The Authoritative Magazine About High Fidelity

Audio

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BEST TURNTABLE EVER?

SONY PCM-F1-RECORDINGS AS GOOD AS A DIGITAL DISC?

HOW PHONO CARTRIDGES WORK

SONIC HOLOGRAPHY TEST DISC INSIDE!

REVIEWS-
DENON DR-330 CASSETTE DECK
SONUS DIMENSION 5 CARTRIDGE

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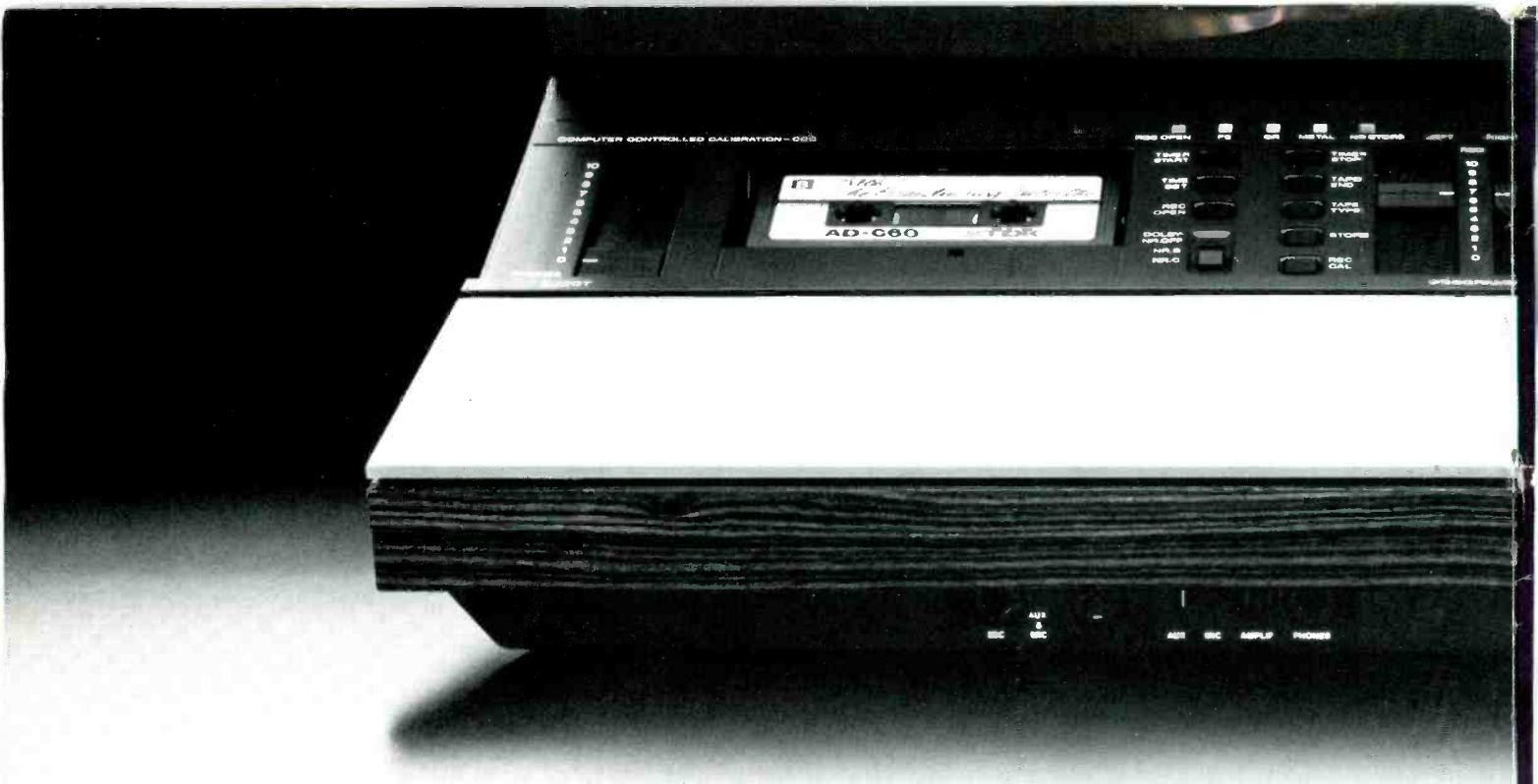

THE BEOCORD 9000. MOST TECHNICALLY ADVANCED

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Ever since their invention in the mid 60's, cassette decks have held out the promise of quality sound reproduction, combined with true convenience.

Convenience has been achieved, to one degree or another.

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Until now.

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In 1978, Bang & Olufsen began exploring technologies which could complement noise reduction systems by offering significant headroom expansion.

The result of these explorations is Bang & Olufsen HX Professional (not to be confused with Dolby HX**), pioneered by Bang & Olufsen of Denmark and perfected in collaboration with Dolby Laboratories.

Utilizing an automatically regulated variable bias oscillator to compensate for the bias effects of high frequency signals, Bang & Olufsen HX Professional offers the discriminating audiophile a cassette deck that, for the first time, truly achieves disc-quality sound reproduction.

Overall dynamic range is increased by up to 10 dB. Definition of bass frequencies is audibly superior. Frequency response with any type of tape is ±1.5 dB from 20 to 20,000 Hz, with a S/N ratio of up to 80 dB. The ability of any kind of tape to record and play back higher levels of mid-range and high frequency signals is increased significantly.

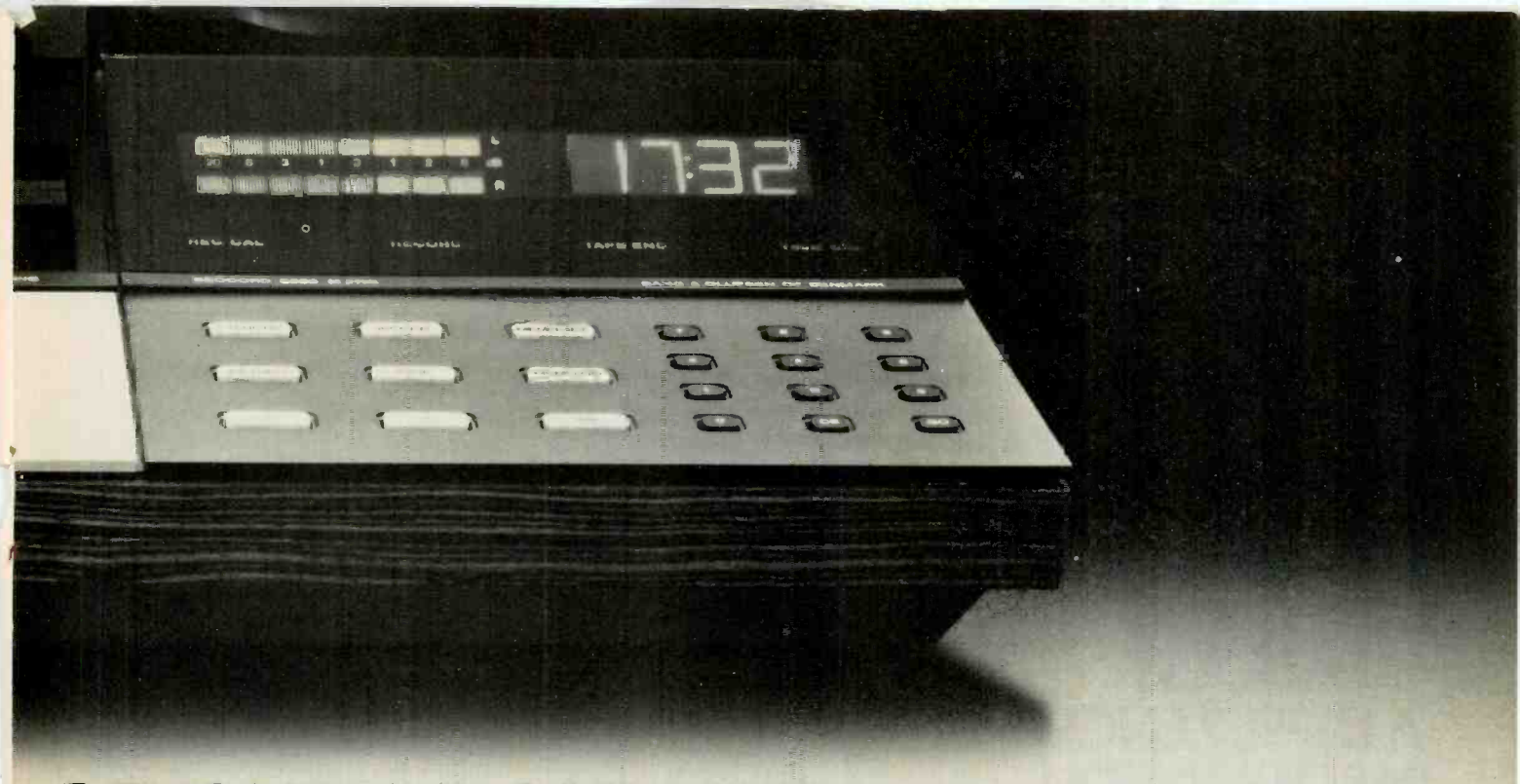
Bang & Olufsen HX Professional operates independently on each channel, allowing optimum compensation for the particular signal content of each channel. And since Bang & Olufsen HX Professional is not an encoding system, tapes recorded on it will sound better, even when played on other cassette decks.

OPTIMUM CALIBRATION, FOR EVERY INDIVIDUAL TAPE. IN JUST 9 SECONDS.

The second major advance that is unique in the Beocord 9000 is a computerized tape calibration system that performs all tape calibration functions, completely automatically, in just 9 seconds.

You simply insert a cassette, and push the Tape Calibration button. The Beocord 9000 proceeds to record a test tone on the

*HX Professional is exclusively available on the Beocord 9000 and Beocord 8002 cassette recorders. **TM Dolby Labs, Inc.



BEYOND A DOUBT THE CASSETTE DECK IN THE WORLD.

cassette, and sets the appropriate bias, sensitivity, and equalization. It also actually reads the tape itself to determine what type it is and indicates the tape type via LED.

In the calibration process, the Beocord 9000 also measures distortion and sets its recording levels and meters according to the characteristics of the particular tape you are using. This exclusive Peak Program Meter function assures you of recordings free of audible distortion, with any tape you use. The specifications on types of cassettes you use frequently can be placed in memory and recalled instantly, making future calibration unnecessary.

IN EVERY OTHER RESPECT, MERELY STATE-OF-THE-ART.

There is not space here, to go into further detail on the many other capabilities of the Beocord 9000.

It of course includes Dolby B and C, and all of the functions, such as LED real-time tape counter with real-time tape remaining, random access programming, automatic return, and programmable timer, that you would expect in a state-of-the-art deck.

You will only find them unexpectedly simple to use.

WRITE FOR THE WORDS. AND THE MUSIC.

As much as we've said here, there is a great deal more to be said for the Beocord 9000.

And we've said it in a white paper which we will gladly send you, at no cost whatsoever. It will allow you to absorb, at your leisure, the remarkable capabilities of this unique machine.

We have also prepared a cassette of music recorded on the Beocord 9000. Played on any cassette deck of reasonable quality, it will allow you to immediately appreciate the accuracy of music recorded with Bang & Olufsen HX Professional. If you send us $3.00 to cover handling costs, we will send you the cassette, and the white paper. Please allow 4 to 6 weeks for delivery. Offer expires June 30, 1982. Please address requests to Dept. AM.

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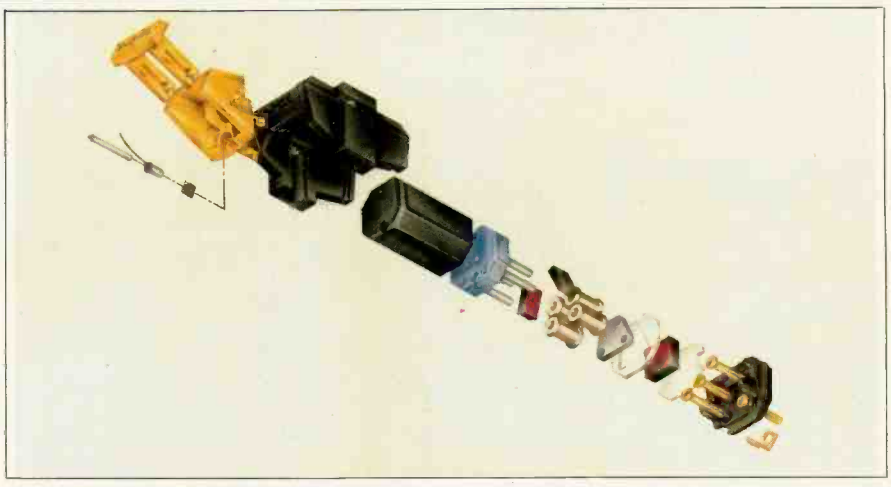
Audio MARCH 1982 VOL. 66, No. 3



FEATURE ARTICLES

EQUIPMENT PROFILES

RECORD REVIEWS

AUDIO IN GENERAL

ABC MPA

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TDK.
The Machine For Your Machine

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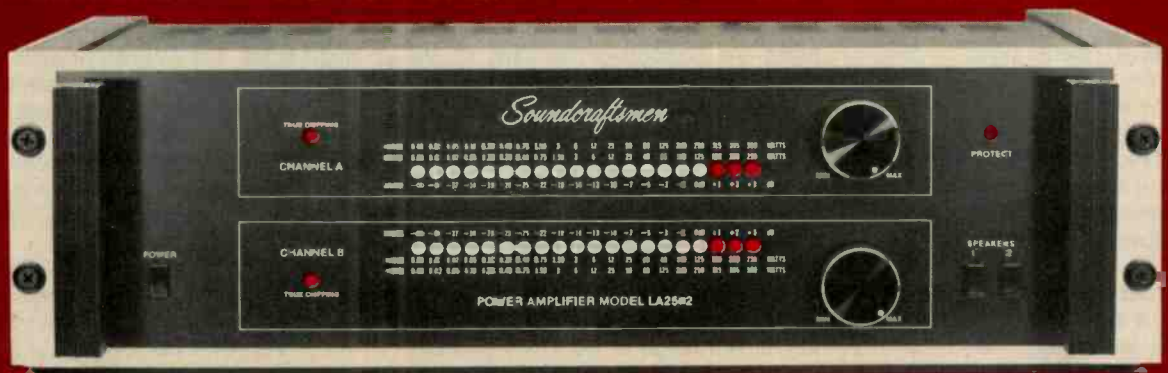

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VIDEO SCENES

BERT WHYTE

Akai has garnered a lot of attention with its Activision VP-7350 portable VHS videocassette recorder. It is a very versatile unit with some unique features, not the least of which is that stereo recording is possible and Dolby B noise reduction is incorporated in its audio circuitry. The VP-7350 is part of a system which includes the VU-7350 color TV tuner and, of major import, the VC-X1 auto-focus color video camera. This new camera may well signal the beginning of a new era in what we used to call home movies.

The VP-7350 VCR is fairly large for a portable recorder. Without the nickel-cadmium battery, the machine weighs in at a rather substantial 14.5 lbs., but a built-in handle helps to tote it around. The tape-motion controls are of the usual piano key mechanical type and are quite usable. In this particular unit, the play and record levers must be pressed simultaneously to initiate recording. The front panel of the VP-7350 is plentifully endowed with various controls. Among them are an audio monitor selector switch for the left and right channels of the stereo input with a mix position, normal- and double-speed tracking control, still/cue and slow control, Dolby NR switch, sound dub key, dew/battery/tape-run LED indicators, camera and earphone jacks, and microphone jacks for channels one and two of a stereo input. Another feature of the VP-7350 is a keyed lock, presumably to prevent unauthorized use of the unit. On the rear panel are inputs for external power, r.f. out jack, and two audio-out jacks for left and right channels of a stereo signal. A compartment on the top rear of the recorder houses the nickel-cadmium battery for portable powering; an accessory charger is available to keep the battery at the proper voltage level, and this VCR can also be powered from a car's cigarette lighter via a special adaptor.

The VC-X1 color video camera weighs 5.3 pounds, making it fairly easy to handle. It is a fascinating exercise in optical high technology. Needless to say, while we have had both still- and motion-picture cameras with automatic iris diaphragm control in years past, automatic focusing is a relatively new development. Here is a brief explanation of how the auto focusing feature of this camera works. On top of the camera lens housing are two "windows" which admit light to fixed mirrors and image-forming lenses. The light beam is then directed to opposite sides of a mirror prism. The prism reflects two images to a 240-segment charged coupled device which converts the light to electrical signals. The output of the CCD is monitored by a microprocessor which compares the difference between the signals, notes the position of the lens at the moment of signal address, and then activates the zoom lens motor to move the lens backward or forward to achieve an accurate constant focus. The VC-X1 uses a single ⅔-inch vidicon pickup tube with a 2-to-1 interlaced 525-line scanning system. Horizontal resolution is more than 270 lines, and the video signal-to-noise ratio is more than 46 dB. The camera has an automatic sensitivity adjustment range of 50 to 64,000 lux, providing a minimum practical illumination of more than 50 lux at a diaphragm opening of f1.4. The f1.4 zoom lens ranges from 11 mm wide angle to 70 mm telephoto. A two-speed motor activated by a switch on top of the camera permits easy forward or backward zooming, while a macro position on the lens allows focusing as close as two inches from the subject. Underneath a slide cover are special controls, including a white balance selector (automatic white balance is provided). An iris control is available to override the automatic diaphragm for greater or lesser light input, and fade-in and fade-out buttons can be used to provide professional visual and audio fades. The Normal/Reverse selector is, in essence, a reverse polarity control. While the instruction manual makes much of the so-called "creative" possibilities of this feature, its real value is that typical color film negatives can be converted to videotape positives with an adaptor.

The VC-X1 is equipped with an electronic viewfinder, which of course shows you the picture field in black and white. Within the viewfinder are various colored LEDs which either flash at varying rates or remain illuminated to indicate battery condition, fade in/fade out, VCR recording, normal or reverse polarity, and if there is sufficient light to record. On the auto focusing housing are controls for selection of manual, semi-automatic, and automatic focusing. The camera's

Photo: Susanne Buckler

Professional quality breaks the cassette barrier.

A true professional recorder must do more than deliver superb sound reproduction. It must do so *consistently*, hour after hour, year after year.

Now, for the first time, you can buy a cassette deck with long-term performance comparable to the finest reel-to-reel recorders. Not surprisingly, it's from Revox.

When you look inside a Revox B710, you'll see the difference immediately. First, the tape transport chassis is made from aluminum alloy die-castings (not plastic or imprecise metal stampings), with parts machined to the same critical tolerances as in our pro recorders. And second, the B710's dual capstan tape drive employs *two* servo-regulated Hall Effect motors, with two additional microcomputer-controlled motors for tape spooling. No belts, pulleys, or clutches will be found in the B710, because such compromises are not acceptable in a professional machine.

Granted, the B710 does offer a long list of convenience features. A precise 4-digit LED counter, for example. A 24-hour timer for programmable start and stop in record or play. Mic/line mixing. Automatic sensing of tape types. Automatic start-of-oxide cueing with counter reset to zero. And Dolby noise reduction.

But don't let the features or pretty face fool you. At heart, the B710 is a seasoned pro. Hear it today, along with our other superlative audio components from Switzerland and West Germany, at your Revox dealer. For more information, contact: Studer Revox America, 1425 Elm Hill Pike, Nashville, TN 37210; (615) 254-5651.

STUDER REVOX

Professional standards in audio components

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Akai's VP-7350 permits stereo recording and incorporates Dolby B noise reduction in its audio circuitry.

The Akai VP-7350 portable videocassette recorder.

built-in folding handle has a handy camera switch. When this switch is depressed, it activates recording in the VP-7350 VCR; pressing the switch again will stop recording.

On the right-hand side of the camera is a built-in cardioid microphone mounted on an extendable boom of about 8 inches, while a jack for an external microphone is located on the camera's bottom left side. On top of the camera housing is an accessory shoe designed to accept the ACM-11V one-point stereo mike. This is apparently a pair of cardioid microphones in a 90° pattern, affording a sort of coincident pair stereo pickup. Unfortunately, this is a rather new item and was not furnished to me. I did some stereo recording via the two input jacks on the VCR using a pair of Crown PZM mikes.

In use, the camera viewfinder was bright and sharp with good contrast, and the motor-driven zoom lens worked quite smoothly. With the automatic diaphragm and auto focusing, operating the camera became as simple as the old aim-and-shoot techniques of the Brownie Cine Kodak of yore. The video recordings made with the camera and played back through the VP-7350 VCR were of excellent quality with good resolution, brightness ratio, and contrast. Colors were quite pure and well saturated, and black-and-white images were very clean. The sound from the built-in microphone with or without Dolby noise reduction was fairly wide range and clear. However, it must be said that even with Dolby noise reduction, I could still detect some residual tape hiss. The same could be said of the stereo recording, although directional effects were well maintained. As I noted some months ago, Akai intends to make prerecorded videocassettes available with stereo sound, but I have not heard any as yet. In all, the combination of the VP-7350 and VC-X1 proved to be of excellent quality and is apparently quite reliable.

A few caveats are in order, however. In spite of the fact that the extendable microphone is of the cardioid pattern, the whine of the zoom lens motors was picked up and heard on playback. With the camera in the automatic focusing mode, as the system worked to establish and then maintain focus, I heard a low-frequency "clicking" noise which unfortunately also appeared during playback. Of course, it is entirely possible that the auto focusing system needed adjustment. What is happening is that the device is "hunting" in an attempt to maintain focus, and you can see this in the viewfinder. At times this process is quite rapid and therefore imposes many of the clicks on the sound. It is possible to establish a focus so that the "hunting" can be avoided by using the semi-automatic function of the focusing device, although any panning or changing of focal distances with subject movement will upset the initial focus. On playback of the VCR recordings, some scenes were slightly out of focus, but for the most part the auto focusing mechanism did a far better job than one is likely to obtain from manual focusing. Of course, depth of field is also working, even with the auto focusing in operation, and this helps to obtain a consistently sharp picture.

The suggested retail price of the VC-X1 camera is $1295.00, with $1695.00 the price for the VP-7350 portable videocassette recorder and VU-7350 tuner/timer. Summing up, in general these units offer a winning combination, but some attention should be paid by Akai to the elimination of the zoom and auto focus motor noise imposed on the recordings.

Bob Carver explains (briefly) how the Magnetic Field Amplifier works. (Others tell how it sounds.)

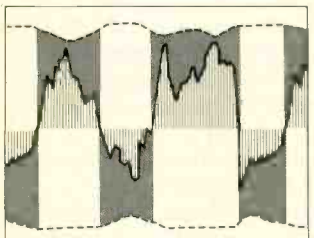
Q. How is it possible for an amplifier as small and as light as the M-400 to deliver so much power and to cost so little?

A. The M-400's size (less than 7 inches) and weight (less than 10 pounds) reflect the advanced technology and the new patented designs used in both its power supply and amplifying stages—and the innovative relationship between them. (Not to mention the incredibly low price that resulted: $399.)

Q. What is different about the M-400's power supply and amplifying stages?

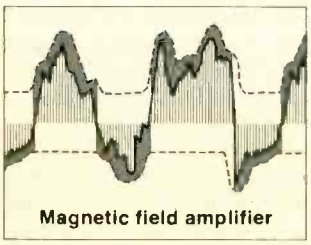
A. In any amplifier, the power supply produces and stores energy for use by the amplifying circuits.

Conventional amplifier power supplies are very inefficient because they produce a constant high voltage level at all times—irrespective of the demands of the ever-changing audio signal—and even when there's no audio in the circuit at all!



Conventional power amplifier

Solid line: audio output signal
Broken line: power supply voltage
Shaded area: wasted power
Vertical lines: power to speakers



Magnetic field amplifier

This inefficient approach demands large and expensive power transformers and electrolytic capacitors. Large heat sinks are also needed to get rid of the heat associated with the constant high voltage of conventional power supplies.

In sharp contrast, the M-400's "smart" power supply produces only the power that the amplifier section needs from moment to moment to handle the signal accurately. In effect, the M-400's power supply is *signal*-responsive. As a result, overall efficiency is extraordinarily high.

Q. Do I really need 200 watts per channel?

A. Yes! If you want to hear music reproduced with full realistic impact and dynamic range, the musical peaks must be handled without compression, clipping or overload.

You'll be amazed at the improvement in openness and clarity when your system is able to deliver the power that music really requires.

When full digital audio arrives, dynamic-range capability will be even more significant. And the M-400's power will be even more necessary—with its ability to deliver 500 watts in mono, 900 watts for brief time periods, and more than 1200 watts on peaks!

Q. Now I understand why the M-400's power capability will improve my system, but can my speakers take it?

A. Speakers with a power rating of 50 watts or so will have no problem with the M-400. That's because speakers are not generally blown out by high, clean power, but rather by low-powered amplifiers pushed beyond their overload points. These low-powered amplifiers "clip", generating speaker-damaging transients.

In addition to providing better sound and sufficient power, the M-400 has special protective circuits that guard both itself *and* your loudspeakers from almost any conceivable damaging circumstance. These include long and short-term overload, sudden overdrive signals (such as from dropped styli), shorted speaker leads, etc.

M-400 Magnetic Field Amplifier 201 watts minimum continuous power per channel (500 watts mono) into 8 ohms, 20 Hz to 20 kHz, with no more than 0.05% total harmonic distortion.

All this protection operates via the signal-controlled power supply circuits, not the amplifier stages, so there's absolutely no chance of the typical distortions caused by conventional protection circuits.

Q. Aside from the technical innovations in its design, how does the M-400 sound when it comes to music?

A. My design goal was to make it sound musically accurate, and I'm proud to say that it does. More convincing perhaps, others confirm this. Leonard Feldman in *Audio* reported: "Music reproduction was superb and completely free of any false bass coloration or muddiness. The amplifier handled the toughest transients we were able to feed to it with ease...there was none of the brittle quality that one often detects from amplifiers that are beginning to strain."

Julian Hirsch reported in *Stereo Review* that "...Its distortion and noise levels are entirely negligible... hardly conceivable that a small, inexpensive, lightweight cube such as this could deliver as much clean power as any but a few of the largest conventional amplifiers on the market—but it does."

Q. Is the M-400 limited to systems with separate amplifiers?

A. No. The M-400 can be used in many different types of systems, including those with receivers and integrated amplifiers. With our new Z-coupler device, you can upgrade your existing low-power system into a superb 200 watts-per-channel system. What's more, the M-400 is easily connected without accessories to put out 500 watts mono!

Q. How can I get more information?

A. Easily. For literature, test reports and the address of your nearest Carver dealer, circle the number below. For faster response, write to us directly.

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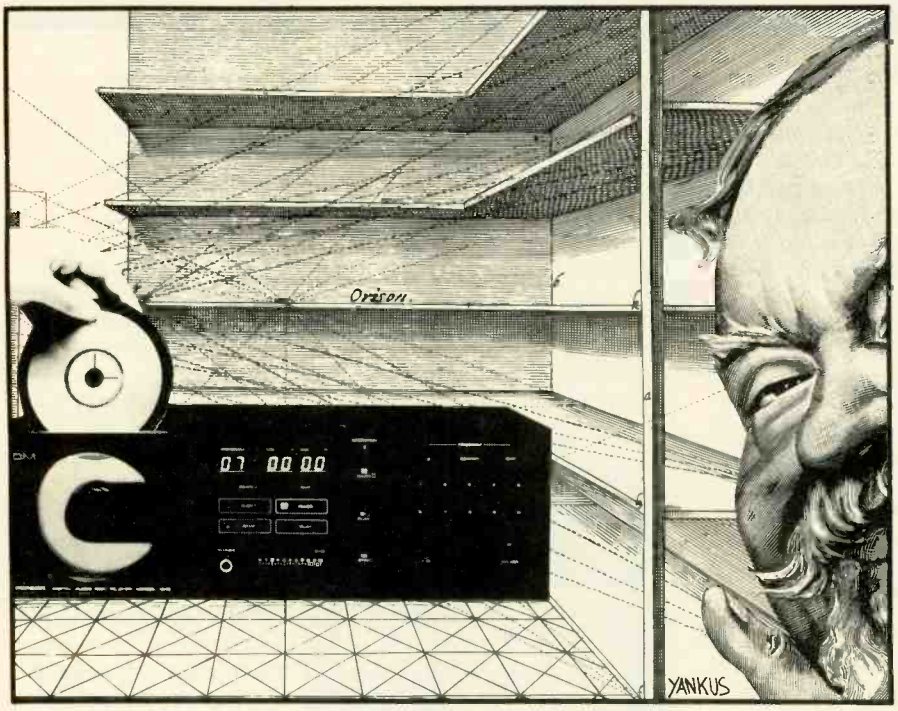
BEHIND THE SCENES

BERT WHYTE



As noted last month in the first part of my report on the 70th AES Convention in New York, the resolution to establish digital recording standards means that digital recording has finally come of age. The introduction of new digital recording equipment into the professional marketplace had been proceeding at a moderate rate, with a certain amount of timidity evident in some manufacturers' attitudes towards digital technology. Now, with the imminent establishment of digital recording standards, the "digital derby" will be off and running. Apparently, there were quite a number of manufacturers who anticipated the standards, for there certainly was much new digital equipment on display. I reported on several items last month, and herewith a rundown on more new digital devices.

Not all the digital equipment was in the form of recorders. Sony drew large crowds with a demonstration of their CD (compact disc) DAD (digital audio disc) player, which was jointly developed with Philips. The device has been demonstrated before, but this time it appears to be close to being a production prototype. The laser tracking is via a solid-state laser diode, and the digital-to-analog circuits are apparently in the form of a Sony-developed LSI chip. Although the music played during the demo wasn't my cup of tea, it was obviously very clean and of wide frequency range, albeit not the kind which would show the 90 dB dynamic range of which the CD disc is capable.

The CD system is slated for introduction in Japan this fall, but the present economic situation in the audio industry might just hurry things along a bit. Polygram is supposed to have a CD software plant in West Germany ready for production by June, and Sony says that the LSI chip production is proceeding ahead of schedule. Thus, an earlier introduction of the CD system isn't out of the question, especially since Polygram (and supposedly CBS/Sony) would have "blades for the razors!"

Not to be outdone, Pioneer also showed a prototype CD digital audio disc player. Pioneer had previously developed a proprietary laser-scanned digital audio disc system but decided to become a licensee for the Sony/Philips CD system. Their player loads the 4.7-inch diameter digital disc in a "disc well" on the front panel, somewhat in the manner of a front-loading cassette deck. A semiconductor laser is used to track the CD disc, rather than the larger gas laser Pioneer uses in their video LaserDisc player. According to Pioneer, the CD player has extraordinary random-search capabilities and can be ordered to search out any program selection in three ways: By program number, by elapsed playing time from the start of the disc, or by elapsed playing time in a given musical selection. Even such a complex search function as, for example, ordering the player to commence play at 2 minutes 10 seconds into the third selection of the disc takes only a few seconds to accomplish. All commands are visually confirmed via the player's front-panel program and time displays.

Technics was on hand with some very practical new digital devices. They feel, and rightly so, that fancy digital recorders shouldn't have to accept analog signals from such things as mixers, equalizers, and reverb units. Thus, they introduced their Digital Audio Mixer/Equalizer and Digital Audio Reverberator with memory. The mixer/equalizer handles digital signals with eight inputs and two outputs. (There also are two analog outputs for monitoring.) Full panning and level adjustment are provided as well as facilities for special effects via AUX output terminals. The fully digital equalizer uses recursive-type digital filters to allow high-speed real-time data processing of complex digital filtering operations. Linearity is maintained with an internal 35-bit capacity — more than twice the usual 16-bit signal to be processed. The equalizer affords high- and low-frequency roll-off and shelving, as well as midrange cut and boost. Quantization is 16-bit linear, and while the sampling rate on the device is currently at 50.4 kHz, you can be sure it will be changed to the new proposed 48-kHz standard.

The Technics Digital Reverberator has two digital input and two digital output channels. Initial delay times range from 0 to 155 milliseconds, while reverberation covers 0 to 10 seconds. Quantization is also 16-bit linear with a 50.4-kHz sampling rate at present. Low, high and midrange reverberation can be applied separately to simulate the absorption and reflection characteristics of particular acoustic environments. The device is equipped with three programmable memories, each of which can store four kinds of data: Initial reflections and later reflections in low, mid and high range. The memories are nonvolatile,

Illustration: Marc Yankus

MAGNIFICENT OBSESSION.

In our zeal to build superb tape recording equipment in the extreme, we at Teac are sometimes driven to steal. From ourselves.

The extraordinary X-1000R illustrates this very well. In it, we have incorporated professional features originally designed for our TASCAM recording studio equipment.

These include a linear LED counter which measures tape in hours, minutes, and seconds. A Search To Cue (STC) and Search To Zero (STZ) capability. In addition, there's Auto Reverse in both directions, in play or record.

The X-1000R, as is current professional practice, employs DBX* noise reduction. An exclusive in home reel-to-reel. And also, as in professional recording equipment, full-tension servos guarantee high stability and accuracy. And low wow and flutter specs of just .03% @ 7½ IPS.

All of which add up to an impressive collection of features, we think you'll agree. And if we happened to borrow a lot of them from our professional designs, well that shouldn't bother you one bit.

TEAC® MADE IN JAPAN BY FANATICS.

With the imminent establishment of digital recording standards, the "digital derby" will be off and running.

which means you won't lose them during a power failure, and settings can be held for subsequent mix-down sessions. The system features very natural reverberant generation, without the colorations characteristic of plates, springs, etc. A remote control is available.

The Studer company has been quite active in digital equipment. While their multitrack digital recorder won't be introduced until the 71st AES Convention in Montreux, Switzerland, they did show their interesting new Digital Sampling Frequency Converter (SFC-16) in New York. This unit makes possible interchange and recording between digital recorders with differing sampling frequencies. For example, if a recorder has a 44.056-kHz sampling rate and another digital recorder has a 50-kHz sampling rate, they can successfully be converted, up or down, through the Studer SFC-16. The converter accepts arbitrary sampling frequencies, and since it operates strictly under control of the clock signals, no programming is required. The SFC-16 will permit dubbing from one digital recorder to another without leaving the digital domain. In other words, it makes digital-to-digital dubbing possible. In addition to format conversion, one of the major uses of the SFC-16 will be in mastering to the 44.1-kHz sampling frequency of the Sony/Philips CD digital audio disc.

Of course, in the midst of all this digital activity, analog audio is still very much with us. In fact, at the Studer exhibit, engineers were casting lustful looks at the Studer A80 MK Two, an update of their well-known analog magnetic recorder now featuring two-channel stereo recording on half-inch tape. Ampex introduced this format several years ago, and it has become quite popular. It is claimed that in the A80 MK Two, with all electronics nicely tweaked and using a hot tape at 30 ips, the signal to-noise ratio approaches 80 dB!

Speaking of Ampex, they are helping to keep analog magnetic racording alive. They have a new machine, the ATR-800, which is specifically designed for the international broadcast market. There are certainly features galore that will appeal to broadcasters, a "dump edit mode," cue amplifier, and quick change heads in mono, stereo and four-channel formats in both quarter-inch and half-inch tape widths. The ATR-800 is switchable between NAB and IEC setups, including bias and level changes as well as equalization curves. There is a universal power supply, and single point "search-to-cue" is standard, as is three-speed operation. The ATR-800 does have a capstan/pinch roller drive, but it is under closed-loop servo control. There are many other standard features as well as several options, things like a built-in tape marker, a tape cutter, and a noise-reduction interface kit for Dolby or dbx. Price begins at $5,450.00 for the basic two-channel recorder, and delivery is expected by the time you read this.

JVC exhibited their DAS 90 digital recording system, but they also showed photos and details of the newly modified and updated JVC Cutting Center in Los Angeles. In addition to a special direct-drive motor for the Neumann cutting lathe, they have a newly designed CH-90 cutter head. This unit features a "rocking bridge" cutter bar system, which has *no* cantilever and is extremely stable as to phase and crosstalk characteristics. A highly heat-resistant (250° C) material is used for the moving system which, combined with a double-chambered helium cooling system, permits high dynamic ranges with a maximum velocity of a staggering 127 centimeters per second! This is also possible due to the new CA-9011 cutting amplifier, using their "Super Linear" circuit which puts out a mere one horsepower (800 watts) per channel!

I have previously reported on the JVC UHQR (ultra-high quality) 200-gram "super record." Here is how one was recently produced. JVC took their DAS 90 digital recording system to Moscow and recorded the Moscow Radio Symphony Orchestra in Stravinsky's "Rite of Spring." Then it was cut with the new cutter head and cutting amplifier and pressed on a UHQR disc. The result is rather terrifying — there are monumental transient pulses on this disc that present a formidable challenge to the tracking abilities of even the finest phono cartridges. Unfortunately, this recording is not permitted to be sold in the United States; if you want a copy, you must pick it up in Japan or arrange for someone there to send it. But if you do manage to get one of these recordings, I think you will find JVC has made a significant advance in the state of the art in disc processing. It's a doozy!

