HI-FI FOR BEGINNERS

MEN OF HI-FI -- DISCRETE

FOUR-CHANNEL BROADCASTING

AUDIO

MAY 1972 60c

The Authoritative Magazine About High Fidelity ® A

23602

Our 25th Anniversary

Audio's First Issue

1972 - 1982

If you choose to buy a $400 receiver, here are some choices.

	Power output continuous (RMS) watts per channel, both channels driven into 8 ohms	Power output continuous (RMS) watts per channel, both channels driven into 4 ohms	Harmonic distortion @ rated output, %	IHF power bandwidth	IHF sensitivity, μV	FM signal to noise ratio, dB	FM distortion, %	Capture ratio, dB	Spurious response rejection, dB	Manufacturer's suggested retail price
Fisher 450 T	55	NA	0.5	10Hz to 30kHz	2.0	65	0.5	2.5	90	$399.95
Kenwood KR 6160	55	65	0.5	12Hz to 30kHz	1.6	68	0.5	1.5	100	$429.95
Marantz 2245	45	NA	0.3	7Hz to 70kHz	2.3	NA	0.15	1.6	95	$449.95
McIntosh 1700	40	40	0.25	NA	2.5	65	0.5	2.0	NA	$599.00
Pioneer SX 828	60	75	0.5	10Hz to 60kHz	1.7	70	0.2	1.5	100	$429.95
Sansui 5000 X	55	75	0.8	15Hz to 30kHz	1.8	65	0.5	1.5	95	$429.95
Scott 477	70	100	0.5	15Hz to 40kHz	1.9	70	0.5	2.5	80	$399.90
Sony 6065	70	80	0.2	50Hz to 30kHz	2.2	70	0.2	1.5	100	$410.00

These data were obtained from manufacturers' literature.

(Scott 477 is your best choice.)

As an astute audiophile, you naturally want to compare specifications and prices on the better makes of equipment before committing yourself.

If it's a high quality receiver you're after, we've aided your selection by preparing a spec chart comparing our 477 AM-FM Stereo Receiver with its closest competitors.

We invite you to study the specifications of the respective units along with their prices. You'll find the Scott 477 is the value-for-the-price leader among this distinguished grouping of receivers in the $400 price class.

If you're not convinced by specs alone, we further invite you to ask your Scott dealer for a listening test of the 477 receiver connected to your favorite speaker system. Check its performance on both recorded and broadcast program material of your choice. Then, compare the 477 with any other receiver in its price class.

You'll find the Scott 477 AM-FM Stereo Receiver is your best choice.

SCOTT®
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H.H. Scott, Inc., 111 Powdermill Road, Maynard, Mass. 01754

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Sound like the pro you'd be if you were recording for money instead of love.

If you're serious about tape, the TEAC 3300 is a tape deck you can take seriously.

It'll accept 10½-inch reels, like a professional deck, for up to 6 hours of recorded material. And it has professional features you won't find on any other tape deck for the price. $549.50.

Like the new Front Panel Bias Switch for the proper selection of bias current and recording equalization for either conventional tapes or the new low noise/high output tapes.

And expanded scale professional-type VU meters for each channel. The wide excursion scales simplify recording at higher (up to 6dB) signal levels, a must when using the new tapes, assuring better signal-to-noise ratio and an expanded dynamic range.

Another is TEAC's unique Edi-Q, an electronic pause control; it interrupts taping but keeps the recording amplifiers on and ready, eliminating recording clicks and tape bounce during quick-start operation.

Of course the 3300 has the kind of professional specs you'd expect from TEAC (after all, we make the professional systems too) – S/N: 58dB, wow and flutter: 0.06% and frequency response: 25–24,000Hz (±3dB; 30–20,000Hz) at 7½ ips.

Before you spend your money on any tape deck, spend some time with the TEAC 3300. At your dealer's.

TEAC®

TEAC Corporation of America, 7733 Telegraph Road, Montebello, California 90640

TEAC Corporation, 1-8-1 Nishi-Shinjuku, Shinjuku-ku, Tokyo, Japan
TEAC EUROPE N.V., Kabelweg 45-47, Amsterdam – W.2, Holland

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AUDIO

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EQUIPMENT PROFILES

RECORD AND TAPE REVIEWS

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The Maker of the Microphone Award was established in 1963 in memory of Emile Berliner, the great inventor who developed the microphone, the disc record, the gramophone, the method of mass producing records from a master and created the trademark, "His Master's Voice." The winners—all of them recognized for the special significance of their work in the audio field—have been Roland Gelatt, Goddard Lieberson, Dr. Harry F. Olson, The Bell System, Audio Magazine, KTBT Radio/Telaudio Centre, NARAS, the National Library of Canada, and Garrard Engineering, Ltd. Garrard was particularly honored because 1971 marked the first time the award was bestowed upon a manufacturer. It was given to recognize the achievement of zero tracking error in the Zero 100 Automatic Turntable.

"Audio" has been the only magazine to receive the Maker of the Microphone Award. It was presented in 1967. This month, on Audio's 25th Anniversary, G[illegible] and the entire high fidelity industry congratulate this pioneering publica[illegible] continuing contributions to the world of sound.

Check No. 14 on Reader Service Card

What's New in Audio

coming in June

* **Buyer's Guide to Turntables and Record Changers**
* **How We Test Turntables**—C. G. McProud
* **Beginner's Guide to Hi-Fi, Part II**—Martin Clifford

Equipment Reviews—
* Harman-Kardon 930 Receiver
* BSR 810 Turntable
* Rectilinear III Lowboy Speaker

LATE FLASH

RCA Records has announced their first release of discrete four-channel records will be made in early May.

About The Cover: This issue celebrates our 25th anniversary, and the inset shows the cover of our May, 1947 number. The illustration shows Norman Pickering testing his new pickup, and at the bottom is a view of the Western Electric control consoles at WOR. It is understood these are not now in ...on. . . .

SAE Mark XII loudspeaker

Transistorized protection circuitry is featured in this speaker system which incorporates a three-panel array of electrostatic elements for mid and high frequencies, 5-in. lower-mid driver, and a 12-in. bass speaker. Tone controls are provided to compensate for room characteristics, and adjustments can be made in the slope characteristics of the mid and lower-mid frequencies. Price: $850.00 per pair.

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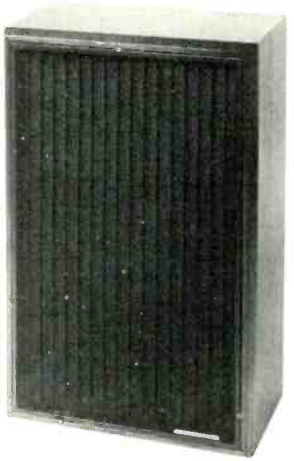


E-V/Game HP-30 headphones

This top-of-the-line co-axial unit incorporates separate tweeters and woofers, with a built-in crossover network. Four reflex ports are used for maximum bass response. Other features include a 25-ft. coiled cord and plush, foamy ear cushions. Price: $67.50.

Check No. 5 on Reader Service Card

Studio Reel 7-in. reel

This aluminum 7-in tape reel is available in five anodized colors to aid in identification of program material—silver, black, gold, blue, and fire orange. Suggested retail price: $3.50.

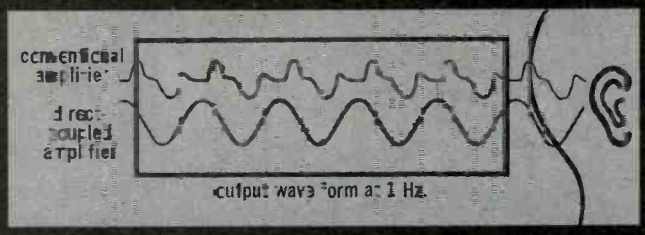
Check No. 6 on Reader Service Card

Heathkit AS-104 speaker

This three-way acoustic suspension system is said to handle up to 100 watts music material, with response extending from below 30 Hz to beyond the upper limit of audibility. Units in the system are a 10-in. woofer, a high compliance 4½-in. midrange which is sealed in a lined sub-enclosure, and a closed-back 3½-in. cone-dome tweeter. Individual high and midrange controls are provided. Price $89.95.

Check No. 7 on Reader Service Card

Our receivers have something you'll never hear. Our amplifiers.



Because our amplifiers don't have those circuits that can distort the sound. We took out the input transformer, the output transformer, and the output capacitor. Now the amplifier circuit is coupled directly to the speaker terminals. So you get less than 0.3% distortion. In all Panasonic FM/AM, FM stereo receivers.

We call this new system direct coupling. It improves transient response and damping. So cymbals go clash instead of pop. And a high C doesn't sound like a screech.

We offer you this more direct route in 4 different receivers. Starting with the SA-5500 and its 70 watts of music power (IHF) Plus features we put in our more expensive models. A high-filter switch. A loudness switch. Two 4-pole MOS FET transistors. To pull in stations you thought were out of reach. Even an FM muting switch to cut down on interstation noise. When you put all this in numbers, it means 1.8μV FM sensitivity and a frequency response of 20-30,000 Hz±1dB.

The SA-5500 also makes tuning easier with a linear-dial scale to separate FM stations. A sensitive tuning meter to measure signal strength. And dual-tone controls for custom-blended sound.

If all this isn't enough, we have models with even more features and power. You can move up to 100 watts with the SA-5800. Or take another step up, and get 150 watts of power on the SA-6200.

But if you want the most, there's the SA-6500. It has 200 watts of power. Plus features that the leading receivers in this price range can't match. Like a power bandwidth of 5-60,000 Hz. A crystal filter in the FM IF Amp. A Lumina-Band dial that lights up. Two 4-pole MOS FET transistors. And, of course, direct coupling. Besides all that, the SA-6500 gives you a low-filter control. Two tuning meters. And linear-sliding controls for bass, treble, volume and balance.

You can hear all our receivers at your franchised Panasonic Hi-Fi dealer. But it's not just what you hear that counts, it's what you don't hear.

Panasonic
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200 Park Ave., N.Y. 10017. For your nearest franchised Panasonic Hi-Fi dealer call 800 631-1971. In N.J.

Check No. 9 on Reader Service Card

Dollars for Tapes

RESPONSE TO THIS competition has far exceeded our expectations, and we have literally been overwhelmed with tapes. After many hours listening, we have finally selected the winners for March as follows:

FIRST PRIZE of $50.00 to William Hoskins of Jacksonville Univ., Florida, for his "Galactic Fantasy," a composition for Moog Synthesizer. This is a very impressive work, and it is obvious that Mr. Hoskins has considerable musical talent.

SECOND PRIZE of $25.00 to Donald G. Calvi of the Univ. of Maine. Donald recorded three pieces for guitar and bass using sound-on-sound. He also composed a song which was sung by Mrs. Calvi. Quality is outstanding with excellent signal/noise.

* * *

The following will receive a reel of low noise TDK tape as a consolation prize:

Donald C. Becker of Schorie, N. Y., for a recording of roll playing machines, including a National air calliope which Donald says, "plays so loud that you can hardly hear the four-cylinder gas engine driving the electric motor pump.

M. D. Hohenstine, Columbus, Ohio, for a recording of his Rialto organ using an Ampex AG-600. Mr. Hohenstine says he is self-taught and we congratulate him on the superb playing—and many happy returns for his 80th birthday.

Ron Harris and Art Scott of Palo Alto, Calif., for an amusing tape about "Godawfilla, The Monstah You Love To Hate" and other parodies. The accompanying letter says, "It represents an entertaining and creative use of the tape medium which ought to provide some novel relief for the judges. . . . Win or lose, we hope you enjoy listening to these gems as much as we enjoyed making them.—Num Nume Productions." We did, NNP, it was the only tape we played six times, but the cat didn't like it—he hasn't been seen since!

W. C. Gott of Ava, Montana, for a tape comprising a selection of miscellaneous records, sound effects, and some nice piano playing by Mrs. Gott. Mr. Gott is a youngster of 76 and a lover of country music.

Finally, *Kenneth Flory of Silom Springs, Arkansas,* for a recording of "Folk Feast '72" presented at John Brown Univ. Kenneth used six Sony ECM-19B electret mikes, one Sony MZ-12 mixer, and one Ampex 755 tape recorder. A Sony 252 was used for the tape duplications.

* * *

As might be expected, the quality of the tapes sent in varied enormously, but the most common faults were these:

1. Overloading the amplifier microphone stages. A good many people did not allow for peak transient outputs and either placed the microphones too close to some instruments or did not control the gain accordingly.

2. Tape hiss.

3. Some excellent recordings using several sound sources were spoilt by poor mixing—transitions were too abrupt. Background music should always be faded in—not suddenly blast forth.

Keep the tapes coming—and have fun! Æ

NOT ALL CHROMIUM DIOXIDE CASSETTES ARE EQUAL...

ONE IS MORE EQUAL THAN THE OTHERS

KR™
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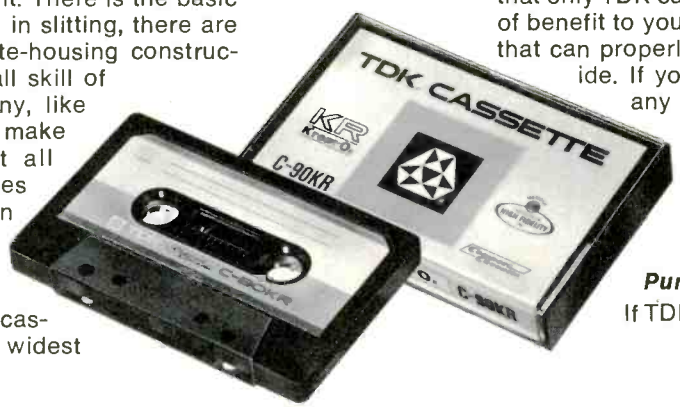
There's a lot of performance capability locked up inside chromium dioxide, but it takes the right know-how to liberate it. There is the basic tape, there is the accuracy in slitting, there are the dozens of little cassette-housing construction details and the over-all skill of a world renowned company, like TDK, that altogether will make the difference. Yes, not all chromium dioxide cassettes are equal. Now you can have chromium dioxide tape with TDK's own special touch.
Of course KROM-O_2 is the cassette that gives you the widest possible range of frequency response, the famous dynamic range and the complete reliability that only TDK can offer. But all these will only be of benefit to you if you have a cassette machine that can properly be biased for chromium dioxide. If you have only standard bias, use any of the TDK superior tapes and cassettes, either the famous TDK Super-Dynamic or the Low-Noise. TDK cassettes are just a little more equal than the others.



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Tape Guide

Herman Burstein

Modular-Unit Hookup

Q. I have an OKI 555 tape recorder that I would like to hook up to my Zenith stereo model ML 2607R. What would be the best way to make this hookup?—Roland A. Nadeau, Lewiston, Maine

A. Where the radio/phono fails to provide a tape output jack, a commonly used technique is to obtain the signal for the tape recorder across the speaker terminals. For this purpose you can buy or make a patchcord with alligator clips at one end (connecting to the speaker terminals) and an audio plug at the other end (connecting to the tape recorder input). Usually a better technique, providing a signal of better quality, is to connect the patch cord across the hot and ground terminals of the volume control. However, do not use alligator clips, for these may move and short something. The patch cord should be soldered to the terminals of your radio's volume control. The cord should be as short as possible and of low capacitance per foot in order to minimize treble loss.

5-in. vs 7-in. Reels

Q. I plan to use 1 mil tape, which comes 1800 feet to a 7-in. reel. However, half that amount of tape will be more than sufficient for a majority of the recordings I intend to make. I have considered the economics of buying the same tape on 5-in. reels. However, as the minimum diameter on which the tape is wound on a 5-in. reel is less than on a 7-in. reel, it appears that the torque exerted on the reel would be correspondingly greater. As I intend to make the best quality recordings possible, I would like to know whether the use of 5-in. reels will be a problem. If so, do you have any solutions to the problem?—Dave McComb, Boston, Mass.

A. To minimize motion problems, a larger reel is generally advisable. If you are interested in top quality, I suggest that you stay with the 7-in. reel. For tape economy you might do either of two things: (1) Buy tape on a 5-in. reel and wind it onto a 7-in. reel; however, there may be little economy left after you consider wastage of the 5-in. reel and the higher price per foot of tape when you buy it in small quantity. (2) Buy tape on a 7-in. reel, and wind the excess part onto another 7-in. reel.

