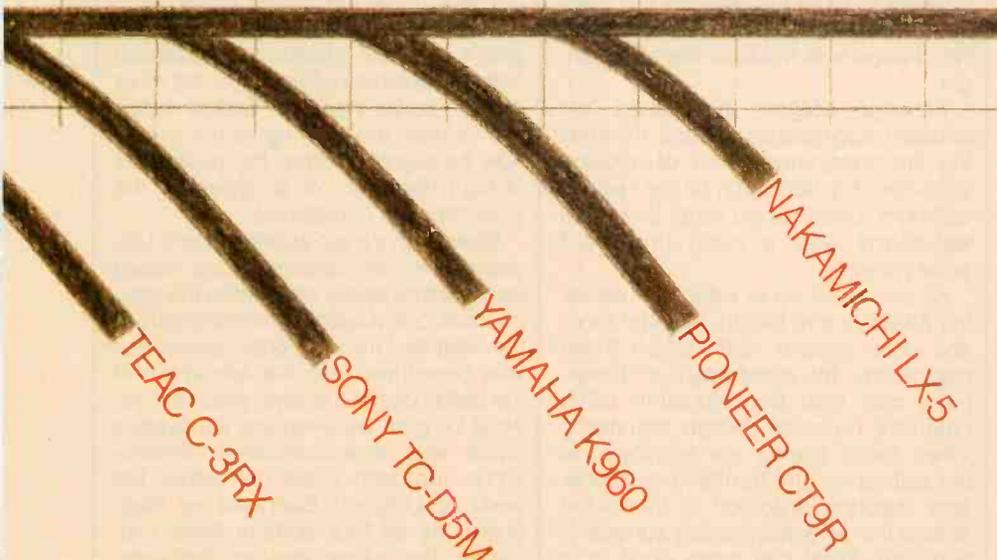
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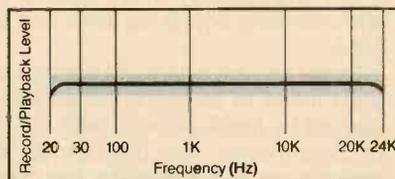
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Magnificent Obsession

Dear Editor:

I feel I have an incurable disease, and maybe you can help. Several years ago, I began reading *Audio*, and it has led to an addiction to your magazine and to a constant equipment upgrading. I wonder how many readers are, like me, never satisfied. In 1976 I started out with a Marantz 2220B 20-watt receiver. Now, thanks to you, I own Klipsch LaScalas (with custom cane grilles) stained in walnut, a Yamaha CT-810 tuner, Yamaha CA-810 amp, Bang & Olufsen turntable, B & O MMC3 cartridge, TEAC cassette deck, dbx expander, Mitsubishi DA-720 stand, Monster Cables, and Sennheiser phones.

After reading your last few issues, you have convinced me I need a Sony compact digital disc player, a Nakamichi Dragon cassette deck, a Carver tuner, Polk speakers—the list goes on.

When will it stop? Will I ever be satisfied? I often wonder—does Len Feldman upgrade his equipment monthly?

Please send help or money!

Vernon Neal
Arlington, Tex.

Tonearm Geometry

Dear Editor:

The article "Tonearm Geometry and Setup Demystified," by Martin D. Kessler and B. V. Pisha (Jan. 1980), should be understood as a historical survey as well as a survey of tonearm geometry.

During the past decades, several important contributions toward the optimization of tonearm geometry have been published. The earliest known use of the application of offset and overhang principles of which I'm aware was by Percy Wilson [1]. However, Wilson's design minimized tracking error alone, and not the tracking error weighted with the inverse of the groove radius. Wilson also published the design of an alignment protractor [2] based on the principles of [1].

The work of Löfgren [3] is the earliest paper known to me which aims at minimizing tracking distortion by minimizing the weighted tracking error. Löfgren showed that distortion due to lateral tracking error, which results from the use of a pivoted tonearm, can be minimized by using optimum geometry.

The required offset angle and overhang equations for optimum geometry are given in that paper. These solutions are later referred to as the "exact" solutions, and produce the three-point, equal-weighted tracking-error curve.

Löfgren also considered an alternative approach. He believed that the annoyance factor of tracking distortion was cumulative with time. He considered altering the offset angle and overhang values to lower the maximum distortion between the null radii, and accepting the higher distortion thereby created (for a short period of the playing time) at the beginning and end of the record playing surface. Using the method of least squares applied to the distortion function, Löfgren derived a different formula to calculate the overhang, based on his alternate concept. No change was made to the offset angle.

Although Löfgren considered two different approaches toward minimizing the annoyance factor of tracking distortion, his derivation of the "exact" optimum offset angle and overhang equations was a most important achievement.

All one need do is select values for the effective arm length, and the inner and outer groove radii. Given these parameters, the offset angle and overhang may then be calculated using Löfgren's optimum design equations. When these figures are employed in the setting up of a turntable and tonearm, tracking distortion is minimized across the selected playing surface of a record. What has been done is to minimize the tracking error per unit of radius, and not simply tracking error, because tracking distortion is directly proportional to the tracking error and inversely proportional to the radius.

Works by Baerwald, Bauer, Seagrave and Stevenson later followed [4, 5, 6, 7 respectively], where offset angle and overhang equations were also derived.

So far as I am aware, no attempt has been made to compare the equations derived by these authors, with the aim of determining the differences between them and assessing the "best" design equations. I did such a comparison, and found the results to be quite significant.

The design equations for optimum offset angle and overhang given by Baerwald, Seagrave and Stevenson are mathematically identical to those given by Löfgren, differing only in notation and arrangement. I have enclosed a copy of my analysis, which shows the mathematical equivalence of the various works, and it also contains a comparison and a summary of the results.

Stevenson also considered two different approaches toward the reduction of the effects of tracking distortion. His secondary approach is identical to Löfgren's main approach (the three-point, equal-weighted concept). Stevenson's primary approach considered that the annoyance factor of tracking distortion was basically dependent upon the amplitude of such distortion, a concept opposite to Löfgren's alternate approach. Stevenson placed the inner null radius at the inner groove radius. While the overall distortion across the playing surface may now be slightly higher, the probability of high distortion (of all types) at the inner grooves is reduced.

Stevenson's main approach and Löfgren's alternate approach are based upon factors totally different to the geometrical optimization (minimization) of the weighted tracking error. Stevenson was concerned with the amplitude of the distortions at the inner groove area, while Löfgren believed the annoyance factor was time-cumulative. Stevenson's approach does not refute the work of Löfgren, Baerwald or Seagrave, as all four authors have produced the same design formulae, based on the same (unique) geometrical problem. What Stevenson does is to employ the same formulae in two different ways, based on two different concepts.

Löfgren's alternate approach and Stevenson's primary approach are indeed worthy of attention, but as they are in fact different in psychoacoustic terms, which "modification" should be employed? Is there any need to modify the basic approach?

Some recent advertisements and conjectures argue that Stevenson's equations are more accurate than Baerwald's, which is "outdated." I would argue that the difference really lies in the criteria used for selecting the

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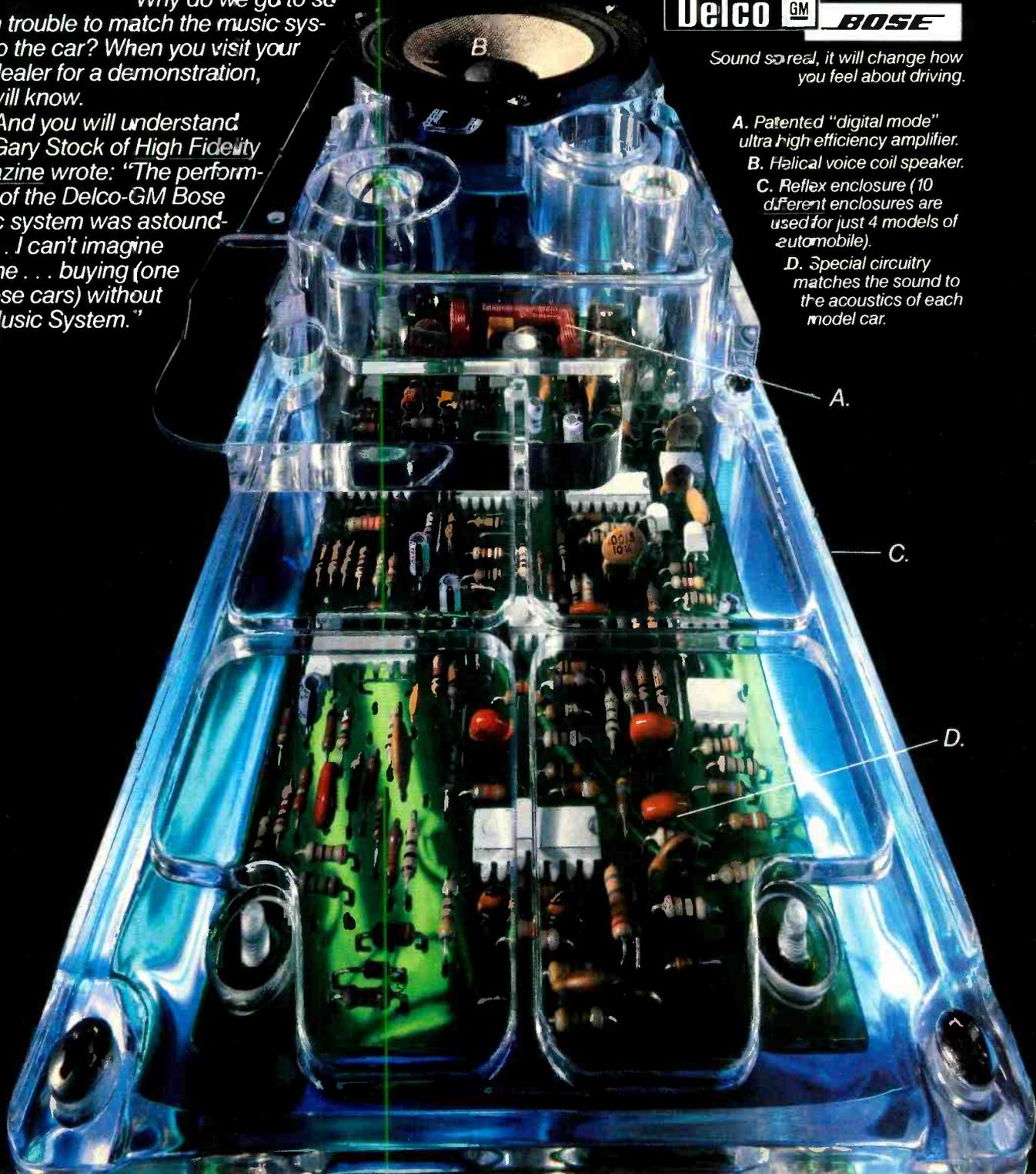
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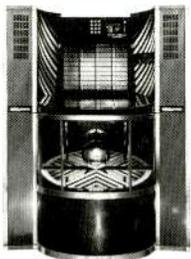
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inner and outer recorded groove radii as design parameters (and hence the location of the inner null radius), and *not* in the mathematics of the papers discussed so far. Quite simply, the advertiser has chosen to use the (same) optimum design formulae, which were derived by Löfgren, in the manner proposed by Stevenson's main approach, which placed the inner null radius at the inner groove radius. It should be noted that Stevenson's design equations are identical to Löfgren's.

The optimum design formulae derived by Bauer [5] will result in a small increase in overall distortion compared to Löfgren's, as Bauer used two simplifying approximations in his analysis.

I will now attempt a summary of the various works discussed above:

1. Löfgren, Baerwald, Seagrave and Stevenson produced identical, and exact, equations for optimum offset angle and optimum overhang.
2. Löfgren and Baerwald also produced identical, but approximate, equations for overhang.
3. Bauer's offset angle equation was an approximation.
4. Bauer's overhang equation is identical to item 2, above.
5. Seagrave also produced an approximation for overhang which is more accurate than item 2.
6. Löfgren's secondary approach and Stevenson's primary approach are simply modifications to the three-point, equal-weighted tracking-error concept, and aim at reducing the annoyance factor of tracking distortion. However, they are different in psycho-acoustic terms.

My analysis shows this comparison in a much clearer way than I have described here. References [8, 9, 10] provide comprehensive summaries on the subject.

In conclusion, the equations derived by Löfgren in 1938 are not outdated. The fact that Baerwald, Seagrave and Stevenson produced equations identical to Löfgren's certainly confirms the preciseness and validity of Löfgren's work. The contributions of Löfgren and Baerwald are the definitive references on the subject of tracking distortion and its reduction. However, it should be stated clearly that if Löfgren's paper had been the only paper ever published on the subject, we would still

have the same optimum design equations to employ in the reduction of tracking distortion as we have today.

The real problem we have today is the selection of an acceptable inner recorded groove radius to use in Löfgren's optimum design formulae and not *which* design formulae to use. For that, we have the choice of Löfgren's, Baerwald's, Seagrave's or Stevenson's!

Upon request, I will forward a copy of my complete analysis to any interested readers.

Graeme F. Dennes
Member A.E.S., Member I.E.E.E.
104 Whippoorwill Drive
Warner Robins, Ga. 31093

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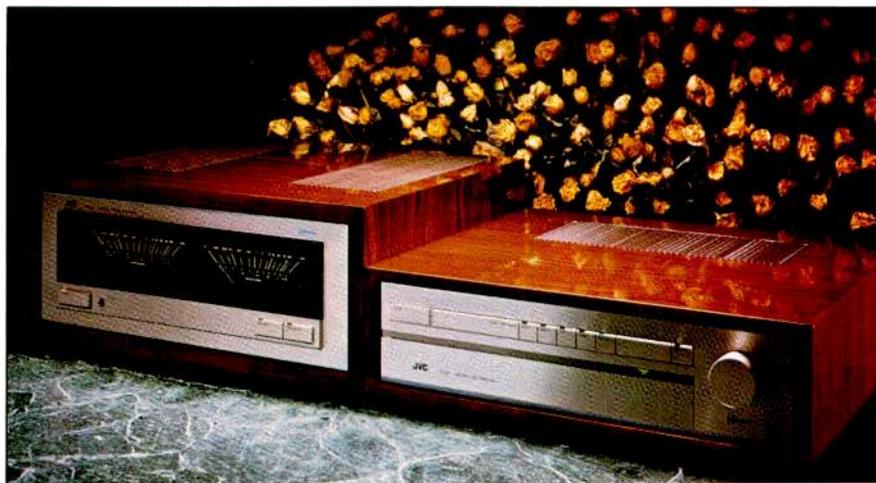
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Author's Note: After almost three years of searching, I have finally located the Löfgren paper of 1938 which was cited by Baerwald in his 1941 definitive analysis of tonearm geometry. It is now established that the derivation of the various optimum equations was originally done by Löfgren and not Baerwald. I did not cite the Löfgren work because I had not read it. After having read Mr. Dennes' treatise, "An Analysis of Six Major Articles on Tone Arm Alignment Optimization and A Summary of Optimum Design Equations," I was pleased to know that he, too, had found the Löfgren and Baerwald papers to be the most definitive analyses of tonearm geometry to date. The Löfgren work has certainly withstood the test of time. Martin Kessler's and my original intent in writing the 1980 article was to bring together, in a comprehensive manner, all the important contributions to tonearm geometry, including the world literature, that we had read, so that young engineers and students might have the information more readily available. We made no claim to any original work, and we regret that we were unable to cite the "first" contribution to tonearm geometry, the 1924 classic work of Percy Wilson. Like the Löfgren work, we knew that the paper existed but were unable to find it until a copy was located by the late Percy Wilson's son, Dr. Geoffrey Wilson, and sent to us after our article was published. Mr. Dennes' treatise was truly a labor of love, and it is hoped that many of our readers (engineers and very technically oriented audiophiles) will request a copy of this excellent mathematical analysis of the six major articles on tonearm geometry. With the advent of the compact digital audio disc and the laser beam stylus, all this, of course, becomes moot as it is relegated to the pages of history, but at least we now know the true historical facts.—*B. V. Pisha*



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Plug Those Ears

Dear Editor:

I write with reference to the article entitled "Ears" by Simeon Costa published in the December 1982 issue.

The impression engendered by this article is that sensor i-neural (S-N) hearing loss, in particular noise-induced loss, can be corrected or at least ameliorated by the proper type of hearing aid.

As a practicing acoustician and industrial hygienist, I feel that this is a misleading and dangerous statement, since it implies that all deterioration of the hearing mechanism can be reversed by means of a prosthesis. As a group, noise-exposed workers have the largest incidence of hearing damage in North America, and therefore have the most to gain by protecting their hearing. Human nature embraces the idea of cure rather than prevention (this is nowhere more obvious than in the continuing automobile seat-belt debate in North America). Thus, if an authoritative magazine such as yours suggests the existence of an easy after-the-fact "fix" for S-N loss, it provides no incentive for noise-exposed workers to wear their hearing protection.

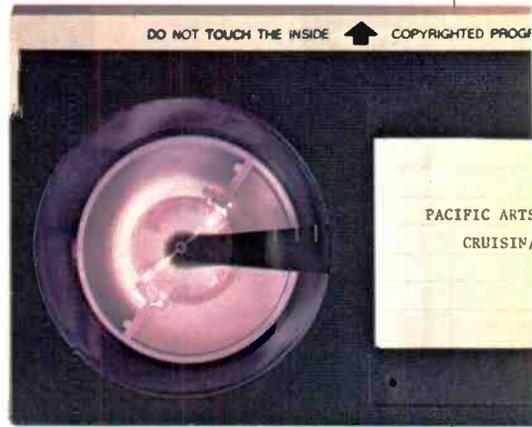
The article should have stressed that the *only* path to continued good hearing is assiduous use of hearing protection both at work and at play, when noise levels exceed about 80 dBA. The hearing-impaired person may well be helped by a hearing aid, but the degree of aural fidelity restored in this way will only be a pale shadow of the real thing, akin to viewing the Mona Lisa through a thick fog.

Good earplugs—one size fits all—are available for about 25¢ at any industrial safety supply house. No audiophile should be without a supply of them if he is to retain the full audible frequency range and acuity with which Mother Nature endowed him.

Michael R. Noble
Vancouver, B.C.

Editor's Note: Mr. Noble is correct about the importance of prevention inasmuch as no hearing aid can fully compensate for hearing loss. I use E*A*R foam plugs which I obtained from the Cabot Corp., 7911 Zionville Rd., Indianapolis, Ind. 46268.—E.P.

BETA HI-FI BETTER AUDIO VIDEO for VIDEO



by LEONARD FELDMAN



Until very recently, major manufacturers of video equipment paid very little attention to the quality of audio their products delivered. Although FCC rules allow the audio portion of TV broadcasts to have as wide a frequency response range as is used in FM broadcasting, makers of TV sets have traditionally equipped their sets with low-power audio amplifier cir-

cuitry and small, improperly baffled loudspeaker systems. While there were occasional TV broadcasts with good quality sound, that quality never made it to the viewer's ears because of TV set limitations.

The audio quality available from home videocassette recorders also left much to be desired. Operated at fastest tape speed (Beta II in Beta-format

machines, or SP in VHS VCRs), some of these recorders could deliver frequency response extending to a bit beyond 10 kHz, but their levels of distortion and wow and flutter were well in excess of what any serious audio enthusiast would tolerate. At slower tape speeds, commonly used to obtain longer continuous recording time, high-frequency cutoff was even worse

"For more than a year, there have been rumors about better audio for video, but no one suspected how good it would be."

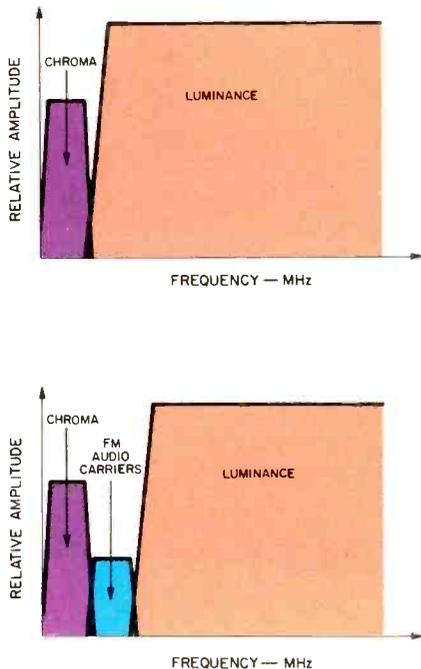


Fig. 1—Frequency spectra of a conventional video head (top), and Beta Hi-Fi video head (bottom), show how Beta Hi-Fi sandwiches the new audio signal between the chroma and luminance signals.

(often not much better than 4 or 5 kHz), and other performance areas suffered further degradation.

