

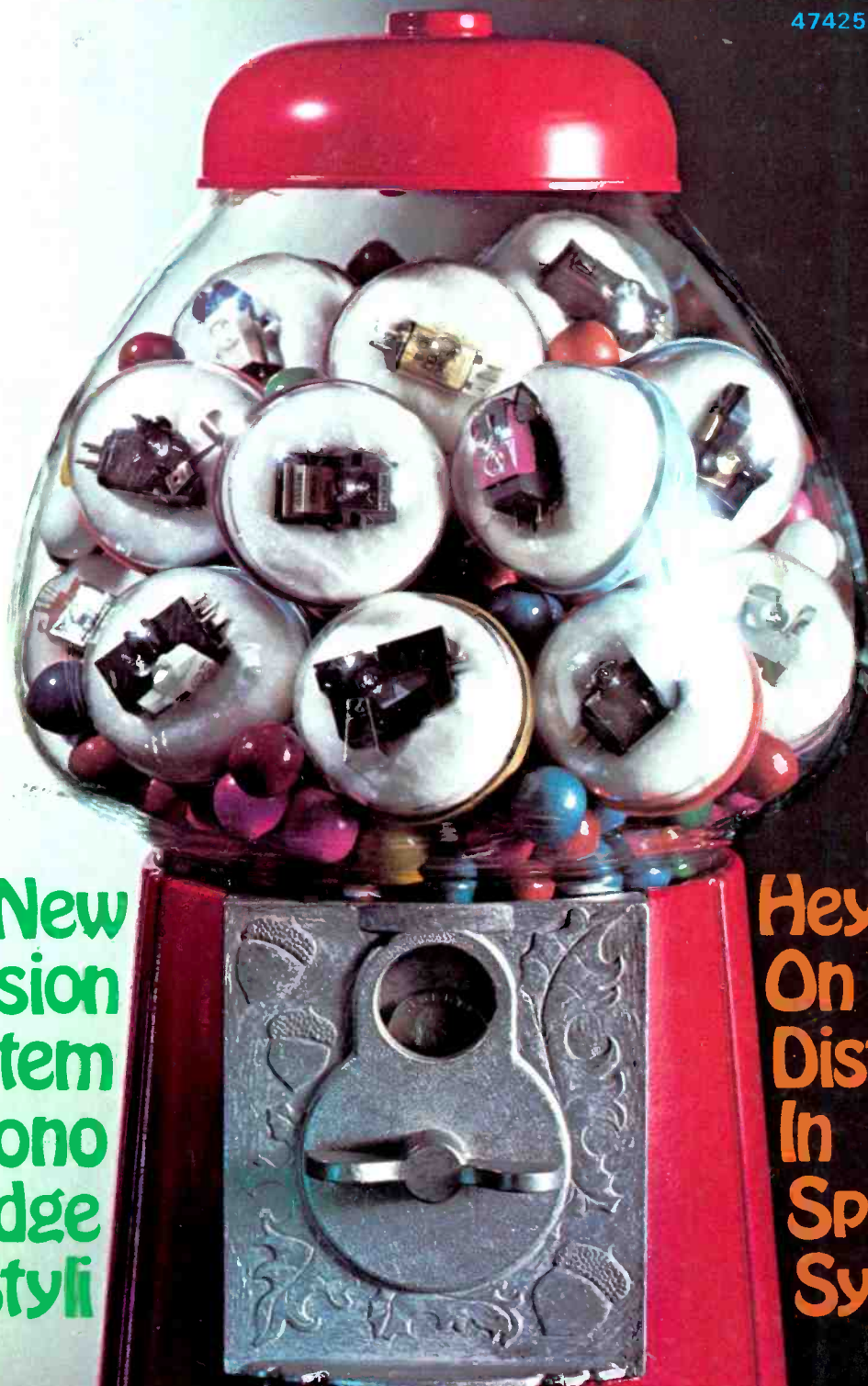
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Minneapolis  
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# Audio

THE AUTHORITATIVE MAGAZINE ABOUT HIGH FIDELITY • MARCH 1976 75¢

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**A New  
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System  
For Phono  
Cartridge  
Styli**

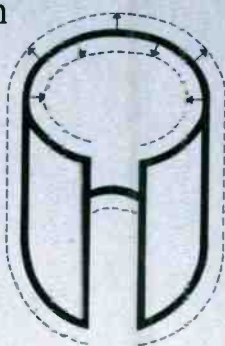
**Heyser  
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Distortion  
In  
Speaker  
Systems**

# THE FIRST SPEAKERS THE SOUND EXPENSIVE, CAN PRODUCE.

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driver. A 2-1/2" neoprene-impregnated cloth dome unit that, unlike most speakers, is peripherally driven for low distortion. Also unlike most speakers, this midrange unit is accurate to within 3 dB, even at 60° off axis.

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High Polymer Molecular film produces sound directly on the surface. So there's no need for voice coils or magnets.

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And, to keep all five HPM-200 drivers in balance and working together, we've engineered a massive crossover network that keeps all sound waves in phase over the entire listening area.

But no design dissertation can fully describe what the HPM-200 actually sounds like.

Irving Kolodin wrote for *Saturday Review*, after hearing Berlioz' "Symphonie Fantastique" over a pair of HPM-200s "...such towering presence that one could diagram the disposition of the Chicago Symphony just from the reproduced sound."

0 also has a  
l midrange



We believe the HPM-200 represents a new standard of accuracy in loudspeakers. Its dynamic range, transparency and overall lifelike impact are without precedent.

Ask your Pioneer dealer to play the super amplifier of your choice through speakers similar to the ones you're now using. Then ask him to play it through HPM-200s.

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**PIONEER**

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# INTRODUCING HPM-200. THE DESIGNED TO DELIVER ALL THE HIGH-POWER AMPLIFIERS CAN

Most speakers available today were designed at a time when most of the powerful amplifiers you could buy produced under 100 watts a channel.

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So Pioneer has developed a speaker system that can bring you all the peak levels, all the



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There are no magnets. And no voice coils. So there are no mechanical moving parts to get between the sound your amplifier puts out and the sound you hear.

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Instead of one



The revolutionary High Polymer Molecular film tweeter and supertweeter. They don't look, or work like conventional speakers.

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drivers. But they're made like conventional drivers. The cone materials include carbon fibers that are both exceptionally strong and low mass. So they can fully reproduce the sound without breaking up when driven by enormous power.

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# Audio

March, 1976

"Successor to RADIO Est. 1917"

Vol. 60, No. 3

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Contributing Editors: Herman Burstein, Martin Clifford, Fred De Van, Leonard Feldman, Martha Sanders Gilmore, Joseph Giovanelli, Richard C. Heyser, Bascom H. King, C.G. McProud, Dan Morgenstern, B.V. Pisha, Donald M. Spoto, George W. Tillett, Jon Tiven.

**AUDIO** (title registered U.S. Pat. Off.) is published monthly by North American Publishing Co., Irvin J. Borowsky, President; Frank Nemeyer, and Jay L. Butler, Vice Presidents; R. Kenneth Baxter, Vice President/Production; Vic Brody, Promotion Director; Mary Claffey, Circulation Director.

**RATES**—United States only: 1 year for \$7.00, 2 years for \$12.00, 3 years for \$17.00; outside the U.S.: 1 year for \$9.00, 2 years for \$16.00, and 3 years for \$23.00. Printed in U.S.A. at Columbus, Ohio. All rights reserved. Entire contents copyrighted 1976 by North American Publishing Co. Second class postage paid at Philadelphia, Pa. and additional mailing office. Back issues, \$2.00 each. **World Library Congress** number: ISSN 0004-752X. **Dewey Decimal** number: 621.381 or 778.5.

**REGIONAL SALES OFFICES:** Jay L. Butler, Publisher and Sanford L. Cahn, Marketing Director, 41 East 42nd St., New York, N.Y. 10017, telephone (212) 687-8924.

Jay Martin, 2525 West 8th St., Los Angeles, California, 90057, telephone (213) 385-2917.

**REPRESENTATIVES: Continental Europe:** V. B. Sanders, International Publishers Advertising Service, Raadhuisstraat 24, Graft-De-Rip, Holland; telephone 02997-1303.

For Benelux and Germany, W.J.M. Saunders, Mgr., Herengracht 365, Amsterdam, Holland, telephone 24.09.08.

Japan: Japan Printing News Co., Ltd., No. 13.2 Chome Ginza Higasi, Chuo-ku, Tokyo, telephone 541-5795.

**AUDIO** Editorial and Publishing Offices, 401 No. Broad St., Philadelphia, Pa. 19108

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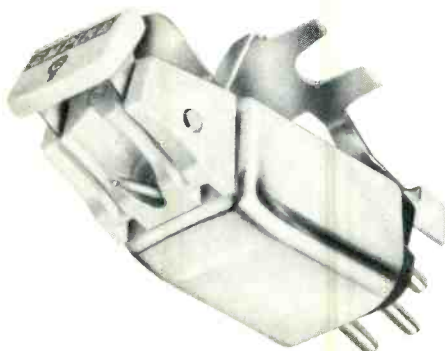
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## Audioclinic

Joseph Giovanelli

### CD-4 Disc Playing Time

*Q. What are the recent developments concerning CD-4 albums in regard to playing time? It is well known that one of the original drawbacks of discrete discs was the shorter amount of time they would play on each side relative to conventional stereo discs. Recently, however, I purchased some CD-4 albums, which I already owned in the stereo version. The CD-4 versions apparently took up less of the disc side than the stereo counterparts. Is this due to the improvements in the CD-4 process or is bass information being severely compressed?—Walter C. McKinnon, Ft. Worth, Texas*

A. Any conventional LP disc tends to suffer from distortion when playing the inner grooves, and the nature of this distortion is such that the carrier on CD-4 discs will not reproduce properly if the diameter of the groove is too small. It has, therefore, been the practice, when cutting CD-4 records, to close out the side at a diameter larger than is usually called for with a regular stereo disc. Early on, the way this was done was to cut the CD-4 disc with either reduced bass information (for narrower grooves) or to use shorter material time. However, so much attention has been paid to this problem over the past few years that it is now possible for the CD-4 recording engineers to put the same information onto a disc with larger inner diameter than is standard practice with stereo discs.

Judging from your letter, I would say that what you see on your CD-4 discs is a case of the record cutting engineer being as careful as possible to have a large inner diameter, rather than limiting the bass.

### Eight-Ohm Speaker Wire?

*Q. While working in my fix-it shop, somebody asked me for "eight-Ohm wire" so he could hook up some speakers to his receiver. I offered him 16-gauge zip cord, saying that it*

*would do the job, but he insisted on "eight-Ohm wire," explaining that television receivers needed 300 Ohm lead-in to interconnect the antenna to the input terminals of the tuner.*

*Does wire actually have an impedance? Is there "eight-Ohm wire?" If so, why doesn't anyone talk about it? Or is TV lead-in only 300 Ohms at TV frequencies as a result of capacitive properties, but not at audio frequencies?—John Shelton, Chagrin Falls, Ohio*

A. Problems encountered at radio frequencies in terms of requirements of the interconnecting cables between the antenna and the tuner input are quite different from those problems at audio frequencies with speaker connection wire. In radio frequency work, it is essential to have an impedance match between the antenna and the transmission line, as well as between the transmission line and the input of the equipment being fed. When considering the electrical properties of wire, it does not have just d.c. resistance; it also possesses inductance and, in the case of a pair of wires, capacitance. At audio frequencies the inductance and capacitance of speaker wire are of too small a value to be much of a factor in the performance of the system. At radio frequencies, however, these properties, together with the d.c. resistance of the wire, combine to make up an impedance which must be taken into account.

Transmitting audio power from an amplifier to a loudspeaker should be done with as little a loss of power as possible. The interconnecting cable, therefore, must have as low a d.c. resistance as possible, and thus you were right in offering a fairly heavy wire, such as 16 gauge.

If you have a problem or question on audio, write to Mr. Joseph Giovanelli, at AUDIO, 401 North Broad Street, Philadelphia, Pa. 19108. All letters are answered. Please enclose a stamped, self-addressed envelope.



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But we don't have to tell you how good these turntables are. Read some of the reviews\*. And see for yourself.

The concept is simple. The execution is precise. The performance is outstanding. The name is Technics.

\*SP-10 - Audio, 8/71; Stereo Review, 9/71; Audio, 10/73, 3/74.

SL-1100A - Stereo Review, 7/73; High Fidelity, 9/73.

SL-1200 - Radio Electronics, 7/74; Audio, 7/74; Stereo, Fall '74.

SL-1300 - FM Guide, 9/74; Stereo Review, 2/75.

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# Technics

by Panasonic



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# Tape Guide

Herman Burstein

## Static Sparks

*Q. During fast wind on my Ampex 2160, I have frequently noticed a spark jump from the axle to the tape spool or from the spool to the tape or from the surface of the deck to the spool. This appears to me to be an electrostatic spark, and it is accompanied by a characteristic "snap" sound. Is this a common phenomenon during dry winter months and will such a spark degrade recorded material on the tape?—K. W. Dickman, Urbana, Ill.*

A. The phenomenon you describe is, I believe, rather uncommon, and it may well be cured by grounding the machine. If this doesn't help, try writing Ampex. I doubt that the spark will affect recorded material, however, you are in a much better position than I to answer this question.

## Using Computer Tape

*Q. I recently picked up a number of reels of 1/2-in. computer tape from the local salvage yard. More out of curiosity than necessity, I attempted to slit the tape to 1/4-in. width for use with my home recorder. Unfortunately, I could not obtain a uniform cut, and the tape wanders over the heads and will not reproduce accurately. The signal occasionally fades out on one channel or the other. What kind of frequency response could I expect from this tape, assuming I can slit it accurately? Could there be a lubrication problem with consequent head wear?—George B. Moore, Ar., APO, Seattle, Wash.*

A. If wide tape is to be slit, this must be done very accurately to a nominal

width of 0.246 inches plus or minus 0.0002 inch. Otherwise you will run into problems of sticking in the tape guides, skewing, etc., and this would account for your fading of signal.

Without some specific information on this tape, I cannot give you definite information on response but you can probably expect somewhat elevated treble and perhaps very low output. It's rather doubtful that computer tape would be rougher on your tape heads than regular audio tape, however, this may be the very reason the tape wound up in the salvage yard.

## Demag of Cassette Heads

*Q. My problem concerns the demagnetizing of a cassette-type record/playback head in a General Electric Model M8350A. The external shell of the head is magnetized, and even replacement heads seem to be premagnetized. Demagnetizing with a Robins TD-3 head demagnetizer fails to remove the flux in the head. The external shell attracts a steel object. Does some type of head have a built-in magnet that is not intended to be demagnetized? Would a cassette-type demagnetizer be more suitable than my Robins unit?—E. L. Freeland, Indianapolis, Ind.*

A. To my knowledge, heads are not intended to be magnetized, because magnetization is a source of noise and treble loss due to the erasing effect of the magnetized head. It may be that you can achieve adequate demagnetization of your cassette head by using a bulk eraser with a sufficiently powerful magnetic field when brought up within a few inches of the head. I can't comment on the adequacy of the cassette-type demagnetizers as they vary and I haven't a great deal of experience with them. I suggest that you also address your query to the manufacturer of the cassette machine.

If you use a bulk eraser and your equipment has a VU meter, be careful not to bring the eraser within about six inches of the meter for the eraser's strong field might damage the meter.

## Peaking an Erase Head

*Q. Can the erase head be peaked for maximum efficiency? I noticed that my recorder has a small capacitor in series with the erase head and was curious about whether the unit had, in fact, been peaked.*

A friend of mine suggests that as the tape moves over the heads, capstan, and guides, static electricity is generated. I agree with him, but he further contends that this charge is d.c. and results in noisy tapes and magnetized heads. His conclusion is that the machine should be well grounded. What is your opinion?—Vincent Mogalero, Woodside, N.Y.

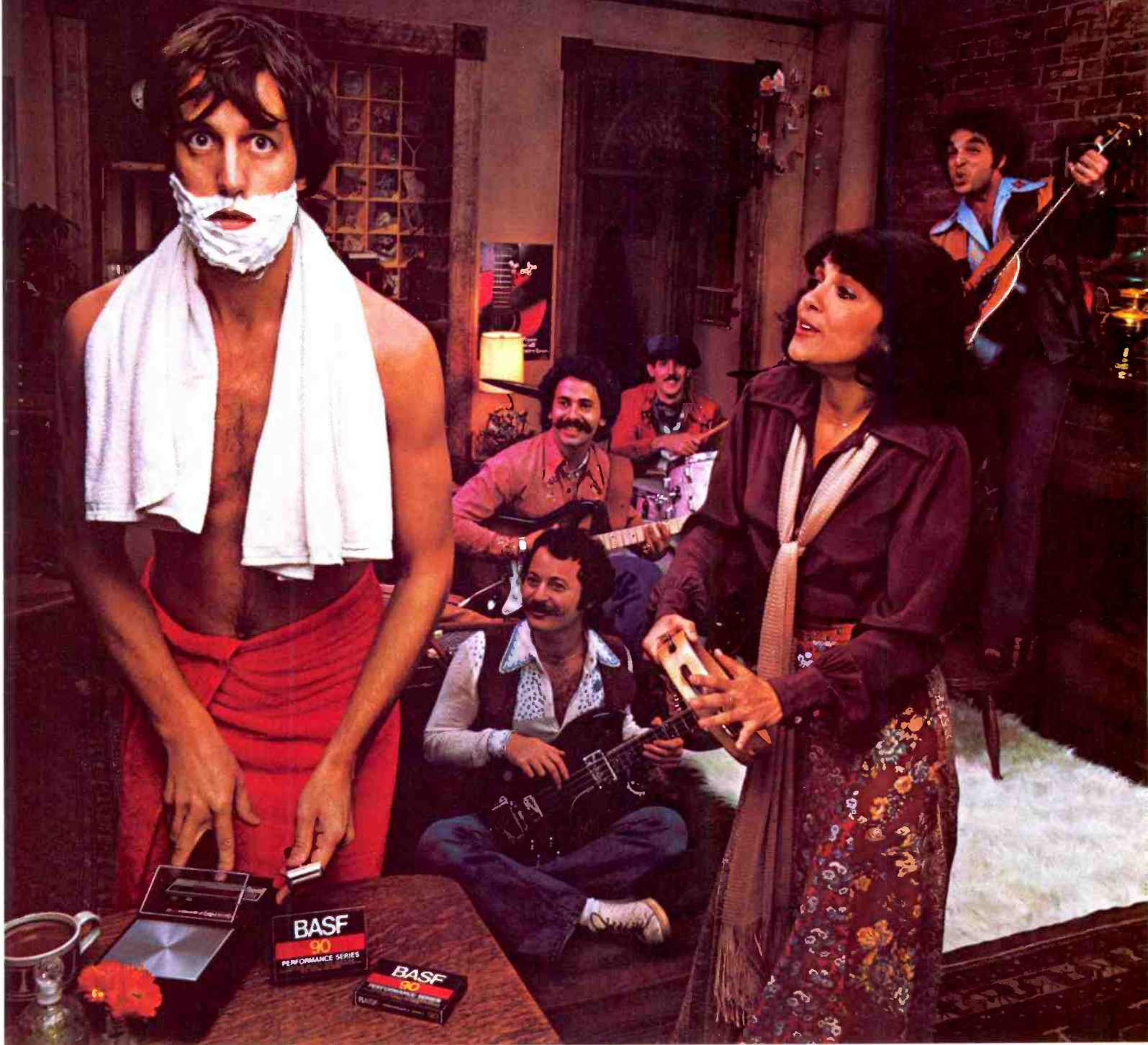
A. The erase head can be peaked with a series capacitor. Often the oscillator provides more than enough current to drive the erase head, so that the objective is to limit this current by an appropriate resistor or capacitor. However, when dealing with very high oscillator frequencies, peaking may become desirable because head inductance may be a barrier to sufficient current flow through the head.

What your friend may be referring to is that audio signals (a.c.) are asymmetrical. This asymmetry represents a d.c. component, which tends to magnetize the heads. Magnetized heads and other components contacted by the tape tend to produce noise on the tape and to erase the very high frequencies. I doubt that grounding the machine will take care of the problem. The solution is to subject the heads, guides, etc. to adequate demagnetization on a regular basis, though this doesn't have to be done as often as head cleaning. Consult the machine's manufacturer for information on how often this should be done and with what strength demagnetizer if this is not in your owner's manual.

**About The Cover:** There are so many good phono cartridges on the market now that you don't need the persistence and luck of a gum ball wizard to get a prize cartridge; all you really need to do is read the test reports, like those in *Audio*. Gum ball machine courtesy The Nut Vender, 611 West Ave., Jenkintown, Penna. 19046.

If you have a problem or question on tape recording, write to Mr. Herman Burstein at AUDIO, 401 North Broad Street, Philadelphia, Pa. 19108. All letters are answered. Please enclose a stamped, self-addressed envelope.

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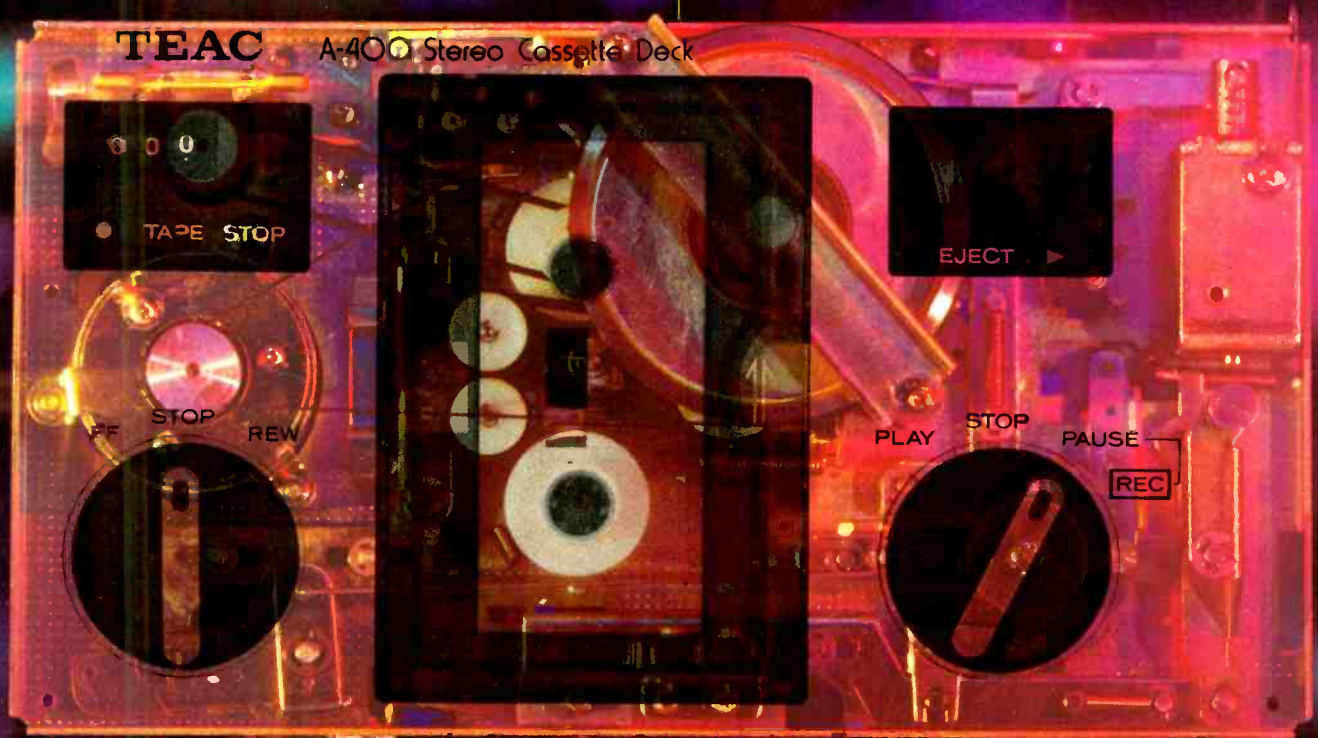
them, you get rid of most of the noise.)

So what you're left with is sound so rich and clear, you don't just hear it. The music happens.

Which really isn't that surprising. After all, BASF invented audio tape in the first place.

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# The component look.

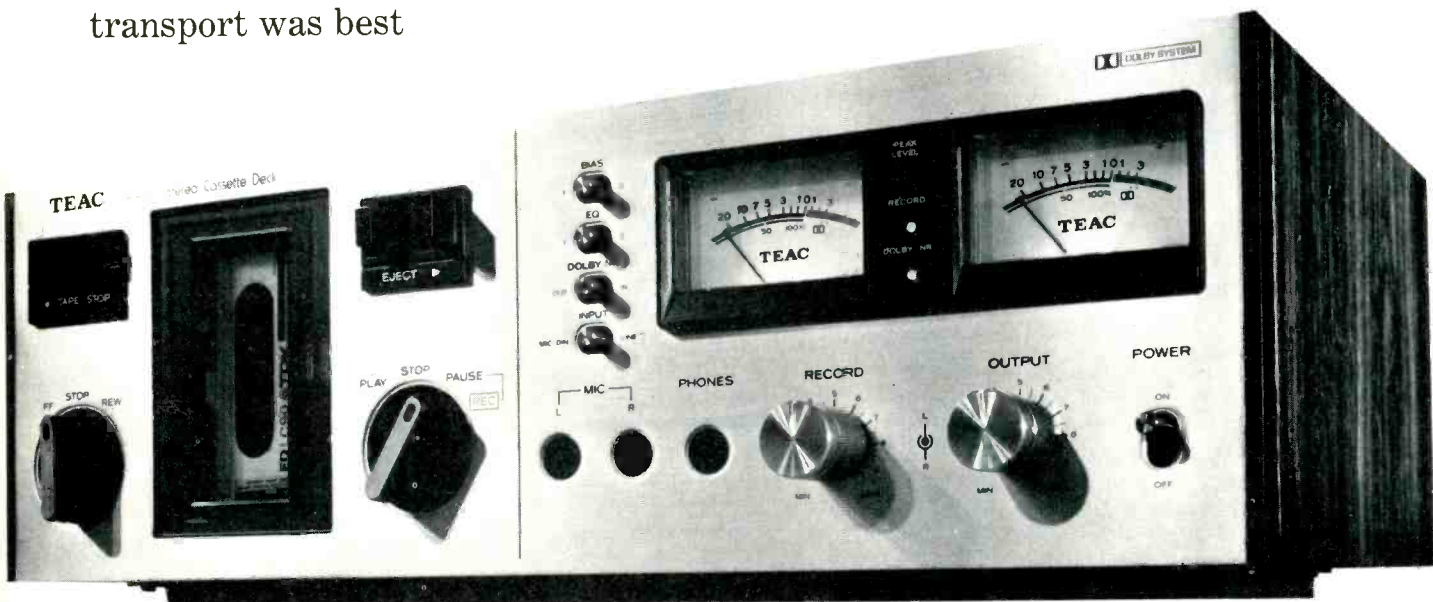


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# A-400

The 450 redefined the cassette deck as a true high fidelity component. That remarkable transport design generated a new found measure of respectability for the cassette format.

Our engineers then determined that a vertical transport was best



suited for a front load application. In terms of overall design integrity and mechanical stability. So rather than adapt one transport design to fit another need, we produced a completely new, highly streamlined mechanism. From the inside out. It's called the A-400.

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# What's New in Audio

## ADS Speaker



The Model 200 speaker system is a miniature, precision, two-way unit in a solid metal housing. Unlike the ADS 2001, this model has no equalization/amplification and is a passive speaker, with built-in crossover network, to be used with amplifiers having from 10 to 50 watts continuous output. The Model 200 is rated at 30 watts under the DIN 45500 specification. Frequency response is specified at 70 Hz to 20 kHz  $\pm 3$  dB. Components are a one-inch, soft-dome tweeter and a four-inch, long excursion, high compliance woofer. Size: 6-5/8 in. by 4 1/4 in. by 4 1/4 in. Weight: 4 1/2 lbs. Price: \$100.00 in silver or black brushed anodized aluminum.

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## Nuclear Disc Cleaner



Staticmaster 3C500 is a natural bristle cleaning brush using a Polonium 210 active element that emits alpha particles which ionize the air to remove static from a record's surface. Price, \$14.95.

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## Primo Microphone



The DM-1525 omni-directional dynamic microphone features a flat frequency response with uniform off-axis response. The mike has a shock-mounted and wind-protected cartridge, a die-cast aluminum case with a nickel-plated finish, and a heavy-duty plated windscreen. It has a 200-ohm balanced output impedance and is supplied with a standard 3-pin Switchcraft connector. Response is uniform from 50 to 15,000 Hz, and the output level is -76 dBV. It is 6.8 in. long and 1.6 in. maximum diameter. The DM-1525 is supplied complete with cable, stand adapter, and vinyl carrying case.

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## White Sound Analyzer



Model 142 Sound Analyzer, is designed primarily as a monitor for program material and incorporates a 28 x 11 LED matrix display of the 27 one-third-octave channels from 40 Hz to 16 kHz, plus one broadband channel for overall indication of level. A front panel switch selects display ranges of 10 through 30 dB. Input is calibrated in 10 dB steps from -30 to +10 dBm. Decay time can be varied from 0.1 to 2.0 seconds. Model 142 is 3 1/2 in. H. x 8 in. D. on a standard rack panel. Weight, 10 lbs. Fifteen watts is required for either 115 or 230 V a.c. power. Price, \$3,200.00.

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## Auratone Speaker



The 5C Super-Sound-Cube has a useable response from 50 to 15,000 Hz and is specified as flat within  $\pm 3$  1/2 dB in the 200 Hz to 12.5 kHz range. The 6 1/2 in. H. x 6 1/2 in. W. x 5 3/4 in. D. cube has a 4 1/2 in. driver capable of handling a continuous 150 Hz sine wave signal input of 30 watts with peaks up to 60 watts.

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## Vu-data DMM-Counter-Scope



A digital multimeter, frequency counter, and oscilloscope are packaged here in a single unit with all three measuring devices having their own displays. Model PS195 miniscoposcope is a 20-MHz bandwidth, triggered sweep, single-trace oscilloscope. Vertical sensitivity is 10mV/div. The fastest sweep rate is 100 nSec/div which can be increased to 20 nSec by a 5x magnifier. Unit also has external trigger and external X-axis input capability. CRT viewing area is 6 x 10 major divisions, each 1/4 in. Model 975 DMM-Counter has a 3 1/2-digit, auto-ranging digital multimeter, and a 4-digit 20MHz frequency counter. Combined, Model PS915/975 is 6 in. H. x 8 1/2 W. x 12 1/2 D. Weight, 10 lbs. Price, \$1,250.00.

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the definition  
you have never been  
able to get before!**

**AH! DEFINITION**—That elusive quality of clearness and accuracy never quite attainable before. (If you can't extract it at the point of contact with the record, the rest of your equipment won't deliver it to you.)

The design philosophy of the SONUS cartridge is to use the latest refinements in material and techniques to convert the motion of the record groove into a precise electrical replica, thus assuring the highest possible sonic accuracy and definition.

The electromagnetic structure of the cartridge is exceptionally efficient and has been arranged in such a way that the point of transduction is placed as close as possible to the record surface. This enables the distance from the stylus tip to the energized armature to be kept extremely short, thereby minimizing the chances of the motion being significantly changed, and/or extraneous resonances introduced. It further enables the moving element to be kept exceedingly light and rigid. Indeed, we believe the total moving structure to be lighter than that of any other magnetic cartridge of which we are aware.

Great care has been taken with the cartridge geometry, not only to minimize vertical tracking error but also to ensure accurate transmission of the stylus motion to the generating armature. This has been

achieved by (among other things) positioning the stylus tip on the same axis as the armature so that none of the stylus motion is lost in rotation or affected by any possible rotational resonances.

The stylus pivot is located at the dynamic center of rotation of the moving system and is fabricated from material having optimum elastomeric properties, providing an extremely linear and highly compliant suspension.

In sum, we have a transducer system characterized by reproduction of exceptional accuracy, clarity and definition, and capable of perfect tracking and tracing at very low stylus forces.

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# Behind The Scenes

**Bert Whyte**

**L**AST MONTH, at the conclusion of my report on the Audio Engineering Society Convention in New York, I reported that banquet guest speaker Avery Fisher had revealed some of the plans for the reconstruction of Avery Fisher Hall (formerly Philharmonic Hall). Mr. Fisher noted that Dr. Cyril Harris, of Columbia Univ., would be the acoustician for the redesign of the hall, and I mentioned that Dr. Harris had been the acoustician for the new Orchestra Hall of the Minnesota Symphony Orchestra in Minneapolis, and I had a story to tell you in regard to all this.

Actually, there are two tales to tell, and I would be most remiss if I didn't give equal weight to these stories. It all began with an invitation from Dick Ziff, ace public relations man for the 3M Company in New York, to join an audio press junket to the 3M Magnetic Products Division laboratories in St. Paul. Dick assured me that this would not be the usual "how-de-doo," hand-shaking, "quick run through" type of PR visit, but would include an in-depth, "nitty gritty" evaluation and survey of current magnetic tape technology and test procedures. 3M always does things with great style, and thus it was that yours truly, and such audio journalists as Julian Hirsch, Len Feldman, Larry Zide, John Woram, Martin Clifford, and Craig Stark, along with Frank Barr and Bob Finger of CBS Technology Center (they do the testing for *High Fidelity*) and Ed Foster (formerly with CBS TC and now tech.ed. of Stereo), boarded a 3M executive jet-prop at La Guardia. We were soon winging our way to St. Paul, and needless to say, sustained by heaping platters of Dungeness crab and shrimp, with liberal dollops of "spirituous beverages," there was much camaraderie and lively bull sessions on board. In St. Paul, Clark Duffey, PR supervisor for the tape division, shepherded us to a cocktail party and reception, where we met the executives of the division and the technical personnel with whom we would be associating in the laboratories.