Dropouts

Q. Every time I buy a new prerecorded tape, my machine (presumably the playback head) puts dropouts on the tape. These dropouts are so small (about 1/10th second) that you cannot hear them unless you are right next to the speaker or using headphones. This completely ruins my listening. I get maybe one per song, sometimes more or less. There seem to be a few more at 3¾ than at 7½ ips. I have checked all other equipment. It is the tape recorder. I have had the same trouble with two different tape machines. I love tape, but I am getting annoyed. I clean and demagnetize my heads regularly. Many have tried to help me and have failed. Please do your best to help me.—Bill Walter, Chicago, Ill.

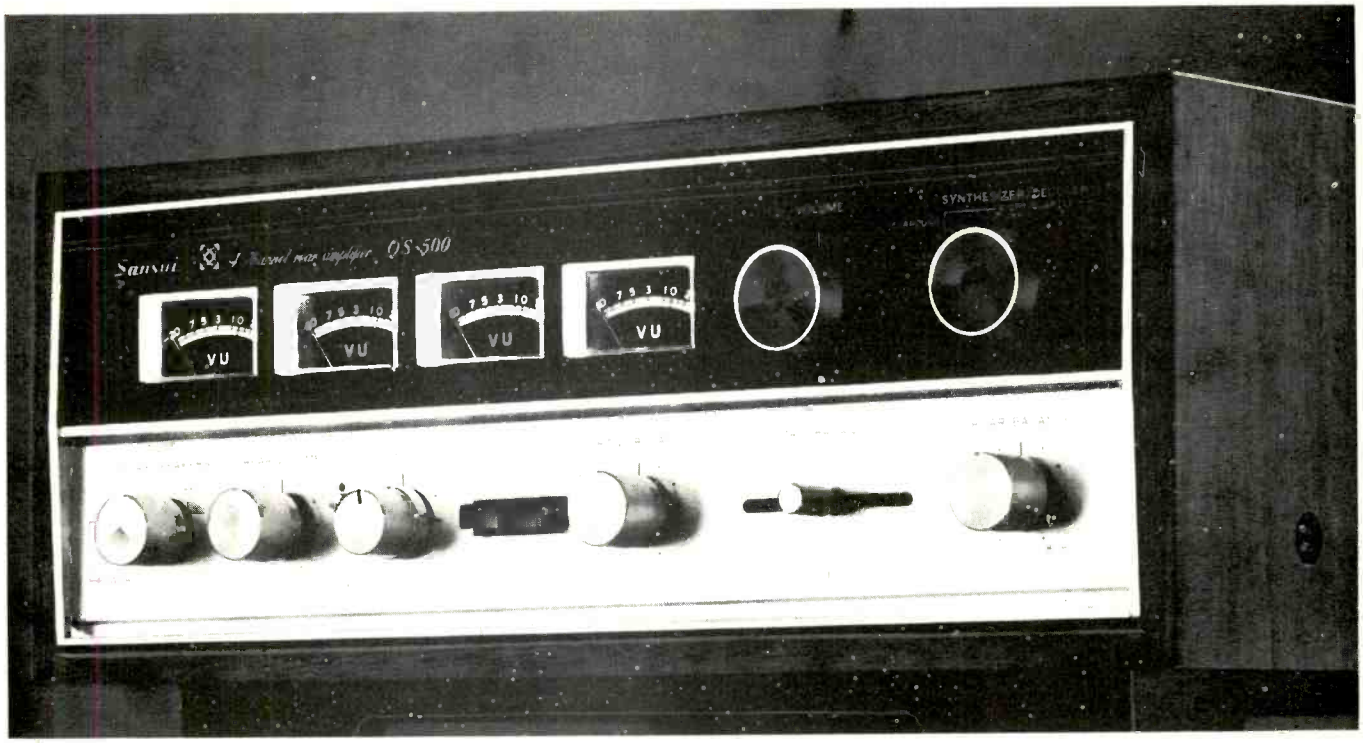
A. Is it possible that the dropouts of which you complain are already in the prerecorded tapes you buy, rather than imposed on them by your tape machine? Putting this differently, have these tapes first been played on another machine to ascertain whether they already contain the imperfections of which you complain? The presence of dropouts in prerecorded tapes is altogether possible, particularly in view of the fact that the copying process goes through several generations before the final tape reaches the consumer. If any of the tapes in the copying chain contain dropouts, then the final version must contain dropouts.

$ For Tapes $

Many readers must have tapes which they are particularly proud of. AUDIO will pay $50.00 for the best tape of the month—cassette or reel-to-reel. They will be judged on technical excellence and content. Selected tapes can be processed and marketed—if the owner wishes. Who knows, that old tape may make you a fortune! Please mark your entries TAPE COMP. and send them to AUDIO, 134 No. 13th St., Philadelphia, Pa. 19107.

If you have a problem or question on tape recording, write to Mr. Herman Burstein at AUDIO, 134 North Thirteenth Street, Philadelphia, Pa. 19107. All letters are answered. Please enclose a stamped, self-addressed envelope.

if you go for four channel...



you don't have to go for broke

Buy yourself a miracle for as little as $214.95 That's all it takes to get your conventional two-channel stereo to do anything any total four-channel receiver and control center can do, now or in the future.

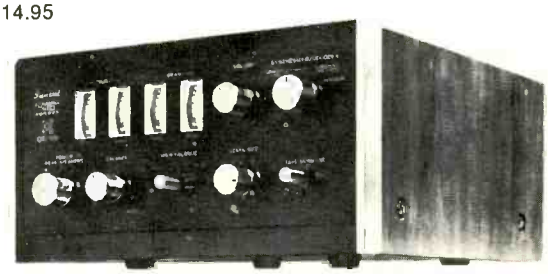
The Sansui QS500 and QS100 converters are complete Four-Channel Synthesizer-Decoder-Rear-Amplifier-and-Control-Center combinations that transform standard two-channel stereo totally. The only other equipment you need is another pair of speakers.

You can decode any compatibly matrixed four-channel broadcasts or recordings and reproduce them in four authentic channels. You can detect the ambient signals present in most two-channel recordings or broadcasts and propagate them through the rear channels. In Sansui matrixing, the exclusive phase-shift technique prevents the cancellation of some signals and the change in location of others that occur in many matrixing systems. And the exclusive phase modulators restore the effect of the live sound field.

You can plug in a four-channel reel-to-reel or cartridge deck or any other discrete source. In the future — if you should have to — you can add any adaptor, decoder or what-have-you for any four-channel system for disc or broadcast that anyone's even hinted at. And a full complement of streamlined controls lets you select any function or make any adjustment quickly and positively.

The QS500 features three balance controls for front-rear and left-right, separate positions for decoding and synthesizing, two-channel and four-channel tape monitors, electrical rotation of speaker output, alternate-pair speaker selection, and four VU meters. Total IHF power for the rear speakers is 120 watts (continuous power per channel is 40 watts at 4 ohms, 33 watts at 8 ohms), with TH or IM distortion below 0.5% over a power bandwidth of 20 to 40,000 Hz. In its own walnut cabinet, the QS500 sells for $289.95

An alternate four-channel miracle-maker is the modest but well-endowed QS100, with total IHF music power of 50 watts (continuous power per channel of 18 watts at 4 ohms and 15 watts at 8 ohms). In a walnut cabinet, it sells for $214.95



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Audioclinic

Joseph Giovanelli

How Many Speakers?

Q. My amplifier, a Kenwood KR7070, produces music power of 350 W. at 4 ohms output resistance, 260 W. at 8 ohms, and continuous power of 90 watts per channel at 8 ohms. How many speakers can I drive with this amplifier?—EN3 Don Lauer, USN, FPO San Francisco, Calif.

A. There is no way of stating definitely how many speakers a given amplifier will drive. If the impedance of the speakers is 4 ohms, you may be able to drive just one pair. The reason for this is that power amplifiers do not like to be loaded below 4 ohms. The only way to overcome this problem is to connect the speakers in series. The speakers which are not needed at any given time can be shorted out by closing a switch which shunts each one. See Fig. 1 This arrangement will enable you to use two speakers per channel. Their combined impedance will be 8 ohms, well within the capabilities of the amplifier.

Another limitation as to the number of speakers which can be successfully driven is speaker efficiency and the amount of power required to produce the listening level desired. If you plan to do lots of loud listening—such as would be involved with rock or perhaps organ music—you will not drive too many speakers because there will not be enough power to do so. Of course, if the speakers are more efficient than the average bookshelf unit, you can drive more of them. Horn speakers are quite efficient and you can, by series-parallel connection, drive at least four of them per channel and have loud levels. The wiring arrangements for this are shown in Fig. 2 If the speakers used are 4 ohms each, then the resistors shown must be 4 ohms each. If they are 8 ohm speakers, the resistors must be 8 ohms each, 20 W minimum power rating. The resistors serve to maintain a constant load, thereby keeping output level constant, regardless of the number of speakers switched into the circuit. Each individual speaker or pair of speakers is fitted with its own switch. These switches can be mounted at the speaker sites or they can be all grouped together on a single panel. It's best to use make-before-break switches. While no pads were shown, they could be installed between the speaker and the rest of the circuit. They could then be used for adjustment of volume at the particular speaker location.

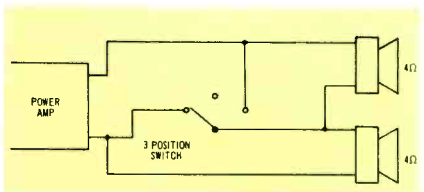
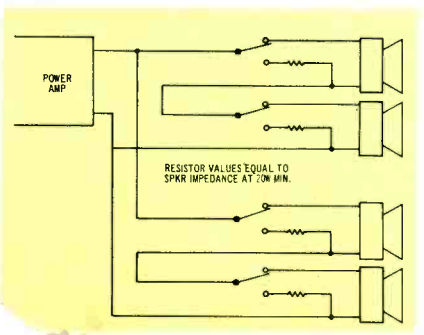


Fig. 1—Speaker switching, one channel shown.



Multiple speaker switching, one shown.

Remember that inefficient speakers may eat up enough power that you cannot drive more than two of them per channel. In fact, one per channel could be your actual limit if your listening levels are extreme and the efficiency is low.

Another factor we have not considered is the listening room in which the speakers are to be housed. In a room containing many pieces of furniture and heavy drapes the amplifier must supply a greater amount of power than would be required in a room where there are a lot of reflecting surfaces. This, of course, will limit the total number of speakers which can be driven by the particular amplifier.

Background music demands very little power for each speaker. Therefore, you will be able to drive a rather large number of speakers, even where they are not efficient. Of course, they must be wired in such a manner that the amplifier does not look into an impedance of less than 4 ohms.

Acoustic Feedback

Q. *My problem is "acoustic feedback." My speakers are wall-mounted on wooden shelves with thick foam rubber between the speaker cabinets and the shelf. The turntable is mounted on three-inch foam rubber.*

Because the whole system is in a small room, I am forced to turn the bass controls up slightly passed "flat." It is impossible to compensate for any records which might be deficient in bass without "blowing the cones right out of the cabinets."

The turntable is located on a heavy, low chest of drawers. I do not want to change the location of my equipment as it sounds fine and is convenient where it is. I simply want to get rid of the "acoustic feedback."—Frank V. Marsicovetere, Jr., Staten Island, N.Y.

A. Your acoustic feedback problem may be difficult to correct. If the sound is conducted through the air, foam will not be sufficient. You must separate the turntable and speaker by a greater distance than you now have them. Most of the time, however, sound is conducted by way of structure floors, walls, etc. Foam will be effective if you find the right combination of thickness and density.

I suggest a minimum thickness of two inches. However, if the speakers are heavy enough to completely collapse the foam, it will serve no function, since the speakers will be effectively resting on the shelf. On the other hand, if the density of the foam is such that the speakers rest on it, without sinking in at all, the foam will still not act as an isolator. What you need is a foam which is a happy medium. The speakers should sink down into it, perhaps half the total thickness of the foam. You should be able to press lightly on top of the speakers and observe they sink further into the foam. Then the speakers are isolated. They can be compared to an object floating in water.

The mounting arrangements for the speakers also hold for the turntable assembly. However, in the case of the turntable, I have found that the structure on which it rests should be extremely solid. Placing a piece of heavy equipment on this same structure often serves to damp out vibrations.

If you have a problem or question on audio, write to Mr. Joseph Giovanelli at AUDIO, 134 North Thirteenth Street, Philadelphia, Pa. 19107. All letters are answered. Please enclose a stamped self-addressed envelope.

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That's why we're especially enthusiastic about our newest cartridge, the ADC-XLM. It does everything a well designed cartridge should do. It may not be perfect, but we don't know of any that are better, and few that even come close.

Now, we'd like to tell you why.

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To begin with, it is generally agreed that the first consideration in choosing a cartridge should be low mass. And as you may have guessed by now, the LM in our model designation stands for low mass.

Not only is the overall weight of the ADC-XLM extremely low, but the mass of the all-important moving system (the stylus assembly) is lower than that of any other cartridge.

Translated into performance, this means effortless tracking at lighter pressures with less distortion.

In fact, used in a well designed, low mass tone arm, the XLM will track better at 0.4 gram than most cartridges at one gram or more.

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One of the thorniest problems confronting a cartridge designer is how to get rid of the high frequency resonances common to all cartridge systems.

Over the years, various remedies have been tried with only moderate success. Often the cure was worse than the disease.

Now thanks to a little bit of original thinking, ADC has come up with a very effective solution to the problem. We use the electromagnetic forces generated within the cartridge itself to damp out these troublesome resonances. We call this self-correcting process, "Controlled Electrodynamic Damping," or C.E.D. for short.

And if it seems a little complicated, just think of C.E.D. as a more effective way of achieving lower distortion and superior tracking, as well as extending frequency response.

Naturally, there's much more to the new ADC-XLM, like our unique induced magnet system, but let's save that for later.

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At ADC we've always felt that reliability was just as important as any technical specification. That's why we now guarantee every ADC-XLM, exclusive of stylus, for a full ten years.

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And something more.

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*We guarantee (to the original purchaser) this ADC cartridge, exclusive of stylus assembly, to be free of manufacturing defects for a ten year period from the date of factory shipment. During that time, should a defect occur, the unit will be repaired or replaced (at our option) without cost. The enclosed guarantee card must be filled out and returned to us within ten days of purchase, otherwise this guarantee will not apply. The guarantee does not cover damage caused by accident or mishandling. To obtain service under the guarantee, simply mail the unit to our Customer Service Department.

Audio Dynamics Corporation
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Behind The Scenes

Bert Whyte

AS YOU CAN SEE from the proclamations on every hand, this issue marks the 25th anniversary of AUDIO Magazine. Like any anniversary, it is an occasion for celebration and a time for reflection. I think it is worth noting that when this publication was launched in 1947 as "Audio Engineering," it was coincident with what is generally considered the beginning of the high fidelity era. The impact of audio technology on the recording and reproduction of music, especially in the context of the home listening experience, was more than any of us could have foreseen. For 25 years this journal has faithfully chronicled the spectacular growth and advances in this field. That's a long time, and it sounds more so when you say a quarter of a century; and a great many audio triumphs and tragedies, innovations and "breakthroughs" have occurred in this span of time. Let's go back to 1947 for a looksee and a capsule account of this reporter's personal involvement in the audio scene for the past 25 years.

In 1947 the living rooms of America were filled with the typical "Queen Anne" mahogany monstrosities . . . consoles with open-back construction, housing mini-watt amplifiers and tuner sections, single PA-type cone speakers with cheap stamped baskets and tiny magnets, and changers with crystal cartridges operating at a "lightweight" couple of ounces of stylus pressure! The really affluent had Capeharts, whose claim to fame, besides magnificent cabinetry, was a special changer that could play each side of a record consecutively. The records were, of course, the old fragile 78 rpm type, and needless to say the quality of sound from any of these consoles was just plain awful.