In recent years several events have combined to draw attention to the poor quality of audio for video. Simulcasts, in which local FM stations carry the stereo audio associated with video concerts, have introduced the viewing public to the pleasure of better sound as an accompaniment to their TV programming. Many cable TV services offer stereo music (via the subscriber's FM radio) as an accompaniment to some of their video programs. There is talk of imminent standardization of stereo audio for broadcast TV programs, and general awareness that just switching to stereo will not improve sound quality. Finally, people are beginning to combine their audio and video systems and to discover, in so doing, how bad the audio quality of their TV sets and VCRs really is.

For more than a year there had been rumors about a new and better method of recording the audio tracks on videotape. Until the official announcement came in early January, none of us suspected just how good the new system would be. It turns out to be better in terms of dynamic range, wow and flutter, and distortion than even the best audio recordings made on the costliest open-reel audio tape recorders! The new system is called Beta Hi-Fi and it is being adopted by all of the Sony licensees who make and distribute Beta-format VCRs. They include such well-known names as Aiwa, Marantz, NEC, Sanyo, Sears, Technika, Toshiba, and Zenith plus, of course, licensor Sony. Recent additions to the list of licensees are Pioneer and Nakamichi.

Beta Hi-Fi Versus VCR Low-Fi

To give you some idea of just how much of an improvement in sound quality the newly announced Beta Hi-Fi system offers, here are some comparisons between its claimed performance characteristics and those of either conventional Beta VCR sound reproduction or VHS audio quality:

Audio signal-to-noise ratio in conventional VCRs runs around 40 dB; a bit higher if you use top-grade tape and are lucky enough to get a machine that's on the good side of nominal specs. It doesn't take a "golden ear" to

hear that ever-present tape hiss, which gets even worse at slower tape speeds (Beta III or, in the case of VHS, LP or EP). Even the poorest quality standard audio cassette tapes, operated in low-cost cassette decks without any Dolby or other noise-reduction system, yield considerably better signal-to-noise figures than that these days. Beta Hi-Fi offers a dynamic range (or signal-to-noise ratio, if you prefer) of more than 80 dB!

Consider the matter of frequency response. The very best VCRs I have ever measured offer treble response out to perhaps 12.0 kHz at their -3 dB cutoff points. At slower tape speeds they typically begin rolling off response at around 5 kHz. Neither conventional Beta nor VHS VCRs ordinarily reproduce frequencies below 50 or 60 Hz. The Beta Hi-Fi system boasts flat response from 20 Hz to 20 kHz—the full range of human hearing. Furthermore, it makes no difference whether the recording is made at the faster Beta II or the slower Beta III tape speed.

Harmonic distortion, which typically runs around 3% for the audio signals played back on conventional VCRs, is reduced by a whole order of magnitude—all the way down to 0.3%—in the new Beta Hi-Fi system. (That's referenced to maximum recording level.)

Finally, perhaps the most annoying defect in the soundtracks of conventional VCRs, wow and flutter, is reduced to insignificant levels in the Beta Hi-Fi sound system. In conventional VCRs I have measured wow and flutter figures as high as 0.5% to 0.75% wtd. rms when recordings are made at slowest tape speeds. In Beta Hi-Fi sound reproduction, wow and flutter has been reduced to less than 0.005% and is, for all practical purposes, inaudible.

High Speed on Slow Tape

With these performance specifications, you might conclude that Beta Hi-Fi utilizes some sort of digital technology. In fact, at the press conference which announced the development last January, just that sort of misconception seemed to be present, judging by some of the questions that were asked. Certainly, the performance does come remarkably close to that mentioned in connection with compact

digital discs and PCM processors, but Beta Hi-Fi is very much an analog and *not* a digital sound system. As such, it may well find its niche in the world of audio as a future competitor to digital sound, but more of that presently.

As you may have already guessed, the audio information in the Beta Hi-Fi system is "laid down" on the magnetic medium using the same fast-spinning heads that are used to record the video signals. In other words, instead of the tape writing speed for the audio signals being limited to only a couple of centimeters per second (when a stationary audio record/playback head is used), the effective tape writing speed is now the same as that used for the video signals, typically 6.9 meters per second in the case of Beta. Given the wide bandwidth that results, it becomes possible to use what amounts to an r.f. (radio frequency) carrier (see Fig. 1) or, more correctly, two separate r.f. carriers, each of which can be frequency modulated by a left- or right-channel stereo audio program. These two extra carriers are neatly nestled into the available spectrum between the chroma (color) and luminance (brightness) video signals. In the Beta VCR format, the luminance signals are located between 3.5 and 4.8 MHz, while the chroma signal is centered at 688 kHz. It is an amplitude modulated or AM signal whose upper sideband somewhat overlaps the FM luminance signal spectrum.

An interesting side benefit arises

from this arrangement, besides the superb performance already outlined. If you operate the fast scan feature of a Beta VCR (say, at two or three times normal viewing speed), the audio doesn't take on the "chipmunk" quality that is characteristic of conventional audio tape reproduction at higher than normal speeds. If you stop to think about it, actual tape-head to tape writing speed doesn't really change that much when the longitudinal tape speed is increased by two or three times or, for that matter, when it is decreased for slow-motion viewing. That's because the longitudinal tape speed is a very small part of the total effective tape-to-tape-head writing speed when we talk about the video recording heads.

The Beta Hi-Fi track allows for total compatibility with earlier hardware and software. The conventional longitudinal audio track, read by a stationary audio tape head, is still present on a Beta Hi-Fi tape, as shown in Fig. 2. An older Beta videocassette played on a new Beta Hi-Fi VCR will still deliver its old (albeit inferior) audio sound, as before. And, because newer Beta Hi-Fi cassettes will have a monophonic (L + R) equivalent soundtrack recorded longitudinally where it always was (in addition to the two FM-modulated audio tracks that become part of the video composite diagonal tracks), newer tapes can be played back on conventional Beta-format machines. The availability of three audio channels sug-

gests, too, that some enterprising software producer may, sooner or later, come up with a movie that employs ambience enhancement using the third limited-bandwidth longitudinal channel.

Measure for Measure

I recently had an opportunity to measure the audio section of a prototype Beta Hi-Fi VCR which came through my lab. The unit, a Sony Model SL-5200, will be available later this year. While I can't speak for the video quality of this machine, I was able to measure audio performance much as I would for a high-quality audio tape deck. Using a Sound Technology 1500A Tape System Tester and the hard-copy video printer that's connected to it, I documented some remarkable performance characteristics for this machine. All during the measurements, I had to keep reminding myself that this was not a digital PCM system.

Figure 3A represents a plot of record/play frequency response at a nominal record level of 0 dB. At 18.5 kHz, response was down a mere 1.2 dB! Meter calibration on this machine extends to a +6 dB notation, which is followed by a red "overrecord" warning light. Since metering of this type is arbitrary and related to the amount of FM deviation of the extra carriers rather than to any tape saturation characteristics, I pushed up the level to the maximum allowable metered indication just short of the overrecord notation. Under those circumstances, there was some roll-off at the high end (-4.1 dB at 20 kHz) and a lesser amount of roll-off (1.8 dB) at 20 Hz. (See Fig. 3B.)

The excellent results obtained at this higher record level suggested that the meter calibration's 0 dB point was put there as a safety factor for inexperienced recordists and that other measurements ought to be made relative to the higher +6 dB mark on the metering system. So, to determine the distortion characteristics of the system, I re-adjusted the test instrument's reference level so that its 0 dB point actually caused a recording level of +6 dB on the VCR's metering system. Even at this higher recording level, third-order distortion was an incredibly low 0.12%, as shown in Fig. 4A. Raising the level, which moves the dotted line cursor up

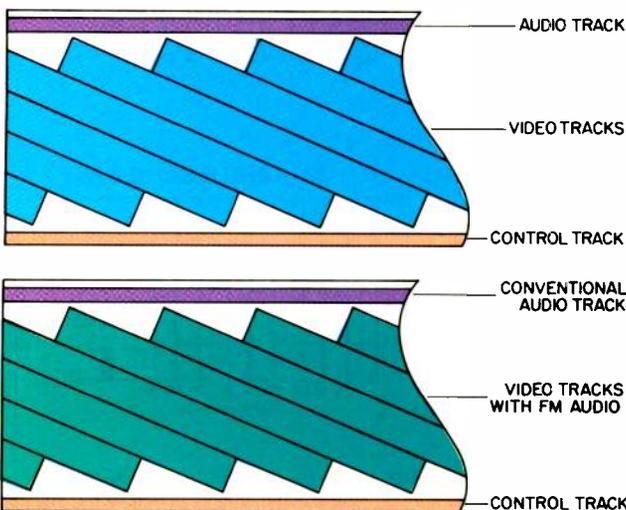
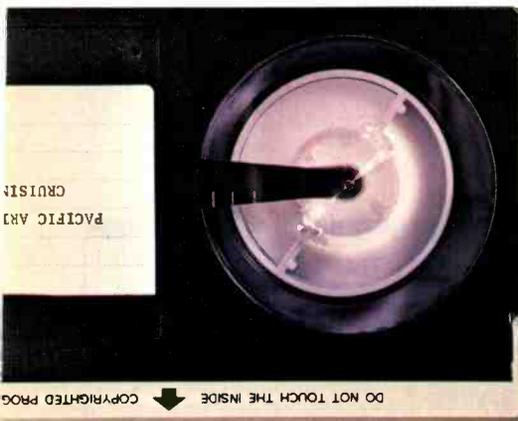


Fig. 2—A comparison of track formats between conventional Beta (top), and Beta Hi-Fi video shows no difference in layouts so that there is perfect compatibility in this regard.



"Perhaps the most annoying defect in sound with the conventional VCR, wow and flutter, is reduced to insignificant levels with Beta Hi-Fi."

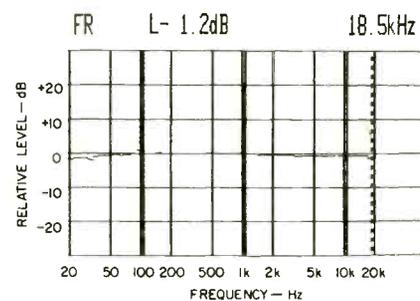
from the nominal 0 dB point shown in Fig. 4A, I determined that 3% third-order distortion occurs at a bit under +7.0 dB relative to the new reference level (that's a full +13 dB above the nominal 0 dB point on the VCR's own meters). The new distortion level for +7 dB is 3.4%, as shown in Fig. 4B.

I measured signal-to-noise relative to the newly established 0 dB reference level of the test instrument and came up with an A-weighted S/N value of 71.2 dB, as shown at the top of Fig. 5. To this must be added the +7 dB of extra headroom that was previously determined (Fig. 4B), bringing the effective dynamic range of the system up to an incredible 78.2 dB! Remember, there is no form of companding or electronic noise reduction employed here. Finally, I recorded a 3-kHz test tone onto a videocassette and played it back to determine wow and flutter. As shown at the top of Fig. 6, it measured 0.005% wtd. rms, exactly as claimed!

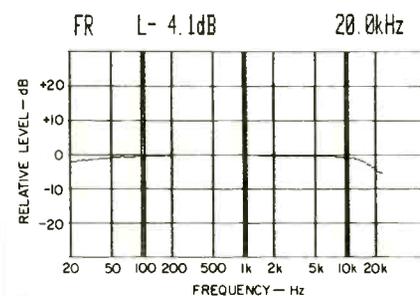
Competition for Digital?

As a result of the introduction of Beta Hi-Fi, several questions arise concerning the emerging digital audio technology. If you can get that kind of audio performance, along with a TV picture, using purely analog techniques, is the industry perhaps placing too much emphasis on the coming digital audio era? The question arises on purely economic terms, since the addition of Beta Hi-Fi to a conventional VCR is estimated to add no more than \$100 to its cost, leaving the VCR's price not much higher than the proposed price of some CD players. And certainly, the cost of such a VCR has got to be a lot less than the cost of a PCM processor plus any type of VCR, the elements now needed for recording digital audio on tape. Looked at from that point of view, the ability to record pictures as well as such high-quality stereo sound is almost an extra bonus, one that you can ignore, if you so choose, by not even using it for video.

Fig. 3—Record-replay frequency response of Beta Hi-Fi system at 0 dB record level on meters (A) and at +6 dB meter indication (B).

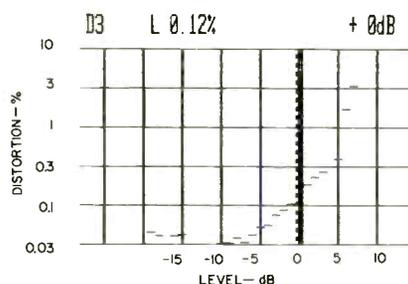


A

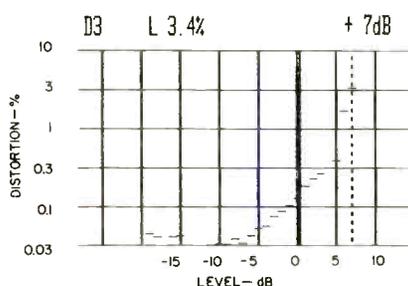


B

Fig. 4—At 0 dB record level, third-order harmonic distortion measured only 0.12% (A), while 3% third-order harmonic distortion occurred at a record level of just under +7 dB on the unit's meters (B).



A



B

Fig. 5—Signal-to-noise ratio measured relative to 0 dB record level was 71.2 dB, A-weighted. Adding +7 dB to this figure gives a dynamic range of more than 78 dB.

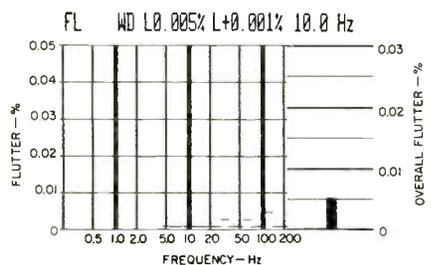
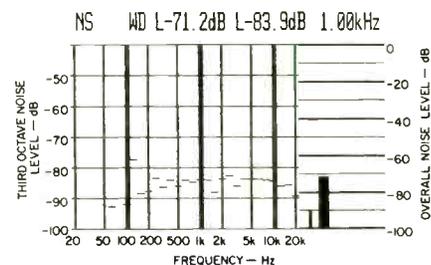


Fig. 6—Wow and flutter of Beta Hi-Fi unit measured only 0.005% wtd. rms.

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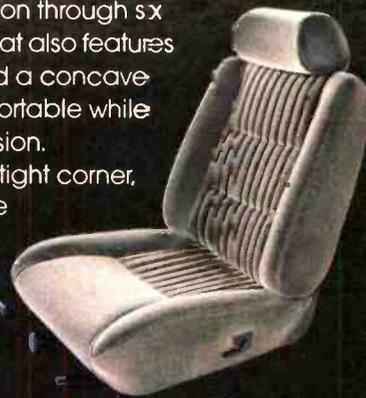


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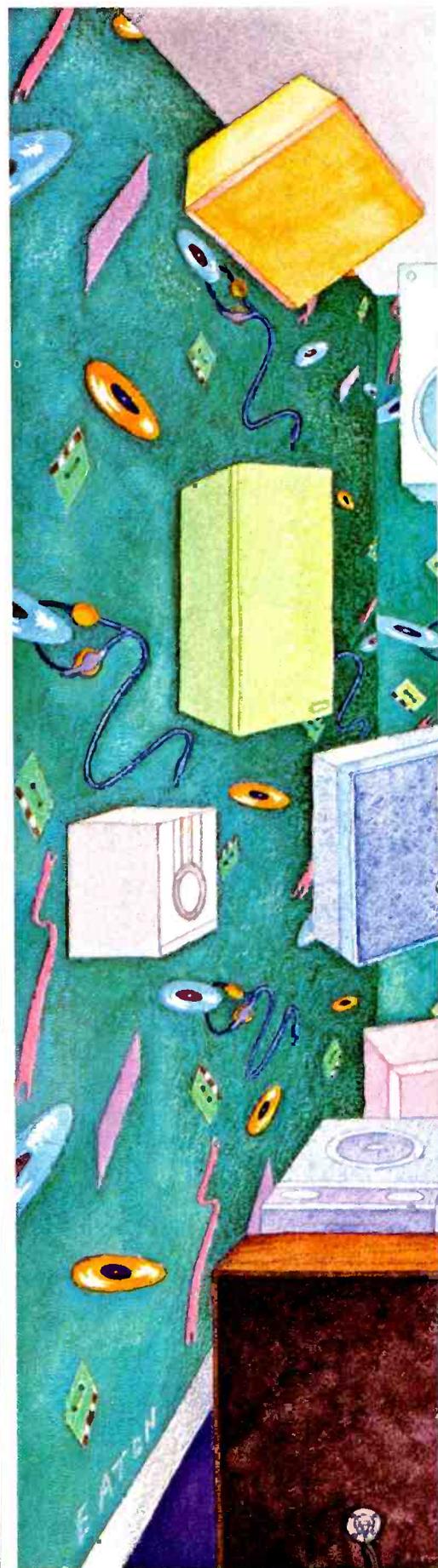
HOW TO BUILD A LOW-COST STEREO ENHANCER

RICHARD J. KAUFMAN

There are several classes of accessory systems on the market whose purpose is to improve the spatial quality of stereo sound reproduction. Quadraphonic sound, in all its many splended varieties, was one of the first, and it still has its adherents. The "ambience recovery" or "ambience generation" systems are another major group. These use digital or analog delay lines to feed a delayed version of the left and right channels through one or more auxiliary speakers behind the listener. The intent is to superimpose the acoustic qualities of the recording space on the listening environment so that a small den can sound like a large hall.

Now there is another class, the image enhancement or image recovery device. Bob Carver, the first practitioner of this art, dubbed his system Sonic Holography; soon after, Joel Cohen of Sound Concepts introduced his Image Restoration system. To my ears, image enhancers are among the most successful and satisfying accessories available.

To understand how Carver's Sonic Holography works, consider what happens when listening to a stereo system: A signal leaves the left speaker and, travelling at the speed of sound, reaches the listener's left ear. A portion of the signal's wavefront is diffracted around the listener's head and, travelling an additional 5 or 6 inches, reaches the right ear about 100 microseconds after reaching the left ear. This "interaural" time difference is one of the brain's major clues to the spatial location of sounds. With uncanny accuracy, the human brain pinpoints the location of the speaker, which may not coincide with an accurate



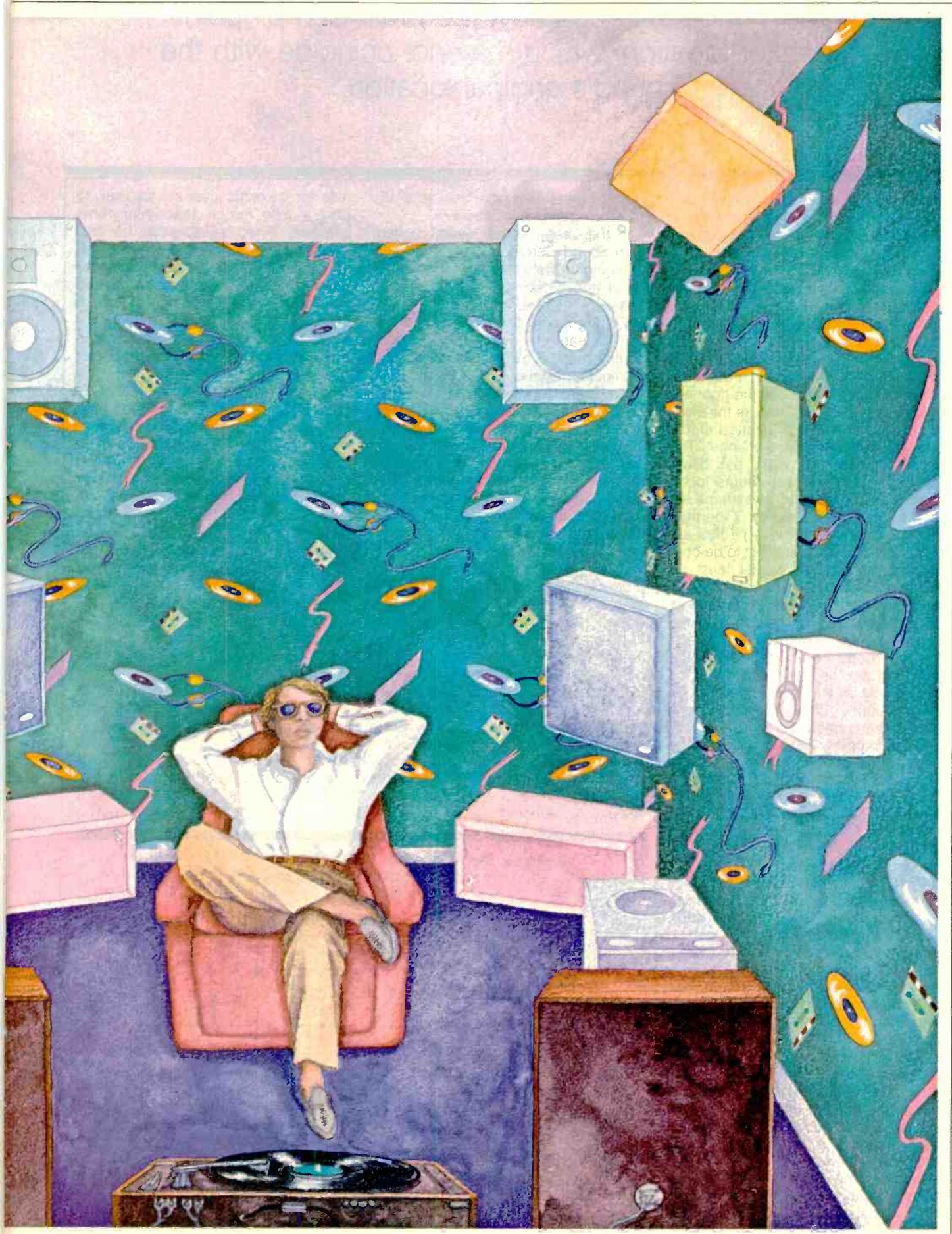


Illustration: Robin Eaton

“With uncanny accuracy, the brain can pinpoint speaker location, which may not coincide with the sound’s original location.”

representation of the sound’s original location. Listen to your system. You’ll find you’re always aware of the location of the speakers, even with your eyes closed.