The next morning, we were duly impressed with the scale and scope of the Magnetic Products Division laboratories. Housed in a very functional modern building, there are superbly equipped laboratories dealing with every aspect of magnetic tape technology. There are environmental testing chambers to subject tape to every climatic condition from tropical to arctic. In some rooms are banks of dozens of 8-track players, constantly recycling for "life testing" of cartidges. Labs are filled with oscilloscopes, third-octave analyzers, and frequency spectrum analyzers. There is one totally fascinating lab with an electron microscope, which can magnify magnetic oxide particles some 5 million times! It goes on and on, lab after lab.

We were then taken to our training classroom, which was heavily instrumented with 'scopes, meters, a new General Radio frequency spectrum analyzer with chart recorder graphic read-out, plus representative hi-fi equipment including cassette, cartridge, and open-reel recorders from 3M's own Wollensak units, to units from Teac, Nakamichi, etc. Our training instructor was Mr. Del Eilers, Technical Service Specialist, a most erudite man in matters magnetic, who must be commended for the thoroughness of his presentation and for his patience and indulgence in fielding the often far-out questions from our press group.

## **Technical Seminar**

Like some of those "crash" language-study courses, Mr. Eilers completely "immersed" us in the subject of magnetic tape and took us right back to the basics, starting with the electro-magnetic characteristics of magnetic tape and covering parameters like sensitivity, maximum undistorted output, peak bias, and tape noise. Then on to recording system properties such as frequency response and signal-to-noise ratio. Next came recorder properties ... wow, flutter, speed accuracy, crosstalk, etc.

We evaluated tape for coating uniformity, surface uniformity, physical distortions, slitting quality, wind quality with and without the special 3M Posi-trak back coating. Then we delved deeper into the intrinsic magnetic properties of tape—coercivity, remanence, retentivity. Much attention was paid to the effects of differing bias settings and its influence on short and long wave length, maximum undistorted output, third harmonic distortion at various levels, and weighted and unweighted tape noise levels. All of these subjects were covered with actual demonstrations and comparisons of different tape oxides, with chart recorder read-outs permitting curve overlays and making evaluations relatively simple.

Near the end of our day, we enjoyed a lecture by Dr. John Holm, who is head of research on magnetic oxides and pigments. Dr. Holm discussed the differences between various forms of gamma ferric oxides, including modified oxides using cobalt. Chromium dioxide was discussed at some length, and finally Dr. Holm told us about 3M research in metal particle coating for tapes. These are of the same type as the tape Philips demonstrated to me in the summer of 1974. Dr. Holm verified that it would be indeed possible to gain 6-8 dB better S/N ratio with this kind of tape, noting however that there were difficulties to be overcome in its use, such as proper erasure and that such finely divided iron powder is pyrophoric i.e. can burst into flames in spontaneous combustion! When pressed for more details, Dr. Holm stated that these problems can probably be solved, but that commercial introduction of a metal particle tape was at least several years in the future.

Thus, our day-long seminar at the 3M magnetic tape labs ended. We all learned a great deal about tape and tape testing, and I am sure I voice the opinion of all of the members of the audio press corps present, that we much appreciated the candor and openness of the presentation and the



# THE END OF THE DOUBLE STANDARD.

## OUR LEAST EXPENSIVE RECEIVER HAS THE SAME LOW DISTORTION AS OUR MOST EXPENSIVE RECEIVER.

IM Distortion Comparison

YAMAHA	Brand "A"	Brand "B"	Brand "C"
CR-1000	.1%	.15%	.3%
CR-800	.1%	.3%	.5%
CR-600	.1%	.5%	.8%
CR-400	.1%	1.0%	1.0%

With most manufacturers, price determines quality. However, in the above chart, you can see how Yamaha alone offers the same quality (low distortion) throughout our entire line, regardless of price.

At Yamaha, we make all our stereo receivers to a single standard of excellence.

A consistently low intermodulation distortion of just 0.1%!

A figure you might expect only from separate components. Maybe even from our \$850 receiver, the CR-1000.

But a figure you'll surely be surprised to find in our \$330 receiver, the CR-400.

So what's the catch?

There is no catch. Simply a different philosophy. Where high quality is spelled low distortion.

You'll find Yamaha's single-mindedness particularly gratifying when compared to the amount of distortion other manufacturers will tolerate throughout their product lines. (See chart.)

Particularly gratifying and easily explained.

### Less of what irritates you most.

While other manufacturers are mostly concerned with more and more power, Yamaha's engineers have concentrated

on less and less distortion.

Particularly intermodulation (IM) distortion, the most irritating to your ears. By virtually eliminating IM's brittle dissonance, we've given back to music what it's been missing.

A clear natural richness and brilliant tonality that numbers alone cannot describe. A new purity in sound reproduction.

### A musical heritage.

Our seeming preoccupation with low distortion, in general, and the resulting low IM distortion, in particular, stems from Yamaha's own unique musical heritage.

Since 1887, Yamaha has been making some of the finest musical instruments in the world. Pianos, organs, guitars, woodwinds, and brass.

You might say we're music people first.

With our musical instruments, we've defined the

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Between our \$330 CR-400 and our \$850 CR-1000, we have two other models.

The \$460 CR-600 and the \$580 CR-800.

Since all are built with the same high quality and the same low distortion, you're probably asking what's the difference.

The difference is, with Yamaha, you only pay for the power and features that you need.

Unless you have the largest, most inefficient speakers, plus a second pair of the same playing simultaneously in the next room, you probably won't need the abundant power of our

top-of-the-line receivers.

Unless you're a true audiophile, some of the features on our top-of-the-line receivers might seem a bit like gilding the lily. Selectable turnover tone controls, variable FM muting, two-position filters, even a special five-position tape monitor selector.

However, you don't have to pick one of Yamaha's most expensive receivers to get a full complement of functional features as well as our own exclusive Auto Touch tuning and ten-position variable loudness control.

### The End of the Double Standard.

Just keep in mind that all Yamaha stereo receivers, from the most expensive to the least expensive, have the same high quality, the same low distortion, the same superlative tonality.

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rare opportunity for a behind the scenes experience with this important subject.

### Minnesota Orchestra Hall

The technical part of our visit to 3M concluded, our hosts took us to Minneapolis for an excellent dinner. Then, with typical 3M hospitality, we were taken to the fabled new Orchestra Hall for a concert by the Minnesota Orchestra conducted by Stanislaw Skrowaczewski. With all due apologies to the 3M technical people, I must confess that for me at least this was the highpoint of the 3M visit. I had been eagerly anticipating a visit to the new Orchestra Hall ever since it opened in October of 1974, with rave reviews for its acoustic excellence. The hall has been widely heralded as one of the finest concert halls in the world. Harold Schonberg, music critic of the New York Times, waxed rhapsodic about "acoustics that are almost too good to be true," and praised the "power and projection," the "articu-

lation and detail," and the "phenomenal bass response." Bill Anderson, Editor of *Stereo Review*, was equally fulsome in his praise for the acoustics of Orchestra Hall, as were many others. Now, almost exactly a year since the hall opened, I would have a chance to judge this acoustic marvel.

As noted, Dr. Cyril Harris was the acoustician for this new hall. Dr. Harris is a man with formidable talents and an impressive list of accomplishments. He is Professor of Architecture and Electrical Engineering at Columbia University, a Fellow and Honorary Member of the Audio Engineering Society, Fellow and Past President of the Acoustical Society of America, and in 1975 was elected to the National Academy of Engineers, the highest tribute that can be paid to an American engineer. Dr. Harris was the acoustical consultant on the Metropolitan Opera House, Powell Hall in St. Louis, and the complex of auditoriums in the Kennedy Center in Washington, all of which are consid-

ered to be acoustically successful. Dr. Harris is a traditionalist in his approach to the design of concert halls. He opts for the rectangular shapes of the old halls in Europe, like the Musikvereinsaal in Vienna or the Gewandhaus in Leipzig, with two or three balconies arrayed along the sides and the rear of the hall, and with many irregular shapes on the ceiling, walls, and balconies for proper diffusion of sound throughout the hall.

Orchestra Hall in Minneapolis is essentially a modern expression of those old halls, with all the help available from the measurement data and scientific disciplines of acoustical engineering. The hall is a rectangle with three balconies, giving a seating capacity of 2,573. The hall itself is made of concrete and red brick, with a unique noise-attenuating feature in that the entire hall is actually separated by a one-inch gap from the supporting structure of steel, aluminum, and glass. There are splayed panels of inch-thick, cross-braced, solid white oak along the sides and rear wall of the hall, disposed so there are a minimum of parallel plane surfaces. Wood is also used for the stage and hall seats. There are irregularly tilted surfaces on the undersides of the balconies. In the old European halls, the walls and the ceilings and the balconies were heavily plastered with ornate baroque ornamentations . . . scrolls, bas relief, cherubs . . . the gingerbread that broke up the sound and gave reasonably uniform diffusion in the hall. Such florid sculpturing isn't used anymore, but nonetheless the use of heavy plaster is retained in what is probably the most striking (and controversial) feature of Orchestra Hall. The entire ceiling is composed of a random pattern of huge plaster cubes, and it gradually slopes down over the audience and continues unbroken to the back of the stage. Thus, there is no shell or proscenium as such, similar to the situation in the original unmodified Orchestra Hall in Chicago. These huge cubes give hundreds of reflecting angles, so there is no reflective reinforcement of sound and diffusion is quite uniform. The great rigidity of the walls of the hall, with solid oak paneling over concrete, gives negligible flexure of the walls and thus avoids sound absorption and aids in the clarity and brilliance of the sound. Since the stage is not the "room within a room" typical of most concert halls and since there is no shell, the continuation of the ceiling to the back of stage acts like a giant horn and all the sound on the stage is projected



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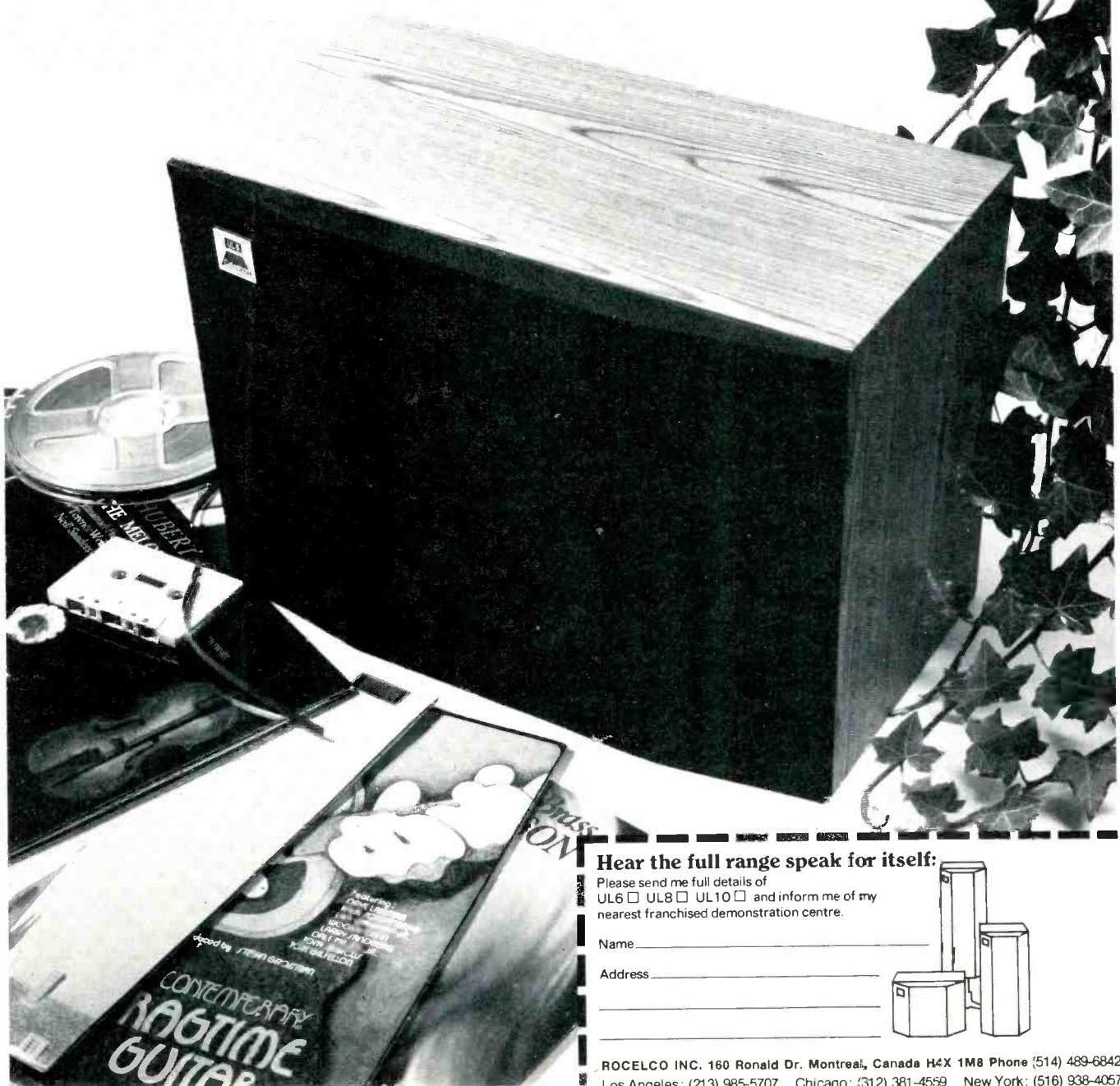
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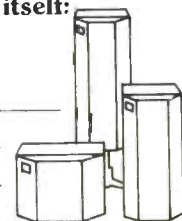
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into the hall. I would note however, that the stage is on the small side for such a hall; with the chorus for the Beethoven *9th Symphony* added to the orchestra, things might be a bit crowded.

The foregoing is an abbreviated description of Orchestra Hall in Minneapolis and cannot do full justice to the many clever aspects of the design. What Dr. Harris had accomplished was a concert hall designed to simulate the traditional qualities of the fine old European halls, bolstered by all the resources of modern acoustical engineering, and using traditional materials, such as wood and plaster, in new ways. Now, on with the concert!

### Reaction to the Acoustics

John Woram and I sat together in the middle section about the 12th row, while the rest of the audio press corps and the 3M people were seated in the balconies. Orchestra Hall was just about filled to capacity, a good test for the acoustics.

The program began with Handel's *Royal Fireworks Music*. Most immediately notable were the good internal balances and the superb string quality, which combined a lovely luminous tone with good clarity and articulation. Woodwinds were very smooth, yet well focused. The overall hall sound was quite live, but oddly enough, at the end of phrases, the reverberation seemed to decay fairly rapidly. The music moved along nicely, with good ensemble playing, and when Mr. Handel gave us some big *tutti* with the *fortissimo* brass and percussion, all hell broke loose! Gawdalmighty, what projection! This huge sound just completely swamped the strings. There were the musicians sawing vigorously on their instruments, and all we could hear was the all-pervasive brass and percussion. When the orchestra returned to moderate levels, the balances were restored. Along came another *fortissimo* passage for brass and percussion, and the strings were completely covered. And so it went to the conclusion of the piece. John and I were shocked! Could this be happening in the vaunted acoustics of this hall?

Next on the program was pianist John Ogden performing a work he had composed for piano and orchestra. Here was a pianist pounding out great chords from a Steinway concert grand piano, and what we heard was a rather thin tone, not very well projected. Here too, when the big *fortissimo* passages came along, the strings and, to some extent, the woodwinds were covered.

At intermission, John and I went up

to the first balcony. The last work on the program was Schumann's *2nd Symphony*. While the same problems prevailed in the more athletic passages, the overall sound was marginally better. We did notice poor projection and lack of bass from the contrabassi, which were strung along the back wall of the stage, rather than in the usual right side of the orchestra in front-to-rear configuration.

At the end of the concert we all assembled at the front left of the stage, as we were to visit the broadcast booth upstairs, where station KSJN had been doing an SQ quadracast of the concert. The audio press corps turned to me and in virtually one voice said to me, "Well, what do you think?" I told them I was stunned and disappointed and that I couldn't quite believe what I had heard after the acoustics of the hall had been so highly touted. Everyone of my colleagues agreed quite vociferously, that something was amiss. No matter what their seat location, all had heard the imbalances and the swamping of the strings. As we were standing there, the hall had just about emptied and we immediately noted, and a few handclaps and whistles verified, the considerable increase in the reverberation period. That explained how my friend Marc Aubort got such an excellent spacious sound on the Ravel recordings he made in Orchestra Hall for Vox Records, which have been much acclaimed by the critics. In the empty hall with fairly close mike placement, he got the advantage of the fine reverberation, while maintaining orchestral definition, and that close to the stage avoided the brass and percussion imbalances. Our handclapping also verified the bit of low frequency slapback you can hear in the hall. Up in the broadcasting booth, Mike Shields, the very knowledgeable chief engineer of KSJN, was explaining their transmission practices, mike pickups, and SQ set-up. He acknowledged that there had been some experimenting with instrumental positioning to clear up the imbalances, but didn't shed much light on the subject. I went to the Green Room to see Maestro Skrowaczewski. In 1960, when I was recording William Steinberg and the Pittsburgh Symphony, Dr. Steinberg was on the selection committee which was to choose a new conductor for the Minneapolis Symphony. I met Maestro Skrowaczewski at that time, and he won the audition and the position with a splendid performance of the Shostakovich *5th Symphony*. I had a most pleasant conversation with the Maestro, and asked him about the

placement of the contrabassi at the back of the orchestra. He said he was trying to get more projection and a fuller tone from the instruments and had tried other experiments to improve balances.

### Either/Or

From the foregoing, it is obvious we have an odd situation on our hands. On one side we have the distinguished critic of the *New York Times*, as well as other well-known critics, who have given lavish praise to the acoustics of the new Orchestra Hall in Minneapolis. We know the hall is the work of Dr. Cyril Harris, an acoustician with impeccable credentials. On the other hand, all of us who are members of the audio press are trained listeners. We know what we heard, and we concur absolutely and unanimously that there were gross imbalances in the sound we heard in Orchestra Hall. Who is right? Who is wrong? If we are right, are there remedial steps that can solve this problem? Some critics have suggested that after such a long tenure in the acoustically unsatisfactory Northrup Auditorium, where the Minnesota Orchestra players had to play mightily to achieve a *fortissimo*, that they are not yet used to Orchestra Hall and are still forcing their tone. Well, perhaps, but after a year in the new hall this doesn't seem likely.

Of course, we heard just one concert. Maybe it was some sort of fluke or temporary aberration, though I doubt it. In the best of all possible worlds, I would like our group and all the critics and Dr. Harris to have the opportunity to hear together a dozen widely varied concerts in Orchestra Hall and then have a little symposium on what we all heard. Anyone like to pick up the tab for this? 3M? Pioneer? Howard Hughes?

The reason behind these stories is simple. Avery Fisher Hall, as of May 1976, will have all of its interior removed leaving only the steel and concrete shell of the building intact. It will then be rebuilt as a new concert hall. Considering the original hall and the two "band-aid" modifications, this will be the fourth time around, and I think this time we must come up with a really good concert hall. I think Dr. Harris is a brilliant man, for whom I have the highest respect. Although it may be presumptuous of me, I happen to agree wholeheartedly with the "traditionalist" ideas of Dr. Harris. I do respectfully suggest that whatever acoustic anomaly our audio press group encountered in Orchestra Hall be investigated and the problem resolved.





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# Dear Editor:

## Motional Feedback

Dear Sir:

A number of letters have been received from readers who want to know where they can get copies of the NASA circuit I referred to in my August article on motional feedback. Here is the address: Technology Utilization Office, NASA, Code KT, Washington, D.C. 20546. The number of the Tech Brief is: B72-10059.

G.W. Tillett  
Contributing Editor

## International Record Exchange

Dear Sir:

I am a high fidelity and record enthusiast. Country & Western and American Pop music are my favorites, especially Johnny Cash, Marty Robbins, Buck Owens and Hank Snow. In Czechoslovakia, I cannot buy these records anywhere. I would like to correspond and exchange records with someone in the United States. I can offer pop and classical records from Czechoslovakia and other socialist countries.

Pavel Ruml  
170 00 Praha 7  
Argentinska c. 8  
Czechoslovakia

## AM Sound Revisited

Dear Sir:

I would like to comment on Mr. Paul Shwartzendruber's letter on AM radio fidelity in the January 1976 issue of *Audio*, and I refer your readers to my letter on this subject in the February 1975 issue of *High Fidelity*, a brief synopsis of which follows.

Virtually all AM transmitters in use today are capable of transmitting full-fidelity sound. Assuming the transmitter is fed a clean, high-fidelity audio signal and looks into a reasonable flat antenna or common-point impedance over a carrier bandwidth of  $\pm 10$  to 15 kHz or so, there is no reason why a properly maintained AM transmitter cannot broadcast a high-quality, low-distortion signal, flat from 30 to 15,000 Hz.

FCC rules define an AM channel as being 10 kHz wide. A few engineers misinterpret this rule and think that

they are not allowed to broadcast any audio frequency over 5 kHz. To this end, they install low-pass filters in their audio consoles with cutoff frequencies of 5 kHz. Fortunately, only a few engineers continue to do this. There is no FCC rule that requires broadcasters to limit their high end to 5 kHz except in the case of adjacent channel interference, which is a rather rare occurrence in most installations. The rule simply states that an AM channel is 10 kHz wide, nothing else.

The problem of AM fidelity has almost always been at the receiving end. AM tuners, even with high-priced, luxury AM-MF tuners and receivers, range in quality from barely adequate to miserable, not only having limited high-end response, but generating distressing amounts of THD and IM distortion. This leads many listeners to wrongly blame the station for the bad sound. Since they paid a high price for the receiver, they naturally expect (and rightly so) to get a high-quality AM section also, but most manufacturers couldn't care less about the AM section, if they even put one in the receiver at all.

If you look at it from the manufacturer's stand point, you really can't blame them. AM radio has been wrongly accused over the years of being a low-fidelity medium to the point where people actually believe it. Interest in serious AM listening subsided with the appearance of FM, and it became an unnecessary expense for manufacturers to design and build a good AM section into their receivers. Thus, the poor quality of available receivers seems to support the myth of AM's inherent low fidelity.

Interest in AM is reviving, however, with the appearance of the McKay-Dymek AM-3 and, more recently, the AM-5 tuners. These units are true high-fidelity instruments. The AM-5 has a multi-pushbutton selection of i.f. bandwidth to  $\pm 10$  kHz, excellent sensitivity, and extremely low distortion and noise. To my knowledge, it is the only true high-fidelity AM tuner on the market. However, I am

told that the AM section of the Dynaco AF-6 tuner is no slouch on performance, but I have never heard one perform.

It is interesting to note that the revived interest in AM seems in part to have been sparked by the default on the part of FM stations to maintain their engineering standards to the state of the art. There are FM stations all across the country whose sound is less than exciting and many whose sound is inexcusably bad. I worked for one of those once. It was an AM-FM outlet that had to be, without a doubt, the worst sounding radio station I had ever heard. I am proud to say, though, that when I left, its sound, technically, was the standard for all the other stations in the area to shoot for. I have noted, happily, upon visiting that they have maintained the engineering standards I established and even improved a few.

Only when demand by listeners increases for good quality AM receivers will manufacturers respond with better receiving equipment. With AM stereo right around the corner, maybe this will help to create the demand.

Robert I. MacDonald  
Engineering Div.  
WRDU Television  
Durham, N.C.

*Editor's Note:* The Dynaco AF-6 has a variable bandwidth selector switch, which trades off some selectivity for increased response for use with stations having extended bandwidth and relatively little interference.

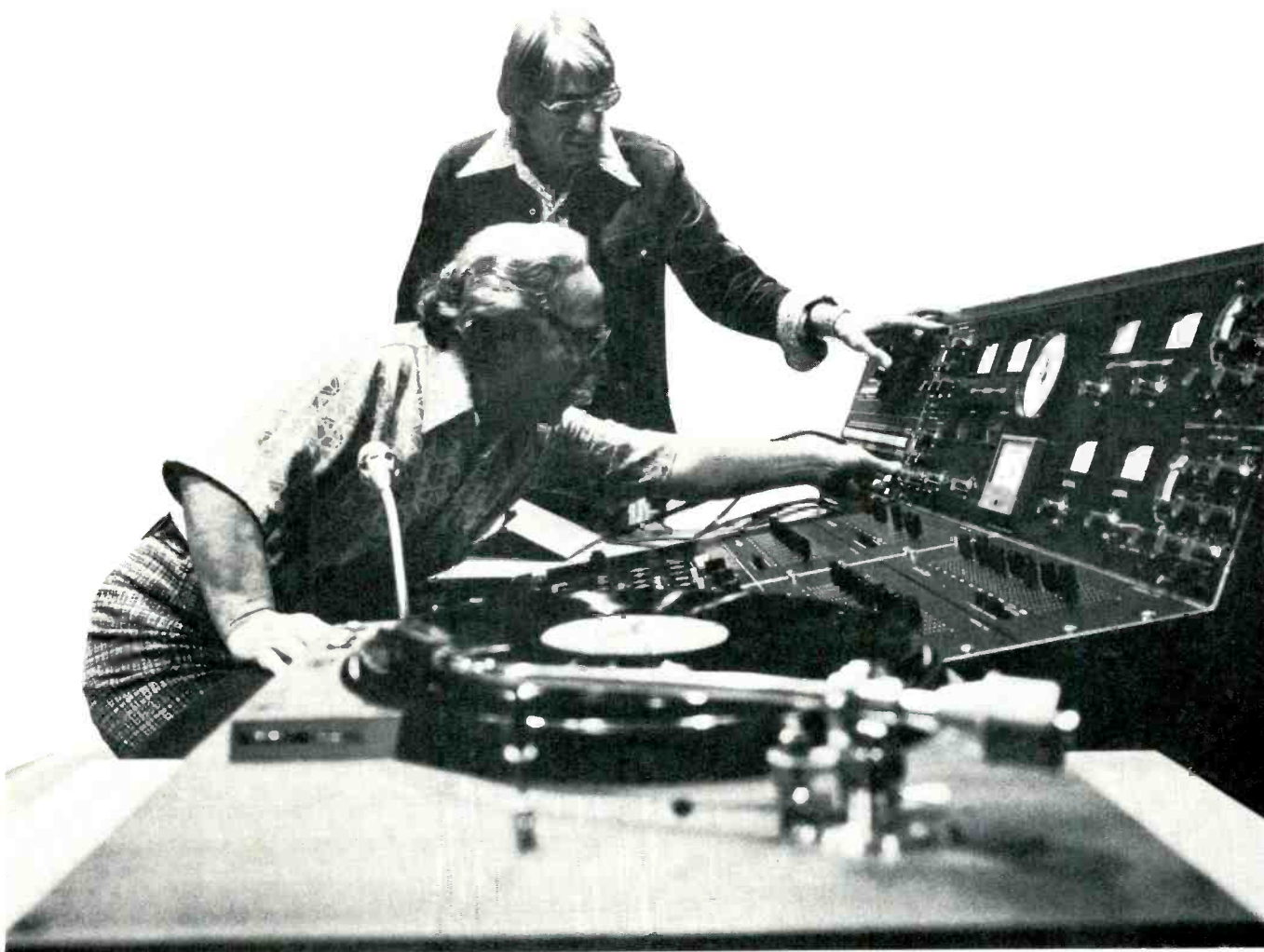
## AM Air Checks

Dear Sir:

I have run many AM proofs and know any good AM station is capable of flat audio out to 10 kHz and beyond. However, if receivers were made available with wide bandwidth, many stations would sound excessively bright because many records and spots are processed at the recording studios to have a mid-range and high-end boost so they can cut through and stand out on a typically junky AM radio.

Anyone who doubts the quality of AM radio should visit a good station

# Creation of the new Calibration Standard filled a need...the acceptance of Stanton's 681 TRIPLE-E is unprecedented!



It was no accident!

The Recording Industry needed a new calibration standard because it had been cutting discs with higher accuracy to achieve greater definition and sound quality.

So, the engineers turned to Stanton for a cartridge of excellence to serve as a primary calibration standard in recording system check-outs.

The result: the new calibration standard, The Stanton 681 TRIPLE-E.

The rest is history!

Major recording studios adopted it... as did many of the smaller producers. Radio stations across the world put the 681 TRIPLE-E on all of their turntables, both for on-the-air broadcasting and for disc-to-tape transfer.

And, audiophiles by their purchases have voted it the outstanding stereo cartridge available.

The Stanton 681 TRIPLE-E offers improved tracking at all fre-

quencies. It achieves perfectly flat frequency response beyond 20 kHz. Its ultra miniaturized stylus assembly has substantially less mass than previously, yet it possesses even greater durability than had been previously thought possible to achieve.

Each 681 TRIPLE-E is guaranteed to meet its specifications within exacting limits and each one boasts the most meaningful warranty possible. An individually calibrated test result is packed with each unit.

As Julian D. Hirsch of Hirsch-Houck Labs wrote in Popular Electronics Magazine in April, 1975: "When we used the cartridge to play the best records we had through the best speaker systems at our disposal, the results were spectacular"

Whether your usage involves recording, broadcasting, or home entertainment, your choice should be the choice of the professionals... the STANTON 681 TRIPLE-E.



For further information, write: Stanton Magnetics, Inc. Terminal Drive, Plainview, N. Y. 11803.

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in their area and listen to the air monitor. If the monitor is derived from the station modulation monitor, they will be very surprised with what they hear.

Noel M. Moss  
Chief Engineer  
KEZK-FM  
St. Louis, Mo.

### Why Do It?

Dear Sir:

Does it make sense for a station to spend much time, effort, and money in producing and maintaining a high

level of quality in their broadcast signal, when it is largely unappreciated by virtue of the fact that AM receiving equipment is on the whole only mediocre? Sure, there are minimum performance parameters set up by the FCC but they are just that—minimum.

Our own proof of performance reveals that we, like WTON, have far more than bare minimum; in fact, we run from 50 Hz to 9 kHz  $\pm 2$  dB and to 15 kHz at 3½ dB! But is anybody listening? I doubt it. With our Easy Listening MOR format, I doubt that my show is heard over anything more so-

plicated than your average car or kitchen table radios, with maybe an occasional compact in the group.

So why not cut corners in engineering and tailor the signal down in quality? Because that same reasoning can be used in other departments too. Why not skimp on the quality and variety of music on your playlist because most people don't know the difference anyway? And why not hire cheaper, less experienced air people or let the overall quality of your programming go—just to make a bigger buck?

The answer, of course, must come from the listening public. The listening public must want to be able to hear the quality that many AM broadcasters pride themselves on putting out. However, the years of aural conditioning to which the listening public has been subjected leads me to believe that any change in listener demand for the better may be nothing more than wishful thinking on my part.

I'm sure that there will always be a market for certain high-quality ancillary equipment we see marketed by a few manufacturers, but they will always be in the minority. To these pioneers, I say "Bravo!" and encourage others to make even their bottom-of-the-line kitchen table radio deliver laudable sound.

Jay Mullins  
WGSM  
Long Island, N.Y.

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Dear Sir:

Most AM receivers that I have seen compromise between a narrow bandwidth, where selectivity is desired, and a wider bandwidth for greater selectivity. This situation is satisfactory for the average listener who always listens to the local station and doesn't know whether he's hearing 20 Hz to 20 kHz or 200 Hz to 3 kHz. Unfortunately, most AM broadcast engineers know this and think that all the critics are listening to FM anyway, so their audio is not given much consideration. They're satisfied if they know that their audio is as good as necessary for the average receiver. But I feel very strongly that any AM engineer who thinks of r.f. first and audio second is not a credit to this profession. Achieving a good, bright, dense, high-fidelity sound with an AM transmitter is quite a trick because of the obvious limitations that we face but it can be done.

H. Edgar Cole II  
Chief Engineer, WSIR  
Winter Haven, Fla.

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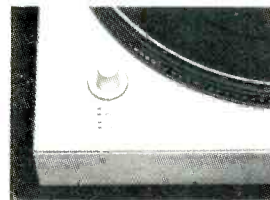
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# A New Suspension System For Phono Styli

Dipl. Ing. Werner Fidi\*

**D**ISCUSSIONS about phono-cartridge design often center around the pros and cons of various transducer types. However, regardless of the electrical-generating principle used in a phono cartridge (moving magnet, moving coil, variable reluctance, etc.), all designs have in common the need for a mechanical moving system or stylus assemble.

Serving to couple the movement of the stylus tip to the generating element, the moving system is at the very heart of a cartridge's "personality." Any flaws or non-linearities in this system or its transfer characteristics become part of the

cartridge's final output. No matter how good the design of the generating system (or any other part of the listening system), it cannot correct or remove any ill effects of the moving-system's design and construction.

Although choice of generating principle has secondary effects upon the parameters of the moving system, we will limit discussion in this paper to the design considerations directly involving the moving system.

One of the first and best known goals is a moving system with a minimum of equivalent mass. Choice of generating principle (moving-iron) was made with this and numerous other considerations in mind. However, minimum equivalent mass, alone, is far from the complete design concept for a moving system of high quality.

## The Traditional Moving System

The construction of a typical stylus assembly is illustrated in Fig. 1. It consists of a diamond stylus (a), an aluminum cantilever tube (typically 5 to 6 mm long, and  $\frac{1}{2}$  mm in diameter) (b), and an iron tube (c). These three elements are rigidly connected to each other, forming the stylus assembly which, in turn, is elastically suspended at an appropriate point. Conventional stylus suspensions are fabricated by connecting a thin wire (d) near the pivot point of the stylus, fixed to the suspension carrier at the other end (e). For purposes of damping, some type of rubber element (f) is usually used. Result: The moving system.