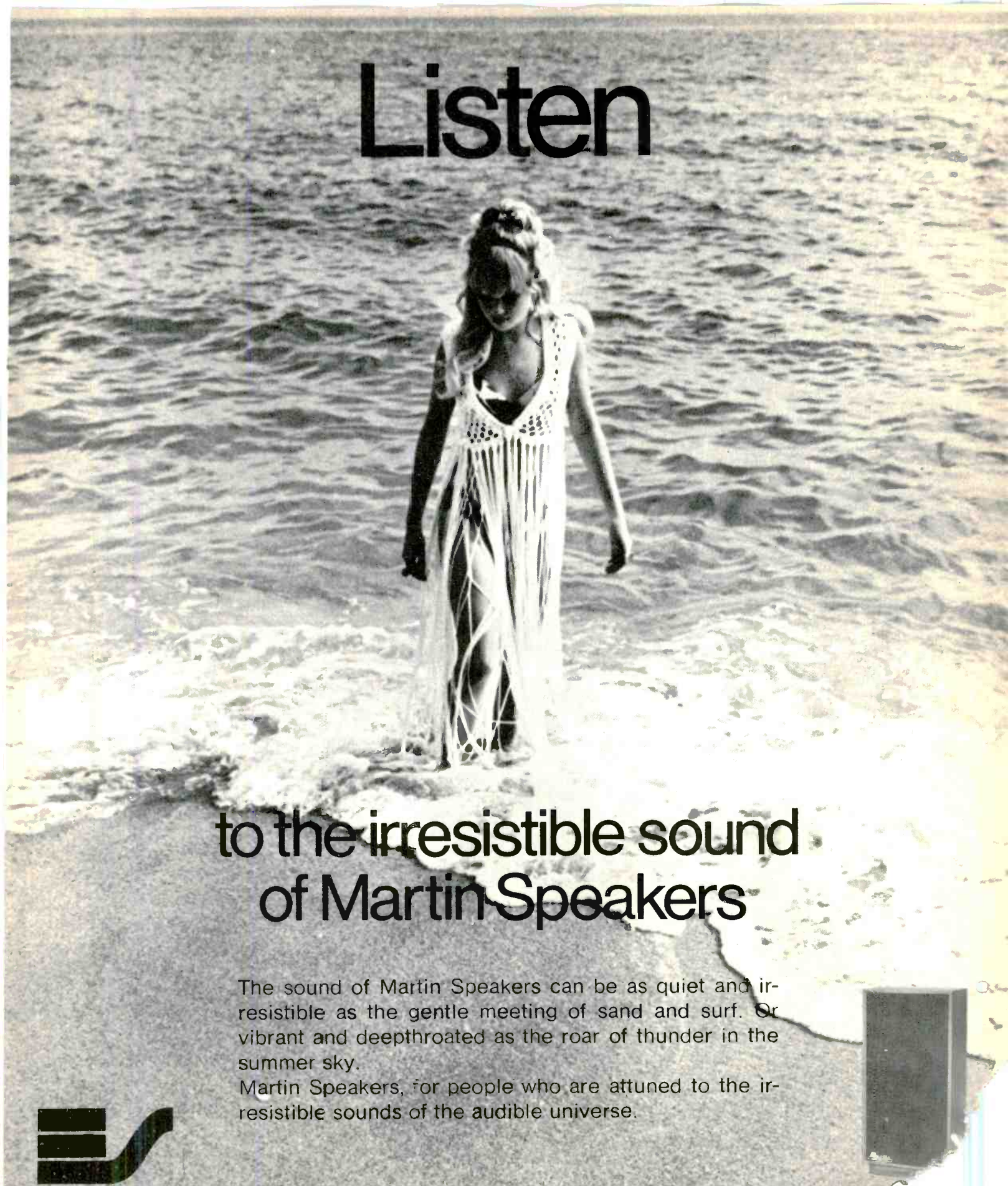
In marked contrast to this was the equipment to be found in the homes of some engineers in the broadcast and movie theatre sound fields. Recognizing the deficiencies of the commercial consoles in the consumer market, they brought home the big co-axial and woofer/tweeter theatre speakers, push-pull amplifiers, transcription turntables and arms made by Altec and Western Electric. Presumably they had indulgent wives because the equipment certainly wasn't pretty. However, in ms of sound quality, their rigs were ears ahead of the home consoles. urse of time some music lover uest at the home of one of these engineers, listen to the quality of sound in open-mouthed astonishment, and demand to know where he could buy such a system. Usually the engineer would direct him to a typical radio parts jobber such as Allied Radio or Lafayette/Concord, which in those days maintained an image as "wholesale" operations. Our music lover would buy the equipment he wanted at an *apparent* 30 to 40 percent off "list price," and with the superior sound his system afforded was delighted with the whole transaction. Naturally the new hi-fi convert would invite friends to hear his great new sound, who in turn became infected with the hi-fi virus, and so on and on, ad infinitum. Word of mouth recommendation was the foundation of the hi-fi business, and demand for equipment zoomed to such proportions that the parts houses gave up the fiction of the "wholesale" prices and opened special sales and demonstration salons catering to this new hobby. As the hi-fi phenomenon grew, alert manufacturers made equipment specifically tailored to the requirements of this market. This was the time when reputations were made and names established that signified excellence in amplifiers or speakers or with any of the component parts of a hi-fi system. McIntosh, Fisher, H. H. Scott, Altec . . . these are household names today. Others, of singular excellence at the time . . . Browning, Radio Craftsmen, REL, Audak . . . have vanished from the audio scene.

By 1950, the "hi-fi bug" had been dignified with the appellation "audiophile," and I was selling well-heeled members of that group such items as a 50-watt McIntosh amplifier, Browning tuner, Rek-O-Kut turntable, Pickering arm and magnetic cartridge, a speaker system consisting of the superb Western Electric 713C driver with cast aluminum sectoral exponential horn, crossing over at 800 cycles to a 15-in. Altec theatre woofer in an 11 cubic feet bass reflex baffle, and a Magnecord PT6 tape recorder. A little later on the vogue for horn-loading of speakers was upon us, with enthusiasts experimenting on every hand. Audio's own C. G. McProud designed a widely heralded and much constructed horn. A huge bathtub-like back-loaded horn was designed for the Jensen triaxial speaker. Ollie Read of Radio TV News had his "Fold-A-Flex" horn. It was practically *de rigeur* for EE students at MIT and CIT to build their own Klipsch horns, an agonizing exercise in "screwing and gluing." Perhaps the ultimate was reached when a giant concrete 30-odd foot exponential horn was built, the mouth of which occupied one whole wall of a living room. I'm not sure, but I believe this was in the home of Al Kahn, former president of Electro-Voice.

Along about this time, the long-playing 33⅓ rpm record became an important factor in the hi-fi scheme of things. Introduced in 1948, its quality wasn't very good, and for the sound-enthusiasts, the London/Decca *FFrr* 78 rpm recordings were of amazingly good quality and were preferred in spite of their cumbersome format. But the advantages of 25 to 30 minutes of uninterrupted playing time were not to be denied nor was the much lower noise level of the vinyl. When improved cartridges from Pickering and GE and better pressing techniques solved the LP mistracking problems, the 78 rpm record was dead. The silly 45 rpm versus 33⅓ rpm battle waged at that time was a sheer waste since it was quite obvious that the 45 rpm record was strictly in the province of the "pop" singles market and could never be a factor in the classical market. The LP record while clearly the winner, still had its share of problems, not the least of which was a thing called equalization. No one could seem to agree on an ideal recording and playback curve and so for a number of years we had the so-called LP curve, the AES curve, NAB curve, and all the preamps of those days had to furnish playback equalization for each of these curves. Finally of course, the RIAA curve was adopted as industry standard, but I would be remiss if I did not tell you that some very influential engineers today feel that certain aspects of the RIAA curve would benefit from re-examination and possible change in the light of present knowledge.

The boom in LP recordings was really initiated by the ready availability of high quality magnetic tape recorders. It was said in those days that anyone with an Ampex and the price of a ticket to Europe could start a record label. And it was literally true! One could tape a performance, have masters cut, records pressed, labeled and packaged for less than a thousand dollars! The result of this was an outpouring of musical exotica never since equalled. Magnetic tape recorders were the glamour items in the hi-fi world.

Listen



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Ampex and Magnecord shared the professional field, with the Magnecord garnering some sales among audiophiles because of its lower cost. In 1951 I became sales co-ordinator and musical director of Magnecord and this was to have a profound effect on my life. Up to that point, my experience with magnetic tape recording was with the full track monophonic format. My first day at Magnecord, I was invited to put on a set of headphones and listen to something called binaural sound, an experimental process that had its genesis with "Oscar the Dummy" at the Chicago World Fair in 1933. "Oscar" was a life-like model head with a microphone at each ear, situated in a closed room. Via headphones outside of the room you perceived sounds directed at the dummy, as if you were sitting in the dummy's seat. In essence, the microphones spaced 6-8 inches apart on the dummy head were your surrogate ears! As I recall, the recording I heard was of a high school band, made with the 6 to 8 in. binaural mike spacing. I listened to this recording with utter astonishment. I was simply stunned by the incredible realism of the sound. A binaural recording was and is today (with some minor updating of mike technique) the ultimate expression of realism in the reproduction of music. One should note here that the current popularity of headphones is not related to the binaural phenomenon. Almost without exception the kind of recordings people listen to on headphones are made with the typical wide spaced array mike techniques intended for stereophonic playback through *loudspeakers* and thus the spatial perspective they perceive is grossly exaggerated. People obviously like this, but I think their response to a true binaural recording would be even more positive. It is interesting in retrospect how the binaural recording got started at Magnecord. The Navy Special Devices Center in New York wanted a special tape recorder for underwater sonar research and a requirement was that two separate channels could be recorded simultaneously on the standard quarter-inch magnetic tape. At that time there was no such thing as stacked heads, so Magnecord solved this by the expedient of using two half-track heads spaced some 1½ inches apart. These became known as "staggered" heads, and some old-timers will remember some very early stereo tapes made in that configuration. Having made this special two-channel recorder for the Navy, someone at Magnecord remembered the "Oscar" binaural experiments and realized they had a of recording this kind of sound. se, I was sold on binaural made it my pet project.

Magnecord decided to sell the binaural recorders and we demonstrated the units extensively, especially at the New York Audio Fairs. Naturally we needed demonstration material, so I was busy recording and learning about this new sound. I found out about the classical stereo experiments of Bell Telephone and Western Electric in 1933, and a study of the papers on these experiments proved invaluable. One fine day the morning mail brought a letter from Leopold Stokowski who said he had heard of our binaural experiments and related some experiences he had in Europe with stereophonic perception. The Maestro said he was giving a conducting seminar at the University of Illinois and asked if we would like to make a binaural recording of the final concert. Of course, I flipped! Up to that point I had been recording relatively small groups. However, what the Maestro had scheduled was rather mind-bending . . . no less than the Monteverdi "Vesper Mass of 1610," with full symphony orchestra, a chorus of 250 voices and organ! Rather early on at Magnecord, I had decided that while true binaural recording was indeed exciting and unique, it was cumbersome to demonstrate, especially to groups. I therefore modified the mike spacing to permit stereo recording and reproduction through loudspeakers. I always used the famous Telefunken U47 condenser microphones for my recordings, and if hall acoustics were suitable, always used the omni-directional pattern. Whenever possible, I hung the mikes, in preference to mike stands and booms. The hall acoustics of the University auditorium were just a shade over-reverberent when it was empty. With an audience there was enough absorption to overcome this problem. The recording turned out quite well, although the organ pedal was on the heavy side. The Maestro and I worked well together and he invited me to record him with the Detroit Symphony Orchestra a few weeks hence. Subsequently we made other recordings, but little did I realize that eight years in the future we would make commercial recordings for Everest Records in New York. That Univ. of Illinois recording is 21 years old now, and in case you are wondering about the longevity of magnetic tape . . . it was on Audiotape Type 1251 and except for some slight "cupping" seems to be in perfectly playable condition. The tape has been stored under normal home conditions.

Having made a major foray into the classical recording field, I was lucky enough to meet Mr. Frank Holzfiend, owner of the famous Blue Note nightclub in Chicago. His club was the home of the "big bands," and with his cooperation I recorded the orchestras of Benny Goodman, Stan Kenton and Woody Herman and a number of lesser luminaries. The club was not overly large and the ceiling was a mere 8 feet, and there was the omnipresent crowd noise. The U47's were switched to the cardioid pattern, stereo spacing adjusted to the conditions, and I got some very exciting sounds. The Blue Note is long gone . . . but the memories are still fresh. Here again, I was recording with someone . . . Woody Herman . . . with whom I was to make commercial recordings in the future. And now my friend Bill Putnam of United Recording in Los Angeles has sent me an ambient four-channel stereo recording Stan Kenton's orchestra on half-inch tape at 15 ips with A Type Dolby! Makes my 1951 effort sound pretty feeble. Well, that's progress!

During my association with Magnecord, I got another lucky break. Mr. Bob Fine, the well-known engineer responsible for the great Mercury Records "Olympian Series" classical recordings, invited me to his recording sessions with the Eastman Rochester Orchestra. What he recorded monophonically, I recorded in stereo. The Mercury recording crew was a great bunch, co-operative in every respect. The stereo recordings were sensational and conductor Howard Hanson delighted with his first stereo experience. Bob Fine and I hit it off so well that I went along on sessions with the Chicago, Minneapolis, and Detroit Symphony Orchestras, and while Bob made those great mono recordings of that era, with Rafael Kubelik, Antal Dorati, and Paul Paray, I recorded the same repertoire in stereo. A few years later I became general manager of Fine Sound in New York, and got involved with "PerspectaSound," Mr. Fine's special stereophonic process for motion pictures.

If my memory serves me right, it was late in 1952 and I was sitting in my office at Magnecord, when my secretary told me there was a call for me from a Major Armstrong in New York. Cocking a somewhat skeptical eyebrow, I picked up the phone and was a bit stunned to learn that it was indeed *the* Major Edwin H. Armstrong himself! The Major said he understood that I had a number of stereo tape recordings. When I replied in the affirmative, he then proceeded to tell me how the stereo tapes could be broadcast via a technique he had invented called FM multiplexing. Further, would I like to cooperate with him in some experiments?

This story and the conclusion of this saga next month.

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Dear Editor

Phase Linear Amp

Dear Sir:

I am most happy to see the increase in quality of material evident in the Feb. 1972 issue of AUDIO. It is far too seldom that one sees material as good as that done by H.F. Olson, or Stanley and McLaughlin, in a popular magazine. The authors and AUDIO are to be congratulated.

In the same issue, however, I find six pages devoted to the observations and opinions of Mr. Robert Carver. Now I have no objection to the presentation of unorthodox views, but I think they should be clearly stated and the author's evidence supporting his viewpoint should show why present opinion is in error. As far as I am concerned, Mr. Carver has failed completely in both respects. My reading of the material seems to indicate that he has discovered that given equal rms ratings on three amplifiers, the one having the highest IHF m rating will sound the best. He then goes on to tell us that this proves the superiority of amplifiers having poor supply regulation.

Now really, gentlemen, this is ridiculous. Anyone familiar with amplifiers and rating methods could tell you that the "great discovery" that Mr. Carver has presented to us is an obvious fact well known for many years. The conclusion he reaches is however unusual, to say the least, for someone who is supposed to be in the quality amplifier business. He does not tell us what is wrong with the usual approach in the design of quality equipment of putting a reasonably well regulated supply in the amplifier so it can deliver something near its IHF m rating when tested for rms output. Does he object to the cost of the larger transformer and additional capacity needed, or what?

Having led us astray, Mr. Carver then leads the unwary into complete error. He proceeds to inform us that voltage losses in the average transistor amplifier power supply are approximately 30%. Now this may be true of his power supplies, but not of any of the other amplifiers sold as high fidelity products. In general, the full load voltage will be no more than 5% lower than the no load voltage in a typical amplifier. Thus in his example the ply that has 63 volts output at full uld have no more than 67 to 68 t with no load, not 95 as gests.

We are next presented with two pages telling us of the shortcomings of an unidentified protection circuit. Now once again the fact that some types of protection circuits cause very undesirable side effects is also rather well known. Had Mr. Carver shown in schematic form the type circuit or circuits that are prone to the problems he described he would have done us some service. This information was not included, however, and we are left to wonder just what kind of protection circuit he is talking about.

Mr. Carver next attempts to make a case for high power amplifiers, but does not indicate what type speakers would require this much power to reproduce the sound level of an actual piano. There is really no argument on this point though. If speaker efficiency is known, the amount of amplifier power required to generate a desired sound pressure level can be quickly calculated. With the normal type of electrostatic or acoustic suspension speakers used in sound systems, high amplifier power will be required to match the sound levels of an actual piano playing the type material suggested.