Sonic Holography works to change that perception. This “black box” sends the left-channel signal through a delay line, inverts it, and mixes it with the right-channel signal. When the left-channel signal is diffracted around the listener’s head, it reaches the right ear at precisely the same time as the electronically delayed and inverted signal that was fed to the right channel. The signals cancel, the right ear hears nothing, and the signal seems to be coming from the listener’s extreme left instead of from the speaker. (The right channel is treated similarly.) There are complications. For the effect to be convincing, the delayed signal must be attenuated slightly, and the bass filtered out. Bass is nondirectional in its propagation, and to include it in the processing would result in an unwanted bass boost. The highs should be excluded too, or the sound could be excessively bright, since shorter wavelengths aren’t diffracted and so don’t need to be cancelled.

When properly set up—and setting up is a little tricky—the effect of Sonic Holography can be quite startling. If the unit is switched off while listening, the sound field seems to collapse into the plane of the speakers, and the instruments sound as if they’re lined up on a string in between.

With the unit on, the sound becomes three-dimensional, at once pleasingly convincing and spatially textured. Sounds appear in front of or behind one another, and even beside the listener. Of course, the listening area is more proscribed than for stereo; one must be equidistant from the speakers and the proper distance away from them.

You might expect earphones to give the same three-dimensionality, but they don’t. Psychoacoustic research has shown that tiny, almost imperceptible head movements are used by the brain to focus a sound’s location or direction. When you move your head, earphones move with you, foiling the brain’s sound location system. The only logical location for a sound that moves with your head is inside it.

Headphones just are not spatially convincing for most people.

In the image enhancement system from Sound Concepts, only the difference signal between channels is delayed and crossed to the respective speakers. It is claimed that by operating on right-only and left-only information instead of on the entire signal, comb filtering is eliminated, resulting in a smoother frequency response.

I’ve heard both systems but have not had a chance to compare them directly. Both sound good, and are a distinct improvement over ordinary stereo.

It is possible to achieve somewhat the same results as do these electronic boxes, by passive means. If you enjoy experimenting, or want to try out the effect before investing in the electronics, this project is for you.

If any *Audio* reader wishes to produce the device described in this article, Bob Carver grants to such a reader a royalty-free license for the apparatus as covered by his U.S. Patent 4,218,585. Such license is for personal use only and does not extend to commercial use or to manufacture for sale.

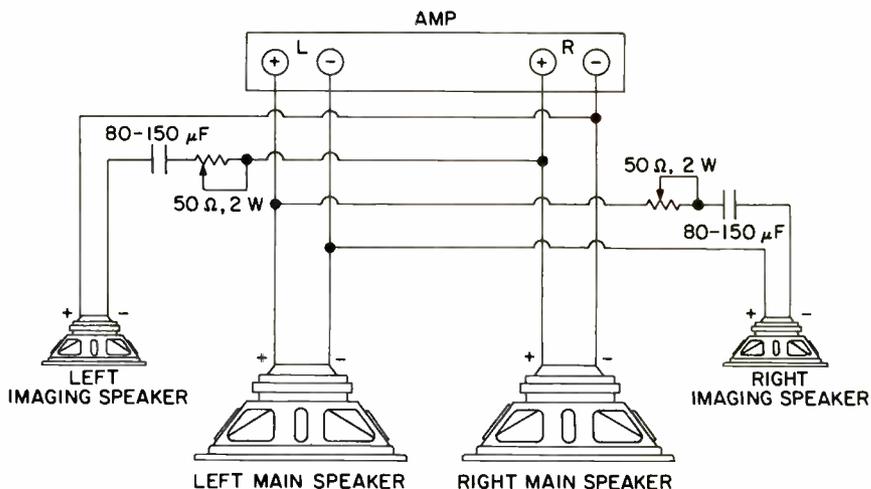
Basically, two speakers are wired to invert the signal, and positioned at the proper distance to provide the required cancellation. Figure 1 illustrates the hookup. Potentiometers or L-pads are used to attenuate the imaging sig-

nals, for the extra speakers are likely to play a little louder than your main speakers. Fixed resistors can be substituted if they provide the proper attenuation. A capacitor is included for bass attenuation, and may be omitted if the extra speakers do not reproduce the bass below 100 Hz or higher. I would recommend using capacitors in any case, for by blocking high-power bass signals, they increase the auxiliary speakers’ power handling ability.

How image restoration works sonically is shown in Fig. 2. In addition to the direct L and R signals heard by each ear, the delayed signals R’ and L’ are also heard, attenuated by factor α . Each ear hears both speakers with image recovery, but the delayed signals $\alpha R'$ and $\alpha L'$ are cancelled by an inverted crossed signal. Note that though a delayed cancellation signal reaches each ear ($-\alpha^2 L''$ and $-\alpha^2 R''$), these signals are attenuated by the square of α and so have little perceptual effect. The left ear hears a pure L signal, while the right ear hears a pure R signal.

Finding suitable speakers should be easy. Anything with a reasonably smooth frequency response can work well, though an 8-ohm impedance is desirable. Nor is it necessary to cover the full audio spectrum. In fact, a somewhat limited frequency response is an advantage. I am using a pair of

Fig. 1—This passive image recovery system consists of two extra speakers connected to play an inverted crossed signal. Capacitors are 50 V, nonpolar.



"Psychoacoustic research has shown that tiny head movements are used by the brain to focus a sound's location or direction."

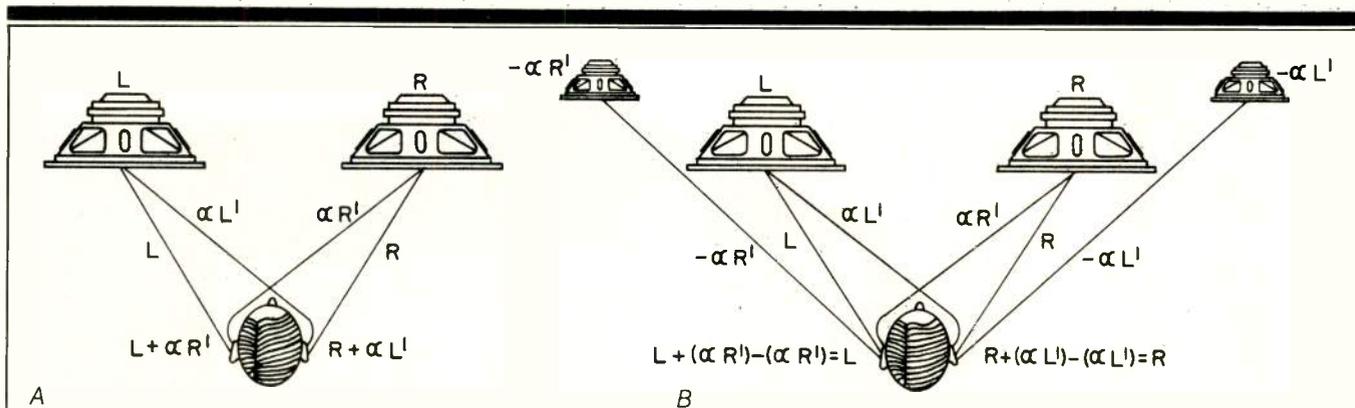


Fig. 2—In a normal speaker setup, each ear hears both speakers (A), while in the image recovery system, the left ear hears only the left speaker and the right ear only the right (B). See text.

midrange speakers from my junk box. They go from about 250 to 5,000 Hz; 300 to 3,000 Hz is the minimum range to aim for, and it may be possible to get good results with an even narrower range. Even 3- to 5-inch automobile speakers should be suitable when properly mounted. (One nationwide electronics chain carries a number of speaker systems in the \$10 to \$25 price range that look like they'll work well.) Note that overall system impedance should not be less than 4 ohms, or some amps will have trouble driving the load. And note, too, that there is a difference in most cases between the maker's stated impedance and the speaker's real impedance.

If the highs prove too bright, disconnect the tweeters in the auxiliary speaker systems or angle the speakers away from the listening area. Another solution is to cover the speaker with a layer of tightly woven fabric.

Positioning the extra speakers will be critical. Ideally, the signal path should be 5 or 6 inches longer to the imaging speakers. I have my speakers mounted on stands, with the imaging speakers underneath and on the floor, slightly behind the front plane of the main units' cabinets. They could as well go beside or on top.

One method I've found useful for positioning the imaging speakers is this: Play only the left channel, either by disconnecting the right channel or adjusting the balance control. Vary the position and sound level of the right imaging speaker until the sound seems to be coming from the extreme left (or as much to the left as possible)

when you are in your chosen listening position. Repeat for the right channel. You may find that moving your main speakers closer together will enhance the effect.

Your listening location is more flexible for the passive system than for electronic imagers. It is possible to arrange the speakers so that the listening position is not on the center line between the main speakers.

Too many reflective surfaces will diminish the imaging effect. If your listening room is too live, you may want to add draperies, rugs and perhaps paintings. This will also improve the acoustics for ordinary stereo.

A complication may arise with many speaker systems that don't use minimum-phase (i.e. linear-phase or Time-Aligned®) crossover networks. The proper location for the auxiliary speakers will be different at different frequencies. It may not be possible to obtain a stable image with such speakers using a passive imager. In any case, experiment with speaker location for the best effect. Less-than-perfect may prove acceptable. (Most speaker systems have sufficiently accurate phase response to work with a passive system.)

If the imaging speakers are connected to the auxiliary speaker outputs of your amp or receiver, the imaging effect can be switched in and out. Everyone I've played it for prefers the sound with the imaging speakers in. Hearing them switched off invokes an eerie sensation of space collapsing, as if the instruments were suddenly sucked into the speakers.

There is a striking similarity between

this setup and some of the early passive devices used to simulate quadraphonic sound. As I recall, an admonition with these units was that speaker positioning was critical. Could it be that the proper position was one that produced the same signal cancellation as does image recovery? And that the rush to discrete four-channel sound completely missed the point? Of course, this is speculation, but psychoacousticians have shown that a dummy head equipped with microphones for ears, when made to follow exactly the head movements of a listener wearing headphones, gives a convincing representation of sonic space. Image enhancement systems are the closest we can now come to matching this experimental condition with recorded media. Only listening will allow each reader to judge the merits of image enhancement systems. The passive image enhancement system will allow many more people to listen and, I believe, enjoy. **A**

Because L-pads waste power and the required potentiometers are not readily found, I have arranged to make a set of potentiometers and capacitors available for \$12.00 while the supply lasts. This cost includes shipping and handling in the U.S. and Canada; New York residents, please include local sales tax, and foreign orders should include an additional \$3 for shipping. Please allow six to eight weeks for delivery. If you are interested, send a check or money order to: RK Systems, Box 10-E, 780 West End Ave., New York, N.Y. 10025.

HEADPHON

BUILD A STEREO



PARTS LIST

(With Radio Shack part numbers, except where noted)

- C1, C2—470- μ F, 35-V electrolytic capacitors (272-1018).
- C3—0.22- μ F, 50-V, 5% mylar capacitor (272-1070).
- C4, C6—22- μ F, 35-V electrolytic capacitors (272-1014).
- C7, C8—1- μ F, 16-V electrolytic capacitors (272-1419).
- C5, C9, C10, C11, C12, C13, C14—0.1- μ F ceramic disc capacitors (272-131).
- CR1, CR2, CR3, CR4, CR5, CR6—1N4002, 200-PIV, 1-A diodes (276-1102).
- F1—1-A fuse (270-1273).
- IC1—LM340T-8, +8 V regulator (Jameco, 1355 Shoreway Rd., Belmont Cal. 94022).
- IC2—LM320T-8, -8 V regulator (Jameco).
- IC3—LM1877 stereo amplifier (276-702).
- J1, J2—Phono jacks (274-346).
- J3—3-conductor headphone jack, quarter-inch (274-282) or 3.5 mm (274-249).
- R1, R2—10-kilohm, $\frac{1}{8}$ -W, 10% resistors (271-1335 or 271-034).
- R3—100-kilohm, audio-taper, stereo volume control (275-1732).
- R4, R5—100-kilohm, $\frac{1}{8}$ -W, 20% resistors (271-1347 or 271-045).
- R6, R7—2.7- or 3.3-ohm, 1-W resistors (271-075).
- S1—SPST toggle switch (275-602 or similar).
- T1—18 to 36 V, CT transformer, 450-mA or greater (270-1366).
- Perf. Board—2 $\frac{3}{4}$ x 3 $\frac{3}{4}$ in. (276-158).
- Fuse-Holder—(270-364).
- Cabinet—Approx. 3 x 5 x 5 in. (270-253).
- Misc. Hardware—One knob, screws, nuts, washers, lock-washers, four circuit-board standoffs, one power cord.

IE AMPLIFIER

PAUL D. CHAPMAN

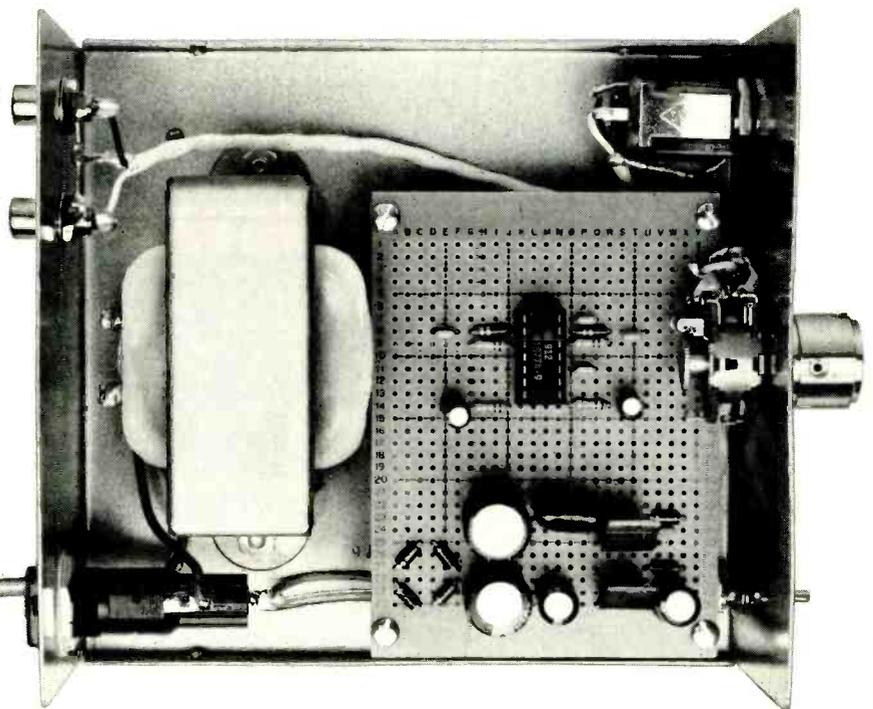
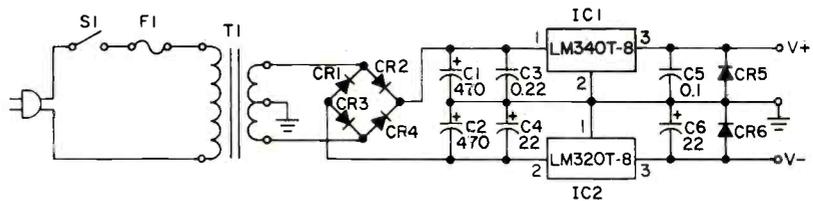
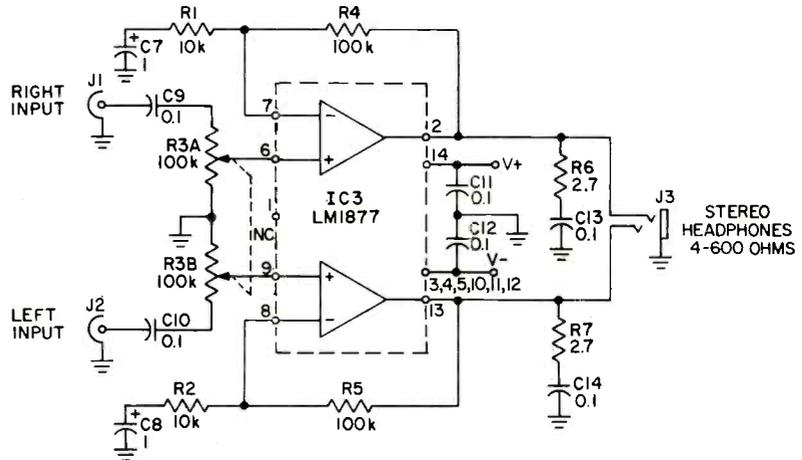
When listening through headphones is desirable, sometimes it isn't possible, either because the component you're listening to lacks a headphone output or because (as with many tape decks) its headphone output doesn't deliver enough signal to power the phones you have. This easy-to-build stereo headphone amp will solve both problems. All parts are available from Radio Shack (except the voltage regulators) for about \$35. If you shop around, you can probably cut that price still further.

The circuit is quite straightforward. The split power supply minimizes components and eliminates the need for large electrolytic capacitors on the audio output. Voltage regulators are used for clean power without large, expensive filter capacitors. (You can also use two 9-volt batteries in center-tapped series, but their life may be short, the more so with lower impedance headphones.)

The power supply is well bypassed, and the 2.7-ohm resistors (R6, R7) and 0.1- μ F capacitors (C13, C14) on each output help suppress oscillations. The amplifier's gain of 20 dB is set by the 100-kilohm feedback resistors (R4, R5) and the 10-kilohm resistors (R1, R2) on the inverting inputs.

Construction details are left up to the builder. The circuit is too simple to justify a p.c. board; use an experimenter-type perf. board, such as Radio Shack's 276-158. Be sure to place capacitors C3, C4, C5, C6, C11 and C12 as close as possible to their respective ICs, to suppress oscillations.

This simple amplifier should prove satisfying to build and, since its THD is below 0.1%, to listen to. A



Z-5000



3 Heads, Direct Drive Capstan Motor, dbx[™], Dolby[®] B & C NR, Manual and Reference Bias/Level/EQ Calibration, Digital Real Time Tape Counter, 14-dot FL Bar Graph Meter, Monitor Sync, Block Repeat (Memory Repeat), Auto Locator, Memory Stop/Play, Computomatic Program System, Power-Assisted Eject Door, Auto Spacer, Standard Remote Control Unit.

Z-6000



3 Heads (Ferrite Play, Sendust Rec), 3 Motors, Direct Drive Capstan Motor, Dual Capstan, dbx, Dolby B & C NR, dbx Disc Position, Manual & Reference Bias/Level/EQ Calibration, Digital Real Time Tape Counter, 30-dot FL Bar Graph Meter, Monitor Sync, Auto Tape Select, Block Repeat Memory Repeat, Auto Locator, Memory Stop/Play, Computomatic Program System, Power Assisted Eject Door, Patch Control, Auto Spacer, Resonance Free Diecast Chassis, Remote Control.