MAXELL IS PLEASED TO PRESENT AN EVEN HIGHER PERFORMANCE TAPE.

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

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

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

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

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

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

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

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TAPE GUIDE

HERMAN BURSTEIN

Stacking the Decks

Q. My integrated amplifier has provision for two tape decks. I would like to use an open-reel deck in addition to my present phono cartridge and cassette decks, but I detest the job of swapping my three decks among the two sets of tape jacks. Inasmuch as the amplifier has unused preamp-out/main-in jacks, may I successfully use these jacks for the third deck? — Henry Stafford, Jr., Cincinnati, Ohio

A. If the third deck has provision for routing the incoming signal straight through (from deck input to deck output) when the deck is not in use, you could use the preamp-out/main-in jacks for this unit. Otherwise, all other signal sources will be cut off from the power amplifier section. Also, the deck so connected will be subject to the volume and tone controls and other signal processing elements of the preamp section when recording, but it will not have the benefit of these elements in playback. I think a better solution would be to purchase a tape switching device that permits two or more tape decks to be connected to one set of tape jacks.

Recording Levels

Q. I am aware that high-frequency response tends to improve as record level is reduced when using a cassette deck. Is it necessary to reduce the record level to the neighborhood of -10 to -20 dB, thus adversely affecting the signal-to-noise ratio, in order to maintain high-end frequency response? Or are the high frequencies generally at a low enough level in relationship to the other frequencies so that one can record at about the 0-dB level without affecting high-end response? —Tom Irwin, Davis, Cal.

A. Rephrasing your own statement, musical material above 1,000 Hz or so *typically* declines in amplitude to an extent sufficient to compensate for the growing inability of the tape system — at low tape speed — to cope with high-level signals as frequency increases. This inability to cope is due to the treble boost required in recording. The lower the tape speed, the greater the treble boost required. Therefore, a problem which is slight at 7½ ips and nonexistent at 15 ips becomes a considerable problem at 1⅞ ips.

If the record level indicator of your cassette deck is peak reading, ordinarily you should be able to record safely (maintain extended treble response along with low distortion and high signal-to-noise ratio) at or about the 0-dB level. If the indicator is average reading, it will have been calibrated by the manufacturer (assuming good quality control in the plant) to make allowance for high-magnitude transients that might otherwise be overrecorded — with consequent distortion and treble loss. Typically, such a meter reads 0 dB when the signal is about 8 dB below a level producing 3% harmonic distortion. If you are recording off the air or from a disc, you can *probably* record near the 0-dB level. But if you are recording live, particularly material with strong transients (such as guitar), you may find it necessary to back down on the recording level about 5 to 10 dB in order to avoid obvious distortion.

Reversing the Aging Process

Q. I've heard that tapes start to deteriorate after the first few plays. Is this true? What can I do to prevent or slow down this process?—Mike O'Leary, Waialua, Hawaii

A. During the first few plays of a tape, there tends to be a loss of a few dB in the upper frequencies. At the higher tape speeds these losses tend to occur at frequencies far above the normal range of human hearing. At lower speeds, however, particularly at 1⅞ ips or less, these losses may occur within hearing range. On the other hand, continuing improvements in tapes tend to make such losses quite small, and perhaps insignificant, even at speeds as low as 1⅞ ips. Choice of tape is one of your recourses. Another is to regularly clean the tape heads so as to remove tape oxide that can form a barrier between the heads and the tape, thereby impairing treble response.

Souvenirs from The Sixties

Q. I have several reels of tape bought in 1966. Some are virtually unused. I have just purchased an open-reel deck and hesitate to use this tape if it may damage the heads. I would also like to ask about prerecorded tapes that I bought between 1966 and 1968. Do you think these could damage the heads of my new deck? — Raymond Disbrow, Belleville, N.J.

A. I very much doubt that use of your old tapes will in any way harm your tape deck. The only possible reason for not using the old tapes has to do with their suitability for recording on modern tape decks. These decks generally provide greater bias than was required by the old tapes; the result would be a drop in treble response. However, this drop might not be an audible one or, if audible, would not necessarily be so gross as to produce displeasure.

With respect to your prerecorded tapes, or tapes that you recorded, there is no problem in playback. Bias does not enter the picture in playback, and playback equalization standards haven't changed. Therefore, such tapes should play back perfectly well, assuming that both the deck on which the tapes were made and your new deck have correct azimuth adjustment and that the old tapes were in the correct quarter-track stereo format.

Speaker Rumblings

Q. After using my cassette deck for a year, I have begun to notice a slight rumble which is audible through my speaker, even without a cassette in the deck. Could you give me a reason for this? — Neil Nagai, APO Mich.

A. I suspect that the problem lies in the playback electronics of your tape deck; a faulty resistor, capacitor, or transistor could be responsible. It is also possible that the problem is in the power supply; a likely culprit is the filter capacitor(s). You will require the help of an authorized service station.

Angle Angst

Q. I notice that my cassette deck loads the cassette at an angle of about 3° rather than loading it parallel with the front of the deck. Does this affect the deck or the sound? —Tracy Ching, Sacramento, Cal.

A. I doubt it. Even though the cassette is not parallel with the front of the deck, what counts is whether it is in proper position with respect to the transport mechanism. Generally, these mechanisms will not operate unless the cassette is in correct alignment. To alleviate your concern, you might visit your local audio store to see whether other decks of the same model have the same or similar offset. However, if these other decks appear to have parallel alignment, it may be best to have your unit checked.

Life in the Fast Lane

Q. I own two open-reel decks which I frequently use with 10½-inch reels. At times it is necessary to use the fast rewind mode in order to locate a desired point in the recording. However, I am unhappy with the excessively fast rewind speed and would like to reduce this by about half. I have been thinking of using a rheostat during the fast rewind mode to reduce voltage and thus reduce the speed. But would this damage the motor or other components? — Anthony Benson, Pacifica, Cal.

A. I am somewhat dubious about your method of reducing the rewind speed. Operating a motor at substantially reduced voltage could be harmful unless the motor is designed to be operated in this manner. Another possible problem is that at reduced speed you might not get as smooth a wind of the tape onto the reel.

By far the best course is to seek an answer from the manufacturer of your deck. They know the machine better than anyone else and can suggest a proper solution to the problem of reducing its rewind speed.

Consider the Source

Q. When making a tape, would you recommend equalizing (if necessary) during recording, or recording flat? If you equalize during recording, should the tape be played back flat? — Bob Hoffman, Worth, Ill.

A. Equalize in recording only if you believe that frequency response of the source is incorrect. If you do equalize in recording, try to avoid excessive treble emphasis, because this increases the risk of tape saturation. If a good deal of treble must be added, it may be wise to add part of this in playback (although this raises the hiss level). Once you have recorded a tape in such a manner that you believe response abnormalities have been fully corrected, the tape should be played back "flat" — meaning that only *standard* playback equalization is supplied — unless you want to compensate for a response error in the playback system (such as dull-sounding speakers).

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.

AUDIOCLINIC

JOSEPH GIOVANELLI

Paint It Black

Q. I found while studying organic chemistry that polyvinyl chloride ranges from colorless to amber. All of the records I have ever seen are black. Why do record manufacturers add pigments to make the records black?

Doesn't this degrade the quality of the record? If so, why do present audiophile records, which are supposed to be of superior quality, continue to use pigments which may have the potential to degrade the quality of the record? — Filemon K. Tan, Jr., Arlington, Tex.

A. The pigment which was used for many, many years to produce the black coloring in phonograph records is called lamp black or carbon black. Today, however, a black liquid dye is used, so that you really don't have to worry about noise from non-pure PVC since the dye is not finely divided grains as was the carbon black. The reason the record makers issue black records is that the general public seems unable to accept records in any other color, save as a novelty item.

The Hole Story

Q. Please tell me why a standard 12-inch LP record has a small center hole while a 7-inch, 45-rpm record has a large one. —Richard Savoy, Methuen, Mass.

A. The small center hole in phonograph records has been used from the inception of flat discs. When Columbia produced the first successful microgroove, 33⅓ rpm disc, this center hole was retained. The difference consisted of a lower turntable speed along with a greater number of grooves per inch — with consequently smaller styli tip radii. Naturally, the competition immediately went into action.

To promote its development, Columbia Records introduced a very inexpensive record changer; it was practically given away. This changer was capable of playing microgroove discs, and microgroove discs only. No attempt was made to incorporate the then-existing 78 rpm record speed.

Not to be outdone, RCA introduced its own inexpensive record changer, again designed as a virtual giveaway to promote its new product: The 45 rpm record.

Thus there existed two completely different standards, not including the 78 rpm disc. One used a small center hole with a turntable rotational speed of 33⅓ rpm; the other used a large center hole with a turntable rotational speed of 45 rpm. Rather than one of these giants becoming successful to the detriment of the other, both systems coexisted and caused the ultimate demise of the 78 rpm record. Inventive phonograph manufacturers were able to provide machines capable of playing all three varieties of phonograph record. This is essentially where we stand today.

Just You Weight

Q. I get a lot of distortion when playing warped records. This distortion consists of a wavering sound and sometimes includes a muffled "pop," almost as if there was a scratch on the record.

Included with my turntable is a 7.5-gram weight to be used on the headshell if the phono cartridge weighs less than 6.0 grams. Because my cartridge weighs 5.5 grams, I added the weight. When I set the balance weight at 0.5 to 0.8 gram, the tonearm bounces off the warp. Increasing tracking force beyond this point produces the muffled pop and wavering sound.

How can I eliminate this distortion? What does the headshell weight do? — J.C. Fat, Sacramento, Cal.

A. The headshell weight is intended to balance light phono cartridges. Without it, you might not obtain proper tracking force or the tonearm might not even rest on the record. The problem is that such a weight also adds mass to the system, and this added mass is sufficient to change tracking characteristics of the cartridge and tonearm such that they cannot follow a warped disc. The stylus is bouncing rather than tracking the grooves.

I suggest you remove the weight and try to adjust tracking force and anti-skating. If you are successful in obtaining adequate tracking force, then try playing some of your warped discs. I think you will probably need to use an independent force gauge to verify the tracking force.

If the problem clears up, fine. If it does not or if you find that you do need to add the weight, I suggest that you add a subsonic filter to your system. This filter will reduce low-frequency response and reduce intermodulation distortion in both the speaker and the amplifier. It should also remove that pop, which may have resulted from the speaker's voice-coil moving beyond its design maximum (which could wreck the speakers in time) or from the action of your amplifier's protection circuits.

In any case, there appears to be a fairly serious mismatch between the characteristics of your tonearm and those of your cartridge. As you've noted, the cartridge alone, at 5.5 grams, is just under the minimum specified by your turntable's maker. But the cartridge and the weight together, at 13 grams, is too much for the cartridge to operate properly. Check with the maker of your turntable to see whether a 3- or a 5-gram weight is available. The combined weight of 8 to 10.5 grams seems to be the area where your cartridge operates best so as to track warped discs.

Separate Tables

Q. I have accumulated three turntables and have use for each of them. Can I hook up tables two and three to "Station 2" on my preamplifier by way of a "Y" connector? I would not be using them at the same time because they would be serving separate purposes.— C.M. Flores, Saginaw, Mich.

A. You would not want to connect both turntables to a single preamplifier input. This arrangement could lead to added hum and loss of flat frequency response. The cable capacitance of one turntable would be added to that of the other; one phono cartridge would feed into the other one while driving the desired preamplifier input. No harm can result from doing this, however. If the sound is at least satisfactory, all well and good.

A more sophisticated approach requires connecting turntable 2 to "Station 2" of your preamplifier. Turntable 3 would be connected to a phono-stage preamp, sold by various mail-order houses and also manufactured by some phonograph cartridge makers. The output of this unit would feed into one of the high-level inputs of your preamplifier.

Switch Before You Feed

A. Can one set of speakers be hooked up to two power amplifiers by running wires from the speakers to one amplifier and another set of wires directly to another amplifier? By utilizing one amplifier at a time, would any damage be

done to either the amplifiers or the speakers? —Robert G. Delorme, West Warwick, R.I.

A. You cannot use one set of speakers connected to two separate amplifiers as you have proposed. Even if one amplifier is turned off, the amplifier being used will, in addition to feeding the speakers, feed into the other amplifier. This second amplifier will present impedance to the amplifier being used and damage it. The fact that the speakers will likely not be damaged is academic.

Switching must be provided so that the speakers are connected only to the amplifier actually in use. This switching will eliminate the need to physically connect or disconnect the speakers to or from either of the two amplifiers.

On Cable

Q. I have considered locating my amplifier midway between the speakers, which would result in equal, 9-foot cable runs. I now have a 25-foot cable run on one speaker and 15 feet on the other. Are there advantages in using equal cable runs? — C.T. Lewis, Morrisonville, N.Y.

A. No problems will be encountered because of differing lengths of cable from amplifier to speakers.

No Morning Glory

Q. Before I bought my tuner and timer I had a problem with the volume control on my amplifier. Occasionally, when I tried to lower the volume, the sound level remained constant until I turned this control up and down several times.

Since I bought the tuner and timer, I have had a different problem. We use the timer, tuner and amplifier to wake us up at 6:30 a.m. and turn off at 7:30 a.m. After coming on and playing for perhaps 20 minutes, the volume gradually rises to a loud level all by itself, when no one is near the equipment!

I wonder if this second problem is caused by the same source as the first one. — Jeff Culbertson, Overland Park, Kans.

A. Both of these problems are the result of a volume control which, at the very least, is in need of cleaning with appropriate contact cleaner; at most, it will have to be replaced.

A volume control which is either defective or has oxidized contact surfaces will tend to change resistance at the point of contact between the wiper and the resistance element, leading to erratic changes in volume even if you have not touched the control.

If the volume control is not sealed, squirt some contact cleaner into it at the point where the connecting terminals emerge. If the problem still persists or if you cannot force cleaner into the control, replace it.

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

AKAI Cassette Deck

The GX-F66RC features Intro Scan and Blank Search, automatic play of one side, both sides or continuous playback, and automatic tape selection. Intro Scan allows quick and easy location of specific songs, while Blank Search seeks out unrecorded sections of the tape to facilitate recording on partially recorded cassettes. This cassette deck also has a microprocessor-controlled Random Program Search System that can select up to 20 programs in any order up to 99 selections on either side of the cassette. The Dolby B and C noise-reduction systems are featured, along with AKAI's automatic reverse, 16-segment LED bar meter and electronic digital tape counter. Frequency response for metal tape is 25 to 19 kHz, ±3 dB. Price: $575.00.

Enter No. 100 on Reader Service Card

Bang & Olufsen Receiver

The Beomaster 6000 is a 75 watt/channel remote-controlled, computer-directed, programmable receiver. It can be programmed to start or stop automatically, play a radio program, or shut off the system at any time. Microcomputers control the receiver and reduce complex operations to a touch of a button. The Beomaster 6000's control panel or the wireless remote control terminal will select any of six preprogrammed FM stations, raise or lower the volume, or turn the entire system on or off. The volume control is also automatic, and can be programmed for seven different volume levels as well as preset for a favorite listening level. This receiver also allows for interruptions while a recording is being made. Volume can be turned off by touching the mute button without interrupting the recording process; touching the mute button again will return the volume to the prior sound level. The Beomaster 6000 can be combined with the Beogram 8000 turntable, Beocord 8002 cassette recorder, or the Beocord 9000 cassette recorder. Price: With remote control, $1,600.00.

Enter No. 102 on Reader Service Card

Proton Table Radio

The Radio is a self-contained music system with add-on capability for accessory speakers as well as tape players. It comes equipped with a single two-way, biamplified speaker, with 20 watts for the woofer and 5 watts for the tweeter, and a built-in equalizer insures bass response down to 60 Hz. A single add-on speaker converts the system to full stereo operation, while up to 10 pairs of speakers can be connected to provide music in any room of a home or office. Prices: The Radio, $280; additional speakers, $150.00 each.

Enter No. 101 on Reader Service Card

TEAC Open-Reel Tape Deck

The X-1000R uses a dual-capstan, closed-loop drive and full tension servo control in its transport system. Transport functions are handled through a logic system that permits search to zero, search to cue, and block repeat operations. Bidirectional record and playback facilities are included using a six-head arrangement, and reel sizes up to 10½ inches can be accommodated. Both the dbx noise-reduction system as well as the ability to use the new EE, or extra efficiency, tape formulations are offered as features on this unit. In addition to wide-range VU-type meters, full mike/line mixing facilities and separate-channel input and output controls are provided. Price: $1,400.00.

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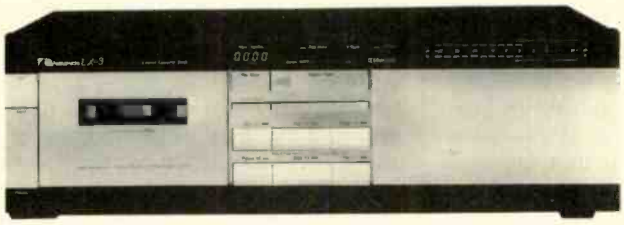

Nakamichi Cassette Deck

The LX-3 is a two-head cassette deck featuring a microprocessor-controlled tape transport which allows automatic playback after rewind or fast forward, record mute, high-speed shutoff, and slack-tape take-up as well as remote operation and unattended recording and playback via any accessory timer. The unit offers both Dolby B- and C-type noise reduction, as well as a Master Fader with choice of two fade rates. The LX-3 incorporates separate bias and EQ switches for ferric, chrome and metal tape formulations, as well as individual record-level controls, output control, and defeatable MPX filter. The 16-segment peak-responding LED display indicates record levels over a 50-dB range. Price: $545.00.

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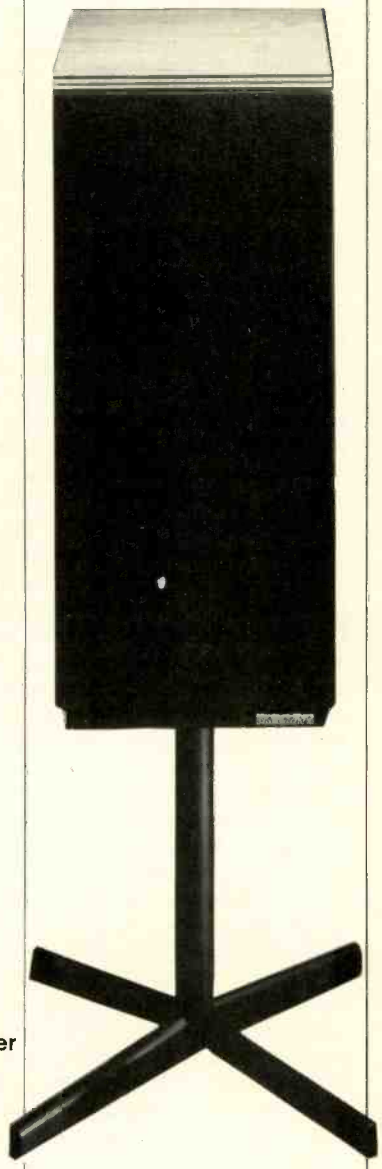


Mordaunt-Short Loudspeaker

The Pageant 3 uses three transducers in a distributed reflex design to achieve a free-field response of 60 Hz to 20 kHz, ±3 dB. Designed primarily for those who desire a high quality system within practical budget limitations, the system is intended to eliminate the unpleasant colorations associated with single ducts with a large cross-section. This allows excellent generation of low frequencies with great clarity, transient attack, and low distortion. The midrange unit has its own sealed enclosure to prevent interaction with the woofer, while the tweeter is only 12 mm in size for minimum loss of high frequencies off axis. Price: $765.00 per pair; with stands, $815.00 per pair.

Enter No. 105 on Reader Service Card

THE COLUMN

MICHAEL TEARSON
JON & SALLY TIVEN

Shake It Up: The Cars
Elektra/Asylum 5E-567, stereo, $8.98.

Sound: B Performance: A

On their debut LP, The Cars appeared to have the essentials for an aesthetic and commercial success — great material enhanced by state-of-the-art production. A number of hit singles — "My Best Friend's Girl," "Let the Good Times Roll," and "Just What I Needed" — propelled the group and their producer to instant superstardom, becoming the new yardstick by which other pop groups were measured. Although he became the industry darling, accruing accolades along with astronomical percentage points on each successive project, Roy Thomas Baker couldn't make lightning strike the second or third time he and The Cars ventured into the marketplace. Concentrating more on futuristic production than the quality of the compositions, The Cars' second and third attempts wandered away from the rock 'n' roll basics they had perfected the first time out. It appeared that this group was misdirected into transcending a form they had lost their feel for. Now, three years after their initial splash, The Cars have managed to make their second rock 'n' roll album.

Shake It Up is full of killer tunes — these guys have been suffering for their art or graced by the Muse lately, because the songwriting comes close to that on the first LP. Structurally and lyrically, the songs are a shining example of the less-is-more school of pop composition. Ocasek maintains a constant muffled rhythm with his guitar, Easton plays spare but tasty fills and solos, but most of the melodic figures are left to imaginative keyboardist Hawkes. The spacious quality of this LP compliments the simple tunes perfectly — this time out the synthesizers aren't used as screen for song fragments, but are moderately employed to add an evocative level to Ocasek's deadpan delivery. "Shake It Up," for instance, is propelled by repetition and a rolling beat so well that we overlook such throwaway lyrics as "Dance all night, get real loose/You don't need no bad excuse." The Cars come off best when they shake off their pretensions to the making of pure art and get down to rocking, and with *Shake It Up* it would appear that they have returned to this form. It is a record as masterfully created as their first, yet ably demonstrates that they *have* grown both as individuals and as a unit without losing their focus.

Jon & Sally Tiven

Time: ELO
CBS FZ37371, stereo, $8.98.

Sound: A Performance: B

If you like your Beatles transformed into heavy metal, you listen to Cheap Trick, but if you like your Beatles orchestrated, you go for ELO. What they do is faultless — *Time*, like all their previous albums, boasts great production values, terrific vocals, and fine arrangements, all built on a meaty rhythm track that lends this group their rock 'n' roll validity. The only way you could dislike this LP is on principle, because its sound is impeccable. Despite the preponderance of background music numbers on this record, there are a few standouts that make the band sound absolutely like what's happening.

"Ticket to the Moon" is a pretty ballad that shows Lynne's basic vocal and songwriting skills in a positive light. "The Way Life's Meant to Be" is a good country & western flavored rocker with amusing lyrics and Spectoresque production from the multiple backing vocals through handclaps to lush string sections. ELO can imitate genres as well as they synthesize their primal musical influences (Beatles, Spector, and Roy Wood if you're too young to catch their stylistic borrowing), and they offer a cute reggae number called "The Lights Go Down" to break up the sequence of futuristic pop tunes here. Whatever style of composition this outfit lends their touch to, they manage to load it with saccharin without being too cloying, and it's no wonder that ELO was one of John Lennon's favorite bands — they sound a lot like him. So much so, in fact, that one is surprised that they didn't do more of a tribute to the late Beatle on this LP — an ELO version of "Imagine" could, in fact, be mind-blowing.

Unfortunately, the group isn't particularly into blowing minds these days. Their inventive heyday ended somewhere around the third album, and ever since they've been very nice but hardly astounding. You'd think that with all the dough they rake in, they would be able to move a little further left of center, but instead they stay heavily indebted to their progenitors and make pleasant albums. One can't wait around for Jeff Lynne to get inspired once more, but you have to give him some credit for not sounding forced and making pop music a few steps ahead of what you hear on the AM dial. The trouble is he is capable of much more.

Jon & Sally Tiven

Best of The Blues Brothers
Atlantic SD 19331, stereo, $8.98.

Sound: B Performance: B+

With tongue firmly in cheek, John Belushi and Dan Aykroyd pay tribute to blues and soul classics of years gone by, and not so amazingly have established a humongous following. It's not that amazing because (a) John can really sing, (b) Dan plays a mean harp, and (c) these are all great tunes. As an added attraction, the band comprises half of the original Booker T. & the MG's (who wrote some of The Blues Brothers' hits) as well as some of New York's top session men, so it isn't exactly amateur night at the OK Corral. This is your typical repackage to catch the Valentine's Day market, and it contains some of The Blues Brothers' best-known tunes like "Rubber Biscuit," "Soul Man," and "Gimme Some Lovin," as well as the previously unreleased "Expressway to Your Heart," all tied together in a snazzy cover designed by Judith Jacklin (an up and coming bassist in her own right).

Those detractors of the brothers Blues may claim that (a) John and Dan are far too white to sing these classics and (b) their versions do not measure up to the originals. But the artists responsible for these tunes are likely more than happy to see these songs once again in the public ear, and it is indeed a service to black-music lovers everywhere that The Blues Brothers are bringing this heritage to a new and younger audience. Granted, John is not Otis Redding and Dan is not Junior Wells. But the chemistry between the two of them and these tunes is something else again, and no one can tell us that their rendition of "She Caught the Katy" is any less moving than Taj Mahal's. *Jon & Sally Tiven*

Rock & Roll Adult: Garland Jeffreys
Epic FE 37436, stereo, $8.98.

Sound: B– Performance: B+

I don't like many live rock albums. They tend to be note-for-note reconstructions of studio performances but with less precision. They also tend to be fillers during periods when the artist owes an album and hasn't been able to develop enough real new stuff to make it worth going into the studio, so they add little to the body of an artist's work. Rare is the live album that reveals a dimension of the artist that the studio kept hidden. Garland Jeffreys' *Rock & Roll Adult* is one of those, rare, fresh and urgent.

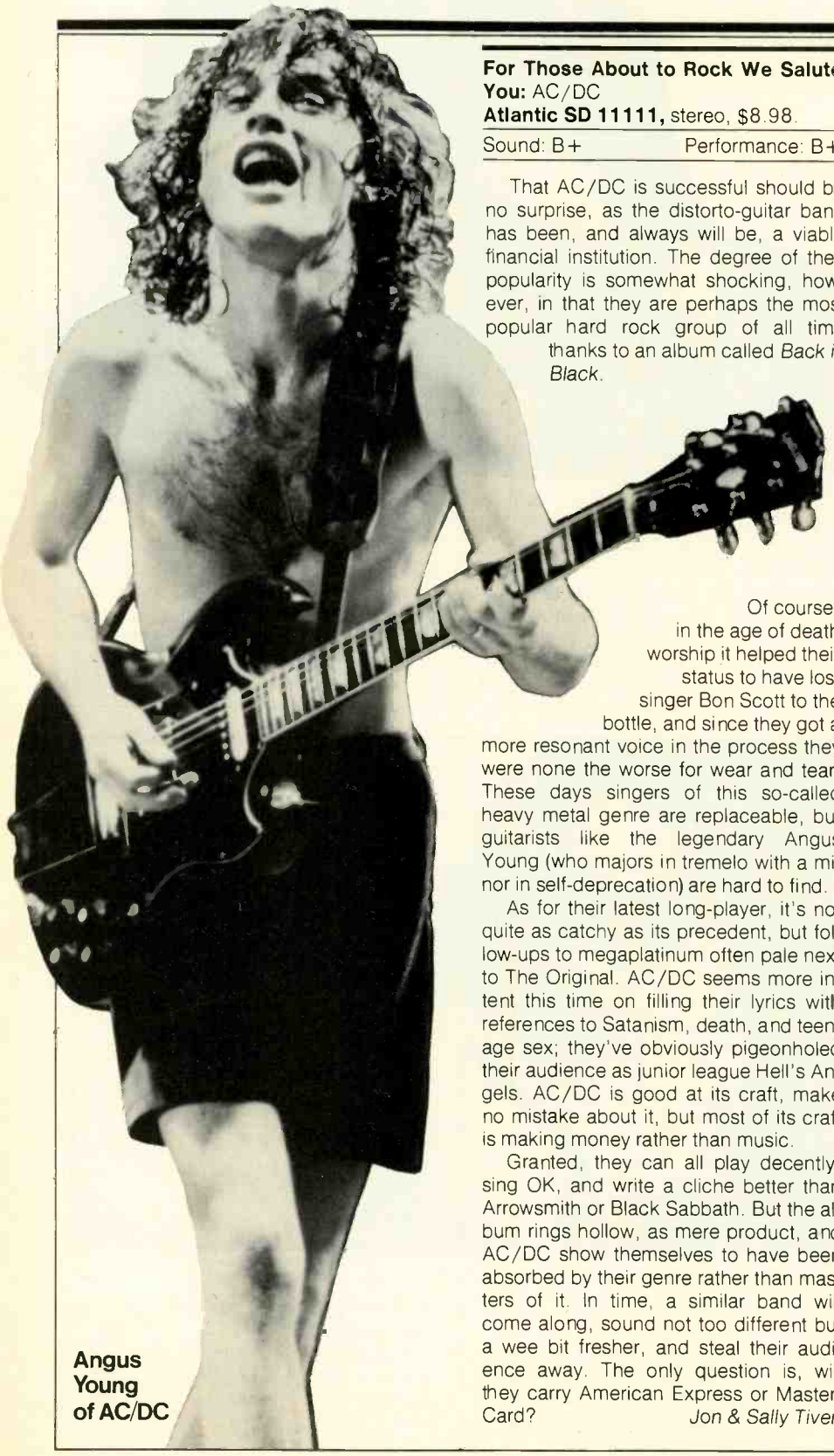
Jeffreys is no spring chicken. Pushing 40, he rocks with abandon and cool at the same time. Here he's got a major prerequisite for a hot live recording: A hot-shot, crackerjack band behind him, namely Graham Parker's former band The Rumour, guys who play with authority and real power. Then there's the material, always one of Garland's strong suits. "Wild in the Streets" is a bonafide classic song, and "R.O.C.K.," "I May Not Be Your Kind," "Matador," and "35 Millimeter Dreams" deserve to be.

In live performance, Garland brings whole new meanings to them.

The sound has the raw edge of live performance and the feel of the live staging in its mix. The crucial element of Steve Goulding's drums has been captured with a sock you can feel, while the guitars really sting.

Garland Jeffreys has always made songs of real substance. If you have not yet made his acquaintance, *Rock & Roll Adult* is the place to do it. *M.T.*

AC/DC is good at its craft, but most of its craft is making money rather than music.



Angus Young of AC/DC

For Those About to Rock We Salute You: AC/DC
Atlantic SD 11111, stereo, $8.98.

Sound: B+ Performance: B+

That AC/DC is successful should be no surprise, as the distorto-guitar band has been, and always will be, a viable financial institution. The degree of their popularity is somewhat shocking, however, in that they are perhaps the most popular hard rock group of all time thanks to an album called *Back in Black*.

Of course, in the age of death worship it helped their status to have lost singer Bon Scott to the bottle, and since they got a more resonant voice in the process they were none the worse for wear and tear. These days singers of this so-called heavy metal genre are replaceable, but guitarists like the legendary Angus Young (who majors in tremelo with a minor in self-deprecation) are hard to find.

As for their latest long-player, it's not quite as catchy as its precedent, but follow-ups to megaplatinum often pale next to The Original. AC/DC seems more intent this time on filling their lyrics with references to Satanism, death, and teenage sex; they've obviously pigeonholed their audience as junior league Hell's Angels. AC/DC is good at its craft, make no mistake about it, but most of its craft is making money rather than music.

Granted, they can all play decently, sing OK, and write a cliche better than Arrowsmith or Black Sabbath. But the album rings hollow, as mere product, and AC/DC show themselves to have been absorbed by their genre rather than masters of it. In time, a similar band will come along, sound not too different but a wee bit fresher, and steal their audience away. The only question is, will they carry American Express or MasterCard? *Jon & Sally Tiven*

Beds: The Beds
Elektra/Asylum SE-533, stereo, $8.98.

Sound: A Performance: B

New Wave music has infiltrated mainstream America to the extent that U.S. Army recruitment commercials are accompanied by a blistering soundtrack of punk rock guitars, so it shouldn't be surprising to discover a Vegas singer backed by synthesizers. Maybe she'd disavow the label, but compared to the Chrissie Hyndes of this industry, The Beds' Merle Miller is just that — a well-trained voice that's stronger on technique than sincerity. Still, Miller has a sense of humor and a command of funny voices which she performs on this LP, and this puts her miles ahead of other cabaret crooners clothed as New Wavers, who it would be kinder not to name. Now that the group Blondie has fallen by the wayside, perhaps The Beds' electronic cabaret music will be propelled by their sexy front woman to the top of the charts, a place where they'd appear positively innovative compared to the heavy-metal queen Pat Benatar and her reign of boredom that's plagued the airways much too long.

Jan Warner, the musical arranger, composer and keyboard player on this LP, is responsible for its extremely modern, at times even futuristic, sound. The drums, synthesizers and vocals ride way in front of the supporting instruments — an unusually humble position for a guitar which plays some beautiful figures unjustly buried in the mix. The single outstanding tune, "Don't You Shy Away Boy," melds a Latin beat to humorous lyrics and a chorus that rocks.

The producers did well by the clean mix, which is the only context in which The Beds' cabaret synthesizers could really excel. From Miller's husky pipes to the sparing instrumentation that dramatizes them, The Beds' first album is nothing if not well crafted. *Jon & Sally Tiven*

It Don't Hurt to Flirt: Keith Sykes
Backstreet BSR-5277, stereo, $8.98.

Sound: B+ Performance: B-

When I spent some time living in Memphis, Keith Sykes was a performer of some note (Jerry Jeff Walker had covered a couple of his tunes) and he was

The songs are alright and the singing somewhat droll, but Keith Sykes' album lacks the fire to distinguish it from elevator music.

able to attract Memphis' most talented out-of-work musicians to his fold. At that time he was doing a lot of Carl Perkins covers, had a semi-rockabilly approach distinguished by the stinging guitar of the late Chris Bell, and was spending a fair amount of time in the studio making demos. The demos eventually got him a deal with Midsong Records, which released an overproduced album of his about four years back. Eventually, Keith landed on Backstreet, which did fairly well by him a year ago with his debut album.

This brings us to the record most people know as Keith Sykes' second, which is a little bit on the mediocre side with no melodic instrument to interact with the lead figure. (Sykes is playing all the leads this time, and he's not much of a player.) The support of John Hampton (drums and engineering) and Mike Brignardello (bass), both formerly of Walk 'n' Wall, is ample but not exactly blistering. It ends up sounding like Derek & The Dominoes without Eric Clapton or Duane Allman playing lead guitar. The songs are alright, the singing is somewhat droll, but the album lacks the fire to distinguish it from elevator music. Keith Sykes is a good (not great) rockabilly songwriter; unfortunately he's leaning altogether too hard on that. It isn't enough to make this album a must-have. *J.T.*

The Other Side of Town: Chuck E. Weiss
Select SEL 21611, stereo, $5.98.

Sound: C- Performance: A-

The third half of an infamous triangle with Tom Waits and Rickie Lee Jones, Chuck E. Weiss is finally heard from with this seven-song mini LP that is crackling good low-life fun. His songs are as lively, clever and smart as they'd better be, considering the company he keeps. Speaking of company, he's got an amazing studio band for the album, with Mac "Dr. John" Rebennack on the 88s, Alvin "Shine" Robinson on guitar, Freddy Stahle on skins, and funky Larry Taylor on bass. Friend Rickie Lee joins in too for an uncredited cameo duet on the woozy, boozy "Sidekick."

The territory is familiar and run-down and outrageous, but that just lets everyone get funky and into the spirit of things. Rob Fraboni's recorded sound and production are nicely uncluttered, but Select's pressing is just lousy enough to gum things up a bit.

I don't know if Chuck E.'s still in love or not, but I'm in love with his little album. (Contact Select Records at 175 Fifth Ave., New York, N.Y. 10010.) *M.T.*

ROBERT W. CARVER *

SONIC HOLOGRAPHY

The illusion presented by conventional stereo sound is, in my estimation, severely flawed by fundamental distortions of space and time. Although we accept it because we must, and love it when we can, I don't think any of us really believes this illusion approaches a real-life experience. By "conventional stereo" I mean the sort of presentation that works mostly or entirely through loudness or amplitude manipulations. For a sound supposed to come from the left, the left speaker dominates in amplitude; for a sound from the right, the right speaker plays louder. The speakers are equally loud for a sound intended to come from exactly in between, and appropriate degrees of louder or softer are employed for "somewhat left" and "somewhat right" sounds. *Interaural amplitude difference* or IAD is one common name for these manipulations we use to fool the ear and brain. Thus, if the left ear picks up a sound as being significantly louder then the right ear, the ear-brain mechanism will locate the sound source to the left. The converse is true when amplitude favors the right ear. If both ears detect no amplitude difference in what they separately hear, the ear-brain "visualizes" the sound source as being directly in front of the listener.