Having established that we should have high power amplifiers, Mr. Carver again reverts to complete error. He tells us that supply voltages of over 200 volts are required to produce an output of 350 watts with an 8.0 ohm load. This may be true if we are using Mr. Carver's power supply which has a 30% loss, but a more normal power supply with 5% or so regulation would only require a d.c. supply voltage of 155 to 160 volts.

We are finally told that of the methods to get the desired high power output Mr. Carver's choice of high voltage transistors is the best. If this is his opinion of the possible choices, fine, but why doesn't he tell everyone that this approach also involves some undesirable aspects. High voltage transistors of the type he describes have much poorer frequency response than epitaxial base types having lower voltage ratings. Many times by as much as an order of magnitude. They also can only be obtained in NPN polarity making necessary a quasi-complimentary output circuit. The large junction capacities make it necessary to add something to the circuit to control secondary crossover notches. The quasi-complimentary circuit is inferior as far as basic linearity is concerned and will cause the amplifier to have higher distortion figures than a similar full complementary system. With all the facts known, some people just might prefer some other method of obtaining the desired high power.

In short, it rather appears that you have published some very bad material along with the good. I will hope that this was just a slip and that AUDIO will not contain any trash like this in the future.

Daniel Meyer
Southwest Technical Products
San Antonio, Texas

We reviewed the Phase Linear 700 last June and I subsequently asked Robert Carver to tell us something about his design philosophy—which may be unorthodox but certainly produces the results!—ED.

Dear Sir:

Thank you for giving me the opportunity to reply to Mr. Meyer's letter in the same issue in which it will appear.

Mr. Meyer seems to object primarily to my claim that voltage losses in the typical transistor power amp are approximately 30%. He makes the flat statement that, "In general the full load voltage will be no more than 5% lower than the no load voltage in a typical amplifier." We need not play any "whom do you trust" games to resolve this discordant point: Since we know that power at clipping is proportional to the square of the d.c. supply voltage, we need only compare IHF m and rms ratings advertised for several popular receivers and power amps. Such a survey reveals that the ratio between IHF m and rms power under ideal conditions (1,000 Hz and rated distortion) *never* is greater than 0.8, implying power supply losses *never* less than 10%. Since these ratings are taken at rated distortion, the IHF m figure does not perfectly reflect the no-load d.c. power supply voltage of the amplifier, thus making even 10% a low number for a best-case situation.

Without naming brands and citing specific voltage drops, I can go no further along this line of argument except to say that, given Mr. Meyer's admission that high power is not a bad idea, and that a 155 volt d.c. supply is necessary to produce 350 watts rms of audio across 8 ohms, I must point out that a power supply which doesn't "droop" at all would require either an

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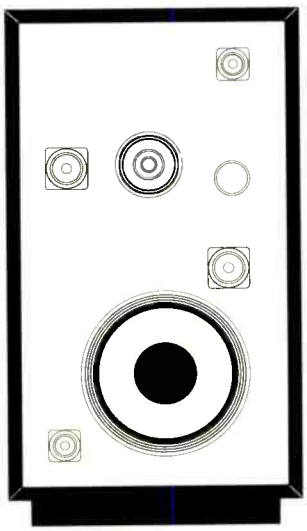
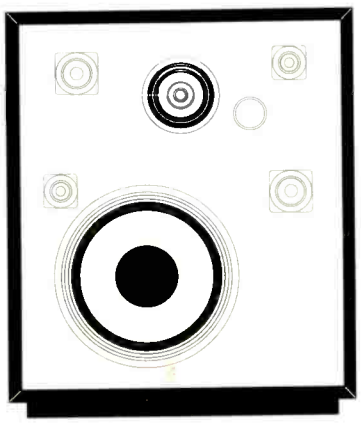
That was the original **Rectilinear III,** which we are still selling, to this day, for $279.

Within a year, virtually every hi-fi editor and equipment reviewer went on record to the effect that the **Rectilinear III** was unsurpassed by any other speaker system, regardless of type, size or price. (Reprints still available.)



Then came about forty-seven different breakthroughs and revolutions in the course of the years, while we kept the **Rectilinear III** unchanged. We thought it sounded a lot more natural than the breakthrough stuff, but of course we were prejudiced.

Finally, last year, we started to make a **lowboy** version of the **Rectilinear III.** It was purely a cosmetic change, since the two versions are electrically and acoustically identical. But the new **lowboy** is wider, lower and more sumptuous, with a very impressive fretwork grille. It measures 28" by 22" by 12¼" deep (same internal volume) and is priced $20 higher at $299.



The new version gave *Stereo Review* the opportunity to test the **Rectilinear III** again after a lapse of almost five years. And, lo and behold, the test report said that "the system did an essentially perfect job of duplicating our "live music" and that both the original and the **lowboy** version "are among the best-sounding and most 'natural' speakers we have heard." (Reprints on request.)

So, what we would like you to figure out is this:

What was the real breakthrough and who made it?

For more information, including detailed literature see your audio dealer or write to Rectilinear Research Corp., 107 Bruckner Blvd., Bronx, N. Y. 10454.

Rectilinear III

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infinitely large power transformer, or an electronic regulator equal in complexity and cost to an additional channel of amplification. Even settling for Mr. Meyer's favorite figure of 5% regulation would require our Phase Linear 700 amplifier's power transformer to contain five times as much copper and iron as it does now (the 700's d.c. supply drops 25% under full load), and we at Phase Linear don't wish to increase the incidence of hernia among audiophiles with state of the art, but power hungry, speaker systems.

In any case, power supply regulation is Mr. Meyer's game, not mine. The output operating area charts included in my article show why the change in power supply voltage from no load to full load as evident with an unregulated should be viewed an advantage not a disadvantage. The extra operating area allows this type of amplifier to supply higher power for short durations or into higher than 8 ohm speaker loads than an amplifier with the same rms rating and a *regulated* power supply could ever provide. I am not suggesting that conventional techniques are in any way wrong, I am simply saying that there is a better way.

The only design problem posed by the use of a power supply whose unloaded voltage rises to 200 volts is that of selecting the proper output transistor, as was discussed on page 34 of my article. I don't know how old Mr. Meyer's transistor reference books are, but a fast look at any printed in the last two years will show that the epitaxial base power transistors preferred by Mr. Meyer has an upper frequency limit only one third that of the triple-diffused power transistors used in the Phase Linear amplifier. As a matter of fact, the new Phase Linear 1000-watt, two-channel instrumentation amplifier with its 0.5 mHz power bandwidth will make its debut later this year as, among other things, further verification of the basic Phase Linear power amplifier design philosophy. Only through the use of triple diffused transistors can a 0.5 mHz power bandwidth be attained.

Certainly some clever circuitry is required to realize low distortion in a pseudo-complimentary amplifier, but we think the performance of the Phase Linear 700 as evidenced by its review in AUDIO magazine attests to the fact that these problems have been more than adequately solved by our engineering development staff.

As a final point, I must comment on matter of protection circuits. It possible to draw pieces of ame names in the example of misbehaving protection circuitry without stepping on a lot of toes, but the circumstantial information given about the test parameters, coupled with some knowledge of currently available brands of high power amplifiers and their ratings, should enable Mr. Meyer (as it did many other audiophiles who have written and called me in the last month) to identify the amplifier in question (and for that matter the speakers used in the piano allegro test). As for the type of protection circuitry guilty of the misbehavior, it is sufficient to point out that it was a very common VI-sensing system in a popular amplifier, and further, it is not possible to safely restrict an amplifier to exactly its safe operating area by sensing output transistor emitter current alone. Either a "loophole" in the protection will result, wherein a particular type of overload will go undetected and initiate destruction of the amplifier, or a misbehavior will result, whereupon distortion will be generated during operation *within* the safe area limit. The comprehensive energy limiting circuit in the Phase Linear amplifier does not suffer from either of the aforementioned ills.

In summary, we see that the Phase Linear approach to amplifier design has produced an amplifier which can supply more power at lower distortion into a wider range of loads and for a more reasonable price than any other amplifier currently available; it can even be carried around by a single human being of average physical development. This achievement represents a system approach to power amplifier design that we are rather proud of and we consider it rather unlike a gentleman or scientist to label as trash an effort to communicate this philosophy to the readership of a technical high fidelity magazine such as AUDIO.

Robert W. Carver
Phase Linear

Why not Watts (rms)?

Dear Sir:

Your editorial comment (AUDIO, p. 16, Feb., 1972) regarding the specification of amplifier power in rms watts accurately defines what is meant by this terminology. Essentially, we would agree that this is a "truthful" power rating. However, an academic nit-picker can compute a quite legitimate quantity for rms power and therein lies another booby trap that the audio industry should avoid.

After the publication of my recent letter [1] in the *Journal of the Audio Engineering Society*, McKnight [2], Eargle and Locanthi [3] have pointed out a very real pitfall that *could* come about if some unscrupulous salesman ever discovers the true theoretical meaning of rms power. Essentially, the booby trap is simply that this is another method of inflating a power rating ("bigger numbers sell") outside of the laboratory; that is, the theory show that

rms power = 1.225 × (average power).

Eargle and Locanthi clearly point out the danger of this theory and I think it well to quote their words of wisdom.

> This means that a 100-watt average-power amplifier can quite accurately be called a "122.5-watt rms" power amplifier! Likewise, a manufacturer of an 81.3-watt average-power amplifier could accurately and honestly refer to his device as a "100-watt rms" power amplifier—while his equally honest but less informed competitor would refer to the same device as an "81-watt rms" device!
>
> Rms power can be computed, but it is irrelevant; there is no wattmeter which reads in terms of it. As long as nobody bothered to compute it, rms power could easily be reconciled and identified with average power in the minds of most engineers. But now that it has been shown, quite accurately, to be just one more inflated power rating, it should no longer be ignored. We all want to measure power accurately, and there are a number of statements which could be used in amplifier specifications to accomplish this. For example, "This amplifier has a power rating of 100 watts, average sinewave power (28.3 volts rms at 0.1% third-harmonic distortion measured across an 8-ohm resistive load)." A statement such as this accurately defines the terms it uses and states to a certain degree the conditions of the test. An approach of this sort is sorely needed in the high-fidelity and commercial sound fields.

To this I add my hearty amen!

Prof. J. Robert Ashley
Univ. of Colorado

[1] J. Audio Eng. Soc., Vol. 19, No. 9, p. 793 October 1971.

[2] J. Audio Eng. Soc., Vol. 20, No. 1, p. 46, Jan./Feb. 1972

[3] J. Audio Eng. Soc., Vol. 20, No. 1, p. 45, Jan./Feb. 1972

Dolbyized FM

Dear Sir:

In the letter which you have entitled, "Is Dolby Necessary?" (AUDIO, January, 1972), Mr. Clyde Wade, in describing the broadcast practices by which fidelity is suppressed, seems really to be asking whether or not FM itself serves any purpose.

If, as he suggests, FM is preponderantly a medium for the transmission of highly compressed, limited, and distorted program material, and the dynamic range of such broadcasts is rapidly decreasing, what, indeed, is the purpose of *any* attempt to improve reception quality and audience coverage?

(Continued on page 99)

It stopped the traffic in Times Square.

We took our new ST-5130 FM stereo/FM-AM tuner to Times Square, where traffic — and ignition interference noise — are at their peak. Then with a flick of a switch, we stopped the noise dead.

That switch cuts in our new, exclusive, Impulse Noise Suppression circuit. It instantaneously cuts out the man-made impulse noises that can plague FM reception.

With this background interference gone, it's easy to hear and appreciate the rest of the 5130's super-tuner performance. The numbers are unbeatable: 1.5 uV IHF, sensitivity, 1.0 dB capture ratio, 100 dB selectivity, and 100 dB rejection of images, i.f., and spurious response (with equally remarkable AM performance, of course).

And you'll also like such features as the 5130's oscilloscope output jacks for multipath indication, and it's independently-controlled headphone jack.

Impulse Noise Suppression. Hear the difference it makes, at your nearby Sony Dealer. Sony Corporation of America, 47-47 Van Dam Street, Long Island City, N.Y. 11101.

New SONY ST-5130 FM Stereo/FM-AM

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Editor's Review

THIS ISSUE celebrates our 25th anniversary, as AUDIO first saw the light of day in May, 1947. Title then was "Audio Engineering," and it had evolved from "Radio Magazine," which had been established some 30 years earlier. Editor in 1947 was John Potts with C. G. McProud as Managing Editor and Sandy Cahn Advertising Director. The Editorial Advisory Board included C. J. LeBel, Howard Chinn, and John Colvin. The first issue had 56 pages and there were articles on square wave analysis, graphical characteristics of cathode coupled triode amplifiers, the Altec 603 speaker, and IM testing. In addition, there was a page of record reviews by one Edward T. Canby. Mono 78's, of course. The Radio Music Corporation was advertising phono transcription pickups for both vertical and lateral cut discs and the Racon Company had a new range of speakers . . . "Only Racon makes speakers with Racon Acoustic Cloth which is processed by a patent method which gives a nonvibratory wall." New Products mentioned included a Fairchild cutter head (response 30 to 8000 Hz) and two wire recorders. I almost said "Happy, uncomplicated days" but anyone who had unwound yards of steel wire from drive wheels and spindles would contest *that* one. . . . But we had no stereo, no LP's, no transistors, and tape recorders were very primitive, to say the least. We certainly have come a long way in 25 years.

The Next 10 Years

The prognostications by some of the leaders in the audio industry (page 22) make interesting reading. Our prophets seem cheerfully optimistic about the future—although Stephen Temmer looks over his shoulder at quadraphonic sound, saying "We've abandoned the fundamentals of communication: the transmission of information in favor of transmission of location." This argument could also be applied to two-channel stereo, but the truth of the matter is that two channel gives us more information than one and four gives us a more accurate sound field than two. In one of his recent WNYC broadcasts, Harry Maynard said, "One of the most impressive four-channel demonstrations was given by Advent almost two years ago. They played Boston Philharmonic four-channel tapes through a two-channel system with two $114.00 Advent speakers and then compared with a four-channel system using four AR-4x's—which then cost about half the price of the Advent. After hearing this demonstration, I must say I'd rather have $500.00 invested in four AR-4x's and four-channel equipment than in two $114.00 speakers and two-channel equipment." (Since then, Advent has released their own small speaker which we will review in due course.) Stephen Temmer may be concerned about the use of too much gimmickry in quadraphonics—in this respect we agree with him. But condeming quadraphonic sound for this is about as logical as blaming his Neumann microphones for the ghastly noises made by some alleged singers. . . .

More and more companies are using the CBS SQ system and matrix records of various kinds are now finding their way to the dealers. But this does not mean that discrete systems are dead—far from it, as the article on the JVC-Dorren broadcasts (page 57) shows. Discretophiles (if I can coin such a horrible word) glibly talk about 45 dB between channels, "if you listen closely to channel A, you will not hear a peep from anything carried by channel B, or C, or D." But matrixers point out that a violin or saxophone or whatever playing in one corner of a room is not 45 dB down in the other corners. . . . It seems to me that the only real argument for discrete systems is the undeniable fact that it is a better medium for the composer—particularly for electronic music. So the battle goes on.

Snap, Crackle, and Pop

Here is something which has had me guessing for a long time. It concerns static crackles and pops on records. I have certain records which I have played hundreds of time, taken them to demonstrations where they were subjected to all kinds of infamy—yet the surface is as quiet as a Dolby tape. But other records, made by the same companies, produce the most irritating noises at the slightest provocation. Right from the first playing in fact. I must stress that this phenomena is not confined to any particular make of record—all very puzzling.

Oh, John!

A few months ago, I commented on the ingenuity of designers who had built transistor radios into the most unlikely places. Since then I have come across another one worthy of mention. Marketed by Unique Boutique of Martinez, Ga., it is called John's All Transistor Radio and—you've guessed it—it is housed in the toilet roll holder!

G. W. T.

Playing records with some cartridges is like listening to Isaac Stern play half a violin.

The trouble with some stereo cartridges is that they don't offer even reproduction across the entire musical spectrum.

In the important upper audio frequencies, some cartridges suffer as much as a 50% loss in music power.