Z-7000



3 Heads (Ferrite Play, Sendust Rec), 3 Motors, Direct Drive Capstan Motor, Dual Capstan, dbx, Dolby B & C NR, dbx Disc Position, Auto & Reference Bias/Level/EQ Calibration, Digital Real Time Tape Counter, 30-dot FL Bar Graph Meter, Monitor Sync, Auto Tape Select, Search To Zero, Search To Cue, Search To Record, Spot Erase System & Position, Intro Check, Block Repeat, Auto Locator (S T C & S T Z), Computomatic Program System, Power Assisted Eject Door, Patch Control, Auto Spacer, Ceramic Tape Guide, Resonance Free Diecast Chassis, Standard Remote Control Unit.

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One top-of-the-line cassette deck is sufficient for most manufacturers. But not for Teac. We make three. Our new Series Z. The most advanced, most feature-filled cassette line we've ever built.

Most manufacturers would be content with two direct drive motors. Our new Z-6000 and Z-7000 have three.

Having Dolby* B and C noise reduction was not enough. We had to add dbx** and dbx disc. Plus more bias control, more automatic systems, more professional features than anyone ever dreamed of in a cassette deck.

They all come with Computomatic, Teac's micro-chip memory system. Combine the memory with its list of programmable functions and Series Z's capabilities are expanded to unheard-of levels of performance.

But the unheard-of is commonplace at Teac. When it comes to building tape recording equipment our obsession with excellence drives us beyond the bounds of all reason.

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Enter No. 39 on Reader Service Card

1

NAKAMICHI DRAGON CASSETTE DECK

Manufacturer's Specifications

Frequency Response: 20 Hz to 21 kHz, to 22 kHz with metal tape.

Harmonic Distortion: 0.8%.

Signal/Noise Ratio: 66 dBA with Dolby B NR, 72 dBA with Dolby C NR.

Separation: 37 dB.

Crosstalk: Down 60 dB.

Erase: 60 dB.

Input Sensitivity: Line, 50 mV.

Output Level: Line, 1 V; headphone, 45 mW at 8 ohms.

Flutter: 0.019% wtd. rms, 0.04% wtd. peak.

Dimensions: 17 $\frac{3}{4}$ in. (450 mm) W × 5-5/16 in. (135 mm) H × 11-13/16 in. (300 mm) D.

Weight: 21 lbs. (9.5 kg).

Price: \$1,850.00.

Company Address: 1101 Colorado Ave., Santa Monica, Cal. 90401.

For literature, circle No. 90



The Nakamichi Dragon cassette deck is an exciting combination of innovative design, convenience features and outstanding performance. The centerpiece of the innovations is the fascinating NAAC (Nakamichi Auto Azimuth Correction) system which automatically adjusts the play head to match the azimuth of the material already recorded! Most readers are probably familiar with Nakamichi's scheme for automatically adjusting the record head to match the play head, and that approach ensures the best performance for each deck and tape combination. In the past, however, many have commented on the fact that tapes made on one deck might not sound their best when played on any other model, because of azimuth discrepancies. Only by careful and tedious work could the play head's azimuth be matched to what was on the tape.

With NAAC, however, the Dragon senses the azimuth of the recorded material and adjusts the play-head azimuth to match, obtaining the best possible response. The concept is fairly simple, as many good ideas are, both the implementation is something to marvel at. The head core for one of the stereo channels is actually split into two cores, both still just the total width of one track. The two core outputs are fed through bandpass filters into the rest of the NAAC system: Waveform squaring circuits, a phase comparator, an operational amplifier and drivers with a motor to shift the play head into position for zero phase deviation. The bandpass filter restricts signals to the range from about 3 kHz to a bit above 15 kHz, ensuring that accurate phase and angular deviation information can be obtained.

The Dragon is Nakamichi's first auto-reverse deck, and



NAAC is operational in the reverse-play direction as well, automatically compensating for such effects as changing tape skew. The transport drive system is of dual-capstan design, unusual in that each capstan is driven directly, with the motors locked to a quartz crystal reference. The supply capstan (in either direction) runs 0.2% slower than the take-up capstan to maintain the proper tape tension over the heads.

A number of other features are most easily introduced by describing the front panel. The right center is dominated by an array of fairly large, angled, rectangular pushbuttons which are grouped by function.

On the top row are playback functions (reverse play, stop and forward play). Just below are the rewind and fast-forward buttons, flanking the button which actuates the

"Cue" function during fast wind. As on other Nakamichi decks, this moves the head closer to the tape, to make the fast-wind "chatter" audible, and reduces the winding speed (to one-third normal with one push, to one-sixth normal if the winding button is held down). Cueing direction can be reversed by pushing the opposite fast-wind button; pressing the appropriate play button selects which tracks the "Cue" function will scan. Green lights indicate which of the buttons in these top two rows are actuated.

The next two rows are for recording functions. First are the "Rec Mute," pause and record buttons, with red LED indicators. (There is no reverse recording function.) On the bottom row is the fixed, button-like "Auto Fader" with direction-indicator lights. It is flanked by the "Down" and "Up" fade buttons themselves. There are two rates of fade, with the faster rate obtained by a second, light push or a single hard one. The fade indicator arrows change intensity to show the direction and level of fading.

To the right of the control buttons are the tape selection and calibration controls: Left and right level pots for three tape types grouped beneath the test button marked "Level (400 Hz)," and left and right bias pots for each tape type grouped beneath the "Bias (15 kHz)" button.

Between these test-signal buttons is a smaller, "Reset" button which shuttles the tape back to the counter zero point. Beneath that are the tape type selector buttons. Unfortunately, these are marked only with Nakamichi's own tape designations: "EX" (normal, IEC Type I), "SX" (chrome, Type II) and "ZX" (metal, Type IV). Each is flanked by its bias and level pots.

The Dragon's calibration procedure is slower than the automatic setups used by some decks, but as accurate. After setting the tape type and switching the monitor to "Tape," you actuate the record/pause and "Rec Mute" buttons to disable the inputs. This also sets the counter to 0000. Start the tape, push the "Level (400 Hz)" button, and set the level-adjust pots for a zero indication on the meters, whose scales expand during this test. Next, push "Bias (15 kHz)." The NAAC system immediately adjusts the play head to compensate for any tape skew, etc., between it and the record head. Then, channel bias levels are adjusted for zero. A push of the "Reset" button returns the deck to the 0000 counter point. After a short familiarization period, this procedure seemed simple and direct.

On the right side is a vertical row of four knobs ("Master," "Left" and "Right" recording gain, and "Output") and seven buttons. The latter are for "Monitor (Tape/Source)," "Eq μ sec (120/70)," "Dolby NR (Off/On)," "Dolby "B-Type/C-Type," "MPX Filter (Off/On)," "Subsonic Filter (Off/On)," and "Auto Rec Pause (Off/On)." Most of these are self-explanatory, though the helpful inclusion of a subsonic filter is worth noting. "Auto Rec Pause," however, is an unusual convenience, automatically switching from record to record/pause mode if there is no input signal for 40 seconds. With this, you need not stand by, waiting (im)patiently to stop the deck when the music ends.

In addition to its "Auto Rec Pause" feature, the Dragon will also check for silences in playback. When "Auto Rev" is enabled, if there is a blank of more than 40 seconds, the deck fast-winds to the end of the side being played, and

"The concept of the NAAC system is fairly simple, as many good ideas are, but the implementation is something to marvel at."

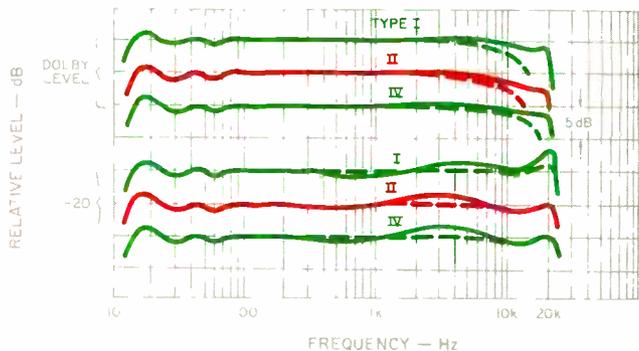


Fig. 1—Frequency responses with (solid lines) and without (dashed lines) Dolby C NR, using Type I (Nakamichi EXII), Type II (Nakamichi SX) and Type IV (Nakamichi ZX) tapes.

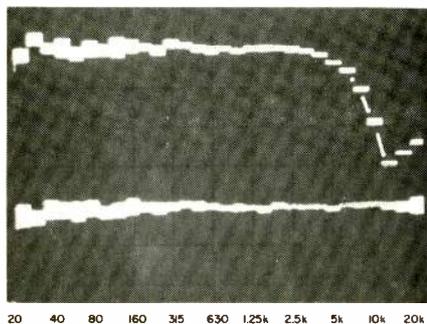


Fig. 2—Record/playback response of Nakamichi 582 cassette deck with misaligned record head (top) vs. playback of same tape on Dragon with NAAC system (bottom). Vertical scale: 5 dB/div.

then starts play in the other direction if the reverse controls are set for that. This eliminates the need to fast-wind manually past long blank spaces at the end of a side, common in classical recordings.

In the center of the front panel are the four-digit, LED counter and the 20-segment, vertical bar-graph level meters which read from -40 to +10. During tape calibration, the meter scale is expanded for finer resolution. The counter reads from 9999 to -999.

Between these two displays and the main transport controls are five small buttons in a vertical array: Three are for the counter—"Reset," "Memory (Off/On, Stop/Play)"—and the other two are for auto reverse, "Off/On" and a switch to select continuous play or a single auto-reverse cycle.

Above the window in the cassette-compartment door are LED arrows which show the direction of play. These glow red in recording (forward only), green in play, and flash whenever the NAAC system is adjusting play-head azimuth to match the tape in use.

At the far left are a large "Power" button, small "Timer" buttons ("Off/On, Play/Rec"), a large eject button, and a headphone jack.

On the rear panel are gold-plated line in/out phono jacks, a socket for the optional RM-20 remote control, and a d.c. power jack for such Nakamichi accessories as the MX-100 microphone mixer.

Removing the metal top and side cover revealed a few p.c. boards supported and surrounded by a rugged, metal chassis frame. The soldering on the boards was excellent. Interconnections were made with multi-conductor cables, ending in plugs and sockets or wirewrap. All parts and adjustments were labelled.

Measurements

The playback responses were well within 2 dB of reference for both equalizations and for both directions of play, with the exception of the 18-kHz points at +3 dB with the 70- μ S tape. Most of the points for this equalization were within ± 0.5 dB, excellent results. Play speed was about 0.07% fast in forward play and about 0.1% fast in reverse play, excellent figures. Average playback-level indications were 0.5 dB high. Record/playback responses were checked for approximately three dozen formulations. Excellent results were possible with all of them after using the built-in calibration—with the exception of low-bias Type I tapes (non-premium), which would be bad choices for the Dragon anyway.

The supplied Nakamichi EXII, SX and ZX tapes were used for all of the detailed testing that followed. The swept-frequency responses were taken at Dolby level and 20 dB below that for the three tapes, both with and without Dolby C NR. Figure 1 shows the resultant plots, and Table I lists the 3 dB down points for all of the traces. Of particular note are the general flatness, the extended responses at both ends of the band (especially at Dolby level with Dolby C NR), and the good Dolby tracking at -20 dB. The peak at 20 kHz with the EXII tape is somewhat high, but calibration was purposely done rather quickly; slightly more bias would bring it down. It must be noted, however, that bias calibration must be done without Dolby NR for the most stable playback of the 15-kHz tone and its tracking by NAAC. A check of responses with Dolby B NR showed them to be excellent, with very good tracking over a range of levels.

A number of tests were conducted to learn more about the performance of NAAC. The earlier playback response tests showed that the system would align the play head to the 12.5-kHz test-tape tone within 15° to 20° of phase, equivalent to an azimuth accuracy better than 1' (1/60 degree). This is excellent.

Pink noise was recorded on a separate Nakamichi 582, with its record head purposely misadjusted to cause a loss of almost 20 dB at 15 kHz, as shown in the top trace in Fig. 2. (The relative rise in level for the 16- and 20-kHz bands was from tape noise.) The cassette was then transferred to the Dragon, and the bottom trace shows the response after NAAC operated for about five seconds. Next, the pink noise to the 582 cassette deck was purposely band-limited to 50 Hz to 12.5 kHz to simulate a run-of-the-mill recording (Fig. 3, top), and then the record head was misaligned (middle).

“Of particular note are the general flatness, the extended responses at both ends of the band (especially at Dolby level with Dolby C noise reduction).”

The bottom trace shows how the Dragon operated on the response of the simulated poor deck's tape to achieve correct alignment—further proof of the success of this amazing system. In checking the response limits of the deck, it did appear that NAAC might do some “hunting” with a test signal of 20 kHz or so, which is above its normal response band. This was not considered a defect; there is no known music consisting of a single, 20-kHz tone. There was also some hunting at the start of the swept-frequency response tests, but with a slower sweep rate NAAC had no tracking problems. This was also, of course, a nonmusical condition, and the pink-noise tests indicated what it would do under normal (non-test) conditions.

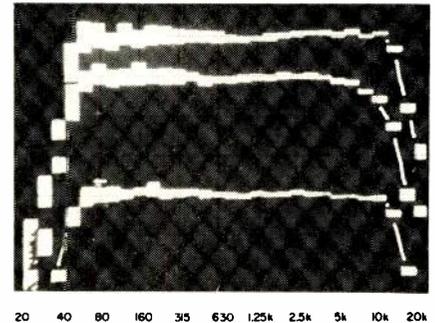
Table II lists various record/playback test results, and they are all excellent, with the exception of the multiplex filter which had its 35.4 dB notch at a higher frequency. I suspect that, in the rush to get this first-of-its-kind unit out, this simple adjustment was overlooked. The subsonic filter was 3 dB down at 15.8 Hz and 22 dB down at 10 Hz. The level-adjust pot (400 Hz) had a range of -6.1 to $+4.5$ dB relative to zero indication for ZX tape. The bias pots could set the 15-kHz level anywhere from -8 to $+6$ dB with the same tape. There was some bias in the right channel output in “Tape” but none in “Source.” The 400-Hz (396.7-Hz actual) and 15-kHz (15.24-kHz actual) tones both had less than 1.0% distortion, quite acceptable for the purpose. In the process of running tests with pink noise, it was noted that Dolby C tracking was not affected by the bandwidth of the noise source. (Such effects had been observed with other decks with Dolby C NR). Reference to the frequency responses confirmed that the roll-offs above 20 kHz were very sharp, reducing the likelihood that the Dragon would have any mistracking caused by above-band energy, such as might be generated by a synthesizer. This was another design nicety which showed up without the manufacturer having made any mention of it.

Table III lists the distortion figures for the three tapes at 400 Hz with Dolby C NR over a range of levels from 10 dB below Dolby level to the points where HDL₃ reached 3%. The results are excellent, especially so for the EXII and ZX tapes. Table IV shows the excellent signal-to-noise ratios obtained for all three tapes. Table V lists the figures for HDL₃ versus frequency, from 50 Hz to 6 kHz with ZX tape, both at Dolby level and 10 dB lower, again using Dolby C NR. The results are outstanding—the best overall for a deck to date. Tests were also run at Dolby level using Dolby C NR with both EXII and SX tapes, and those results were also impressive. In general, distortion figures without Dolby NR were, as usual, 30% higher.

Table VI lists a number of input/output characteristics, all substantially to specification as expected. All of the values listed stayed within acceptable limits from 20 Hz to 20 kHz. The two sections of the master input-level pot tracked together within a dB for 50 dB from maximum, which is very good. The output-pot sections tracked to the same criterion for about 30 dB, which is acceptable. The output polarity matched the input polarity both in “Source” and “Tape” monitor, a desirable configuration.

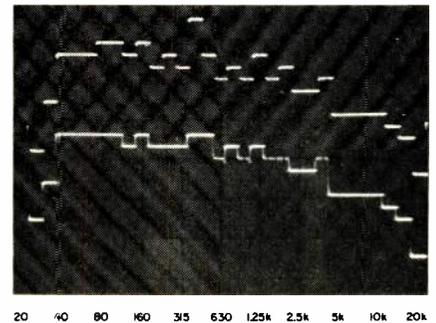
The thresholds for most of the segments on the level meters were quite accurate, but the lowest ones were about

Fig. 3—Nakamichi 582 cassette deck's response to pink noise rolled off at 10 kHz, with correct record-head alignment (top); 582 with record



head out of correct azimuth alignment (middle), and Dragon's response with off-azimuth tape from 582 (bottom). Vertical scale: 5 dB/div.

Fig. 4—Record and playback of the opening passages of Respighi's Feste Romane on a correctly aligned 582 (top) and playback on the



Dragon of the same passages recorded on an incorrectly aligned 582 (bottom). See text. Vertical scale: 10 dB/div.

3 dB too sensitive compared to the zero reference. The bargraph response was slower than that of true peak-responding meters, but the zero segment showed a faint glimmer at 30 mS, which is quite fast. The decay time was 1 S for 20 dB, shorter than the IEC standard. The frequency response of the meter was down 3 dB at 47 Hz (on the high side) and 21.6 kHz (just fine).

There was no measurable change in play speed with any line voltage from 110 to 130 V. Speed variations appeared to be less than 0.005%; better instrumentation would be necessary to get more accurate figures. In the reverse play direction, the results were the same. The flutter at any point in a cassette was 0.014% or less, wtd. rms, and 0.028% or less, wtd. peak. In reverse play, the figures were slightly higher, but still better than specified. The Dragon even operated up to specification with a cassette known to be of poor quality. Fast-winding time averaged 51 seconds for a C-60 cassette. All mode changes, including shutoff at the end of the tape, took less than a second.

"The Dragon even operated up to specification with a cassette known to be of poor quality."

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
Nakamichi EXII	11.5	20.4	11.3	22.1	11.5	12.0	11.3	22.7
Nakamichi SX	11.7	19.5	11.4	22.4	11.7	10.6	11.4	23.5
Nakamichi ZX	11.4	21.0	11.3	23.1	11.4	15.2	11.3	24.0

Table II—Miscellaneous record/playback characteristics.

Erasure At 100 Hz	Sep. At 1 kHz	Crosstalk At 1 kHz	10-kHz A/B Phase		MPX Filter At 19.00 kHz
			Error	Jitter	
70 dB	61 dB	–85 dB	15°	25°	–21.8 dB

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

Tape Type	NR	Record Level						HDL ₃ = 3%
		–10	–8	–4	0	+4	+6	
Nakamichi EXII	Dolby C	0.08	0.12	0.19	0.3	0.9	1.9	+7.2 dB
Nakamichi SX	Dolby C	0.11	0.16	0.4	1.0	2.8		+4.2 dB
Nakamichi ZX	Dolby C	0.06	0.10	0.2	0.45	1.1	1.7	+8.2 dB

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

Tape Type	IEC A Wtd. (dBA)				CCIR/ARM (dB)			
	W/Dolby C NR		Without NR		W/Dolby C NR		Without NR	
	@ DL	HD=3%	@ DL	HD=3%	@ DL	HD=3%	@ DL	HD=3%
Nakamichi EXII	67.5	74.3	51.4	58.2	69.2	76.0	49.1	55.9
Nakamichi SX	70.7	74.5	54.8	58.6	71.9	75.7	52.1	55.9
Nakamichi ZX	69.3	77.0	53.2	60.9	69.4	77.1	50.4	58.1

Table V—HDL₃ (%) vs. frequency using Dolby C NR.

Tape Type	Level	Frequency (Hz)						
		50	100	400	1k	2k	4k	6k
Nakamichi ZX	–10	0.12	0.10	0.06	0.05	0.04	0.05	0.12
	0	0.70	0.60	0.47	0.42	0.40	0.60	1.3

Table VI—Input and output characteristics at 1 kHz.

Input	Level			Imp., Kilohms	Output	Level			Imp., Ohms	Clip (Re: Meter 0)
	Sens.	Overload				Open Ckt.	Loaded			
Line	53 mV	>30 V		50	Line	971 mV	819 mV		2.2k	+17.2 dB
					Hdphn.	1.0 V	47 mW			

Use and Listening Tests

Tape loading was a simple drop-in. Access for head cleaning and similar maintenance was fairly good with the door cover in place, very good with the cover removed.

The Dragon was very quiet in all its modes, including the cam-drive positioning of the heads. It was interesting to watch the smooth shifting of drive components as tape direction was reversed.

The instruction manual was lucid and quite complete, although some users might desire more technical background. It had a number of helpful, pertinent notes, and the illustrations were well done and well tied to the text.

All controls and switches were completely reliable throughout my testing. The angled buttons looked slightly odd, but they were very easy to use, especially with their bright indicators. The arrangement was one of the best I've used, and the angling seemed just right. However, the small, black pushbuttons blended into the panel, putting their in/out status in doubt at times. This was judged most important for the Dolby NR and EQ pushbuttons, where an error would not be immediately apparent.