In stereo recordings, each wall of the record groove is

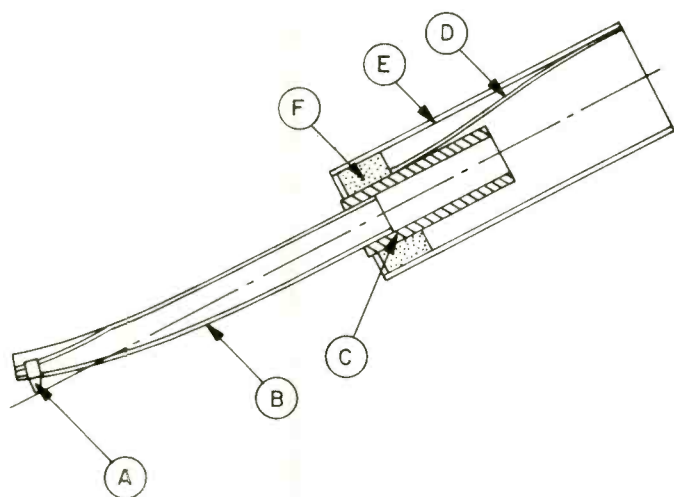
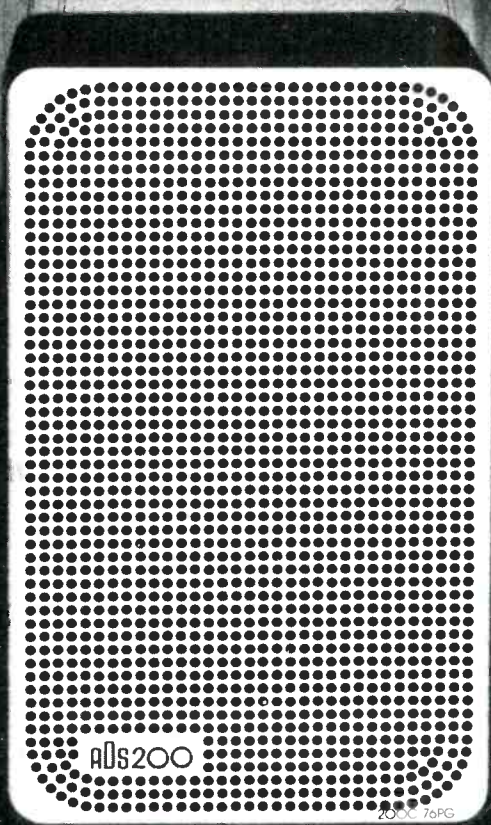


Fig. 1—Typical stylus assembly; a is diamond stylus, b aluminum cantilever tube, c iron tube, d wire suspension, e carrier, and f rubber damping element.

\*Director, Research and Development,  
AKG, Vienna;  
With English text by Geoffrey M. Langdon,  
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modulated independently, at 45 degrees to the vertical axis of symmetry. This modulation applies signal-dependent forces to the stylus tip which can lead to transverse motion in any direction. It is important that the translation of this modulation into electrical signals remain even and independent of direction of stylus motion over the full audio spectrum. In other words, the moving system should be capable of omnidirectional response without introducing frequency-dependent amplitude or phase distortion. This is a necessary requirement if correct and stable stereo imaging is to be maintained.

Analysis of the moving forces acting on the stylus assembly, as well as of all elastic and frictional moments (Fig. 2), reveals an interesting phenomenon: the pivot point of the stylus assembly actually shifts along the axis of the cantilever at higher audio frequencies. This results from the fact that,

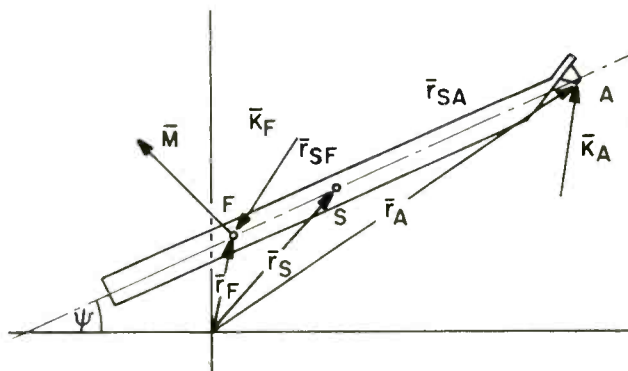


Fig. 2—Analysis of moving forces of stylus assembly.

at these frequencies, the inertial forces of the moving system significantly counteract the forces of the suspension system. Uneven frequency response, insufficient channel separation, unstable stereo imaging, and poor tracking ability result from this "wandering" pivot point.

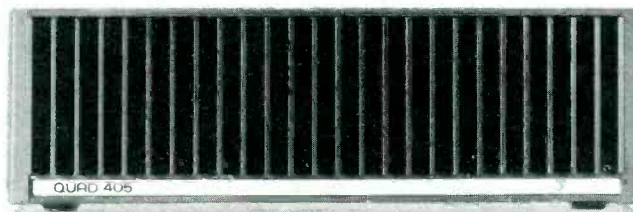
The following points evolved as requirements for an optimal suspension design:

1. Universal symmetry with respect to transverse (side-to-side) movements.
2. A single-point bearing (pivot point).
3. Maintenance of control parameters by all frictional and elastic moments in all directions of transverse excitation.
4. Suppression of torsional and axial moments.
5. Resonance-free suspension and proper damping of the stylus assembly.
6. Components with extra strength and resistance to aging, and with superior stability under varying climatic conditions.
7. Ease of production and uniformity from unit to unit.

### The Transversal Suspension

The solution to the pivot problem is relatively simple: a single-suspension element comprises both the spring (suspension and restoring force) and frictional (damping) functions. This results in a pivot point "drift zone" which is limited to a small, practical dimension. The tracking force of the cartridge is transferred to the stylus tip through torque forces created at the suspension element. To be more specific, as the stylus tip rests in the record groove, the cantilever will swing up at the stylus end until the torque-generated force reaches equilibrium with the tracking force. By minimizing the length of the lever over which this torque is

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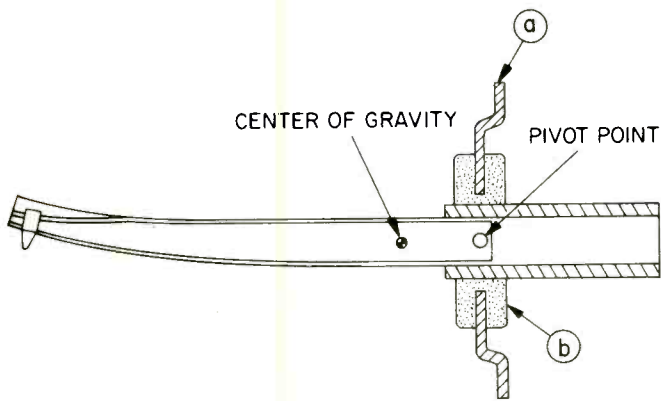


Fig. 3—Construction of AKG Transversal Suspension System.

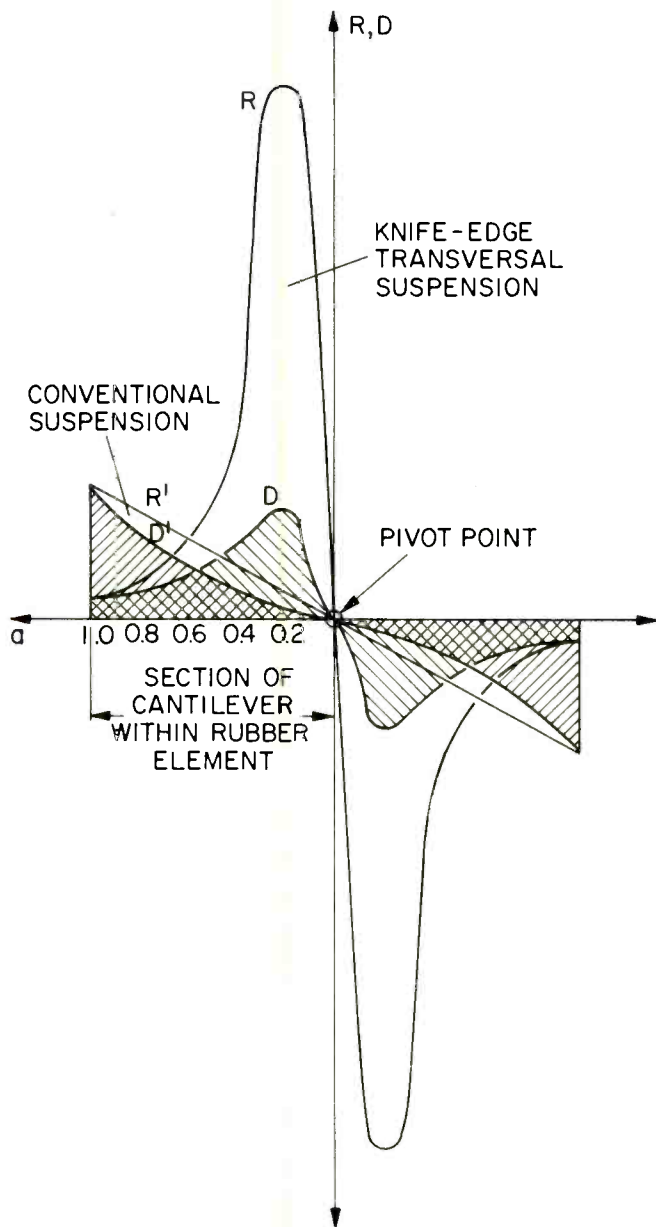


Fig. 4—Distribution of restoring and damping forces versus distance from the pivot point for a conventional moving system and AKG Transversal Suspension System.

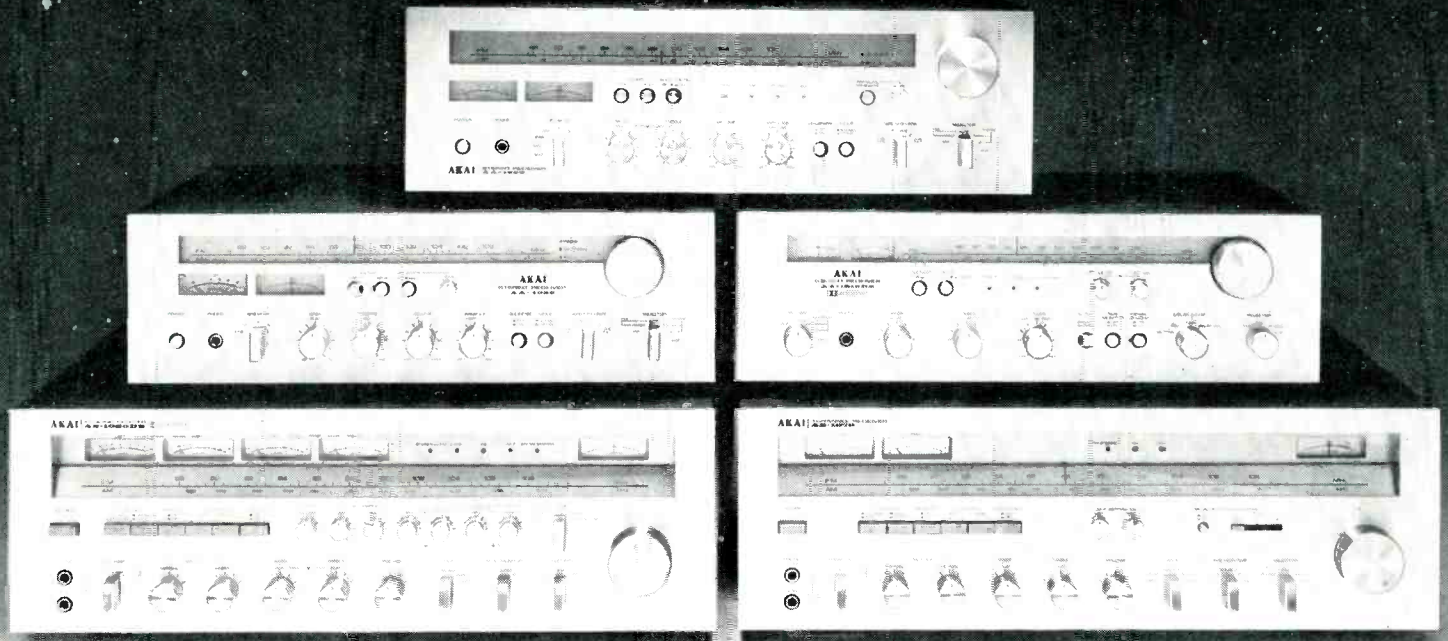
generated, the chance of dynamic shifting of the pivot point is greatly reduced. Further, placing the plane of the suspension force perpendicular to the cantilever axis and directly through the pivot point concentrates all forces essentially at one point. In conventional designs, the plane of the suspension force (wire) is parallel to the antilever, and therefore, not clearly defined as a single-point force.

Figure 3 illustrates the construction of the Transversal Suspension System. The cantilever is centered symmetrically in a small hole in a very thin, gold-plated metal plate (a). The hole is only marginally larger in diameter than is the cantilever assembly. The plate and the gold-plated cantilever assembly are connected to each other by a newly developed rubber element (b) which is vulcanized to both metal parts via a special process. The gauge of the suspension plate is quite small in comparison to the diameter of the cantilever assembly. The result is a knife-edge bearing of incredibly small size. When transverse force is applied to the stylus, the cantilever assembly "rolls" back and forth over the knife-edge. Due to the design's complete symmetry, the same mechanical conditions exist for transverse excitation in all directions. Essentially attributable to the extremely small distance between the cantilever assembly and the edge of the hole, the knife-edge effect virtually eliminates dynamic shifting of the pivot point. Variation of the shape of the rubber element allows control of the dynamic forces and torque distribution free from any effects on the pivot point. Figure 4 shows the distribution of restoring (R) and damping (D) forces versus distance from the pivot point for both a conventional moving system and the Transversal System. A distinct advantage of the Transversal System is that the effect of the rubber element upon restoring force (compliance) decreases quite rapidly with distance from the pivot point, while a definite contribution to its effect upon damping is to be found at extended distances. Independent control of these two forces may thus be accomplished. By tailoring the shape of the rubber element, or by combining two rubber elements, it is possible to control the damping. If two rubber elements are used, a hard rubber may be used in the vicinity of the pivot point (where forces are large) while a softer rubber may be used at greater distances for damping control. This has the advantage of maintaining the desired firm, small, fixed pivot point. It also provides the softer material necessary for damping at a position which prevents any negative effects on the critical pivot and support functions, and where it is free from large static suspension forces. This eliminates one of the basic reasons for inclusion of the support or tie-back wire characteristic of traditional designs: hysteresis or sagging of the soft rubber element due to the large static suspension (tracking) forces.

### In Summary

The moving system operates "omnidirectionally" in the transverse plane as a result of symmetrical construction and the "knife-edge" technique. Damping is controlled independently of other functions, greatly easing a traditional compromise situation and providing resonance-free performance without sacrificing other parameters. Torsional and axial pulling forces and thrusts are controlled by the minute distance between the suspension plate and the stylus cantilever, and by using a harder rubber suspension element than previously possible. The harder element also ensures robustness, thermal stability, and a high resistance to aging and hysteresis (permanent deformation) effects. All these contribute to a new standard of performance accuracy for stereophonic and matrix-quadraphonic image delineation and stability.

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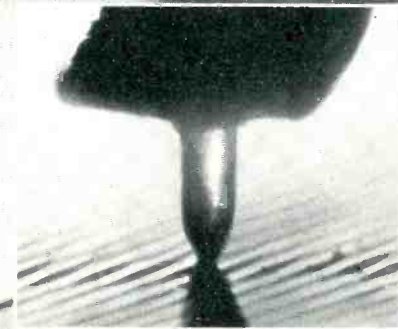
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# HEARING LOSS OF ROCK MUSICIANS

Dr. David M. Lipscomb

CONSIDERABLE CONCERN has been expressed about the possible damage caused to the ears and hearing of young persons as a result of their exposure to loud mu-

About the author, Dr. David M. Lipscomb is Professor in the Department of Audiology and Speech Pathology at the University of Tennessee in Knoxville, directing the department's Noise Research Laboratory. Author of numerous professional articles and frequent lecturer, Dr. Lipscomb has recently published a lay-oriented book: *Noise — The Unwanted Sounds* (Nelson-Hall, Chicago, 1974).

sic. Interesting research observations have led to a confounding situation in which it has been noted that rock musicians have suffered surprisingly little hearing loss. It is the purpose of this article to review the information gathered to date and then to speculate on a possible explanation of this seemingly contradictory situation.

## Hearing Loss

Most people have had at least one hearing test in which a tone is presented to the ear. If the tone is heard, the person responds. The test is continued until "thresholds" for

hearing are found for several frequencies ranging from 250 Hz to 8000 Hz. These thresholds are the presentation levels of tones at which one can just hear the sound. In testing young persons, it is anticipated that their hearing responses will be within the normal range according to standards which have been established by the American National Standards Institute. A rather disconcerting trend has been noticed in some of our audiometric data as can be seen in Fig. 1. In a series of tests, it was observed that the prevalence of high frequency hearing impairment (HFI) increased dramatically. It is axiomatic that the first indication of noise-induced hearing loss is a reduction in hearing sensitivity for those frequencies above 2000 Hz.

In the Spring of 1968, three studies were undertaken in city schools. In each study, a total of 1000 students at three grade levels were given modified hearing screening tests in order to determine the prevalence of screening failures for those pure tones above 2000 Hz. Of the sixth graders tested, only 3.8% of the students failed the criterion for normalcy. This figure rose to 11.0% for the ninth grade population and held at approximately the same level for the high school seniors (10.6%). This apparent trend to greater HFI failure rates caused us to conduct a similar survey of college students.

In the Fall of 1968, a total of 2769 incoming freshmen between the ages of 16 and 21 years were given the same modified screening test used earlier in the public schools. The staff was concerned to note that 32.9% of the students fell into the HFI category. To confirm that striking finding, a portion of the incoming class (1410 students) was screened for hearing in the Fall of 1969. Rather than there being a

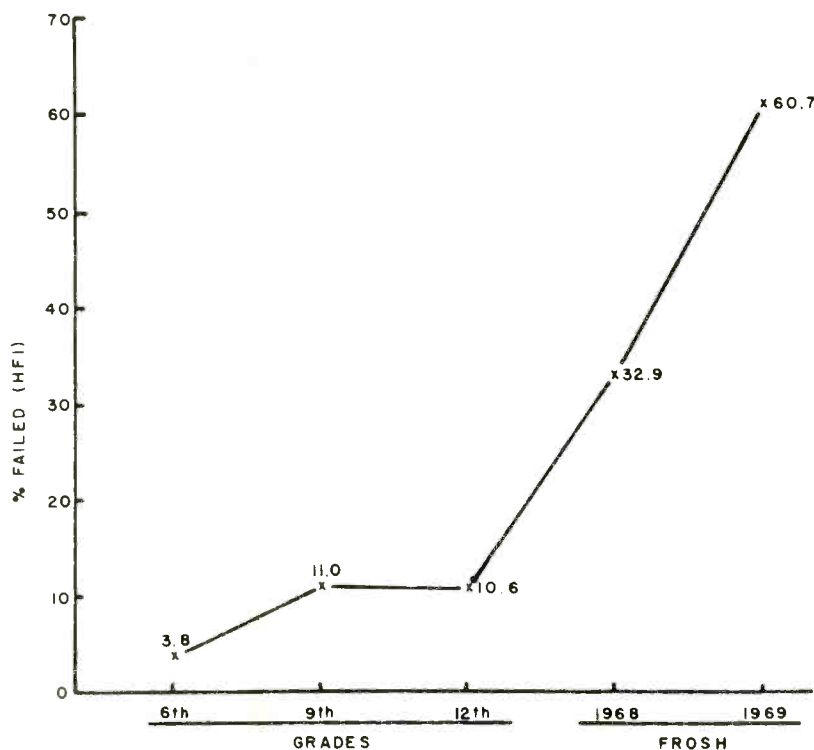
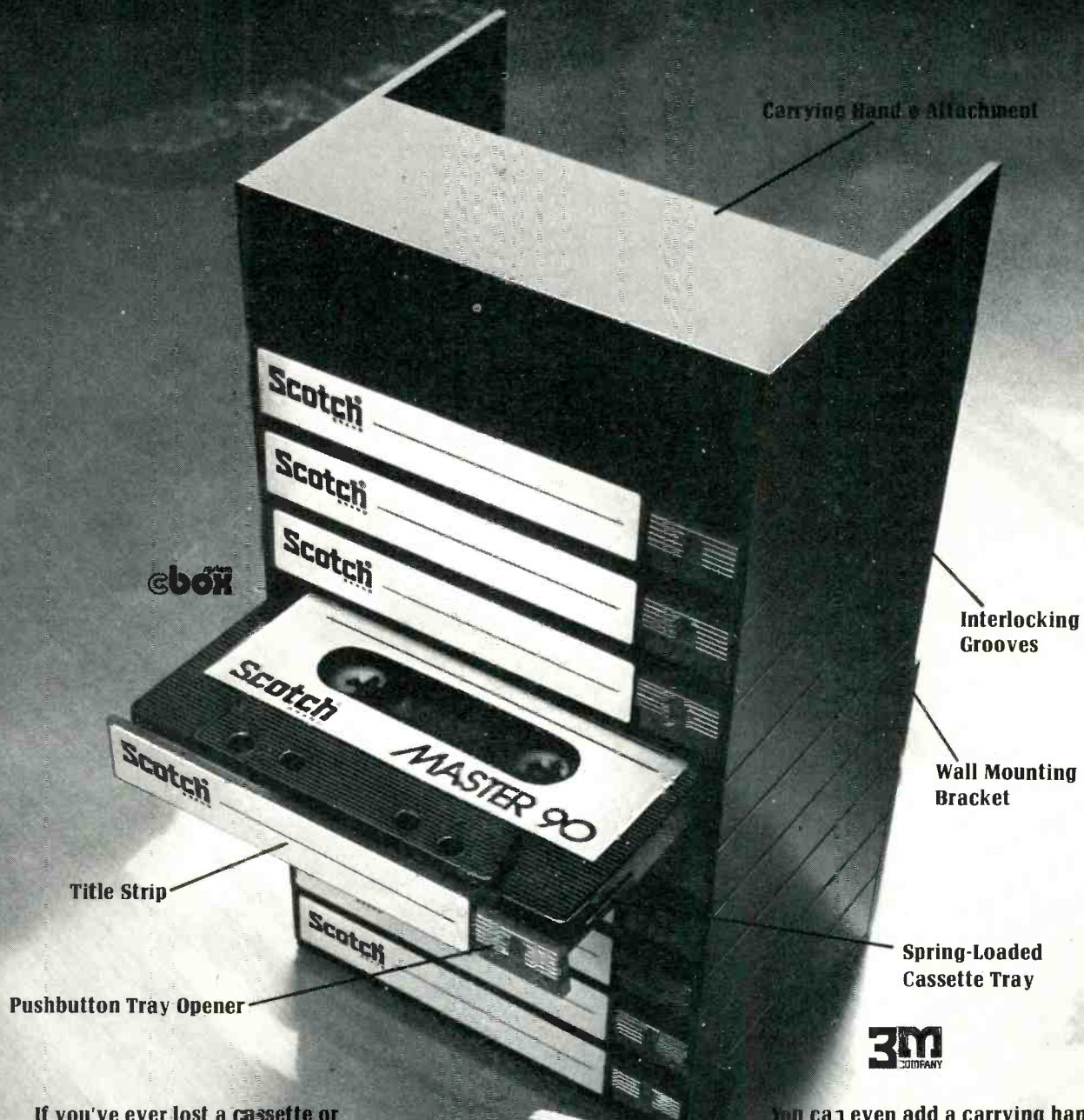


Fig. 1—Results of hearing tests of 7129 students. See text for discussion of this data.

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decrease in the prevalence of HFI, the reverse was true; the survey yielded an incidence indication of 60.7%.

These data offer evidence, based on measured hearing levels of 7179 young persons age 21 or younger, of a trend toward loss of high frequency hearing of serious proportions. It must be emphasized that nearly all of the students did not manifest serious hearing impairments, in fact, most of those who were found to have HFI were unaware of any loss of hearing. The point remains, however, that persons in the age range tested should have better hearing than we found.

It is interesting to point out that all of the hearing defects we saw were seen much more often in the young men than in the girls. This sex difference in the susceptibility to ear damage in response to high level sound stimulation is an observed fact. There are many studies which support that condition. We have speculated as to why this is the case, but it is not fully understood why the females, as a group, have "tougher" ears than males.

We have never attributed the rise in prevalence of HFI singularly to noise exposure. It is reasonable, however, to suggest that the popularity of high intensity recreational sound sources, such as live rock music, sport shooting, motorcycling and sport racing, coupled with the apparent rise in community noise levels should be

considered potentially to have a distinct effect on the auditory sensitivity of young persons.

### Laboratory Data

We have found, with the use of experimental animals, that high intensity sound is capable of causing widespread destruction to the irreplaceable sensory cells in the inner ear (cochlea). A comparison of sensory cell tissue removed from a guinea pig appears in Fig. 2. Arrows point to sensory cells which were irreversibly destroyed by exposure to intense rock music. This animal was subjected to a total of slightly over 88 hours of music in 27 different listening periods over a 58 day period. Some days, the exposure would be for 30 minutes; other days, the stimulation would last for nearly four hours. Some days, there would be no exposure at all. This schedule was selected as an attempt to duplicate the type of intense sound exposure many young persons experience in listening to live rock music. It is not possible however, to generalize these results to human response for many good reasons.

### Implications

It has appeared to us that there is an unfortunate paradox in our modern acoustic environment. Industry is becoming more aware of the need for hearing conservation among its per-

sonnel, and this interest was heightened by Federal regulations forcing compliance. Yet, on the other hand, the non-occupational and recreational environment is becoming glutted with high intensity sounds which are hazardous to the delicate structures of the auditory mechanism. Thus, it is entirely possible that an industrial worker might be protected from damaging noise in his work environment only to go into his non-occupational surroundings and suffer ear damage from a multitude of intense sound-producing items.

Among all the available high intensity sound sources in the recreational environment, we have considered live rock music to be the single most oto-hazardous in terms of the amplitude of the sound, the broad spectrum of sound energy, the impulsive character of the music, the duration of exposure to the sound by individuals and the number of persons who are exposed to the sound source.

We have extended the above statement to include earphones. Numerous commercially available stereo receiver sets used in conjunction with high efficiency stereo earphones are capable of providing sound levels which hover in the 135 to 140 dBA range for extensive periods of time when driven by contemporary rock music tapes.

### Rock Musicians

From all of the above information, it would seem reasonable to assume that rock musicians would suffer great hearing deficits. To the contrary, they have been found to have an inordinately small degree of hearing loss when compared with other young persons who are engaged in high noise pursuits (industrial workers, etc.).

One of the first studies which emphasized this was conducted at Michigan State University by Dr. William Rintelmann and Judith Borus. They reported that of 42 musicians actively engaged in rock and roll combos, only two (5%) were found to have hearing thresholds outside the normal range. In reviewing their data, they observed that rock music was intermittent, with an on-time of about three minutes and a one minute off-time. They postulated that this off-time, brief as it was, is apparently sufficient to allow at least partial recovery from auditory fatigue. Although it was not a popular concept among their colleagues, Rintelmann and Borus suggested that rock music does not appear to pose any particular

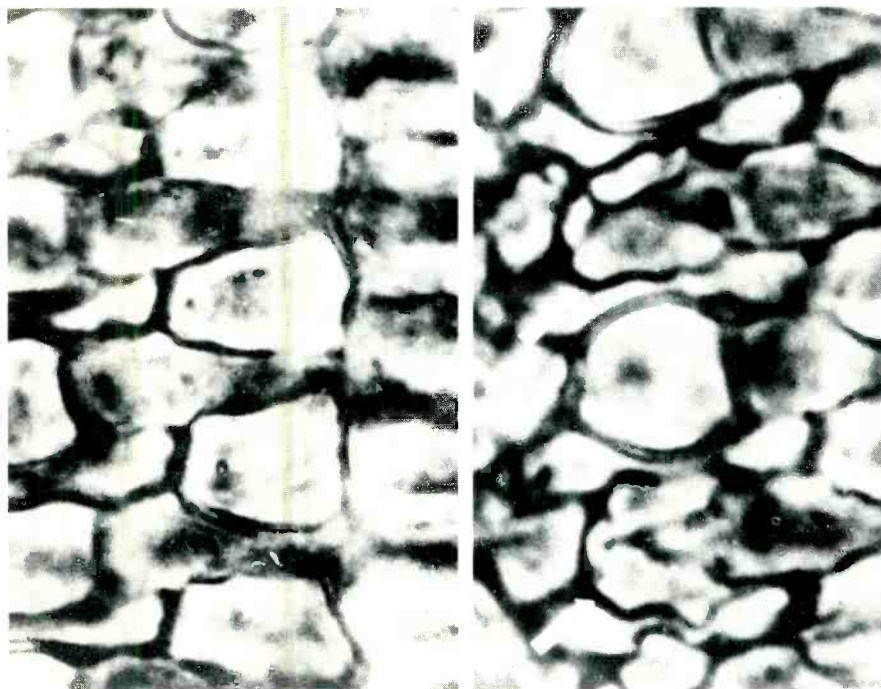
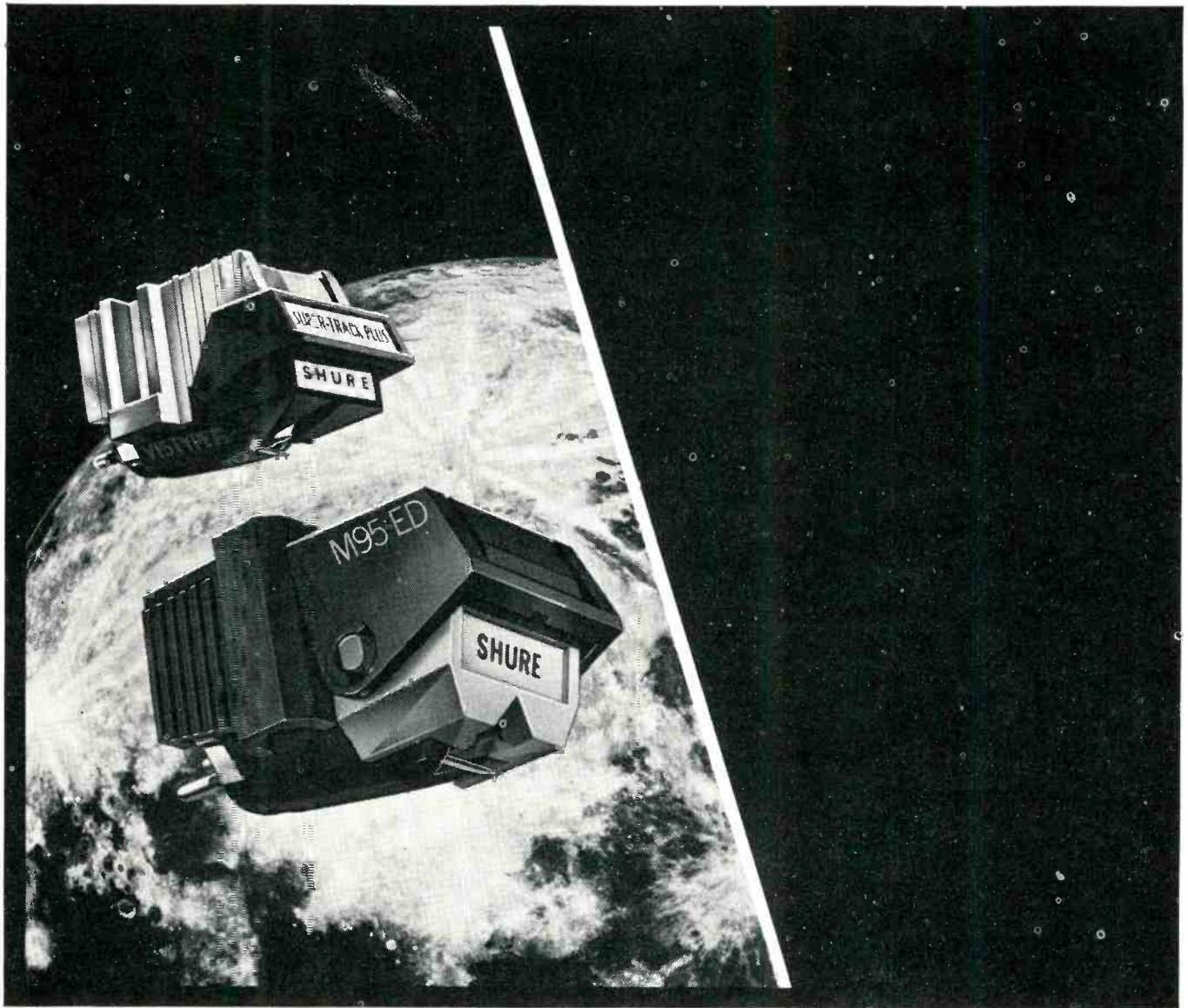


Fig. 2—A composite illustration of guinea pig ear tissue. The left half shows normal cells removed from an ear which had no noise exposure. On

the right, two arrows point out damaged sensory cells, the result of high level noise exposure.



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threat to the ears of rock musicians. Perhaps, to a certain extent, they were right.

### A Possible Reason

There may be an interesting "protective" mechanism which modified the damage potential of loud sound. But, before it is discussed, it is necessary to review some of the possible mechanisms for causing ear damage after exposure to intense sound.