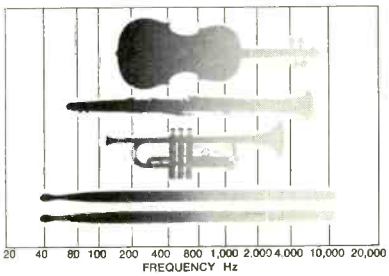
So, there's a lack of definition in the reproduction of violins, as well as clarinets, oboes, pianos, the organ and other instruments which depend on the overtones and harmonics in the upper frequency range for a complete tonal picture.

The Pickering XV-15 cartridge delivers 100% music power 100% of the time. Which is why we call it "The 100% Music Power Cartridge." At 100% Music Power, *all* the instruments are distinct and clear, because the XV-15's have no music-robbing output drop anywhere in the entire audio spectrum. It makes an enormous difference!

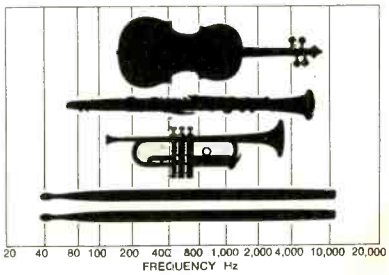
Pickering XV-15 stereo cartridges are priced from $29.95 to $65.00, and there's one to fit anything you play records with. For more information write: Pickering & Co., Inc., 101 Sunnyside Blvd., Plainview, Long Island, New York 11803.

Cartridge power does this to the instruments:

A 50% music power cartridge can mask some musical instruments.



The Pickering XV-15 gives you 100% Music Power 100% of the time.



Pickering. The 100% music power cartridge.

"for those who can hear the difference"

All Pickering cartridges are designed for use with all 2 and 4-channel matrix deriv

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THE NEXT TEN YEARS

1972-1982

Some Prognostications From Leaders of the Audio Industry

IN 1967, on the occasion of our 20th anniversary, we asked some of the pioneers of the audio industry to prognosticate, to look 20 years ahead and tell us what to expect. Now, as we look back we find many of these prophesies to be surprisingly accurate—the only error being the time factor. For instance, Herb Horowitz (Empire) said, "A black and white video disc should be appearing within three to five years, followed by full color video a few years later." And Saul Marantz, "The general public will have become much more discriminating about sound quality. It will expect and demand the highest standards of performance. Traditionally dedicated to advancing the state of the art in improving his products, the component manufacturer will have gained the larger share of the market." Joseph Tushinsky's remarks must have seemed very far fetched . . . "anything we say will be recorded automatically through some sort of tape system that will be available for immediate recall. If this comes to pass, the tape recorder of the future could even affect men's morals." However, this "science fiction" is closely paralleled in Alvin Toffler's recent book, "Future Shock," which tells us that soon everyone will have a kind of computer-recorder built in! Fortunately, we will be spared this scientific achievement for a few more years. . . .

We have asked the industry pioneers to stick their necks out once again and tell us what to expect in the next 10 years. Events are happening so rapidly these days, it was felt that a 20-year period is much too long. Some of the 1967 contributors are sadly no longer with us; Leonard Carduner passed away in 1970 and Haskell Blair just a few months ago. One or two—like Ed Villchur—are no longer in the industry so we have added a few names to the original list.

A. J. Hoffman
President
Acoustic Research, Inc.

Ed Villchur's comments in 1967 are largely still applicable. The movement towards integration continues. Quality continues to improve and size of [illegible] continues to shrink along with his prediction of improved treble dispersion from loudspeakers is coming true; much improvement has been made in the last five years. In the case of Acoustic Research, the AR-3a, AR-5 and AR-6, all introduced since 1967, follow Ed's prediction.

The recreation of the ambience of the concert hall through four channels will make slow but steady headway. Once the system and hardware have been settled, there will still be the resistance of the mistress of the house to having four speaker systems in the living room. In my opinion this is the greatest long-range hindrance to universal multi-channel reproduction in the home. It will be partially overcome by further reduction in the size of speaker systems without affecting quality and the use of attractive decorator colors.

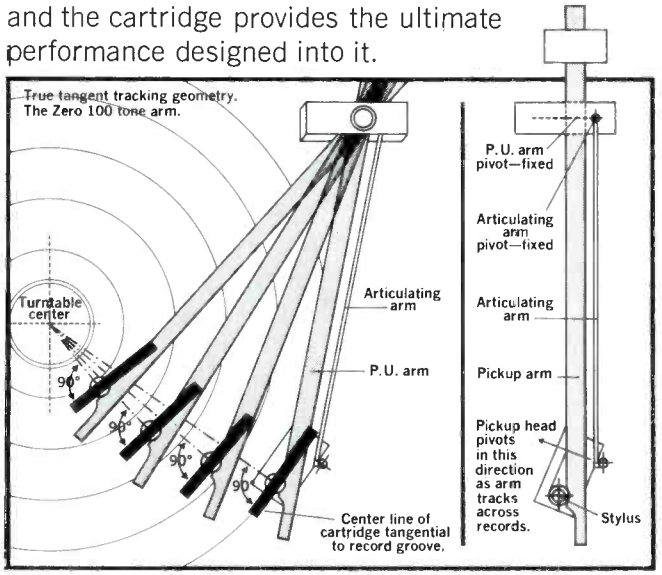
MUSIC GOES ON A RECORD AT A PERFECT TANGENT. NOW IT COMES OFF AT A PERFECT TANGENT.

For years, Zero Tracking Error has been the elusive goal of the automatic turntable maker.

The objective: to develop an arm which would keep the stylus perpendicularly tangent to the grooves... to each groove throughout the record, because this is the way music is put on a record.

Garrard's Zero 100 is the only automatic turntable to attain this. It is done with an ingeniously simple, but superbly engineered tone arm. Through the use of an articulating auxiliary arm, with precision pivots, the angle of the cartridge continually adjusts as it moves across the record.

The stylus is kept at a 90° tangent to the grooves... and the cartridge provides the ultimate performance designed into it.



The results have been recorded by experts in their reviews of the Zero 100. Some of them are saying things about this instrument that have never been said about an automatic turntable before.

They have confirmed that they can *hear* the difference that Zero Tracking Error makes in the sound, when the Zero 100 is tested against other top model turntables, in otherwise identical systems. Until now, we cannot recall any turntable feature being credited with a direct audible effect on sound reproduction. Usually that is reserved for the cartridge or other components in a sound system.

Zero Tracking Error is more than just a technical breakthrough. It translates into significantly truer reproduction, reduced distortion and longer record life.

Once we had achieved Zero Tracking Error, we made certain that the other features of this turntable were equally advanced. The Zero 100 has a combination of features you won't find in any other automatic turntable. These include variable speed control; illuminated strobe; magnetic anti-skating; viscous-damped cueing; 15° vertical tracking adjustment; the patented Garrard Synchro-Lab synchronous motor; and our exclusive two-point record support in automatic play.

The test reports by independent reviewers make fascinating reading. You can have them, plus a detailed 12-page brochure on the Zero 100. Write today to British Industries Co., Dept. E12, Westbury, New York 11590.

GARRARD ZERO 100

The only automatic turntable with Zero Tracking Error.

$189.50
less base and cartridge

Mfg. by Plessey Ltd. Dist. by British Industries Company

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Tape cassette technology should advance to the point at which cassettes equal or surpass disc records in quality, and the disc record as we know it will be in serious decline. But the disc as an information storage device is potentially very efficient, and it may be transformed within 10 years to a new kind of animal.

Semiconductor technology with modular chips certainly will result in smaller, cheaper, and more reliable hi-fi electronics products.

There is room for drastic improvement in TV sound systems, and it is logical that this would be a fertile ground for hi-fi expansion. There ought to be multi-channel high-fidelity TV sound to complement the flat TV screens that will be here.

The proliferation of new kinds of components as well as new brand names will for a time cause great confusion among consumers and will tend to blur the distinctions we have previously known between components that are truly faithful to the original sound and lesser equipment which assumes the appearance of high fidelity components but not the quality. Larger companies striving to market so-called high fidelity components on a tonnage basis have in the past proven incapable of consistently providing faithful reproduction equal to the state of the art. Whatever the reason, history has shown that this is more likely to come from small and medium sized component companies.

Joseph N. Benjamin
President
Benjamin Electronic
Sound Corp.

"...have seen so many changes in ...e years, that the projections which were supposed to last into the 1980's must be revised. I am just as sure that the projections we make now for the next 20 years will require revision before that time.

Two areas of development have come to the forefront. One is the ever increasing use of integrated circuitry with the consequent advantages of size, additional functions, and cost reduction. The second is, in conjunction with large scale integration (LSI), the additional control operations which can be accomplished.

Looking ahead at this time I see great strides being made in certain categories of high fidelity equipment, ie: receivers, turntables, and tape recorders. Taking each category by itself, the future looks this way to me:

Actual performance of receivers, that is, the ability to transform a broadcast signal to undistorted audio, has reached the state where very little can be done to improve the almost perfect reproduction now achieved. However, in regard to ease of operation, and additional control and remote functions, receivers will be considerably changed in the future. We should expect new remote control features including motor driven tuning and programming for simplified station selection, all incorporated in units occupying less physical space than those on the market today. A feature I expect to see shortly will be the instant replay feature of television, applied to radio. This may be in the form of a built-in memory unit (tape or otherwise) to enable you to reconstruct a program played a half-hour ago or so, by pushing a button.

The greatest advance in tape recorders and turntables will undoubtedly be in the extension of remote control and automatic modes of operation. Today, everyone expects a push-button to initiate actions such as power, tuning, program, and speaker selection in the receiver as well as in a tape recorder. We should also expect it in the new, practically weightless tonearm turntable of the future.

Audio power requirements are still increasing in the home just as commercial power requirements are increasing. As the home owner adds additional speakers and more elaborate equipment, he demands more from his system. Today's transistored equipment has come a long way from the early days of germanium output transistors and is as reliable as the electric clock on the wall. Overload control and main control circuitry has been developed to the point where there are very few problems, even with abuse of equipment.

The demand, however, for additional channels of sound probably will not be completely satisfied with today's four-channel operation, and this will increase the demand for power from the receiver.

Tomorrow's juvenile will be surrounded by sound in his own cocoon, (just as the narrator in Arthur Burgess' "Clockwork Orange") and this may demand as much as 12-channel reproduction. This will certainly be available from tape, but possibly from other program sources as well in the future.

There is much more, of course, to be said on this whole subject. These are but a few highlights in the explosion in electronics that is occurring today.

R. T. Bozak
The R. T. Bozak
Mfg. Co.

The past 25 years have seen the infant high fidelity industry grow from a relatively small group essentially of individuals to a mammoth industry, making their products available to an ever-increasing number of people and thereby almost swamping out the audiophile and his influence.

The biggest progress in this period has been the electronic art and technology. In this race the lowly loudspeaker just dragged along in a very unspectacular manner. Some would have us believe loudspeaker technology has advanced substantially because of numerous variations of the old theme, really there has been nothing radically new. Perhaps it might best be said: Their loudspeakers sound better because of better electronics.

The above remarks are not intended to convey a feeling of hopelessness for the loudspeaker. It can be said

The world's most distinguished musicians have chosen Acoustic Research high fidelity components for use in their homes.

The reason is accuracy. Professional musicians appreciate a stereo system that reproduces the musical performances of their colleagues and themselves while adding no coloration of its own. For applications where accuracy is the standard, AR components are the only logical choice.

Erich Leinsdorf	Karl Böhm	Claudio Abbado
Don Ellis	Seiji Ozawa	Aksel Schiøtz
Herbert von Karajan	Miles Davis	Judy Collins
Virgil Thomson	Arthur Fiedler	Dizzy Gillespie
Woody Herman	Evelyn Lear	Rafael Kubelik
Zubin Mehta	Thomas Stewart	Dietrich Fischer-Dieskau

AR
Acoustic Research

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with confidence that a revolution comparable to that we witnessed in electronics is in the offing. The exact nature and time cannot be foretold. It will be as different from the present-day loudspeaker as the vacuum tube is different from a transistor. It is stored somewhere in the next decade.

Simon Sheib
President
Avnet, Inc.
(Parent company of British Industries Corp.)

The next ten years will bring a continuation of what has occurred during the last ten years, during which everything relating to audio got better, and relatively cheaper. While the finest equipment is still expensive, the overall quality of all high fidelity equipment has improved.

The ability to produce fine equipment, at prices which more and more people can afford, will be the thrust of the next ten years. A decade ago the general public was just becoming interested in high fidelity. A much larger segment of this public is now interested. Within ten years, a geometrically larger proportion of the population will discover the pleasures of good sound, as well as the fact that they can afford it.

While I do not know whether there will be any startling innovations, I really do not believe that there is the need for any. Refinement of what we now have in more popular versions, and in more attractive and practical designs, will be the thrust of high fidelity in the 70's.

Herb Horowitz
President
Empire Scientific Corp.

Here's my prediction for the future. There will be four channel and even more channels as high fidelity heads towards the 1980's. Sound will come from all corners of the room, from the ceiling and from the floor. The listener will feel as though he is in a womb of high fidelity.

Video tape is here; video records are just around the corner. Then, we'll blend audio and video; audio visual effects will be part of sound.

For the near future, quality turntables are back with new low tracking force cartridges spurring their use. Speakers that look like useful furniture are in vogue.

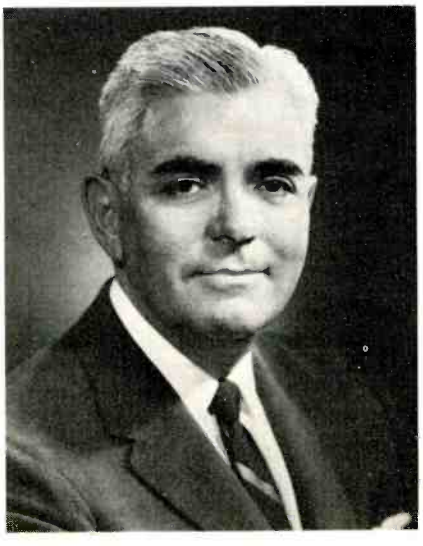
High quality sound for the great outdoors will come in the next few years. [illegible] speakers for the patio, back yard, [illegible] will usher in the develop- sounding outdoor radios.

And, for the icing on the cake, how about records that don't accumulate dirt coupled with hi-fi equipment that never wears out!

Avery Fisher
President
Fisher Radio

As one who began his manufacturing career in 1937 by offering a broad-tuning TRF receiver, I may perhaps be pardoned for some of the technological speculation that follows.

In my own lifetime virtually every area of man's experience and capability has literally exploded—and that is true whether we are speaking of the maximum speed at which human beings were traveling 50 years ago versus today, in space; whether one considers the maximum explosive power available in the "gentle" days of TNT versus today's nuclear fission bombs; whether one compares Marconi's beeps across the Atlantic with today's communications satellites in space. Wherever we turn, the change has been almost too much to comprehend. The same rate of development has of course been true in the electronics industry and the general public will unquestionably enjoy the benefits of a growing technology, whose end is not yet in sight. In my opinion, here is what we can look for in the next ten years, whether in the form of broader acceptance or original introduction:



More automatic operation of receivers, tuners and amplifiers; frequency indication by digital readouts; increased ease of operation through remote control; computerized design to eliminate parts tolerances; concentration of low level and high frequency circuits in a few LSI chips; power amplifiers on hybrid modules; integration of the complete stereo receiver unit in a home electronic control center serving also for paging, security and TV video recording and playback; the widespread use of cables, with multiplex techniques; the use of D-amplifiers in which the operating frequency is between 400 KHz to 1 MHz, allowing a great reduction in power dissipation, the size of heat sinks, and the unit itself. Speakers will remain substantially as they are today, with refinements; direct radiation will continue to dominate, with additional sound reflection from the walls, for increased texture; and the size of the overall units will continue large enough to allow comfortable space for many features that will be retained, or will appear in the future; the unchanging size of the human hand will be the key factor. And, as always, the race will be to the swift.