Setting recording levels was easy, with the bright, vertical bar-graph meters and the three input level pots. The knobs on the individual channel pots were smallish, in contrast to the "Master" gain control, but their friction was low.

Other features that particularly appealed to me included flying-start (punch-in) recording, the "Auto Fader," "Cue," and "Auto Rec Pause." It goes without saying that the NAAC system operated all the time, trimming play-head azimuth as needed.

The opening passages from Respighi's *Feste Romane*, one of the records used for the listening tests, was taped twice on a Nakamichi 582—first with the record head correctly aligned, then with the record head set to drop the 15-kHz response by 10 dB on a normally aligned playback head. This second version was played on the Dragon, and its maximum-level spectrum (Fig. 4, bottom) compared with playback on the aligned 582 (Fig. 4, top). There are a few minor discrepancies, but it can be seen that, as the listening indicated, NAAC had aligned the Dragon's play head to restore the original high-frequency spectrum.

Neither ear nor meter detected any noise pulses on the tape when switching into record or pause modes. However, switching from record to stop generated just a slight click, so far down in the noise that it's only audible when using Dolby C NR.

Listening to the Dragon's playback of tapes made from favorite discs was most enjoyable. The sound was clean, even at quite high levels, and a drummer friend was particularly impressed with the bass tightness and clarity.

It's tempting to make some sort of cute remark about a deck called "Dragon," but it's much more important to call attention to the value of its exciting, auto-alignment innovation, NAAC. That, and its superbly low distortion and flutter, excellent calibration facilities for all premium tapes, flat and wide frequency responses, superior reverse-play performance, and many convenience features, all make the Dragon—even with its \$1,850 price tag—certain to interest high-end audiophiles and professionals, particularly for normal-speed duplicating.

Howard A. Roberson

2

PHOENIX SYSTEMS P-10-MM PHONO PREAMP

Manufacturer's Specifications

Frequency Response: Phono, RIAA or IEC ± 0.25 dB; high level, -3 dB at 16 Hz, 0 dB at 100 kHz.

Phono Input Sensitivity: 1.5 to 10 mV at 1 kHz.

Phono Input Impedance: 47 kilohms, 100 pF.

S/N Ratio: 85 dB, IHF A-weighted.

THD: Less than 0.01%.

Phono Input Overload: 150 mV at 1 kHz.

Output Clipping: 8 V rms into 2 kilohms.

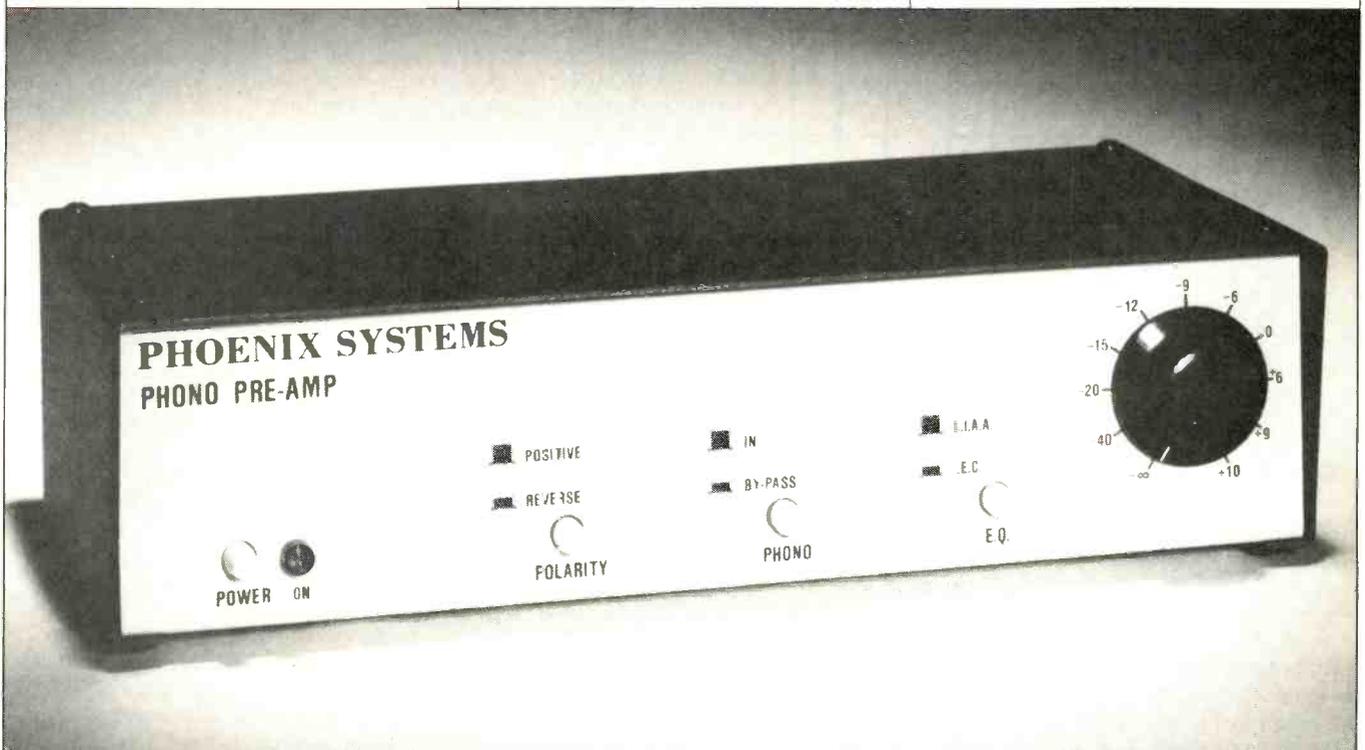
Slew Rate: High level, ± 13 V/ μ S; phono, ± 2 V/ μ S (EQ-limited).

Dimensions: 11 $\frac{1}{4}$ in. (28.6 cm) W \times 5 $\frac{1}{2}$ in. (14 cm) D \times 3 in. (7.6 cm) H.

Price: Assembled, \$200.00; kit, \$150.00; optional variable input load (P-10-IL), \$15.00.

Company Address: 91 Elm St., Manchester, Conn. 06040.

For literature, circle No. 91



I always have a great deal of admiration for any small company that attempts to compete with the giants of the audio industry and comes out with a product that is competitively priced and performs well. This is probably because I found myself in exactly that position some 20 years ago, when both the audio industry and I were a lot younger. It was tough for a newcomer then; it's even tougher now.

John Roberts, President of Phoenix Systems, has developed a little preamplifier offered in several forms. Basically, the P-10 is a kit, with a rather amateurishly written set of assembly and wiring instructions. The version tested was supplied fully assembled, however, so I can't comment too meaningfully on the ease of assembly or, for that matter, the accuracy of the assembly instructions. (John Roberts says

"If you subscribe to the audio notion that simpler is better, you will like the Phoenix Systems P-10-MM."

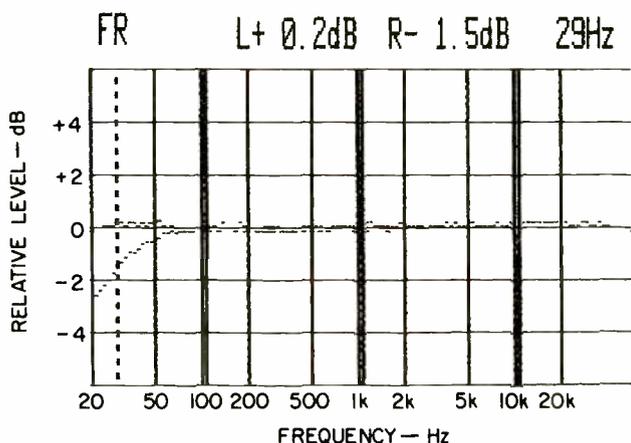


Fig. 1—Normalized phono playback response. Upper curve is RIAA, lower is response of IEC equalization to RIAA test signal. Note that vertical scale is 2 dB/div.

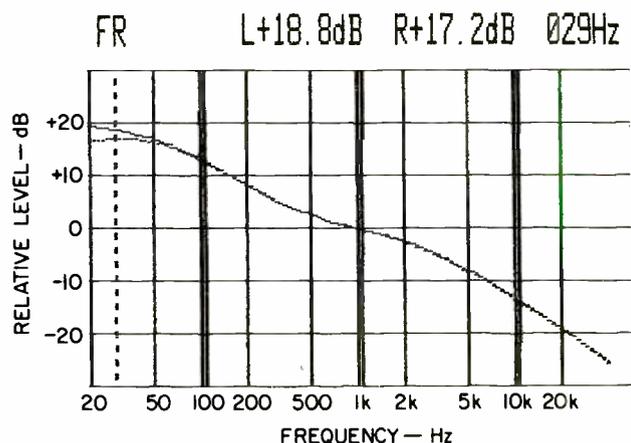


Fig. 2—Response curves of phono preamp to constant-amplitude signals. Upper curve is RIAA, lower is IEC.

he put together my unit in 3½ hours and estimates that a novice might do it in from 6 to 7 hours.) Since the instructions were obviously composed on a word-processing computer (as I could tell by the dot-matrix printing), they've probably been checked and double-checked. (Computers and word processors never make mistakes, RIGHT?)

The P-10 I tested was designed for use with a moving-magnet or moving-iron cartridge, and is accordingly designated P-10-MM. An alternate version, the P-10-MC, can be had for use with—you guessed it—moving-coil pickups. The tested sample also incorporated an optional Input Load (P-10-IL) which involves a switch, found inside the preamp, that allows switching in up to 475 pF of capacitance in 25-pF increments.

The preamp is mounted in a brown metal wrap, and its

beige front panel has only one rotary control knob which is coupled to a mechanically detented master volume control. Calibration is in dB, from +10 through -40, to "infinite." The 0 dB setting corresponds approximately to unity gain for the high-level AUX inputs of the preamp. Four small, white pushbutton switches handle power on/off, phono/high level selection, RIAA/IEC equalization selection, and selection of output-signal polarity. A red LED near the power switch illuminates when the unit is turned on.

The rear panel has pairs of phono, high-level and output jacks plus a chassis ground terminal. A small hole provides access to an internal, channel-balance trim pot, which affects only the phono input. Phoenix may feel that once you've adjusted your system's channel balance, there's no need to readjust it (which is true if you always sit in the same spot when listening) and that your power amp will have input controls so you can balance for off-center listening (which is usually true). If those assumptions apply to you, I suppose there's some justification to this simplification of the control panel, especially for the purists among us.

Circuit Highlights

The Phoenix P-10-MM employs two matched pairs of pF5103 J-FETs as the input stages for the phono section. A split-pole playback EQ network provides either standard RIAA playback equalization or the modified IEC version (which incorporates a gentle roll-off at the low end), using a 7,950- μ S high-pass single-pole network. The circuit also includes a 2-pole high-pass filter with a cutoff at 10 Hz for roll-off of warp and infrasonic signals.

Measurements

As received, the input sensitivity of the phono stages was 2.8 mV for 0.5-V output. This sensitivity is adjustable over a wide range, however. Signal-to-noise ratio for the phono inputs measured 83 dB, referred to a 5-mV input with the volume control adjusted to produce 0.5-V output. The S/N measurement was made using an A-weighting curve. Signal-to-noise ratio via the high-level input measured 91 dB referenced to 0.5-V input, with the volume control set for unity gain. Phono overload at 1 kHz measured a more than adequate 215 mV.

Figure 1 is a plot of frequency response for the phono inputs. To obtain a "flat" curve, the applied signal had a very accurate (to within 0.1 dB) inverse RIAA response. Note that vertical sensitivity of the display has been deliberately increased to 2 dB per vertical division, so as to show up any small deviations from true RIAA response. For the "R" plot, the RIAA/IEC switch was in the IEC position, and, as you can see, there is a deliberate roll-off of -1.5 dB at 29 Hz. The "L" plot employed the RIAA setting, and response was almost absolutely flat at 29 Hz (0.2 dB deviation noted above the diagram for that frequency).

The more usual RIAA response curve is plotted in Fig. 2. Here we see the typical bass boost and treble cut curves associated with RIAA equalization. The action of the IEC equalization setting on the preamp is depicted in the lower of the two curves seen at the left end (bass) of the diagram. Again, the difference between the two curves is close to what we saw earlier in Fig. 1: +18.8, +17.2 or a difference

“What Phoenix has tried to do (and mostly has succeeded in doing) is to offer a simple, no-frills, good-sounding preamp.”

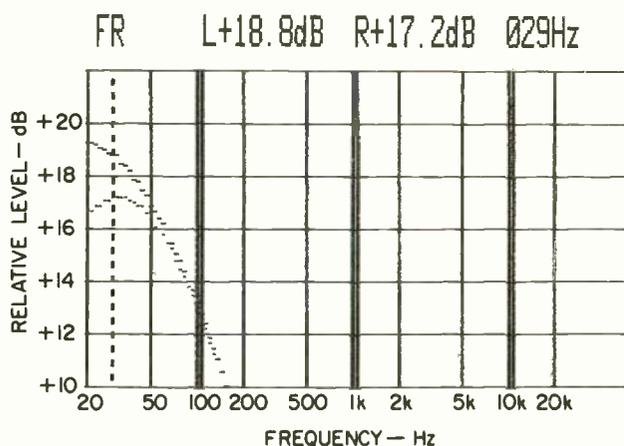


Fig. 3—“Magnified” (2 dB/div.) display of phono-EQ bass boost. Upper curve is RIAA, lower is IEC.

of 1.6 dB. The 0.1 dB difference is attributable to measurement equipment tolerances.

To more clearly depict the difference between the low-end EQ curves of RIAA and IEC, I “magnified” the extreme bass end of Fig. 2 and displayed the results in Fig. 3. Here, vertical sensitivity is 2 dB per division instead of the 10 dB per division used in Fig. 2.

Use and Listening Tests

If you subscribe to the notion that simpler is better, you will like the Phoenix Systems P-10-MM. The power supply within this unit has been well positioned and well shielded to provide hum-free operation of the sensitive phono stages. I connected the P-10 directly to my reference power amp and

played a wide variety of LP discs using the RIAA and IEC playback settings. The cartridge was a Shure V-15 Type V which behaved very nicely looking into a total of 250 pF, as selected using the internal load switch. I know that some people claim to hear a difference when signal polarity is reversed on a preamp, but I must confess that I heard none. Music sounded equally good to me regardless of the setting of the polarity switch. This was not the case with the IEC/RIAA switch. I am convinced that the RIAA’s reluctance to go along with the IEC, an internationally recognized standards-writing body, is a mistake. The RIAA continues to live in a world in which everything is “perfect,” whereas we all know that records do have warpage and turntables do have rumble. I’m all for an IEC low-end response in phono playback EQ, and Phoenix Systems was wise to incorporate this feature in their low-cost preamp. You can hear the difference, even on good turntables and even with records that are only slightly warped.

Obviously, the designers of this preamp could have gone a lot further if they wanted to cater to the super-fidelity purists. We might have seen gold-plated phono terminals, a power supply external to the body of the preamp itself, etc., etc., etc. It seems to me that what Phoenix has tried to do—and has for the most part succeeded in doing—is to offer a simple, no-frills, good-sounding preamp that is easy to build and is low enough in cost to be affordable by just about anyone.

The unit is, in fact, so low priced that if you are unhappy with the phono section of your present preamp, you might even consider adding this unit for phono only, without discarding your more elaborate control unit. You could hook up your cartridge to the P-10-MM (or MC for that matter) and have its outputs go to the AUX inputs on your present preamp. If that displaces whatever was originally going to the AUX inputs on your existing preamp, the P-10’s extra high-level inputs will take care of that situation as well.

Leonard Feldman

**“TechniClean...
the best hand-held
disc-cleaning device
available!”**

— Rich Warren
Noted hi-fi writer for
High Fidelity, *Chicago Magazine*,
and *The Chicago Sun-Times*.

audio-technica



TechniClean™
Record Cleaning System
Model AT6015
\$24.95



3

KOSS CM/1030 LOUD- SPEAKER

Manufacturer's Specifications

System Type: Four-way, vented enclosure.

Drivers: One 10-in. woofer, two 4½-in. cone midranges, two 1-in. dome tweeters.

Crossover Points: 300 Hz, 2.5 kHz, and 7 kHz.

Impedance: 5 ohms nominal, 4 ohms minimum.

Frequency Range: 26 Hz to 19.5 kHz.

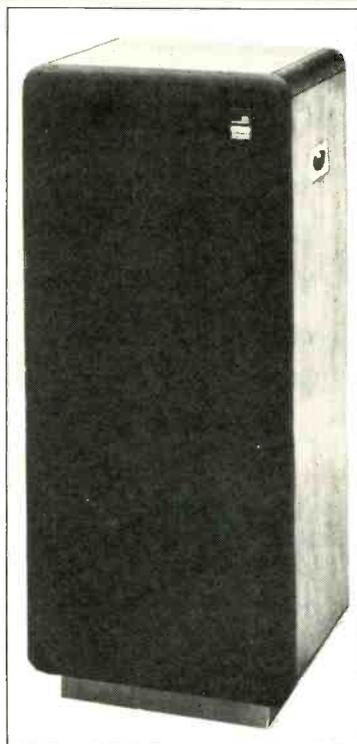
Dimensions: 16½ in. (41.9 cm) W × 14½ in. (36.8 cm) D × 38¾ in. (98.7 cm) H.

Weight: 74 lbs. (33.3 kg).

Price: \$1,000.00 per pair.

Company Address: 4129 North Port Washington Ave., Milwaukee, Wisc. 53212.

For literature, circle No. 92



The "CM" of Koss Corporation's CM/1030 loudspeaker stands for "computer maximized." A 250-mm (10-inch) woofer has been combined, through computer analysis, with the optimum size, shape and configuration of enclosure to provide a solid bass response. By first selecting the variables, such as the number of bandpass ranges, the efficiency, and the cabinet size, Koss claims to have been able to specify an optimum design for the ports, drivers and crossover networks.

The CM/1030 is a four-bandpass loudspeaker system which, in addition to the woofer, uses two midrange drivers and two tweeters. The grille is easily removed to reveal three equalizer switches mounted on the front panel. These are marked "Midrange," "Treble," and "Tweeter" and allow for a +3 dB, "Normal," or -3 dB level adjustment in their respective bandpass ranges. A handy user's guide is provided immediately above the switches, in the form of a symbolic frequency-response plot with color-coded bandpass

ranges (orange for midrange, green for treble and blue for tweeter.) This is an excellent visual guide and can be readily understood without need to refer to an operating manual. The ease of adjustment and resettability of these controls could allow them to be used as minor touchup program equalizers, should that be felt necessary.

The cabinet is sturdy and heavy. Although tall enough to be ranked as a small tower system, its center of gravity is sufficiently low that the enclosure could not be readily tipped over by an inquisitive toddler.

Electrical connection is made to rear-mounted, push terminals placed in a recessed cavity along with a protective fuse. The terminals are clearly marked for polarity convention, and no difficulty should be encountered in hookup.

The entire enclosure is finished—front, sides, and rear. This allows the CM/1030 to be placed anywhere in a room without detracting from the decor.

Measurements

The electrical impedance of a loudspeaker is an indication of the load which the audio power amplifier must drive in order to provide high-quality sound. It represents not only the amount of energy that will be spent in work and heat, but the amount of energy which will be stored in the loudspeaker and will have to be controlled as it pushes back against the amplifier. One could liken this to pushing a child's swing—the job isn't over when the swing gets to its highest spot; it's going to come back when you've quit shoving. Some amplifiers do not like taking the loudspeaker's recoil in the teeth.

The magnitude of impedance for the Koss CM/1030, plotted in Fig. 1, has a double peak in the bass region, which is characteristic of a vented system. The average value of impedance above 100 Hz is about 5 ohms, and it never drops below its rated 4-ohm value.

The complex impedance (resistance and reactance) plot of Fig. 2 reveals a possible amplifier problem in the lowest registers. The bass alignment for uniform sound pressure level at constant-voltage drive produces impedance resonances at 21 Hz and 41 Hz for this system. This is satisfactory for proper acoustic performance and indicates no problem in design. But the result is a large capacitive phase shift to the driving impedance, which reaches peak values at 26 and 55 Hz. The 63° lag at 55 Hz, where the impedance is 10 ohms, could cause some amplifiers to distort prematurely if driven near their maximum output levels at this frequency. I recommend using high-quality amplifiers with the CM/1030 to avoid this potential problem. The remainder of the frequency range, above 100 Hz, provides a very benign load to any amplifier. The number of impedance loops in the upper range causes some confusion in the plot of Fig. 2, which has been scaled to show the bass resonance peaks. Figure 3 is an expanded plot of the complex impedance above 75 Hz.