1. *Physical force.* High intensity sound creates quite a stir in the fluids and tissues of the inner ear. These tiny and delicate membranes may yield to the force exerted by the sound so that damage occurs as a gradual weakening of the tissues from continuous bombardment by sound pulses.

2. *Structural damage.* Just as a hurricane will uproot trees and smash houses, sudden blasts of acoustic energy may tear and dislodge the tiny components in the inner ear.

3. *Lack of blood.* Veins and arteries constrict in the presence of high-level noise. Blockage of the delivery capacity of the oxygen-bearing blood cells may play a role in damaging the inner ear.

All of these factors in various combinations may ultimately be found to contribute to noise-induced hearing loss. There is, of course, the possibility that none of these are as important as some yet-to-be-discovered factor.

In addition to there being a distinct effect in the ear, high level noise stimulation can give rise to numerous physiological reactions in the body. Perhaps the most significant of these is the vaso-constrictive reaction mentioned above. It is interesting to ponder the interrelationships which may exist between stress reaction and ear damage. It certainly is not wise to state that there is a direct cause/effect situation where ear damage will occur each time a person becomes upset. There is more than a simple chance correlation between the two aspects, however.

As indicated earlier, there are some confusing findings regarding the hearing status of some individuals who engage in extremely noisy occupations. Although their exposure conditions would lead us to believe that they should have remarkable hearing deficits, they do not.

At this point, it is mere speculation, but eventually, it may be discovered that the less stressful a sound is considered to be, the less prone the recipient of the acoustic signal will be to cause auditory damage. As an ex-

ample, two men working side-by-side in an industry are exposed to the same amount of noise. The hypothesis just advanced would suggest that if one of these men enjoyed his job and accepted the noise as part of it, he would suffer less ear damage. The other man would likely consider the noise to be just another part of that @#&&#@&@ job. With that attitude, the combination effect of the noise beating on the delicate ear tissues and the lessening of blood supply because of his anger and stress reaction could create havoc in his ear.

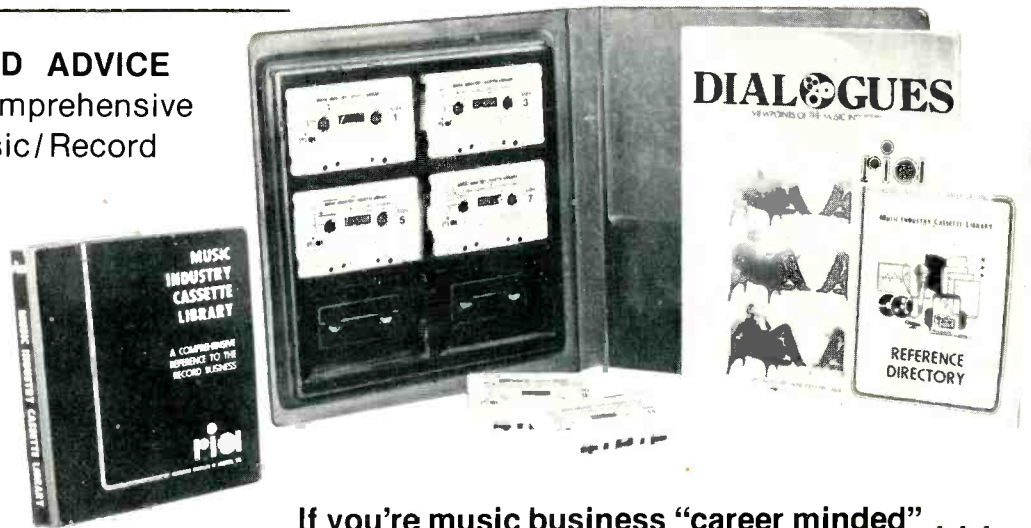
In the case of rock musicians, that sound (called noise by some) is their baby. They created it. It is the product of their planning and teamwork. They have nurtured and produced the sound which possesses "that certain quality." The pulsing, throbbing, screeching expression of their innermost being comes back to their ears as if it were a balm (not bomb). If there is any bodily stress, it is most likely from unadulterated ecstasy.

Lest I be misunderstood, I must emphasize the probability that some ear damage is occurring. But absent are the additive effects promoted by incurring extreme internal distress resulting in a reduction of blood supply. Consequently, since the musicians are not unduly stressed, their ears may not be placed in the same double jeopardy as would be the case if they were forced to endure a sound they could not tolerate. If this theory is ultimately borne out, it will be another great insight into the forethought which must have been applied in the creation of the human body. This *pleasure principle* simply adds another dimension to the already crowded list of factors which have a bearing on the human response to sound and the prospects of ear damage from immersion into high intensity sound.

I believe it was the great philosopher A. N. Whitehead who advised us to seek simplicity — but not to trust it. The material in this review has been simplified to make it interesting and readable. Concepts treated in this presentation are extremely complex because we are dealing with human response. The theory set forth should in no way be interpreted as license to overexpose oneself to noise. It is, rather, an attempt to explain to an interested audience some seemingly baffling observations. In our laboratory, we are currently undertaking a series of experiments to shed more light on this subject. Perhaps a sequel on this will appear in the not-too-distant future.

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AU/3/76

# IM Distortion In Speaker Systems

Richard C. Heyser

**I**F A MUSICAL tone is altered in its properties by the presence of a second tone, this is described as intermodulation. When we listen to natural sound, separate musical voices are usually due to separate instruments. When we reproduce a signal through amplifiers and loudspeakers, these otherwise separate voices must share the same channel. The mere presence of one voice may then modify the other if there is not enough "shoulder room" for both. This jostling may take the form of an alteration of the dynamic level of each or even a slight modulation of the pitch. Timbre and dynamics are most noticeably affected, and the subjective image of what should be a completely separate instrument modifying, by its presence, another completely separate instrument can be quite unnatural.

## Test Procedure

In order to provide a measurement of this distortion, *Audio* uses two pure musical tones mixed in equal level. There are many classes of intermodulation, but one that is readily identifiable is due to the woofer which is called upon to reproduce the lowest bass as well as a major piece of the musical spectrum containing fundamentals.

Audio has settled on a low bass tone of  $E_1$ , which is 41.2 Hz, and the tone of  $A_4$ , which is 440 Hz, as a standard for this particular test. If the speaker

which reproduces  $E_1$  is not called upon to pass  $A_4$ , then we choose a musical tone about a half octave within the band which it is suppose to handle.

$E_1$  and  $A_4$  are mixed at equal voltage level into the speaker, and  $A_4$  is our primary concern in the reproduced signal. We want to know how  $A_4$  is modulated by the presence of  $E_1$ .

Both a spectrum analyzer and special coherent filter are used for this test. The output from the test microphone is measured on a spectrum analyzer to determine the power spectral density of sidebands about 440 Hz due to the 41 Hz. The bandwidth of this analyzer can be made as narrow as 2 Hz, and the exact frequency under test is measured by a frequency counter. The total power in the sidebands about 440 Hz is measured as a percentage of the power in the unmodulated 440 Hz. This is the percentage value of IM which we plot as a function of drive power. The power level in watts on this plot is average power expressed as the square of a measured voltage divided by the resistor equal to the stated loudspeaker impedance, usually 8 ohms. The voltage is the peak value of the composite 440 Hz and 41 Hz presented to the speaker divided by the square root of two. This is done to be consistent with amplifier standards. On the curve we supply, the peak power is thus twice the indicated "average" power, just as though it were a single sine wave.

The IM is calculated on the basis of power where each component adds quadratically. From a voltage standpoint, this is the square root of the sum of the squares of the components. It is a one-number measurement which can be used as a relative measure between speakers. Furthermore, a perfect speaker will have no IM distortion.

That's fine, but there are many researchers who believe that this number and fifty cents will buy a cup of coffee in most restaurants. *Audio* supplies this measurement because we believe intermodulation distortion is a very real thing and somebody should pioneer the making of such a measurement, rather than sit around and haggle about whether the measurement should be made. We deliberately use a power spectrum basis because that is conventional in testing cartridges and amplifiers. You can thus use this measurement for speakers exactly as you would for amplifiers.

We don't stop there, however. Besides the spectrum analyzer, we use two specially developed coherent filters to view the intermodulation on a oscilloscope. We coherently multiply the microphone output against the exact 440-Hz signal in order to know precise amplitude and phase relationships of the acoustic tone. We first up-convert to 225 kHz where a precision goniometer/phase shifter is available.



**Would you recommend  
your turntable  
to your best friend?**

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If you were to replace any of your present components, would you know exactly what its successor would be? And then buy it without further consideration? Perhaps. But we think it more likely that you would look for more information, either in a music/equipment magazine or from a knowledgeable friend. Probably from both.

Which brings us to turntables . . . and Dual.

Each year we hear from a sampling of Dual owners in response to a lengthy questionnaire. A high percentage tell us they're now on their second Dual. An even higher percentage formerly owned manual turntables. And nearly all rate their Duals as either "excellent" or "good."

Although there are other fine turntables, few match Dual's reputation for quality performance and reliability, and none match Dual's operational versatility. For example, if you want to be able to play records in sequence, you have four single-play/multi-play Duals to choose from. If you simply want fully automatic convenience in a single-play-only turntable, you have two to choose from. And there is now a semi-automatic Dual.

The way a tonearm is moved to and from the record is not critical. Nor is the type of drive system. What is critical is how faithfully the tonearm permits the stylus to follow the contours of the groove and how accurately and quietly the platter rotates. To compromise with quality in these respects can risk damage to your precious records and produce sounds which were never recorded.

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Dual 1225



Dual 1249



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Then, the signal is coherently down-converted to zero frequency into an in-phase and a quadrature component. The original 440-Hz sine wave is now two d.c. voltages. These are viewed on an X-Y oscilloscope. A second filter using quadrature integrate and dump circuits is also available for oscilloscope view.

When the 41 Hz modulates the 440 Hz, we can independently measure both the angle modulation and amplitude modulation on the 440 Hz. In addition, we can measure the precise shift in static phase due to the 41 Hz

and the exact change in average power.

Now we have a different ball game. Not only can we measure Doppler versus amplitude, but we can spot static cone displacement due to heavy drive in a nonlinear magnetic structure. This lets us describe the IM plot in a much more meaningful manner than had we depended upon a power spectrum measurement.

If the nature of the distortion above a certain power level is different than that at lower levels and can give rise to a different sonic effect, we state this

fact in the review. This means the IM curve is now more valuable in its comparative ranking.

The IM test that is printed is, of course, a test of only the woofer. To test the tweeter, two tones of equal level are again used but they lie in the frequency range covered by that speaker. The spectrum analyzer is used to check the intermodulation fragments for this case. This data is only reported if it discloses something significant.


### Interpretation

One of the first things which is evident in the intermodulation distortion of speakers is the magnitude of distortion. An audio aficionado who would not consider buying an amplifier with more than one tenth of one per cent distortion at any level must view as incredulous that "good sounding" speaker which runs a neat three per cent at his normal listening levels. Rest assured this is not unusual, and the speaker may "listen" very well at this level of distortion.

Just as in amplifiers, a lower distortion on a power spectrum basis may not mean a cleaner reproduction. However, the distortion should rise smoothly from a low level at low power. Sudden changes in curvature are undesirable because they may signify a change in form of the intermodulation.

Distortion levels above 5 per cent generally indicate noticeable subjective modification of the sound. The type of intermodulation enters into this. There is a sonic difference between tremolo and vibrato as a modulation of one musical note by another.

Compare the harmonic and intermodulation distortion measurements for each speaker as some measure of how it may sound. Remember, that in order to keep the peak power the same value, the average 440-Hz power level in the IM measurement is 6 dB (one fourth) less than the average 440 Hz power level in the harmonic distortion. Read the harmonic distortion curve at 1 watt and the IM curve at 4 watts to get those measurements corresponding to the same loudness of 440 Hz. How loud the 440 Hz is in your listening environment can be obtained from the one-meter SPL reading on the harmonic distortion plot.

The IM test, plus the supporting narrative *Audio* supplies, can give a fair idea how low bass can modulate other musical components, whether this is due to a thundering classic organ or a chest-thumping kick drum. 

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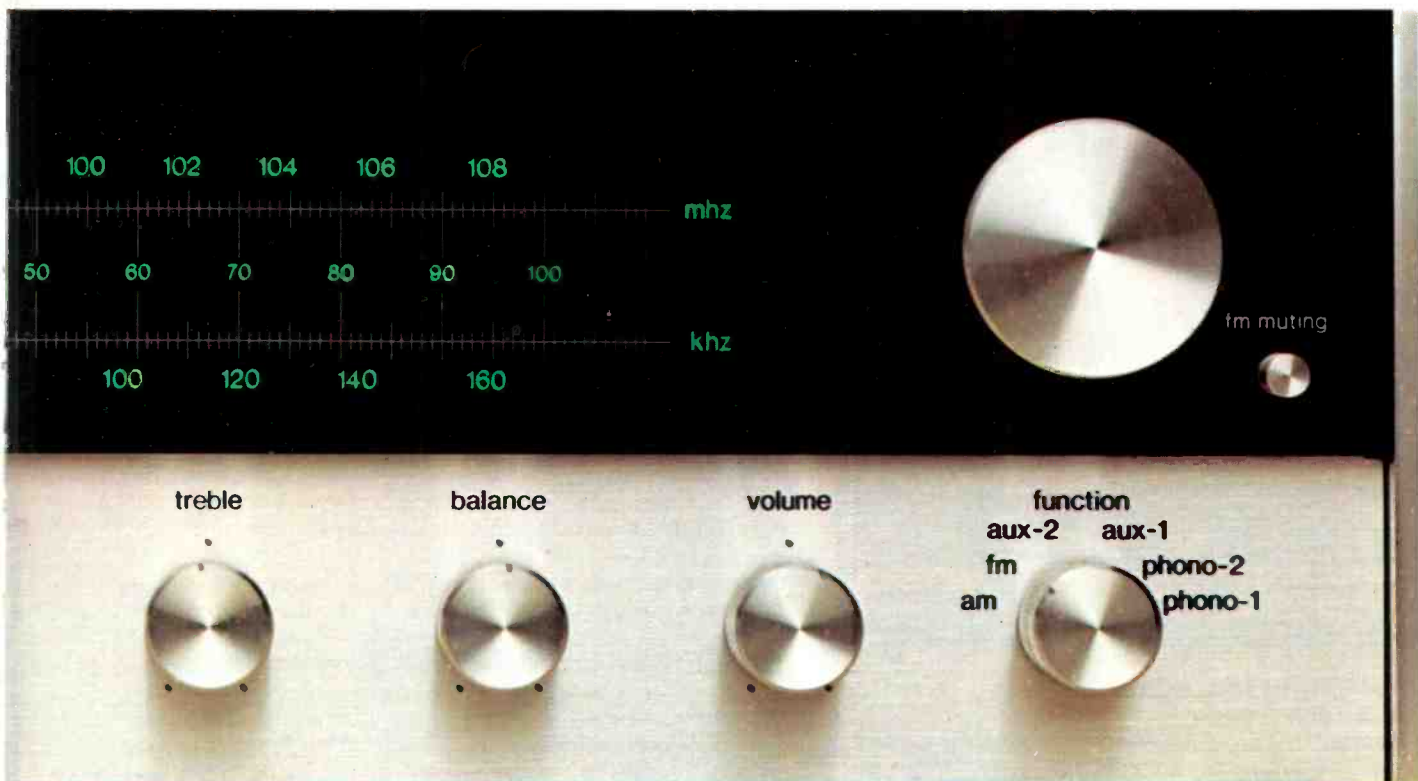
Any fine tuner measures signal strength. The 730 incorporates a

patented system which measures not strength, but signal-to-noise ratio. As a result, it can be tuned to the precise point where the signal is purest for listening or recording.

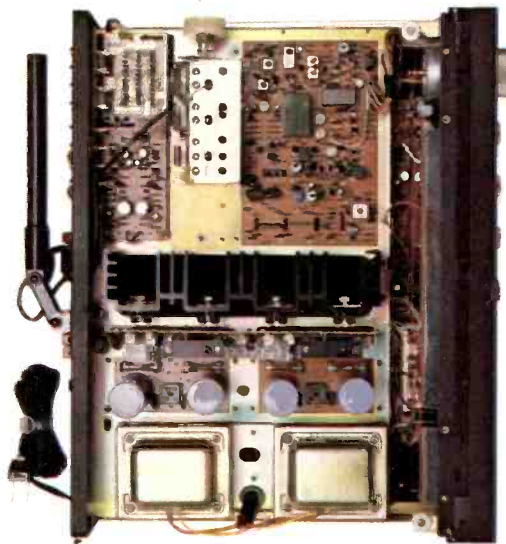
Equally important, the twin-powered 730 has all the basic design elements that identify it as a Harman Kardon instrument: wide bandwidth, phase linearity, ease of operation and a wide range of input and output elections.

All of this suggests further discussion. If you are interested in such an exploration, please write us (directly, since we imagine you are impatient with coupons and "reader service" cards, and so are we). We'll certainly write back, enclosing a brochure also unconventional in its detail.

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<b>Power Bandwidth</b>	From 10Hz to 40kHz at < 0.1% THD into 8 ohms, both channels driven simultaneously at 20 watts per channel.	<b>Phono Overload</b>	>95 mV
<b>Frequency Response</b>	20-20 kHz $\pm$ 0.5 dB	<b>RIAA Equalization</b>	$\pm$ 1.0 dB
<b>System Rise Time</b>	1.5 $\mu$ sec	<b>Tone Control Action</b>	a. 50Hz $\pm$ 12 dB b. 10kHz $\pm$ 12 dB
<b>System Square Wave Till</b>	<5%	<b>Contour Effect (50Hz)</b>	+10 dB
<b>Total Harmonic Distortion</b>	<0.1% from 250 milliwatts to 40 watts RMS, both channels driven simultaneously into 8 ohms, 20Hz to 20kHz.	<b>High Cut Filter (10kHz)</b>	-10 dB
<b>Intermodulation Distortion (40 watts—SMPTE)</b>	<0.12%	<b>Low Cut Filter (50Hz)</b>	-6 dB
<b>Intermodulation Distortion (1 watt—SMPTE)</b>	<0.15%	<b>FM Sensitivity</b>	a. IHF 1.9 $\mu$ V b. -50 dB (mono) 3.5 $\mu$ V c. -50 dB (stereo) 35 $\mu$ V
<b>System Hum and Noise</b>	Better than 60 dB below rated output (unweighted)	<b>Ultimate S/N</b>	-70 dB
<b>Damping Factor (1kHz @ 1 watt)</b>	>30	<b>Capture Ratio</b>	2 dB
<b>Power Amplifier Input Sensitivity</b>	<1.2V	<b>Image Rejection</b>	-80 dB
<b>Power Amplifier Input Impedance</b>	33 kilohms	<b>Spurious Response Rejection</b>	-80 dB
<b>Power Amplifier S/N (40 watts)</b>	>90 dB	<b>IF Rejection</b>	-90 dB
<b>Power Amplifier Square Wave Rise Time</b>	<1.5 $\mu$ sec	<b>AM Rejection</b>	-60 dB
<b>Preamp Input Sensitivity</b>	a. Aux <150 mV b. Tape Mon. <150 mV c. Phono <2.5 mV	<b>Alternate Channel Selectivity</b>	80 dB
<b>Preamp Input Impedance</b>	a. Aux 30 kilohms b. Tape Mon. 30 kilohms c. Phono 47 kilohms	<b>Multiplex Separation (1kHz)</b>	40 dB
<b>Preamp Input S/N</b>	a. Aux > -75 dB b. Tape Mon. > -75 dB c. Phono > -67 dB	<b>FM Harmonic Distortion (1kHz)</b>	a. Mono 0.3% b. Stereo 0.4%
<b>Preamp Harmonic Distortion</b>	<0.15%	<b>Pilot Suppression</b>	-55 dB
<b>Crosstalk</b>	a. Aux -47 dB b. Tape Mon. -47 dB c. Phono -37 dB	<b>De-Emphasis</b>	75 $\mu$ sec
		<b>Mute Level</b>	Variable
		<b>Mute Suppression</b>	-65 dB
		<b>Stereo Indicator Threshold</b>	(Pilot signal expressed as % of base band.) a. "off" <3% b. "on" >6%
		<b>Audio Output</b>	0.5V
		<b>AM Sensitivity</b>	>250 $\mu$ V/r
		<b>AM Signal for 1 watt Output</b>	<150 $\mu$ V/r
		<b>AM Selectivity</b>	35 dB
		<b>Alternate Channel Selectivity</b>	55 dB
		<b>Image Rejection</b>	-75 dB
		<b>IF Rejection</b>	-60 dB
		<b>Hum</b>	-40 dB

# harman/kardon

# Equipment Profiles

## Tandberg Model TR-2075 Stereo AM/FM Receiver



### MANUFACTURER'S SPECIFICATIONS

#### FM Tuner Section

**IHF Sensitivity:** Mono, 1.8  $\mu\text{V}$  (10.3 dBf). **50-dB Quieting:** Mono, 3  $\mu\text{V}$  (14.8 dBf); Stereo, 40  $\mu\text{V}$  (37.3 dBf). **S/N:** Mono, 78 dB; Stereo, 75 dB. **Muting Threshold:** 6  $\mu\text{V}$  (20.8 dBf). **Stereo Threshold:** 15  $\mu\text{V}$  (28.8 dBf). **THD at 50-dB quieting:** 0.3%. **THD at 65 dBf:** Mono, 0.2%, Stereo, 0.3%. **Capture Ratio:** 0.9 dB. **Selectivity:** Alternate channel, 80 dB; Adjacent channel, 10 dB. **Spurious Rejection:** Better than 95 dB. **I.F. Rejection:** Better than 95 dB. **Image Rejection:** 70 dB. **AM Suppression:** 70 dB. **Frequency Response:** 30 Hz to 15,000 Hz, +1, -2 dB. **Stereo Separation:** 40 dB from 60 Hz to 10 kHz. **Sub-carrier Rejection:** 60 dB.

#### AM Section

**IHF Sensitivity:** 20  $\mu\text{V}$ , external antenna; 250  $\mu\text{V}/\text{M}$ , internal antenna. **Selectivity:** 45 dB. **I.F. Rejection:** 80 dB. **Image Rejection:** 90 dB. **THD:** 0.8% re: 30% modulation.

#### Amplifier and Preamplifier Section

**Power Output:** 75 watts continuous power per channel, 20 Hz to 20 kHz, 8 ohm loads (100 watts at 4 ohms). **THD:** No more than 0.15% (0.2% for 4 ohm power rating). **IM Distortion:** Less than 0.15%. **Damping Factor:** 60 at 8 ohms. **Overall Frequency Response:** 6 to 80,000 Hz, -1.5 dB. **S/N:** Phono 1 re: 4.4 mV input, 70 dB; Phono 2 re: 3 mV input, 68 dB; Tape 1 and 2, 82 dB. **Input Sensitivity:** Tape 1 and 2, 150 to 600 mV; Phono 1, 2.2 to 10 mV; Phono 2, 3 mV. **Maximum Phono Input at 1 kHz:** Phono 1, 150 mV; Phono 2, 50 mV. **Bass Control Range:**  $\pm 15$  dB @ 50 Hz. **Treble Control Range:**  $\pm 15$  dB @ 10 kHz. **Mid-Range Control Range:**  $\pm 7$  dB @ 1 kHz. **Low Filter:** -3 dB at 70 Hz, 12 dB/octave. **High Filter 1:** -3 dB @ 8 kHz, 12dB/octave. **High Filter 2:** -3 dB @ 8 kHz, 6 dB/octave.

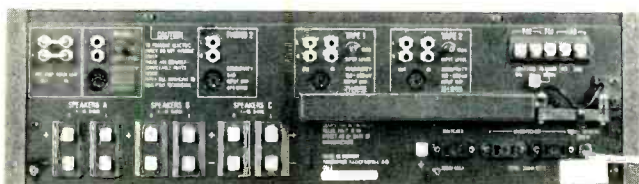


Fig. 1—View of back panel.

### General Specifications

**Dimensions:** 20-1/8 in. W x 6 in. H x 13-7/8 in. D. **Weight:** 27.1 lbs. **Price:** \$1,100.00.

Before even considering the features and performance of Tandberg's most powerful and most complete receiver, we'd like to comment on the fact that this is the first receiver we've tested that is accompanied by fully spelled out FM specifications, listed in accordance with the newly approved IHF/IEEE FM Measurements Standards issued in mid-1975. Besides being a "first" for that well-respected Scandinavian company, it tends to tell us something about their design philosophy and marketing approach: Tandberg is proud of its products and has nothing to hide. Those familiar with Tandberg's earlier receiver efforts will note that this time the low, sleek front panel format has been retained, but without the hinged door which covered less-often used controls on the less powerful models. Tandberg evidently felt that they wanted prospective customers to see all the flexibility and control features at first glance—and they are certainly plentiful and well organized.

The upper section of the panel is devoted to a carefully calibrated FM dial scale (with calibration marks every 500 kHz), and AM scale, signal-strength and center-of-channel tuning meters at the left, and a tuning knob at the right coupled to one of the smoothest acting flywheel arrangements we have yet encountered. To the right of the tuning knob are four tiny push buttons which select mono FM operation, FM interstation muting, choice of 25 or 75 micro-second de-emphasis (the former required for proper listening to Dolby FM broadcasts), and offer a choice of panel lighting brightness.

The lighter colored center section of the panel is equipped with seven square pushbuttons which are easily activated by a light touch of a finger. The leftmost button turns on power, while the remaining six choose program sources including the two tape monitoring circuits which are available at the rear panel. Rotary volume and balance controls

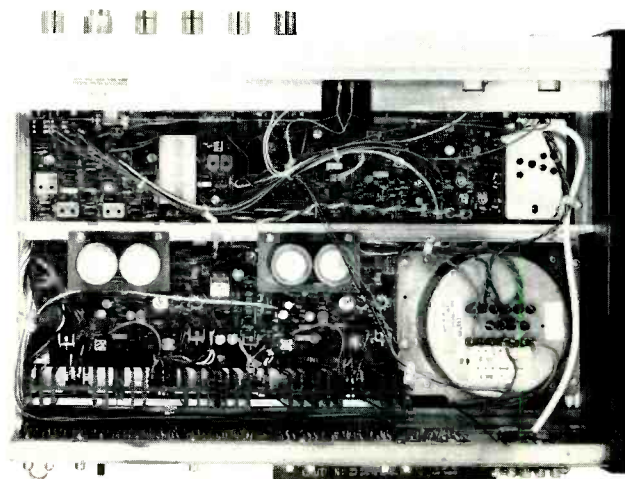


Fig. 2—Internal view.

come next, followed by dual concentric bass, treble and mid-range tone control knobs, and a rotary speaker selector switch which selects one or two pairs of speakers out of the possible three pairs which can be accommodated by the TR-2075.

The lowest section of the panel contains twin phone jacks and a dozen more rectangular push buttons which take care of such less-often used functions as tape copying (from either tape deck to its alternate), loudness compensation, mono or stereo mode (including left or right only to both channels as well as L+R mono mix), low-and high-cut filter selection, and a most useful function called *preamp record*. This circuit, also found on Tandberg's lower priced receiver, enables you to pre-equalize recordings applied to a third tape deck (connected via a ring-tip-sleeve phone jack nearby) by inserting the tone control circuits *ahead* of this particular tape output point. Finally, a twelfth button, located near the phone jacks, converts the signal-strength meter to a peak-reading power meter. A handy reference guide in the owner's manual enables the user to convert the arbitrary 0-25 secondary scale of the meter into actual watts delivered, depending upon load impedances (of speakers) connected.

The rear panel of the TR-2075, pictured in Fig. 1, offers a choice of DIN or phono-plug connection for both phono inputs and both tape in and out circuits. One of the phono input pairs and both tape circuits are equipped with input level controls to enable proper matching of phono cartridge or tape deck levels to built in AM or FM levels. Plug-in jumpers can be removed from the preamp-out, main-amp-in jacks to permit separate use of these two sections of the receiver. Three sets of polarized speaker screw terminals are well separated from each other to prevent possible speaker cable shorts. FM and external AM terminals are also of the screw type and include 300-ohm and 75-ohm facilities for FM, along with an extra grounding terminal for the shield of an unbalanced 75-ohm transmission line. A chassis ground terminal is located near the three available convenience a.c. outlets, and a rotatable AM ferrite bar antenna is also provided.

The unique internal layout of the TR-2075 appears in the pair of photographs of Fig. 2. It is one thing to pile circuit board upon circuit board into a receiver chassis in the interest of reducing overall size, but it is quite another to make each board as accessible for servicing as Tandberg has managed to do. The entire upper front section, including dial scales, can be pivoted out of the way to disclose pre-amplifier and tone sections, as can be seen in Fig. 3.

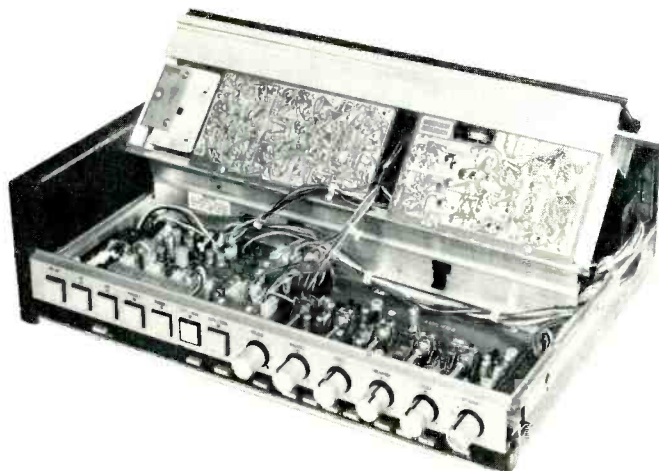


Fig. 3—View with front panel swung up for servicing.

Completely separate preamplifier-equalizer circuits are used for the *Phono 1* and *Phono 2* inputs, thereby avoiding the necessity of switching at low-level circuit points. AM and FM tuner sections are also completely independent, with a 3-gang tuning capacitor and an FET r.f. amplifier used in the former. The FM front-end employs a pair of FETs for the r.f. amplifier and the mixer stages and is electronically tuned by means of four sets of back-to-back varactor diodes. I.f. section interstage tuning is accomplished by means of a pair of solid-state filters and a TCA-420A IC is used as a limiter-quadrature FM detector. For optimum linearity, a transformer is used as the quadrature element instead of the simpler single coil often used with this IC. This detail insures extremely linear detection and results in lower distortion under controls of 100 per cent FM modulation. A Motorola MC-1210 IC forms the heart of the phase-lock-loop stereo decoder section and a pair of steep bridge-T notch filters effectively suppress 19-kHz carrier signals in the output of the mpX section.

Tone control sections are of the popular Baxandall negative feedback type and cut-off filters are two active and one passive RC network. Power amplifiers are fully direct coupled and a differential input stage is used in each channel. Output transistors are operated at  $\pm 52.5$  volts d.c. A dynamic time-delay circuit prevents accidental activation of the low-impedance, safety-cutout circuit when momentary signals occur at frequencies corresponding to low impedance points of the speaker's impedance characteristics. An electronic power limiting circuit is activated whenever loads below 3 ohms are presented but is unaffected by 4 ohm or reactive loads. The unit can safely sustain no-load or short-circuit conditions at the speaker output terminals. In addition, a thermal protection circuit protects against overheating in the event of inadequate ventilation. Diode protection circuits are included as protection against transient feedback from inductive speaker loads. A center-zero voltage-sensing circuit activates a relay to protect loudspeakers from subsonic oscillation or the presence of d.c. at the output terminals. Turn-on transients are prevented from reaching the loudspeakers by means of a 4-second time-delay circuit when the unit is turned on.

### FM Performance Measurements

Figure 4 depicts some of the major performance characteristics of the FM section of the TR-2075. IHF sensitivity in mono measured  $1.8 \mu\text{V}$  (10.3 dBf), while stereo switching occurred just below  $15 \mu\text{V}$  (28.8 dBf) as claimed. The 50-dB quieting point in mono occurred with a signal input of  $3.0 \mu\text{V}$  (14.8 dBf), while in stereo that quieting was reached with a signal input strength of only  $33 \mu\text{V}$  (35.7 dBf). Best signal-to-

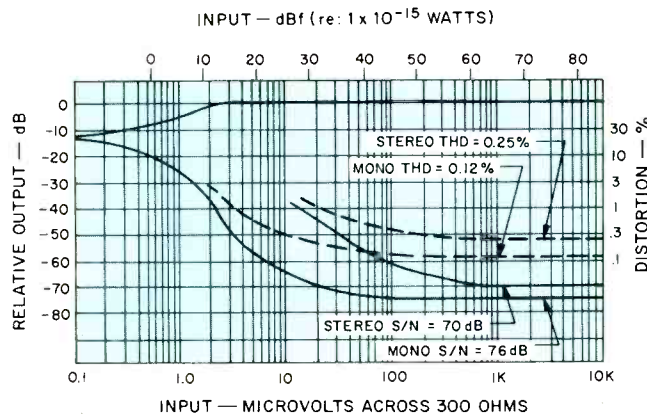


Fig. 4—FM quieting and distortion characteristics.

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**Sansui SR-212<sup>1</sup>** at under \$130.00.\* Auto-return, two speed, belt drive by 4-pole synchronous motor.

Statically balanced S-shaped tonearm, skating force canceller. Low capacitance cables.

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**Sansui SR-525<sup>3</sup>** at under \$280.00.\* Direct drive. 20-pole DC brushless servo-motor. S-shaped tonearm, special Sansui resonance absorber, knife-edge support system. Low capacitance cables. S/N: better than 64 dB. Pitch controls. Illuminated stroboscope. Heavy aluminum die-cast platter.