Steven F. Temmer
President
Gotham Audio Corp.
Neuman mics,
EMT studio and
lab equipment, K&H
speakers)

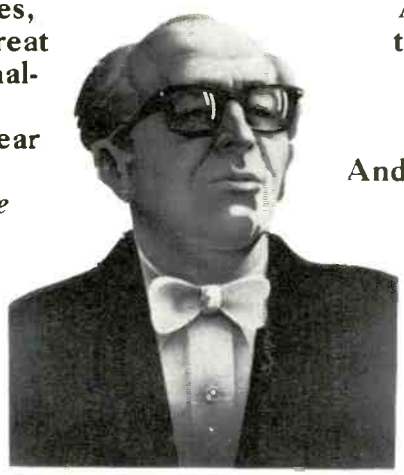
In re-reading my contribution to the May, 1967 issue on the occasion of AUDIO's 20th anniversary (my, how time flies), I think that the closer tie between audio and video I foresaw then still holds true today, especially in view of the fact that five years in this business is not a very long time. The prediction is about to come true with introduction of the color video disc with multi-channel sound scheduled for March 1973 release in West Germany. I see no benefits to anyone, least of all the consumer, from the "Quadrocondriacs" which are haunting the world of audio in the USA and Japan. Stereo, properly done (and that'll take a few years till we get to that

Copland's music challenges Altec's finest.

Aaron Copland's music: western prairies, big cities, Billy the Kid, Appalachian Spring, ballets, symphonies, chamber music, film scores. It's great American music. The kind that challenges a stereo.

Right now, we invite you to hear a particular piece at your Altec dealer—Aaron Copland's *Fanfare for the Common Man.*

Listen to it on Altec's finest stereo system and you hear every high and every low strong and clear. Because the big Altec Barcelona bi-amp speakers have an electronic crossover and two separate built-in power amplifiers. One to separately handle the highs. Another to separately handle the lows. Altec's finest system also includes the new Altec 724A tuner pre-amp with an exclusive 4 FET Varitronik tuner. So you hear better stereo separation. And finally, there's the Altec Acousta-Voicette stereo equalizer. It lets you hear, for the first time, the original acoustic environment of the recording hall rather than the acoustics of your room. Great American music sounds better on a great American stereo. Listen to it at your Altec dealer.



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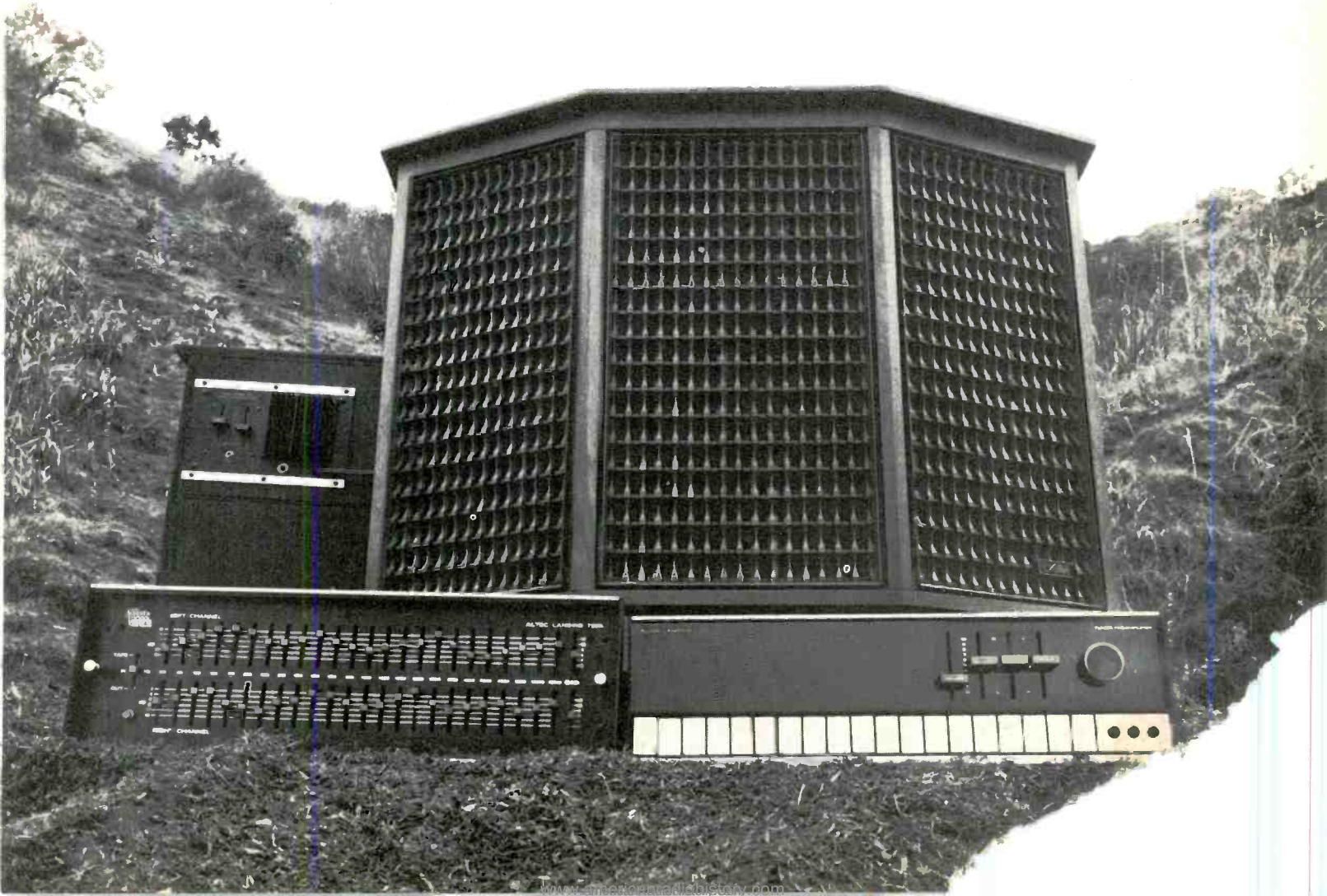

point), and played over systems costing as much as manufacturers would like the public to spend on four-channel, will without any question sound better than what looms on the horizon at present. We seem to have abandoned the fundamentals of communications: the transmission of information, in favor of transmission of location.

Watch for significant metamorphosis of the phonograph record, perhaps to a flimsy plastic film disk, such as the videodisc, and with it lower cost, multi-channel, lower noise, and higher fidelity all resulting from application, of the well known principals of FM to the recorded groove. But, records will be around forever, I am sure of that.

Sidney Harman
President,
Jervis Corp.
(Harman-Kardon & JBL)

I can recall readily and nostalgically those early days of the high fidelity industry when a large radio corporation payed us grudging acknowledgment with an advertisement in which a lunatic-looking fellow was presented before an array of hardware, tubes, transformers, and wire with the caption "High Fidelity for the Few." Immediately to his right, appeared an altogether proper looking fellow, listening intently to a furniture console, under the caption "High Fidelity for the Many." We were seen then as a foolish fringe, going nowhere. In those very first years of the industry, and of Harman-Kardon, I was fond of addressing small gatherings with the information that after only 18 months in business we were the world's largest manufacturer of Harman-Kardon high fidelity amplifiers and tuners. I think it correct to suggest that many of us—now regarded as pioneers—did not take ourselves very seriously in those early days and rather secretly shared the disrespect of the big companies, wondering from day to day when they would move in and take it all away from us.

Surely, the last 10 years have established the reality and the validity of the high fidelity component industry and surely no one needs my recitation of the desperate efforts of the big companies to find a place within it for themselves.

Still it seems most fundamentally clear that this is an industry ideally suited to the spirit and purpose of the small or relatively small company. It is no accident that components now represent the significant expression of home music reproduction equipment. They are in every way consonant with the changes in cultural value and life style which are dramatically evident around the world. The days in which the big house, the chauffeur-driven car, the over-stated furniture, were the symbols of status have yielded to the mobile society, the apartment dweller, the sports car, and quite significantly the sweet efficient expression of high fidelity componentry—which speak to performance, quality, and integrity, rather than to impression, personal power, and affectation.

There is a corollary between this still new kind of product and the small dedicated company composed of people who truly love what they are doing.

I am confident that the high fidelity component industry will grow steadily and wisely in this perspective and that it will be dominated over the next decade by people and companies who are genuinely creative and genuinely devoted to the constructive and loving service their products provide.

As for JBL and Harman-Kardon, I see intimate connections with the music makers and the young music listeners. I see continuing and increased interest in the exploration of new techniques, new materials, new textures, and new electrical and mechanical expression. It is precisely that enchantment with discovery and creativeness which has marked the successes of the past two decades and will identify the leaders of the next.

I. Grossman
President
KLH Research & Development

Perhaps the most immediate and significant development we'll see during the next ten years is a dramatic improvement in the performance of loudspeakers under $75. In a few years probably the only meaningful difference we'll have between very expensive and low-priced speakers will be in the power handling capability. The establishment of four channel will be immeasurably helped by these low-priced, small, high performance speakers which will, most likely, be packed four to a carton and matched at the factory. Four channel will give impetus to the development and marketing by the major manufacturers of still smaller, very uniform loudspeakers, well under $50, and these will markedly affect the private label or "black box" market.

We'll surely see a steady improvement of quality in the audio portion of TV programs as the caliber of the electronics and speakers in the receivers improve. Simulcasting of musical programs may even become a commonplace occurrence. The simulcasts over WGBH in Boston have been extremely well received, are popular, and will influence in large measure the adoption of simulcasting in other areas, particularly since the number of homes in which high quality playback equipment is available is growing continually at an accelerating rate.

Ken Kai
U.S. Pioneer Electronics Corp.

Unlike the song lyric that marvels at the up-to-dateness of Kansas City and the fact that it has "gone about as far as it can go," high fidelity, as I see it, is just starting to make use of the developments that have made possible a trip to the moon.

To put it succinctly, electronics and computers will play a dominant role in the high fidelity picture of the 1990's. They will help both audio and video

Crown

PROFESSIONAL STUDIO EQUIPMENT

Specs	15ips	7½ips
w. & fl.	0.06%	0.09%
f. resp. +2dB	40Hz to 30kHz	20Hz to 20kHz
S/N	-60dB	-60dB

3 speeds - 15, 7½ & 3¾ips; hysteresis synchronous drive motor

computer logic controls for safe, rapid tape handling and editing; full remote control optional

torque reel motors

"capable of providing the most faithful reproduction of sound through the magnetic recording medium . . . to date" -Audio magazine, 4/68

optional Trac-Sync

individual channel equalizers

third head monitor with A/B switch; meter monitoring of source, tape, output and source+tape; sound-with-sound, sound-on-sound and echo

2 mixing inputs per channel

individual channel bias adjust

"construction . . . rugged enough to withstand parachute drops" -Audio magazine, 4/68

$1790 for basic rack-mount half-track stereo deck, about $2300 with typical accessories; Formica floor console $295, rugged portable case - $69

modular construction with easy access to all 10 moving parts and plug-in circuit boards; deck rotates 360° in console, locks at any angle

CX822

RECORDERS & REPRODUCERS

SX711

Claimed by its pro audio owners to be the finest professional tape recorder value on the market today - price versus performance ■ Frequency response at 7½ips ±2dB 20Hz-20kHz, at 3¾ips ±2dB 20Hz-10kHz ■ Wow & flutter at 7½ips 0.09%, at 3¾ips 0.18% ■ S/N at 7½ips -60dB, at 3¾ips -55dB ■ Facilities: bias metering and adjustment, third head monitor with A/B switch, sound-with-sound, two mic or line inputs, meter monitoring same as CX822, 600Ω output ■ Remote start/stop optional, automatic stop in play mode ■ $895 for full-track mono deck as shown, $995 for half-track stereo deck

SP722

Ideal reproducer for automation systems ■ Meets or exceeds all NAB standards ■ Remote start/stop optional, automatic stop in play mode ■ $595 for half-track stereo reproducer

Crown tape recorders and reproducers are available in 42 models with almost any head configuration, including 4 channels in-line. Patented electro-magnetic brakes maintain ultra-light tape tension and never need adjusting. They are made by American craftsmen to professional quality standards, with industrial-grade construction for years of heavy use.

All Crown amplifiers are warranteed three years for parts and labor. They are 100% American-made to professional quality standards. All are fully protected against shorts, mismatch and open circuits. Construction is industrial-grade for years of continuous operation.

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STUDIO MONITOR AMPLIFIERS

D60

Delivers 30 watts RMS per channel at 8Ω ■ Takes only 1¾" rack space, weighs 8½ lbs. ■ IM distortion less than 0.05% from 1/10w to 30w at 8Ω ■ S/N 106dB below 30w output ■ $229 rack mount

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Delivers 75 watts RMS per channel at 8Ω ■ IM distortion less than 0.05% from 0.01w to 75w at 8Ω ■ S/N 110dB below 75w output ■ Takes 5¼" rack space, weighs 20 lbs. ■ $429 rack mount

DC300

Delivers 150 watts RMS per channel at 8Ω ■ IM distortion less than 0.05% from 0.01 w-150w at 8Ω ■ S/N 110dB be 150w output at 8Ω ■ Lab Stan formance and reliability ■ to absolute perfection a we have ever seen" 10/69 ■ $685 ra

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Check No. 28 on Reader Service C

products to achieve new heights in performance and versatility. In fact, the shape of things to come may very well not even resemble today's home entertainment products. For instance, it's not farfetched to envision a high fidelity receiver that can be wall mounted and lies flat as a picture frame. FM broadcasts would be computerized as would FM receivers. In place of the present electromechanical 3- or 4-gang capacitor tuning, electronics would take over this function completely.

Today's electronic calculators employ memory registers. A similar type of memory could be incorporated into a high fidelity receiver so that it automatically turns on the receiver at one or several designated times, pre-programed by the user, to record programs for playback at a later time. It's quite possible that the technique of recording 20 years from now may not even be on disc or tape, but something similar to a sheet of acetate that could possibly store the information for hundreds of musical compositions on something that measures as small as a sheet of typing paper.

The record player or turntable as we know it today is a result of continuous advancements and refinements. Cartridges can track as low as one half gram. Yet the basic design is electromechanical, a few steps removed from Edison's original concept of the stylus in a groove. Why not completely electronic?

What with improved cones, coils, and magnets, today's loud-speakers offer the finest in sound reproduction. Yet the design of the dynamic speaker goes back to the late twenties. It's still electro-mechanical. Here's another area that electronics can take over. After all, the sound we hear is simply the rearrangement of air molecules. Why can't it be done electronically?

We, at Pioneer, have made a total and continuing commitment to quality sound reproduction. We know high fidelity will constantly improve because of the increasing demands of the listening public, musical artists and dedicated high fidelity manufacturers. This total involvement is destined to produce the highest possible achievements in sound.

Dr. Harry F. Olson
RCA Laboratories

During the next decade there will [illegible] advances towards achieving both [illegible] and an ideal transfer characteristic. The perfect transfer characteristic is one in which constant relationships between the input and output parameters. In the ideal transfer characteristic, the relationship between the input and output parameters is modified as dictated by the subjective aspects involving realism and emotionalism. In order to attain the ideal transfer characteristic, by the application and implementation of the appropriate modifications to attain the desired

subjective characteristics of sound reproduction, the start must be from a perfect transfer characteristic.

The important factors involved in achieving a perfect transfer characteristic are frequency response and transient response, nonlinear distortion and signal-to-noise ratio. Today uniform response and faithful transient response over the audio frequency range can be achieved in all the elements of the various sound reproducing systems. However, imperceptible nonlinear distortion and adequate signal-to-noise ratio have not been achieved in some of the elements. These two important problems will certainly be solved in the next decade.

In the case of the major electroacoustic transducers, namely, the microphone and the loudspeaker, there will be major developments. Highly directional microphones with uniform directivity will be developed to provide discrimination against noise and other unwanted sounds. Loudspeakers of small cubical volume capable of reproducing the entire audio frequency range with adequate sound output will be developed.

In 95% of the records produced today, modifications of the original recorded sound are employed to heighten the artistic and emotional impact towards the goal of the ideal transfer characteristic. Delayers, frequency response and timbre modifiers, vibrato and tremolo generators, reverberators, and nonlinear distortion and fuzz producers are employed to modify the original recorded music. These and other electronic means will undergo improvements to enhance the subjective response. Electronic music synthesizers will be developed to a high order of excellence of performance to assist in achieving the ideal transfer characteristic. Auditory perspective and acoustic ambience are areas in which tremendous improvements in performance will be made.