The substantial impedance variations above 30 Hz suggest that not only low-resistance, but low-inductance hookup wire be used between the power amplifier and this speaker. As little as a half-ohm loop impedance could cause a change of several decibels in frequency response due to line drop.

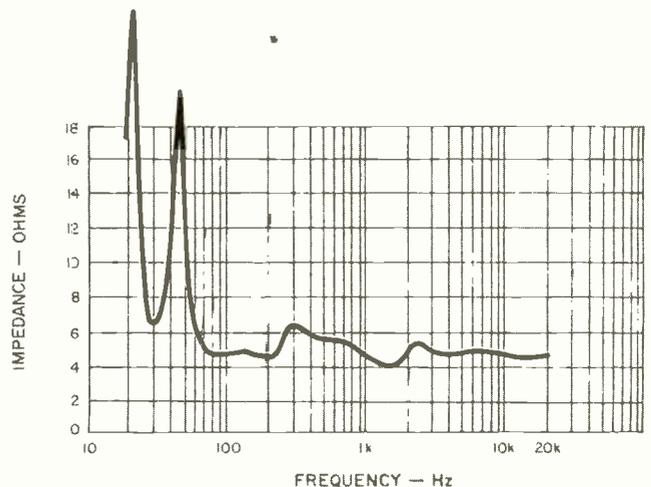


Fig. 1—Magnitude of impedance, all controls set to normal.

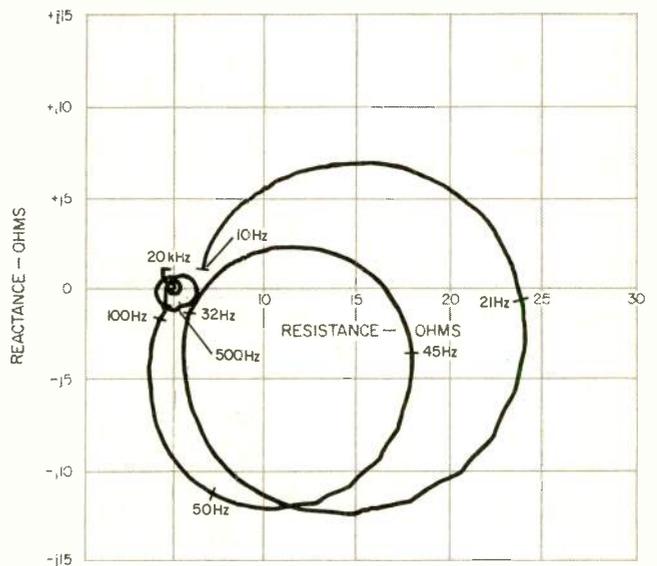


Fig. 2—Complex impedance plot, 10 Hz to 20 kHz.

The measured one-meter on-axis anechoic frequency response is plotted in Figs. 4 and 5. Since the Koss CM/1030 is a 4-ohm system, the drive level was adjusted to represent a constant 1-watt-average power level into 4-ohms resistance throughout the frequency range. Midrange, treble and tweeter controls were set to their indicated normal positions, and the amplitude response for this setting is shown in Fig. 4. Sound pressure rises gradually at an average rate of

"Since the response is more uniform in the straight-ahead position, I recommend rotating these speakers toward the listening position."

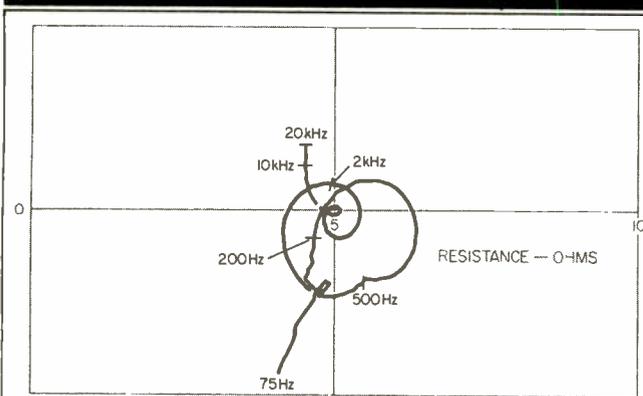


Fig. 3—Expanded complex impedance plot, 75 Hz to 20 kHz.

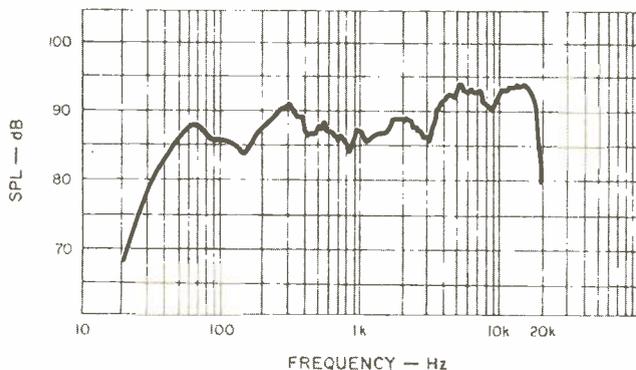


Fig. 4—On-axis frequency response at 1 meter, driven by constant voltage corresponding to 1 average watt into 4 ohms.

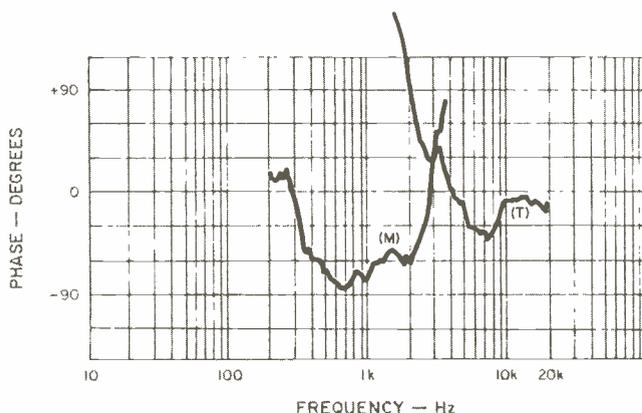


Fig. 5—On-axis phase vs. frequency response at 1 meter, corrected for delay of 3.3608 mS and (T) the tweeter's air-path delay of 2.9909 mS. (M) the midrange's air-path

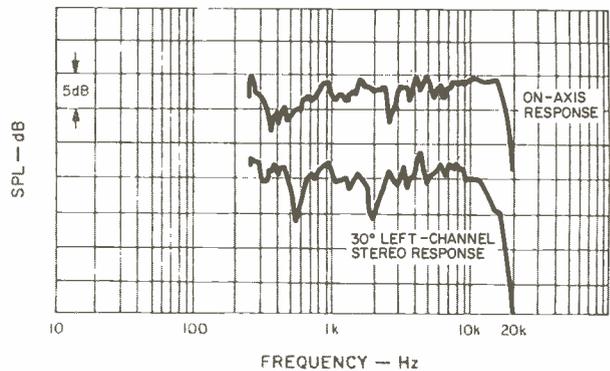


Fig. 6—Three-meter room response.

about 2.5 dB per decade up to a cutoff of 19 kHz. Bass response, as expected, is good down to 35 Hz.

The sound pressure phase response is plotted in Fig. 5. Since the acoustic positions of tweeter and midrange differ slightly, the corrected phase plot is shown in two parts. Both parts are corrected for absolute polarity in which the air-path delay is removed; 0° phase corresponds to a sound pressure increase which is precisely in phase with a positive-going electrical drive at the loudspeaker terminal marked with a plus sign. The midrange driver has a corrected time delay of 3.3608 mS for a one-meter air path, and the tweeter has a 2.9909-mS correction.

Acoustic crossovers occur at around 3 kHz and 330 Hz. The tweeter phase shift is well-behaved and near the 0° polarity convention, while the midrange, although well-behaved, lies near -60°. Each driver is of minimum-phase type, although the composite response has nonminimum phase properties due to the arrival-time difference. Some mild emphasis of upper musical partials, with timbral irregularities in the range of Middle C, are implied by these plots.

The three-meter room response of Fig. 6 shows a much more uniform sound aspect than does the anechoic response. In this test, the Koss was placed in its recommended listening position and the measurement performed at a normal listener position of three meters in front of the speaker at a seated ear-level position of one meter above a carpeted floor. The first 13 mS of direct sound is captured, apodized (band-limited), and displayed using a time-delay spectrometer. The time gate of 13 mS is chosen from psychoacoustic literature and is believed to correspond to the interval of time necessary to establish timbre for transient tones. Thus, this is intended to measure how the Koss "sounds" in a normal listening environment.

The Koss should sound pretty good, according to this measurement. The anechoic peaks and dips are nicely leveled, and a slightly off-axis listening position above the geometric axis actually tames the top-end bite. The upper measurement shown corresponds to a straight-on forward position, such as might be encountered when sitting directly in front of the speaker or when the speaker is rotated to

“The Koss can handle high sound levels in the middle and upper registers, but should not be driven too hard in the lowest ones.”

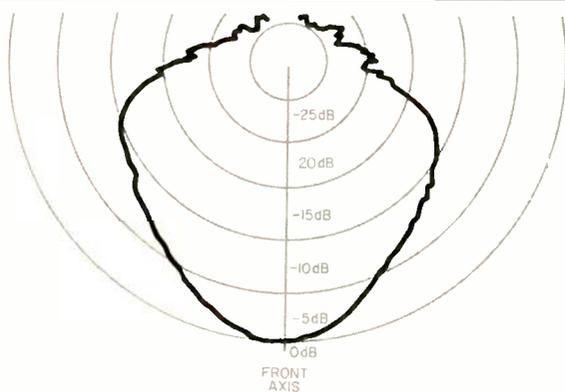


Fig. 7—Horizontal polar energy response.

point to the listening position. The lower measurement corresponds to a traditional, 30° off-axis, left-channel stereo speaker location. Since the response is more uniform in the straight-ahead position, I recommend rotating these speakers toward the normal listening position.

Uniformity of sound is also evident in the polar energy plots of Figs. 7 and 8. In these measurements, the energy from 20 Hz to 20 kHz is plotted as a function of angle relative to the front of the system. The horizontal angular energy response, Fig. 7, shows a straight-ahead projection of sound with a uniform fall-off of energy as one moves either to the left or right of center line. The vertical energy response shows some lobing due to time-delay interference between midrange and tweeter drivers. This also shows why the geometric on-axis amplitude response of the anechoic measurement is less uniform than the slightly higher position used for the three-meter test. This is an effect readily discerned if one moves up and down while listening to the CM/1030, since left-right motion produces little change in sound. The implication of these tests is that good stereo lateralization, with minimal influence on imaging by objects to the far side or back of the enclosure, can be expected.

The vertical energy response does show a substantial amount of sound being launched upward and downward. The speaker should not, therefore, be placed on an acoustically hard surface, such as a hard wood floor, or immediately below overhead projecting objects, such as shelves. In normal listening positions, however, the measurement shows good sound quality.

Harmonic distortion for the musical tones of E₁ (41.2 Hz), A₂ (110 Hz) and A₄ (440 Hz) is plotted in Fig. 9. Tones A₂ and A₄ remain very clean at all power levels, up to 100 average watts, while E₁ is a bit higher in distortion than I would like to see for a speaker of this high quality. This measurement is a burst test, in which the test tone is applied for only a short duration and then removed while the acoustic distortion products are computed and plotted. The intent is to measure the acoustic distortion of brief sound surges of the type likely to be found in music. A sustained sine-wave measurement at any particular frequency, such as can be

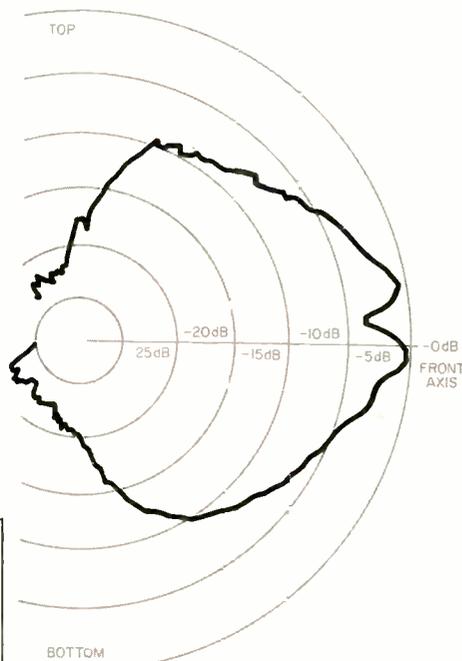


Fig. 8—Vertical polar energy response.

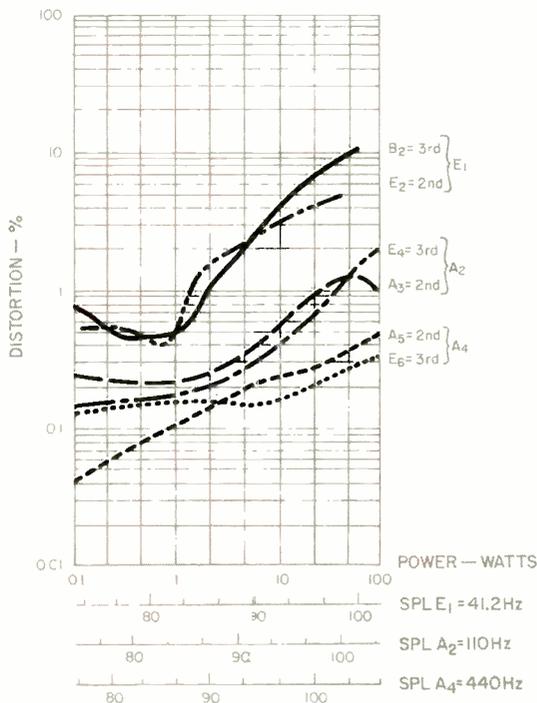


Fig. 9—Harmonic distortion for the musical tones of E₁ (41.2 Hz), A₂ (110 Hz) and A₄ (440 Hz).

“The Koss produces clean sound from the standpoint of IM by bass notes, THD and crescendo peaks, but tends to compress dynamics.”

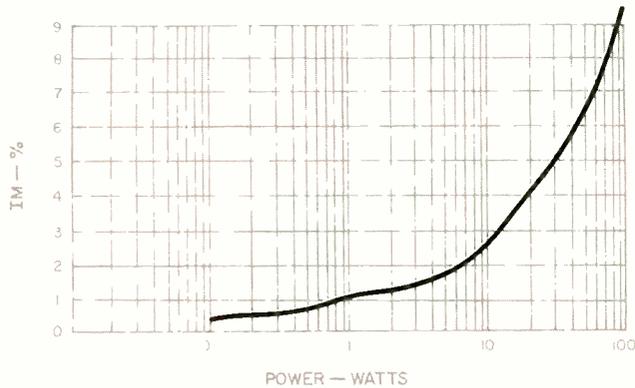


Fig. 10—IM distortion on 262 Hz (Middle C) produced by 41.2 Hz (E_1) when mixed in 1-to-1 proportion.

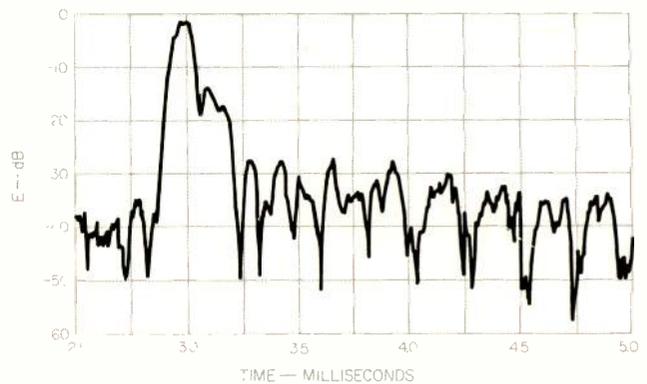


Fig. 11—Energy-time response.

used to test an amplifier, would either fry the speaker or produce invalid data due to unnatural heat rise.

Second-harmonic distortion creates a false tone which is an octave above the test fundamental, while third-harmonic distortion creates a false tone which is a fifth in the octave above. Close, but not perfect, harmonic partials, such as found in piano, may tangle with these distortion fragments and produce unnatural timbral balance. The upper partial distortion fragments of the Koss stay acceptably low below 30 average watts, while the lower register E_1 is moderately clean below 10 watts. This measurement indicates it can handle high sound levels in the middle and upper registers but shouldn't be driven too hard in the lowest registers.

Intermodulation distortion on Middle C (262 Hz) caused by the addition of E_1 (41.2 Hz) at equal drive level is plotted in Fig. 10. Middle C was chosen for this test since A_4 (440 Hz) is substantially carried by the midrange driver, and the intent of the test is to determine the distortion which the bass driver causes when asked to carry two important musical tones simultaneously. This, again, is a burst test, where the acoustic signal is captured and Fourier analyzed for all modulation sidebands on Middle C caused by E_1 .

Like the harmonic distortion, low-level IM is not as low as I would like to see for a system of this high quality. The lowest measured level was 0.315%, but the IM rises only gradually with increasing drive level. Phase measurements indicate that the IM is principally phase modulation throughout the range, corresponding to a vibrato on Middle C at a rate of E_1 . At 60 average watts, the modulation on Middle C is 5% peak-to-peak amplitude modulation and 13° peak-to-peak phase modulation. At the peak test level of 100 average watts, the amplitude modulation (tremolo) rose to 18%, while the phase modulation (vibrato) rose to only 15° peak-to-peak. The overall IM is quite low for the Koss.

Two other distortion measurements are made to uncover any unnatural musical dynamics which the loudspeaker might create. In the first test, the acoustic transfer gain linearity is measured from very low to very high sound levels. If a loudspeaker is perfectly linear, an increase of 1 dB in amplifier drive should produce a corresponding sound pressure level increase of precisely 1 dB. If it does

not, then the tone is altered, even if it does not produce distortion fragments. In the second test called (with apologies to Bert Whyte) a crescendo test, I try to determine what happens to a solo instrumental tone when every other instrument in the orchestra lets go triple forte. If the speaker is perfect, the solo tone will not be altered in level or pitch by the presence of other nonmusically-related instruments. I use a fixed tone for the solo instrument and 20-kHz band-limited white noise for the other instruments, something like a loud cymbal crash.

The Koss survived the crescendo test quite well. There is a change of less than 0.1 dB in solo voice intensity when noise is added at a 20 dB higher rms level, even up to combined instantaneous peak levels of 400 watts for tones of A_2 (110 Hz) and A_4 (440 Hz). Middle C remained steady at less than 0.1 dB variation from perfection up to 200 watts peak, then dropped by 1 dB at 400 watts peak, a truly good performance.

Acoustic transfer gain, however, is not as good. Middle C (262 Hz) and A_2 (110 Hz) remained perfect up to 1 average watt, but Middle C began to drop in gain above that level. Middle C was 0.3 dB lower than its desired sound level at 10 watts and 0.8 dB lower at 60 watts average. The tone of A_4 (440 Hz) was similar but dropped to 0.3 and 0.6 dB, respectively.

In summation, the Koss produces clean sound from the standpoint of intermodulation by bass notes, harmonic distortion and crescendo peaks, but tends to drop intensity level with increasing orchestral peaks. This amounts to a slight compression of dynamics.

The energy-time curve for the CM/1030 is plotted in Fig. 11. This is a test of the speaker's ability to reproduce a perfect impulse transient. The energy-time curve is the true envelope of the impulse response, plotted in decibels as a function of time. The first sound is due to the tweeter, commencing at 2.85 mS and cresting at 2.99 mS for a one-meter air path between the speaker and the microphone. A subsequent arrival at 3.08 mS is due to diffraction of the tweeter sound from the front of the enclosure. Midrange driver contribution begins at 3.25 mS and effectively suppresses the net sound to produce a low-level response after

"Piano and voice are generally difficult. On both, the Koss performed with reasonable credibility and presented a fairly accurate sound."

that time. Perfection would be a single hump at 2.9 mS with a -30 dB width on the order of 0.1 mS. The Koss energy-time curve is good, but not spectacular. This measurement indicates a good transient response with a moderately small time spread imparted to crisp sounds.

Use and Listening Tests

The CM/1030s were placed near, but not against, a draped wall. This gave, to my ears, a better sound than when the speakers were placed either directly against a hard wall or away from the wall by more than a half meter. The change was in the bass region; direct wall placement yielded dominant bass, while the opposite was noted when the speakers were well into the listening area.

My first impression was that the extreme top end was down in level, so I tried listening with the tweeter control in the +3 dB position. I finally decided that the best overall balance was obtained with the "Normal" switch positions and the speaker rotated toward the listening area. Removing the grille had no noticeable effect on the sound.