A classic acoustical experiment, made some years ago, vividly illustrated the power of this mechanism. Listeners were exposed to identical and simultaneous impulse "pips" coming from two spaced loudspeakers, one of which was a little closer to the listeners so that its output arrived slightly ahead in time. The listeners perceived both sound sources as one, and identified "it" as coming from the near speaker. But when the near speaker was turned down in level and the far one up, it was possible to make the pips shift gradually over to the far speaker, showing that amplitude cues could be made to override temporal cues in the ear-brain's localization process. It took quite a difference in amplitude to bring this about, however, and listeners also noted that the sonic character of the pip changed with the shift, becoming somehow fuller and more diffuse.

*President, Carver Corp., Woodinville, Wash.

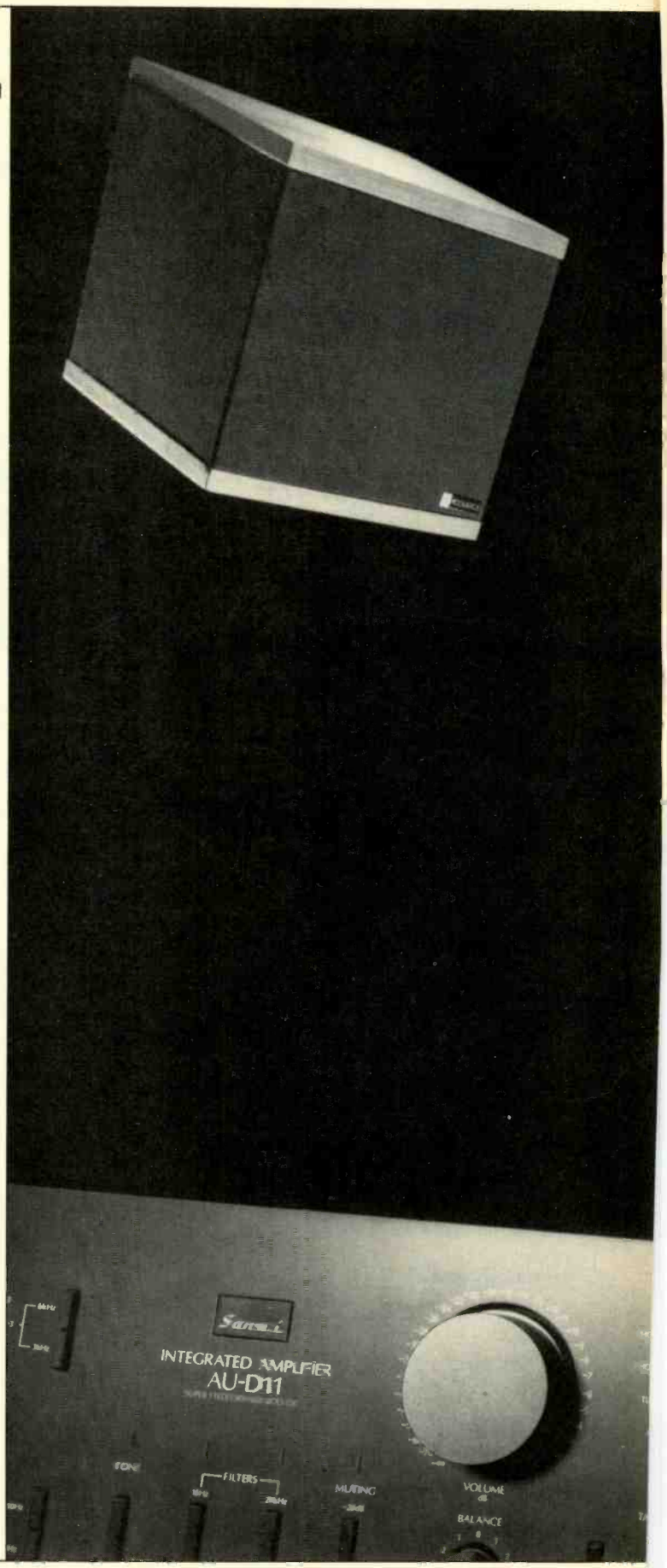
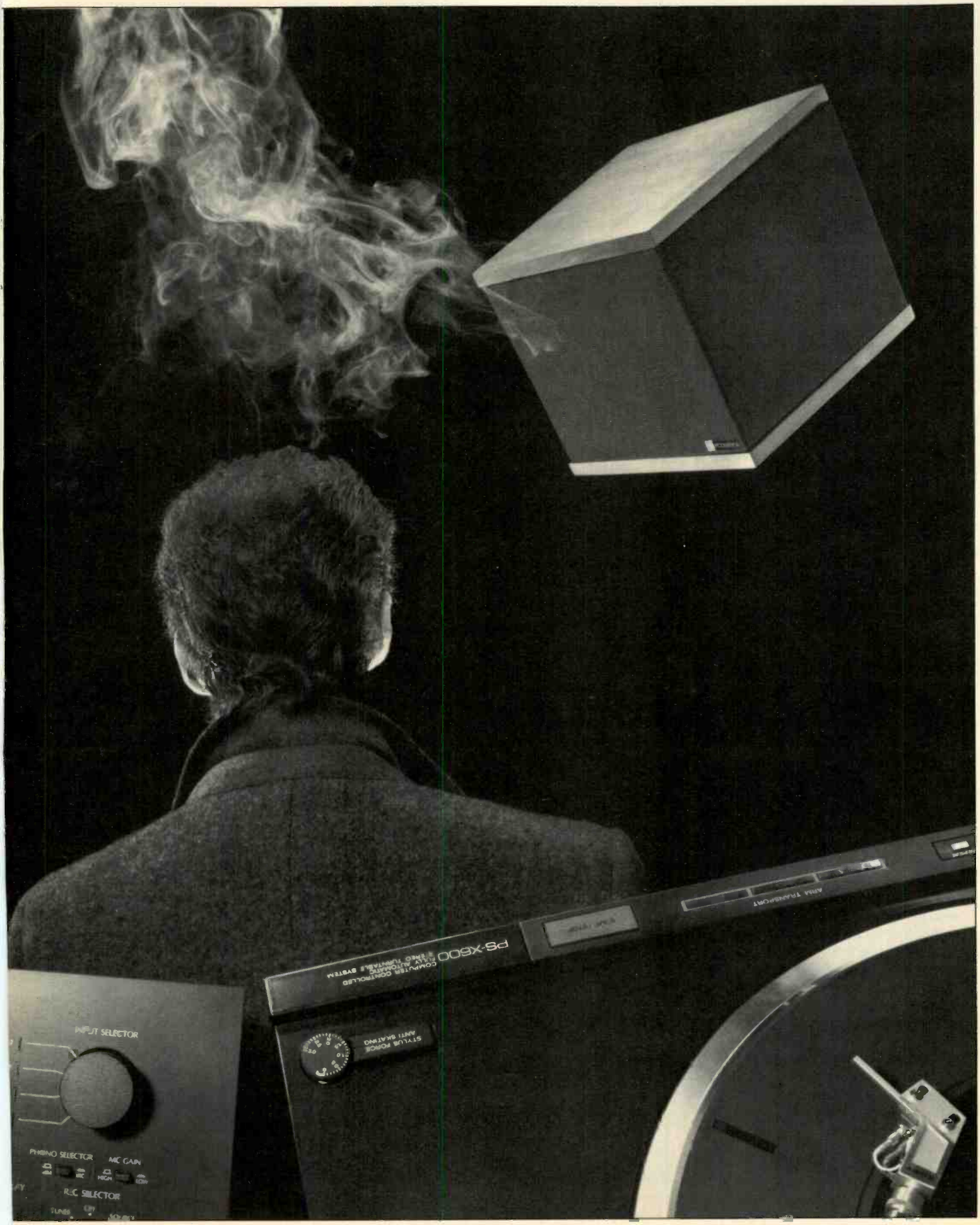


Photo: James Wojcik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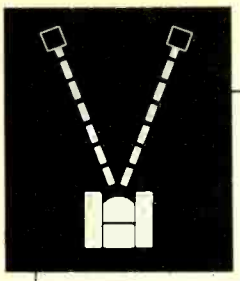


Nevertheless, the mechanism can persuade the ear-brain that it heard sounds from places other than their true origins, and it is the basis for what we call stereophony. It works well enough to be the basis for most all sound recording today, and especially for the creation of records from multitrack tapes.

Just because this trick could be performed, it was easy to assume that we had unlocked the whole of nature's secret to ear-brain localization. But this was wrong because the ear-brain functions with several localization mechanisms, which can reinforce or conflict with each other. It may be true that amplitude cues such as IADs are important and even dominant for close sounds. But because of the inverse-square law, IADs reaching a listener seated back in an auditorium are negligible, even for first-arrival or direct sounds. As Fig. 1 shows, IADs can be expected to reduce to about 0.4 dB at a 16-foot distance from the sound source — an amplitude difference that would have had virtually no effect on localization of the pip in the above experiment.

On the other hand, although IADs rapidly diminish with distance, temporal cues, that is, interaural *time* differences (ITDs), remain absolutely unchanged for a given sound-source direction, no matter what its distance. We appear to have an internal clock that ticks steadily and reliably away under all circumstances, timing the interval between a sound's arrival at ear 1 and ear 2 (see Fig. 2). Therefore, it seems reasonable to conclude that for a typical audience member at a concert, ITDs have great importance in localization of sounds, but IADs mean next to nothing.

Another localization factor often cited is acoustic "shadowing" of the far ear by the head and face. Shadowing alters the frequency spectrum perceived by the far ear, presumably in a way that is informative to the ear-brain about sound-source location. Unquestionably this is an important factor, but probably more so in a nonreverberant environment such as occurs outdoors, where the head casts a truly steady and well-defined shadow. In an auditorium the far ear is not shadowed from the all-enclosing reverberant field, so the ear-brain has only the ITD period associated with the first-arrival sound to sense shadowing. Since determining spectrum shape requires a much longer sample of sound than ITD discrimination, it's by no means certain that shadowing is quite the aid to localization in concert halls it might be otherwise. But that doesn't mean shadowing won't have to be considered in the context of home listening rooms.

For purposes of source localization then, IADs are probably of very small consequence in auditoriums. Shadowing may have some consequence, but it's hard to assign an absolute or even typical rating of influence. ITDs, we know, are fixed and always present, and they seem to be of central importance.

A Matter of Time

Ironically, however, it is timing or temporal cues that get the shortest shrift in conventional stereophony. Multi-microphone techniques pretend they don't exist. There is no spaced-microphone array that rationalizes them properly for loudspeaker listening. Coincident microphones eliminate them totally, a shame because they're sorely missed by the ear-brain. Perhaps most seriously, stereo loudspeakers ultimately make a mess of the time factors by adding new and utterly inappropriate temporal cues.

Figure 3 shows how this happens. Let's take, as an arbitrary example, a "phantom" sound image that has been panned so it seems to come from directly between the two speakers. Equal-amplitude sounds travel from left speaker to left ear along the path L and from right speaker to right ear along path R. The ear-brain's IAD detector is satisfied and shouts "Sound dead ahead." For an instant the ITD sensor is satisfied too. But 100 microseconds or so later, sound traveling from the left speaker along path L_r reaches the right ear simultaneously with the right-speaker sound's arrival at the left ear along path R_l. At this point the ear-brain's ITD sensor whispers "Not a single sound dead ahead, but *two* equal sounds equally spaced to right and left," and there is confusion at the helm.

Ultimately, your conscious mind will probably accept the decision of the IAD sensor, for otherwise, stereo wouldn't work at all. But there is still the situation of conflict in which one localization mechanism is trying to "fuse" two separate sounds into a single sound while another keeps insisting that it just isn't so.

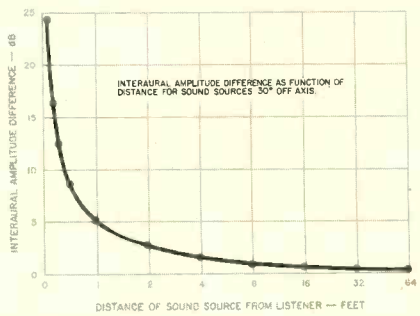


Fig. 1A—Interaural amplitude differences diminish rapidly with increases in distance from the sound source.

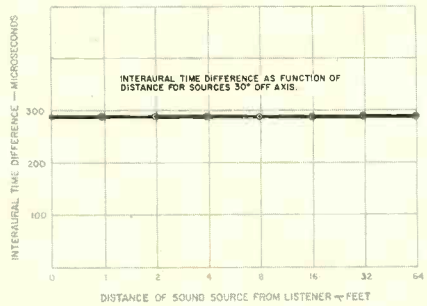


Fig. 1B—Interaural time difference remains constant whatever the subject's distance from the sound source.

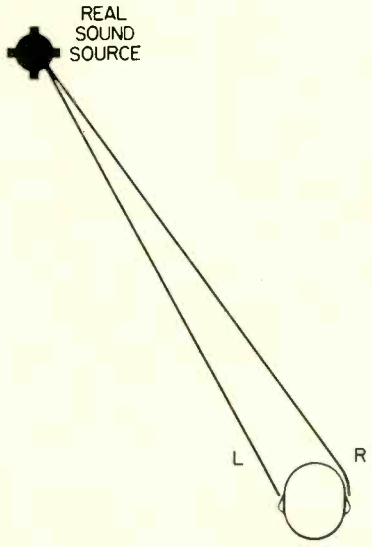


Fig. 2—How the sound from a real source, located to the listener's left, approaches the listener's ears.

Evidently, ITDs can be bullied by stereo techniques into letting IADs have the final say, but this is no victory for the integrity of our perceptions. ITDs are basic to our sound-localization ability, not secondary or supplementary. If ITD sensors are to be satisfied, they must hear two and only two arrivals from a single sonic event, and not the four that occur during conventional stereo playback. Anything else is nonrealistic and subject to deep suspicion if not outright rejection.

Is it any wonder that, if we're honest with ourselves, we never find our stereo systems sounding nearly as convincing and credible as the real thing? There is, in the end, an indistinctness, flatness, and diffuseness (if you recall the listener impressions in the experiment described earlier) that never quite go away unless certain brain centers have been lulled into a mood of acceptance. It is not so much as if something were missing, but more as if something spurious has been added. I submit that the "something" consists of two extra sound arrivals that never exist in real life and that result in a conflict of localization cues and a consequent indistinctness of time and place in the stereo image.

Sonic Holography Defined

Let's look back at Fig. 3 again. Remember that when we had just paths L and R, both the IAD and ITD sensors were satisfied. For a magic 100 microseconds or so, everything was fine. But then L_r and R_l intruded, and the "one source versus two" dilemma arose. Suppose it were possible to eliminate L_r and R_l, not just for a center-front image, but for sound images occurring anywhere on the stereo stage — to make it as if the left speaker didn't exist for the right ear and vice versa? Might this help? And if it does, how could it be accomplished?

First of all, it clearly could not be done by any electronic method alone. It would require an electronic method designed to invoke the assistance of some other mechanism, specifically, the mechanism of wave interference. We know that sound waves interfere in the air of any environment in which sound is contained, and that the interference gives rise to local reinforcements and cancellations of sound throughout the area. We're used to thinking of such interference as being, if not unpredictable, at

Fig. 3— How conventional stereophony uses equal amplitude signals to produce a stage-center location for the apparent sound source. But note that both speakers are heard by both ears.

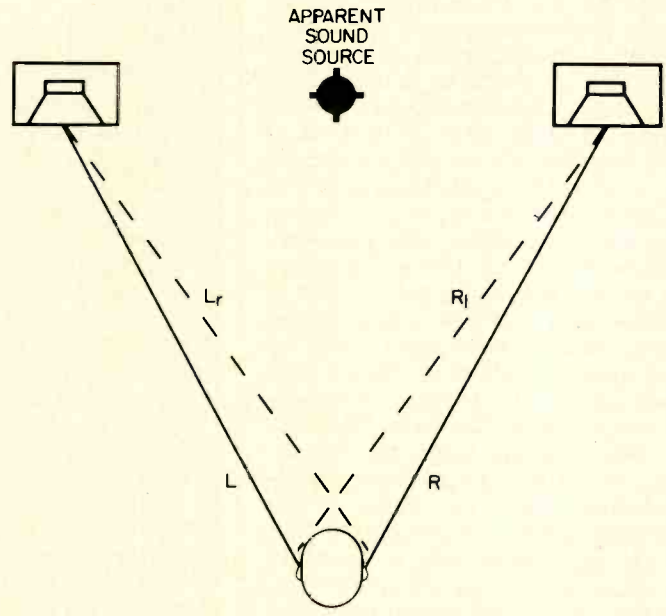
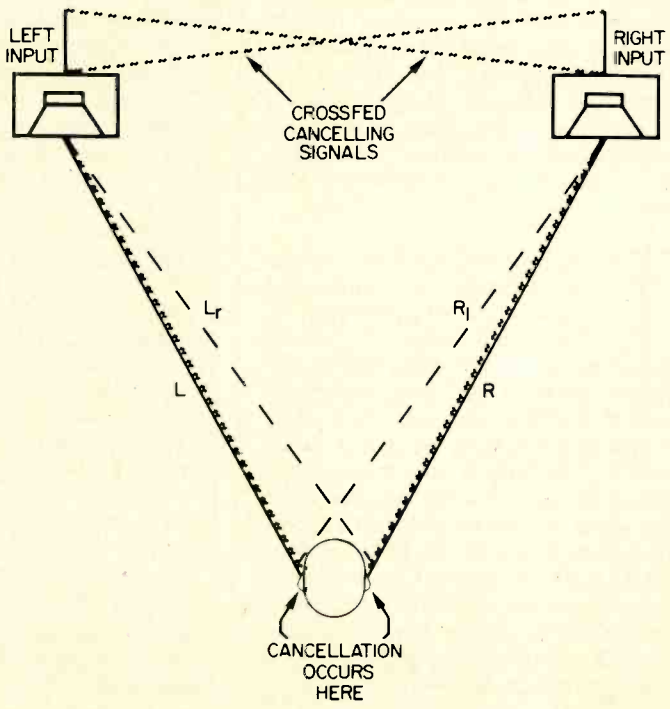
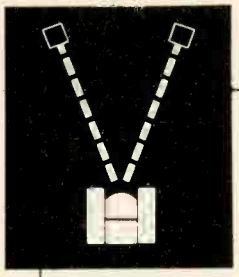


Fig. 4— Careful addition of the crossfed cancelling signals will cause the L_r and R_l signals to drop out of the sound field at a selected listening location.





least too complex to be controllable. Yet while this may be essentially true for much reflected sound, it is not true for sound proceeding directly from a sound source to a prescribed destination. In this case, we know the sound's point of origin, its speed, and how far it has to go. Therefore, it's theoretically possible to arrange for an interfering sound to meet the unwanted sound at its destination and, by acoustical interference, cancel much or all of it. If the sound's origin is the left speaker, its path L_r, and its destination the right ear, cancelling that sound upon its arrival should make the left speaker disappear for the right ear. And the same thing should be possible for the left ear vis-a-vis the right speaker.

What is required of the cancelling signal? First of all, it should be appropriately derived from and related to the unwanted signal coming along L_r, but 180° out of phase with it. Second, it must arrive at the ear the instant the L_r signal does. Finally, it must come from some other source than the left speaker, or the signals would cancel at the speaker itself and nothing would come out. The obvious choice is projecting it from the right speaker. This turns out to be the way to do it. Conceptually, all we need do is tap off part of the left-channel signal at some line-level stage, invert its phase, adjust it temporally for simultaneous arrival with the L_r signal at the right ear, and then crossfeed it to the right channel for launching through the right speaker. A portion of the right channel is tapped off and processed in the same way to cause cancellation of the R_l signal at the left ear. Figure 4 shows the total result.

The temporal adjustment needed is about a 100-microsecond delay (125 microseconds, to be exact), which is nothing more than the ITD between the left ear, which receives sound along the shorter path L, and the right ear, which hears the left speaker along the slightly longer path L_r. Needless to say, the listener's ears must be in the approximate spots the whole process expects if the proper cancellations are to take place right at them. However, although such interference effects are relatively local, position is not quite so critical as you might expect. So long as the listener's seat is where it should be, he can move his

SONIC HOLOGRAPHY RECORDED

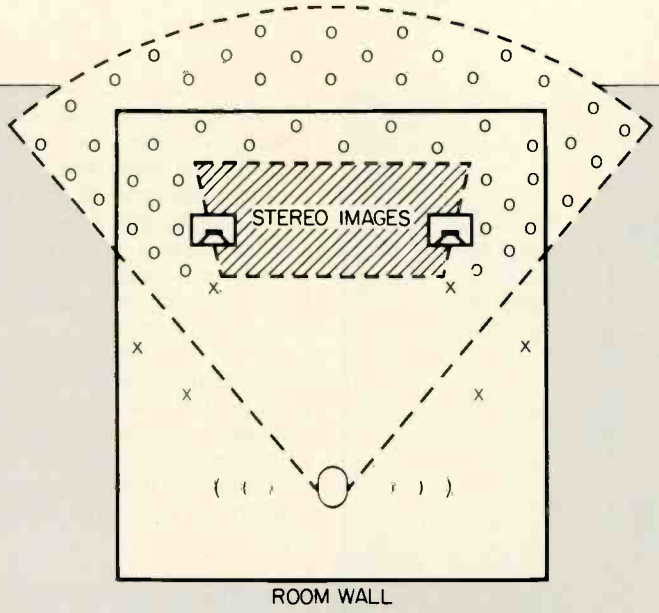
Sonic holography happens because of acoustical interference patterns set up in the air around a listener's head, but the signals that bring about holography are not so intangible. They can be detected, quantified, analyzed, and replicated. They can even be recorded — on a tape by you, if you have a Sonic Hologram Generator, or on an ordinary phonograph record such as the Soundsheet bound into this magazine. Playing the tape or record produces the full holographic effect. A Sonic Hologram Generator is needed only for material that has not been holographically encoded.

Nevertheless, just playing the enclosed Soundsheet record may not do a thing for you unless you take steps to ensure that your listening chair (and you should use a chair) and your loudspeakers are properly positioned relative to each other, and sufficiently far from walls and other reflecting surfaces that might impair the propagation of the holographic image. Remember that you're trying to achieve the intersection of your head and two relatively small regions of acoustical interference. Special pains taken in positioning — at least at first — will not go unrewarded.

The Soundsheet record has been especially recorded in sonic holography and will play back on a normal, conventional stereo system to produce the full sonic hologram sound image. To set up your system for sonic holography, follow these step-by-step instructions. You will first need to obtain a steel tape measure, length of nonstretchable rope or speaker wire for measuring distance, and a temporary listening chair that may be easily moved about. Inspect Fig. B1, which represents a top view of a room, two stereo speakers, and a listening chair. The first step is to temporarily move your loudspeakers out and away from all walls and reflecting surfaces, as shown in the diagram. Next, space the speakers relatively close together (three to five feet, center to center, is good). Using the nonstretchable wire, rope or tape measure, carefully measure the distance from the left speaker to the center of the listening chair. Repeat the measurement for the right speaker, and make both distances (d1 and d2) *exactly* the same. Accuracy to within ⅛ inch is desired; the actual distance themselves are not too critical as long as d1 and d2 are equal.

The Soundsheet record is too flexible to be supported by a ribbed or contoured turntable mat, so support it with a conventional LP. Play the record, and listen for the following: (1) A performance extending in an arc in front of you, with a spread ranging from 45° to 90°; (2) sound images that normally spread beyond the boundaries of the left and right speakers, and occasionally turn up at full-left and full-right positions, but without instabilities or elusiveness; (3) an augmented sense of front-to-back depth, with sound images occurring well behind the speaker plane and occasionally in front of it, and (4) a palpable spatial dimension and clarity to the performance, suggestive of flesh-and-blood musicians occupying actual space.

Turning your head or otherwise moving it should not materially affect your perception of the above, so long as you remain seated in the listening chair. Getting up and leaving the chair should diminish the experience to no more than what you're used to from conventional stereo. If you're not certain you're hearing the full holographic effect, or that you notice a drastic diminution of it when you leave the chair, review the accuracy of the chair and speaker positionings and try again.



= CONVENTIONAL STEREO IMAGES

o = PRIMARY IMAGES HEARD WITH HOLOGRAM

( ) = REVERBERATION AND AMBIENCE OF CONCERT HALL/STUDIO (HOLOGRAM ONLY)

x = OCCASIONAL IMAGES HEARD WITH HOLOGRAM

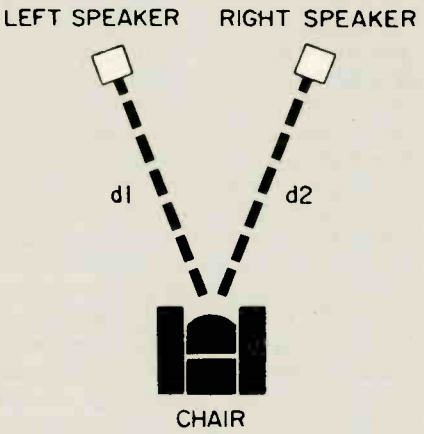


Fig. B1—Setup for sonic holography. Make d1 and d2 as close to equal as possible.

Once you've got a "fix" on the holographic experience, begin gingerly inching your speakers back toward their original locations to find out just how far you can go before unacceptable loss occurs. Be sure to keep d1 and d2 equal at all times.

One final note. The Soundsheet record is plainly not the sort of vehicle to raise expectations of ultimate sonic excellence, and indeed nothing very spectacular has been attempted or achieved on it. Thus you may find that fidelity limitations require a few mental adjustments on your part before you can appreciate the substance of what you're hearing, but you'll probably be surprised at how few will be necessary.

Sonic Holography in Detail

The block diagram, Fig. B2, shows the basic configuration of the Sonic Hologram Generator, with the various operators indicated. The injection-ratio block is actually switchable between nominal values of -3.5 dB relative to the main signal, which is the theoretically correct value for the interference signals, and -5 dB, which has occasionally been found subjectively preferable for certain installations and recordings — particularly those employing "manufactured" stereo sound from multitrack masters.

The delay introduced in the crossfeed lines is essentially 125 microseconds, but two designs incorporating the Hologram Generator permit two additional delays of 115 and 95 microseconds to be switched in as well. Working together, the three delays make the position of the ideal "stereo seat" somewhat less critical so as to accommodate other listeners.

The spectral-shaping circuitry has not been mentioned and certainly deserves an explanation. Shaping is performed both on the cancellation-signal channels and on the main channels. The contours employed are shown in Fig. B3. They were determined empirically, but once established they clearly fulfilled certain requirements that might have been predicted beforehand. At least three factors are involved:

Factor One. One of the great flaws of conventional stereo is that signals L and R_l, and R and L_r as well, as shown in Fig. 3, unavoidably interfere at the point where they are listened to, and one inevitable result is a change in perceived spectrum, which becomes different from what is actually embodied in the left and right channels of the recording. Often the recording engineer hears this when he listens to the master tape (in stereo, of course) in the process of mixing it down to final form, and he'll often attempt to "fix" it with equalization. If so, the holographic generator must "unfix" his fix, because sonic holography does not suffer such interference effects and needs no compensation for them.

Factor Two. A number of complex things happen when sound wavelengths shorten to approach the human-head dimension that produces ITDs — things that conventional

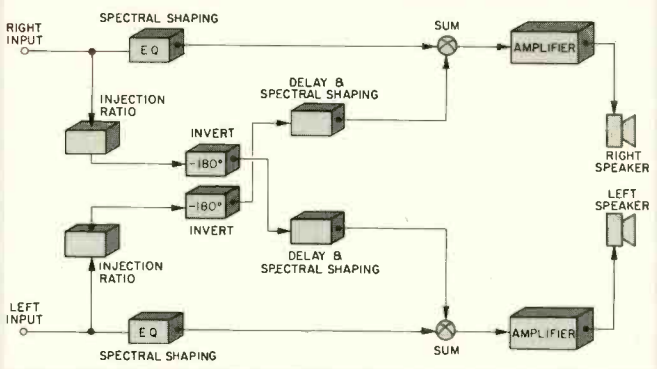


Fig. B2—Basic block diagram of the Sonic Hologram Generator.

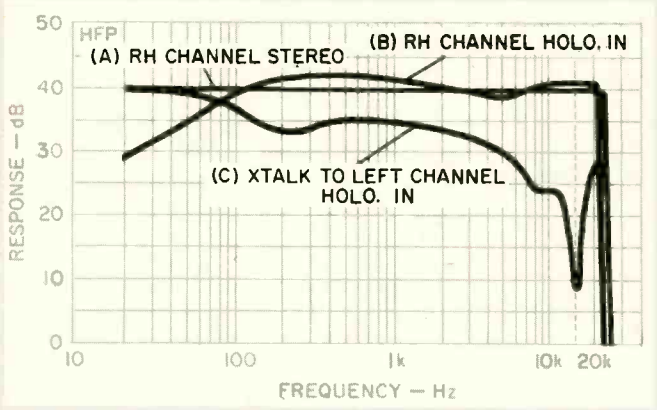


Fig. B3—Frequency shaping in the Hologram Generator: (A) Response in standard stereo, (B) contouring on main channel through Generator, and (C) relative level and contouring on crossfed signal. Chart recorder causes roll-off above 20 kHz.

stereo has never properly taken into account. First, the L and R_l (and R and L_r) interferences tend to become additive rather than subtractive, and an appreciable peak forms. Second, acoustic shadowing of the far ear by the head starts coming into its own. (You'll remember we underplayed the importance of shadowing in the reverberant-field conditions of an auditorium. However, in the direct field of nearby loudspeakers, shadowing is certain to assume a more significant role.) And third, the ear rises to its point of maximum sensitivity. The chosen contours deal with these matters in combination, in a way that properly corresponds to the spectra generated by real-life ("nonphantom") sound sources.

Factor Three. We all know and despair of what happens when deep bass is reproduced in a home listening room of typical size. The long wavelengths, confined within close room boundaries, set up large-scale interference patterns ("standing waves") with sizable fixed regions of reinforcement and cancellation. Since sonic holography works by controlling interference patterns in the vicinity of the listener at *all* wavelengths, it represents a golden opportunity to attack this problem at its roots. The low-frequency contours chosen for the main and cancellation signals are particularly effective in subduing the speaker-to-rear wall room mode — the most troublesome one in the majority of stereo installations. Note carefully that, despite casual appearances, the contours as shown do actually sum vectorially to flat response.

head around freely without risking serious anomalies. Two listeners cannot occupy the same seat, of course, but even a listener a bit removed from the prime stereo seat will experience some of the benefits, while listeners well removed will experience nothing worse than conventional stereo heard under those conditions.

I call the results of this acoustical mathematics "sonic holography" because of its obvious similarity to the sort of wave interference that creates an optical holographic image. In terms of what is perceived, there are other parallels between the sonic and optical images as well.

Experience of Holography

Those who have heard sonic holography properly presented report an impression of realism and palpability, with a good sense of depth, three-dimensionality and solidity imparted to the performance. Sound localizations occur behind, in front of, and beyond the plane between the two loudspeakers, and seem entirely natural when they do so. The sound becomes dissociated from the listening space, seemingly transported back to its original environment. Bass seems less troubled by room boundaries, and it seems to be spreading itself throughout a much larger volume of space. The experience is beyond the usual stereo but is clearly related to the best that conventional stereo can do.

Here I should anticipate a question that has probably occurred to many readers: Does sonic holography help with the many temporal problems that inevitably are built into the average recording? I don't think it does. They remain intact, just as undesirable as ever, awaiting some other kind of solution. But does that mean sonic holography will not make these undesirable records more listenable? Emphatically not.

It's my impression that many phase or time difficulties encountered in recordings are not fixed disfigurements that persist throughout both sides. Rather, I think they shift around or come and go with a sort of randomness that makes them less than blatantly obtrusive — or if they were blatant, they probably got tidied up a bit in the mix. But the problems that sonic holography aims to cure (and they have both temporal and spectral aspects) are fixed by the geometry of

the home listening situation, and as such can be thought of as extreme and permanent colorations that influence everything coming through the sound system. Alleviating them can only improve the sound of everything that passes through the system, no matter how good or bad it intrinsically is.

Work on sonic holography was begun several years ago because the intent of conventional stereo to dissociate the stereo image from the loudspeakers that were the actual sound sources seemed fundamentally unrealizable. With some recordings, played under some circumstances, you could *convince* yourself that there was genuine depth, spread and space conveyed by the image and that the loudspeakers were no more propagators of the sound than were the microphones used to pick it up originally. But a certain amount of convincing was always necessary.

Sonic holography grew as a research project when we realized that the underlying theory of stereo reproduction needed amendment if a convincing and consistent sense of space, with integrity, was to take place. The sense of space came fairly easily; there are a number of signal processors now on the market that afford it. But consistency, integrity and credibility were harder to achieve. In the end they could be gotten only with a linear device, behaving in a theoretically correct way, that addresses itself to the several crucial faults in conventional stereo and leaves everything else pretty much alone.

Conventional stereo is a deliberate illusion, and sonic holography is a deliberate illusion. Neither one is a replica of what we experience in the real world. But by all psychoacoustical considerations, I believe sonic holography comes closer to reality and I hope you can appreciate that from the theory. But try listening to it yourself. A

Editor's Note: We wish to thank Bob Carver and the Carver Corp. for the technical and financial assistance which made possible the inclusion in this issue of an Eva-Tone Soundsheet demonstrating Sonic Holography. Additional thanks to RealTime Records and the Roger Wagner Chorale for the music "Encore," RT-110, and to Boston Lettershop for the music "Chords."— *E.P.*

THE FORUM

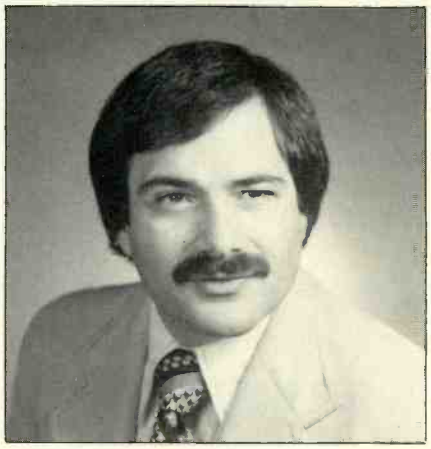
JOEL SCHWARTZ

"The Forum," which appears periodically, gives our readers the chance to share their feelings about specific areas of common interest or concern. Mr. Joel Schwartz, Vice President of Mordaunt-Short, Inc., has some comments regarding the single-brand systems now appearing in the marketplace.

New concepts seem to come in cycles, somewhat like a seven-year plague. Each time they are accompanied by their outriders, hype taking the point, with advertising and promotion guarding the flanks. In the early 1970s it was the "compact system"; in the mid 1970s it was "quadraphonic sound"; a few years back it was the micro-miniature components, and today, the audio enthusiast is being offered the single-brand system. Caveat Emptor — Let The Buyer Beware!

My father used to say that there was no one in this world who served no purpose, that the worst among us could always serve as a bad example. Though it may not be true that the single-brand system represents such an extreme, there are very few benefits in it for the consumer, some benefits perhaps, but the detriments far outweigh them. The only absolute benefit is for the first-time buyer who, for convenience sake, may choose the single-brand system. Rather than having to face an enormous and confusing smorgasbord of componentry, with almost infinite permutations and combinations, the first-time buyer can visit his local department store or discount store and find a single-brand system. The cost of this convenience is high — mediocrity.

If each single-brand system represented the best that the manufacturer had to offer, the concept might work. Unfortunately, this is not the case. When the consumer purchases a single-brand system, he is buying a manufacturer's weaknesses as well as his strengths. Though the manufacturers of one-brand systems would be loath to admit it, they do have weaknesses. Perhaps one manufacturer is better at amplifiers than preamplifiers, another better at turntables than cassette decks, and the next better at cassette decks and turntables and weaker in amplification. The single component that is weak in virtually all one-brand systems is the loudspeaker system.



Joel Schwartz, Vice President, Mordaunt-Short, Inc.

When purchasing a single-brand audio system, the consumer is buying a manufacturer's weaknesses as well as his strengths.

Loudspeakers, where accuracy, musicality, stereo image, ease of listening, dynamic range and value for dollar are to be the end result, should not ever be an afterthought to be quickly included in a single-brand system. The number of independent loudspeaker manufacturers around the world is in the hundreds. Each of these manufacturers has given his undivided attention and the bulk of his effort to the design of loudspeakers that will express his design philosophy about musicality and sound. Since we all readily admit that there is no such thing as "the perfect loudspeaker" and that all designs are one form of compromise or another, the consumer has always been the final judge as to whether the design and the execution of this design through manufacture has been successful. Now we have a number of electronics manufacturers, admittedly good at what they do best, invading another arena for the sake of convenience.