To summarize: During the next decade there will be major objective improvements leading to a perfect transfer characteristic and almost limitless possibilities in the subjective aspects leading to an ideal transfer characteristic.

H. H. Scott
President
H. H. Scott, Inc.

High fidelity is both young and an old art. One may talk to Edison, Berliner, and many of the old pioneers, yet this field is changing constantly with new developments in sound recording and reproduction occurring frequently.

Within the short period of the last 10 years, we have witnessed the birth of commercial stereophonic broadcasting using only one FM station. This has brought high quality stereophonic sound to millions of listeners in the world—not only in their homes but also in their cars and in other places.

We have also witnessed the growth of the use of solid state devices in high fidelity equipment with the consequent demise of the vacuum tube in circuit design. Today most equipment employs solid state circuits with silicon devices being used almost exclusively. Ger-

(Continued on page 90)

it really comes alive...

It would be silly to ask if you dig real live sound. Of course you do. The same holds true for **quality** — for things that are **really** made, and **really** perform.

Our objective in developing the B-301 (**Tempo 1**) was to give you the best, most lifelike sound obtainable, in a well-engineered, well-constructed bookshelf system. The fact that performance fully met expectations, and that we could furnish full-fledged BOZAK construction quality for a modest price, were the real measures of its success.

The BOZAK B-301 is a three-way system based on a long-throw, high-compliance bass driver with a solid low-bass response. The high-compliance midrange unit with its well-damped aluminum cone was developed especially for this loudspeaker system: its clear definition, or transient response, is remarkable and we know of no other that can equal it. The latest version of the BOZAK high-frequency driver, originally introduced over twenty years ago, is highly regarded for its wide dispersion and silky-smooth response. All three drivers are of standard BOZAK quality — sturdily constructed, with generous magnet structures and unique BOZAK-made cones assembled on solid cast frames.

You will have to compare this speaker system to really appreciate it. And its price is very modest — especially for a real BOZAK!

the facts:

Bass Speaker: 12″ high-compliance, long-throw/**Midrange:** 4½″, with 2⅝″ damped aluminum cone on high-compliance suspension/**Treble:** 2″, with foam-damped diaphragm and wide dispersion/**Crossovers:** 1200 and 3600 Hz
Frequency Response: 40-20,000 Hz
Impedance: 8 Ohms/**Power Handling:** 40 Watts Program average/**Acoustical-Environmental Switch:** 3-position/**Enclosure:** oiled walnut, 14½″ x 23⅛″ x 11½″ deep
Grille: snap-out/**Weight:** 40 pounds.

Bozak

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THE LANGUAGE OF HIGH FIDELITY

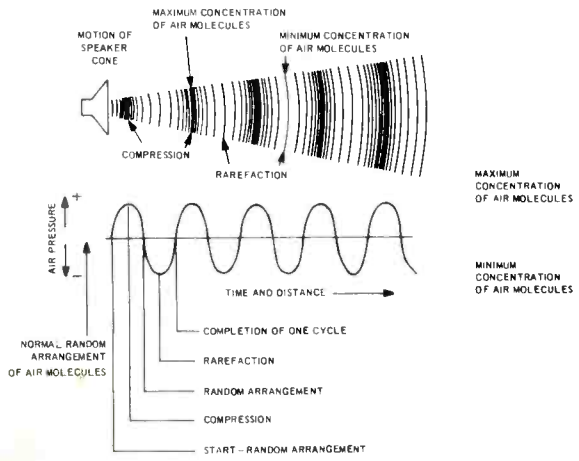
Martin Clifford

THIS IS THE FIRST of a series of articles intended to act as your guide to high-fidelity sound. Their purpose is not to make you a technician or engineer, but to supply an understanding of the electronic principles on which high fidelity is based. Buying high-fidelity equipment presupposes a certain measure of user sophistication, but the ability to talk about dB, IM, THD, bandwidth, signal-to-noise ratio, or anti-skating, doesn't necessarily involve understanding. Words such as these, and similar words and phrases, formerly confined to engineering discussions, have become part of the daily language of high fidelity. It is the intent of this series to strip these words of their mystery and, at the same time, to supply an overall concept of the roadblocks that stand between the creation of a sound source and the listener. Math will be detoured unless completely unavoidable. The design here is for comprehension, not engineering proficiency.

THERE ARE MANY DEFINITIONS of high fidelity for the simple reason that there is no single, satisfactory, all-encompassing concept. The manufacturer of a bargain-basement FM receiver refers to his product as high fidelity; so does the manufacturer of a thoroughly researched component selling for ten times the price. Two different units and two different definitions of high fidelity.

The search for high fidelity is like the search for the Holy Grail; elusive, tantalizing, always out of reach. And therein lies the charm and beauty of high-fidelity sound. It's a standard beyond obtaining. But each new technological advance, each new bit of research brings us that much closer. In the meantime we have in our homes music of a quality which was undreamed of just a few short decades ago.

But what is so difficult about high fidelity? Surely it should be easy to record an orchestra, or the human voice, convert it to its electrical equivalent, and then to reproduce it. Yes, that's no problem, for it has long since been solved. What is now involved is the reproduction of more subtle factors. If an orchestra records in a music hall, what we now want is to reproduce not only the orchestra, but the peculiar and individual acoustics of the music hall, for these acoustics have a direct effect on the recording. The room in which you listen, though, has its own acoustics. It is probably smaller; its reflective surfaces more or less sound absorbent. And, during a recording, not only is the direct sound recorded, but also the ambient sound—the sound reflected from walls, ceilings, people, seats. But when you play disc or tape, or listen to a receiver, your own room doesn't disappear. It adds its own ambience, and so what you hear isn't a true reproduction. Yes, headsets might solve this particular problem, and in this sense headsets are remarkably closer to true sound reproduction than speakers. Headsets, though, may present a psychological disadvantage. When you attend a live concert you have nothing pressing against and enclosing your ears, and so, to some people, headsets may prove a mental stumbling block.



The wave is a graphic representation of the compression and rarefaction of air molecules.

Sound Waves

Modern high-fidelity reproduction systems consist of arrangements of highly complex electronic circuits, far more sophisticated and detailed than they were a few years ago. But while high-fidelity circuitry has made tremendous forward advances, the basic stuff and substance of high fidelity has always remained the same. We start with sound.

Sound is rather unique for it is a form of energy, and there aren't too many such forms. Electrical energy is another one. So are light, heat, mechanical, and nuclear energy. And when you include chemical energy you have just about completed the list. This is a small compilation supplied by a nature generally profligate in its varieties. Fortunately it is enough. Equally fortunately, we can convert one form of energy into another, desirable since it leads directly to high-fidelity music reproduction in the home. We can take sound energy, change it to electrical energy, and then get it back to sound energy again. That is exactly what we do when we broadcast signals and receive them.

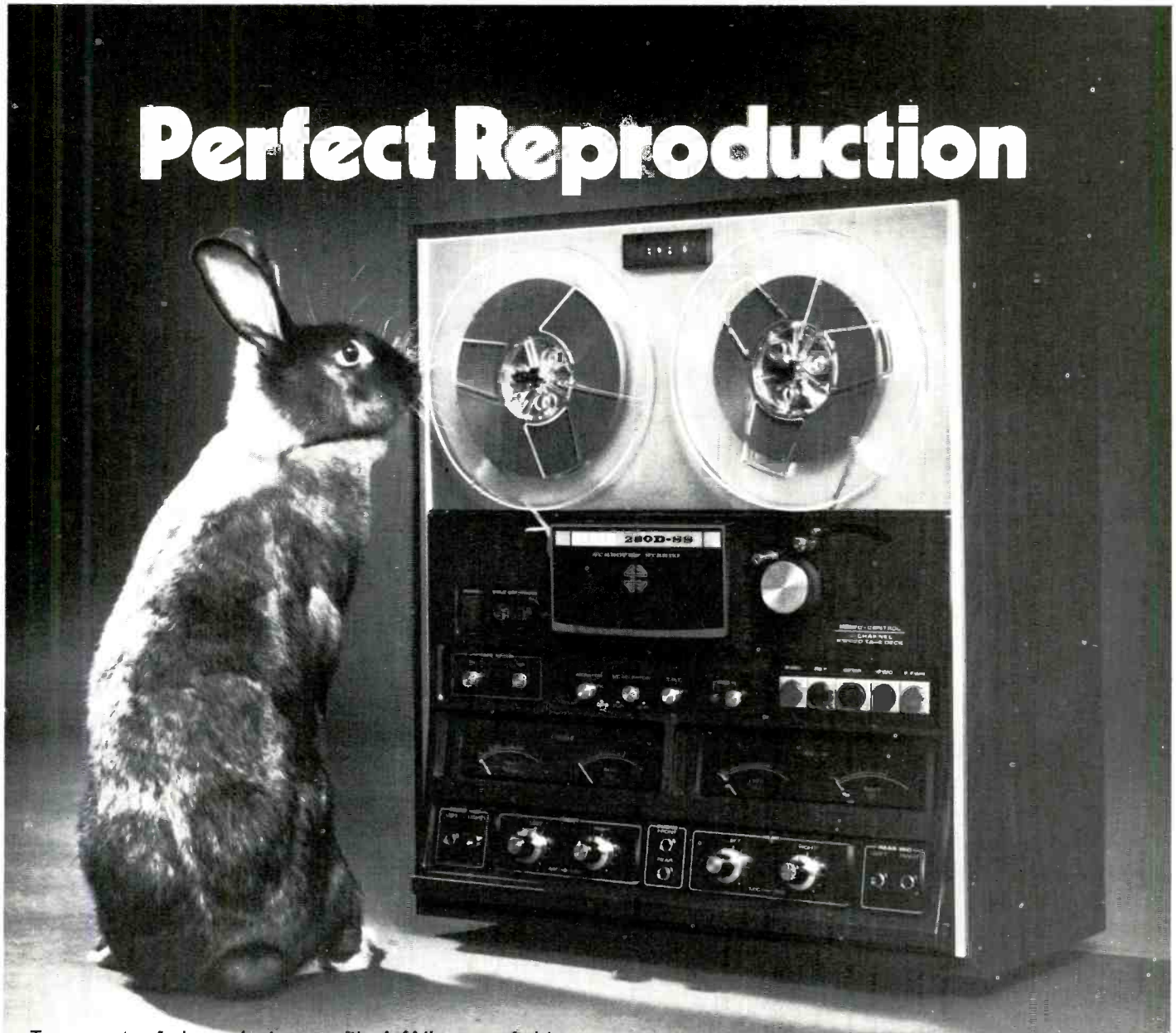
How Sound Waves Are Produced

It's easy to produce sound waves, too easy in fact, for it is almost impossible not to do so. We are constantly surrounded by sound and cannot avoid it. Listen, and you will hear the sound of your own breathing. You can escape from it but the alternative is unpleasant. Since it would be intolerable to be consciously aware of sound at all times, our brains perform a protective function and shut out most of it. We do need this help, but when we listen to music we must really learn to hear all over again. Listening to music requires a conscious, intelligent effort. It not only takes effort, it demands continuous practice.

The Production Of Sound

We live at the bottom of an ocean of air, a fortunate circumstance since it enables us to hear as well as breathe. Although invisible, air is made of particles of matter we call molecules, just as a brick wall is made of particles of matter. The difference between the two is in the kind of molecules used, their density (that is, the number of molecules per cubic inch), and their freedom of movement. Again, we are fortunate that air molecules can move for it is their motion that helps

Perfect Reproduction



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The 280D-SS creates the *new* sound. Records on four separate channels. Making it possible for you to play back through four separate speakers. To surround you in sound.

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And the fidelity is incomparable. Because the 280D-SS is loaded with sophisticated features.

Like 4 heads. 3 motors. 4 pre-amplifiers. Stereo Sound-on-Sound. And 4 VU meters for flawless recording. Plus Automatic Continuous Reverse in 2-channel mode. And it's compatible with all 2-channel conventional stereo sound systems.

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Perfect reproduction. AKAI's superbly engineered 280D-SS makes it possible. Hear it now. At your AKAI dealer.

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produce sound. However, this statement must be modified somewhat for air molecules are apparently in constant motion. Any wind is evidence of that.

But we aren't interested in the random motion of air molecules, but in their movement that results in sound. We can get sound if we force air molecules to travel in large groups, much like a pack train. This compacting of molecules, forcing molecules to acquire a greater unit density, is called compression. But if we compress molecules into a smaller space, we must take them from somewhere. Sound doesn't create molecules; it simply uses those that are available. Consequently, some parts of the space that surrounds us are deprived of molecules, an action known as rarefaction. Sound, then, is related to the compression and rarefaction of air molecules (Fig. 1).

This compression and rarefaction of air molecules is what happens when a musician draws a bow across a string. The vibrating string causes the air molecules to rearrange themselves in a very particular way, quite different, for example, from that resulting from a vibrating skin of a drum. In your home, the moving cone of your speaker produces compression and rarefaction of air molecules in an identical manner, enabling you to distinguish between a violin and a drum. If a speaker cone is able to do this reasonably well, we call it a high-fidelity unit. To the extent to which the cone adds its own compressions and rarefactions of air molecules it is not high fidelity, for then you are not longer listening to violin or drum music, but to cone music.

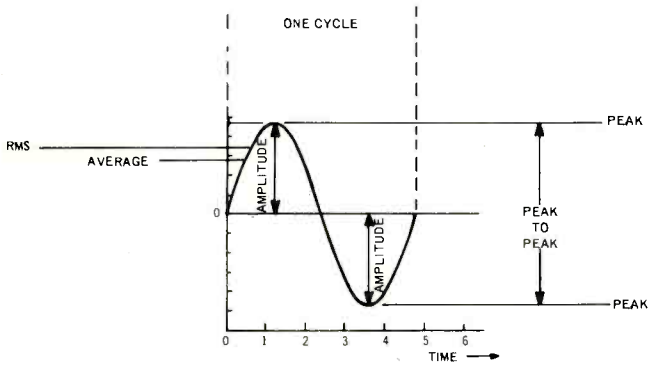


Fig. 2—A cycle is one complete waveform. The units along the bottom line are usually in seconds. The four ways of measuring this wave are average, rms (also known as effective value), peak, and peak-to-peak. These terms are often used in manufacturers' specification and catalog sheets.

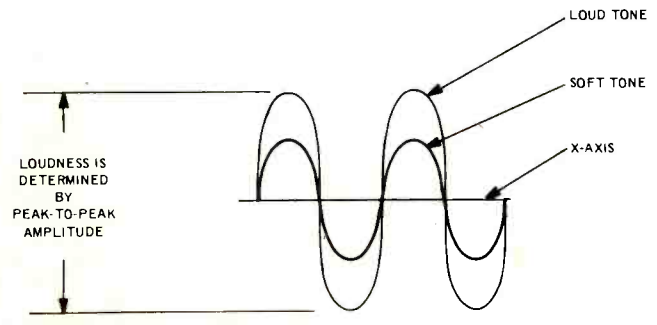


Fig. 3—The horizontal line or x-axis represents a condition of no sound or random arrangement of air molecules. As peaks become smaller, the waveform approaches the x-axis is caused by a reduction in the compression and rarefaction of the air molecules.

Kinds Of Sound Waves

It is quite unlikely that anyone else in the world writes in quite the same way you do, a simple fact on which banks place great reliance. Similarly, no two sound producing devices yield exactly the same combination of air molecules. The particular rearrangement of air molecules from all those that are present at random is the signature of the device producing the sound. The sound can be stronger or weaker, just as you can write your name larger or smaller, but there does seem to be an almost infinite number of ways in which air molecules can be patterned. This gives us the large variety of sounds which most of us take for granted. And, instead of referring to them as compressions and rarefactions of air molecules, an awkward phrase at best, we simplify and call them waves.

The Sine Wave

Although there is substantial evidence to the contrary, man does try to be a rational creature, particularly when it concerns science or some branch of it, such as electronics. There are tremendous numbers of waves, of all sizes, shapes and descriptions. Offhand, it would seem a chaotic condition and while we cannot, indeed would not, want the number of sound waves reduced, we can make some attempt at grouping them.

The simplest of all these, the most basic of all sound waves is called the sine wave. Technically, it is the graph of a trigonometric function called the sine. Not so technically, it is a readily reproducible acoustic ruler against which we can measure or compare other sound waves. It is rather easy to produce sine waves by electronic means. Devices that do this are called signal generators, or more simply, generators. But it isn't quite that easy to produce sine waves directly from musical instruments, for they ordinarily yield more complex waveforms.