Piano and voice, both solo and chorus, are generally the most difficult sorts of program material and are the ones where a system's faults will show up most readily. On both these sources, the Koss CM/1030s performed with reasonable credibility and presented a fairly accurate sound. While I was not able to say, "Ahh, this is the first real illusion of a

piano," I was reasonably satisfied with the reproduction of this instrument. With vocals, both solo and massed in chorus, there was no lateral spreading, so that there was a good and stable stereo image. There were no serious problems or particular changes in timbre unless I moved widely about the listening area. However, articulation and crispness of vocals, particularly choral voices, were not fully satisfactory to my ears.

With the speakers positioned as I have mentioned, general timbral balance is good, and general orchestral balance seemed proper up through the range of 1 to 5 kHz. In addition, low bass is quite good and is properly balanced with the rest of the musical spectrum so long as the speaker is properly positioned in the room. There is some moderate spectral beaming evident so that the listening area having the best balance will not extend throughout a large room.

This system is capable of providing high levels of sound without audible distress. It's not a disco speaker and shouldn't be used at lease-breaking levels, but the CM/1030 does give a good account of itself on the loudest musical passages when using high-quality program material.

In general, I found this loudspeaker system to be quite listenable for extended periods of time, as it does not provoke listening fatigue. It does not provide the very best sound I've ever heard, but the CM/1030 is extremely good for this price range.

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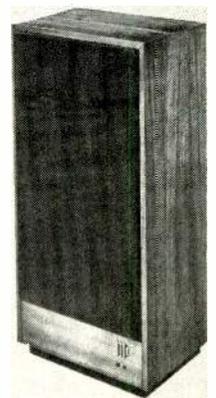
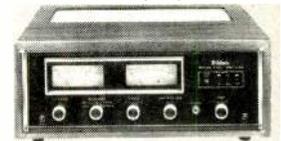
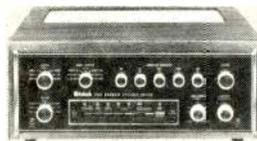
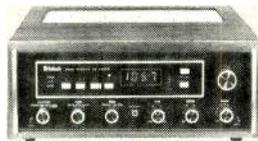
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4

KYOCERA R-851 TUNER-AMP

Manufacturer's Specifications

FM Tuner Section

Usable Sensitivity: Mono, 9.8 dBf (1.7 μ V).

Fifty-dB Quieting Sensitivity: Mono, 14.8 dBf (3.0 μ V); stereo, 35 dBf (31 μ V).

S/N: Mono, 88 dB; stereo, 76 dB.

Stereo Separation: 58 dB at 1 kHz; with high-blend filter, 20 dB at 1 kHz.

Alternate Channel Selectivity: 85 dB, narrow i.f. bandwidth.

Capture Ratio: 1.0 dB, normal i.f. bandwidth.

Image Rejection: 85 dB.

I.f. Rejection: 120 dB.

Spurious Rejection: 95 dB.

THD: Mono, 0.06% at 1 kHz; stereo, 0.07% at 1 kHz; both normal i.f. bandwidth.

Frequency Response: 30 Hz to 15 kHz, +0, -0.5 dB.

Muting Threshold: High, 40 dBf (55 μ V); low, 20 dBf (5.0 μ V).

Stereo Threshold: 20 or 40 dBf.

Subcarrier Product Rejection: 65 dB.

AM Tuner Section

Sensitivity: 300 μ V/meter, loopstick antenna.

Image Rejection: 50 dB.

I.f. Rejection: 85 dB.

Selectivity: 45 dB, \pm 20 kHz.

Distortion: 0.3%.

Amplifier Section

Power Output: 85 watts per channel, 8-ohm loads, both channels driven, 20 Hz to 20 kHz.

Rated THD: 0.015%.

SMPTM IM: 0.015%.

Damping Factor: 50 at 8 ohms, 1 kHz.

Slew Rate: 60 V/ μ S.

Rise-Time: 1.0 μ S.

Sensitivity for Rated Output: High level, 150 mV; moving magnet, 2.5 mV; moving coil, 125 μ V.

Frequency Response: 20 Hz to 20 kHz, \pm 0.3 dB.

Phono Overload: Moving magnet, 200 mV; moving coil, 10 mV.

S/N: High level, 100 dB; moving magnet, 86 dB; moving coil, 68 dB.

Tone Control Range: Bass, at 500-Hz turnover, \pm 10 dB at 100 Hz; treble, at 2-kHz turnover, \pm 10 dB at 10 kHz; midrange, at 800-Hz turnover, \pm 10 dB at 800 Hz.

Tone Control Turnover Range: Bass, 100 to 500 Hz; treble, 2 to 10 kHz; midrange, 500 Hz to 2 kHz.

High Filter: -6 dB at 10 kHz, 6 dB/octave.

Subsonic Filter: -3 dB at 20 Hz, 12 dB/octave.

Loudness, -30 dB: +7 dB at 100 Hz, +3.5 dB at 10 kHz.

General Specifications

Power Requirements: 120 V a.c., 60 Hz.

Dimensions: 18 $\frac{1}{8}$ in. (46 cm) W \times 5-3/16 in. (13.2 cm) H \times 14-9/16 in. (36.9 cm) D.

Weight: 27.1 lbs. (12.3 kg).

Price: \$855.00.

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Kyocera and Cybernet are corporate relatives, and this time the corporate decision has been to bring out a line of receivers (or tuner-amplifiers, if you insist) under the Kyocera brand name. The top unit in that line is the Model R-851, a frequency-synthesized, full-featured AM-FM tuner combined with an equally full-featured preamplifier-power amplifier capable of delivering in excess of 85 watts per channel into 8-ohm loads.

I must warn you at the outset to ignore the major published specifications of this receiver. Too many of them are optimistic. Why it was necessary for Kyocera to engage in a game of "specsmanship" I don't know; the receiver is a good performer and has many excellent control features which work well. Couldn't they have been content with a 0.05% rated distortion spec (which the amplifier section easily meets) instead of claiming a 0.015% spec (which it fails to meet)? Signal-to-noise ratio of 70 dB in stereo FM is a perfectly respectable performance spec for a frequency-synthesized tuner. So why do you suppose Kyocera has to claim S/N of 76 dB (or 88 dB in mono) when it actually makes only 73 dB?

Having gotten that off my chest, let's examine the nicely laid-out front panel of this receiver. Kyocera has wisely chosen to cover the less-often-used controls with a hinged, swing-down door along the lower edge of the dress panel. With the door obscuring the secondary controls, the panel takes on an uncluttered look. At the extreme left is a power on/off switch. Near panel-center is a multi-function display consisting of a frequency readout (AM or FM), stereo indicator light, five-LED signal-strength display, and a power output per channel LED display. The latter can be switched between two ranges so that even at low listening levels, the display will be active. The display section also incorporates indicator lights to tell you which tuning mode you are in (auto or manual), which i.f. mode has been selected (narrow or normal) and when a station has been "locked in" by the quartz-synthesized tuning circuitry.

To the right of the display area is a vertical row of seven station-preset buttons, each of which can recall an AM and an FM station frequency previously committed to memory. Additional touch buttons to the right of these are used for up and down tuning, selecting auto-seek tuning or incremental manual tuning, and memorizing desired station frequencies.

A calibrated, vertically oriented, master volume slider control is located to the right of these buttons, and to its right are an "Audio Muting" switch and a pair of switches related to the tape copying functions of the receiver. Six program-source pushbuttons ("Phono," "FM," "AM," "AUX," "Tape 1" and "Tape 2") are located at the extreme right of the front panel.

When the hinged door is swung down, the additional controls that are revealed include two speaker selector switches; bass, midrange and treble controls, each equipped with continuously variable turnover controls; tone, subsonic and high-filter on/off buttons; switches for FM mute threshold, i.f. bandwidth, blend on/off and 25/75- μ S deemphasis; a channel balance control; loudness on/off, stereo/mono and MM/MC phono switches, and a stereo phone jack. As you can see, there isn't much by way of controls that Kyocera has chosen to omit from this, their top receiver.

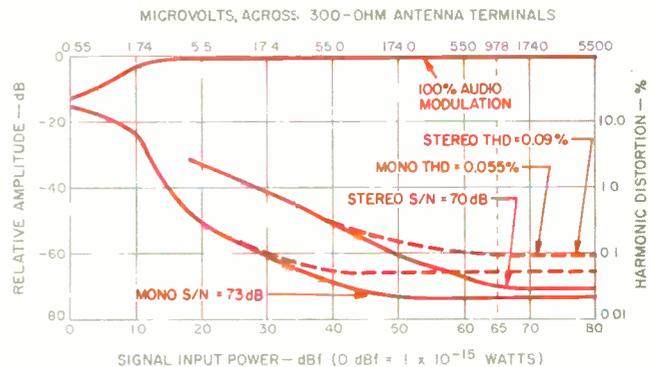


Fig. 1—Mono and stereo quieting and distortion characteristics, FM section.

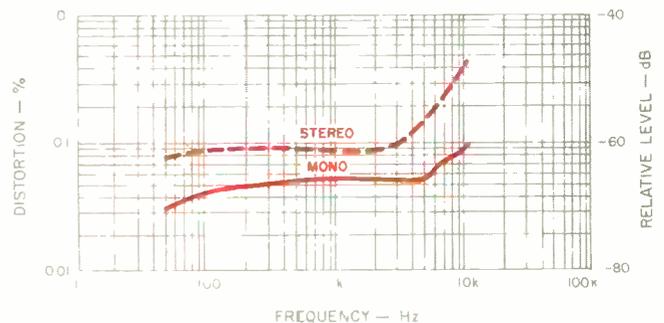


Fig. 2—THD vs. modulating frequency, FM tuner section.

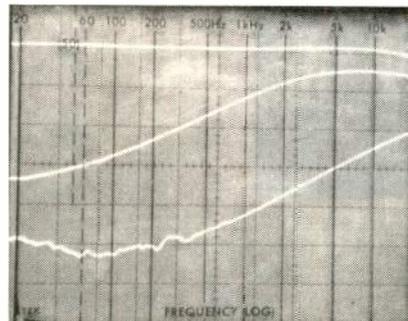
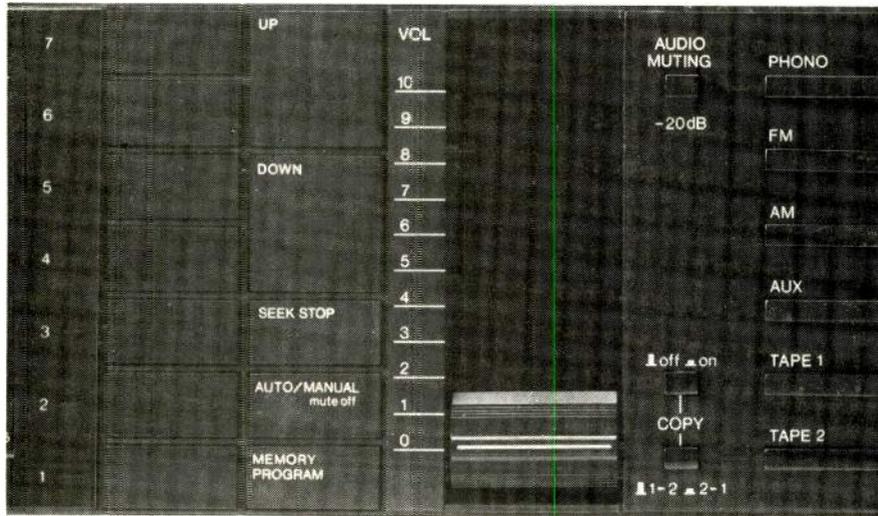


Fig. 3—FM frequency response and stereo separation. Middle trace is separation with blend switch activated.

“Why did Kyocera engage in a game of ‘specsmanship’? The receiver is a good performer and has many excellent control features.”



Neat and knobless main control section of the R-851 concentrates tuning functions (including seven presets each for AM and FM) to the left, general audio functions at the right. Hinged lower flap conceals tone controls, speaker selector, MM/MC phono selector, and other miscellaneous controls.

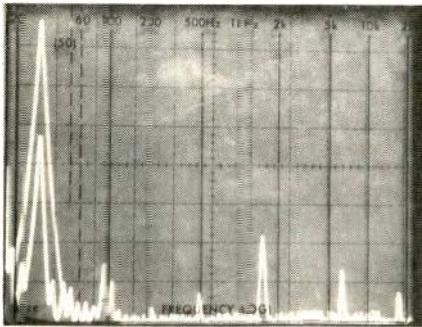


Fig. 4—FM stereo crosstalk components, 5-kHz modulating signal.

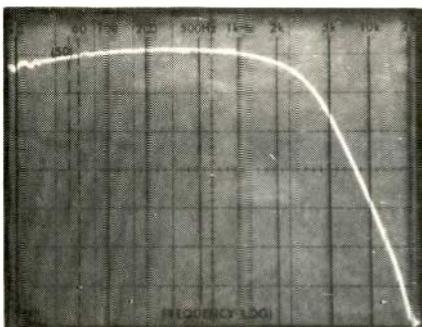


Fig. 5—AM frequency response.

The rear panel of the R-851 has only one connection terminal for an FM antenna transmission line, and it is of the coaxial, 75-ohm F-type. Kyocera supplies a 300/75-ohm transformer in its bag of accessories for those who want to connect 300-ohm, twin-lead transmission lines to the receiver. AM “hot” and “ground” antenna terminals are also found on the rear panel, as are the usual array of input and tape output jacks, a turntable ground terminal, polarized spring-loaded speaker terminals, a rotatable AM loopstick antenna,

and three convenience a.c. outlets (one switched, two unswitched).

FM Measurements

Usable FM sensitivity in mono measured 12.0 dBf (2.2 μ V across 300 ohms). Stereo usable sensitivity measured 20 dBf (5.5 μ V across 300 ohms). Fifty-dB quieting required a signal level of 20 dBf in mono; the figure of 39 dBf for stereo is not particularly outstanding but nevertheless acceptable. With the standard “strong signal” level of 65 dBf applied to the antenna terminals, signal-to-noise ratio in mono leveled off at 73 dB, while in stereo, the best S/N obtainable was 70 dB for the same or greater signal strengths. Using a 1-kHz modulating signal, total harmonic distortion decreased to a low of 0.055% with strong signals in mono and 0.09% in stereo. These are both excellent figures, even though the stereo result falls short of Kyocera’s claimed 0.07%. Quieting and mid-frequency distortion characteristics are plotted as functions of incoming signal strength in Fig. 1. Figure 2 is a graphic plot of THD versus modulating frequency for the FM tuner section of this receiver, operated in both the mono and stereo modes. In mono, THD measured 0.045% at 100 Hz and 0.07% at 6 kHz. In stereo, harmonic distortion was 0.09% at 100 Hz and 0.2% at 6 kHz.

Figure 3 is a ‘scope photo of a spectrum analysis sweep from 20 Hz to 20 kHz, with the upper trace representing the frequency response at the output of the modulated left channel and the lower trace showing the crosstalk or separation as measured at the output of the unmodulated channel. The middle trace shows what happens to separation when the blend switch is activated, as it might be used to reduce background noise during reception of weak stereo signals. I measured a mid-frequency separation of between 45 and 47 dB (depending upon which channel was measured), far short of the 58 dB claimed by Kyocera, but certainly more than adequate for “real-world” stereo FM reception. For a modulating frequency of 100 Hz, the separation was 48 dB; it dropped to 27 dB at 10 kHz.

Figure 4 shows what happened when I applied a 5-kHz

“The amplifier never got down to its rated distortion. But at 85 watts per channel, THD was only 0.03% at 1 kHz.”

signal to the left-channel input of the FM generator at 100% modulation level. The tall spike at the left denotes the desired output signal. A second linear sweep (from 0 Hz to 50 kHz) was then made with the analyzer input connected to the output of the unmodulated (opposite) channel. The short spike nestled inside the taller one shows the relative level of the 5-kHz crosstalk appearing in the unmodulated channel. Other components at higher frequencies (to the right) represent levels of harmonic distortion, subcarrier and crosstalk products in the output of the unmodulated channel.

Capture ratio measured 1.5 dB. Alternate channel selectivity measured 85 dB in the narrow position, dropping to around 45 dB in the normal i.f. bandwidth setting, as might be expected. I.f., image and spurious rejection were all between 95 and 100 dB. Though not specified by Kyocera, AM suppression measured a satisfactory 55 dB. Figure 5 is a plot of frequency response for the AM tuner section.

Power Amplifier and Preampifier Measurements

The power amplifier section of the Kyocera R-851 was able to deliver nearly 100 watts per channel before there was any evidence of real clipping. However, at lower power levels (including its rated level of 85 watts per channel driving 8-ohm loads) the total harmonic distortion level never got down as far as the 0.015% specified (FTC take note!). So, based on the FTC rule, I guess I'd have to say (facetiously, of course) that the amplifier is incapable of delivering any power at its rated distortion. But seriously, folks, at 85 watts output per channel, THD measured only 0.03% for a 1-kHz signal, 0.045% at 20 Hz, and 0.08% at 20 kHz. The SMPTE-IM distortion for that same output level was only 0.03% (but not 0.015% as claimed). These results are plotted as continuous power output versus distortion levels in Fig. 6. The CCIF-IM distortion measured 0.03%, while IHF IM, calculated from the spectrum analysis sweep of a two-tone input signal in Fig. 7, worked out to be 0.17%. All of these results are perfectly respectable and are not likely to introduce audible artifacts when listening to music.

Damping factor was approximately 50, as claimed, measured at 50 Hz and with 8-ohm loads. (Kyocera quotes damping factor for 1 kHz, 8 ohms.) Dynamic headroom was approximately 1.0 dB.

The combination of bass, treble, and midrange tone controls, all with variable turnover, makes for an extremely flexible tone control system. Kyocera refers to this control group as a parametric equalizer. I wouldn't go quite that far (parametric equalizers can usually vary the "Q" of their filter bands, as well as center frequencies and amplitude), but I will admit that it comes pretty close.

Figure 8 plots the maximum boost and cut characteristics of the bass and treble tone controls found on the R-851. One set of curves was taken with the variable turnover controls associated with each tone control turned fully clockwise, and the other set was taken with the variable turnover knobs rotated fully in the opposite direction. So as not to make the display too confusing, the action of the midrange control and its associated variable turnover control is plotted separately in Fig. 9. Figure 10 shows the action of the loudness compensation control as the volume control setting is lowered in steps of approximately 10 dB.

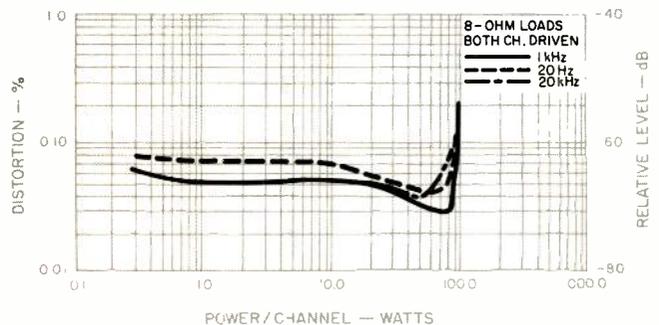


Fig. 6—Distortion vs. power output per channel, at three frequencies.

Fig. 7—Spectrum analysis of IHF-IM components, using 9- and 10-kHz twin-tone test signal.

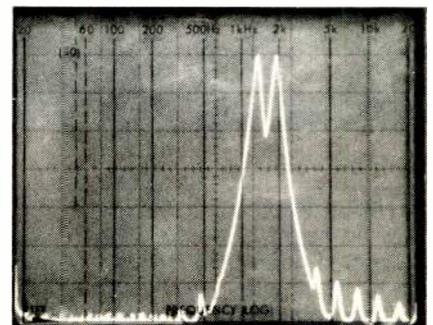
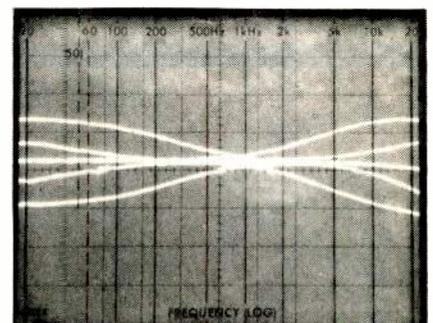


Fig. 8—Range of variable-turnover bass and treble tone controls.



Input sensitivities and signal-to-noise ratios for the various high- and low-level inputs of this receiver were all measured relative to the new IHF reference levels and will therefore not agree with Kyocera's published figures. (I wonder when some of these manufacturers are going to start realizing that most of us don't listen to our systems at rated output, and that therefore signal-to-noise ratios referred to rated output are meaningless.) In any event, I measured input sensitivities (for 1-watt output) of 0.29 mV and 14.5 μ V for the MM

"Once I got over those inflated published specs, I found the R-851 very well designed, ergonomically and in actual, audible performance."