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SR313

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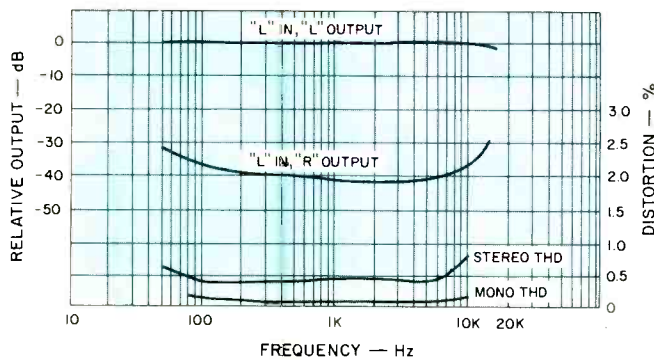


Fig. 5—Separation and distortion versus frequency.

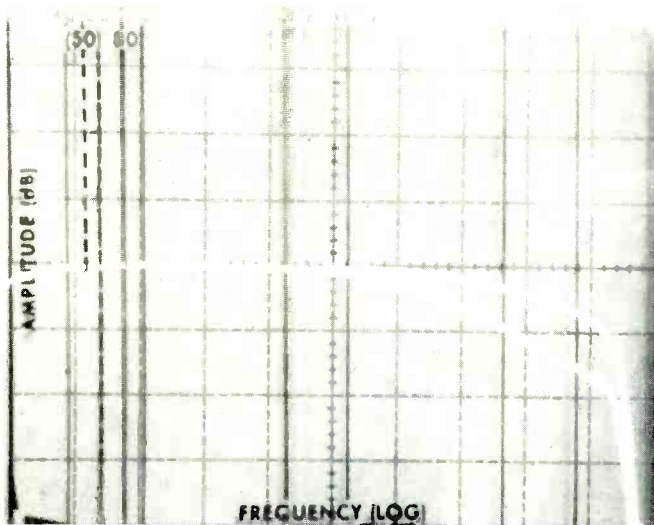


Fig. 6—Response of FM section when swept with unpre-emphasized audio signals from 20 Hz to 20 kHz. Upper curve shows 25  $\mu$ s de-emphasis; lower curve is 75  $\mu$ s de-emphasis. Note steep 19-kHz rejection.

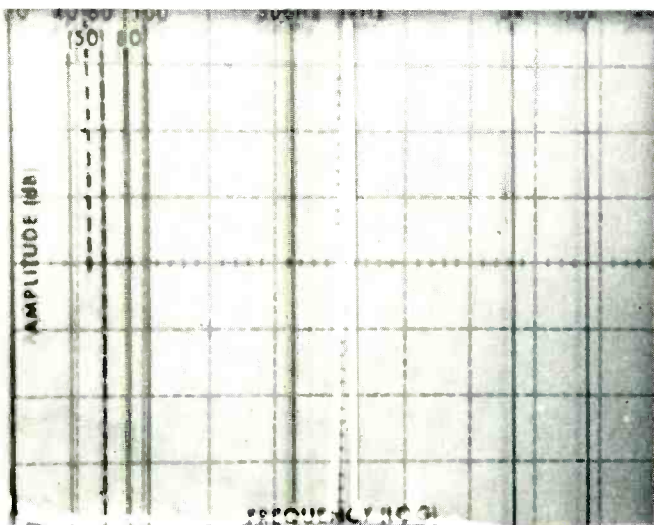


Fig. 7—Harmonic distortion content at 75 watts per channel output, both channels driven into 8 Ohms. Distortion is primarily second-order harmonic and is nearly 70 dB below fundamental.

noise ratio in mono was 76 dB, while in stereo, S/N measured 70 dB, as high as our test equipment is capable of reading accurately. Capture ratio measured exactly 1.0 dB, as against 0.9 dB claimed. Alternate channel selectivity was 82 dB, while adjacent channel selectivity measured 12 dB, against 10 dB claimed. Image rejection was 70 dB as claimed while i.f. rejection was an impressive 97 dB. Sub-carrier rejection measured 62 dB.

Figure 5 plots stereo FM separation, which reached 42 dB at mid-frequencies. Distortion versus frequency is also shown in this graph for both mono and stereo reception and is seen to remain well below 1.0% even at the high frequency extreme in stereo mode. Frequency response in FM deviated by -2.0 dB at 15 kHz, a direct result of the 19-kHz notch filter which so effectively suppresses sub-carrier products at the output of the tuner section. This action, as well as the response of the FM system when set to 25 microsecond or 75 microsecond de-emphasis, is clearly shown in the sweep-frequency 'scope photo of Fig. 6.

### Power Amplifier Measurements

The Tandberg TR-2075 delivered 87 watts per channel, at 1 kHz, with both channels driven into 8 ohm loads for its rated THD of 0.15%. At rated output of 75 watts, THD measured 0.05% and consisted mainly of a minute amount of second-order distortion, as clearly seen in the spectrum analysis photo of Fig. 7. THD at all other power levels down to 250 milliwatts was around 0.05% or even less, as shown in the graph of Fig. 8. The same graph also plots IM distortion for various power levels, and IM reached 0.2% at a power output level of 76 watts per channel. Tandberg's statement of power band (20 Hz to 20 kHz), now required by the FTC, is an extremely conservative one. As shown in the THD versus frequency plot of Fig. 9, the power band extremes could actually have been rated as extending from 14 Hz to 32 kHz. To put it another way, if one sets the power band limits as extending from 20 Hz to 20 kHz, the "FTC power" of the Tandberg TR-2075 might well have been rated at 81 watts instead of 75 per channel.

### Preamplifier Measurements

Phono input sensitivity of the variable *Phono 1* inputs ranged from 2.2 mV to 9.5 mV. RIAA equalization was ac-

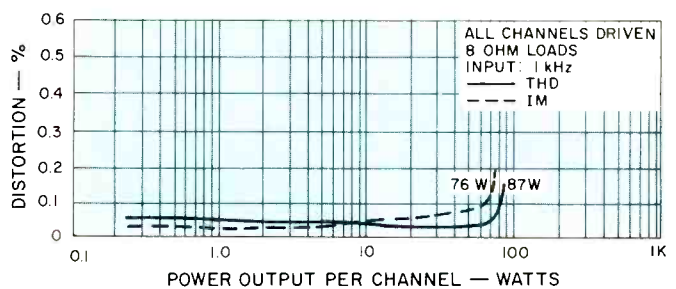


Fig. 8—Total harmonic and intermodulation distortion characteristics.

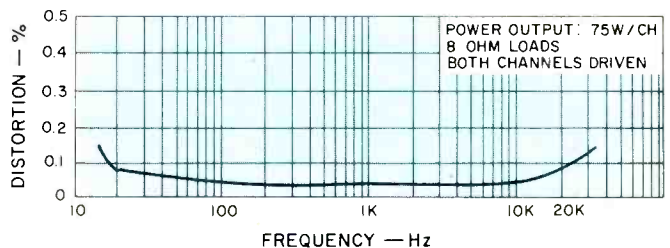


Fig. 9—Total harmonic distortion versus frequency.

# Ten years after the revolution.



1966

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Plus total immunity from line voltage and frequency variations. That's because the PS-4750 has a unique system that, in essence,



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consists of a sensitive magnetic head (with eight gaps instead of the normal one) which monitors platter speed by picking up a magnetic coating on the outside of the platter. This speed data goes through a small computer connected to the motor, instantly compensating for variations.

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We've even done something

about the resonance caused by warp in the record itself. Those round doohickies on the platter are rubber suction cups that actually provide greater contact surface, reducing the longitudinal vibration caused by warp. The end result is a cleaner sound.

So, all in all, our engineers think the PS-4750 is pretty nifty. But don't take our word for it. Just stop into your Sony dealer and show your independence by listening for yourself.

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curate in both *Phono 1* and *Phono 2* to within 0.3 dB at the high-frequency end and to within 1.0 dB at the low-frequency extreme. Overload input measured 52 mV at worst, improving, of course, as input sensitivity was reduced. While this figure is not as good as some we have measured on competitive receivers in this price category, the presence of the input sensitivity control offsets the overload limitation. Hum and noise referred to actual input sensitivity measured 68 dB for *Phono 1* inputs and 72 dB for the *Phono 2* inputs. Hum and noise for high-level (tape) inputs measured exactly 82 dB as claimed (referred to a nominal 300 mV input), while residual amplifier hum and noise was less than 1 mV. The composite range of bass, mid-range, and treble tone controls is depicted in the 'scope photo of Fig. 10, while the action of the various cut-off filter combinations is shown in the tracings of Fig. 11. Note that the two high-cut filters can be used together to create yet a third roll-off characteristic at the high-frequency end of the audio spectrum (most extreme cut shown). Figure 12 displays the action of the loudness control circuitry at various settings of the master volume control and, as can be seen, Tandberg elects to boost highs (moderately) as well as lows in affecting loudness compensation.

## Listening and Use Tests

We used the Tandberg TR-2075 in our listening room for a period of about three weeks after completing lab measurements. The receiver has enough power to drive our low-efficiency acoustic suspension speakers (used with all higher powered receivers we test) to louder-than-life loudness levels without clipping. Controls on the TR-2075 are ideally arranged, as far as we are concerned, and our chief delight in using this instrument was that *record preamp* facility used in connection with the *Tape 3* front-panel output jack. As might be supposed from the previously described test results, FM performance was excellent and limited only by the quality of broadcasts received. Transition from mono to stereo is positive, and muting is overcome at signal strengths of about 5 or 6  $\mu\text{V}$  (around 20 dBf)—just about ideal for this receiver since signals that do overcome the mute circuit are sufficiently "quiet" to be enjoyed. The inveterate "dx-er" can always defeat the mute circuits if he wishes to seek out those less usable signals of lower signal strength.

The power meter option was also worthwhile and, since we seldom rely upon a signal strength meter for tuning, we used that function during all our listening tests to confirm power levels being auditioned. The peak-reading action of the meter movement was such that we were able to read very nearly actual peak power values on all but the shortest bursts of musical transients. Having adjusted phono and tape inputs by means of those input level controls, we fully appreciated their inclusion and wished that less expensive receivers could afford this luxury as well. It's comforting not to have to grab for the volume control every time we switched from one program source to another. Clearly, the Tandberg TR-2075 is an example of a higher priced receiver that should not be judged on a simple "dollars per watt" basis. Admittedly, there are lower priced receivers that offer as much or even more power per channel, but the TR-2075 has so much more going for it than power output that we urge interested readers to experience "hands on" auditioning of this fine piece of equipment before deciding that its price may be too high for a "75 watt per channel" integrated receiver. Actually, the receiver should be thought of as a top-performing tuner and an equally good amplifier which happen to have been constructed on a single well-designed chassis. Taken in that light, the Tandberg TR-2075 becomes rather a bargain at its \$1,100.00 suggested retail price.

Leonard Feldman

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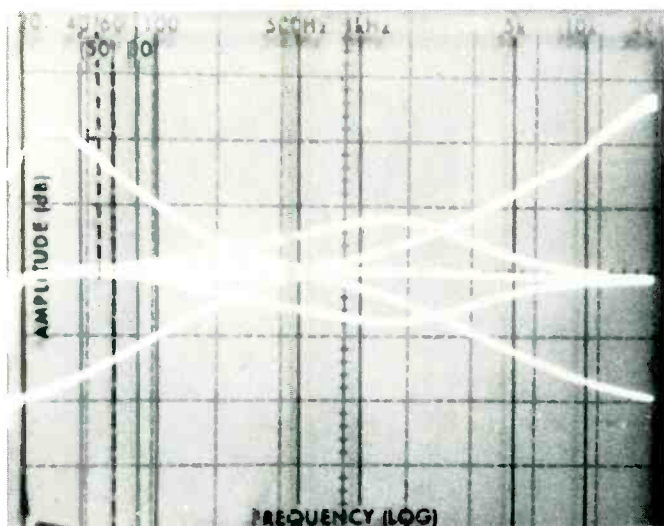


Fig. 10—Tone control characteristics.

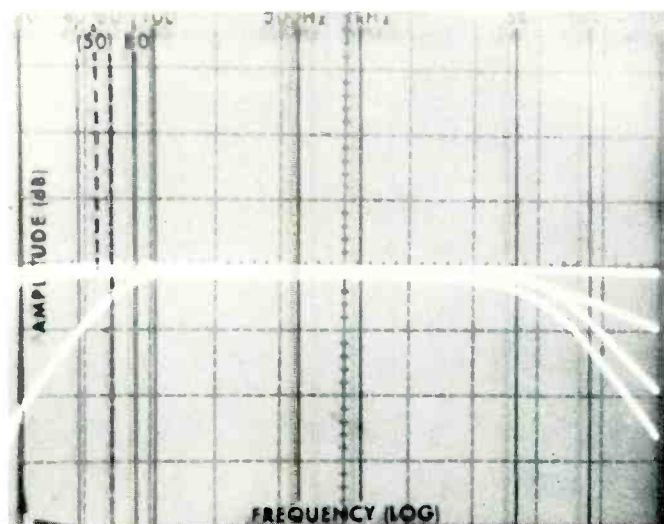


Fig. 11—Low- and high-cut filter combinations.

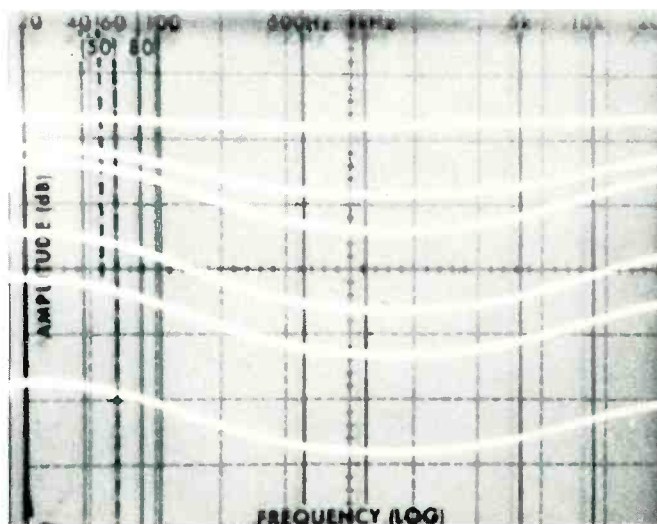


Fig. 12—Loudness control characteristics.

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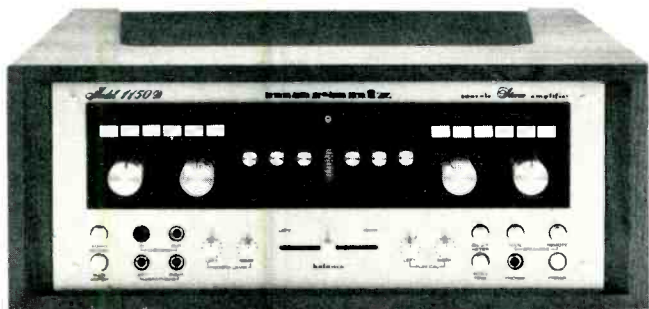
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**Marantz Model 1150D  
Stereo Control Amplifier**



**MANUFACTURER'S SPECIFICATIONS**

**Amplifier Section**

**Rated Power Output:** 75 watts per channel, 8 Ohm loads, 20 Hz to 20 kHz. **THD:** 0.1%. **IM Distortion:** Less than 0.1%.

**Main Input Sensitivity:** 1.5 V. **Frequency Response:** 1 watt, 5 Hz to 50 kHz  $\pm 1$  dB.

**Preamplifier Section**

**Rated Output Level:** 1.5 V. **THD at Rated Output:** 0.05%. **IM Distortion at Rated Output:** 0.02%.

**Frequency Response:** Phono, RIAA  $\pm 0.5$  dB; Aux, 20 Hz to 20 kHz  $\pm 0.3$  dB. **Input Sensitivity:** Phono and Mike, 1.8 mV; Tape or Aux, 180 mV.

**Phono Overload:** 300 mV. **Tape Out Level:** 0.775 V. **S/N Ratio:** Phono re: 7.5 mV input, 78 dB; Aux re: 775 mV, 88 dB.

**GENERAL SPECIFICATIONS**

**Dimensions:** 15 3/8 in. W x 5 3/4 in. H x 12 3/8 in. D. **Weight:** 33 lbs. **Price:** \$499.95; \$399.95 for model 1150, without Dolby system.

Now that the Dolby noise reduction system has been adopted by many FM and stereo FM stations, there are several ways in which you can take advantage of the greater dynamic range and quieter reception inherent in this broadcast system. You could, of course, purchase a new tuner equipped with both Dolby decoding and the proper 25  $\mu$ S de-emphasis. If you already own a good tuner not so equipped, you could add a separate Dolby box plus a small accessory that converts signal output to the proper de-emphasis (or you could rewire your tuner for 25  $\mu$ S de-emphasis). Or, you could consider Marantz's new 1150D integrated amplifier if you happen to be looking for a new control/amp unit with just about every conceivable control feature *plus* Dolby encode and decode facilities that can be used in conjunction with your tape equipment. Interestingly, all that Dolby circuitry will effectively cost you only \$100.00, be-

cause Marantz's Model 1150, an integrated amplifier that's similar to the 1150D sells for that much less than the Dolbyized version we tested.

The front panel of the Marantz 1150D has a centrally positioned, vertically deflecting meter used together with the built-in 400 Hz generator for calibrating record and playback of Dolbyized tapes. Above the meter is a pilot light and flanking the meter are three slide controls on each side, each with click-stop positions, for adjustment of bass, treble, and mid-range response on an individual channel basis. Symmetrically positioned pairs of rotary control knobs at the left and right ends of the panel select Dolby operation mode, tape monitoring (two tape monitor circuits are provided), program mode (left, right, stereo, reverse, and mono-mix), and adjust master volume level. The Dolby Mode switch has positions for playing back Dolby FM, playing other Dolbyized program sources, non-Dolby listening, making Dolby recording from "flat" program sources and making "flat" recordings from Dolby-encoded program sources. Six pushbuttons at the upper left of the panel select program sources (including two phono inputs, the second of which may be used for microphone amplification) and tape copying (from either tape input to the other). Symmetrically placed pushbuttons at the upper right take care of loudness compensation, low and high-cut filter activation (two high-cut frequencies are available: 5 kHz and 9 kHz) and select alternate turnover points for the bass and treble tone controls (250 Hz and 4 kHz as opposed to the "normal" mid-frequency pivot points).

The lower, gold colored section of the panel contains push-buttons for the 400-Hz test tone, left or right channel level indications on the Dolby level meter, audio muting, tone defeat, main and remote speaker system selection and power on/off. Centered below the meter is a horizontally moving slide lever control for channel balancing. Two pairs of rotary controls adjust recording and playback level for proper Dolby calibration. Microphone input jacks, dubbing in and out jacks, and a 'phone jack complete the front panel layout.

The rear panel of the 1150D, pictured in Fig. 1, has spring loaded speaker terminals for two stereo pairs of speakers, five convenience a.c. outlets (two switched, three unswitched), two sets of tape in and tape out jacks (plus DIN connectors for each circuit), preamp-out/main amp-in

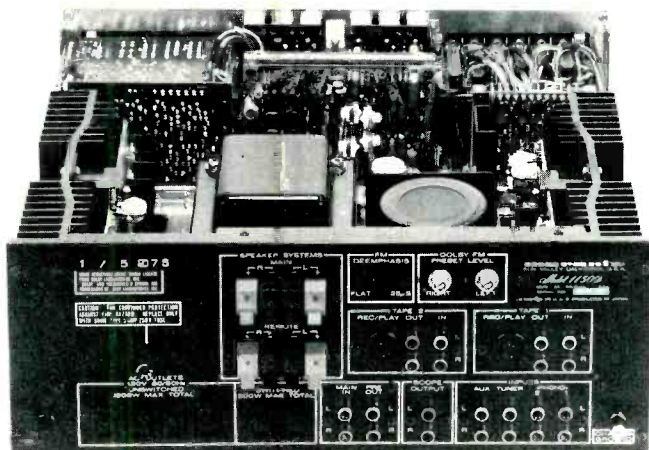


Fig. 1—Rear panel.

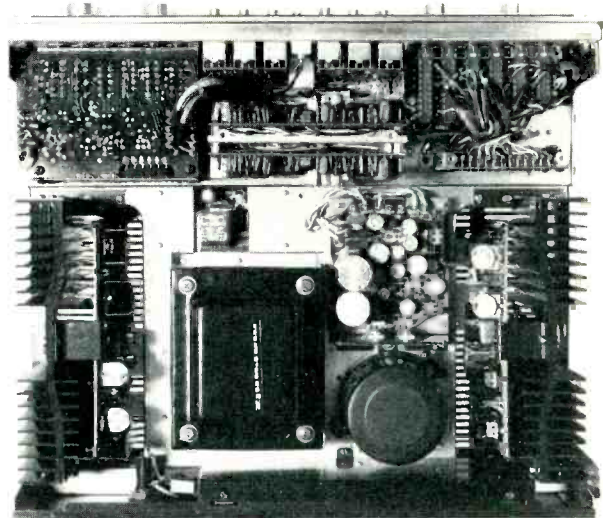


Fig. 2—Interior view.

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★ **STEREOPHONIC FREQUENCY TEST RECORD STR 100** Designed for the evaluation of pickups and systems. Provides a constant amplitude characteristic below 500 Hz and a constant velocity characteristic above 500 Hz. Tests include: Sweep Frequency—with the sweep rate synchronized for use with a graphic level recorder; Spot Frequency—with voice announcements; Channel Separation; Wavelength Loss and Stylus Wear—to pinpoint oversize or worn-out styli, and excessive pickup tracking force; Compliance; Phasing; Vertical and Lateral Tracking; Tone Arm Resonance—to check system performance at low and subaudible frequencies and thus reveal undamped resonance which may cause equipment overloading.

★ **318 MICROSECOND FREQUENCY RESPONSE TEST RECORD STR 170** Provides pickup designers and recording studios with a high-level, easily-equalized signal for frequency response and channel separation measurements. The STR 170 employs a 318 microsecond characteristic corresponding to the "test" or "flat" mode common to most disc recording equipment. Constant amplitude recording is employed in the region below 500 Hz with constant velocity recording in the region above. The transition is smooth, in contrast with the STR 100 which employs a sharp breakpoint at 500 Hz. The record is suitable for use with a graphic level recorder to provide permanent, visible records for precise evaluation.

★ **SQUARE WAVE, TRACKING AND INTERMODULATION TEST RECORD STR 112** Enables detailed study of tracking capabilities of stereophonic phonograph pickups. The square wave modulation allows a rapid appraisal of stylus-tip mass, damping, and tracking. Low frequency compliance and tracking are determined by means of 300-Hz bands of progressively increasing amplitude. Intermodulation distortion measurements are made possible by graduated 200-Hz intermodulation test bands. The Str 112 has been cut with vertical angle approximating 15°, which is representative of current recording practice.

★ **WIDE RANGE PICKUP RESPONSE TEST RECORD STR 120** Makes possible the measurement of pickup response at frequencies far beyond the audible range, where elusive distortion elements can cause audible distortion. The low-frequency range includes glide-tones at twice normal level for the detection and elimination of arm resonance, loudspeaker cone and cabinet rattles. Other tests include: silent grooves for measuring rumble and surface noise characteristics; and standard level bands at 0 dB for overall system S/N measurements. This record is suitable for use with a graphic level recorder to provide permanent, visible records for precise evaluation.

★ **BROADCAST TEST RECORD STR 151** Developed especially to meet the needs of broadcast engineers, audiophiles, and other professionals seeking a convenient signal source for the testing and adjustment of all audio equipment. Tests include: phonograph pickup response and separation, speed accuracy at 33 1/3 and 45 rpm, wow and flutter, rumble and hum detection, ballistic test of V. U. meters and many others."

★ **QUADRAPHONIC TEST RECORD SQT 1100** Designed for calibration, verification, and adjustment of SQ™ decoding equipment. The record provides test bands for pickup measurements, for adjustment of decoder electronics and for channel identification and balance. Each band is described in terms of recorded characteristics and its intended use.

★ **RIAA FREQUENCY RESPONSE TEST RECORD STR 130** Provides RIAA frequency characteristics for the calibration of professional recording equipment and for testing the response of professional and consumer record reproduction equipment. This record is suitable for use with a graphic level recorder to provide permanent, visible records for precise evaluation. Spot frequency bands for use without automatic equipment are included.

★ **RIAA PINK NOISE ACOUSTICAL TEST RECORD STR 140** Designed for acoustical testing of systems and loudspeakers and for psychoacoustic tests on reproduction equipment. With the STR 140 it becomes possible to test loudspeakers in the room in which they will be used. Spot frequency tones with voice announcements facilitate the testing procedure. Continuous glide-tones in 1/3-octave bands cover the frequency range from 30 to 15,000 Hz and are synchronized with a graphic level recorder.

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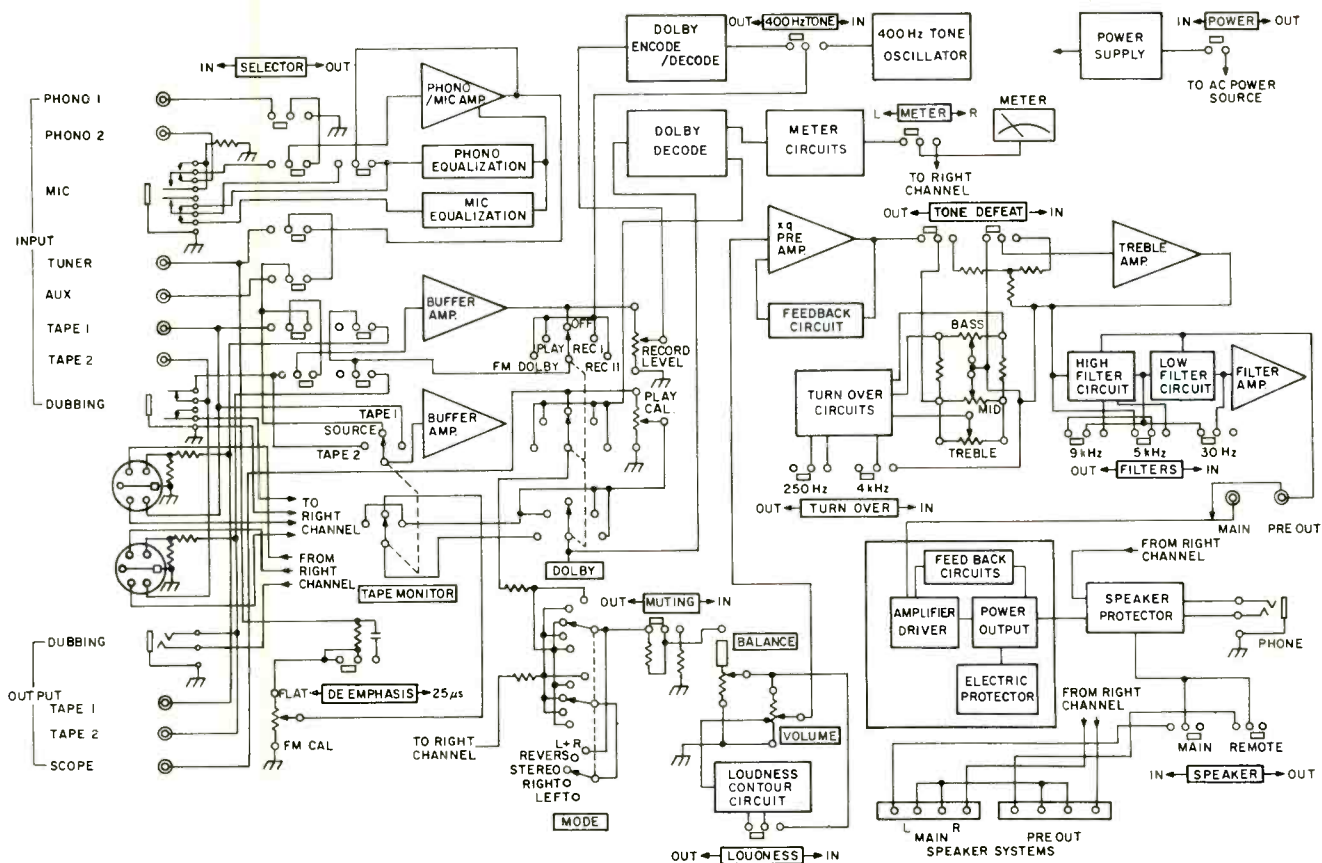


Fig. 3—Block diagram.

jacks, 'scope output jacks (for connection to an oscilloscope for observation of phasing, balance, and channel separation), and the usual program source input jacks. In addition, there is a slide switch, for choosing 25  $\mu$ SFM de-emphasis in the event that your tuner is not equipped with this feature, and a pair of Dolby FM level preset controls to permit adjustment of level from any tuner so that it will match Dolby circuitry in the amplifier for correct decoding. A line fuse-holder and chassis ground terminal are also located on the rear panel.

### Circuit Configuration

An internal view of the Marantz 1150D is shown in Fig. 2 and a block diagram of the system is reproduced in Fig. 3. The phono amplifier section consists primarily of a differential input transistor pair, a constant current source stage and a high gain stage. It is powered by a symmetrical bipolar supply to increase overload input capability. The tone control amplifier consists of a unity gain stage using a continuously variable RC-feedback arrangement. From the pre-amp-out terminals, signals are fed to the power amplifier

section. A differential amplifier and pre-driver circuit amplify the signal to high enough levels to drive the output stages. Each output stage consists of complementary symmetry transistors designed for high current and heat dissipation capabilities. The amplifier stages are direct coupled throughout.

The 1150D contains electronic protection circuits which sense excessive output current and voltage conditions and limit signal to the driver stages to a safe, predetermined value, protecting output transistors and drivers from excessive overdrive and short-circuits. Thermal compensation is also included and a speaker protection relay is provided to disconnect speakers automatically in the event of transistor failure. This relay is also activated by a time delay circuit which keeps speakers disconnected for about four seconds after turn-on to prevent audible popping noises from reaching the speakers during power supply stabilization periods.

### Power Output Measurements

After one hour of preconditioning at one-third rated power (25 watts per channel fed to both inputs, outputs connected to 8-Ohm resistive loads), the amplifier was measured for maximum power output capability. It delivered an impressive 84 watts per channel at rated THD of 0.1 per cent at mid-frequencies and an even more impressive 80 watts per channel at the 20 Hz frequency extreme. With 4-Ohm loads, available power increased to 125 watts per channel at mid-frequencies for rated distortion. Results of our 8-Ohm load measurements are plotted in Fig. 4, and distortion remains well under 0.1 per cent all the way from 250 milliwatt output levels to rated output. IM distortion reached 0.2 per cent at an output of 76 watts per channel, again with both channels driven. Distortion versus frequency for a constant 75 watts output per channel is plotted in Fig. 5, and at no fre-

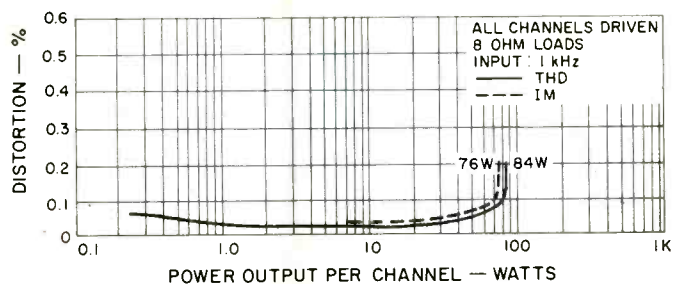


Fig. 5—Harmonic and IM distortion characteristics.



quency did it exceed 0.07 per cent. While Marantz guarantees the full-power frequency range from 20 Hz to 20 kHz, in fact, the amplifier was able to deliver its full rated power of 75 watts at any frequency from 16 Hz to 29 kHz at or less than 0.1 per cent THD.

Much emphasis has been placed recently on the distortion content of an amplifier, rather than on the absolute percentage value read by a single meter-type distortion analyzer. To investigate the spectral makeup of the distortion, we used our spectrum analyzer to scan from 20 Hz to 20 kHz while a 1 kHz signal was applied to produce full rated output

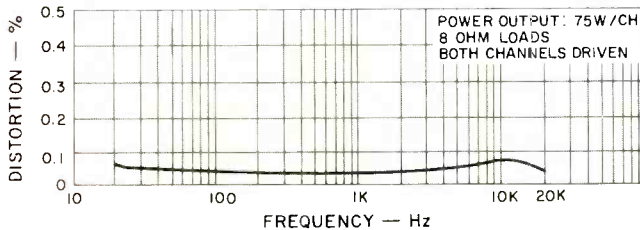


Fig. 5—Distortion vs. frequency.