The true audio enthusiast knows better. He has always and will always demand the right to mix and match componentry to get the very best sound and value for his dollar. If this sounds too pompous, perhaps it is just that the enthusiast has always demanded the right to make his own mistakes in componentry, rather than permit the manufacturer to do that for him. Audio is the most subjective area in the consumer electronics field, and the human ear must be the ultimate judge of what is better and what is only good. If the consumer is satisfied and, over a long period of time, enjoys the sound of the system to which he listens, he has made the correct choice of componentry.

How then, you might ask, can the first-time or uninitiated buyer improve on the convenience offered by the single-brand system? The simplest and most direct way is to upgrade the loudspeakers. If the store will not or cannot accomplish this, he should go to another store, preferably to an audio specialist. How can the first-time or uninitiated buyer determine what is the best sound? It's true that the memory of sound lasts only for seconds, but there is one area of listening that travels well from store to store and is a good and true test of loudspeaker systems — stereo imaging. This dramatic and noticeable acoustic phenomenon can be defined as a field of sound produced by mixing both stereo channels to develop a definite and stable stage-like image. On vocals, the voice will usually appear directly between the two loudspeakers. The accompanying instruments will appear behind, to the left of and to the right of the vocalist, but not directly from either loudspeaker. When the consumer closes his eyes and listens, he should not know where the speakers are. If he can hear and determine where they are, the speakers are getting in the way of the music! The majority of the single-brand systems being offered today will fail this very simple and basic test, but a good loudspeaker system will not.

Seek out the loudspeaker system that offers you the musicality, image, accuracy, listenability, value for dollar and the overall pleasure that you anticipate when you purchase an audio system. Pleasure is what audio is all about. Visit an audio specialist and take the time to audition a system that he recommends, filled with different manufacturers' strengths, not a system filled with both strengths and weaknesses of a single manufacturer. It is well worth the lost convenience of the single-brand system.

HOWARD ROBERSON

NEW CASSETTES TESTED

UPDATE

This article constitutes a follow-up to the survey in the September 1981 issue of *Audio*, and covers a total of 14 formulations: Five Type I or ferric, four Type II or chrome bias, one Type III or ferrichrome, and four Type IV or metal particle. Loran's Normal/Ferric was covered in the earlier report, but improvements made in this tape since then required a second look. Sony introduced a new formulation, UCX-S, in early December, and the additions were updated versions of Denon DX1, DX3, DX5, DX7, and DXM, Scotch Master I and II, and Metafine, and TDK AD, SA-X, MA and MA-R. It should be noted that all formulations showed worthwhile improvements since their last review.

I ran the same collection of tests as for the September article: Swept frequency responses at Dolby level and 20 dB below that, maximum record levels (MRLs) at 100, 400, 1k and 2k Hz using limits determined by third-harmonic distortion = 3%, MRLs at higher frequencies using limits determined by twin-tone intermodulation (TTIM) distortion = 3%, a check on the loss in level at 15 kHz with 10 replays, the signal-to-noise ratio (without Dolby NR) with reference to the 3% distortion point at 400 Hz, the modulation noise with a 1-kHz test tone, bias, sensitivity, output-level stability, dropouts, flutter, skew and consistency. In the past, I have stated that results on my Nakamichi 582 test deck seemed to be confirmed in a relative sense on other decks. In this test cycle, I ran extensive comparisons on the MRL figures for all tapes both on the 582 and on an Aiwa AD-3600. I also included a brief look at the stability of HDL_3 with a recently received deck. This unit had shown great variations in the distortion level from moment to moment at the same time that the fundamental was stable.

In reviewing the results from the earlier survey, it was obvious that many of the -20 dB responses were almost exactly the same. This was particularly true for the Type I and Type IV tapes. A simple experiment was devised: The Nakamichi deck was adjusted for best performance with each tape using the built-in 15-kHz tone, and then pink noise was recorded and played back. The pink-noise playback was fed to a one-third octave real-time analyzer (RTA) and a storage 'scope (Fig. 1). The top-most display includes the responses of *all* Type I tapes covered in this report, plus two others run as a check. All responses were well within ±1 dB of each other. The greater spreading in the low end is partly from the characteristics of the noise and the RTA. With this result, the decision was made *not* to include responses at -20 dB, since they were all the same as long as bias was set correctly for best response.

The results with the Type II tapes (second from top) were not as consistent. Denon DX7 and TDK SA-X were exact matches, with the flattest (middle) response at 5 kHz, but curving up the most at 20 kHz. The response with Scotch Master II was slightly elevated at 5 kHz (top) and fell to zero at 20 kHz. The -20 dB responses were run for all Type IIs, with the exception of DX7 which had matched SA-X so closely. The Type III results were not an exact match (third from top), and those responses were run in each case.

The matching from one tape to the other was very close for the Type IV tapes (bottom display). The total spread was mostly the result of the statistics of the pink noise, except for a little spreading at the highest frequencies. There were no -20 dB responses plotted for this tape type. The conclusion was that the record/playback response would be as flat as adjustments to the *recorder* would make it. There are plots of the Dolby-level responses for all of the formulations, and the maximum record levels (MRLs) are plotted over them. The MRLs are listed in the table which also includes the test results, including the high-end -3 dB points for both Dolby level and -20 dB. Now, let us take a look at the results with each tape with reference to the table and the response and MRL plots.

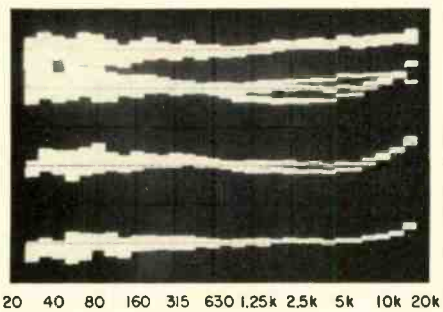
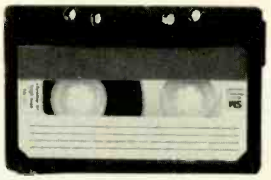


Fig. 1—Top, Type I tape responses. Second, Type II tape responses. Third, Type III tape responses. Bottom, Type IV tape responses. See text for discussion. (Vertical scale: 5 dB/div.)



TYPE I

Denon DX1: This formulation had very good MRLs, little or no skew, and was very consistent among all C-90 and C-60 samples. The modulation noise was very low, the output level was quite stable, and nothing appeared in the analyzer scans that could be classified as a detectable dropout. Overall, this is a well-performing tape.

Denon DX3: As the results show, this is very much like DX1 in most respects, but the lower frequency MRLs are higher, and that does have value. The noise level was slightly lower, but there was slightly more skew. In general, one of the better Type I tapes.

Loran Normal/Ferric: One of the more obvious changes from the earlier samples was the improvement in consistency with steady output and no skew in any of the C-90 or C-60 samples. There was some increase in the low-frequency MRLs — always welcome, as was the sizable reduction in modulation noise. Overall, one of the better Type I tapes.

Scotch Master I: This formulation delivered the highest low-frequency MRLs and the lowest modulation noise in this group, along with excellent consistency and substantially no skew. The output level was quite stable, and there were no dropouts even close to the detection threshold. This is one of the best Type I tapes.

TDK AD: The measured MRLs were very good, the modulation noise was low, and the signal-to-noise ratio matched the best ever measured for a Type I tape. There was just the slightest skew at times, with excellent consistency, in general. The output level was very stable, and there was little that could be called any sort of dropout — one of the best of all tapes in these respects. In toto, one of the best Type I tapes.

TYPE II

Denon DX7: The -20 dB response with this Denon tape was excellent, but the Dolby-level response, however, shows limited headroom, which is further indicated with the low MRLs. There was excellent consistency among all of the samples, both C-90 and C-60, and there was no measurable skew. The output level was stable most of the time, but there were occasional variations of over a dB. Overall, a typical Type II tape.

Scotch Master II: This latest version from Scotch provided high MRLs and low noise with very good output-level stability. A few dropouts appeared in the analyzer scan, but none of them approached the threshold of audibility. Consistency was very good, and there was very little skew. The -3 dB point at -20 dB was not as far out as some of the other tapes because of its particular response shape. Altogether, one of the best Type II tapes.

Sony UCX-S: Samples of this latest offering from Sony were received just in time to meet the test deadline for this survey. The results were excellent, as shown in Table I, with very high MRLs, low modulation noise, and high signal-to-noise ratio. The frequency responses were quite similar to Scotch Master II, as shown in the response plots. There was no skew observed with any of the UCX-S samples. The output level (at 3 kHz) was very steady, and there were no dropouts. This new entry, in my opinion, is one of the best of all Type II tapes.

TDK SA-X: With very high MRLs, excellent responses, an excellent signal-to-noise ratio, and low modulation noise, this formulation performed at the top of its group. Consistency was excellent with no skew and very smooth output, stable within less than 0.3 dB. This is certainly one of the best of all Type II tapes, perhaps *the* best.

TYPE III

Denon DX5: This formulation is not that of a typical FeCr, being a dual-layer ferric, and the excellent -20 dB response shows the advantage of this approach. There was some low-end to high-end droop, but much less than with most FeCr and some CrO_2 tapes. The MRLs were quite good, and the noise was low. The results were very consistent, although there was some skew. The output stability was very good, and there were no dropouts. In summary, this formulation shows some high-level headroom limitations, but, in other respects, it is a match for most Type II tapes.

TEST RESULTS

BRAND	DESIGNATION	TYPE	RESPONSE AT -3 dB (kHz) 0 dB Level	RESPONSE AT -3 dB (kHz) -20 dB Level	MAXIMUM RECORD LEVEL dB re 400-Hz Dolby Level HDL$_3$ = 3% 100	400	1k	2k	TTIM=3% 5k	10k	15-kHz 10-PLAY LEVEL dB	S/N RATIO dBA	MOD NOISE dB	BIAS dB	SENS dB
Denon	DX1	I	10.4	23.1	+3.5	+5.2	+6.8	+5.6	-1.8	-8.6	-1.0	55.2	-49.8	-0.2	+1.1
Denon	DX3	I	10.2	23.6	+5.0	+6.3	+7.1	+4.8	-1.9	-8.7	-0.5	55.3	-50.4	+0.3	+1.2
Loran	Normal/Ferric	I	10.5	24.0	+4.6	+5.8	+6.9	+5.4	-1.8	-8.7	-1.2	56.4	-48.8	+0.1	+0.7
Scotch	Master I	I	10.8	25.4	+7.5	+8.0	+7.8	+4.6	-1.4	-8.0	-1.8	57.2	-53.2	-0.1	+2.0
TDK	AD	I	10.7	23.7	+5.0	+6.2	+6.8	+4.2	-1.3	-7.8	-1.0	58.6	-49.3	+0.8	+0.3
Denon	DX7	II	8.4	25.9	+1.3	+2.6	+2.0	0.0	-6.5	-10.5	0.0	55.4	-49.2	-0.4	-0.2
Scotch	Master II	II	10.5	21.6	+5.3	+6.5	+6.5	+3.5	-5.7	-10.7	-0.3	59.7	-52.9	+0.5	+2.0
Sony	UCX-S	II	10.5	23.8	+6.7	+8.0	+8.5	+4.9	-4.0	-9.5	0.0	60.5	-51.8	+0.8	+2.1
TDK	SA-X	II	11.2	25.6	+6.3	+7.9	+8.7	+5.4	-4.5	-9.5	0.0	60.9	-51.3	+1.8	+3.1
Denon	DX5	III	7.8	24.2	+4.2	+6.2	+5.7	+1.8	-6.3	-11.7	0.0	60.1	-48.8	+2.0	+0.8
Denon	DXM	IV	13.0	25.8	+7.3	+8.9	+8.9	+5.3	-0.6	-5.0	0.0	61.2	-49.8	+4.6	+0.7
Scotch	Metafine	IV	13.2	24.6	+7.3	+8.9	+9.8	+6.2	0.0	-4.4	0.0	62.6	-51.2	+4.0	+1.0
TDK	MA	IV	13.4	26.1	+7.7	+9.7	+9.9	+5.8	+0.4	-5.1	0.0	60.9	-52.4	+4.2	+0.4
TDK	MA-R	IV	13.5	25.9	+8.2	+10.2	+11.2	+6.5	+0.7	-4.6	0.0	60.8	-54.3	+4.9	+0.8

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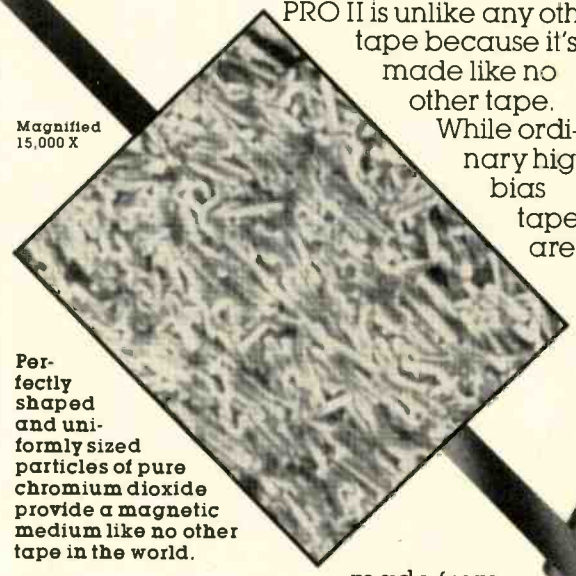

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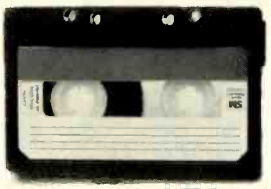


TYPE IV

Denon DXM: This metal-particle tape showed the typical type characteristics of high MRLs, extended responses, and low noise along with excellent consistency. There was no skew among any of the C-90 or C-60 samples, and the output-level stability was outstanding with no dropouts. Denon DXM is a typical, good Type IV tape.

Scotch Metafine: It had been some time since the last testing of this pioneer metal-particle tape, and there have been a number of improvements. The MRLs were good and high across the band, the S/N ratio was among the best measured to date, and the modulation noise was low. The results were very consistent with substantially no skew, and with a stable and smooth output level, with no dropouts approaching the audibility threshold. Scotch Metafine takes its place as one of the better Type IV tapes.

TDK MA: With its high MRLs, excellent responses and low noise, this formulation demonstrated the appeal of the metal-particle tapes. Consistency was the rule, with just the slightest skew in a few cases. The output level was very steady, with infrequent dropouts only halfway to the audibility threshold. In toto, a very good Type IV tape.

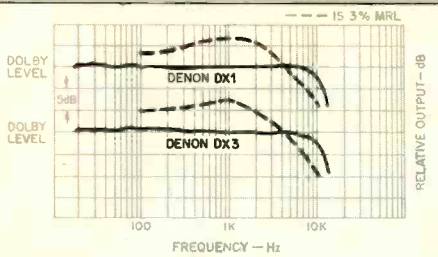
TDK MA-R: For those who might be confused, let it be stated immediately that MA-R has a slightly different formulation from MA. The major difference was that the MRLs were at least 0.5 dB higher, in general, and the modulation noise was also somewhat lower. The results were very consistent with substantially no skew. The output-level stability was very good, with perhaps 0.3 dB wander at most. There were just occasional dropouts that approached the audibility threshold. Add it all up: This is one of the best Type IV formulations.

CONCLUSION

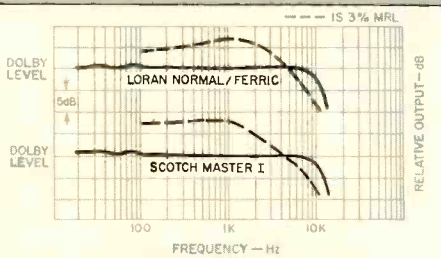
With the improvements in all formulations, there may be some basis for reconsideration of the trade-offs involved. For example, using 70-μS EQ with a Type I tape will reduce noise at the expense of headroom, and using 120-μS EQ with a Type II tape will improve the headroom but bring up the noise level. Here's another way to look at it: The *ratio* between the level for 3% distortion and the noise at any one frequency will remain the same, whatever the EQ.

With Dolby C on the scene and more decks appearing with dbx II systems, there may be more of a basis for the user to experiment with both Type I and Type II tapes and trying "the other" equalization. With either tape, it's 120 μS for better headroom or 70 μS for lower noise. There is no doubt, however, that the best results come from metal tape and a well-designed deck. A

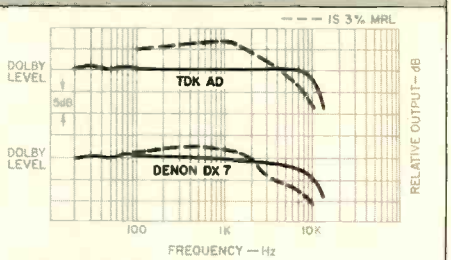
TAPE RESPONSES



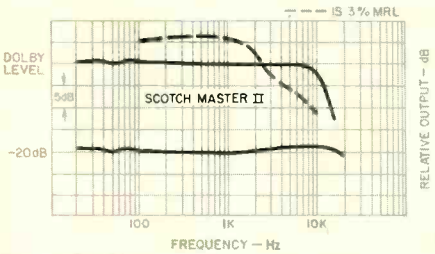
DENON DX1 (TOP) AND DX3



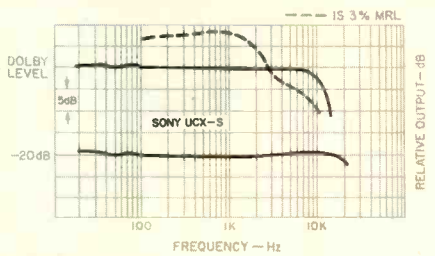
LORAN NORMAL/FERRIC (TOP) AND SCOTCH MASTER I



TDK AD (TOP) AND DENON DX7



SCOTCH MASTER II



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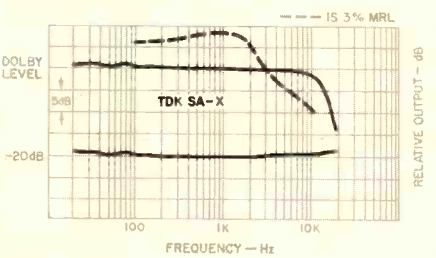

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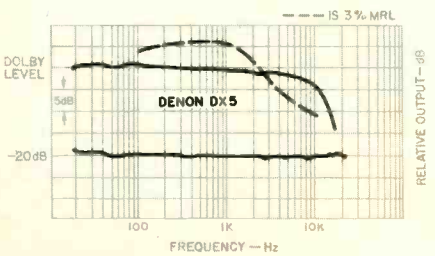
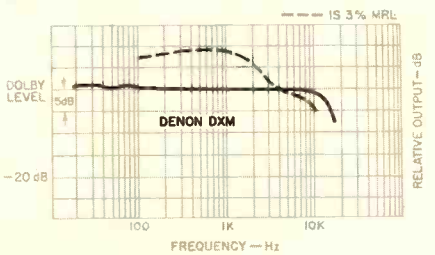


DENON DX5



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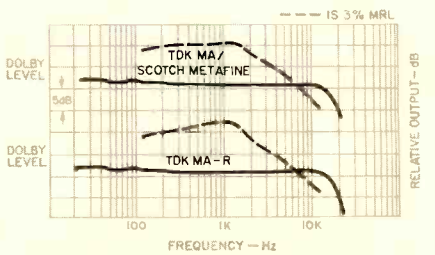

SCOTCH METAFINE, TDK MA & MA-R

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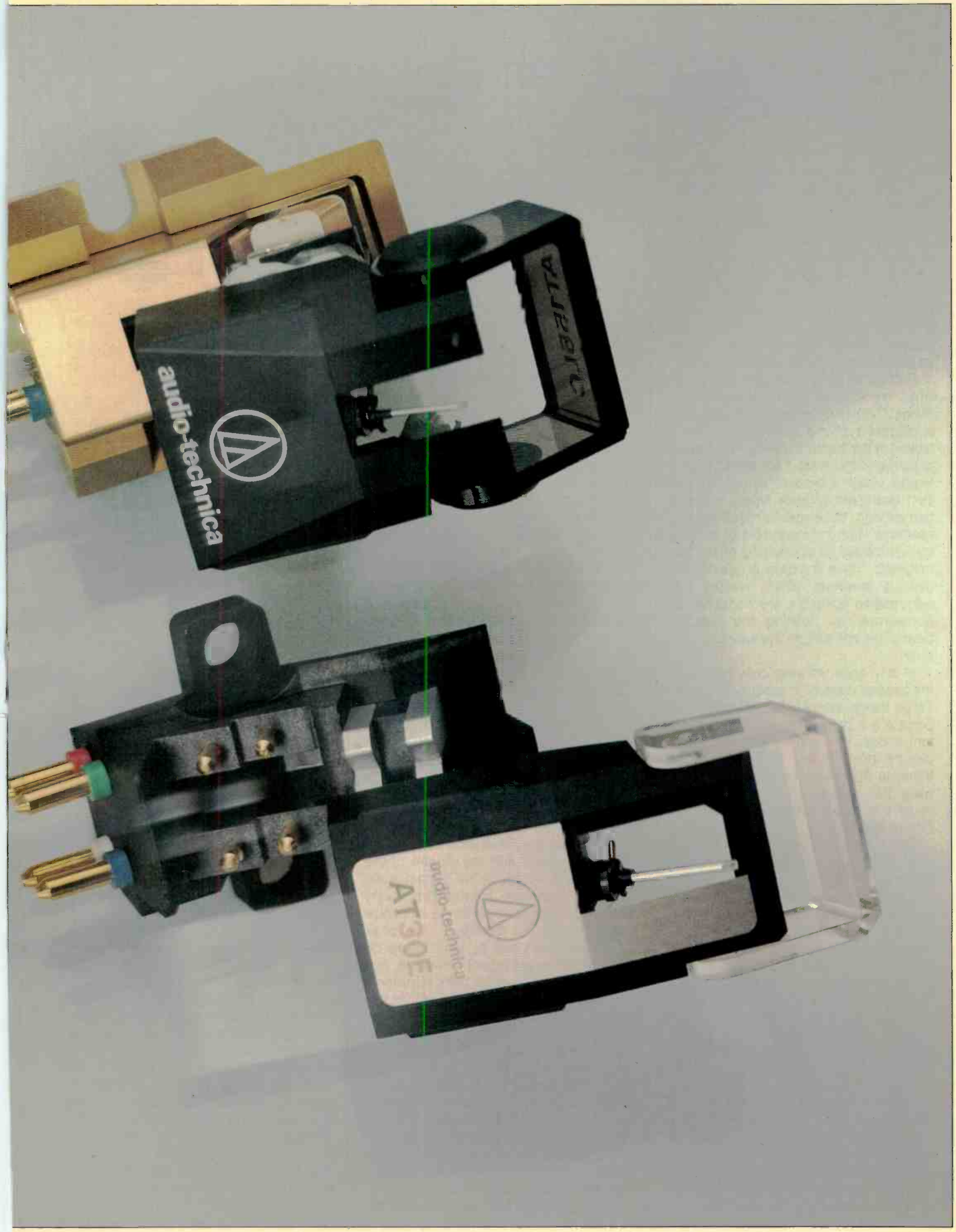
HOW PHONO CARTRIDGES WORK

PETER MILTON

The arguments over the relative merits of moving-coil cartridges versus those with fixed coils has been going on, I suspect, since Alan Blumlein developed the moving coil principle in the 1920s. There has always been a mystique associated with the delicate art of making a moving-coil cartridge, and the higher cost of production has normally led to the conclusion that the quality of the product is higher.

This may have been true when the audiophile had a choice limited to the standard groove-gougers and a custom-made product from a hobbyist-turned-manufacturer, but times have changed; high price and high precision are no longer the sole domain of the moving coil. But legends persist, and most of the moving coil's glamor remains. There are those whose flat statements lead me to believe that they would prefer a $100 moving coil to a $500 moving magnet on principle, but it is a rare listener who can hear the difference consistently under controlled conditions. It is time, perhaps, to re-examine our Articles of Faith and try to see what the basis is of the fabled moving-coil sound.

Photo: Susanne Buckler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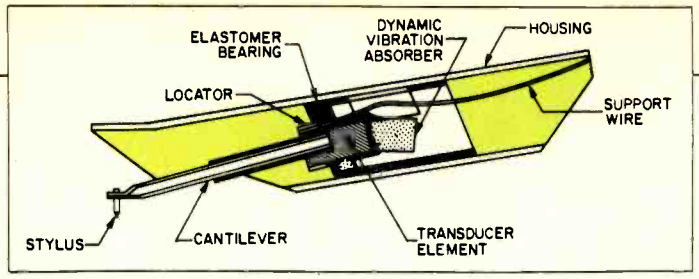


Fig. 1 — Cut-away view of the V-15 Type IV cartridge, courtesy Shure Bros.

During my research I spoke to several respected phono cartridge engineers about the practices and politics of pick-up design, attended long listening sessions, and discussed the problem with others, like me, whose reviewing activities have forced them to pronounce, in a few hours, on the patient results of years of skilled research. (The words I quote are as accurate and as near to context as possible, but the opinions are mine.)

I am often asked, usually at a party, when my mind is occupied with higher things, "Which is better, a moving-coil or a magnetic phono cartridge?" This is typical of the woolly thinking which tends to surround the topic. I am asked to generalize about a product which has brilliant examples of both types, which is bad enough, but evidently my questioner seems to regard the principle of moving-coil cartridges as something other than magnetic. There is a parallel question regarding speakers which implies that electrostatic speakers are nondynamic. Sometimes, by defining the question clearly, we are well on the way to an answer.

In any case, moving coils belong to the general class of magnetic cartridges. Three things are required: A magnet to provide a suitable magnetic field, a system of coils in which an electrical signal can be induced, and finally a stylus to translate the undulations of the groove walls into movement. The way these items are tied together determines the type of cartridge.

The moving-magnet design forms a very large subclass, and its simplicity has made it very popular. In essence, a tiny magnet is attached to the end of the cantilever which is pivoted in a ring of rubber or plastic fitted around the cantilever near the magnet. Usually a restraining or locating wire holds the cantilever assembly in place and defines the location of the pivot point. A good example of this type of construction is found in Shure's V15 Type IV, shown in Fig. 1, and Fig. 2A is a simplified diagram of the system. A soft iron core, passing through the coils, is shaped to form an air gap which intercepts the flux from the magnet.

The early moving magnets, such as those introduced by Elac, were relatively massive affairs, with magnets nearly a quarter of an inch long. The sensitivity was adequate, but the high-frequency tracking performance was very poor by today's standards. Research into new materials for magnets and into stylus design has led to a progressive reduction in tip mass and magnet size. The shape has also changed from the square section bar magnet to the minute disc used by Technics and to the dual magnet system of Audio-Technica (Fig. 3). The idea behind the variations on the theme is to reduce the moment of inertia of the moving parts, and hence the mass reflected at the stylus tip, to an absolute minimum. The approach used by Audio-Technica is to cause the magnet associated with the unused channel to rotate about its own axis. This minimizes the effective mass of the unused channel, and since a bar magnet which rotates about its axis produces no effective flux change, the separation between channels can be improved.

The broadest group of magnetic cartridges is the moving-iron type, which can be subdivided into two categories, variable reluctance and induced magnet.

The variable-reluctance types place the magnet in the iron-core system of the pickup coils; thus there is always a magnetic flux across the air gap. The stylus bar terminates in a hollow iron tube which moves inside the magnetic gap. As the iron moves from the central position, the magnetic reluctance in the gap changes and the flux linking the coils is changed (Fig. 4).

The straightforward variable-reluctance principle carries with it the disadvantage that the reluctance in the magnetic gap varies with the square of the gap spacing. Although the system is virtually a push-pull arrangement, very careful design is required to minimize second harmonic distortion. The challenge has been met by what could be called a series of Elegant Variations, one of the most successful being Ortofon's Variable Magnetic Shunt (Fig. 5). In this design a ring magnet surrounds the iron armature at the end of the cantilever. The magnetic field does not go across the gap as in the normal variable-reluctance type, but runs fore and aft, parallel to the axis of the structure, in a doughnut shape surrounding the magnet. The iron armature is therefore parallel to the lines of magnetic flux. As the armature moves closer to the inner surface of the magnet, a progressively greater proportion of the lines of magnetic flux are shunted, which changes the flux linking the coils and produces an output.

The induced magnet is an ingenious method of obtaining the linearity of the moving magnet and, at the same time, dispensing with its mass. A hollow iron armature is attached to the end of the cantilever and an external magnet induces a magnetic field into it. The field moves with the cantilever and, in turn, induces an e.m.f. into the coils wound around the soft iron poles. The advantage here is that the magnetic circuit operates effectively at zero flux for maximum linearity.

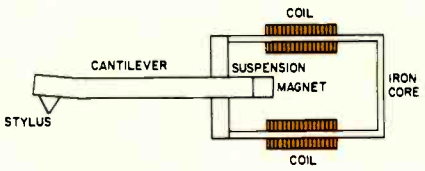


Fig. 2A — Simplified drawing of a moving-magnet type phono cartridge. (After Ortofon's "Everything You Need to Know About Cartridges.")

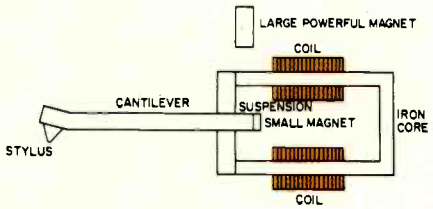


Fig. 2B — Simplified drawing of an induced-magnet cartridge. (After Ortofon.)

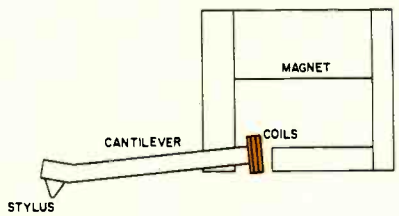


Fig. 2C — Simplified drawing of a moving-coil cartridge. (After Ortofon.)

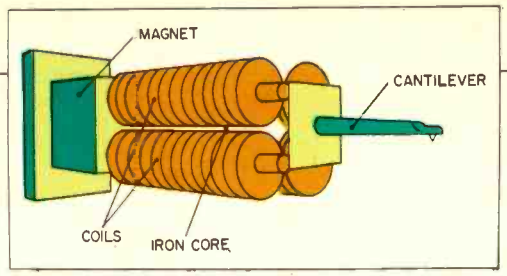


Fig. 4 — Simplified drawing of a variable-reluctance cartridge. (After Osawa's "A Consumer Guide to Phono Cartridges.")

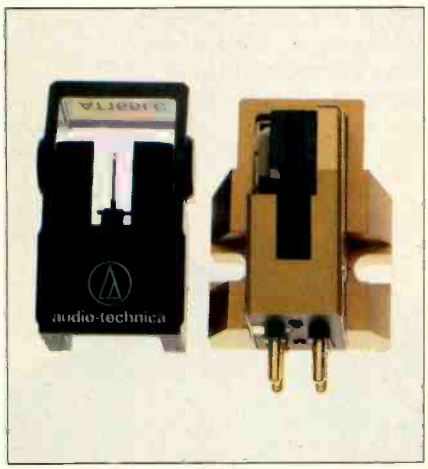


Fig. 3A — Audio-Technica's dual magnet system shown in a moving-magnet cartridge, AT155LC.
Photo: Susanne Buckler

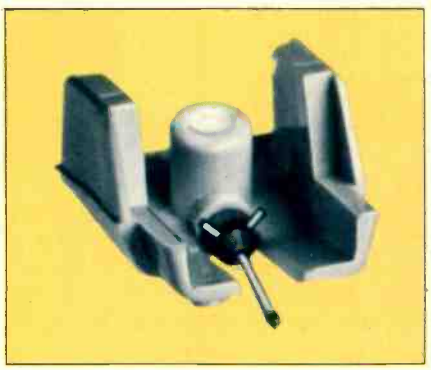


Fig 3B — Audio-Technica's dual magnet stylus assembly.

A popular example of the induced-magnet design is illustrated in Fig. 6, showing Empire's construction. The importance of zero flux in the magnetic cores is emphasized in this design, which has an exclusive method for eliminating the residual flux, as does the Sonus.

Moving-coil cartridges are almost as diverse in construction as fixed-coil cartridges. In all cases the coils are rigidly attached to the stylus bar, which usually makes it necessary to return the complete cartridge to the manufacturer when the tip needs replacement. Two examples will serve to illustrate the construction of a moving-coil cartridge. Figure 7 shows the Ortofon MC-20. The cantilever projects through one pole of the magnetic structure so that the lines of flux are parallel to it. The pivot point is just behind the pickup coils, which are wound on a flat square former. Movement in one channel causes one pair of coils to rock, which allows the flux to cut the turns and produce an output. The coils associated with the other channel twist around their central axis, which produces no output.

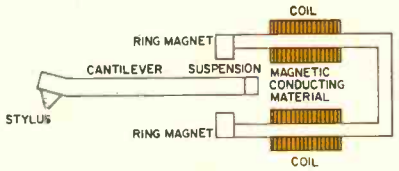
Technics uses an entirely different form of construction. The coils operate in completely separate magnetic gaps and are attached to a driving yoke so that the front view has a strong resemblance to Mickey Mouse. The magnetic field is radial, but operates over half the area of the coil so that the output is not cancelled. The inoperative channel twists around its diameter so that there is no output.

Each of the designs described has been the basis of a successful and highly respected line of cartridges. However, we have not touched on the other important features — damping, stylus construction and material, tip shape and mounting — because the point at issue is the relative merits of the moving coil versus The Rest. But let us redefine the question: Which fixed-coil is better than which moving-coil cartridge and under what circumstances? If we do not consider this, then the inescapable conclusion is that one or the other type is intrinsically better. The question was asked in a different way of James Kogan, President of Shure Brothers: Why does he favor the moving-magnet design? His reply brought in another factor. "We have thought about the moving-magnet and moving-coil approaches very carefully; we are quite capable of making a superb moving-coil cartridge. There are trade-offs to be made in both designs. We have evaluated most of the cartridges of the opposition, and we feel that the moving-magnet cartridge gives a better balance between price and performance." He then added the intriguing comment, "Of course, that does not rule out a moving coil in the future." The real progress, he felt, will be in refinements of technology rather than in a particular method of generating the output. The trade-off known as cost effectiveness is also a factor which we should consider, and if this is to be the criterion, then the traditional moving coil is inferior.

If the moving coil were better technically, then we could smugly explain the presence of the fixed-magnet types on the grounds of cost alone. However, brilliant and marginal performers are found in both categories, so the cost criterion is unacceptable. But, this does give rise to a new form of the same question.

During the November 1981 AES Convention in New York, I asked the cartridge designers: "If you were starting from scratch with an unlimited budget, what form would your cartridge take?" No clear-cut preferences were expressed. The area of cartridge design is so confined with patents that it is most likely that the designer would tend to work along lines already established by his own company.

Fig. 5 — Simplified drawing of Ortofon's Variable Magnetic Shunt principle. (After Ortofon.)



Are there no inventors out there? Well, there are, but the commercial world is competitive and nobody likes to tip his hand.

By what criteria do we judge the cartridges? Ortofon's Frits Nygaard rates the moving coil superior on the grounds of lower moving mass and improved phase response. The moving coil also has a better rise-time and its lower source impedance makes it less susceptible to amplifier interface problems.