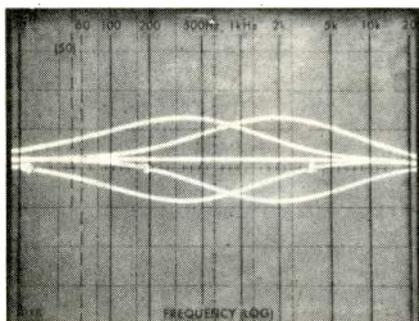


Fig. 9—Range of variable-turnover midrange tone control.

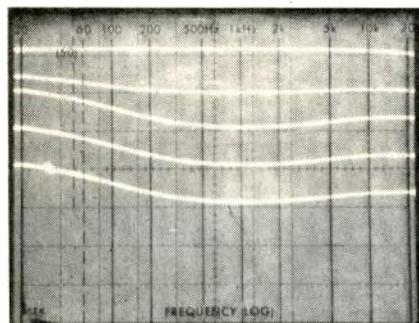


Fig. 10—Loudness compensation at various settings of master volume control.

and MC phono inputs, respectively. High-level input sensitivity measured 17 mV for 1-watt output.

Signal-to-noise ratio for the MM phono input, referred to a 5-mV input and a 1-watt output, measured 79 dB. For the MC phono input, referred to 0.5-mV input, S/N was 77 dB; for the high-level inputs, referred to 0.5-V input, it was 81 dB. All S/N measurements are A-weighted.

Frequency response for the high-level inputs was flat within 1 dB from 9 Hz to 35 kHz and within 3 dB from 5 Hz to

65 kHz. RIAA equalization was accurate to within 0.2 dB from 30 Hz to 15 kHz. MM phono overload measured 150 mV (as against 200 mV claimed), but, surprisingly, MC phono overload was 20 mV (as against only 10 mV claimed by Kyocera). The -3 dB cutoff points for the subsonic and high filters were at 20 Hz and 9 kHz respectively.

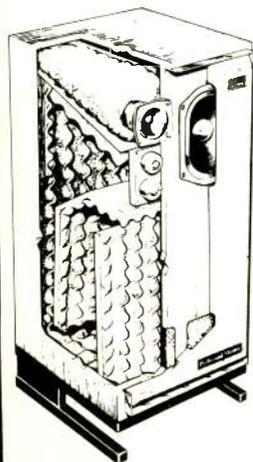
Use and Listening Tests

Once I got over my resentment of the inflated published specifications, I found the Kyocera R-851 to be a very well-designed receiver, both in terms of ergonomics and its actual audible performance. Tuning of both AM and FM stations was totally accurate and drift-free, as you would expect from a frequency-synthesized system. The indicator lights on the exposed part of the front panel serve as helpful reminders of the status of the most often used switches without looking like a neon storefront. With all rotary control knobs recessed and hidden behind the hinged door, the front panel of the R-851 is extremely elegant looking, with no protrusions whatsoever to break up its clean lines.

Using medium-efficiency KEF 105.2 reference speakers, the 85-plus watts per channel available from this receiver proved equal to the task of reproducing several compact digital discs at adequate loudness levels. Sound was very clean, and I am discovering that the use of digital software (either PCM tapes or CD discs) is a great way to zero in on whatever sonic deficiencies a given piece of electronic equipment may try to hide behind noisier, more-distorted analog-program sources.

The extra gain provided by the MC phono input was more than enough to work with several moving-coil cartridges in my pickup collection. Surprisingly, hum and noise using the MC pre-preamp facility were barely more than was heard in the MM phono mode.

The suggested retail price for this receiver does not seem out of line in terms of its power output capabilities, control features, and general performance level. If you like its layout, ignore the spec sheet and enjoy! *Leonard Feldman*



IMF Electronics Professional Monitor Loudspeaker

The Compact "Digital Audio Disc" has finally become a commercial reality, and there is general agreement among engineers that the wide dynamic range, ultra-low frequency response, and high power-handling requirements of the CD discs will seriously challenge the performance capabilities of most loudspeakers.

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**Quoted from Stereo Review Magazine - March 1983 - Julian D. Hirsch.*



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POSTSCRIPT: HITACHI DA-1000 DIGITAL AUDIO DISC PLAYER

Manufacturer's Specifications*

S/N Ratio: More than 90 dB.

Channel Separation: More than 60 dB.

Distortion: 0.03%.

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

For literature, circle No. 94

*For complete list of specifications, see January 1983 issue, page 50.



In the "Equipment Profile" of Hitachi's Model DA-1000 CD player, which appeared in the January 1983 issue of *Audio*, all of the distortion, separation and S/N measurements reported were considerably poorer than claimed by the manufacturer. Both the Editor and I suspected that we might have been testing a less-than-perfect unit. In addition, I noted that some of the programming features were erratic. Since then, I have had an opportunity to check a second unit, one supplied by Hitachi. All mechanical features and programming worked as specified on this second player, and measurements of distortion and separation confirmed our earlier suspicions regarding the first unit. The following table shows a direct comparison between the first set of measurements and those obtained on the second, properly operating DA-1000 player.

Leonard Feldman

Specification	First Unit	Second Unit
Harmonic Distortion, 0 dB		
100 Hz	0.10%	0.0047%
200 Hz	0.12%	0.0050%
500 Hz	0.10%	0.0034%
1 kHz	0.10%	0.0037%
5 kHz	0.15%	0.0047%
7 kHz	0.16%	0.0060%
10 kHz	0.16%	0.0060%
16 kHz	0.18%	0.0080%
18 kHz	0.185%	0.0088%
20 kHz	0.230%	0.0110%
THD at -10 dB, 1 kHz	0.10%	0.0140%
SMPTE-IM Distortion		
At 0 dB	0.06%	0.0034%
At -10 dB	0.16%	0.0320%
Separation (L to R/R to L)		
100 Hz	80.0/81.0 dB	89.0/89.0 dB
1 kHz	80.0/82.0 dB	90.0/89.0 dB
10 kHz	78.0/78.0 dB	88.0/89.0 dB
20 kHz	72.0/73.0 dB	87.0/91.0 dB
Signal-to-Noise, A weighted	87.0 dB	98.5 dB

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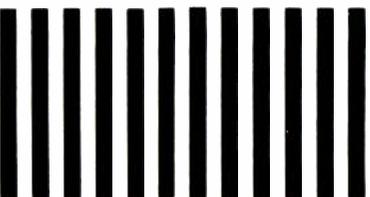
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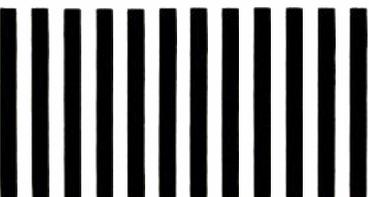
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CONSTRUCTOR'S CLASSIC

21 Custom Speaker Enclosure Projects You Can Build by David B. Weems. TAB Books, No. 1234, \$7.95, paperback.

When you talk about home construction of hi-fi equipment, it's essential at the start to make a distinction between kits and genuine home-brewed, built-out-of-available-parts projects. By and large, these days, kits are just knock-down versions of commercially competitive assembled designs—developed through the same rigorous engineering processes used to design the best off-the-shelf assembled hi-fi components, complete with the benefit of anechoic chambers, computers, and thousands of man-hours of hard-nosed planning. True home-brew builders, by contrast, usually operate on the basis of a few basic formulas, a good pair of ears, and a lot of intuition, looking for some alchemical combination of elements that might magically yield better results than the big boys obtain. Most know in the back of their minds that it isn't likely this magic combination will actually turn up. The satisfaction of such projects comes from a genuine joy in the process of construction—a visceral affection for the smell of cut wood, solder, and printed-circuit etching solution. Home-brew hi-fi, to put it plainly, is often more fun per dollar than superb value per dollar.

David Weems, the author of this book, recognizes this fact, and his writing reflects a warmly informal, joy-in-the-workshop sensibility that most speaker-builders will find very congenial. Weems isn't out to teach anyone how to beat Acoustic Research or JBL at their own game. Rather, he sees his role as a provider of basic information and a group of basic designs that the hobbyist constructor can adapt to personal tastes.

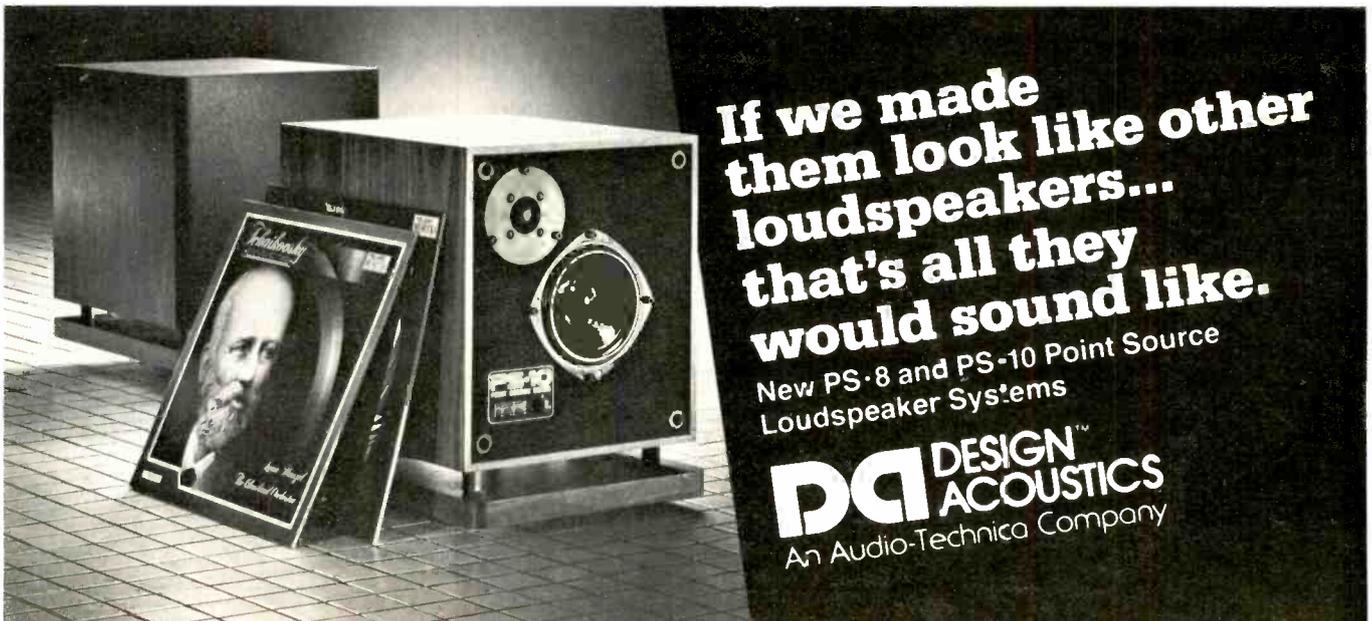
Everything you need to know to get a speaker system running is here. There is extensive discussion of the kinds of woodworking and cabinet-making involved in constructing and finishing speaker boxes, a useful but not overly complex chapter on wiring and crossovers (with just enough electronic theory to make it interesting), and a lot of incidental information on everything from which glues stick on what surfaces to basic soldering techniques. The bulk of the book, though, is taken up with construction notes for every conceivable variety of speaker type—rotund omnidirectionals; out-sized floor-standing systems; tiny, miniature-cube speakers; car and van units with brackets, and many more. All are described in sufficient detail for a careful novice to assemble them, but there is also a wealth of data on refining, customizing, and otherwise fooling around with these designs. Weems

also includes a brief application guide, intended to assist the inexperienced reader in picking a trial speaker project, and an appendix that lists sources for the materials discussed in the book. All in all, a fine do-it-yourself manual.
Gary Stock

The Complete Handbook of Magnetic Recording by Finn Jorgensen. TAB Books, 448 pp., \$10.95.

This volume is classified as a "First Edition," although there was a book by the same author published about 10 years ago with a very similar title. In any event, it must be said that this recent opus has much more information and twice as many pages. The first two chapters briefly cover the history of magnetic recording, from lodestone to VCR, and offer a fast look at different types of recording equipment and some basic characteristics. Several facets are brushed across too lightly to meet the requirements of a true handbook: For example, there are no track format dimensions.

Two chapters on the physics of magnetism and technical magnetization provide much basic information. The author strikes an excellent balance between lucid exposition and technical detail. The two chapters following, also of medium length, deal with recording and playback theory.



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The chapter on magnetic heads is a major portion of the book, 94 pages in length. There is a great deal of information here, with sections on characteristics, materials, recording, playback and erase heads, manufacture, design, testing and other subjects. The next chapter is on magnetic tapes and discs. It is exactly half the length, but covers particles of various types, manufacturing, mechanical and electromagnetic properties, and tape selection. I would have preferred in-depth discussion of tape properties and testing methods, but that is a personal desire.

Two lengthy chapters (75 pages each) on direct recording and recording with a.c. bias cover a broad range of topics. The printing for digital codes in a table was quite faint, making comparisons rather difficult. There is a good presentation on linearity and distortion with high-frequency bias, along with other important material. The section on tape drives seemed out of place, but it was worthwhile including it in the book. There are brief chapters on data analysis, FM and PCM recording, making recordings and maintenance. The limited coverage in the latter pair is more than obvious.

There is an appendix of symbols, a list for additional reading, and an index which is fairly good, but would benefit from more listings to match the detail of the text. There are many illustrations, most of which are simple, but the line drawings were very well done. Although this volume is not "complete" in the sense of having detailed coverage on all facets of magnetic recording, it provides much useful information on many topics.

Howard A. Roberson

How to Install Your Own Stereo System, Second Edition by Jeff Markell. TAB Books, 192 pp., \$6.95.

The first edition of this book was published 20 years ago, and this new version shows a general improvement and updating in the text and illustra-

tions. The original text was largely directed to those making installations for customers, but here there is more emphasis for the do-it-yourself type, with regular hints "from the installer's point of view." The first chapter briefly discusses high-fidelity systems. The next, on needs and preferences for appearance and aesthetics, includes suggestions about planning for possible modifications in the future. Then, a 12-page discussion on components sets the equipment stage, albeit with a few questionable generalities: Bigger speakers are "better." The following three chapters, on interconnections, environmental effects, and noise and interference, contain quite a bit of practical information in relatively few pages. Some exception is taken, however, to the statement that speaker wiring selection is not critical in any way.

The two chapters on acoustic factors and associated problems make a number of very good points, so it is difficult to fault the author for stating that standing waves are more likely in large rooms than in small rooms—maybe he meant echoes. There are good sections on absorptive materials and how they can be applied. Two chapters deal with visual appeal and the elements of style (lines, shapes, forms, proportion and color), with guidelines to achieving aesthetic effects with room layout, system location and speaker position.

The book contains 35 pages on the construction of free-standing and built-in cabinets and the installation of equipment in them. This is not a collection of patterns for specific cabinets. More importantly, there is coverage of such basics as properties of wood, hardware and fitting components. The last two chapters discuss the characteristics of different types of building construction (wood-frame, masonry, etc.) and the installation of wiring. The index is only one page, which is quite limiting, but the table of contents is somewhat detailed. There are quite a few typographical errors, but they were only minor distractions from the generally good text and illustrations. The book contains much good information, and it is recommended to anyone who is contemplating an installation.

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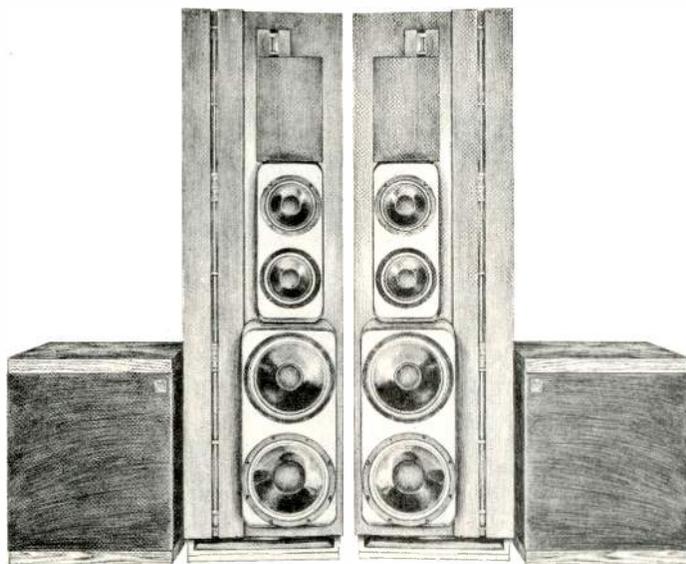
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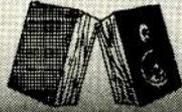
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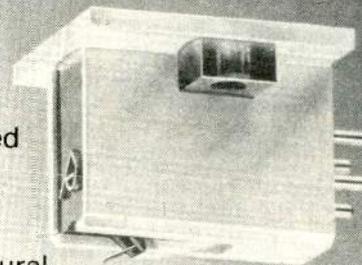
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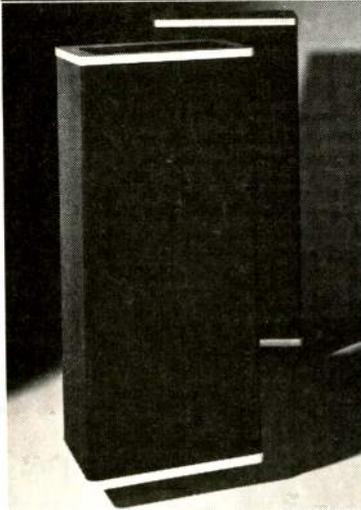
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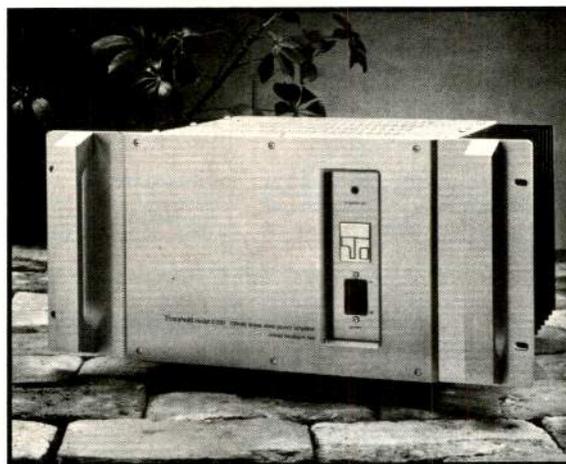
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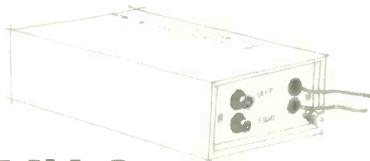
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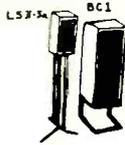
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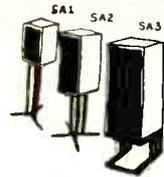
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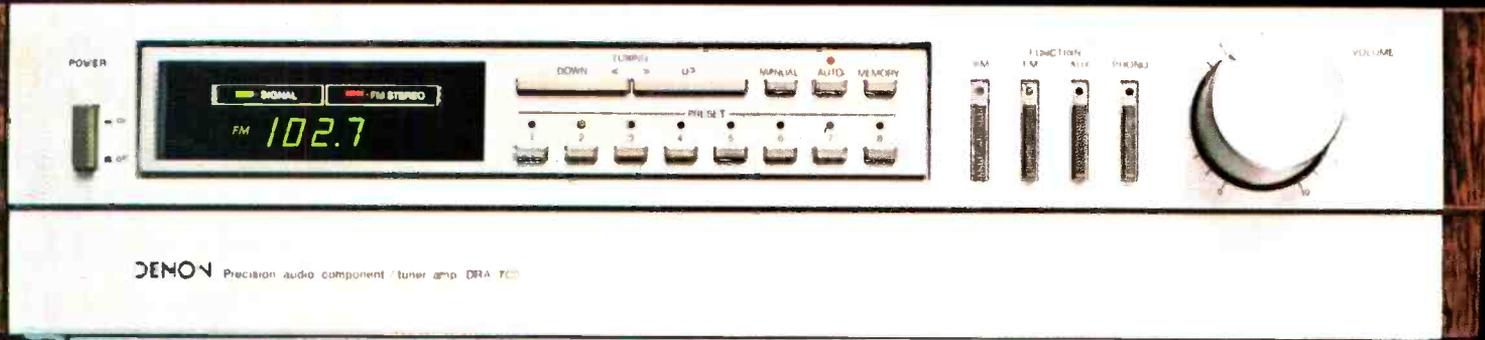
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