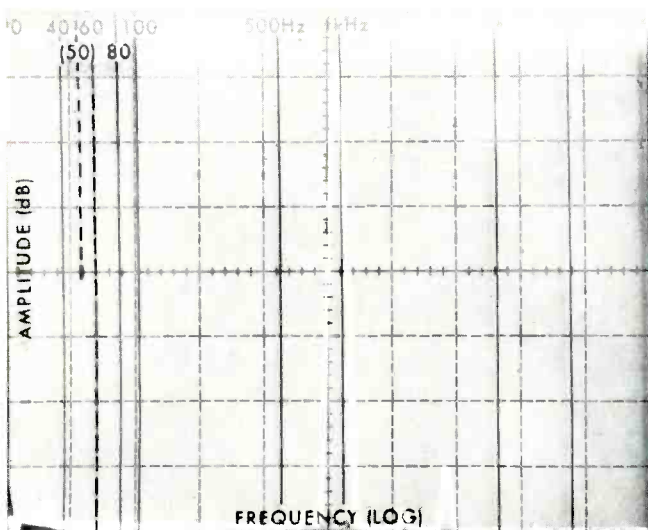


Fig. 6—Spectrum analysis of THD at the rated output of 75 watts per channel at 1 kHz

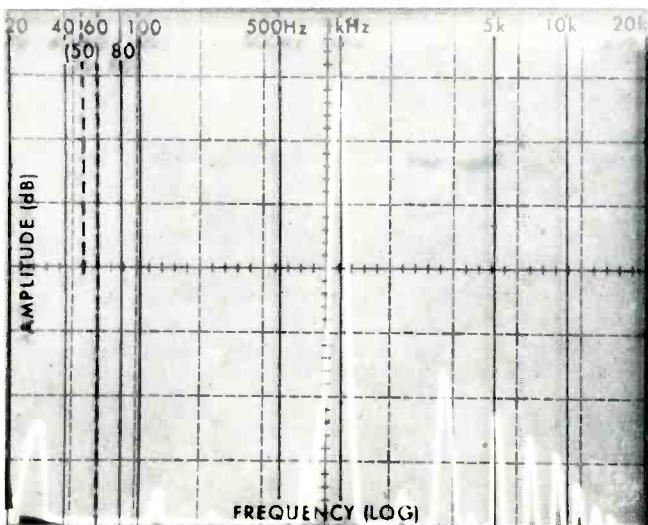


Fig. 7—Spectrum analysis of THD when amplifier is driven to severe clipping.

(75 watts per channel). As can be seen in the 'scope photo of Fig. 6, at rated output (the tall peak in the display is the fundamental 1 kHz signal), distortion product consisted almost entirely of third-order harmonic, which was some 64 dB below full output. Second-order harmonic distortion was down over 70 dB. Also of interest is the harmonic distortion content of the signal produced by an amplifier when it is driven well into clipping. In the case of the Marantz 1150D, even-order harmonics (second and fourth) are seen, in Fig. 7, to be well below odd-order harmonic contributions, while odd-order components decrease in amplitude quite rapidly. Each vertical division of the 'scope presentation equals 10 dB.

### Preamplifier Section Measurements

Phono input sensitivity for the Marantz 1150D measured just over 2.0 mV and phono input overload occurred with signal inputs of 340 millivolts at 1 kHz (well beyond the claimed 300 mV, which is in itself most impressive). Phono hum measured 66 dB below full output referred to maximum input sensitivity. Translated to Marantz's reference of 7.5 mV, the phono hum and noise figure would be -77.5 dB, a half dB short of spec. RIAA equalization was accurate to within 0.5 dB from 20 Hz to 20,000 Hz with the greatest error occurring at the high end. Overall frequency response through the high level inputs was flat to within 1 dB from 10 Hz to 35 kHz, and hum level referred to maximum input sensitivity for high level inputs (188 mV) measured 85 dB. Again, translating these figures to the Marantz input reference of 775 mV would give us a S/N ratio of 97 dB. Bass and treble control range for each of the selectable turnover points was recorded on a storage oscilloscope swept from 20 Hz to 20 kHz and is reproduced in Fig. 8. The advantage of selectable turnover tone controls is clearly evident from this photo since, when the 250 Hz and 4 kHz settings are chosen, it becomes possible to adjust response at the frequency extremes without seriously affecting musical response in the mid-frequency region.

Action of the mid-range boost and cut control was photographed separately, using the same spectrum analyzer sweep technique, together with the response of the single low-cut and dual high-cut filters, all of which are pictured in Fig. 9. Note the steeper slope of the high-cut filters (12 dB per octave) compared with the more gradual attenuation

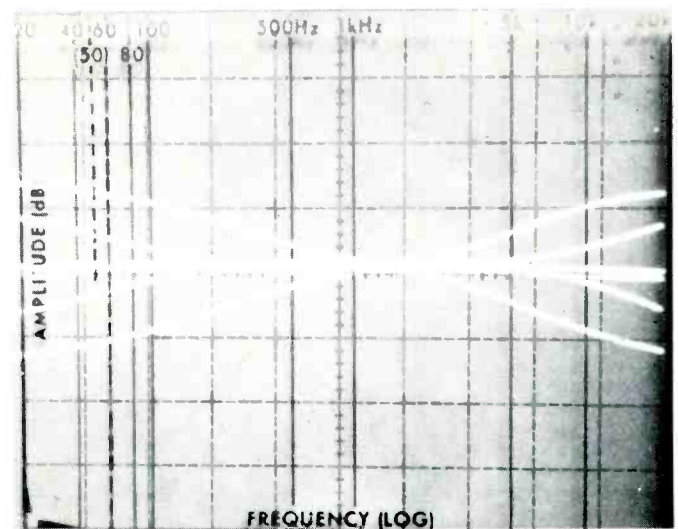


Fig. 8—Bass and treble control range at each of two turnover settings.

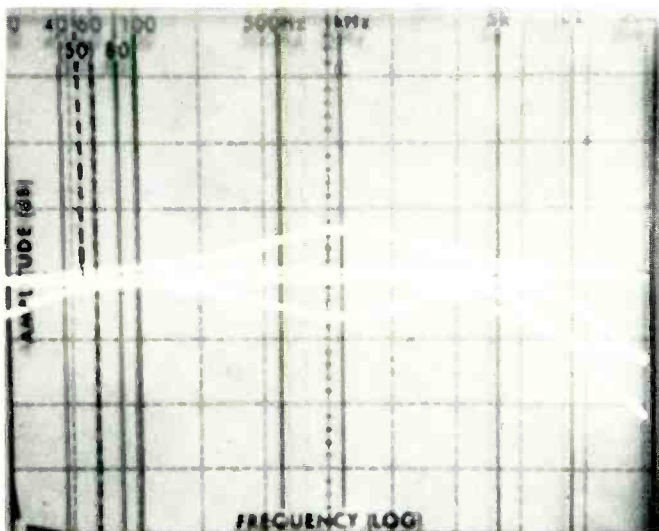


Fig. 9—Action of mid-range tone control and high-and low-cut filters.

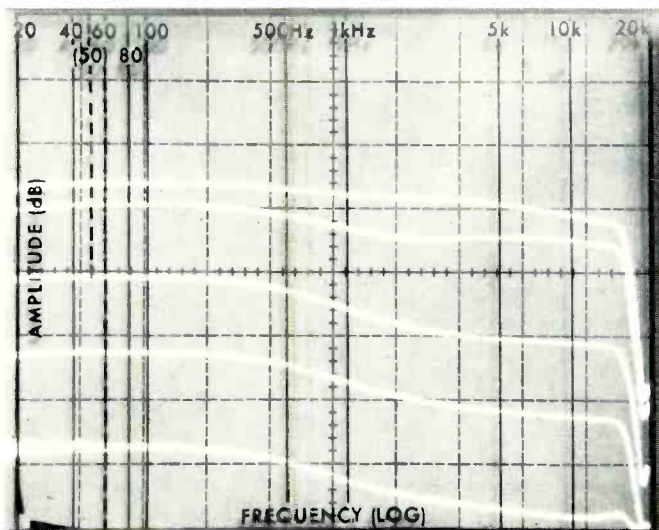


Fig. 10—Dolby decode response at various signal levels from Dolby calibration level downward.

characteristic of the treble cut control which has been superimposed on the storage 'scope for comparison purposes.

Finally, we checked the action of the Dolby recording circuits for decreasing levels of input signal, after referencing an input signal to the correct point of Dolby calibration by means of the self-contained Dolby level meter. Results are shown in the 'scope photo of Fig. 10 in which the familiar Dolby action (attenuation of highs increasingly with decreased signal levels) is apparent.

### Listening and Use Tests

Our first reaction to the inclusion of all those Dolby options in an integrated amplifier was to question whether, indeed, Dolby belongs in such a product. After using the amplifier for a few days (hooked up to an FM tuner and a variety of cassette and open-reel decks), we began to appreciate the idea and agree that if, indeed, the 1150D is used as the heart of a system, then having Dolby facilities for all applications at that one central point in a system certainly simplifies things.

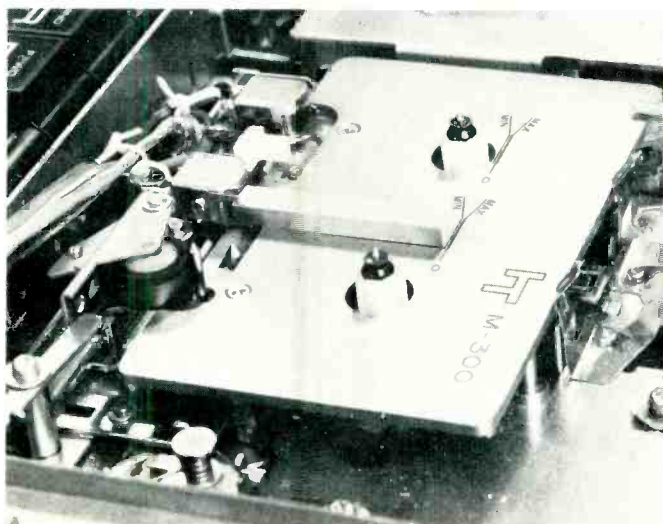
Tone controls on the amplifier work very well indeed and are so precise in their action that we could detect no difference when they are set to flat as against listening to the system when tone controls are fully defeated. The Marantz 1150D had no problem with any of the low-efficiency speaker systems with which we auditioned its performance and rarely clipped on program peaks even when we opened things up to beyond reasonable listening levels. Continued use at high listening levels resulted in only moderate increases of heat sink temperatures. The front-panel dubbing jacks will appeal to recordists who like to copy tapes from friends' machines.

In short, there's not much Marantz could have added to this *top-of-the-line* integrated amplifier, and, in our view, the 1150D is definitely in the Marantz tradition of excellence. The 'scope output jacks are obviously intended to convince users to purchase the companion 150 Marantz tuner (which happens to have a 'scope built in), but one cannot fault the Marantz people for that, since the combination would make a truly fine high fidelity system.

Leonard Feldman

Check No. 91 on Reader Service Card

### Information Terminals M-300 Cassette Gauge



### MANUFACTURER'S SPECIFICATIONS

#### Plate

**Thickness:** 0.096 in.  $\pm$ 0.001 in.; 0.163 in.  $\pm$ 0.001 in. **Flatness:**  $\pm$ 0.002 in. overall. **Parallelism:** Within 0.001 in. **Etch Markings:**  $\pm$ 0.002 in. to mean Philips standard.

#### Bar

**Thickness:** 0.150 in.  $\pm$ 0.000 in., -0.001 in. **Length:** 1.500 in.  $\pm$ 0.001 in. **Width:** 0.25 in.  $\pm$ 0.005 in. Square end perpendicular within 0.0002 in. **Price:** \$85.00.

Information Terminals are makers of precision cassettes for data systems, and they originally made the M-300 gauge for their own use but decided to make it available for other potential users, not by any means confined to the computer field. The gauge is made of high-quality tool steel in the shape of a cassette and is placed in the deck with the heads in the operating position. An angled bar is employed to check the tape guide positions, head tilt, and depth of head engagement, using etched reference marks on the gauge plate. Thus, transport systems set to the gauge will have optimum head-to-tape contact and penetration. Not only that, but the correctly aligned guides will not cause wow and flutter and possible tape damage. The gauge comes in a well-made padded instrument box complete with instructions.

At the price of \$85.00, it is not likely to appeal to many audio enthusiasts but it is certainly an invaluable tool for service engineers and manufacturers—I know of several QC departments that should definitely have one! No doubt enterprising dealers could run “cassette clinics” on the lines of the Marantz or McIntosh affairs, and I am sure some customers would be a little shaken. I used it to check a Naka-

michi 500, Technics RS-676US, and a Superscope CD-302 and found them all within the Philips specifications, but a “Brand X” portable, which occasionally chewed up tape, had incorrectly aligned guides. *George W. Tillett*

Check No. 92 on Reader Service Card

### Thorens TD 145C Turntable



#### MANUFACTURER'S SPECIFICATIONS

**Speeds:** 33-1/3 and 45 rpm. **Wow and Flutter:** 0.06% DIN 45507. **Rumble:** -65 dB, weighted, DIN 45539. **Lateral Tracking Error:** Less than 0.2 deg./in. **Bearing Friction:** Less than 20 mg. **Arm Resonance:** Less than 10 Hz. **Cable Capacitance:** 200pF (standard). **Dimensions:** 17-in. W x 13 1/2-in. D x 7 3/4-in. H (including dust cover). **Weight:** 16 1/2 lbs. **Price:** \$299.95.

Did you think that the Thorens TD 145C is merely a less expensive version of Elpa's TD 125 Mk II? The answer is *no*. Thorens TD 145C *does* incorporate individual features of its own, such as the motor top plate and pick-up arm which utilize an entirely different method of suspension than the 125 Mk II. This transcription turntable also has an ingenious electronic stop mechanism that lifts the tone arm at the end of a record. The arm and cue lifts on both units are *similar*, however, the 145C's 16-pole motor is driven direct from the power line instead of by a transistor generator. And, like the 125, the motor is coupled to the turntable flywheel by a belt, but the speed change is made by a mechanical link which moves the belt on the two-dimensional motor shaft. The speed selector knob is at the front on the left and has three positions—the center one switching the motor *off*. On the right, a matching knob operates the pick-up cueing or lifting device, which uses a black plastic bar just in front of the arm pivot. The lift also becomes operational at the end of a record; first, as the phono stylus travels into the run-off grooves, the arm rotates, bringing a tiny ferrite section near a sensing coil, thus pulsing an 80-kHz oscillator. The pulse is integrated, as shown in the accompanying figure, and operates a Schmitt trigger circuit which causes a decrease in current through a solenoid. As the lever springs back, it operates the motor switch and a microswitch which activates the

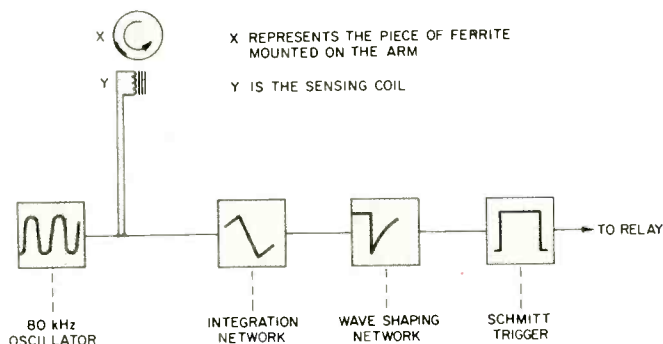
cue lift device. Although it sounds quite complicated, it really is a straightforward arrangement, though it *does* use five transistors, three diodes, plus a 30V supply, and thus must add to the overall cost of the unit.

#### Measurements

As previously mentioned, the arm is similar to the one used on the TD 125 Mk II, and it is just over 9 in. long, with a slide-on counterweight at the rear. The stylus-force fine adjustment is a thumbwheel mounted above the pivot, and it is calibrated in 1/4-gm. steps from 0.5 to 3 gms. The anti-skating control is located to the right of the pivot, and it works by applying a magnetic force to compensate for the inherent tendency of the arm to swing towards the center of the record. The dial is calibrated for elliptical and conical styli with a provision for “wet play”—popular in some European circles—a practice I would not recommend! (*Editor's Note:* For those interested in additional information on the wet play system, we refer them to F. A. Loescher's article “Record and Stylus: How Long Do They Last?” in the June 1975 issue of the British publication *Gramophone*, whose circulation office is at 177-179 Kenton Rd., Harrow, Middlesex HA3 OHA, England.)

Motor speed is 450 rpm. The 4 1/2-lb. cast aluminum turntable rests on a heavy flywheel. Both the motor and the base of the arm are mounted on a sub-panel which is spring mounted from the main topplate. This arrangement is preferable to the more commonly used suspension systems as it is less susceptible to acoustic feedback, *and* there is no indication of any wow when the controls are operated!

The cartridge shell is easy to detach, and no trouble was experienced in mounting my standard cartridge, a Shure V-15 Mk III, with the hardware supplied. The alignment template was used to make certain that tracking was accurate, and then the arm was balanced with the counterweight and tracking force set. The Shure test record was used for this adjustment, and the optimum force was found to be 1 1/4 gms. with the anti-skating dial turned to 1 1/2. Tracking error was within the 0.5 degs./in.—typically good for this kind of arm. Lateral and vertical friction were both too low to measure with any degree of accuracy. Wow and



**Fig. 1**—X represents the piece of ferrite mounted on the arm. Y is the sensing coil.

flutter was extremely low at 0.05% (DIN 45507), and rumble was -65 dB (RRLL weighting) which is one of the lowest figures yet encountered. The stylus force dial calibration was found to be accurate, certainly within 5%, and the arm resonance with the Shure cartridge came out at 8 Hz with a rise of only 3.5 dB. The cue arm lift works easily and smoothly without sideplay with an almost instantaneous lift and a gentle three-second drop. The motor is exceptionally quiet, and speed on both ranges was less than 1 per cent fast. At the end of the record, the motor is automatically switched off and the arm raised from the record. However, the arm

does not return to the rest position, which can be disconcerting until you get used to it; this is minor, and there are no other criticisms.

For those desiring Model TD 125 Mk II, but can do without the refinement of variable speed control, the TD 145C is a quite logical choice, as the difference between the two models' basic performance is minimal. Incidentally, the connecting cables supplied are not suitable for CD-4 applications, but Thorens can supply low-capacity cables if required. The part number is LCC-1.

George W. Tillet  
Check No. 93 on Reader Service Card

## Electro-Voice Interface: A Loudspeaker System



### MANUFACTURER'S SPECIFICATIONS

**System Type:** Vented, equalized system. **Nominal Impedance:** 8 ohms. **Frequency Response:** 32 to 18,000 Hz  $\pm$  3 dB. **Dimensions:** Speaker, 14 in. x 22 in. x 7-3/4 in.; equalizer, 2-3/4 in. x 8 in. x 7 in. **Net Weight:** Speaker, 27 lbs.; equalizer, 2 lbs., 10 oz. **Price:** \$450.00 per pair with equalizer.

Standing only 56-cm (22-in.) high by 36-cm (14-in.) wide and 18-cm (7-3/4-in.) deep, each speaker of this system promises to be that something which can be placed on any reasonable shelf, a true bookshelf speaker. When it comes to sound output, however, this small size is deceptive because the Interface: A is one of the newer breeds of loudspeaker designed for extended low-frequency response through optimizing system parameters rather than brute force methods.

The basis of this design is the fine work of the Australian researcher, A. N. Thiele, who is a leader in describing loudspeaker low-frequency response in the same terms as used in electrical network theory. This, in turn, has led to a much more straightforward method of design than had been previously used by loudspeaker designers.

In the case of the Interface: A, the designers chose to use a system response corresponding to that of a sixth-order Butterworth high-pass filter with a 3-dB frequency of 32 Hz. Instead of using a vent to achieve this system response, Electro-Voice uses a passive radiator, which they prefer to have known as a "vent substitute." Whether we call it a drone cone, passive radiator, or vent substitute, the device, which replaces the equivalent of a 6.1-meter (20-ft.) long air vent, is a loudspeaker without a voice coil that is mass loaded by 400 grams to provide the equivalent volume of air.

In order to achieve the sixth-order alignment, auxiliary equalization is needed, which takes the form of a boost at

about 36 Hz and is provided in a preamplifier accompanying the two speakers. This is not a just simple bass boost to give more low frequency kick, but is designed specifically as a complement to the acoustic response in order to achieve the desired result.

A 20-cm (8-inch) front-mounted woofer provides direct output for frequencies up to 1500 Hz, as well as driving the vent substitute. A front-mounted tweeter takes over for frequencies above 1500 Hz. In order to improve the total high-frequency energy in a room without making the front response too hot, a rear-mounted tweeter carries frequencies above 8 kHz and augments the response of the front tweeter.

The enclosure is walnut finished, with a removable black grille. Loudspeaker connection is made to well-marked terminals on the rear. There is one possible point of user confusion present in the form of an additional set of connections directly below the two speaker terminals and called "tweeter protection." These are provided for an optional protection device for the tweeters, but a hasty hook-up could result in improper connection, particularly for the "do-it-yourselfer" who relies more on touch than on the written instructions when the rear of the enclosure is against a wall and poorly lit.

The user who takes the time to read should have absolutely no problem with this system, however, because the clearly written set of instructions which accompanies the Interface: A covers virtually everything the user might need to know. The Interface: A is warranted against malfunction due to defects in workmanship and materials for a period of 5 years from the date of original purchase.

### Technical Measurements

The electronic preamplifier is an essential element in the reproduction properties of the E-V Interface: A since it not only provides the proper bass equalization but also establishes the treble properties by means of three switchable high-frequency contours. Figure 1 is the measured frequency response of the preamplifier for each of the three control positions. The bass response is the same for all positions and

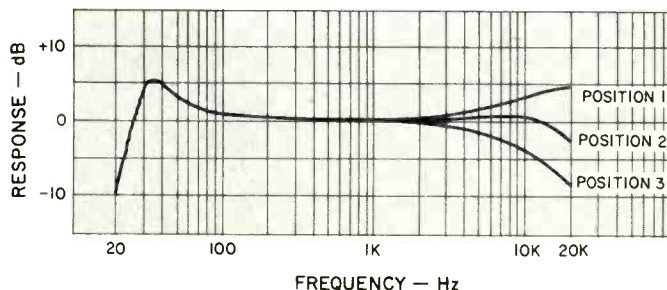


Fig. 1—Frequency response of preamplifier in E-V Interface: A system.

corresponds to a 6-dB peak at 35 Hz with a rapid rolloff below 25 Hz, which should keep the woofer out of trouble with subsonic signals such as those due to warped records. The high frequency response varies from a 5-dB peak at 20 kHz for position 1, to an 8-dB drop for position 3.

The preamplifier can be safely switched on or off without causing a voltage surge in the output signal, which is important from the standpoint of speaker protection. There is, however, a substantial signal that can pass through the preamplifier when its power is removed and cause a distorted reproduction. For that reason the preamplifier should be powered from a convenience outlet in the master system so that it turns on with the other components.

The measured magnitude of impedance is shown in Fig. 2 for frequencies from 20 Hz to 20 kHz. This system uses a passive radiator and technically has the characteristic impedance of a vented speaker with two bass resonance peaks. The lower peak occurs at 18 Hz and is just below the lowest frequency on this plot. The higher peak is at 68 Hz. The largest peak is around 1.3 kHz and is associated with the high frequency drivers.

Figure 3 is the complex impedance plot corresponding to Fig. 2. The lowest impedance is resistive and is around 5 ohms at 180 Hz. The frequencies of maximum phase lag, corresponding to the greatest stress on a power amplifier, are 80 Hz and 2 kHz. The low phase angle at 2 kHz indicates that most amplifiers should be capable of driving the Interface: A to near clipping levels without breakup.

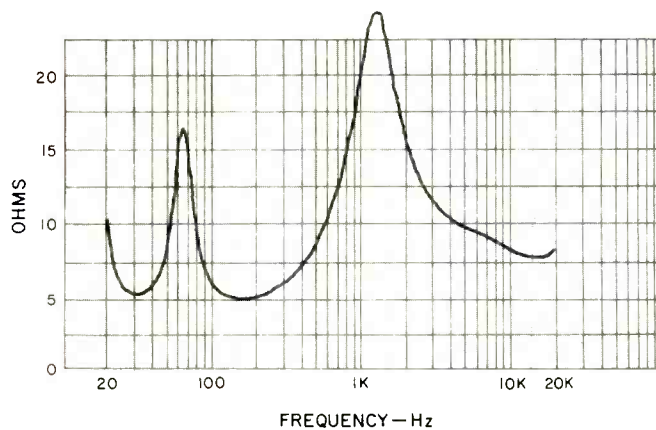


Fig. 2—Magnitude of impedance.

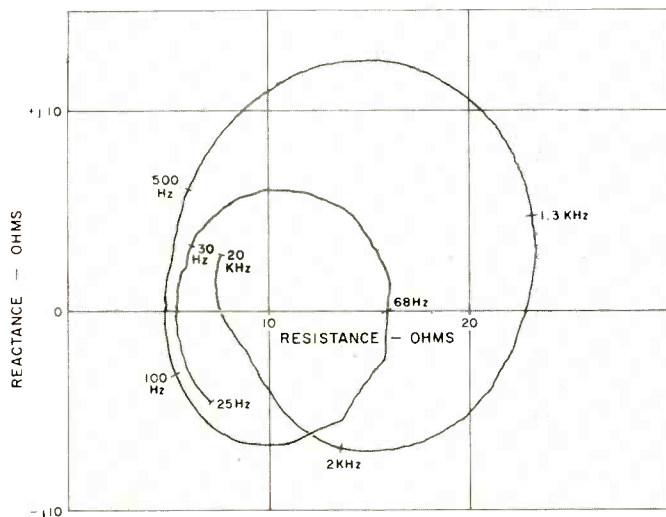


Fig. 3—Complex impedance.

The anechoic one-meter on-axis pressure response with one-watt average drive is shown in Fig. 4 for the magnitude of sound pressure and in Fig. 5 for the phase. This response was measured with the preamplifier set to position 2. The response shows a tendency to roll off smoothly below 50 Hz with a trend toward a rounding off rather than a precipitous drop from a flat plateau. The magnitude of sound pressure extends quite uniformly through the important mid frequencies and has a slight overall downward tilt of about a dB per decade of frequency. The extreme top drops off above 13 kHz but still maintain a respectable level at 20 kHz.

The phase response, Fig. 5, shows a small nonminimum phase break at around 400 Hz and at the acoustic crossover at 2.8 kHz, with another break around 9 kHz. The phase plot is in two parts and is corrected for the acoustic positions at 1 kHz and 10 kHz. The acoustic position of the tweeter is 5.5 cm (2.2 inches) in front of the woofer. Both the woofer and

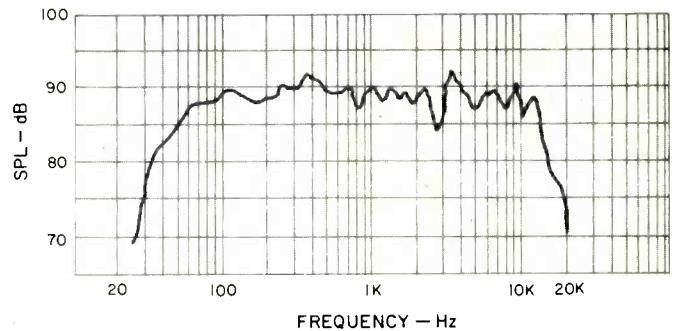


Fig. 4—Anechoic, one-meter on-axis amplitude response with one-watt average drive level.

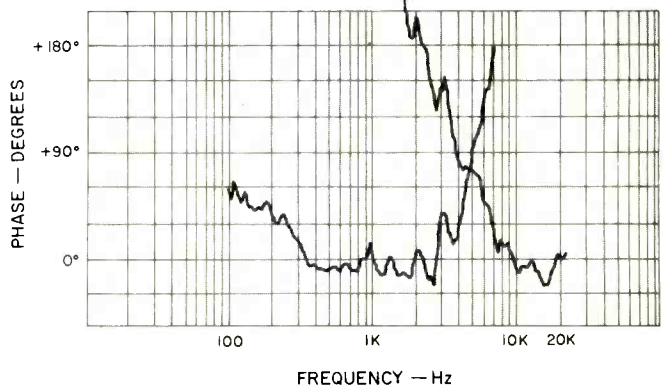


Fig. 5—One-meter pressure phase response, corrected for time delay of woofer and time delay of tweeter.

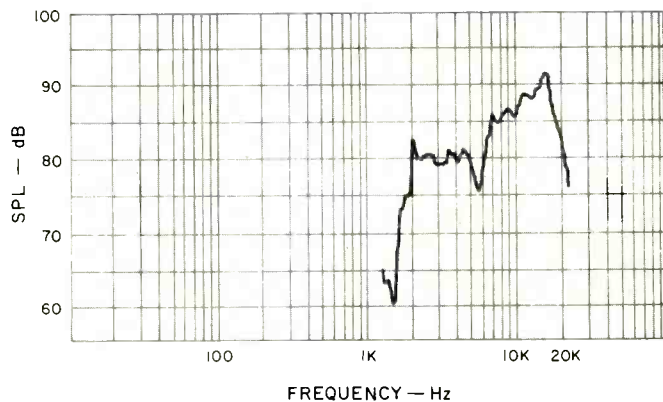


Fig. 6—One-meter anechoic response of rear tweeter.

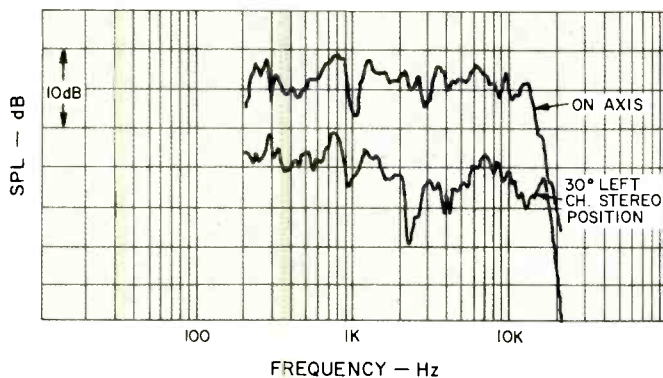


Fig. 7—Three-meter room response.

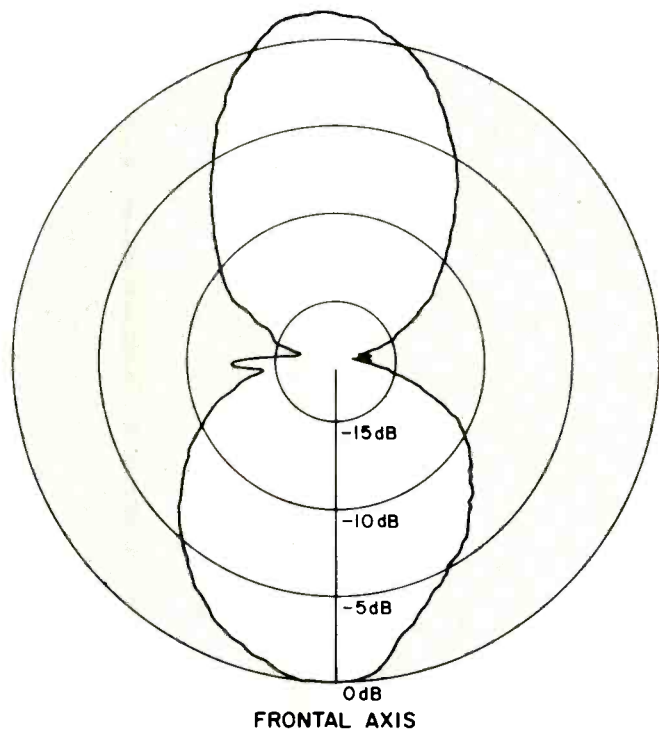


Fig. 8—Horizontal polar-energy response.

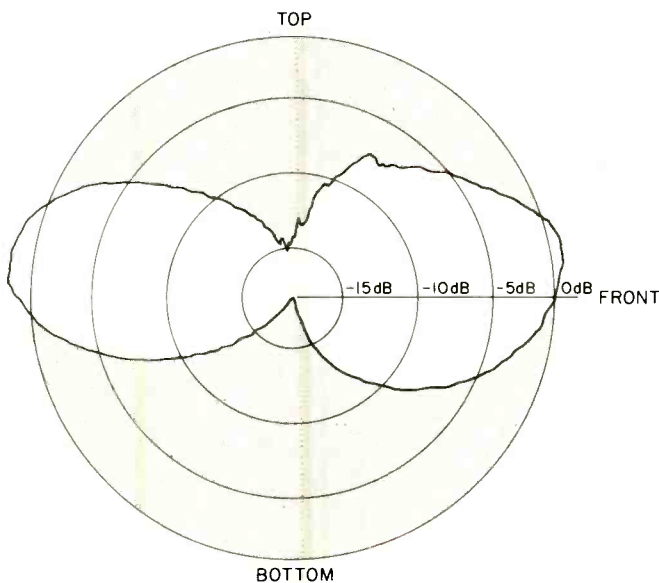


Fig. 9—Vertical polar energy response.

tweeter are phased at zero degrees, which means that a positive voltage applied to the positive marked speaker terminals produces an in-phase pressure increase when the air path delay is subtracted from the measurement.

One surprise is that the rear-mounted tweeter is considerably "hotter" than the front-mounted tweeter for frequencies above 10 kHz. The one-meter response on the rear on the Interface: A is shown in Fig. 6 for the magnitude of sound pressure.

The near-field pressure response of the Interface: A, with the preamplifier equalization, shows a peak in response at around 38 Hz for the passive radiator and a characteristic dip at 30 Hz for the active driver.

The three-meter room response, corresponding to the tonal properties to be expected in an average listening situation, is shown in Fig. 7. The speaker is mounted one meter above the floor and the rear of the enclosure is 46 cm (18 in.) away from a back wall. Two responses are shown, separated 10 dB for clarity. The on-axis response is measured three meters directly in front of the enclosure and one meter above the floor. The other position has the same distance but is 30 degrees off-axis, corresponding to the response to be expected for a left-channel stereo position. Equalizer position 2 was used for this test. The effect of the rear-mounted tweeter is evident in the stereo position where the sound reflected off the wall carries the response to nearly 18 kHz. Except for a diffractive dip at around 2 kHz, the response is reasonably uniform throughout the useful frequency range.

A second set of three-meter measurements (not shown) was made for the condition where the rear of the speaker is only 10 cm (4 in.) from the wall. The effect of this is to reduce the extreme high frequencies and to introduce a mid-frequency rise at around  $A_4$  or 440 Hz. I would recommend pulling the speaker away from any rear wall for smoother response.