This prompts a few specification problems. One important factor is tip mass, which is normally automatically assumed to be lower in a moving coil by reason of the ultra-miniature construction. Lower moving mass can only be taken to mean the *effective* mass as "seen" at the stylus tip, which is not necessarily the mass of the actual tip. The effective mass comprises the total mass of the moving parts — tip, cantilever, and generator reflected through the lever action of the stylus arm and pi-

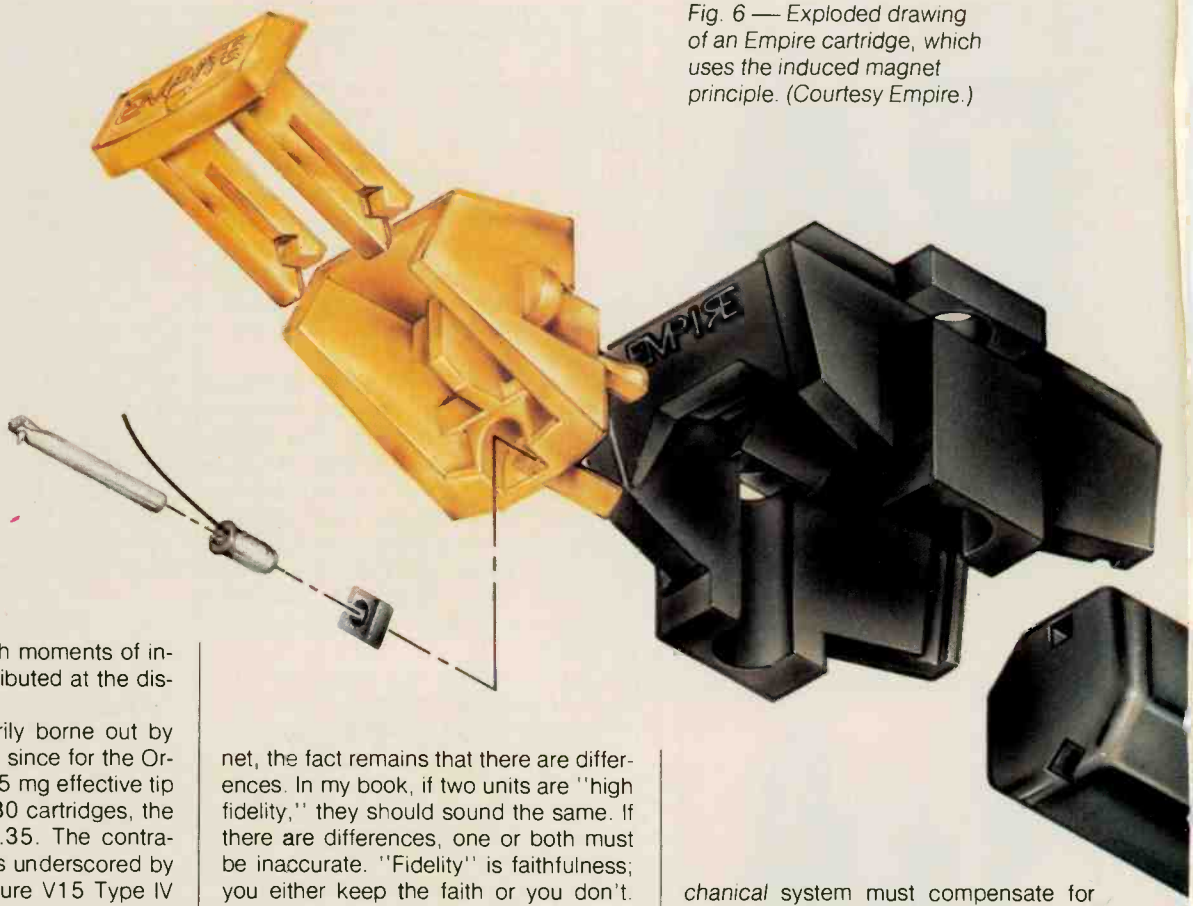


Fig. 6 — Exploded drawing of an Empire cartridge, which uses the induced magnet principle. (Courtesy Empire.)

vot. We are dealing with moments of inertia which can be distributed at the discretion of the designer.

This is not necessarily borne out by the published literature, since for the Ortofon MC-20 we find 0.5 mg effective tip mass and for their LM-30 cartridges, the effective tip mass is 0.35. The contradictory state of affairs is underscored by the 0.33 mg of the Shure V15 Type IV compared to, say, the 0.3 mg of the Technics EPS-305MC. To be fair to both camps, the 0.6 mg of Empire's 600LAC should be mentioned.

It is clear that effective tip mass alone does not account for the differences between the two methods of construction. Identical frequency responses can be obtained with a wide range of tip mass, since it is possible to juggle the effective stiffness of the record surface by changing the contact area.

However, under normal circumstances, the difference between a moving-coil and a fixed-coil cartridge can be heard. On occasion one is substituted for the other in order to achieve an acceptable sound in a hostile listening environment. For instance, when faced with a "hot" hotel room, no time to modify the acoustics, and a preamp with an inflexible high-frequency roll-off, a smart demonstrator will substitute a moving magnet for a moving coil. Whether you favor the "airy" ambience of a moving coil or the less spectacular moving magnet, the fact remains that there are differences. In my book, if two units are "high fidelity," they should sound the same. If there are differences, one or both must be inaccurate. "Fidelity" is faithfulness; you either keep the faith or you don't. Unfortunately, "high" fidelity implies different heights of excellence.

If cartridges having the same tip mass, or nearly so, can have different tonality, then we are left with phase response and frequency response.

Arnold Schwartz, President of Micro-Acoustics, in the March 1981 issue of *Audio*, indicated one possible cause of the differences in sound when discussing the cartridge output network. In his laboratories, he demonstrates the experimental setup which simulates the effect of the pickup coils, the amplifier input resistance, and the cable capacitance on the electrical frequency response of the cartridge. These elements form a low-pass filter for each type of cartridge. The higher relative resistance for the moving coil, coupled with its lower source impedance, renders it less susceptible to the effects of cable capacitance and gives it a more gentle roll-off than the fixed-coil type. Consequently, in order to extend the overall frequency response to beyond audibility, the *mechanical* system must compensate for the fall in electrical output. This can only be achieved by allowing the stylus/record system to resonate, thus producing a compensating peak. In the hypothetical cases illustrated, if the stylus resonance is assumed to be 20 kHz, then the mechanical Q of the moving-magnet phono cartridge would have to be 2, and that of the moving coil a little over 1.

Unfortunately it is difficult to achieve exact compensation in a magnetic cartridge, and the resulting curve often has a 1 to 2 dB dip between 5 and 15 kHz. The gentler moving-coil characteristic usually causes a slight but smooth rise in the high-frequency range — minor but significant differences.

The bandwidth limitations imposed by the electrical network also affect the transient response, as measured by the rise-time, significantly. If the rise-time is to be measured in terms of the reproduction of the leading edge of a square wave, then bandwidth limitations which suppress the upper harmonics will also

slow the response of the cartridge. The solution to the problem of obtaining flat response from a phono cartridge, at least from the point of view of the generating mechanism, is to make the electrical bandwidth greater than the mechanical so that the stylus assembly is freed from its compensating function.

The ultimate test of a phono cartridge is the listening test. It is almost impossible to control all factors in a listening test, but interesting results can be obtained if a large panel of listeners undertakes a series of blind tests and the responses subjected to statistical analysis. Dr. Floyd Toole of the National Research Council in Canada conducted large scale tests in Ottawa during 1980, first of all with nine cartridges and 16 listeners, and then three cartridges, selected from the first batch, with 13 listeners. The listeners were placed in the optimum stereo seats, not more than three at a time, and were cautioned against moving, since some of the differences would be subtle. They were also cautioned about the possibility of nonverbal communication ("body language") influencing the opinion of the group. The three final cartridges selected were the Ortofon MC-30, Denon DL 103D and the Shure V15 Type IV, with the tests divided into two sections — equalized and non-equalized.

Differences were noted during the tests with the non-equalized cartridges. The Denon was found to be brighter than the Ortofon, and the Ortofon seemed to sound similar to the Shure cartridge. In most of the cases the excess of high frequencies was criticized, although there were two listeners who consistently preferred the extra highs of the moving coil. The effects were noticeable only with selected good records, during certain passages and with experienced listeners, but even then, the differences were not particularly different statistically.

During the second part of the test, the Shure was equalized using a Technics 9010 parametric equalizer so that the response was within 0.2 dB of the Ortofon. Again, the results were close, with the interesting result that the moving magnet gained a slight edge over the moving coils, not so much by increasing its score on the evaluation sheet, but by causing the marks given to the moving coils to drop slightly.

It is very tempting to generalize from a test of this nature. One listener was able to pick out the moving-coil cartridge consistently and expressed a clear preference for it.

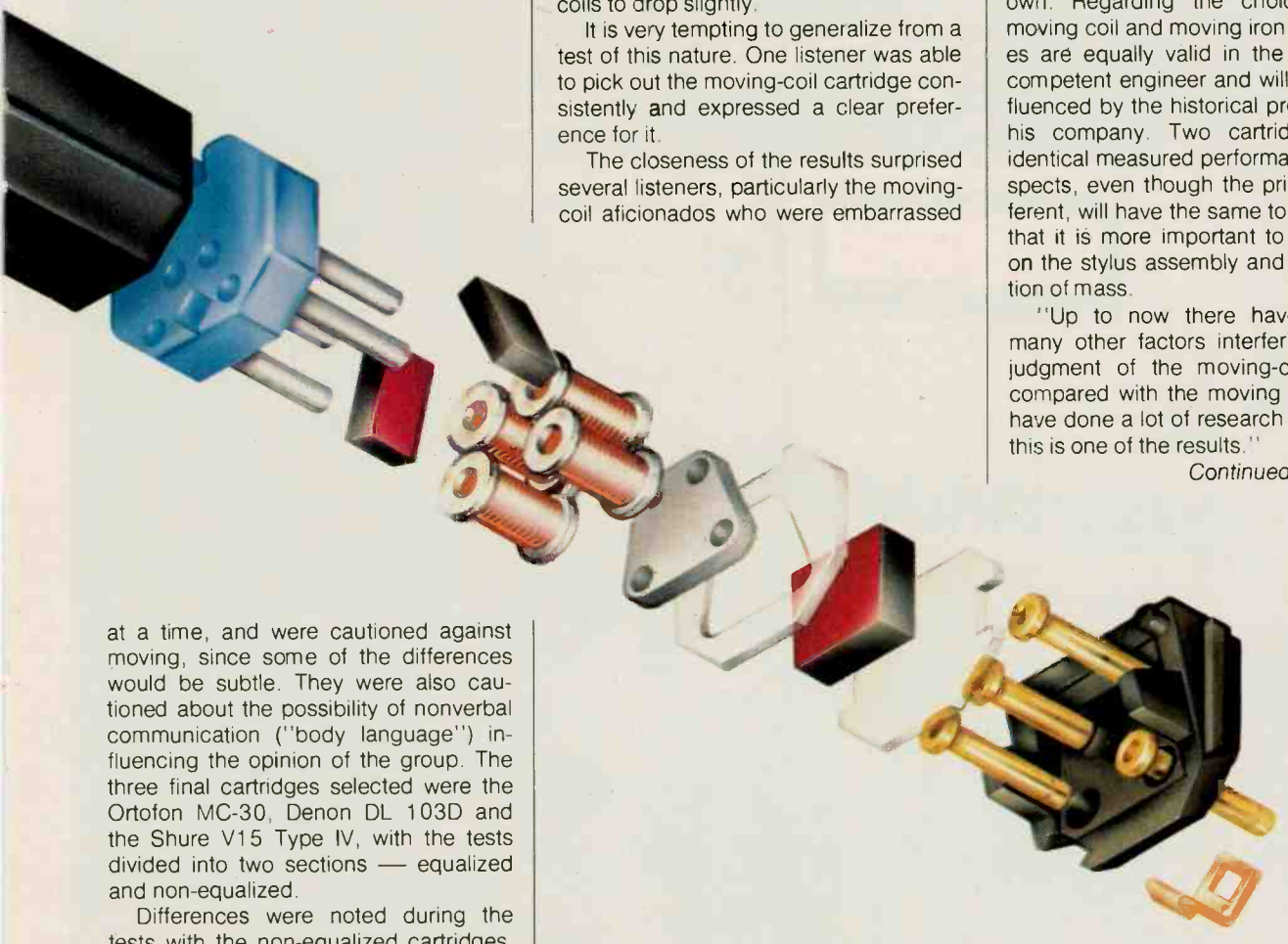
The closeness of the results surprised several listeners, particularly the moving-coil aficionados who were embarrassed to find that they had given their votes to the moving magnet!

But are these results so surprising? Many critics hold the opinion that two amplifiers having the same measured performance will have an identical sound when used under identical conditions. Any listening differences which can be proved to exist would then be the result of some parameter as yet unmeasured. Why should this not also apply to phonograph cartridges?

Mr. Shuichi Obata, General Manager of the Engineering Department for Technics, says of his philosophy of cartridge design: "The recording engineer and the performers have worked very hard to get the sound of their music into the grooves of the phonograph record. I think that it is the duty and the courtesy of the cartridge designer to extract all of this information as accurately as possible. The cartridge should have no tonality of its own. Regarding the choice between moving coil and moving iron, both choices are equally valid in the hands of a competent engineer and will likely be influenced by the historical preferences of his company. Two cartridges having identical measured performance in all respects, even though the principle is different, will have the same tonality. I think that it is more important to concentrate on the stylus assembly and the distribution of mass.

"Up to now there have been too many other factors interfering with our judgment of the moving-coil principle compared with the moving magnet. We have done a lot of research into this and this is one of the results."

Continued on page 92



1

SONY PCM-F1 DIGITAL AUDIO PROCESSOR

Manufacturer's Specifications
Signal Format: NTSC TV standard.
Coding Format: EIAJ standard (14-bit) or 16-bit format.
Sampling Frequency: 44.056 kHz.
Quantization: 14- or 16-bit linear.
Frequency Response: 10 Hz to 20 kHz, ±0.5 dB.
Harmonic Distortion: 14-bit mode, less than 0.01%; 16-bit mode, less than 0.007%.
Dynamic Range: 14-bit mode, more than 86 dB; 16-bit mode, 90 dB.
Wow and Flutter: Below measurable limits.
Input Sensitivity, 0-dB Record Level: Mike, 0.435 mV; line, 95 mV; video composite during playback, 1.0 V p-p.
Line Output Level: 95 mV.
Video Output Level: 1.0 V p-p.
Copy Output Level: 1 V p-p.
Headphone Output Level: Variable, from 50 to 775 mV.
Power Consumption: 17 W d.c.
Dimensions: PCM-F1, 8.46 in. (21.49 cm) W x 3.15 in. (8.0 cm) H x 12 in. (30.48 cm) D.; power supply Model AC-700, 4.2 in. (10.67 cm) W x 3.15 in. (8.0 cm) H x 12 in. (30.48 cm) D.
Weight: PCM-F1, 8.8 lbs. (3.96 kg); power supply Model AC-700, 6.6 lbs. (2.97 kg).
Price: PCM F-1, including a.c. power supply but not including portable VCR, $1,900.00.

Photo: Carl Zapp

When I spent several "kilobucks" just over a year ago for my latest tape and tape deck tester from Sound Technology, little did I suspect that I would run into a tape recording system that would surpass my lab measurement capabilities so soon. But that's exactly what happened to me during these past weeks as I encountered Sony's third-generation PCM digital audio processor — an incredibly small unit that's styled very much like that company's newest portable videocassette recorder, the Model SL-2000, which I used as the tape-transport system in my tests of the audio capabilities of the new PCM adaptor. Long-term readers of *Audio* may remember that we tested the very first PCM adaptor made by Sony (Model PCM-1) more than two years ago. That device was superseded by the PCM-10 shortly thereafter, largely as a result of a Japanese industry (EIAJ) standard having been developed and approved for such video-related PCM audio processors and of Sony's desire to conform to those standards.

The new digital processor, PCM-F1, tested here, features two high-performance ICs recently developed and now being mass produced by Sony: The CX-889 A/D (analog-to-digital) converter and the CX-890 D/A converter, which is also the LSI to be used in Sony's compact disc player. (A compact disc is shown on the cover with the PCM-F1.) Until the development of these new ICs, monolithic chips of this type and complexity were difficult to produce, and the yield was very low. Sony's success in producing these devices at lower cost is part of the reason for the relatively low cost of this new PCM processor. (The older PCM-1 and the later PCM-10 both carried suggested retail prices of around $5000.00 in this country!)

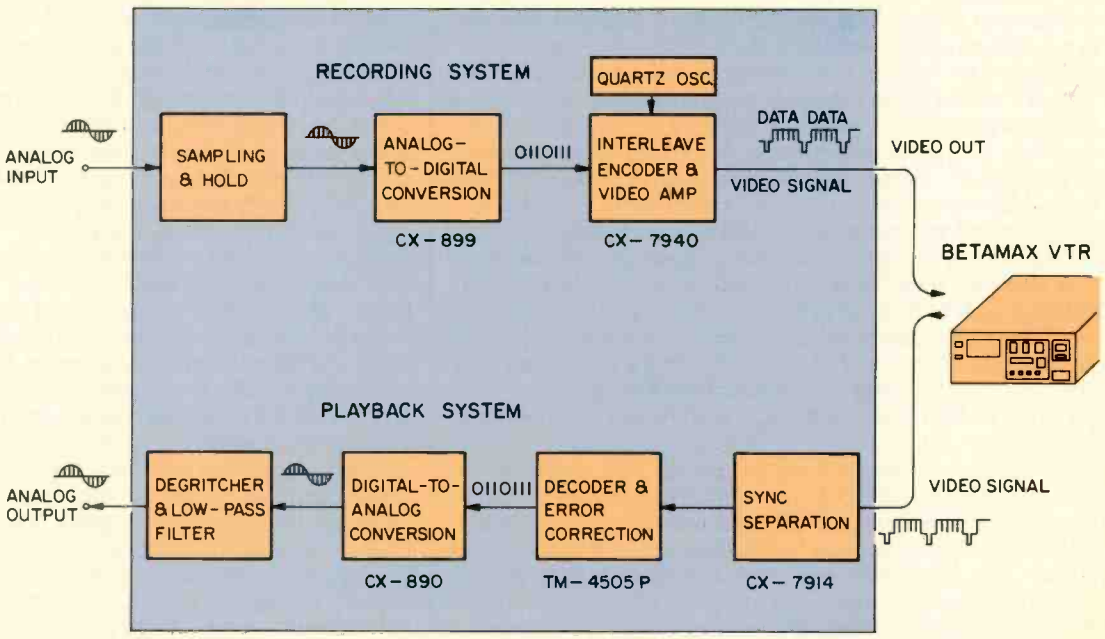
The PCM-F1 also incorporates three new LSIs (one for recording and two for playback) which process digital signals, performing the encoder, sync-separator and decoder functions shown in the block diagram of Fig. 1. The new LSIs were developed jointly by Sony, Sanyo and Toshiba in early 1981, replacing hundreds of ICs previously used in earlier digital processing circuitry. It is the use of these and other ICs that has made possible reduction in the volume and weight of the new PCM-F1. By way of comparison, the PCM-F1 is one-eighth the volume of the PCM-10 and one-fifth the weight; best of all, it sells for about one-third the price.

A typical hook-up for the PCM-F1 is illustrated in Fig. 2. In this diagram, supplied by Sony, the portable VCR shown is the incredibly lightweight, small SL-2000 Betamax unit, and indeed, that VCR makes an ideal companion for the PCM-F1 processor. However, I am sure that Sony is not implying other VCRs can't be used with the PCM-F1; to prove this, after I was through checking out the PCM-F1 with the Betamax SL-2000 and its companion TT-2000 tuner-timer, I hooked up the PCM-F1 to another VCR which uses the "other" format and the PCM-F1 did just as well. All VCRs in the U.S. must be able to deal with an NTSC TV signal format, and that's what the video output jack of the PCM-F1 supplies. I am sure it would work well even with the *third* VCR tape format — the one that uses ¼-inch, smaller videocassettes, in case you just happen to own one of *those*.

Control Layout

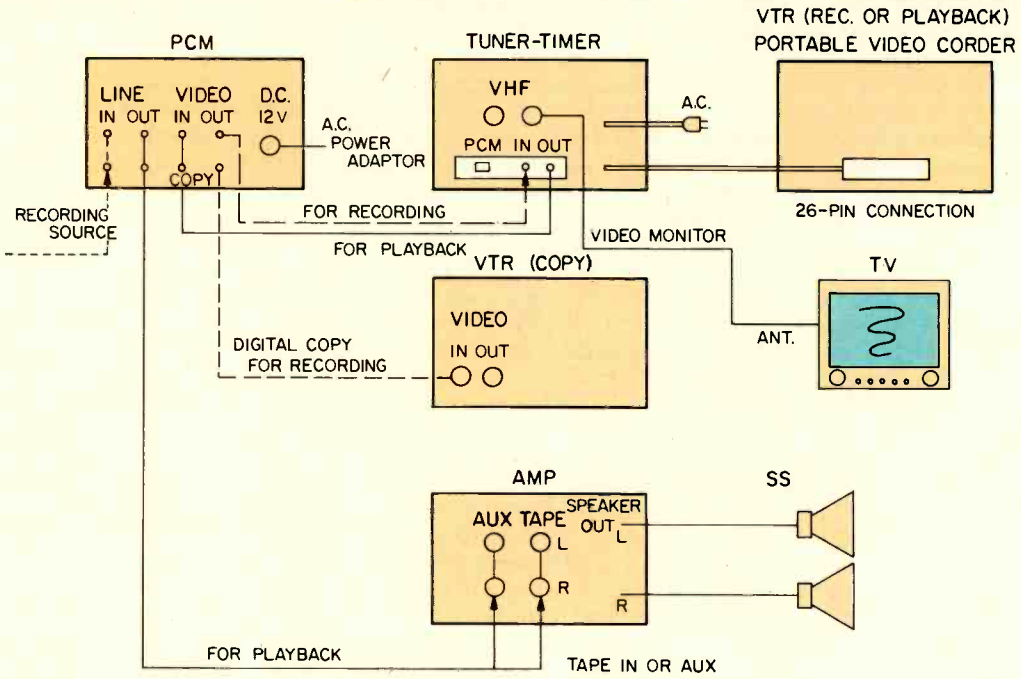
The PCM-F1 can be powered in a variety of ways; for example, you can hook it up via the a.c. power supplied by the Sony TT-2000 tuner-timer. You can operate it from battery power or even from a car battery (using an optional cable). And, as in my case, you can power it from its supplied a.c. power supply, the Model AC-700, in which case the TT-2000 tuner-timer would be available to power the portable SL-2000 VCR which I used first in my tests. If all of that seems very complicated, it isn't — once

Fig. 1 — PCM audio processor, block diagram.



It's clear that
PCM digital recording
is the sound source
of the future.

Fig. 2 — Digital audio PCM system connections.



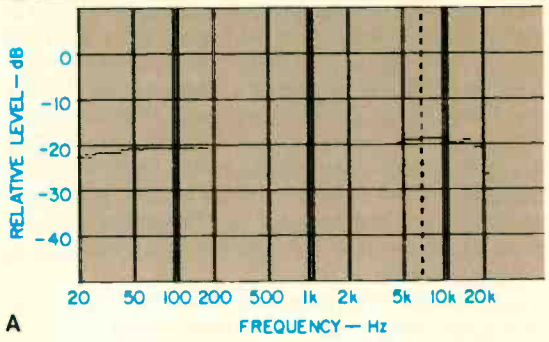
you have all the pieces in front of you and read the diagrams in the owner's manual.

An enumeration of the front panel controls will aid in appreciating the sophistication of this PCM processor. At the left we find a power on/off switch, and just below are a headphone attenuator switch and headphone jack, by means of which you can monitor material being recorded (during the recording phase) as well as playback. A major portion of the left section of the panel is given over to expanded scale LED record/playback level meters (calibrated from below -50 dB to 0 dB and "over record" indications) for left and right channels. Below these scales are several indicator lights; *Mute* lights up if the associated VCR is mistracking or skewing tape or if there are excessive dropouts. *Emphasis* illuminates automatically for all tapes made or played on the PCM-F1. Tapes made on other processor/VCR combinations which may not incorporate pre-emphasis for improved S/N and played on this machine will automatically be played without the de-emphasis circuitry, and the *Emphasis* light will not illuminate for such tapes. Some tapes may have a "copy inhibiting" code included and, if that is the case, the *Copy Prohibiting* indicator on the front panel will light. Finally, a *Tracking* light comes on when you adjust the tracking control on the associated VCR. The right-channel meter scale assists in achieving correct tracking when a *Meter* button at the right of the panel is depressed to select that function.

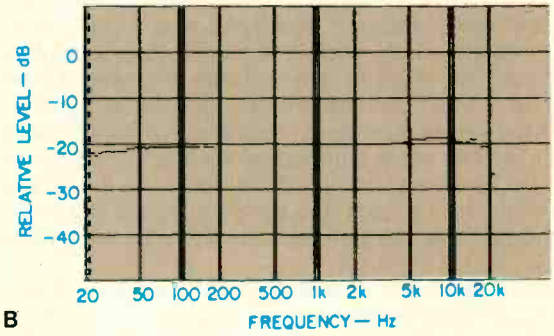
Controls along the right section of the front panel include individual left- and right-channel record level controls, a momentary record/mute button, the meter-function selector button, peak-hold and reset buttons for the meters, and a battery-check button. Tiny toggle switches below the touch buttons choose muting on/off, copy on/off and mike/line inputs. Left and right microphone input jacks are located at the lower right corner of the processor. The muting switch is normally left in the *On* position to guard against possible dropout noise bursts which, if not squelched, could conceivably cause amplifier or speaker damage. If you are sure of a perfect, dropout-free tape, however, this automatic muting feature can be defeated with the muting switch.

Left- and right-channel audio line-in and line-out jacks are found on the rear panel, along with video in and out jacks (these connect via supplied cables to the VCR being used with the processor), and a *Copy Out* jack. When the *Copy* switch on the front panel is activated, an error-corrected signal is available at this output for copying from one digital tape to another. In other words, the signal remains in digital (albeit error-corrected) form at this output jack. Also located on the rear panel is a resolution switch, with positions for 14-bit or 16-bit. I suspect that this is a bit of individuality being exhibited by Sony, whose experience in digital audio processing is extensive. Perhaps what they are trying to tell the rest of the industry is that, despite the fact that the EIAJ-approved standard calls for a 14-bit linear quantization format, Sony's advanced technology permits a finer, 16-bit encode/decode approach for even greater dynamic range and lower distortion. What it all means is that if you should come upon a tape made on any other PCM processor/VCR combination, the PCM-F1 will automatically play it back using the correct EIAJ format. However, in making your own tapes on the PCM-F1 (plus a VCR) you can either use the EIAJ format (if you intend to give tapes to others whose machines may only have EIAJ decoding) or the somewhat superior 16-bit format of which the PCM-F1 is capable. If you opt for 16-bit for your own recordings, you would put the switch in the position that indicates 16-bit recording. Again, in playing back, the position of the switch is not important — the circuitry detects the mode used.

The PCM-F1 is one-eighth the volume, one-fifth the weight, and one-third the price of Sony's previous digital audio processor.

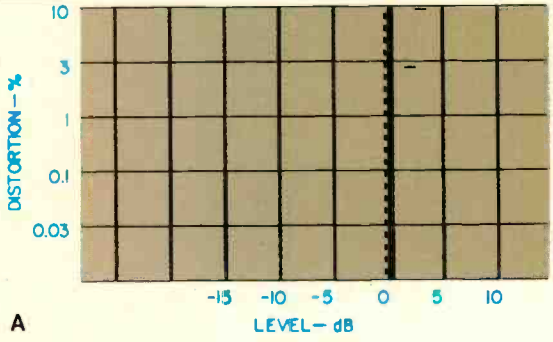


A

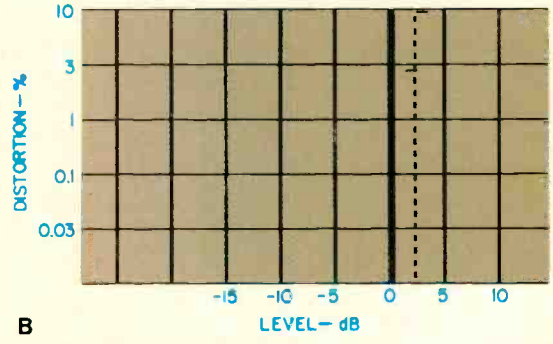


B

Fig. 3 — Frequency response at 0-dB record level, 14-bit mode, with cursor set to show "worst case" deviation from flat response at treble end (A) and bass end of spectrum (B).



A



B

Fig. 4 — At 0-dB record level, distortion is virtually unmeasurable on Sony's PCM-F1 processor (A), but unlike analog tape recording, 3rd-order HD rises rapidly when record level maximums are exceeded (2.8% at +2 dB).

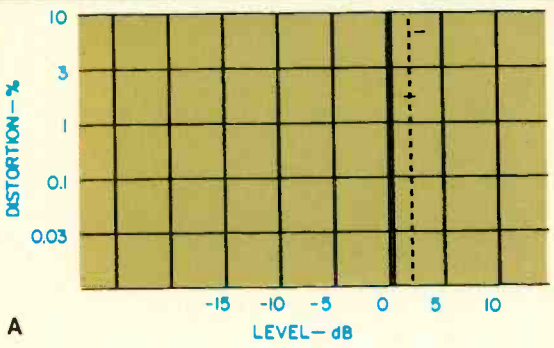
A couple of interesting asides before we get down to the performance specifics of the PCM-F1. Sony recommends that if a Beta format VCR is used with the processor, only Beta I or Beta II speeds should be used. In most cases, that pretty well restricts things to Beta II (only professional Beta-format machines include the Beta I speed). I surmised that if you were to use a VHS VCR with the PCM-F1, that would mean staying with the SP (2-hour) speed, which is what I did when I later tried the PCM-F1 with that alternate type of VCR. Sony also suggests not using anything longer than an L-500 tape package (again, referring to the Beta format). I used L-500, L-250 and L-125 tape packages in my experiments using the SL-2000, and all produced excellent results. (I followed Sony's advice, and did not try using an L-750, for fear of possible dropouts due to thin base material and thin magnetic coatings.) In my experiments with a VHS VCR, I did try T-90 and T-60 tape packages with perfect results. I also tried a few T-120 tapes and found that a few dropouts did occur with some of these. In this regard, of the T-120s tested, Fuji, TDK, JVC and Maxell videocassettes offered best results. All tapes worked well in the T-90 and T-60 lengths, however.

Measurements

One thing the Sound Technology 1500A audio tester was able to do quite adequately in measuring the performance of the PCM-F1/VCR combination was to depict record/play frequency response. Note that in Fig. 3 I have expanded the vertical scale so that each division represents only 2 dB of amplitude change (as opposed to my usual presentations which use a scale of 10 dB/division). In Fig. 3A I moved the dotted-line cursor to the point of maximum deviation from flat (it occurred at 6.9 kHz), which turned out to be an insignificant peak of three-tenths of one decibel (+0.3 dB). In Fig. 3 I sought out the greatest deviation from flat response at the low end, and that turned out to be a half decibel (-0.5 dB) at 21 Hz! Note, too, that these measurements were made at "0 dB" record level, as indicated on the PCM-F1's LED metering system. Imagine ever getting results like that from any analog tape recording system at that recording level! Such is the beauty of PCM digital tape recording!

Next I tried to measure third-order (D3) harmonic distortion as a function of recording levels; results are depicted in Fig. 4. Note that with the cursor set to reference "0 dB" record level, the third-order distortion reading (in Fig. 4A) is 0.01%. In fact, it's probably lower than that, but I happen to know that the Sound Technology tape tester has a test signal with about that level of residual distortion. However, Fig. 4B shows us an important lesson about all digital (PCM) recording systems: Once you go OVER the maximum permitted recording level (in this case, 0 dB on the PCM-F1's level meters), things get pretty horrible pretty quickly. Expressed in oversimplified terms, there aren't enough "bits" to accommodate such signal amplitudes, so the system

Finding source material good enough to "show off" this magnificent recording system's capabilities was difficult.



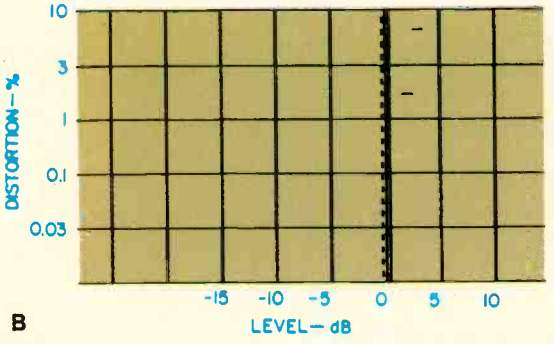


Fig. 5 — A slight improvement in 3rd-order harmonic distortion was noted when 16-bit mode is used on Sony PCM-F1 (A), but so long as recording level does not exceed 0-dB (B), 3rd-order HD is insignificant in both 14- and 16-bit modes.

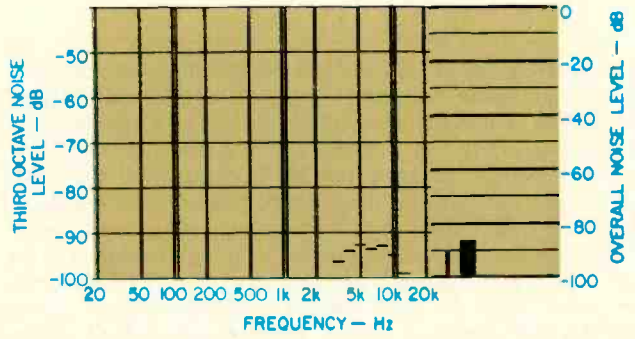


Fig. 6 — Have you ever seen this sort of S/N figure for a "tape recorder" before? The 86.1 dB (below 0-dB record level) is actually the residual noise of the test unit!

encodes with gross levels of error, i.e. distortion. Even as little as a +2 dB of overrecording resulted in third-order distortion levels of 2.8% (Fig. 4A). Had I gone to +3 dB (moving the cursor one more space to the right), we'd intersect a dash-line near the top of the display in Fig. 4A which denotes almost 10% third-order distortion! The lesson, of course, is that even though PCM recording offers vastly greater dynamic range and vastly improved signal-to-noise ratios, these benefits must be taken at levels from "0 dB *downward*," and the concept of "headroom above 0 dB" (which we've all become accustomed to in analog tape recorders) no longer applies.

I was curious to learn whether operation in the 16-bit mode would provide measurably better performance (not that there was anything that I could possibly criticize in the 14-bit results obtained thus far). So, I repeated the distortion measurement using that alternate quantization format and, sure enough, at the +2 dB (overrecord) level, where I had previously observed a third-order distortion of 2.8%, I now did read a somewhat lower 1.7% (see Fig. 5A). My attempts to detect improvement at other, *legal* recording levels were again frustrated by the limitations imposed by the test signal provided by the Sound Technology tester. As you can see from Fig. 5B, the best I could read was 0.01% (even though I'm quite sure that Sony's claim to a somewhat lower 0.007% is well founded and no doubt substantiated in their labs).

I ran into the same sort of test equipment limitations when I tried to measure signal-to-noise ratios for the PCM-F1/SL-2000 combination. I thought I was getting a totally accurate reading of 86.1 dB, as displayed in Fig. 6 (and was all set to exclaim "Gotcha!" to Sony for claiming 90 dB or better in the 16-bit mode), until I disconnected all inputs and outputs to the tester and asked it to measure signal-to-noise ratio (relative to the same previous reference level, of course). As you've probably already guessed, the tester *still* read -86.1 dB or so. The only reason I'm showing you the video printout of this test is because it's probably the first time you will have ever seen a signal-to-noise ratio of any audio tape recording system that exceeds 85 dB and doesn't require any sort of external electronic noise-reduction system!

By this time, having become very nearly totally frustrated with my inability to measure the superb performance levels of this PCM recording system, I tried to measure wow and flutter, and the "smart" test machine told me to forget it by explaining that the "signal (is just) too low." So all that remained for me to do was to measure the audio input sensitivities and output levels of the PCM-F1, and all of these turned out to be pretty much as specified.

Use and Listening Tests

Abandoning the lab bench, I was now ready to try my hand at some actual PCM stereo recording. I was, as in previous PCM recording experiments, immediately confronted with the problem of finding source material that would be good enough to "show off" the capabilities of this magnificent recording system. My editor summarily dismissed my request that he send a 50-piece orchestra to my home so that I could record some wide-dynamic-range live music. Nor was I afforded special permission to set up this equipment at one of the more prestigious concert halls in New York City. That left only two possible alternatives; first, I sang my heart out, using one of my better microphones

During the listening tests, the PCM-F1 neither added nor subtracted *anything* that was audible.

(one I normally use for calibration purposes). When I played back my own performance, it was clear that PCM digital recording is the sound source of the future. No background hiss! Not a bit of pitch wavering (other than the natural kind inherent in all good voices) and no *added* distortion that was discernible. The recorded songs were limited strictly by the quality of the mike, the amplifiers used, the speakers, and — of course — the performance itself!