Figures 8 and 9 are the horizontal and vertical polar energy response, respectively. The energy density of all frequencies from 20 Hz to 20 kHz is integrated for this measurement. Clearly the rear tweeter, which is handling half the frequency range from 10 kHz to 20 kHz, walks away with the energy honors. This gives a dipole-type response commonly found only in open-back electrostatic speakers.

For some reason not evident from physical inspection, there is a left-right dissymmetry of the horizontal dispersion. This implies that the speakers should be rotated toward the listening area for a better balance in stereo reproduction.

Sound is launched slightly upward. The shape of the vertical response implies that the Interface: A should not be mounted near a ceiling or immediately below a hard reflecting surface.

Harmonic distortion is shown in Fig. 10 for the tones  $E_1$  or 41 Hz,  $A_2$  or 110 Hz, and  $A_4$  or 440 Hz. The distortion at  $A_4$  is low throughout the power range. The mid bass tone  $A_2$  begins to show stress above 20 watts, and the power handling drops significantly for the low bass tone of  $E_1$ .

These measurements were not made through the preamplifier, but were made with respect to the actual drive power on the speaker terminals. In view of the 6-dB pre-emphasis of the preamplifier at  $E_1$ , and the fact that sonic distress occurs at levels above 40 watts (where we terminated the measurement), I do not recommend that this speaker be used to reproduce such demanding material as Bach's *Tocata and Fugue* at loud levels, as it would not be musically accurate and could lead to speaker damage if high-power amplifiers are used.

The intermodulation of  $A_4$  by  $E_1$  or 440 Hz by 41 Hz, mixed one-to-one, is quite low, as shown in Fig. 11. The IM starts at one-tenth per cent at an average power of one-

tenth watt and climbs slowly to a low level of 6.36 per cent at 100 watts. The nature of this distortion at its maximum level is mostly amplitude modulation with approximately a one degree peak-to-peak phase modulation. All in all quite clean.

The Interface: A passes the crescendo test handily with no measurable modulation of inner musical voices due to sudden incoherent signals 20 dB higher in average power, such as applause. The measurements were made at levels up to a peak instantaneous power of 200 watts.

The energy-time response is shown in Fig. 12. The first sound at 3.1 milliseconds is due to the tweeter and has a mean average frequency around 10 kHz. This 10-kHz tone persists at a low level until around 3.8 milliseconds. The mid-frequency contribution of the active radiator comes 0.165 milliseconds after the first tweeter signal and appears as the bulk of energy from 3.26 to 3.8 milliseconds in this plot. The low level signals beyond 4 milliseconds are due to midrange diffraction from the sides and top of the enclosure. With reference to the frequency plots of Figs. 4 and 5, the dip in amplitude at 2.9 kHz and the sudden phase slope change at that frequency are revealed as due to the bulk of the mid-range energy arriving slightly over one-third millisecond after the bulk of the tweeter energy.

### Listening Test

In order to assess the listening properties of the Interface: A, the units were mounted slightly less than one meter off the floor and near a back wall. A number of positions were auditioned and the configuration judged to yield the most realistic acoustic illusion was with the speakers pulled out about 18 inches from the wall and angled toward the listening position.

When the speakers were very close to the back wall, a mid frequency peak in response began to be evident. And, a speaker position pointing directly away from the back wall gave, to my ears, a more diffuse space spread for single mu-

sical instruments than when the speakers were slightly angled toward the listening position. Of course, different rooms and different listening preferences suggest that each user should experiment with speaker placement to satisfy his individual needs.

After finding a speaker location, I then began experimenting with the equalizer settings. Even though it definitely pulls the top end down the most, I prefer the acoustic balance afforded by switch position 3. This gives less of a "high fi" bite to the top end, but appears more realistic for musical material recorded under natural acoustic conditions.

My overall impression is that the lower frequencies are quite smooth without any apparent hangover, but sixth-order Butterworth alignment or not, the super low bass is just not there. The middle frequencies, up to about 1 kHz, are uniform and free from peaks, though above that range there is a shallow dip in response until the very high frequencies where the response comes up noticeably.

Stereo imagery is pulled forward and, in my opinion, is spread on a two-dimensional screen passing through the plane of the loudspeakers. I also have the impression that some musical instruments suffer lateral spread and appear wider than they should. Transient response is very good and complicated ensembles are reproduced quite accurately with very little intermodulation smearing. Clean organ music, such as the Bach *Tocatta in D* sample on the Acoustic Research Demonstration Record, begins to sound, in my opinion, very muddy at brisk volume levels. However, kick drum and tom tom sound fine. Female vocals are realistic in sibilant properties, but appear "ten feet wide" on the stereo stage.

The place where the Interface: A begins to shine is in contemporary rock that is mixed "bright." These speakers can carry quite a loud level for such vocals and instrumentals

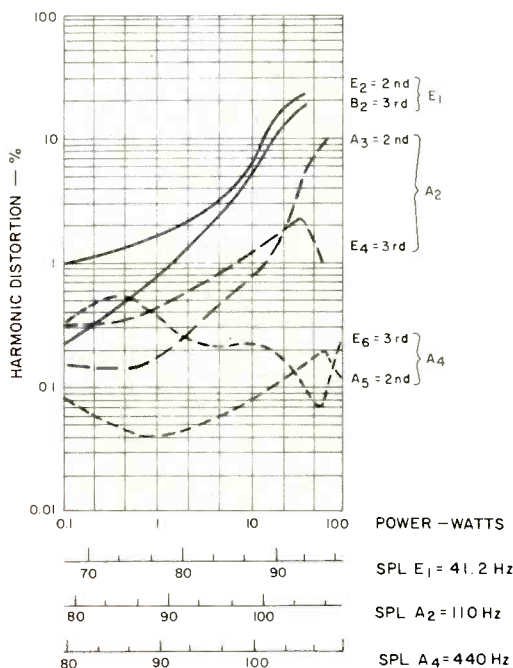


Fig. 10—Harmonic distortion for the tones E<sub>1</sub> or 41 Hz, A<sub>2</sub> or 110 Hz, and A<sub>4</sub> or 440 Hz, measured without use of the equalizer.

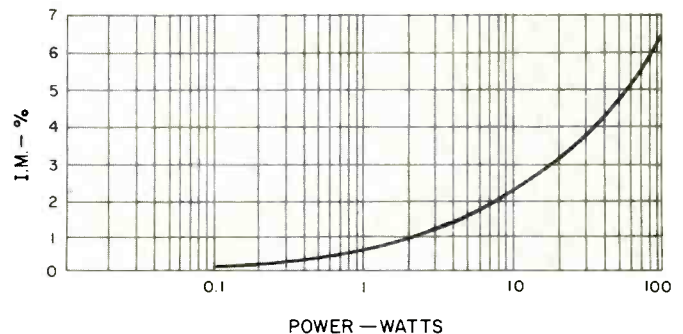


Fig. 11—Measured IM of A<sub>4</sub> or 440 Hz by E<sub>1</sub> or 41 Hz mixed one to one.

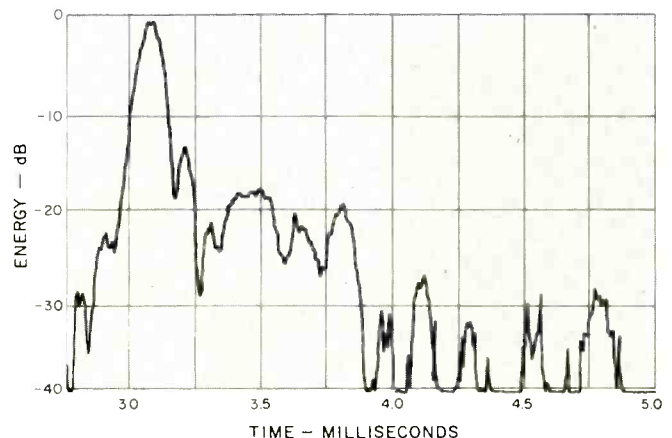


Fig. 12—Energy-time response one meter on axis.

and do so cleanly. You need a good 100 watts or so to make this material come alive, but watch out for dangerous overdrive on kick drum and bass if you have a high-power amplifier. The preamplifier's 6 dB of boost at 40 Hz can jam quite a bit of power into the system.

The low-frequency rolloff in the preamplifier does an excellent job of preventing subsonic signals from getting to the loudspeakers and causing problems, and even severe record warp does not cause sonic distress. No rumble filter is needed for this vented system.

I was not favorably impressed with the accuracy of stereo reproduction for classical music, primarily because of lateral instrumental spread. However, the Interface: A does a darn good job on other types of material, such as Jesse Colin Young's **Songbird** album on the Warner label, and I can recommend this system for rock and contemporary music.

*Richard C. Heyser*

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**Manufacturer's Comment:** We are very pleased to see the close agreement above 60 Hz between Dick Heyser's time-delay spectrometry curve of the Interface: A (Fig. 4) and the curve we ran ourselves of the same unit in our own 20,000 cu. ft. anechoic chamber. However, we are puzzled by the roll-off in response below 60 Hz and would like to make the following comments:

1. Although the Interface: A's low-frequency response in our chamber is  $\pm 1$  dB of that shown in Fig. 4, we consider this coincidental because our chamber is not accurate below 50 or 60 Hz, as it is too small.

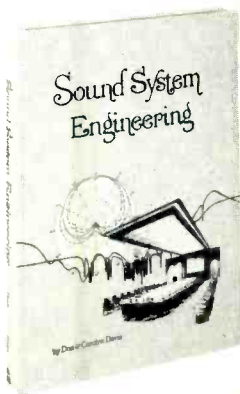
2. Therefore, we assess the low-frequency performance of our vented systems with R. H. Small's in-box microphone technique, which does not require a chamber. Admittedly, this technique indicates the total acoustic power output of

the system, rather than the free-field response at a single point in front of the transducer. However, when the frequency is low enough (for the Interface: A's size, about 150 Hz), speaker output is theoretically and by measurement omnidirectional. Therefore, the two different things being measured end up having the same curve shape.

3. Thus, we find, to our own satisfaction, that the Interface: A does, indeed, provide both anechoic (free field) and total acoustic power responses that are approximately 3 dB down at 32 Hz relative to the 60 to 150 Hz average level. These measurements have always seemed to be substantiated by subjective listening room reproduction of appropriate program material and sine waves as well as objectively by 1/3-octave random noise measurements made in many of the same rooms.

Puzzling also were Dick's comments about maximum power output ability at low frequencies. For us and others, one of the most interesting aspects of the Interface: A has been its combination of extended low-frequency response and rather high acceptably clean output levels. Even where the conversion efficiency is lowest, in the region of 32 Hz, two Interface: A speaker systems in fairly typical listening rooms routinely produce levels approaching 100 dB SPL with about 40 watts total input.

These low-frequency levels seem consistent with the maximum output abilities in the balance of the frequency range. Of course, there are a very few other systems available which do manage to combine the extended low-frequency response of the Interface: A with higher maximum acoustic power output (our own Sentry 3 with SEQ equalizer would be one example), but the systems we know of are both very large and very expensive. Thank you for letting us comment.—Electro-Voice



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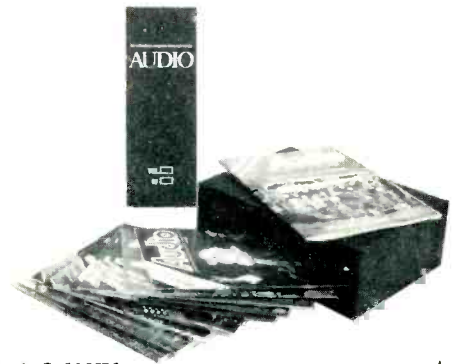
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# Canby's Capsules

## Edward Tatnall Canby

**Spaced-Out Bach II.** Joseph Payne, harpsichord. **RCA ARD1 1042**, CD-4 quadrasonic, \$7.98.

**John McCabe. The Chagall Windows 1974; Vars. on a Theme of K. A. Hartmann 1964.** Hallé Orch., Loughran. **EMI (HMV) EST 3096**, stereo/quadrasonic, \$6.98.

**Carley Simon—Hotcakes. Steven Michael Schwartz. David Gates—Never Let Her Go.** (Not for sale—demo only. Commercial releases are on Elektra.)

**Bruno Walter Conducts and Plays—Mozart: Piano Concerto in D minor K. 466; Eine kleine Nachtmusik K. 525; 3 German Dances, K. 605.** Vienna Philharmonic. (Dec. 1936, May 1937). **Vox Turnabout THS 65036**, mono, \$3.95.

**Mozart: Incidental Music to Thamos, King of Egypt, K. 336a (incl. Symphony in E Flat K. 184).** Soloists, Rundfunk-solistenvereinigung (chorus), Staatskapelle Berlin (orch.), Klee. **Philips 6500 840**, stereo, \$7.98.

**Grieg: Lyric Pieces (selection).** Emil Gilels, piano. **Deutsche Grammophon 2530 475**, stereo, \$7.98.

**The Tilberg Byzantine Choir.** Dir. Frater Frederico Van Dongen. **Philips 6830 194**, stereo, \$7.98.

**Bononcini: Divertimenti da Camera.** Hans-Martin Linde, recorder. (With continuo: gamba, lute, harps.). **Deutsche Grammophon Archiv 2533 167**, stereo, \$7.98.

Vol. II of a memorably entertaining series, musically sober and responsible in spite of the title—Bach for keyboard laid out into four discrete channels—presumably via overdub and tape edit, most ingeniously. Big items here are the *Tocatta & Fugue in D Minor*, huge as any organ, the solo-keyboard *Italian Concerto*, grown to concerto size, a group of Goldberg variations—we could use all of them, please. An excellent stunt and “plainly enjoyable” as the liner notes say.

The first of the (imported) single-inventory EMI discs to come my way—stereo and SQ quadrasonic. Technically it is uneventful—it plays a fine stereo and produces a conservative big all-around ambience in SQ. Why not? The music, conservative-contemporary, is vast, expertly complex, very well written for large orchestra and, I found, remarkably arid.

These three white-label CD-4 demos, not for sale, are too important not to be mentioned; they are cut with the new RCA Quadulator equipment and the Ortofon DSS-731 cutter head. No question, they are all that has been claimed, though pop is easier to cut than most classical, and length is no problem either. Impressively good—silent surfaces, clear sound, levels adequate to compete with stereo. When this processing goes commercial, CD-4 will have reached maturity, I'd say.

Now here is a model reissue, honestly and rightly documented—the only recording of Bruno Walter as pianist with orchestra, and long famed as such. Typical 1930s sound—you notice first the lack of space, the smallness; *what* we have since learned about liveness!! Some very worn sounds—the masters might well be worn, at that. Note that the piano sound is a lot better than the orch. Piano always did well on electric 78, as voice did on acoustic; orchestra is not so good.

Unusual Mozart in the later Beethoven-Schubert-Mendelssohn manner, an imposing set of vocal/instrumental pieces to go with a stage play. As always, this one was altered, expanded, even used for a diff. play; this is final version, including a little Symphony as overture, the music clearly anticipating the “Magic Flute,” echoing the church works, too, with splendid solos, big chorus numbers. A solid Berlin performance, excellent except a slightly wobbly soprano solo—the rest (4) are tops, as is the chorus.

A remarkable piano disc. Gilels, now approaching elder-statesman status, puts aside concert strenuities (like Rubinstein) for quietly mature musical exploration, a dedicated and first-rate penetration of Grieg's short pieces, written intermittently through 30 years or so. Wonderfully sensitive playing, chronologically, through a lifetime of musical output, 1867 to 1901. Required listening for all Romantic-minded pianists. *And* listeners!!

The strange and wonderful Eastern rite in its Russian musical phase, from Holland via expatriates; memorable, unique church music combining Eastern chant with Western harmonies of the Mozart period (Peter/Catharine the Great) and a late-19th c. Romantic expression of mysticism. Music by turn-of-the-century Russians including Tchaikovsky, Bortniansky, Arhangelsky, feelingly projected by these Dutch-based singers.

In spite of fancy title, these are typical Baroque sonatas of the Handel type—composed in England by a resident Italian. Rich, lovely stuff, somewhere between Handel and Telemann and as good, beautifully played and superbly recorded. Lively continuo (accpt.) uses both lute and harpsichord for variety, as well as the gamba.

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# Classical Reviews

Edward Tatnall Canby

**Prokofiev: Peter and the Wolf. Britten: Young Person's Guide to the Orchestra. Will Geer; English Chamber Orchestra, Somary. Vanguard VSD 71189, stereo, \$6.98.**

I collect *Peters*. It's fun. The very first recording of all, late 1930s on 78, was my introduction to this lovely little children's and adults' fantasy, very shortly after it was composed—the Boston Symphony did the great, big sound, with the silkiest of strings, and a very quavery-voiced gentleman by the name of William Hale spoke the texts from stage distance; it must have been a one-microphone job. You always quavered when narrating to children in those days. Sort of Santa Claus-like. Then there was Eleanor Roosevelt—grotesquely delightful! Betcha you haven't heard that one. Eleanor's voice tended to break when she got too enthusiastic, as you may have heard in the old rerun newsreels. From there on, every aspiring kids' man or woman had to have a try at it, including, if I remember, Arthur Godfrey. The one they missed that they shouldn't've was Mayor La Guardia of Noo Yowk. Too bad. He would have shrieked pure falsetto when the wolf came on.

So here we have Will Geer, an older who is the loveable grandpa in "The Waltons" and who has appeared in everything, including "Gunsmoke." At first he put me off. Traditionally, the beginning of *Peter* is done ad lib, explaining what each instrument stands for; Mr. Geer fumbled and bumbled this part, at least as I listened the first time. But his excellent underplaying, his admirable restraint, his mildly cowboy (movie style) voice and a slightly rusty sounding basso, add a new slant to the old story. Excellent engineering—for once, the orchestra is out front as it should be, the voice subservient but always intelligible. Rare thing among *Peters*! Too many engineers think of the piece as a story with musical background. It is exactly the opposite, and never was there a more inter-

estingly detailed performance than this one with Handelian (mostly until now) Johannes Somary conducting. Really splendid.

Britten's *Young People's Guide, Variations on a theme by Henry Purcell*, is such a fabulous orchestra showpiece, section by section through the orchestra, that it palls much more quickly than the loveable *Peter* music, which one can hear forever and never dislike. These two are now traditionally paired (though the Britten can be played without the voice explanations in an alternative version for orchestra alone) and one pleasingly British pair featured—by mixdown—Sir Adrian Boult conducting and reciting the text. Obviously not simultaneously. Here we have a pleasingly American version, vocally speaking, and it is a good companion to the excellent *Peter*.

**Prokofiev: Alexander Nevsky. Betty Allen; Mendelssohn Club of Phila., Philadelphia Orch., Ormany. RCA ARD1 1151, CD-4 quadraphonic, \$7.98.**

It seems likely that Prokofiev will end up as the most important film composer of our time in terms of wider musical value. True, plenty of the "big" composers have tried their hands extensively in the medium, from Shostakovitch to Virgil Thomson (we don't count the involuntaries, like Mozart in "Elvira" and R. Strauss in "2001"). But how many have written music strong enough to live on its own outside the film, recast into pure-music form?

I will not forget my first view of this great film, 'way back when it was new. Who could forget that battle on the ice? I was, maybe, just too busy keeping track of the fighting to notice the music in any positive way. That merely shows what a good job it was doing. The cantata for mezzo soprano, chorus and orchestra which Prokofiev made out of the film music is now a staple of the choral repertory, as witness this all-Phila-

delphia version (in mumbling Russian). Though it is not Prokofiev's best music, always a bit more outwardly dramatic than the content warrants (I am speaking of the cantata version minus the movie), it does convey a macabre excitement that reminds of Moussorgsky and the big scenes in *Boris*. Russian voices, alas, are really a prime requirement, those incredibly big, throaty, vibrant instruments with their extraordinary Russian diction, marvelous both as solos and in massed chorus. Philadelphia, I regret to say, sounds just a bit thinnish and not even RCA's massive CD4 can quite put enough beef into the large chorus with the Mendelssohnian name. Nothing wrong with the Philadelphia Orchestra. There's never anything wrong with that orchestra so long as it doesn't sound bored. It doesn't here.

Betty Allen, a good choice if you don't have a Russian around, is at least three-quarters pure Russian in her solos. Good job! She is immense, any way you look at her. Or listen.

**Beethoven: Symphony No. 5.** Vienna Philharmonic, Kleiber. **Deutsche Grammophon 2530 516**, stereo, \$7.98.

The "Fifth" was such a total fixture in the old Music Appreciation classes that for years I could not bear to hear it. Too much. Now, with so much else to listen to, the old war horse is mercifully diluted and, nice paradox, is able to come back into its glory again, brand new. Such is music history!

I liked this Kleiber version. So many are merely show-off, the conductor putting forth his stuff like a pianist playing the *Revolutionary Etude* (Chopin, and showy). Not so Kleiber, not so the faithful Viennese orchestra, direct descendent of the original in the very same city. The timing is classically strict and pure, no fancy work, the tempo is quite rapid but never rushed. Attention to important details is very good, and most of all, there is a dramatic sweep which is in considerable contrast to the old, bombastic "fate knocking at the door" approach. Here, the first movement is played straight and clean, the lovely variations of the second movement move freshly and quickly (much faster than I learned them and better for it), the scherzo is properly wispy—and the great C major finale bursts out amazingly strong, the focus of the whole per-

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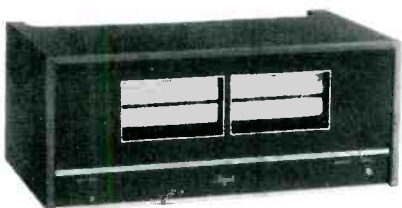
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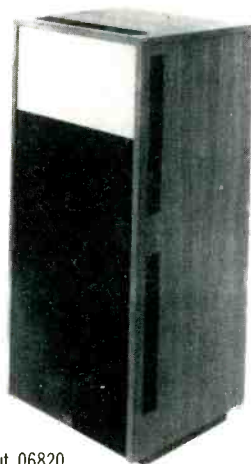
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formance. Even that incredibly repetitious ending, umph, umph, umpa umpa umpa bang, bang, wham, seems to keep its place in the whole and with dignity! A fine recording.

**Monteverdi:** *Vesperae Mariae Virginis, Magnificat I/II, Missa In Illo Tempore*. Vocal soloists, Regensburger Domspatzen, Instr. soloists/orch., Hanns-Martin Schneidt. **Archive 2710 017**, 3 discs, stereo, \$23.94.

This immense collection of sacred works, published together by Monteverdi in 1610 and a recent source of endless musicological battles, here seems to find its proper form and explanation—in a gorgeous book that accompanies the album. This is one of those new German miracles of performing organization, combining enormous research and planning, the use of nothing but authentic instruments of the period—and even the vocal sounds that are thought to be appropriate—with a generally lively and dedicated performance, full of interest for the listener.

Not that Monteverdi is easy—his music, if you have not heard it, is not like anything else. It's a combination of the showiness of Gabrieli, a near neighbor in Italy, the beginnings of Italian opera as applied to sacred music and, indeed, the solid beginnings of the whole Baroque age, here appearing for the first time. Monteverdi moved musical mountains; he was an earth force, a one-man revolution and an authoritatively great composer too. And everything he did was drama itself. If you can make sense of it.

But the idiom, so early-Baroque, is difficult. All sorts of weird hiccupy sounds in the voices, rows and rows of fast notes, ornaments, trills, such that a modern singer can barely encompass it all. But things are improving! In this recording there is rarely any forcing of effect; it all flows rightly and quite naturally, out of long study and practice. You could well be enchanted, if you like “old” music of the sort. Other hurdles, though, may slow you down. As of his time, Monteverdi writes in endless small segments, each in a different time, never lasting more than a few moments, with much repetition of short instrumental interludes. And there are sequences, then a new effect, repeated patterns of harmonies and melody, which can become redundant and tiresome after too much—though at that date they must have seemed

strikingly new and exciting. By the time of Bach, a century later, these fancy effects were used much more sparingly.

The early-on Psalms and vocal "concertos," for solo voices, are the best performed here. The famous *Sonata sopra Sancta Maria*, a lively and varied instrumental piece for colorful orchestra over which a boy choir sings again and again a prayer, *Sancta Maria*, seems to me a bit slack (there have been other more intense recordings, to better effect) and the little boys aren't really too sure of their entrances. They are tentative, where they should soar on wings of sonic glory or something. Minor crabbing on my part; the whole is too good to be hurt by outside comparisons in detail.

Curious facet. The voices are all male, according to the church dictum that in church women are silent. Only men sing. But (see photos on album) in the orchestra there are women! True, their voices are silent, if not their instruments. Would women have played in Monteverdi's church orchestra?

**Stokowski Conducts Brahms - Symphony No. 4; Academic Festival Overture.** New Philharmonia Orch. RCA ARD1 0719, CD-4 quadraphonic, \$6.98.

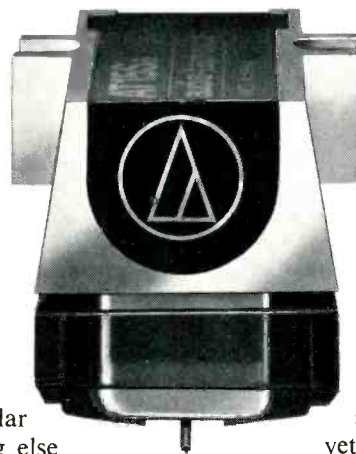
This quadraphonic recording with the New Philharmonia has a less brilliant and lively sound than that of its companions done with the London Symphony—probably a different recording hall—but even so, what a splendid and unique musical job! So intense that the players can barely keep up, there is, indeed, quite a bit of raggedness here and there—no matter. This is Brahms as he hasn't been heard for decades. It sounds new, it sounds modern, it is for real.

Stokowski, whose near-endless conducting career began back only 13 years after Brahms died in 1897, has that completely contemporary and natural understanding of the music which can only come from living in that music's own high time—and, of course, from being a greater interpreter, too. You will find this Brahms Fourth very fast and, as I say, extraordinarily intense if you are accustomed to our note-perfect but slightly soggy and tired latter-day versions, Brahms being now rather out of date, all in all. It is a fact, in any case, that most younger performers take their Romantic music more slowly than did the performers of the early 20th cen-

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ture, Stokowski included. (What went on before we don't really know, there being no accurate recordings.)

Moreover, the newcomers often don't really understand the shape and dramatic emphasis of this older music, the newness of it in its own time, no matter how outwardly passionate they may make it sound. But here we have it really *right*, the right emphases in the right places, the right ritards and dwellings-upon, the right climaxes and, so to speak, musical detentes. Surely right out of Brahms himself, the living aural tradition preserved via the ancient Stokowski in his nineties.

Such a powerful, driving, exultant Fourth! Just superb, and especially the rollicking, potently brassed third movement and the fourth-movement chaconne, a startling innovation in its day. Everything is as it used to be—lithe, youthful, triumphant, utterly modern. And the Academic Festival Overture, which usually sounds, er, academic and a bit stodgy, is even better—you can almost hear the cheers bursting out after the tremendous blast of the last chord. A very great recording and document, once again, from the old man, even if it may be imperfect in detail.

**Glière: Symphony No. 3 Ilya Murometz.** The Large Symphony Orchestra, Moscow Radio and Television, Nathan Rakhlin. **Columbia Melodiya MG 33832** 2 discs, stereo, \$13.96.

Back in the early days of FM broadcasting, *Ilya Murometz* was a prime favorite among classical broadcasters. Partly, of course, because, though composed in the 20th century, it is a riproaring old-fashioned Russo-Romantic work of the sort that turns a fair maiden's heart, especially in a radio station. (I knew such a one!) But also because it is so lo-ong, and fills up a huge hunk of program time with minimum effort. I haven't heard it since, until now, though there are recordings (on one disc) by Stokowski and Ormandy.

Columbia has put the monster onto two discs, and there are some very short playing times as a result—but at least the movements are intact and the music uncompressed. Probably a good idea, all in all. Especially since a nicely named "Large Orchestra" plays its Glière with enormous pomp and circumstance and at a portentous snail's pace—the introduction was so long I

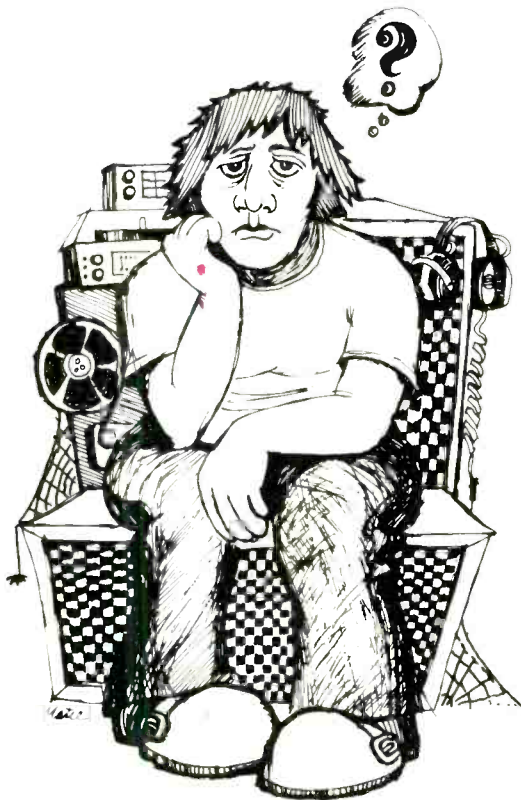
thought something was wrong. No more need be said except that Glière surely knew how to write for the Romantic big orchestra even if his ideas sound bigger, and take longer, than they are worth. You'll love it. Or you will die of boredom.

Glière, by the way, died in 1956—he would be 100 this very year. He has to be rated as one of the Big Soviet Composers, along with Shostakovich, Prokofiev and other worthies.



**Beethoven: Missa Solemnis.** Price, Ludwig, Ochman, Talvela; Concert Chorus Vienna State Opera, Vienna Philharmonic, Bohm. **Deutsche Grammophon 2707 080**, 2 discs, stereo, \$15.96.

It isn't the sterling performance—it's the music. Almost impossible to perform, even today, some 150 years later. This is late



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Beethoven, exalted, fanatic, super-human, one of history's towering works, etc. It just towers too high for mortal singers; it is the last movement of the Ninth Symphony stretched out for hours. Frankly, I have never been able to get through it. The shrieking soloists, the painfully high (and ineffective) choral parts, just jar one's sensitivities, and no matter that Beethoven, being stone deaf and almost totally removed from life around him, could have had no reason to hold back the urgings of genius in favor of human practicality! It is a great work, un-



realized except as you somehow are able to imagine how it *might* sound—if.

Beethoven was always OK with the orchestra, which he knew so intimately that no deafness could blur his knowledge of how instruments speak. But he had very little understanding of voices, except in his few songs and the one big opera; once beyond those areas, he went hog-wild and wrote for some sort of angelic host, audible to him alone. If you have ever tried to sing this *Missa* (Mass), either as soloist or as chorus, you will have to agree with me. It makes very difficult listening, simply because it is so obviously difficult to produce with the human array of vocal-chord power.

This is again, a sterling aggregation of performers, in the rich and somewhat heavy Viennese tradition, and if you want a *Missa*, you won't find any that are better—just some that are maybe louder and faster and leaner. That may, or may not, be your dish of Beethoven tea and iron filings. 

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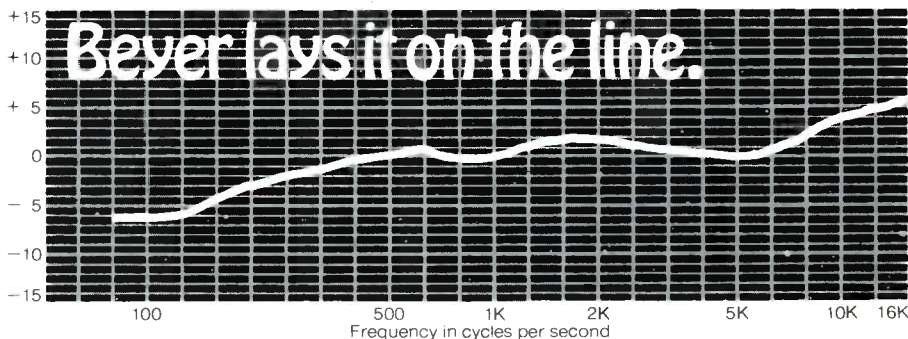
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# The Column



**The Hissing of Summer Laws:** Joni Mitchell

Asylum 7E-1051, stereo, \$6.98.

**Prisoner in Disguise:** Linda Ronstadt

Asylum 7E-1045, stereo, \$6.98.

If we are to believe what we read in the newspapers, then the next musical trend will most surely be the rise of the female popstar. I don't. I like women as much as the next guy (maybe more than most), but I find it difficult to conceive of women coming into their own in rock 'n' roll, given that it is a musical form whose energies are derived primarily from sexual sources.

Unfortunately, most pop/rock women are still hung up in trying to prove something about their own

abilities to be able to immerse themselves in the anti-selfconscious ethic which rock is grounded in. There are few exceptions—The Ronnettes were uninhibited musical innovators, as were the Crystals and a new band out of Los Angeles called The Runaways (five 16- and 17-year-old girls whose main roots are in British rock)—but most rock women are too condescending toward non-intellectual music to come up with something gutsy.

Asylum Records has their share of female popstars. Both Linda Ronstadt and Joni Mitchell sell a lot of records and are fairly well respected. But both fall very short of the mark which separates the rock singer from the rock

artist, although Joni seems to be getting closer. Her latest, *The Hissing of Summer Laws*, indicates a mild amount of artistic growth, but there is more development lyrically than musically. There's a moment or two when Joni actually explores new territory—"The Jungle Line" is probably the best example of this, a neat song and interestingly orchestrated—but most of the time she's covering the same turf, musically speaking. She develops as a lyricist, but such is not the mark of a great musical artist. And her singing is the same as ever—you like it or you don't. I do, but not for extended periods of time.