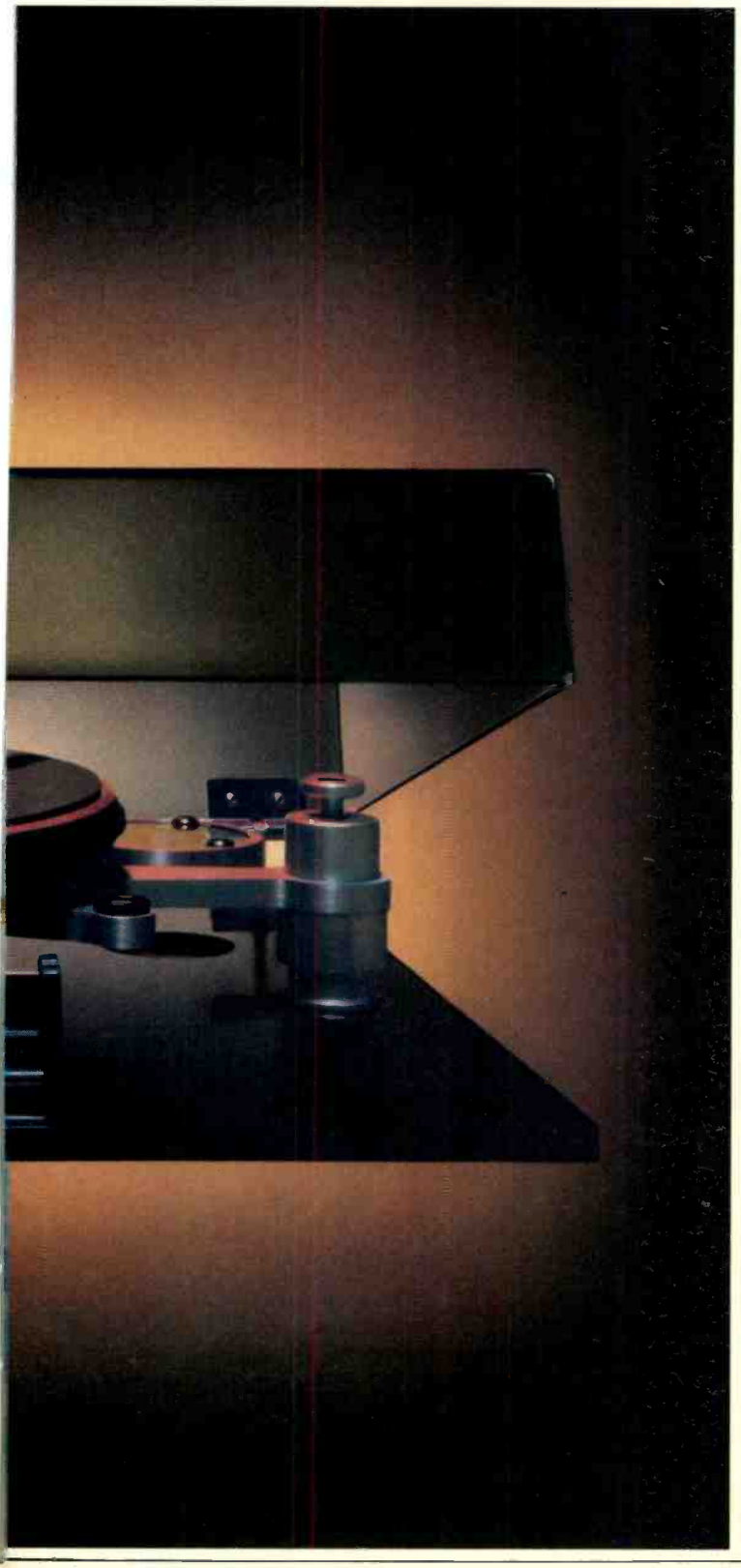
On to my second experiment! As in previous tests of earlier PCM processors, I resorted to dbx-encoded discs. By first decoding them and using the expanded, decoded results as source material to be recorded in digital form using the Sony PCM-F1/VCR combination, I would have a variety of musical source material with enough dynamic range and with inaudibly low record surface noise so that I could judge the quality of the PCM recording process. Since I have a rather large collection of dbx-encoded discs, I must confess that I am *still* engaged in this process. From what I've heard so far (and this setup makes for an easy form of direct A-B comparison between the decoded dbx disc played back directly and the PCM-recorded version of the same decoded disc material), I can say with absolute certainty that I can hear no difference whatsoever between these two forms of the same program source. This suggests that the PCM-F1 is neither adding nor subtracting *anything* that is audible to this listener. Of course, the experiments may take several more weeks to complete. During that time I will absolutely have to hang on to the PCM-F1, the Sony SL-2000 VCR, and the companion TT-2000 tuner-timer and a.c. adaptors. I hope Sony isn't in too much of a hurry to get them back. It's for the benefit of *science* after all! *Leonard Feldman*

Enter No. 90 on Reader Service Card

2

ORACLE TURNTABLE

Manufacturer's Specifications
Speeds: 33⅓ & 45 rpm.
Selector Method: Pushbuttons.
Motor Type: 24 volt d.c., Hall effect.
Motor Mounting: Direct to main chassis, isolated from subchassis.
Drive System: Belt.
Bearing: Tungsten carbide.
Suspension: 3 tapered springs.
Platter Diameter: 11⅞ inches.
Platter Weight: 6 lbs. (2.7 kg).
Platter Material: Magnesium alloy.
Tonearm: Not supplied.
Dimensions: 19 in. (482 mm) W x 14½ in. (368 mm) D x 6¼ in. (158 mm) H.
Total Weight: 22 lbs. (10 kg).
Power Required: 100-130 V a.c. 50-60 Hz.
Ground Wire: None.
Price: $1,095.00.



In recent years, it has been shown that turntables greatly affect sound quality, but correlating sonic performance with laboratory measurements still needs much experimentation. Conceptually, a turntable that contributes little coloration or distortion to the reproduced sound should present a difficult measurement problem, and the Oracle does exactly that, thus deserving its reputation for high performance capability.

The Oracle's appearance suggests, and its performance verifies, that it is not an ordinary turntable. The suspension towers, which support a skeletal subchassis, combined with the smoke-colored main support chassis and the hinged dust cover, impart a distinctive appearance. The attention to detail and care of finish, and even the well-designed protective packaging, exhibit a substantial amount of pride in manufacture.

Each of the three support towers (shown cut-away in Fig. 1) encloses a spring of a different stiffness. The reasoning here is that since the mass of the turntable and tonearm are distributed unevenly, the stiffness of each support should be different. When the proper springs are used, the whole subchassis, platter and tonearm should move up and down evenly, without rocking motion or rotational modes.

Figure 2 shows the unusual design of the subchassis — a seven-layer laminate consisting of four layers of magnesium-aluminum alloy separated by three layers of a special bonding substance, which absorbs internal vibrations. The tonearm mount is a round acrylic disc which can be changed for different tonearms without much difficulty. The manufacturer recommends that the tonearm be fastened securely to the platform without any compliant interface, such as a rubber washer, between them. When the record is clamped firmly to the platter (as it is with the Oracle system) and the phono cartridge is mounted in a stable tonearm with good bearings, the whole assembly moves together as a unit, which is as it should be. I used The Arm from Sumiko for testing.

The Oracle incorporates other interesting features which are designed to achieve what Trans Audio calls Groove Isolation. Part of this isolation is accomplished by clamping the record to the turntable mat with a screw-down clamp, as shown in Fig. 3,

MEASURED DATA

Serial No.: 2413

Specification		**Speed**	**Measured**
Speed Accuracy		33.3	2.5% slow
		45.0	4.0% slow
Speed Stability		33.3	0.213%
Wow	DIN unweighted	33.3	0.25%
	DIN weighted	33.3	0.12%
Flutter ..	DIN unweighted	33.3	0.07%
	DIN weighted	33.3	0.07%
W&F	DIN unweighted	33.3	0.25%
	DIN weighted	33.3	0.13%
Rumble	Unweighted	33.3	-66.8 dB
	"B" weighted	33.3	-82.0 dB
Suspension Resonance			3.5 Hz as specified; moderate "Q"

1939...FIRST DIRECT-DRIVE TURNTABLE SYSTEM.
1951...FIRST MOVING-COIL CARTRIDGE.
1972...FIRST DIGITAL (PCM) RECORDING.

Direct drive. Moving-coil. Pulse Code Modulation. All synonyms for technological innovation in the high-fidelity field, these phrases fill the pages of the audio magazines and the conversations of serious music enthusiasts. But aside from being major breakthroughs in audio engineering, they have one other element in common. They are all innovations developed by one company. Denon.

While other companies have just begun to offer products incorporating these new technologies, Denon originated them. And only Denon has had 41 years to refine direct-drive turntables, 29 years to perfect moving-coil technology, and almost a decade to further develop their invention of PCM digital recording.

1982...DENON DRA-600. THE FIRST RECEIVER FROM A TRUE AUDIOPHILE COMPANY.

The Denon DRA-600, a synthesis of Denon's greatest technological strengths. From our thirty years of experience with moving-coil cartridges, we gave it a moving-coil preamplifier stage sonically as transparent as our renowned separate head-amps.

From our fifty-plus years of electronics design experience, we powered the DRA-600 with a proprietary Denon Class-A power amp, a design that delivers unparalleled definition and openness, yet avoids the excessive heat, size and cost of traditional Class A amplifiers.

And, from our decade of experience since our invention of commercial digital recording (PCM), we equipped the DRA-600 with a digitally synthesized tuner stage for the most precise station tuning with the lowest distortion. Plus we added the convenience of eight AM *and* eight FM presets with automatic station scanning. The DRA-600 from Denon, where innovation is a tradition.

Enter No. 8 on Reader Service Card

DENON

Imagine what we'll do next.

Denon America, Inc.
27 Law Drive, Fairfield, N.J. 07006

The Oracle's appearance suggests, and its performance verifies, that it is not an ordinary turntable.

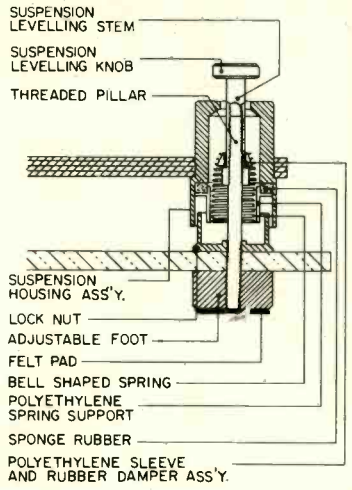


Fig. 1—Cut-away side view of one suspension tower, showing detail of spring mounting.

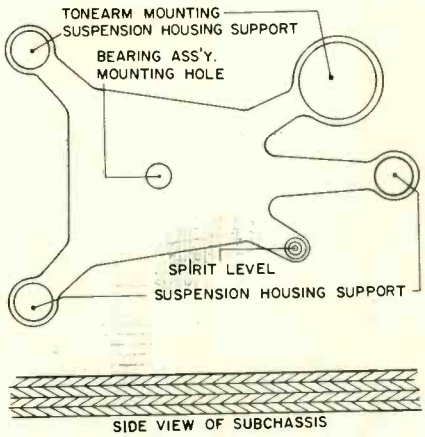


Fig. 2—Side and top views of the subchassis show the unusual design and construction.

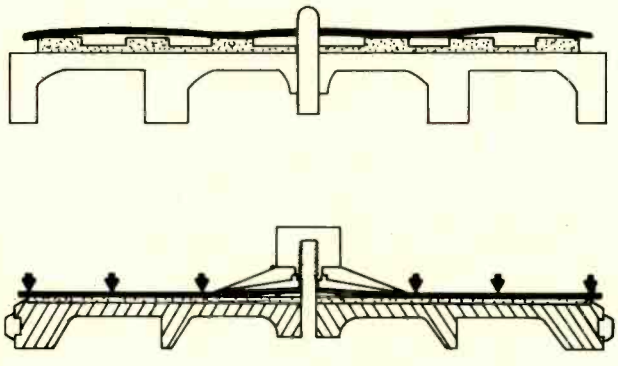


Fig. 3—Top, warped record on an ordinary platter; bottom, clamp system used in the Oracle.

which allows dish-warped records to be flattened and fastened securely. The mat is made of a special composition designed to absorb mechanical vibrations from the record. These vibrations, a result of the stylus interaction with the record groove, have been largely ignored until recently. Such vibrations travel back and forth within the record, forming delayed reflections of mechanical energy, which, if not damped quickly, are picked up by the stylus and blur the detail of reproduced sound.

Another source of unwanted mechanical energy is caused by the normal bell modes of a turntable platter. To absorb this energy, the outer rim of the Oracle's platter has a band of relatively hard rubber the firm calls a Peripheral Wave Trap. My experience with damping the vibrational modes of loudspeaker diaphragms has taught me that this is an excellent way to deal with turntable platter resonances and, indeed, the Oracle has the deadest platter of any I have tested.

The Oracle's unweighted rumble was −66.8 dB below the 10-cm/S lateral groove modulation reference. The rumble using DIN "B" weighting was −82 dB. Since this rumble figure is an average value of all the spectral components up to 500 Hz, two turntables could have the same rumble figure and still have different sonic characteristics. The spectrum of the Oracle's rumble is shown in Fig. 4. The spike in the center, where the cursor is set, is at 18.75 Hz, and the rumble measures −41.9 dB at this frequency. The peak may be due partially to the B&K 2010 test record. In general, rumble measurements are difficult because they are limited by the rumble cut into the grooves of the test disc. The computer-controlled Nicolet 660-2D FFT spectrum analyzer, which was used to make all the 'scope photos and measurements shown, allows a sufficiently detailed analysis to check even the 50-Hz powerline hum, which was measured as −50.3 dB. (This test disc comes from Europe, where the a.c. powerline frequency is 50 Hz.) Analysis of Fig. 4 revealed that the Oracle has very low rumble with the major contribution below 20 Hz, a desirable condition.

The wow-and-flutter meter readings, using the DIN Standard, were 0.25% unweighted and 0.13% weighted. Readings for wow alone were 0.24% unweighted and 0.12% weighted; for flutter alone, readings were 0.07% both weighted and unweighted. Figure 5 displays the spectrum of wow components between 0.125 and 50 Hz. The cursor is set at 0.5 Hz and the next major spike is at 1 Hz; these two frequencies relate to full and half platter rotations at 33⅓ rpm. This cyclical variation results from the difficulty inherent in making a perfectly concentric record and then getting the hole precisely in the center. For these tests I adjusted the disc until this variation was at a minimum. A very noticeable reduction in the 0.5-Hz component occurs when this is done, and the contribution to wow caused by record warp for the 4- to 10-Hz range is more apparent.

The Oracle's lack of flutter was readily noticed by the people who auditioned it during a long series of comparisons with other fine turntables. It was particularly easy to hear when we used a recently released Sonic Arts piano recording, Lab 16, which was mastered digitally. This recording's lack of scrape flutter (usually encountered with analog tape recorders) allowed the intrinsic flutter caused by the different turntables to be easily heard as more or less blurring of detail in the reproduced sound.

Absolute speed stability, while quite good in the Oracle, was not exceptional, but this affects sonic performance less than wow and flutter, rumble, or groove-to-groove isolation does. Fig-

The attention to detail and care of finish exhibit substantial pride in manufacture.

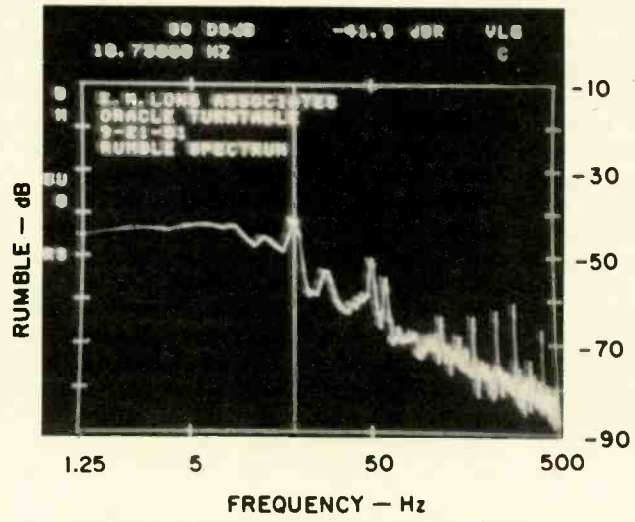


Fig. 4—Rumble spectrum, with most components below 20 Hz. Spikes are harmonics of hum and occur below -60 dB. Resolution of spectral detail is excellent. (Note: Unless noted, 0 dB ref. is 10 cm/S lateral groove modulation.)

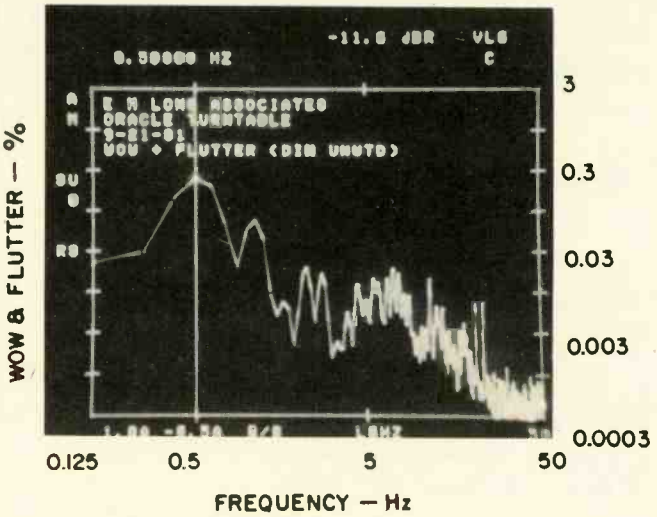


Fig. 5—Wow and flutter spectrum from 0.125 to 50 Hz, with main wow at 0.5 and 1 Hz (see text). Wow at 7 to 10 Hz is probably caused by slight variations in tracking force due to tonearm resonance.

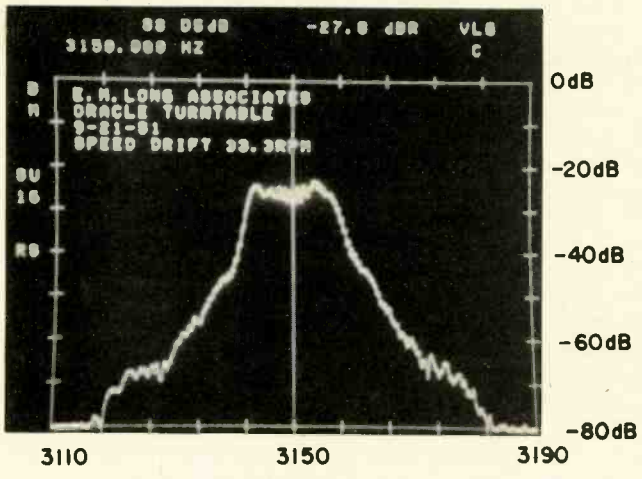


Fig. 6—Speed stability vs. time; shown is pitch variation. Stability was calculated to be ±0.123% for a 20-second sample. (Horizontal scale is 8 Hz/div.)

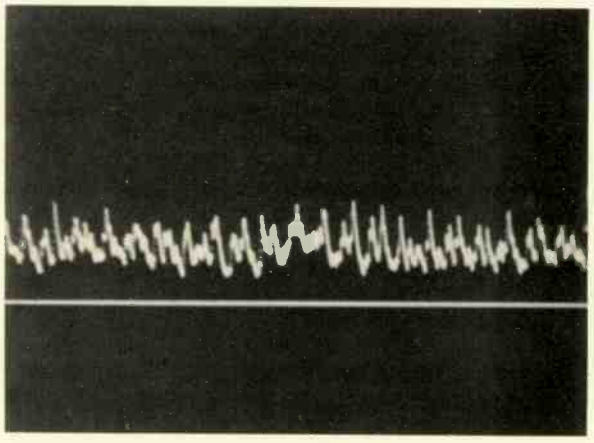


Fig. 7—Speed drift vs. time. Note the cyclic variation of the 3150-Hz tone of Fig. 6.

ure 6 shows the range of speed drift for 16 samples over a 20-second period. The cursor is centered on the 3150-Hz tone of Band 8 of the B&K 2010 test record. The display is calibrated to show 8 Hz per horizontal division and a total window width of 80 Hz. The drift in speed was ±0.213%. Another more commonly used method of displaying speed drift is shown in Fig. 7, a 40-second recording taken from a wow-and-flutter meter. This measurement indicates the somewhat random, low-frequency nature of the drift. During the listening sessions, no comments were made which could be connected directly with the Oracle's speed stability, even when listening to piano recordings which are very good for revealing pitch variation.

The importance of Fig. 8A lies in what it *doesn't* show. The average level of background noise from the B&K 2010 test record is about −75 dB. There is no indication of any spectral contribution between 200 Hz and 5 kHz from the Oracle, which is as it should be. Figure 8B displays the spectrum from 0.5 to 200 Hz and indicates how good the signal-to-noise ratio remains at the lowest frequencies of interest. The main bump in this spectrum is due partly to tonearm resonance.

The Oracle has very low rumble, with the major contribution below 20 Hz—a desirable condition.

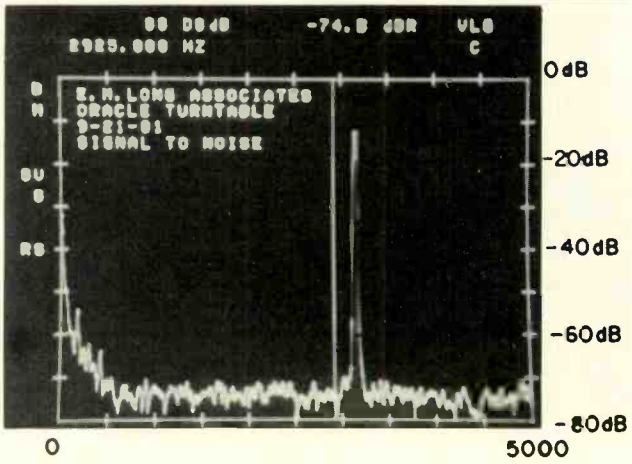


Fig. 8A—Spectrum of signal-to-noise ratio with 3150-Hz tone from B&K 2010 test disc. (Note: Scale is linear.)

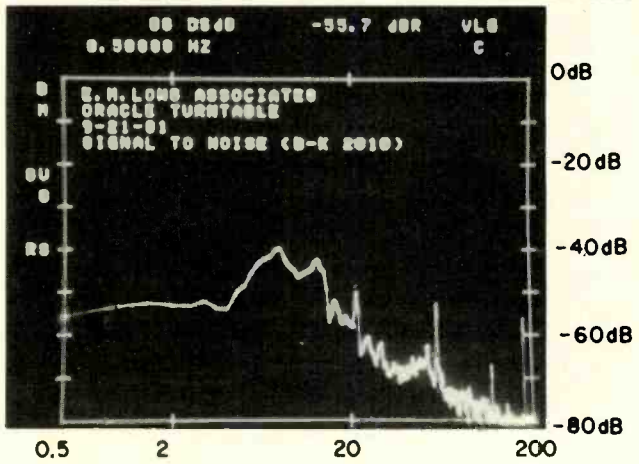


Fig. 8B—As in Fig. 8A but from 0.5 to 200 Hz with log scale. Tonearm resonance is responsible for most of the increase from 7 to 10 Hz, but the level is over 40 dB down from the 10 cm/S reference.

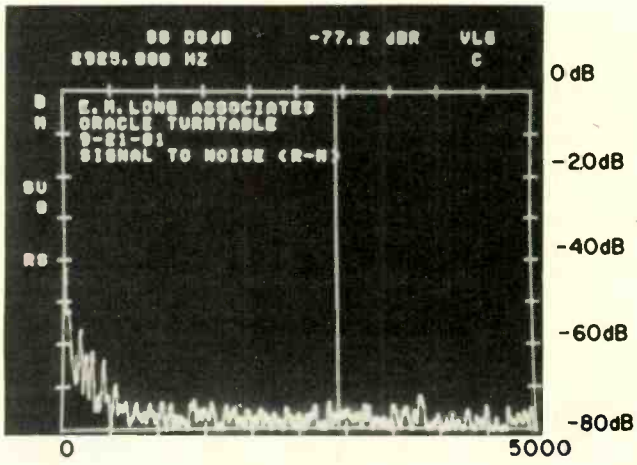


Fig. 9A—Similar to Fig. 8A but measured using Thorens *Rumpel-messkoppler* and showing an even lower noise floor.

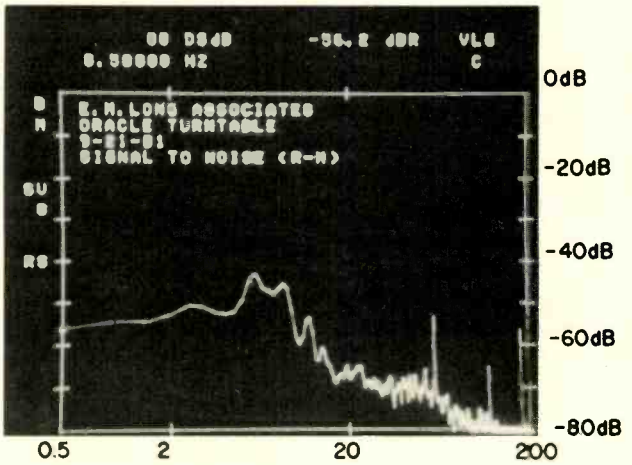


Fig. 9B—Similar to 8B but with the *Rumpel-messkoppler*. The arm resonance is still evident, but the spike at 20 Hz is not, indicating it is probably an artifact of the test disc.

I also measured the signal-to-noise ratio with the Thorens *Rumpelmesskoppler* method. The S/N ratio improvement, shown in Figs. 9A and 9B, is 3 to 4 dB over the results using the B&K 2010 test record. One listener commented on the apparent reduction of background noise when the same record was switched to the Oracle after being played on another turntable. Groove Isolation apparently causes an audible improvement in the background noise level.

The effectiveness of damping the turntable platter resonance with the Peripheral Wave Trap is shown in Fig. 10. I removed the record mat during this test and placed the stylus tip on the metal platter at a distance of approximately 5¼ in. from the spindle before applying a series of eight mechanical impulses to the upper edge of the platter rim and obtaining the average. Then I monitored the uniformity of the spectral content for each impulse and verified the repeatability of these measurements.

The important results of this test lie within the frequencies where energy is concentrated. Absolute level is related to the level of the input impulse and, therefore, is of secondary significance. The relative level among various frequencies, however, is

The Oracle turntable is an excellent choice for those interested in hearing *all* the detail contained in record grooves.

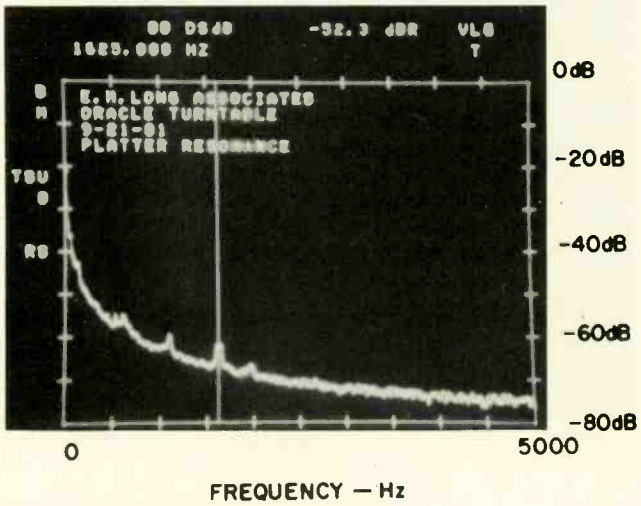


Fig. 10—Spectrum of platter resonance. See text.

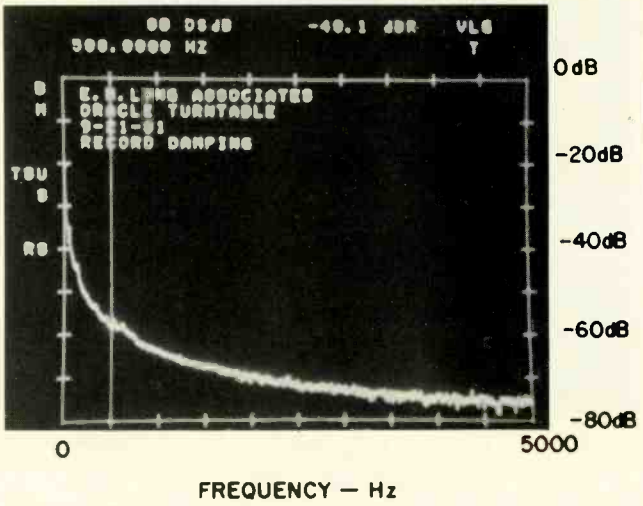


Fig. 11—Spectrum of a record's internal resonances. See text.

of interest and shows that energy in the platter is concentrated at 550 Hz, 600 Hz, 1100 Hz, 1625 Hz (cursor position), and 2000 Hz. The data in Fig. 10 compare most favorably with results from other turntables. The natural resonances of the Oracle's platter are damped very well, even without the record mat in place.

For the next measurement, I placed the record mat on the platter, clamped a standard record in place, and positioned the stylus tip in a quiet groove at the inside diameter of the record. Leaving the turntable stationary, I applied the same mechanical impulses to the rim of the record. Both channels were monitored on the Nicolet spectrum analyzer, but only one channel is shown in Fig. 11.

The results of this measurement are extraordinary when compared to those obtained from other turntables. The correlation between comments made by all of the people auditioning the Oracle and this objective test seem to be excellent. The uniform distribution of spectral components is amazing. Listeners remarked about clarity and realism in the reproduced sound, especially noting how the timbre of individual instruments seemed so well defined. These comments can be traced directly to the Oracle's control of extraneous spectral energy in the record which can otherwise blur such detail. Additional listening tests, conducted with the clamp partially released and with the clamp and domed washer completely removed, revealed a deterioration in this clarity and detail.

I was curious to see if the same improvements could be heard with dbx-encoded records. To find out, I used M&K's RT-202 recording which features Dukas' "Sorcerer's Apprentice" and Chabrier's "Espana." The results were just as significant as those heard with standard recordings. I was not prepared for the substantial differences I heard with different digital recordings. I was surprised to hear a type of defect on some of them which I can only describe as "grundge," and the Oracle allows this defect to be heard quite easily. The M&K recording (digitally recorded with dbx encoding) did not have this "grundge" and sounded excellent. The previously mentioned Sonic Arts Lab 16 also lacked this defect, so I concluded that this particular form of distortion marred some digital recordings, but not all of them.

The Oracle turntable is an excellent choice for people interested in hearing *all* the detail contained in their record's grooves. I also suspect that Oracle owners will be in the vanguard of those clamoring for better record quality.

Edward M. Long

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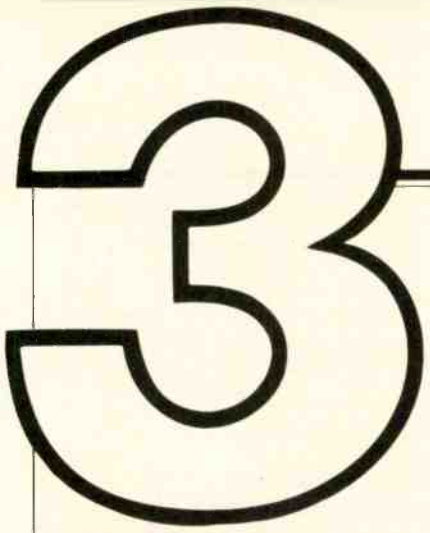
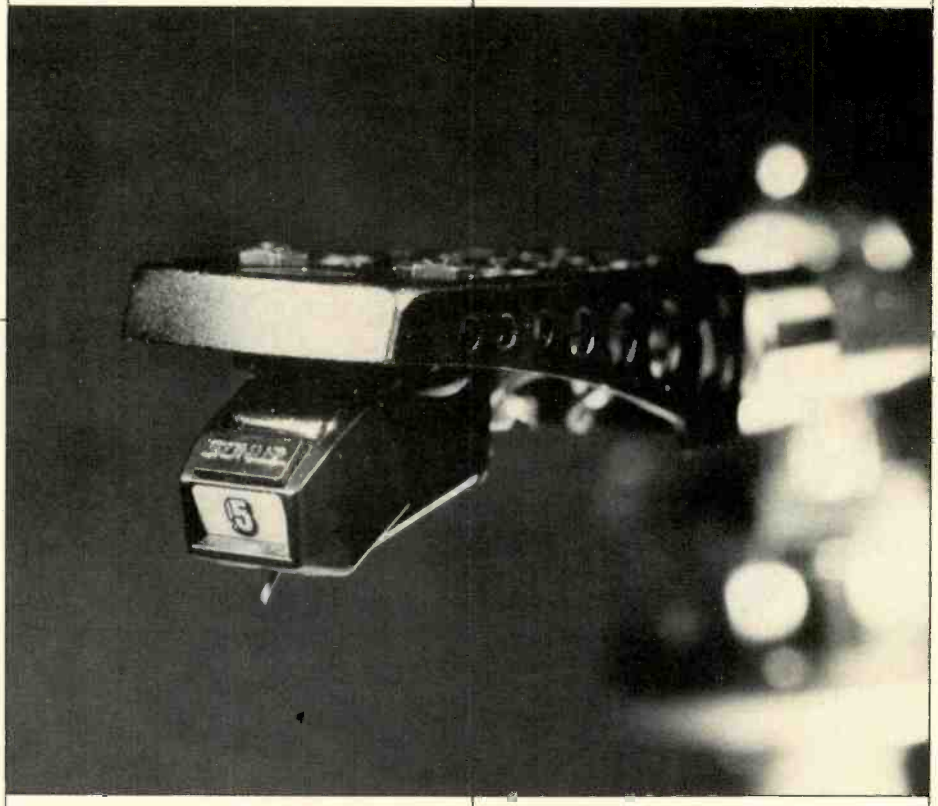


SONUS DIMENSION 5 CARTRIDGE

Manufacturer's Specifications
Frequency Response: 10 Hz to 20 kHz, ±1dB; 20 to 40 kHz, +2, –5 dB.
Compliance: 50 cm/dyne x 10^{-6}
Vertical Tracking Angle: Nominal, 20 degrees.
Channel Separation: 1 kHz, 30 dB; 20 Hz to 20 kHz, 20 dB.

Weight: 5.5 grams.
Recommended Tracking Force Range: 1 to 1½ grams.
Inductance: 150 mH per channel.
Resistance: 300 ohms.
Price: $250.00; replacement stylus, $125.00.



The Sonus Dimension 5 is now the top-of-the-line cartridge from Sonic Research, and its main difference from others in the Series II range is an unusually shaped, highly polished jewel stylus called "Lambda." This is a chisel-shaped design and is mounted in a short low-mass aluminum cantilever. The micro-machined armature is said to have the lowest possible dynamic mass for the required efficiency, and the high-frequency resonance of the moving mass has been pushed up to the 35 to 40 kHz range. The result is that very little damping is needed, and so tracking force can be reduced accordingly. Because the Lambda stylus is mounted to form a smooth extension to the cantilever, instead of making an angular projection, the single transmission path is claimed "to achieve a degree of phase coherence impossible in any stylus-cantilever design now in use." A circular elastomeric unipivot suspension provides equal freedom of movement over 360 degrees. The cartridge is nicely packaged in a small, padded wooden box and comes complete with mounting hardware and a good stylus brush.

Measurements

For test purposes, the cartridge was mounted on a Sony PS-X800 SLT turntable, and the tracking force set to one gram — the lowest recommended figure. The first measurement performed was for frequency response, and the results are shown in Fig. 1. Output began to rise from about 13 kHz, and a further check with a wide-range test record, the CBS STR-120, revealed that the response continued up to about 30 kHz before rolling off gradually.

Separation was 25 to 30 dB in the midrange, decreasing to a quite respectable 17.5 dB at 20 kHz. The square-wave response, shown in Fig. 2, shows a fast rise-time with a single overshoot that is well damped.

Trackability has to be rated as good to excellent. Though the tracking force needed to be increased to 1.5 grams, the Dimension 5 successfully negotiated both the Shure Obstacle Course — Era III's bands four and five and the Deutsches Hi-Fi Test Record No. 2 300-Hz, 80-micron band. IM distortion was quite low — less than 2% at 25 cm/S velocity as measured with the Shure TTR-103 disc.

Output was 4.2 mV at 1 kHz for a 5-cm/S test signal, so that there should be no level or sensitivity problems with a standard preamp or receiver. Channel balance was within 0.5 dB, and thus there will be no shifting image with changes in frequency. Inductance was a relatively low 150 mH, so that a capacitive load should not be at all critical. All of my measurements were made with a total load of 250 pF, but increasing the capacitance to 450 pF produced no significant change in the response in the audio band.

Use and Listening Tests

My listening tests were made with a wide variety of records, which included *Hammond Castle Pipe Organ*, Decibel DB-1000; Earl Klugh's *Finger Paintings*, Mobile Fidelity MFSL 1-025, and Fiedler

The Dimension 5 has a few equals in trackability, but in distortion I know of no cartridge which offers better test results.

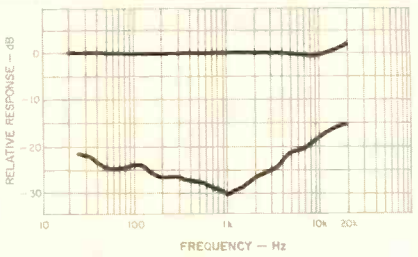


Fig. 1 — Frequency response and separation.

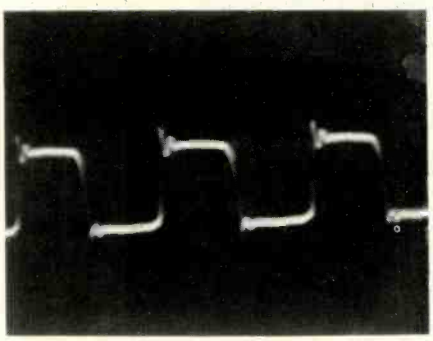


Fig. 2 — Square-wave response.

and the Boston Pops doing Tchaikovsky's *Capriccio Italien*, Crystal Clear CCS-7003. One disc which sounded particularly lifelike was Amanda McBroom's *West of Oz* on Sheffield Lab 15. Incidentally, Peter Pritchard of Sonus tells me that the Dimension 5 is used by Telarc to demonstrate the cannon shots on their *1812*.

Transient response was excellent, while bass was tight and well-defined. The stereo image was stable with a good sense of depth so that large-scale symphonic works were reproduced with a pleasing spaciousness. Occasionally the sound quality had the extra "zing" or "front row center" sort of clarity associated with the rising high end of moving-coil cartridges.

All in all, I must rate the Dimension 5 as a most musical sounding phono cartridge. There are a few which will score equal or higher marks on the trackability tests, but in the distortion measurements, I don't know of any cartridge which comes in with better results.

George W. Tillett

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4

ACE AUDIO MODEL 4100 FILTERS

Manufacturer's Specifications
Infrasonic Filter: -3 dB at 20 Hz, 18 dB/octave.
Ultrasonic Filter: -2 dB at 20 kHz, 12 dB/octave.
Distortion: 0.025% at 2 V output.
Impedance: Input, 47 kilohms; output, 1.5 kilohms.
Gain: Unity.
Maximum Output: 7 V.
Signal-to-Noise: 90 dB, at 2 V.
Dimensions: 4½ in. (113 mm) W x 6 in. (155 mm) H x 2¼ in. (58 mm) D.
Weight: 0.9 lb. (0.4 kg).
Price: $83.00 kit, $108.50 wired — ordered direct, sent postpaid.

The Ace Audio Model 4100 is a band-limiting unit that incorporates both infrasonic and ultrasonic filtering; in other words, it serves to roll off both the high end and the low end. This is handled by a neat little box with *Left* and *Right* input and output jacks, making four in a row — which are a touch too close together for some phono plugs. On the back is an accessory a.c. outlet, a worthwhile convenience in that the outlet the 4100 uses is replaced. The interior layout is open and straightforward, with good separation between the power supply section and the signal filters. For those who like construction, the kit version would be a good choice with a $30.00 lower price.

Performance

The noise measured at the output jacks with the inputs terminated in 1 kilohm was less than 10 μV with A weighting. The signal-to-noise ratio referred to 1 V was over 100 dBA, or over 106 dBA referred to 2 V. The frequency response of the 4100 filters is shown in Fig. 1. The -3 dB points were at 17 Hz and 29 kHz. The response was down 2.5 dB at 20 Hz and 1.7 dB at 20 kHz. Between 30 Hz and 10 kHz, the deviations from zero were very small. The high-pass filter is down about 17 dB at 7 Hz, with a slope of 18 dB per octave with decreasing frequency. This design should gain good reduction of record warp effects with very small effect on most music. The low-pass filter serves as a small-signal roll-off device to reduce the possibility of slew limiting in the power amplifier, as well as removing miscellaneous high-frequency garbage. The attenuation on music energy is very small, but there is a reduction of 17 dB at 100 kHz, where the final 12-dB per octave slope is already well established.

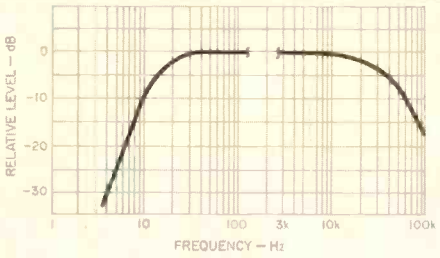

Fig. 1 — Frequency response of 4100 filters.

At 1 kHz, the output was just 0.15 dB lower than the input, which is very close to the specified unity gain. At 1 V in/out, THD + N was 0.006% or less, from 20 Hz to 20 kHz, with a good part of the energy from 60- and 120-Hz hum/buzz components. The actual distortion products were down around 0.0015% to 0.0036%, and they did not increase until a level of about 3 V. With 3 V in at 100 kHz, the output amplitude was reduced almost down to 0.3 V, from the filter roll-off, with absolutely no evidence of slew limiting.

The maximum voltages were 7.7 V at 20 Hz, 8.1 V over most of the band and 6.9 V at 20 kHz, plenty high for any normal usage. The input impedance varied quite a bit across the band: 115 kilohms at 20 Hz, 67 kilohms at 1 kHz, and 19 kilohms at 20 kHz. In most cases, the 19-kilohm figure is more than high enough, and the change in impedance would have little or no effect on the signal delivered from connected units. As was expected with the 1.5-kilohm output impedance, there was a drop of a few dB in output when switching loads from 100 to 10 kilohms. The lower load also caused increased attenuation from the high-end filter — a small change, but worth keeping in mind if very flat, extended response is important.

Use and Listening Tests

To check out the Ace Audio filter unit, I inserted it in the normal signal path from the preamp to the power amplifier. First of all, it can be stated that there was no observed deterioration, such as hum or added distortion. It did prove its worth with a few records which have warps, as my present system doesn't have a subsonic filter. I did not get any listening proof-of-performance of the ultrasonic filter as I don't have a slew-limiting problem, but I didn't notice any music missing. For those who need to add such filtering to their present (or future) system, the Ace Audio Model 4100 performs very well and has an acceptable price. *Howard A. Roberson*

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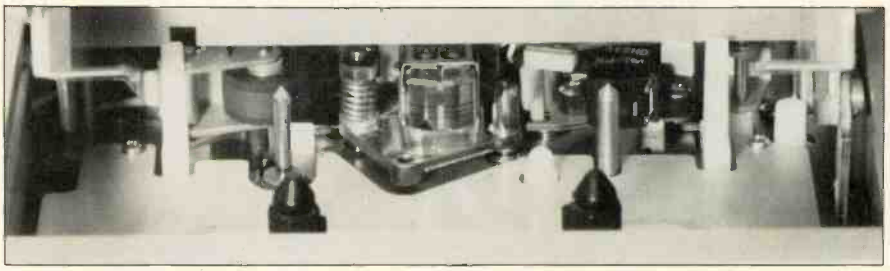
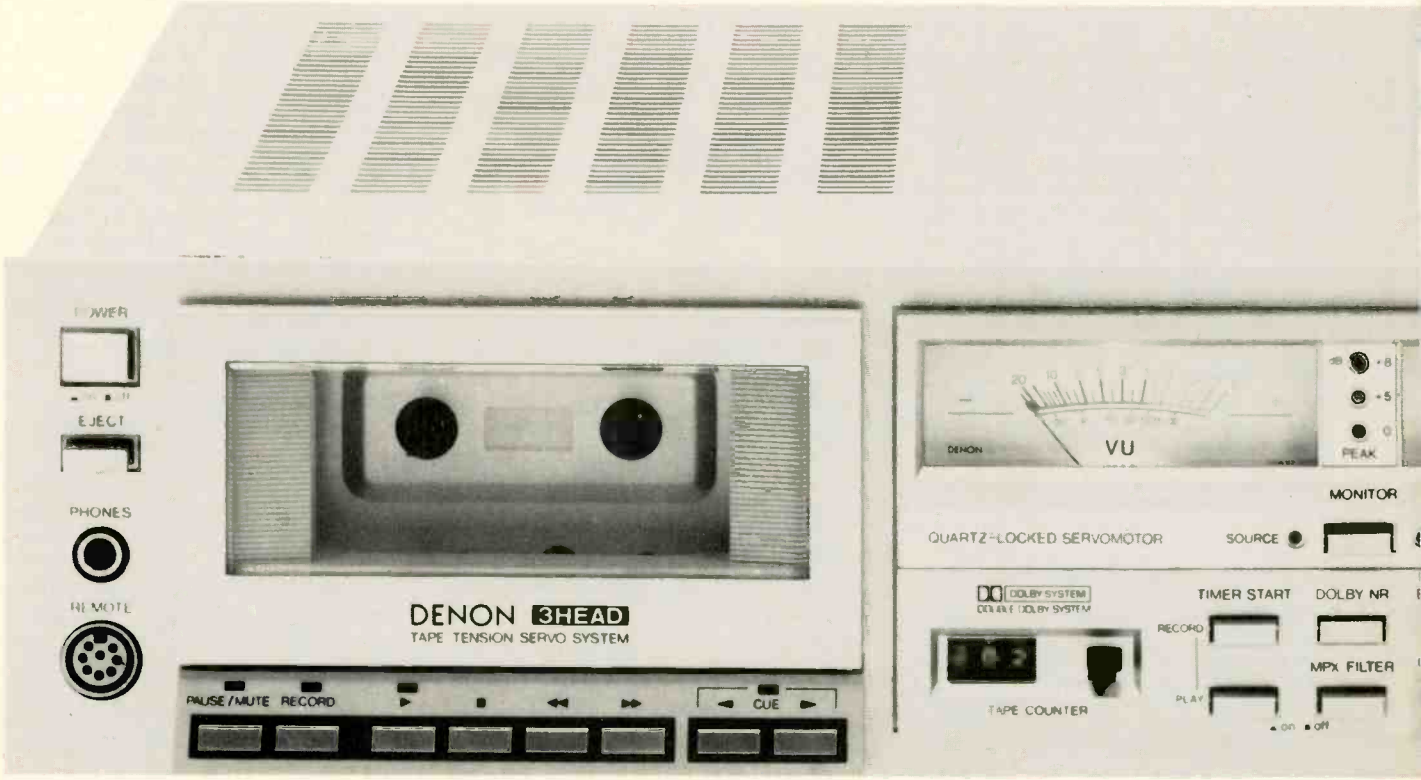
5

DENON DR-330 CASSETTE DECK

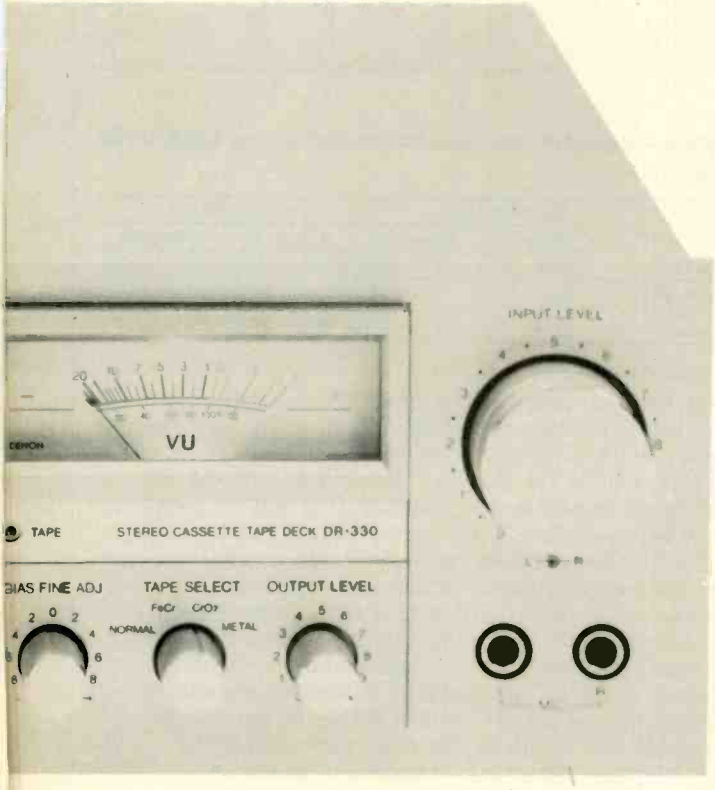
Manufacturer's Specifications
Frequency Response: 30 Hz to 19 kHz, to 20 kHz with CrO_2 tape, to 21 kHz with metal tape.
Signal/Noise Ratio: 67 dB, CCIR/ARM weighted.
Separation: 40 dB.
Crosstalk: −65 dB.
Input Sensitivity: Mike, 0.35 mV; line, 70 mV.
Output Level: Line, 775 mV; headphone, 1.2 milliwatts.
Flutter: 0.04% W rms.
FF& RWD Times: 90 S for C-60.
Dimensions: 17 in. (434 mm) W x 4.6 in. (117 mm) H x 11.8 in. (300 mm) D.
Weight: 15.4 lbs. (7.0 kg).
Price: $500.00.





Denon is one of Japan's oldest producers of professional tape recording equipment, with more than three decades of experience in the field. Their machines are seen not only in the broadcast rooms of the Japanese government's NHK stations but also those of privately held stations, and they were one of the first companies to adapt digital or PCM technology to audio recording.

The Denon DR-330 cassette deck combines very good performance and a number of useful features with an attractive appearance for a medium price. The black lettering on the brushed aluminum front panel is quite easy to read, even in dim room light. The cassette compartment door opens smoothly with a push of the eject button. Loading is a simple drop-in, and there is good access for maintenance tasks, particularly with the clear window door snapped off. Worthy of note is the record-head/playback-head assembly for off-the-tape monitoring while recording. The light-touch tape-motion pushbuttons have helpful status lights for *Play*, *Record* and *Pause/Mute*, which last performs in a special way. It gives the expected pause for either play or record functions, but if held in while in the *Record* mode, it mutes the incoming signal (still indicated on the meters if in *Source*), thereby recording a blank space until releasing puts the deck in *Pause/Record*. This is a good scheme, making one button do what requires two on most other decks. There are also forward and reverse Cue buttons which are effective from any mode, allowing relatively fast winding to the beginning or end of a piece. Holding a button in permits winding past any number of selections, and a status light indicates the location of any music (On) or blank sections (Off). This is a less involved design than some, straightforward and easy to understand.



The Denon DR-330 incorporates a Tape Tension Servo System (TTSS), which is designed to maintain a constant and stable tape-to-head contact pressure, and a non-slip reel-motor drive system, which is intended to add to transport stability by eliminating clutches, belts, etc. A sensing arm in the TTSS is inserted in the tape path and feeds information back to the supply motor so that tape tension is kept within fairly strict limits. The reel drive system is similarly electronically controlled. Examination of the drive system led to the conclusion that it was stable and rigid, with the quartz-lock PLL servo motor and large capstan flywheel most impressive.

The two VU-type meters are very well illuminated, scaled up to "+6" with the Dolby-level reference symbol at "+3." There are three peak-responding LEDs between the meters: Green for zero, orange for "+5" and red for "+8," making for a good combination of record-level metering. The monitor switch just below (a convenient location) has associated indicators: Orange for *Source* and green for *Tape*. The inclusion of such indicators is desirable, so it was a little surprising that there was none for the Dolby-NR *On* condition. The multiplex filter in/out switch is a separate pushbutton. There are similar buttons for timer start: One for *Record* with power turn-on, the other for *Play*. The tape counter has a reset button, but the deck has no memory function, which would be nice to have even with the included cue system.

Bias Fine Adjust is an important feature of this Denon deck, and there is a useful detent at zero for the control. *Tape Select* has four positions, including one for FeCr. There is an output level control, sometimes needed for good matching to the rest of a system and essential for headphone listening. Better index marks would minimize possible errors in the above three functions; the knobs might also be on the small side for some, especially the rotary tape-select switch. In contrast, the dual-section input-level pots have large knobs with fine knurling and "just-right" friction between sections. Use of the mike jacks just below does *not* disconnect the line inputs. The line-power and eject pushbuttons and jacks for phones and remote control are at the opposite end of the panel.

Measurements

The playback responses were similar for both 70- and 120-μS equalizations: Accurate for most frequencies, but rolled off a few dB at the high end. The play-level meter indications were within 0.5 dB, and play speed was just 0.2% fast. The record/playback responses were made at Dolby level and at 20 dB below that using Denon DX3 (Type I), DX7 (Type II), DX5 (Type III) and DXM (Type IV). Many other formulations could be well matched to the deck using the bias trimmer. The best results with these other tapes were obtained with Scotch Master II, Sony FeCr, Memorex Metal IV and TDK MA-R, with TDK AD, OD and SA, BASF Professional II, Sony EHF and Metallic, Osawa FC, Scotch Master III and Metafine, and Fuji Metal not far behind.

Using Denon's DXM metal tape, the DR-330 had superior performance in both response and in low distortion.

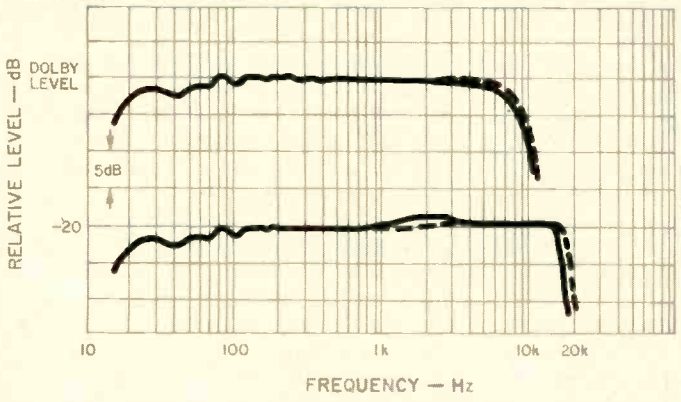


Fig. 1—Frequency responses with Denon DX3 tape with and without (---) Dolby NR.

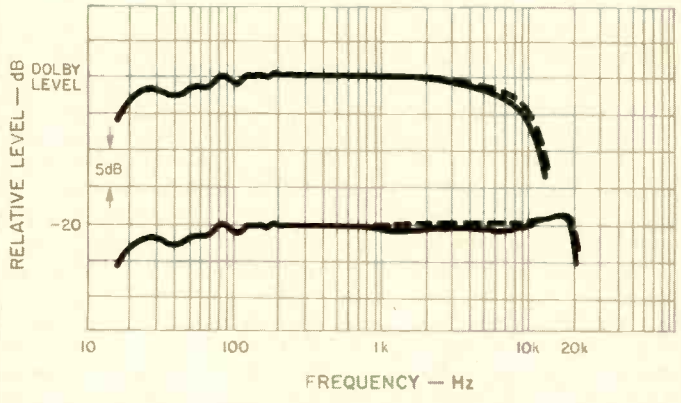


Fig. 2—Frequency responses with Denon DX7 tape with and without (---) Dolby NR.

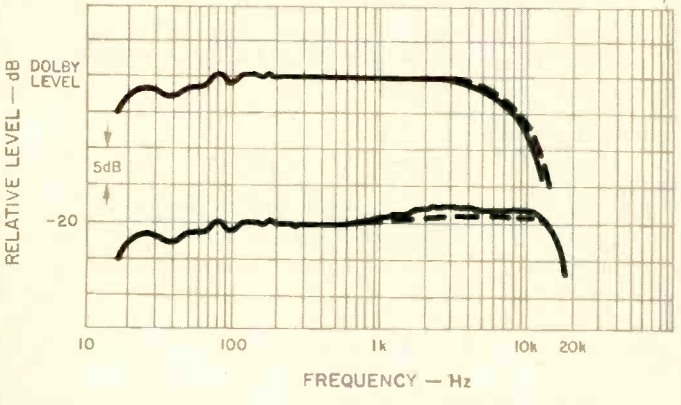


Fig. 3—Frequency responses with Denon DX5 tape with and without (---) Dolby NR.

The best results with the Denon tape came with bias set very closely to that recommended in the instruction manual.

Figures 1 to 4 and Table I show the swept responses and list the 3 dB down points with and without Dolby NR. In general, the responses have very good flatness from 100 Hz to over 10 kHz and excellent Dolby tracking. There is some rise in the response around 3 kHz with DX5, more so with Dolby NR than without. The results, however, are quite superior to those obtained with most Type III formulations on most cassete decks. The superiority of the DXM metal tape is most evident in the headroom extension at Dolby level.

With DX7 tape, the bias trimmer could be set for response anywhere from +1.8 to -4.5 dB at 10 kHz, from minimum to maximum setting. Response of the FM multiplex filter was 1 dB down at 15.4 kHz and had its maximum attenuation of 38.4 dB right at 19.00 kHz — the best observed to date. Bias in the output during recording was very low. With a 1-kHz test tone, separation was 50 dB, and crosstalk and erasure were down at least 80 dB — all excellent figures. Erasure of metal tape at 100 Hz was at least 73 dB, also excellent.

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

	With Dolby NR				Without Dolby NR			
	Dolby Lvl		-20 dB		Dolby Lvl		-20 dB	
Tape Type	Hz	kHz	Hz	kHz	Hz	kHz	Hz	kHz
Denon DX3	21	7.8	21	16.2	21	8.5	21	18.4
Denon DX7	21	7.3	20	20.0	21	9.0	20	20.3
Denon DX5	21	6.5	20	16.8	21	7.2	20	17.0
Denon DXM	22	11.0	21	20.7	22	12.0	21	21.1

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

	IEC A Wtd. (dBA)				CCIR/ARM (dB)			
	W/Dolby NR		Without NR		W/Dolby NR		Without NR	
Tape Type	@ DL	HD=3%	@ DL	HD=3%	@ DL	HD=3%	@ DL	HD=3%
Denon DX3	59.8	63.3	51.3	53.5	57.7	61.2	48.0	50.2
Denon DX7	62.6	65.7	54.8	56.5	61.7	64.8	52.2	53.9
Denon DXM	61.2	68.2	53.0	59.6	59.3	66.3	49.8	56.4

The third harmonic distortion level, HDL_3, was measured with a 1-kHz tone in Dolby mode from -10 dB to that level resulting in HDL_3 = 3%. The results for the Type I, II and IV tapes are plotted in Fig. 5. The excellent performance of DXM over the entire range is quite evident, although DX3 had the lowest distortion below -5 dB re: Dolby level. The three-percent points for DX3 and DX7 were not as impressively high as with DXM; however, the level used would actually be 1 dB above the "+6" maximum on the meter. The level of HDL_3 measured with DXM tape in Dolby mode at a record level of -10 dB is plotted in Fig. 6. These results are superb — less than 0.2% distortion at the frequency extremes, less than 0.07% distortion in midband, and the most unusual 0.016% result at 2 kHz. As the data were not continuous with frequency, the exact curve is in doubt — indicated with the dashed line. A number of points were checked and rechecked, with consistent data in each case.

Signal-to-noise ratios were determined for the DX3, DX7 and DXM tapes with and without Dolby NR, both IEC A and CCIR/ARM weightings. All of these results for both Dolby level and the

It was a pleasure to use this deck with its ability to go to any function without going through the stop mode.

HDL_3 = 3% points are listed in Table II. The perceptive reader may note that there is usually a larger difference between Dolby level figures and 3% limit figures when in Dolby mode than without NR. This is just one indication that there is less distortion with Dolby for most recorders over a range of levels. In any event, the results are excellent, particularly with DX7 and DXM tapes.

Input sensitivities were 0.35 mV for mike, exactly to specification, and 62 mV for line, better than spec. Input overloads were plenty high: 75 mV for mike and over 30 V for line. The line input impedance was 54 kilohms at midband, falling somewhat at the highest frequencies. The output clipping point was at a level equivalent to +14.5 meter indication. The two sections of the input level control tracked adequately for most purposes. The line output was exactly to spec. The headphone drive was more than adequate for any of the headphones tried. The line output impedance was very low (good), less than 200 ohms over the entire band. The output level pot sections tracked within a dB for only about 15 dB down from maximum, rather marginal in performance if level matching to another unit is required. The response time was a little short for a VU meter, reaching 0 dB with a burst of 180 mS. With the standard burst of 300 mS, there was about 1.5 dB overshoot. Scale accuracy was quite good, better than most. The peak-level indicators had thresholds that were exactly as designated, a well-implemented feature.

Flutter was checked both to wtd. pk. and W rms standards. Each trial was separated from the next by using combinations of tape-motion controls to jiggle the tape around before the next check. The Denon deck was unusual in that the results were very consistent, no matter what was done: Excellent figures of 0.06% wtd. pk. and 0.04% W rms. The wind time for a C-60 cassette was 77 seconds. Time for run-out to stop from wind or play was about 2 seconds. Switching between wind directions took much less than a second; from wind to play took less than a second.

Use and Listening Tests

Loading and unloading, cleaning and demagnetizing were all easy tasks with this front-loading deck. All of the tape-motion switches performed without any sort of malfunction, whatever was tried. It was a pleasure to use this go-to-any-function design, and *Cue* was an added plus at times. Setting levels was quite easy with the high-legibility meters and the peak-responding LEDs. The bias trim control was of continual value, and the FeCr tape-select option allowed trying some tapes not easily used on other decks.

The owner's manual has all of the basic information needed, but some of the text would benefit from a rewrite. A bias setting vs. tape chart is a worthwhile inclusion, but its value would be greatly increased if the listing were more in accordance with the formulations available in this country.

A series of listening tests were conducted using a variety of sources including discs and pink noise. The records were some of the dbx-encoded issues and Mobile Fidelity Sound Lab's offerings, such as Respighi's *Feste Romane* with Maazel and the Cleveland Orchestra, and Genesis and *A Trick of the Tail*. There was excellent sound with all of the tapes, and several times I noted a very pleasant, though slight, increase in presence with Dolby NR.

As expected, DXM stood out in the area of high recording levels with minimum negative effects. Record mute was judged to be a good scheme. Timer start had about a 3-second delay after power turn-on. No record or pause clicks were detected, and stop sounds were down in tape noise. The Denon DR-330 has very good to excellent performance in most all categories, and it compares very favorably with other units in the same and higher price ranges.

Howard A. Roberson

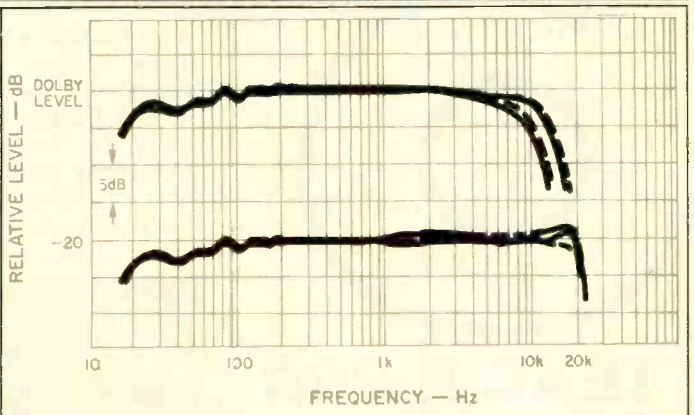


Fig. 4—Frequency responses with Denon DXM tape with and without (---) Dolby NR.

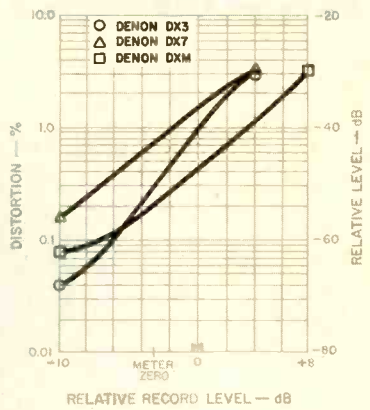


Fig. 5—Third harmonic distortion vs. level in Dolby mode at 1 kHz with Denon DX3, DX7 and DXM tapes.

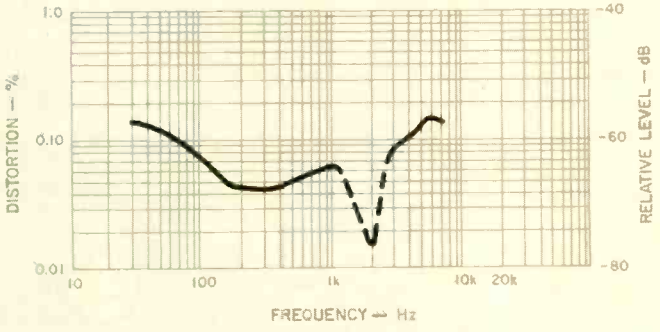
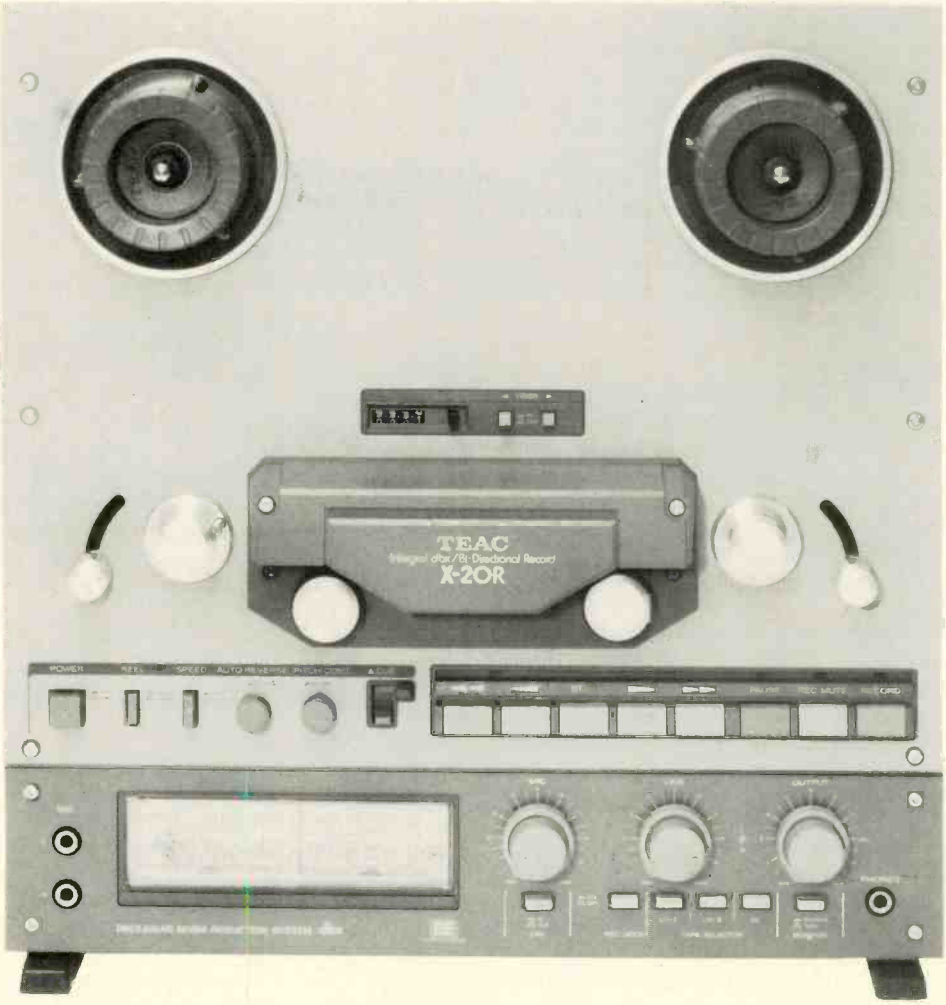


Fig. 6—Third harmonic distortion vs. frequency in Dolby mode at 10 dB below Dolby level with Denon DXM tape.

6

TEAC X-20R OPEN-REEL RECORDER

Manufacturer's Specifications
Type: Quarter-track, bidirectional.
Speeds: 3¾ & 7½ ips.
Wow & Flutter: 0.03% at 3¾ ips and 0.04% at 7½ ips, wtd. rms.
Frequency Response: 30 Hz to 28 kHz ± 3 dB at -10 VU, 7½ ips; 30 Hz to 16 kHz ±3 dB, 3¾ ips.
Distortion: 0.8% at 0 VU.
Signal-to-Noise Ratio: 63 dB, with dbx, 100 dB.
Crosstalk: 50 dB at 1 kHz.
Dimensions: 17 in. (43.18 cm) W x 18 in. (45.72 cm) H x 9 in. (22.86 cm) D.
Price: $1,400.00.



When quality cassette decks came along, many experts were quick to prophesy the early demise of open-reel machines but here they are, nearly 20 years later, alive and well. In the last *Audio* Equipment Directory, there were some 46 machines listed from 14 manufacturers. Although cassette decks have improved enormously over the past few years, open-reel models still offer many advantages. Headroom over the whole band is better, frequency response is wider, and then there is the ability to edit. Signal-to-noise ratios are around 65 dB without noise-reduction systems, and if a dbx unit is employed, as it is here, you have a dynamic range capability of 100 dB!

At the present time, few machines have a dbx system actually built-in. One of them, however, is TEAC's X-20R deck which is a quarter-track model with bidirectional record and playback capability. It features a monitor head, full-logic controls, provision for large reels, and a pitch control. The front panel measures 17 inches wide by 18 inches high, including the feet, and it is finished in gray with a brown subpanel at the bottom. Two large VU meters are on the left of this small panel, and three dual-concentric controls are located to the right. The first knob is for microphones, the second controls the line input, and the third is the output control. Underneath are pushbutton switches, one each for dbx noise reduction and *Rec Mute*, three for tape selection, and then one for tape/source monitoring. Microphone sockets are at the extreme left, while the phone jack is over on the right. Above the VU meters on the main panel are the following switches: On-off, small/large reels, speeds (3¾ or 7½ ips), auto-reverse, pitch, and a lever marked *Cue*. This last disengages the tape lifters in the fast wind or pause modes so the user can listen for the beginning or end of a particular selection. Next to the *Cue* lever is a line of tape transport pushbuttons which include a *Pause* button, one marked *Rec Mute* and, right at the end, one marked *Record*. There are, in fact, two *Record* buttons but I'll explain that later. Above the tape head assembly is a digital counter and two timer buttons — one for each tape direction. There are three motors, and the transport system uses a dual-capstan closed-loop drive. This kind of system isolates the tape from tension produced in the reels, and the stability is usually better because the length of unsupported tape is kept to a minimum. The capstan shaft is kept in firm contact with the thrust bearings by an arrangement of two magnets TEAC calls "Magnafloat." Thus, the capstans maintain a precise axial relationship to the tape without the use of springs or pressure plates.

Table I — Signal-to-noise ratios vs. tape speed and tape type. ("A" weighted, re: 3% THD; all tapes are from Maxell.)

Speed — ips	Tape Type	S/N — dB
3¾	UD 35-90	63
3¾	XL II 35-90	66
7½	UD 35-90	65
7½	XL II 35-90	68

Input and output sockets are in a convenient angled recess at the rear, together with a multi-socket for a remote-control unit, Model RC-100.

This is one of the first machines offered with the ability to handle the new EE or extra efficiency open-reel tapes, which can be thought of as chrome or chrome-equivalent tapes for such decks. As we will see later, there is a significant improvement in both headroom and frequency response in such a machine, so that slower speeds can be used with quite good results. Since open-reel tapes are not inexpensive, this can produce a real savings in tape costs, as well as making for ease in recording because the setting of levels is not so critical.

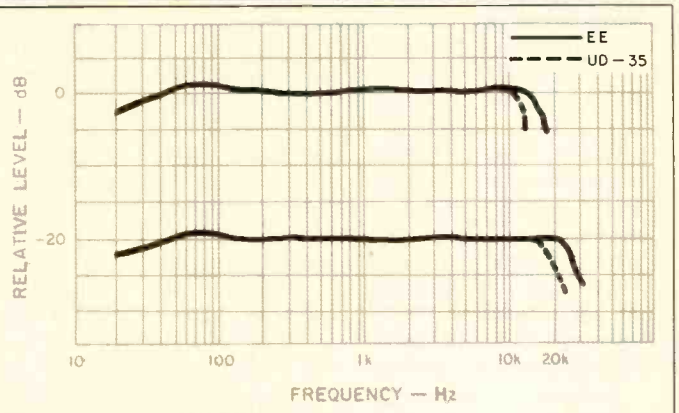


Fig. 1 — Record-replay response at 3¾ ips.

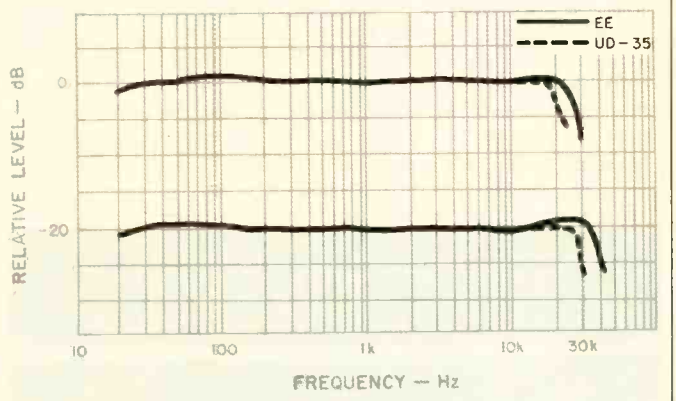


Fig. 2 — Record-replay response at 7½ ips.

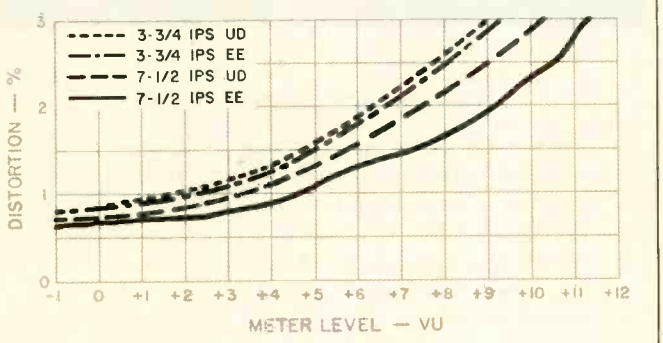


Fig. 3 — Distortion and headroom at 1 kHz.