Linda has always gotten by on (a) her country leanings and (b) her

looks, not necessarily in that order, but she only achieved hits under her own name when she stooped to incorporate r&b music into her repertoire. I say "stooped" because this is the easy way to sell out; she finally gave up trying to make it on the basis of her favorite music and started playing the dance music that seems to go over well in 1976, and with her voice it seemed a natural hit (it was). So she sells a few records. So what.

So what indeed. Her new album is even more vacuous than the last—she sings without the looseness of her last recordings, and sounds like she's reading the words off a lyric sheet. She might as well be—Linda doesn't write any of her own material, so she's forced to rely upon her Asylum/Warners clique to come up with suitable songs (Neil Young, James Taylor, Lowell George, J.D. Souther) which are mostly their rejects. Or she covers Motown faves (all inferior to the originals, not to mention lifeless), a reggae standard (*Many Rivers to Cross*—not very good, especially when the Nilsson/Lennon version is the definitive one), and a few country songs on which Ms. Ronstadt finally sounds at home. Even the guitar of Andrew Gold can't save this album from sounding like it was recorded at a morgue.

So until women rockers start sounding like they've got some energy, some viscera, and some identity other than what's expected, I'm going to pass. I'm waiting for the Runaways (who sound like The Sweet and look like teenage rock femme fatales should look) myself—just as I passed on Bobby Vinton and waited for The Who to come along. *Jon Tiven*

Sound: B- Performance: C

**The Hissing of Summer Lawns:** Joni Mitchell  
Asylum 7E-1051, stereo, \$6.98.

It's tempting and intimidating to try to dissect **The Hissing of Summer Lawns**. In her notes Joni Mitchell calls it "a total work conceived graphically, musically, lyrically, and accidentally—as a whole." The gauntlet is thrown at reviewers everywhere.

Her previous studio album, **Court and Spark**, had been a milestone, a commercial as well as an artistic breakthrough. With that album's sophistication of melody and jazzy fingerpoppin' playing, she had left the simplicity of her "folkie" days far be-

hind. It was the lyric themes that made **Court and Spark** a dead end. The blatantly autobiographical musings, soarings, and pityings were basically the same ones she had explored from the beginning, finally made as pretty and seductive as they were ever likely to be.

The **Hissing** album deftly sidesteps the predicament, bursting into completely unexpected areas. *In France They Kiss on Main Street* is a deceptive opening gambit. Musically very much like **Court and Spark's** *Free Man in Paris*, it is a flashing neon slice of disco and pinball society, and a slinky, soothing number. By comparison *The Jungle Line* which follows is a slap in the face with cold water. It opens sharply with the **Warrior Drums of Burundi** (taken from the Nonesuch Explorer album H-72057) which is the tune's rhythm track. The drums blend with acoustic guitar rhythm and surprising Moog accents as the song overlays imagery from Henri Rousseau jungle scenes on top of the Manhattan skyline. It is at once challenging and exhilarating. After *Jungle Line* it is almost dangerous to listen lightly.

*Edith and the Kingpin* and *Don't Interrupt the Sorrow* glide by, seeming almost effortless. Actually they just sound so good that it is easy to push the lyrics' meanings to the back of the mind. Yet the words hold up when they finally receive full attention. The encounter of Edith, the available dancer, and the powerful gangster-type Kingpin are carefully chosen cinematic stills, conveying the whole story. *Don't Interrupt the Sorrow* and *Shades of Scarlet Conquering* end side 1 with two portraits of mounting desperation, one of a decaying marriage, one of a strong and willful single woman, "cast iron and frail."

Suburban misery set against inner city life again dominates the second side. The title piece and the *Harry's House/Centerpiece* medley form a scathing indictment of the golden illusion of affluence and commuter marital bliss. The wife in *Hissing* opts to maintain the creature comforts despite barren spirit. *Harry's House* depicts the sharp "rising executive" picking up a classy gift for the wife amidst the lights of Manhattan, drifting off to memories of his younger wife some summer ago, and muses the old Jon Hendricks jazz song *Centerpiece*, a corny old thing about how "our happiness will never cease." *Centerpiece* dissolves with a collage of wifely sniping, climaxed with "Nothing's any good—When you gonna be home, Harry?—Nothing's

any good" into a return of the *Harry's House* theme implying the final breakdown of the whole relationship.

Between *Hissing* and *Harry* is *The Boho Dance*. It's about the old, scuffling coffeehouse days "when I was working cheap." She encounters an old compatriot who never really graduated to her own glamour scene and who chides her for the sham of it. The song's final words are perhaps Joni's most personal on the album:

"Nothing is capsulized in me  
On either side of town

The streets were never really mine  
Not mine, these glamour gowns."

The finale *Shadows and Light* is another departure from the predictable. It is an overdub tour-de-force of layered voices and Arp-Farfisa.

As the album's last word, it resolves none of its themes, instead summing the many dualities into a more abstract thought, "threatened by all things/man of cruelty . . . drawn to all things/man of delight."

For Joni Mitchell **The Hissing of Summer Lawns** is a triumph on all levels. The music works on the superficial level of muzak, in that it sounds great paying no attention to the words at all, yet when scrutiny is applied, it takes on depth and subtlety. Her writing seems turned outward as if she's not writing primarily of herself for herself, but about other things. Her growth in the face of challenge is astounding. With **Hissing** Joni Mitchell shows most importantly the confidence to take serious artistic risks, and her artistry in pulling it all off.

*Michael Tearson*

Sound: A Performance: A+

**Ommadawn:** Mike Oldfield  
Virgin PZ 33913, stereo, \$6.98.



The man who brought *Tubular Bells* to us is back again, and although it is unlikely that he will be the musical phenomenon that the sales on his first

album seemed to indicate, his third long playing disc is certainly of a similar level of quality. He hasn't the benefit of *Ommadawn* being used as the soundtrack of a film (yet) to help get the music across to the most people possible, he has never played a concert in America and has only done a very limited series of concerts in England, and Michael doesn't keep a particularly high profile in the music papers except when his album comes out, so it is too much to expect this album to sell well. Unless somebody figures out a way to sell *Ommadawn* as a test record or figures out a proper campaign to link Mike Oldfield with a psychedelic scene (a la Pink Floyd), I'm afraid Oldfield will have to suffer the same fate as other obscure artists, with the compounding albatross of having a first album which sold astoundingly well which he has to "live up to."

Of course, this is a ridiculous situation. Musically speaking, there wasn't much of a gap between *Tubular Bells* and *Hergest Ridge*, and *Ommadawn* is yet another extension of the Oldfield style of composition. The fellow seems to be vying for the throne of King of Overdub, and he certainly deserves the title—but what is it worth? If he was any kind of smart cookie, he'd join some needy rock 'n' roll band (he's done it in the past with Kevin Ayers' Whole World) and get in front of audiences—maybe even do a guest spot singing "The Horse Song"—and finally become famous. He's too talented a musical person to allow himself to rot in musical seclusion, and I'd imagine it'd be annoying to spend so much time and effort to make a record like this only to be remembered for writing the theme song for *The Exorcist*. *Jon Tiven*

Sound: A                      Performance: B+

**Euphrates River:** The Main Ingredient **RCA APDI-0335**, CD-4 quadraphonic, \$6.98.

Musically, it's as if some ill-conceived machine came over our ears and processed the heavy cream of the O'Jays, Isley Bros. and MFSB and made it into some thick skimmed milk, 99% fat-free, artificial product. If the name of this aggregation means anything at all, it points up precisely what their music is devoid of. The main ingredient of the music they are attempting is soul, but their performance here is a gutless wonder. It's pale, plastic, derivative froth! Nev-

ertheless, its very lack of emotional substance makes it palatable. The clocklike performance is overly professional, anemic but not antiseptic. If it's exuberance you want, any polka album would top this. Everybody should be embarrassed by the way this copy band rips off the sinews of soul. If The Main Ingredient would pick on material that they could handle, their gloss plastic sound could be acceptable. Only as soft background Muzak does **Euphrates River**

make it, simply because its oozing factory-made sound is devoid of clarity, dynamics and other interest-giving content.

The CD-4 recording is good enough to encourage you to look for musical substance. That something, the main ingredient, is just not there. Not in four, nor two, nor one-channel. No-channel music served up in good four-channel trappings. *Fred De Van*

Sound: B                      Performance: C

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**Initiation:** Todd Rundgren  
**Bearsville BR 6957**, stereo, \$6.98.  
**Behind The Eyes:** Tim Moore  
**Asylum TE-1042**, stereo, \$6.98.

Two of Philadelphia's native sons are attracting a lot of attention with new albums of Rock 'n Roll, with differing perceptions of what music is about. Both lads got their basic training with an outfit called Woody's Truck Stop and each went his own way toward stardom. While Tim formed a band with Darryl Hall (Gulliver), Todd was racing through the charts with a power-pop quartet called The Nazz. Each ended up as a solo artist, although that's where the comparisons end, for the Todd Rundgren definition of a solo artist differs dramatically from Mr. Moore's. Tim Moore is the more conventional of the two. He writes exceptional pop tunes which, more often than not, sound like hit singles and bear a strong resemblance to Elton John (on the quieter numbers) or Paul McCartney (when he rocks out). *Rock 'n' Roll Lover Letter* could easily pass for the next Wings single in terms of both style and quality. Moore's melodic sense, his voice, and even his guitar playing here remind one of *Junior's Farm* and *Jet*. The producers, Paul Leka and Nick Jameson, seem to share Tim's affinity for the McCartney sound even down to the way the drums are recorded. *Lay Down A Line On Me*, on the other hand, could be an outtake from the first Elton album. How intentional this is I don't know, but it doesn't detract from the album's listenability. It's a very strong album with a minimum of waste material.

Tim Moore's future looks good; this is his first *real* album, as all his other recorded efforts were poorly produced and/or inferior content-wise. With any luck, he'll have a good shot at becoming a superstar. Todd, on the other hand, has been an active solo artist during the past half-decade, building a sizeable following and taking his music in new directions. He's not only an unusual recording artist but an unorthodox human being, and thus his recorded record is a bit erratic—he'll put out an album which is not brilliant for its songs so much as for its *sound*, being a man of style as well as a man of breadth. In this album, Todd reaches out toward the largest audience possible. Although there are lots of quadraphonic records out today, there are very few schizophrenic albums on the market. **Initiation** is one of them—two sides of musics almost totally dissimilar from one another.

Many of Todd's fans are displeased with his forays into electronic music

and prefer his beautiful songs like the ones on **Something/Anything** (not that far from what Tim Moore is doing nowadays). I'm a great fan of that particular period of T.R. music. But side two of **Initiation** is better than most of his lyricless attempts of the past, and though it gets a bit tedious in places, I find it most pleasing.

The first side of the album, except for the useless *Born to Synthesize* is extremely listenable, enjoyable, and interesting. His guitar playing has rarely been better (I'd suspect that he's gotten a chance to toughen up his chops while on the road with his band *Utopia*), his production is wondrous as usual, and his songs have rarely been as varied and as uniformly well-crafted. *The Death of Rock 'n' Roll* is his finest metal creation in a long time, *Real Man* should've been a hit for it's the best disco tune yet, and even something as superficially silly as *Eastern Intrigue* comes off well. The general feel of the music on side one is what Todd was moving toward on his first psychedelic album, *Wizard, A True Star*—a collection of songs which make up one unit, rather than separate entities. It not only works out on paper, it proves itself viable on vinyl. Todd should be applauded for delivering not only quality, but quantity as well—there are over 68 minutes of music on this album, and in these days of tight economics it's nice to find a creative artist who can understand the concept of value-for-money.

Some may complain that Todd's music in the days of his "teenage innocence" was superior, but that's simply denying Todd his right to grow up. Rundgren is not only a recording artist but a human being as well, and those who listen to his music must be willing to accept Todd for what he is, not demand he stay what he was. **Initiation** is his best album in many a year, and deserves many listenings to be fully appreciated and judged, not as a collection of tracks but as a single entity, split in two parts. *Jon Tiven*

### Behind the Eyes

Sound: B+ Performance: A

### Initiation

Sound: B (too soft) Performance: A

**The Rock:** The Frankie Miller Band  
**Chrysalis CHR 1088**, stereo, \$6.98.

There is underproduction, there is overproduction, but rarely have I heard an album with such a blatant case of *mis-production*. You can't tell that this album was made by a band. You can't tell that this album features possibly the greatest undiscovered lead singer since Paul Rodgers (of Bad Company). You can't even tell that

Frankie Miller is a talented songwriter, because you can barely hear anything on this album except what some people call "teabag." A teabag is a foreigner who takes something American out of its musical context and regurgitates it through his own records, and that is what producer Elliot Mazer has done with U.K. resident Frankie Miller. This album might even have been tolerable if they'd left out the Memphis Horns and the Edwin Hawkins Singers, but this Limey has become so Americanized he smells of hot dogs and cheeseburgers.

Just look at the cover pictures and you'll see no glam, glitter, English class, or other Anglicisms here. You see five lobsterbacks wearing American clothes—cowboy shirts, dungarees, and vests. You'd think it was the Eagles.

The music is boring, uneventful, and a tremendous disappointment for me, because I think Frankie Miller is one amazing talent (so does Jeff Beck, I might add). He's made two albums, one an amazing disc recorded with fellow R&B Limeys and one atrociously dull, although produced by a great American producer (Allan Toussaint). Send this guy back to his home country, let him record with a producer who at least understands where he's at, and *then* unleash him upon the American market. Not before.

Jon Tiven

Sound: D Performance: C -

**The Who by Numbers:** The Who  
RCA-2161, stereo, \$6.98.

**Extra Texture:** George Harrison  
Apple SW-3420, stereo, \$6.98.

These two albums are guaranteed to make any diehard fan of Sixties rock cringe. Together, they're almost enough to make me ashamed that I consider 1967 a golden year for music, and make me wonder if what I heard then was that stupendous.

Well, this writer brought out his Beatles albums and his old Who albums, and yes, they were that good. How any groups that powerful could father two albums this bland, impotent, boring and downright bad is almost a mystery. But then the Seventies seem to have spawned a new rock consciousness which thrives on an energy entirely contradictory to the nature of rock: *conformity* and *complacency*; and this mood seems to have infected even the giants of the previous decade.

Both albums suffer from mediocrity and old age to the Nth degree. At one time, George Harrison was seen as a very interesting guitar player for a

musically inventive aggregate, and even his first few solo albums did not reveal his musical weaknesses. But as soon as his efforts got further and further from the fretboard and closer to the cosmic plane, George's lack of command in the musical world became more evident. This album presents one of the weakest voices in the history of the vinyl disc, sailing on top of some backing tracks which are well-recorded, occasionally interesting, but mostly ignorable. No one but an ex-Beatle could get away with

putting out an album like this and have people actually take it seriously, not to mention buy it.

As for The Who, the best thing about their records nowadays is anything but the songs. Like its two predecessors, **The Who by Numbers** sports a neat cover, but Townsend's songwriting abilities seem to be permanently on vacation. Although I like **Quadrophenia** in a way, The Who seem to be plunging further and further into a land removed from music and appear more interested in the



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philosophical questions which plague rock 'n' roll stars who are rapidly approaching the age of mistrust. There is a lot of bitterness, much in the way of lost remembrances, and little in the way of Who music on this record. I do not question The Who's actual talent and abilities, but they appear to be confused and lost. The guitar playing is nice, the singing unrestrained, the bass work faultless, and the drums of Keith Moon as fine as always; it is the spirit which is lacking. Townshend's lyrics are wallowing in basic questions, and the general feeling is that The Who are just cutting a disc because they feel they have to; they'd be letting down their fans if they didn't put out one record a year. As far as this writer is concerned, The Who is over; Daltrey can live out his film fantasies, Entwistle can join Andy Fraser as a member of the "What can a brilliant bassist do except be frustrated?" club, Townshend can worry a lot, and Keith Moon can make foolish solo albums until he gets bored and/or spends the last of his bucks. Because as young as **On Tour/Magic Bus** and **Sell Out** made me feel, **The Who by Numbers** doesn't make me feel much of anything but sympathy for a bunch of geezers who seem to be caught in a time warp shouting, "Well, I know how I got here—but how do we get out?" *Jon Tiven*

**Extra Texture**

Sound: B Performance: D+

**The Who by Numbers**

Sound: B+ Performance: F

**Is It Something I Said?:** Richard Pryor  
Warner Bros. MS 2227, stereo, \$6.98.

If you hear this album and find it offensive, outrageous, gross, unbelievable, and otherwise distasteful, you are perfectly normal. You probably will have to fight with your own tastes and the social conditioning that helped form them. The reason why you will listen is that your imagination will take over for your will. This record is the funniest thing I have heard in a long time. Pryor is so disgustingly funny that this record almost out-strips his madcap stage performance. His delivery is totally ethnic. His references are those of a portion of the Black community. His concepts are of a reality that only exists in his own head. But his messages are universal and universally funny. As long as you are familiar with American basic social elements and colloquial English, you will find Richard Pryor the funniest man alive! It must be something he said. *Fred DeVan*

Sound: A Performance: A

# Jazz & Blues



**Saxophone Colossus and More:** Sonny Rollins.

**Musicians:** Rollins, tenor sax; Clifford Brown, trumpet; Kenny Dorham, trumpet; Tommy Flanagan, piano; Wade Legge, piano; George Morrow, bass; Richie Powell, piano; Max Roach, drums; Doug Watkins, bass.

**Songs:** *Moritat, Blue Seven, Strobe Rode, St. Thomas, You Don't Know What Love Is, Kids Know, The House I Live In, I've Grown Accustomed to Her Face, Star Eyes, I Feel A Song Comin On, Pent-Up House, Kiss and Run.*

**Prestige 24050, \$7.98.**

"**Saxophone Colossus**, the album that made the jazz public . . . aware of the majestic talents of Sonny Rollins, is combined here with seven other

great performances from the same highly-creative period in the long career of this major artist." It would be hard to find a more succinct, definitive statement about this specially-priced twofer (two-record) reissue than this statement from the cover of the album.

These tracks were recorded in 1956, before the first of Sonny Rollins' "sabbaticals" (when he dropped out of sight to study philosophy and music theory). He was "discovered" again, habitually practicing out in the open, atop the Williamsburg bridge.

Rollins' affinity for working over standard tunes (like most great jazzmen) is well-known. But this album contains none of the popular standards jazz musicians most often select

for this treatment; *The House I Live In* is the nearest such here. There's also *I've Found a New Baby*, an up-tempo cooker first released on contemporary 7564 **Rollins and the Contemporary Leaders**. This is an excellent recording, showcasing his fine intonation and full sound, capturing one of his classic thematic essays.

Because he is a great creator, it doesn't seem unusual for Rollins to have composed tunes which have themselves become standards. Best known of these is the poplar *St. Thomas* (also included). This is so clearly a masterpiece that it's easy to see why other tenor players held off recording it for so long after the master did it, despite its attraction to all who heard it. It is obviously among

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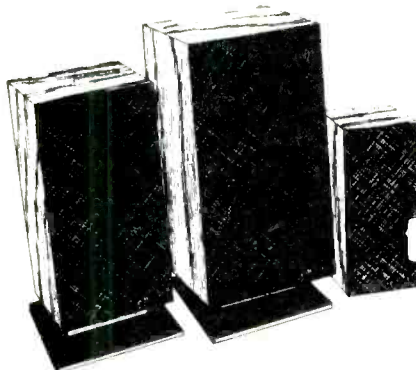


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the jewel-pieces for tenor, along with Coltrane's *Giant Steps*.

*Moritat* is the alternate title for Kurt Weill's *Mack the Knife*, which Sonny rips and tears right through, while the ballad *You Don't Know What Love Is* shows another side of his musical power. Although he doesn't do it here, one of Rollins' trademarks is to tag a ballad with a long cadenza full of dynamic quotes and explorations from standards and his own compositions. He did this on *Mc Dowell's To a Wild Rose* (**The Cutting Edge**, Milestone 9059) and on Hoagy Carmichael's *Skylark* (**Next Album**, Milestone 9042), and he often uses these cadenzas in long, rambling explorations as an entracte in his club dates while he decides what tune to do next—walking around on stage, often wandering through the audience while blowing alone. In this exercise, too demanding for any musician less rhythmically and melodically fluent, he'll suddenly come on a familiar tune while rummaging around; like magic the rhythm section, on stage, is cued in, even though he may be many yards away from them.

Side four features the late great trumpeter Clifford Brown with Sonny on three up-tempo numbers. Both were inspired by *Kiss and Run*, each giving it some greater-than-now, from up-above musical-kiss, running the changes with indescribable fleetness, and before you can say *Oleo*, it's over. Pianist Richie Powell (giant Bud's brother) takes several swinging choruses on Sonny's own *Pent-Up House*.

Tommy Flanagan, the pianist on sides one and two, is in top shape, especially on *Kids Know* and *St. Thomas*. Flanagan, like Hank Jones and Barry Harris, is one of those Detroit keyboardmen possessing a light, immediately-distinguishable touch. Currently Ella Fitzgerald's pianist and musical director, Tommy is unique in having been part of the insiring spring board for the two most important (linear) tenor statements of the past 20 years—with Coltrane on *Giant Steps* (Atlantic S-1311) and here with Rollins, on *St. Thomas* (Coleman Hawkins, the "father" of the tenor, often named Flanagan, along with Barry Harris and Hank Jones, his favorite piano accompanists).

Max Roach, under whose name most of these cuts were initially issued, was the leader of the historic quintet which was destroyed in a few terrible minutes on the Pennsylvania Turnpike when both Powell and Brown were killed. Roach, master time-keeper that he is, is always in-

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identifiable by his story-telling phrasing. Max's tales are always musically consistent, regardless of whether he's backing others or soloing himself. His big ideas and phrases always have the choicest little connecting words to make things flow smoothly. His solo on *St. Thomas* is a classic melding of calypso and jazz rhythms.

Compared to these sessions of nearly 20 years ago, Rollins more recent recordings (**Sonny Rollins Next**, Milestone 9042 excepted) fail to show what this master can do when he's at his best.

**Saxophone Colossus and More** is old wine in a new bottle. Wine ages, often improving with time, even as these recordings. P.S. to Milestone/Prestige: How about getting Dexter Gordon, that other giant of the tenor (one of the two surviving, along with Rollins), into the studio with Sonny and a rhythm section. Ought to be easy, since you have them both signed. How about it, Orrin Keepnews?

Sound: B

Performance: A

**New Agenda:** Elvin Jones

**Musicians:** Elvin Jones, drums; Steve Grossman, reeds; Roland Prince, guitar; Dave Williams, bass; plus the following musicians on certain cuts: Joe Farrell, reeds; Frank Foster, reeds; Azar Lawrence, reeds; Kenny Barron, piano; Gene Perla, piano; Candido, percussion; Guillermo Franco, percussion; Frank Ippolito, percussion.

**Songs:** *Someone's Rocking My Jazzboat*, *Naima*, *Haraseh*, *Anti-Calypso*, *Stefanie*, *My Lover*, *Agenda*.

**Vanguard** 79362, stereo, \$6.98.

If Elvin Jones had been a classical composer he probably would have been named Charles Ives (who by the way was also a drummer). Can you imagine a drum battle between two masters of rhythm, whose thinking shows time moving along in simultaneous multiple layers of various and varying meters? So much for a percussionist's dream. Elvin is just a powerhouse of polyrhythm who beats his sticks into musical plowshares on **New Agenda**.

**New Agenda**, Jones' first LP for Vanguard, is meant to be the first step on a "long new journey for both Elvin and the art of recording jazz drumming." While the caliber of Elvin's performance certainly renders true the former statement, there isn't anything revolutionary insofar as the audio goes. It is an excellent recording, good separation, crisp highs, warm,

distinguishable lows...but, don't expect a new 10 channel disc, in the shape of a globe or a cube, as the cover statement may imply in its extreme. Producer Ed Bland is probably just referring to some technical experiments in the recording or mix.

Jones uses his current group on this recording. Unlike other drummer-leaders, Elvin has always surrounded himself with extra percussionists. He is well aware that his approach achieves

an even greater sound with the added array of hands, sticks, beaters, etc. The added reeds on various cuts make this release similar to **Mr. Jones** (Blue Note BN-LA-110F) and **Merry Go Round** (Blue Note BN 84414), which I consider Elvin's best recent release (1972) in terms of audio reproduction and primarily music.

*Anti-Calypso* is anything but an anti-calypso. In fact, Elvin puts more calypso into this rollicking, frolicking



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Carribbean fantasy with his colorful cymbal work than you'll ever hear on the islands. Listen to him achieve a big fat Latin sound by using his cymbals in tandem with his other stick playing the tom-toms and across the rim of the snare drum. His Latin drumming, as such, is a trademark. It's probably been borrowed since as early as 1960 when Elvin recorded *Buzz-At*, a composition by brother Thad on **Elvin** (his first LP, currently available as a reissue in the Milestone Two-fer, **The Big Beat**, Milestone 47016), on which he trades some Latin four superimposed over a swing feel with Frank Foster and Frank Wess.

Elvin is notorious for having groups without a piano or a guitar player, in favor of two saxes and percussion. Ed Bland's *Stefanie*, however, features some nice guitarwork by Prince as well as Gene Perla, Jones' former bassist, on piano. *Naima* is a magnificent tribute to John Coltrane, with whom Elvin came into his own in the early Sixties.

May I recommend Elvin Jones—**Live at The Village Vanguard** (Enja 2036) as a performance you won't want to miss either. George Coleman, who is outrageous, is featured in a set that takes you to Elvin's home stomping grounds in NYC. No matter who the sax player Elvin chooses for inclusion, Elvin's group sound always surfaces. This is still the case on **New Agenda** despite augmented instrumentation. This is an album where the coming together of old friends produces new ideas. The sounds of this release are a must addenda for your record agenda.

*Eric Henry*

Sound: B+ Performance: A-

### **Ella Sings, Chick Webb Swings:** Chick Webb & His Orchestra **Olympic 7119**, mono, \$4.98.

Sixteen-year-old Ella Fitzgerald was an immediate success when she joined the Webb band in 1935 as a reward for winning one of the weekly Savoy Ballroom amateur contests. Gradually her vocals assumed more and more prominence, and the little girl (who was eventually legally adopted by Webb and his wife) became the band's big attraction. Her 1938 smash, *A-Tisket A-Tasket*, led to a record-breaking, back-breaking tour which contributed directly to the frail, hunch-backed, drummer-leader's death in June, 1939.

**Ella Sings, Chick Webb Swings** consists of off-the-air AM broadcast recordings (the main late-night radio fare of the later 30s was remote pick-

ups from dance bands on location) made several months after Webb's death, when the band was under Ella's nominal leadership (Ted McRae and Eddie Barefield were the real musical directors). In these performances the power and driving intensity that characterized the Webb band under the great drummer are still evident. You can hear Ella shouting encouragement to the musicians in dynamic renditions of *Diga Diga Doo*, *Traffic Jam*, *Swing Out*, *Tain't What You Do*, and *Limehouse Blues*.

Sonically this collection is dismal. It's obviously not a direct transfer from the off-air acetate recording discs but a dubbing perhaps two or three times removed from that. Even so, it recaptures exciting moments from one of the Swing Era's finest bands.

*John Lissner*

Sound: C- Performance: A

### **Flying Start:** The Blackbyrds **Fantasy F-9472**, stereo, \$6.98.

The Blackbyrds is a group formed from the music lab that jazz trumpeter and musicologist Don Byrd conducted at Howard University, and they cut their performance teeth as his backup band. The group has already had a Rock & Roll hit on their first solo record with a tune called *Do It Fluid*. The five-man unit—Allan Barnes, flute and saxophones; Kevin Tooney, keyboards; Keith Killgo, drums; Joe Hall, bass; and Perk Jacobs, percussion—is undoubtedly one of the tightest, most innovative bands around even though they are still all students enrolled full-time at Howard.

The tightness of the rhythm, achieved through tireless practice, is like a fingerprint of the band. The musicians convey excitement and enjoyment in every note that they play, and the vocals get the attention they deserve. As a result the band is on its way to another hit single with *Walkin' in Rhythm* from this album. And Allan Barnes' *April Showers* is a finite merger of lyric and Jazz Rock that should not be missed. Hall and Killgo really show off on *Spaced Out*. Kevin Tooney's Arp synthesizer is always finding something new.

**Flying Start** picks up where the first album left off (**The Blackbyrds**, Fantasy F-94444), and together they make a tremendous two-record set. Donald Byrd (A.K.A. Oscar Brash-Ear in the album credits) has proven himself to be a producer of perfect records, the sound is uncompromisingly right.

**AUDIO • MARCH, 1976**

Byrd had a winning fight with a lip disorder and could not play trumpet for quite some time. Apparently his talent migrated to his ears, and **Flying Start** is as fine a production as the most discriminating audiophile could demand from a recording of Mahler's 9th Symphony. Matrix decoding does more than its usual improvement in the sonic image. SQ gives a different image than QS, but both sound dead right.

Fred DeVan

Sound: A Performance: A

**Poum:** Composer's Collective.

**Musicians:** John Fischer, piano and voice; Perry Robinson, clarinet; Mark Whitecage, tenor and alto sax; Lawrence Cook, drums; Mario Pavone, bass.

**Songs:** Sinfonia; Apollo's Ragtime Journey; t-e-e-t; Moon Walk; Poum; Earthlings.

**Composer's Collective 721.** stereo, \$7.99. Too expensive at any price.

I guess I've been under the misguided impression that a composer's collective is a group of musicians who form an alliance to play and promote each other's compositions and reap economic benefits without giving anything up to producers, corporations, etc. The musicians (?) here come from a jazz background and rely thoroughly on spontaneity. So much so, in fact, that everything happens but music itself. Coughing, chirping, random voice, I suppose even flagellation is disguised in this concoction of er...uh...um...sound.

The collective claims "it has brought together musicians whose talents and originality are marked by a commitment to excellence." They don't quite prove this by me. Formed in 1972 to produce music (**Poum** is anything but) that is not commercially available, they have also cleverly produced material that is commercially and otherwise unacceptable. The album is "Copyrighted" (so I guess someone takes this seriously) and "All Rights Reserved" (whatever they're reserving it for eludes me).

Having already wasted more space than this piece of recyclable vinyl merits, I just wanted to be certain that anyone with only a few bucks to spend on music makes a 180° turn. Also look out for **Newborn Light** by Urzula Dudziak (Columbia KC 32902). They're both out to a long, long lunch!

Eric Henry

Sound: C Performance: F

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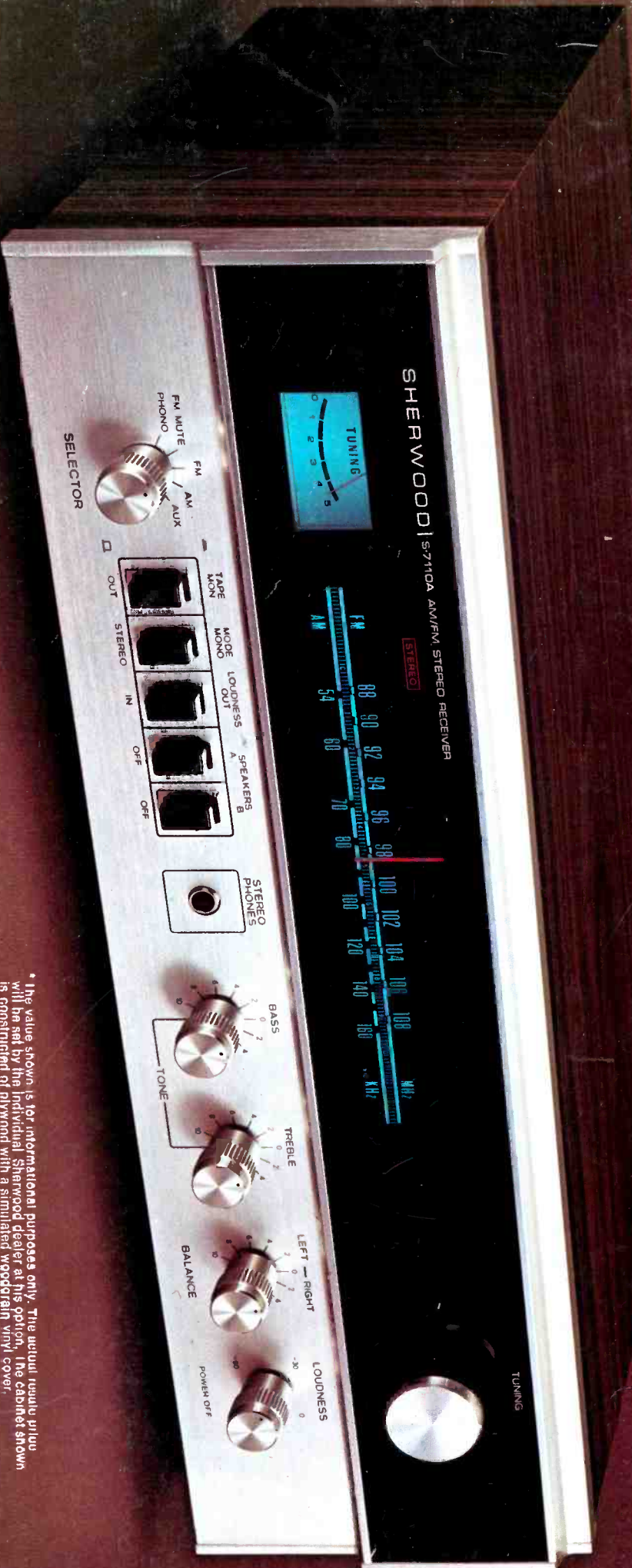
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