The X-20R open-reel recorder was a delight to use. The logic controls worked smoothly, while the VU meters were remarkably accurate.

Measurements

The playback response with standard test tapes was within ±1 dB from 40 Hz to 18 kHz at 7½ ips and within ±2 dB from 40 Hz to 12 kHz at 3¾ ips, showing the normal slight rise at the high end. As mentioned above, the X-20R is one of the first machines designed to take advantage of the new EE tapes, so this was the kind used for most of the tests. The type selected was Maxell XL II 35-90, and it was compared with a standard Maxell high-efficiency formulation (UD 35-90). Figure 1 shows that the EE tape extended the 0 VU response from 12 to 16 kHz and the -20 VU response from 19 to 24 kHz. At 7½ ips (Fig. 2) the gain was from 19 to 23.5 kHz and from 28 to 33.5 kHz. Headroom at 1 kHz can be seen in Fig. 3: Note that 0 VU is at 185 nWb/m and that there is 8 to 11 dB headroom.

Distortion versus frequency is shown in Fig. 4, and these measurements were made at 0 VU, not at -10 dB. It looks as if the claim that "EE tapes can increase the response at 3¾ ips to equal the response of ordinary tapes at 7½ ips" is a reasonable one. However, I found that the gain in signal-to-noise ratios to be just as important, and the figures are given in Table I. Switching in the dbx system increased these figures by about 40 dB. The expansion ratio is the standard 2:1 — the same as for the dbx-encoded records. However, no provision is made for using the unit for records — which seems a pity, though, curiously enough, a switch for this purpose is provided on TEAC dbx cassette decks!

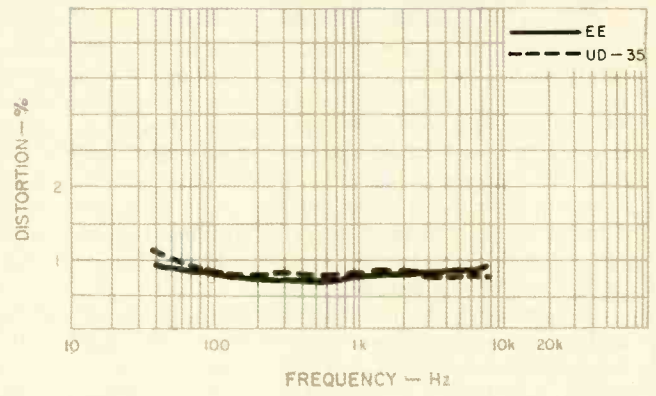


Fig. 4 — Distortion vs frequency.

But here are some more figures: Input required for 0 VU was 73 mV line and 0.23 mV for microphone. Output varied between 600 and 700 mV, depending on the kind of tape used. Maximum signal handling capacity at the microphone inputs was 27 mV. Signal-to-noise ratio decreased by 6 to 7 dB when a microphone was connected. Wow and flutter measured 0.02% at 7½ ips and 0.035% at 3¾ ips (DIN 45-507). Rewind time was 62 seconds for an 1800-ft. reel. The pitch control gave a variation of ±6%. Crosstalk was better than 50 dB at 1 kHz and 40 dB at 10 kHz. Erase efficiency was better than 70 dB. Finally, the VU meter ballistics were checked and found to be within 0.5 dB of the ANSI standard response for 300-mS pulses.

Use and Listening Tests

The procedure for recording is as follows: Having selected the correct position for the tape selector buttons, the *Rec Mode* button is pushed. The indicator located just above the red *Record* tape-transport button will now show a flashing light, so the next step is to depress this button at the same time as one of the two *Play* buttons. If so desired, the *Pause* button can be pressed and the input levels checked before actually commencing recording. If a mode change is made during recording or playback, the tape motion stops and there is a 5-second delay before the new mode starts to operate. Thus, the tape can be switched from slow to fast speeds, forward to reverse without any danger of the tape breaking.

I found the machine a real delight to use: The logic controls worked smoothly, with a nice professional feel, while the VU meters were remarkably accurate. The above-average headroom — especially with EE tape — is a definite plus, as is the convenience of bidirectional operation. And then there is the dbx facility with its almost incredible 100-dB-plus range. I made a number of dbx recordings and found that the best results were obtained with the VU meters kept below the 0 mark on peaks. If the signals were peaking in the +2 or +3 dB range, a slight breathing effect could be heard. I imagine most readers will have heard a dbx system at one time or another, but for those who haven't, the tremendous dynamic range and dead quiet background will be a revelation. *George W. Tillett*

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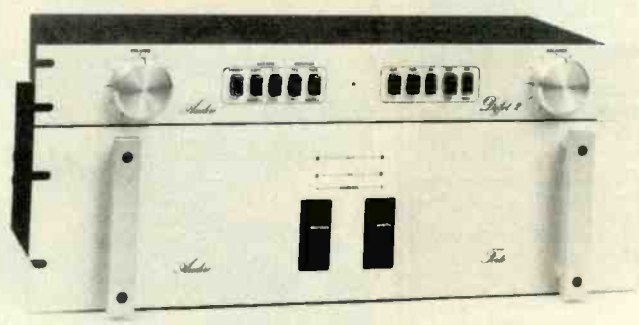

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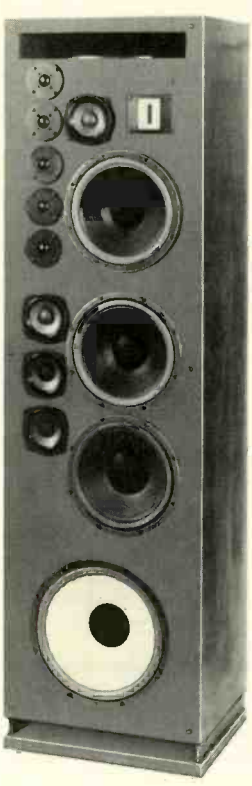

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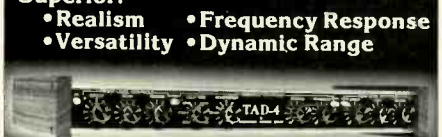

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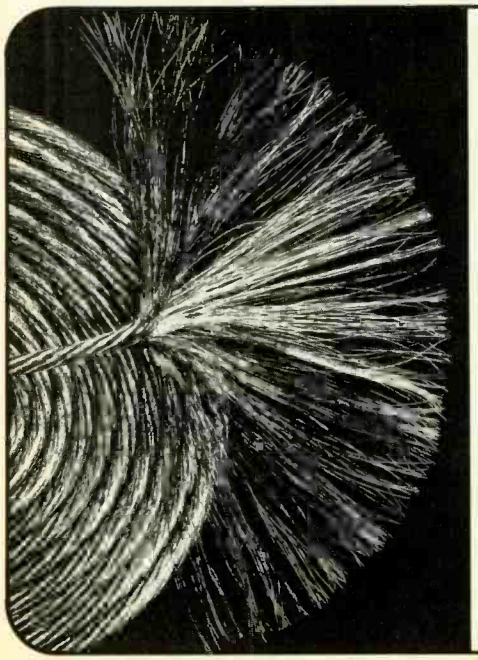

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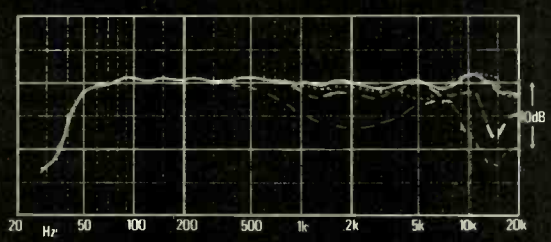

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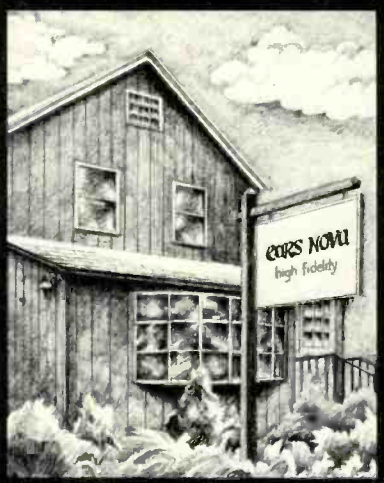

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AD INDEX

EDWARD TATNALL CANBY

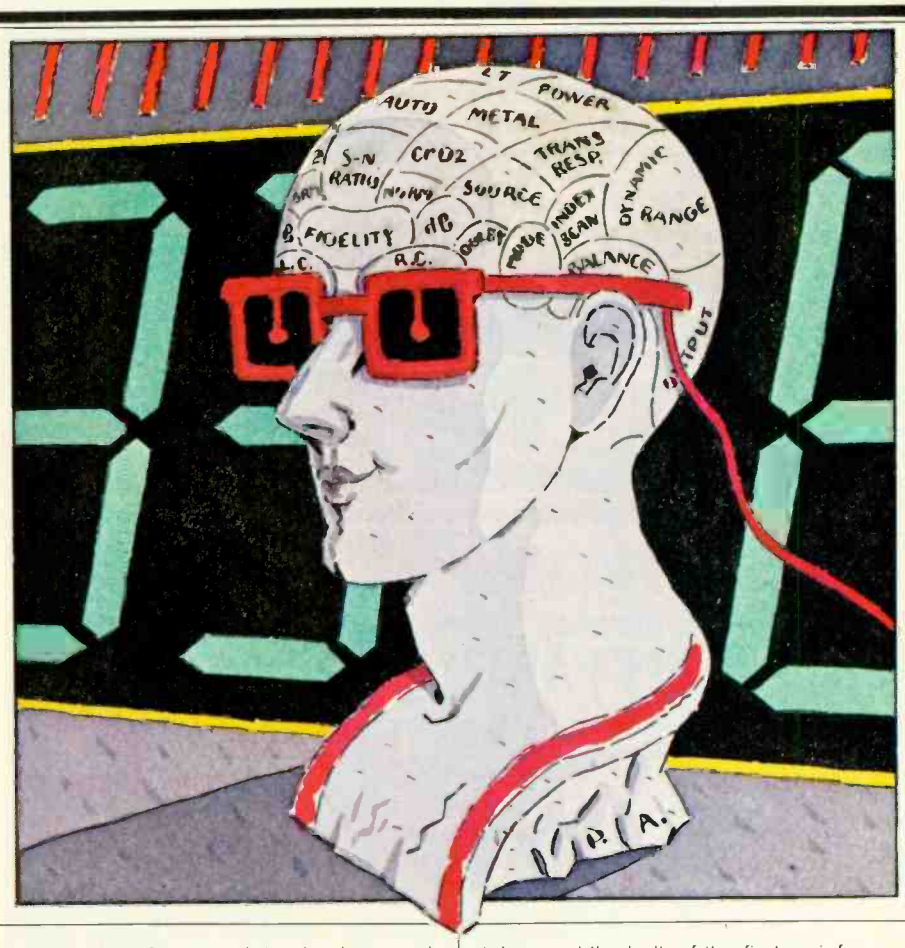
It seems to be Readout time these days, reflecting our new microprocessor heaven, and I have to note a few of the implications. Practical, of course, for tuners, receivers, super cassette decks and the like. Also and especially, a new super computer turntable from Nakamichi.

This Readout Revolution is incredible. (I mean, with poetic license, every sort of flashing mini-light, red, green, amber, pink and blue, as well as the computer's orthodox TV screen or out-printed fold-paper.) Everywhere you look, there they are, the lights and the numbers, maybe even on kiddiecycles and can openers. Pretty soon you'll need a green light from the computer inside your suitcase before you'll be able to unlock it. All of which is, of course, taken for granted by persons beneath middle age. Not by me. Nor, I think, by anybody if you look at the long run. A lot of this is sheer novelty. Soon it all will become so routine that people won't buy unless it's really useful. We do face up to facts, sooner or later. So I have hope, though my eye grows bilious when it comes to much of what we now have around. Even in hi-fi.

We are dealing here on two levels, of course. These flashing indicators merely refer to what's going on inside (though a few are purely decorative, like so many Christmas tree lights). What goes on inside is too often just silly. And yet —

And yet, not all is bad that looks bad. Take me and these new tuners, decks and so on. Splendid equipment, but give me time! Before I could use them at all I had to learn their Readout languages. No longer do I merely reach for familiar knobs and (large) pushbuttons. Radio! I couldn't even get station WXYZ, right there in the middle of the dial (*what* dial?), until I had inputted the tuner's elaborate memories. No more easy flick of the tuning knob, the pointer flying straight to the station of my choice. That was a good system for 50 years, but it is gone. Now you have to commit everything to memory. The tuner's.

Well, good or bad? We'll have to see. It's early in this game. I'll go along. So then there's the cassette deck. Yes, there are little fingertip buttons, activating numerous lights, which more or less follow the old familiar configurations, fast-forward, play, rewind; also a lot of other pushbuttons and lights, needing a magnifying glass to decipher. I couldn't for the life of me get into simple record mode until I'd read the book on how to tell the machine. Memory? Several memories. It's mine that is now at fault; I can't remember to inform these memories what I want them to remember until I remember to look at the Memory Instructions. All very confusing. But —



The raison d'etre, the Reason for Being, in all this, whether good or bad, zany or sober, is very simply an electronic overabundance, mushrooming straight out of the now-familiar and omnipresent chip, the IC, the microprocessor, the minicomputer, a development that has increased our electronic potential by maybe 10,000 to one, or is it 10 million? We have such staggering capability now that we really don't know what to do with it all. So we do everything — anything.

What's an engineer supposed to think when he's tossed a thousand transistors on a fingernail and told to get busy and USE them for something? (Can you remember the size of a thousand vacuum tubes and the bulk of the first mainframe computers, using tubes?) Likely as not, our fingernail engineer will go berserk, in a highly integrated way, and come out with — you know what. Flashing lights. Elaborate ways of doing things that used to be so simple, if requiring a bit of thought, as well as muscle, not to mention knowhow.

You're telling *me* (by computer) when to shift gears on my manual-shift economy car? After my long years of experience! An insult. (But I suppose, helpful for you beginners.) And do I need a power can opener with computer which, when it jams on a sardine can, goes into reverse, flashes red lights, activates a squawk box, and then blows its fuse? I use the simple manual type and I know what to do with sardine cans. And yet. And even so —

Once the overwhelming novelty of all this begins to pale, we'll begin to cut the sheep from the goats, the dogs from the foxes, in the well-known marketplace selection. We'll do okay. Plenty will last.

Illustration: Philip Anderson

Wow is a fundamental problem in all disc reproduction, directly related to music enjoyment.

Plenty is already good. It already leaps at you. Like that marvelous little Canon LC card calculator I got for Christmas-before-last. For more than a year, month in and out, that slim little thing has marked off my days and my hours, minutes and seconds without a stop, all on a battery the size of a thin quarter, and it even keeps time to itself, invisibly, while simultaneously doing my entire checkbook arithmetic. I've even learned to tell it about February. There are dozens of other functions in this little miracle that I'll never use, but each of them is practical and helpful, for somebody.

Surely, a lot of our more flashy hi-fi includes useful elements just as remarkable, which will last and last, after the silliness is over. Time will tell which — and it'll have to be pretty soon, if I guess right. We're going to have to clean up this Readout act (we and our friends in Japan) in somewhat of a hurry if we are to sell our too-expensive fi in these unpleasant times. Look at autos. This could happen to hi-fi from overseas? Perhaps. And yet —

Look at Nakamichi. If you make something really new and useful, where no such thing existed before, you can use *two* thousand transistors. And charge $7,000. The Nakamichi TX-1000 Computing Turntable is that sort. It is unique, and uniquely useful. At the price, I do not ever expect to play with one at home, but I was astounded by its demo performance and I see a large future for the computing principle involved, once it filters down to less costly levels. For the first time in audio history, this turntable cancels out LP disc off-center wow *in the actual playback*, on the spot, dealing individually with each record, reducing the eccentricity to an Absolute Center of Rotation with incredible precision, every time. You can hear the result and it is astonishing.

This TX-1000 is an enormous table, squat and wide with great toad-like feet. It comes, dishearteningly, with neither arm nor cartridge nor even the usual simplified automatic functions. All this you must provide yourself. Nor will you fit the thing into a rack or on an inconspicuous stand; you'll need half a room for it, or a piece of a professional studio. But the thing solves a basic problem that has never before been addressed during a full century of disc manufacture and use. So it will find its place, at any cost.

When you listen to the new Ohm Walsh 2,™ the first thing you hear is a life-like stereo image. This is because we have eliminated stereo ghosts.

What is a Stereo Ghost?

Stereo ghosts are similar to TV ghosts. On TV, ghosts are caused by parts of the broadcast signal reflected off surfaces, arriving out of sync with the picture. Stereo ghosts are secondary sound images caused by a similar effect; the out-of-sync arrival of sound in your ears.

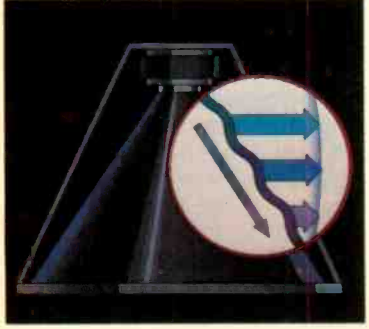
With conventional speakers it is easy enough to distinguish between extreme left and extreme right. But the real life position of the performers, "the stereo image" often seems jumbled and it varies with your listening position.

Stereo Ghosts confuse the stereo image with conventional speakers.

The New Ohm Walsh 2™* eliminates Stereo Ghosts to give you a real life stereo image anywhere.

The new Ohm Walsh 2™ gives a real life stereo image anywhere you sit. To eliminate stereo ghosts, the new Ohm Walsh 2™ uses a unique proprietary design.

Conventional loudspeaker — single arrow represents pulse travelling down cone causing out-of-sync fragments (as represented by 3 horizontal arrows) to enter air along the way causing stereo ghosts. This problem is further aggravated by use of multiple drivers.



Ohm Walsh 2™ loudspeaker — single arrow represents pulse travelling down inverted surface causing in-sync fragments (as represented by 3 horizontal arrows) to enter air along the way eliminating the problem of stereo ghosts.

Ohm turned conventional loudspeaker theory upside down and inside out.

To eliminate stereo ghosts the Ohm Walsh 2™ uses a completely new and different technology related to that of our world famous $4000 a pair Ohm F.

Unlike loudspeakers that use a series of separate conventional drivers, at the heart of the Ohm Walsh 2™ is a proprietary inverted conical surface that radiates sound in perfect synchronization. The result is a stereo image of lifelike clarity anywhere in the room.

Prove it to yourself.

Listen to conventional speakers and walk from side to side. Ghostlike, the stereo image seems to shift. Then, listen to the Ohm Walsh 2™ and contrast the lifelike image you will get from any listening position.

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Ohm

We make loudspeakers correctly.

Perfectly good LPs sound strangely different and better after the Nakamichi TX-1000 has done its work.

The Nakamichi TX-1000 turntable.

Look for a moment at wow. It comes from off-center rotation of the tight spiral of record grooves and it is a product of a whole chain of circumstance — that's the trouble — going back to the earliest stages of disc master preparation. That little center hole is extremely tricky. What *is* the mathematical center of an uneven spiral? Not at all simple, mathematically. But our problem is to determine it in terms of practical fact — and then produce records with a tight fit on every turntable (impossible) and absolutely no warping, shrinking, or other aberration in the plastic (impossible)—to play on tables of variable quality and exactitude, plus damage such as slightly bent spindles. Do we come out with the theoretically perfect spiral that our phono arms are supposed to trace in playback? In spite of enormous effort, hardly ever, though we come close.

There is only one way to do precision correction. On the spot. At playback, for each and every performance. Has it ever been done before? (Well, I did it after a fashion, back in the '30s.) Not, in any case, by machinery.

The human ear is remarkably sensitive to short-term variations in pitch of this rhythmic sort. In the longer run, we have poor pitch memories. We forget in minutes. But once around on an LP, worse on a 78, and anybody's accuracy of discrimination is phenomenal. You need no fancy wow meter to show you, even though Nakamichi did use one (via projection TV) at their TX-1000 demo. So "almost" is not enough. Wow is a fundamental problem in all disc reproduction, directly related to musical enjoyment. There is *no* wow in live music. Nor in genuine real-time live broadcasting. Any musician or music lover can tell the difference, although, minus comparison, we don't much notice it. Just learn to take our wow, like other distortions.

That center hole has always been a problem. I once visited the Columbia pressing plant in Bridgeport (Conn.) shortly after the LP's beginning, when the old traditional centering system was still used, strictly by hand and instinctive expertise. I remember a little man who just stood there and at the psychologically right moment whammed down a lever that punched a hole to match the grooves of a prototype master. (The original lacquer center had earlier been removed.) Now there are improvements but, still, inaccuracies. Plenty of room for Nakamichi to work on most of our present discs when they come to the test of playback.

As for me, I have always detested wow as the worst of all musical distortions, and I was out fighting it with my earliest 78-rpm records. Wow in 78s can be really awful, especially the inner grooves. In those times, the shellac holes seemed to enlarge with every playing, and many were sloppily large to begin with. There was "play" at the spindle on most of them, and a sidewise push on the disc could make the difference between good music and excruciating wow.

After trying many times to push those records sidewise while they played (no use), I had a bright idea which Nakamichi will appreciate. I would mark six or seven places around the rim of a record, then carefully push at each one, for a playing trial, until I found which position wowed the least. A permanent reference mark went on the rim at that point — just place disc on turntable, push sidewise as marked, and play. Success! It worked like a charm. Hours and hours of music were rescued from the curse of wow.

So you've guessed it, Nakamichi pushes too. Though not the record. The TX-1000 is *two* tables, one above the other. The top one is movable sidewise on two axes via machinery underneath. You put on your record, a small auxiliary arm rises up on your left and swings over, to play a few turns of the leadout grooves. That's enough. A "special infrared LED/shutter/photo-diode system" linked to that arm measures its exact out-of-spiral motion and feeds the info to (what else?) an A/D which sends its digital signal to the computer. Said computer, as the arm retires back into its hole, then tells the upper turntable's mechanism exactly how to push sidewise *while the record turns* until the precise Absolute Center of Rotation is reached. Whereupon everything locks up, lights flash, and you're in biz.

The correction is indeed remarkable. Perfectly good LPs, the sort you'd never question, sound strangely different and better after the machine's work. Almost impossible to describe. Smooth water freezing to ice. All motion ceases. Space becomes immovable. Only the music plays on. Like live. Uncanny. There's been absolutely nothing like it before. Unless, maybe, the Canby finger-push system.

...and then came the "Z" Receivers.

There was a time when you had to buy separate components to enjoy the control flexibility and power needed for true high fidelity music reproduction.

Not anymore. Sansui now has developed its "Z" series receivers.

Whether you choose the super-powered 9900Z, the modestly-sized 3900Z, or any of the four models in between, you get the full-frequency benefits of Sansui's DC-servo amplifier technology. And distortion-free FM is assured by genuine digital-synthesized tuning, with the added accuracy of quartz PLL circuitry in our three top models. Twelve convenient instant-tune presets bring in your favorite FM or AM stations (6 of each) at a button's touch.

Real-time spectrum analysis that lets you see the shape of the sound you hear is included in our three most advanced units, along with Dolby FM decoding in the 8900ZDB. All but one of the "Z" receivers include LED displays that instantaneously show you just how much power is going to your speakers. Touch-button FM tuning and volume controls, two-deck dubbing facilities, dual phono capability and multi-system speaker switching are all to be found, in various combinations, in the "Z" receivers. You'll also find all the additional features you've come to expect from a company that has pushed high fidelity to its limits from its beginnings.

And for all their technological sophistication the six Sansui models in the 'Z' series will appeal to your eye no less than to your ear. Visit your nearest authorized Sansui dealer. He'll show you why "Z" stands for the last word in high fidelity receivers.

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HOW PHONO CARTRIDGES WORK

Continued from page 47

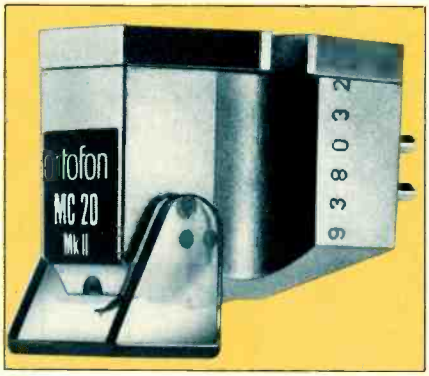


Fig. 7 — Ortofon MC-20 MkII.

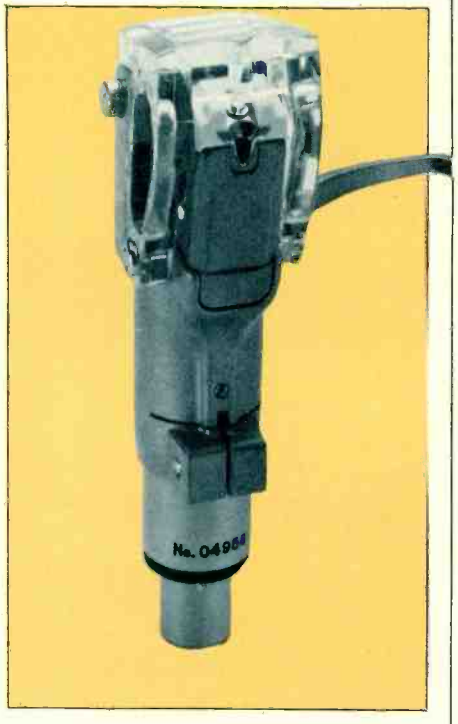


Fig. 8 — Technic's EPC-100 Mk3.

He then produced the latest Technics moving-coil cartridge, the EPC-305 Mk2. The tapered boron cantilever used in this design has the same 0.098-mg effective tip mass as their previous top-of-the-line cartridge, the EPC-100C Mk3. The frequency response is 10 Hz to 100 kHz, wider if anything than the EPC-100C Mk3. The performance is backed by a new "amorphous" transformer, rated to 300 kHz. In effect, the two cartridges have the same stylus system and identical frequency response for at least an octave above the audio band, which should isolate the operating principle.

A very interesting hybrid approach has been taken by the sister firms, Stanton and Pickering, in their XLZ/7500S, 980LZS, and 981LZS cartridges. In basic design these are moving-magnet types, but they have a very low inductance, 1 mH; low d.c. resistance, 3 ohms, and low dynamic tip mass, 0.2 mg. Their output is also low, at 0.06 mV/cm/S, so they require some sort of step-up device. However, these cartridges appear to offer all the advantages of a moving-magnet cartridge without the disadvantages of an MC type.

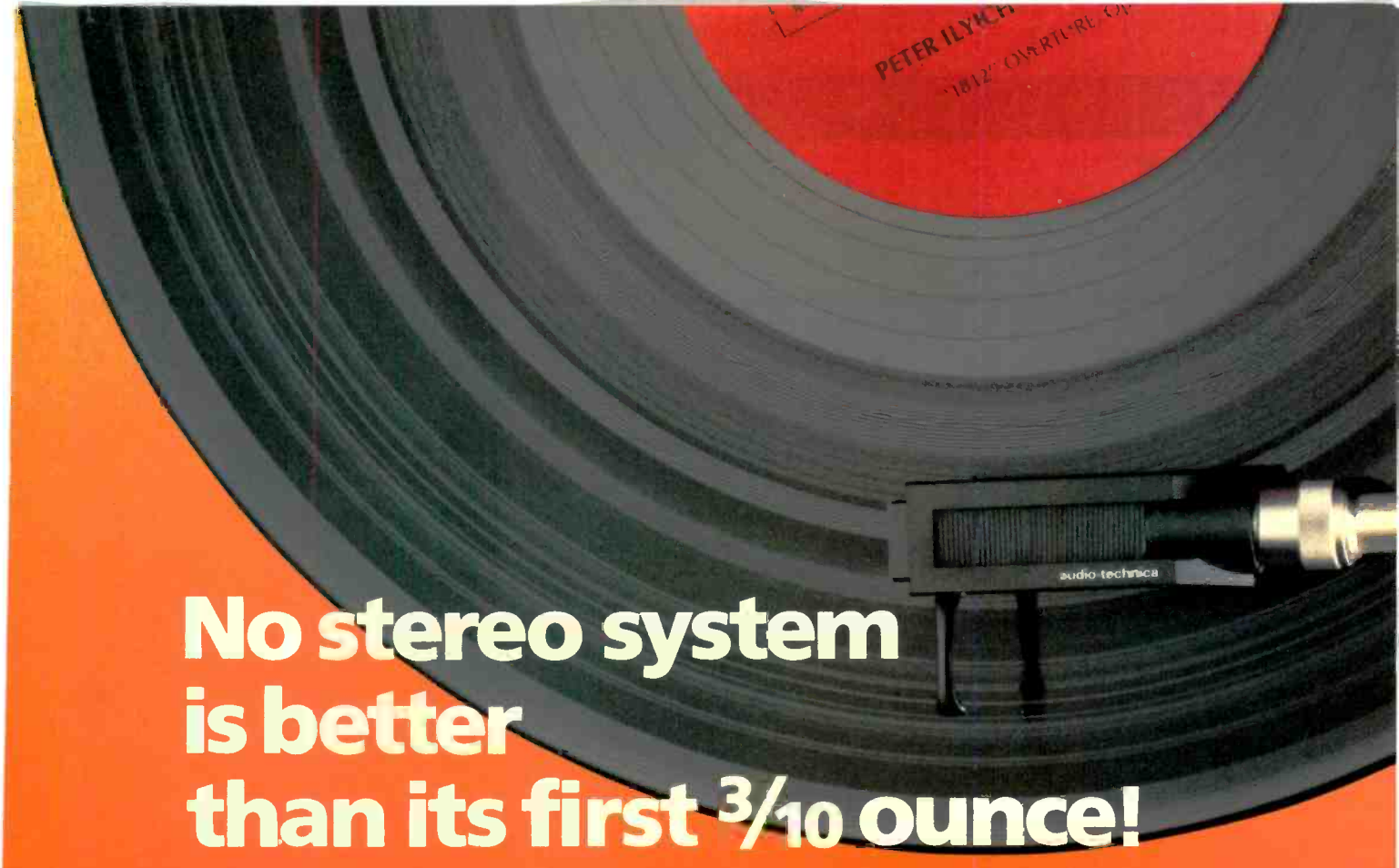
The moving-coil controversy is far from dead. As cartridges get better and closer in measured results, the tonality differences become vanishingly small. Moving magnets have become so advanced that at the high end, the majority of listeners would find no real difference and the decision of one type over the other would be based on economics.

We must not, however, ignore the lone golden-eared individuals who can hear the differences. We could have another TIM situation on our hands.

It is usually the prodding of some lone, serious, experienced listener that spurs the research and development of hi-fi equipment to greater refinement. At the moment, we may admit the differences. We must now find out if they are due to the construction of the cartridge, and indeed, if the "acceptable" sound is indeed accurate. Even our lone and consistent moving-coil fan admitted that his preferences were towards a slightly "hot" high end.

A grace note to our interview, Shuichi Obata said that even the latest and best records are not perfect and that considerable work is needed to perfect them. "Ask for better records," he said, "as well as better cartridges."

The differences are becoming so small that, from my vantage point on the sidelines, the whole issue is becoming a non-controversy. But my guess is that there will still be arguments about it when the last cartridge rolls off the line and into history.



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• Hirsch-Houck Labs Test Report Stereo Review. Sept. 1981

Clearly, the Audio-Technica AT155LC excels in just about every area of cartridge performance, and it came as no surprise to find that it was as silky smooth and "forgettable" when playing music as its measurements would suggest. We would have difficulty describing the "sound" of the cartridge, since it contributes so little of itself to the final sonic quality. Good records often sound superb when played with the

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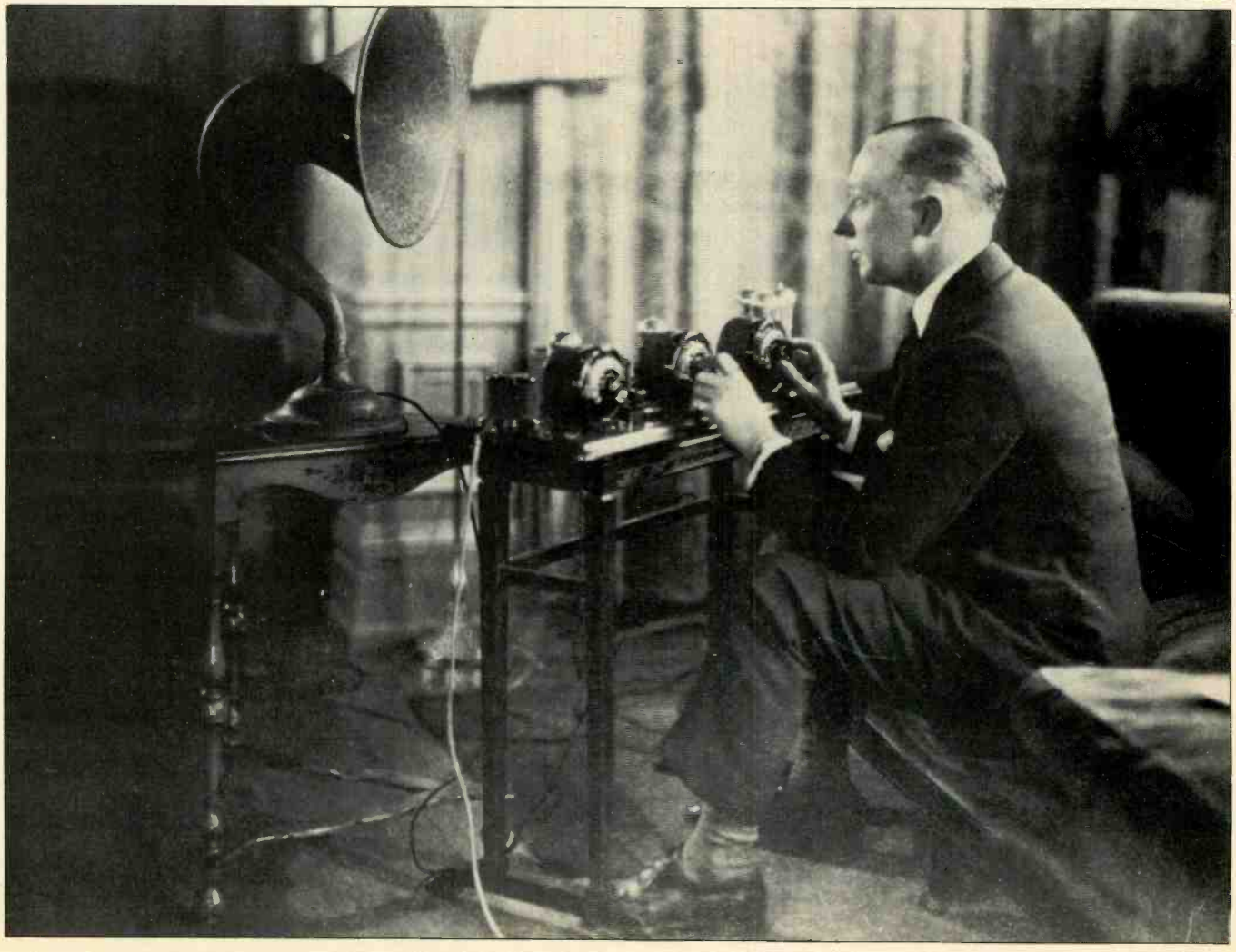
THAT'S THE WAY IT WAS

WALTER I. SEIGAL

Before his death in 1923, electrical engineer and inventor Charles Steinmetz (right) had a chance to try the mike at radio station WGY. By 1925 Atwater Kent had become a household name; in the photo below the Philadelphia radio manufacturer adjusts the volume on his own Model 10 receiver and loudspeaker. (Charles Steinmetz photo courtesy of the General Electric Broadcasting Company; Atwater Kent photo courtesy of A. Atwater Kent, Jr. and Thomas A. De Long, author of *The Mighty Music Box: The Golden Age of Musical Radio.*)



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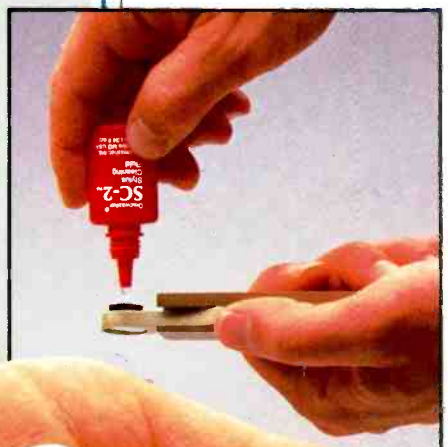

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