The sine wave is not only our standard, but can be measured in a number of ways, leading to a set of values which, in turn, can be used as standards against which other kinds of waves can be measured or evaluated.

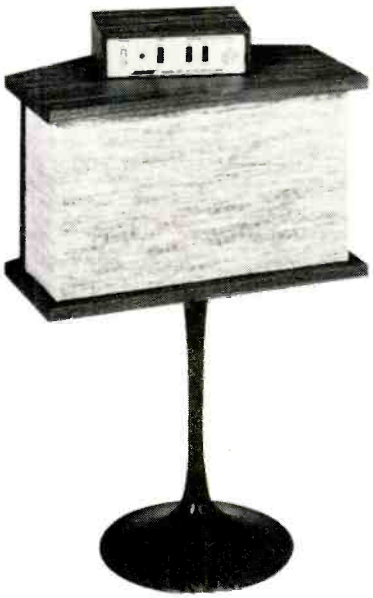
The maximum strength or amplitude of a waveform, sine or not, is called its peak value (Fig. 2). Ordinarily, a horizontal line is drawn through the exact center of the sine wave, dividing it into two equal portions, an upper and a lower. The upper part is called the positive half, and the lower the negative, although these terms are arbitrary and are used to identify the two halves. The horizontal line is synonymously termed the X axis, a reference that has about as much reality as the circumferential line drawn around the earth and known as the equator. It is just a convenient and useful fiction.

The distance from the x-axis to the maximum portion, either positive or negative of the wave, is called the peak value or peak amplitude, words you may often come across when reading manufacturer's spec sheets. Using the same identifying process mentioned earlier, the upper is the positive peak; the lower the negative peak. The distance from the positive to the negative peak is the peak-to-peak value, often abbreviated as p-p. Amplitude could also be called the loudness of sound and is determined by the difference between the maximum compression and maximum rarefaction (Fig. 3).

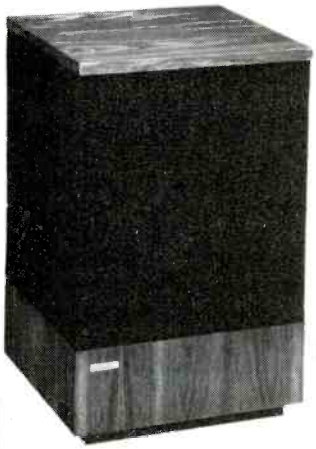
Instantaneous Values

The formation of a complete sine wave takes time. The two peak values, positive and negative, represent just two moments or two instants in the passage of time required for the completion of a sine wave. But we can have other instants as well. We can stop the conditions producing the wave at any moment we

Twelve years — Five major advances



BOSE 901*



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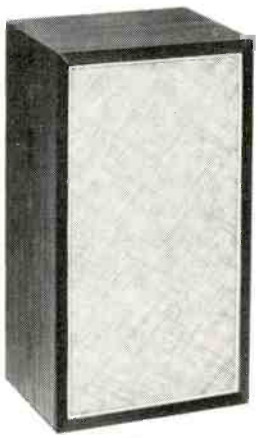
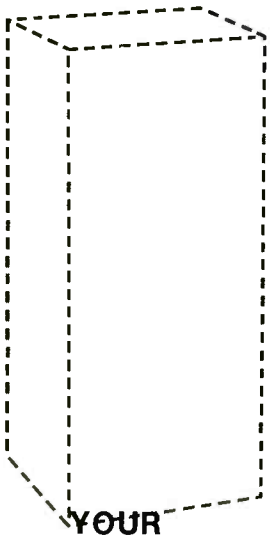


CONVENTIONAL SPEAKER



	BOSE 901*	BOSE 501*	CONVENTIONAL SPEAKER	YOUR SPEAKER ?
1	YES	NO	NO	
2	YES	NO	NO	
3	YES	YES	NO	
4	YES	YES	NO	
5	YES	YES	NO	

The twelve years of university research† that led to the design of the BOSE 901 and BOSE 501 DIRECT/REFLECTING® speaker systems revealed five design factors which optimize speaker performance:—

1 The use of a multiplicity of acoustically coupled full-range speakers — to provide a clarity and definition of musical instrument sounds that can not, to our knowledge, be obtained with the conventional technology of woofers, tweeters and crossovers.

2 The use of active equalization in combination with the multiplicity of full-range speakers — to provide an accuracy of musical timbre that can not, to our knowledge, be achieved with speakers alone.

3 The use of an optimum combination of direct and reflected sound — to provide the spatial fullness characteristic of live music.

4 The use of flat power response instead of the conventional flat frequency response — to produce the full balance of high frequencies without the shrillness usually associated with Hi-Fi.

5 Acoustical coupling to the room — designed quantitatively to take advantage of adjacent wall and floor surfaces to balance the spectrum of radiated sounds.

To appreciate the benefits of these five design factors, simply place the BOSE 901 directly on top of the largest and most expensive speakers your dealer carries and listen to the comparison.

You can hear the difference now.

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* Patents issued and applied for

† Copies of the Audio Engineering Society paper, 'ON THE DESIGN, MEASUREMENT AND EVALUATION OF LOUDSPEAKERS', by Dr. A. G. Bose, are available from Bose Corp. for fifty cents.

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wish, and measure the amplitude at that moment. The height of the wave above the x-axis at that instant is known, logically, as the instantaneous value. A wave can have any number of instantaneous values, beginning with zero at the start of the wave and reaching maximum at its peak (Fig. 4).

Average And RMS Values

Since the sine wave is to be the electronic ruler against which we will compare other waves, identifying the positive and negative peak values only makes about as much sense as calibrating a yardstick solely in half inches, a self-defeating gesture. To have an additional reference, we sometimes use average values.

To find the average value, we select an arbitrary number of instantaneous values using either the positive or negative half of the wave. We may select 50 or 100 instants during which we will "freeze" time and make a measurement from the x-axis to the waveform. Adding these values, and then dividing by the total number of instants, supplies us the average value. This turns out to be approximately 63% of either the positive or negative peak values.

Another measurement, more commonly used than average value, is root-mean-square value, abbreviated as rms, also found on maufacturers' spec sheets.

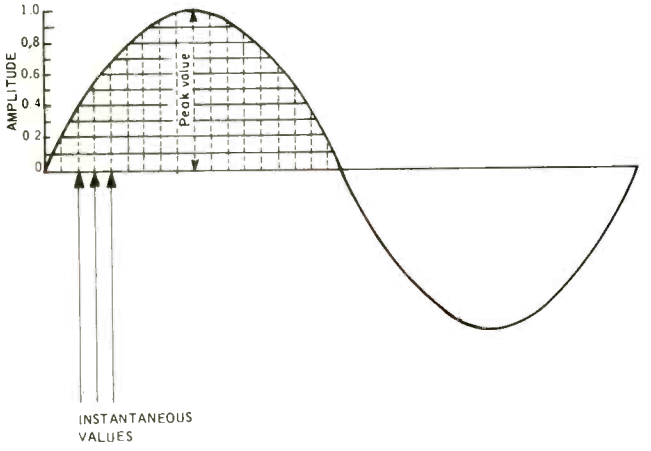

Fig. 4—A wave can have any number of instantaneous values, shown here by vertical lines drawn from the x-axis to the waveform. Peak value is an instantaneous value. Each sine wave has two such peaks; a positive peak and a negative peak, representing maximum compression and maximum rarefaction of air molecules.

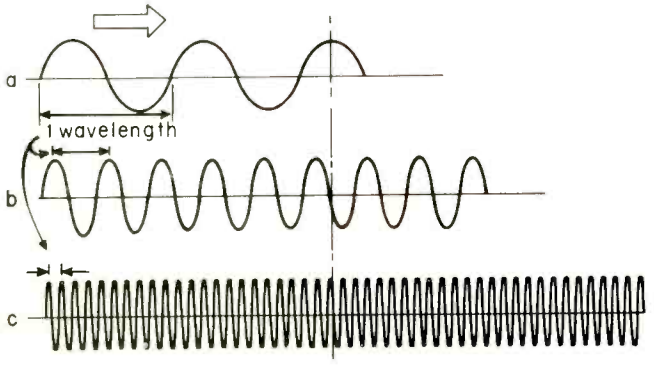

Fig. 5—Wavelength is the distance from start to finish of a single wave, or from the positive peak of one wave to the positive peak of the adjacent wave. Frequency is the number of complete waves per second. The frequency is increasing, drawing a, to b, to c.

The rms value of a sine wave is obtained in much the same way as the average value, but there is a slight variation. Instead of adding each instantaneous value directly, these values are squared. The squared values are then added and the square root is taken of the sum. The rms value of any sine wave turns out to be approximately 70.7% of the peak value.

Meaning Of Frequency

The number of sine waves available per unit of time, the second, is known as frequency. If you have just a single, complete sine wave consisting of a positive half and a negative half, and if this wave requires one second from start to finish, then the frequency is one complete sine wave per second. Since a single complete wave is more conveniently known as cycle, this particular frequency is one cycle per second, abbreviated as cps. The cycle per second has given way to the Hertz, to honor Heinrich Hertz, noted scientist of the late 19th century who pioneered in wave transmission. The Hertz, abbreviated as Hz, is equivalent to the cycle-per-second. Thus, 100 Hz is the same as 100 complete waves, all of which are accomplished in just one second.

Naturally, if we are going to have 100 waves in the same time it takes to complete 1 wave, the 100 waves are going to be squeezed. The distance from the start of a single wave to its completion is known as its wavelength, and is usually measured in meters. As we get more waves per second, the individual waves huddle closer together, and so the distance from start to finish of each single, complete wave becomes less. More elegantly stated, as frequency (number of waves per second) increases, wavelength (distance of wave from start to end) decreases. While both types of measurement are used, you will find frequency units indicated directly on the dial of your FM receiver. These numbers may begin with 86 and end with 108, and indicate millions of Hz. Thus, 86 is 86 megaHertz, an easier way of writing 86,000,000 Hz. Less chance of losing a zero or two (Fig. 5).

Frequency Response

Although we cannot see them without some electronic assistance, waves do take up space, and so if we are to have waves travel without interference through the air or electronic circuits, we must provide a roadway for them, just as we need four or eight lane highways for autos, depending on traffic conditions. The ability—or the inability—of a circuit to pass a large group of frequencies, is known as frequency response. Audio amplifiers, for example, are rated (among other ratings) on their ability to amplify uniformly a large band of frequencies ranging from as low as 15 Hz or 20 Hz to as much as 30,000 Hz or more.

Pure Tones

Because a sine wave is used as a wave reference, it is known as a pure tone. But this isn't the only reason for this designation. It is a pure tone because it isn't associated with other tones. It exists alone. Theoretically, it is possible to produce a pure tone on the violin if a string is bowed in its exact center. This is a most unusual condition since a musician, even when playing a single tone, vibrates his hand so as to produce anything but a pure tone. Further, as the violinist moves away from the exact center of the string, the string will not vibrate as a whole, but in parts. Finally, the string can vibrate as a whole and in parts, simultaneously, a condition which also applies to the piano. The result is that we hear, not a single pure tone (from which we get the word monotonous) but rather the pure tone plus a number of overtones. It is the sum of pure tone plus overtones which lends beauty to music. It is the number of overtones, their amplitude, the way they

If you have a power and performance fetish-cater to it.

When you're really serious about music you'd never sacrifice power for minimal distortion, or versatility for economy. You don't have to with Pioneer's new, dynamic generation of stereo components.

The Pioneer SA-1000 is the most advanced integrated stereo amplifier available. It offers refinements and features not found in any other stereo component of its type. With two power supplies, high power output is maintained with excellent stability. New direct coupled circuitry provides an extremely wide frequency response. With music power at 170 watts IHF (57+57 watts RMS, at 8 ohms, both channels operating) there's limitless power to drive two pairs of low efficiency speaker systems. Yet there's never any fear of overheating speaker voice coils with the advanced protector circuit. Harmonic distortion is less than 0.3%. The SA-1000 is sensibly priced at $329.95. And Pioneer guarantees that the unit you buy will meet or exceed these specs for a year or it will be replaced free.

For the TX-1000 AM-FM stereo tuner, overcrowded or weak FM signals are no challenge. It's designed to deliver optimum reception. An excellent 1.7uV sensitivity is achieved with four FET's and two RF stages in the front end. Selectivity is a highly effective 70dB with a 1.5dB capture ratio due to four IC's plus crystal and IC filters in the IF section. Large twin tuning meters assure minimum noise and maximum stereo separation. Unlike conventional tuners, you can plug in stereo headphones since the TX-1000 has its own built-in amp. At $299.95, it's hard to find a tuner that approaches it for better reception and convenience features.

And for power hungry hi-fi buffs who love records and tapes and rarely use the FM bands, two other matching Pioneer tuners are available with lower prices.

See your Pioneer dealer. He will prove this new generation of fine instruments can outperform any other units in their price range.

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start and finish, that determines the timbre of a tone, the particular characteristics of a tone that enable us to distinguish between a violin and a flute. If you want to hear pure tones, listen to the low notes of a flute or the sine-wave output of a generator.

The combination of a basic sine wave plus overtones produces a complex wave. Each overtone is actually a sine wave also, but when combined with a fundamental the sum of the waves is anything but a sine wave.

The fundamental sine wave of a musical tone has a particular frequency. For bass tones, the frequency is low; for treble tones the frequency is much higher. Each overtone, though, is higher in frequency than the fundamental. The second overtone has twice the frequency of the fundamental, the third three times the frequency, and so on. But if we combine a fundamental and a number of overtones, we no longer contend with a single frequency, but a group of them. And that is what you hear when listening. Again, whether, you will hear the fundamental plus *all* the overtones depends on the equipment you have. Loss of some of the higher frequency overtones is called distortion, but this distortion is just one of the many ways in which you can be robbed of your musical enjoyment.

Transducers

Sound waves, such as those produced by musical instruments or the human voice, can be changed into electrical form by a microphone, a device belonging to a general class of instruments known as transducers. A transducer changes one form of energy to another. Microphones change sound energy to electrical energy. A speaker is a transducer, even though its work is the antithesis of a microphone. Speakers change electrical energy into sound waves. The concepts of wavelength, frequency, and measurements such as average, rms, peak and p-p, are more commonly applied to electrical, rather than sound waves.

The word "harmonic" is used in place of overtone after a sound wave has been converted to its electrical equivalent. Harmonics and overtones are the same; it all depends on when you use them.

Transients

Although music consists of fundamentals sine waves plus related overtones yielding a complex waveform, we think of the music as being continuous. The pitch and amplitude may change, but we still consider it an uninterrupted sequence of sound. Actually, though, music contains sounds, known as transients, which start abruptly and which may also terminate that way. Bowing a violin string can produce a sound whose instantaneous amplitude is very large. Percussion instruments

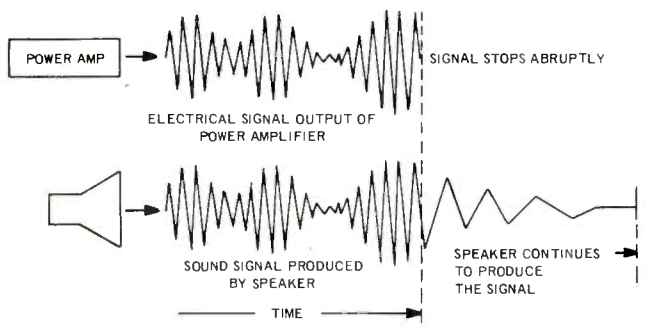


Fig. 5—The inertia of the cone makes it difficult for the cone to move instantaneously. The movement of the cone after the end of the signal produces sound not present in the source.

are more dramatic examples. And so, electronic circuits, such as amplifiers, must not only be capable of handling a wide range of frequencies, but transient sounds as well. An inability to do so results in transient distortion, a condition in which an electronic circuit modifies the transient to conform to its own limitations. Transient tones can cause amplifiers to act as generators, producing signals of their own. And so, an amplifier with poor transient response becomes a member of the orchestra, adding sounds not present in the original. Because the amplifier now has two signals to work with—the original transient and the self-produced signal—it can become overloaded. Incapable of handling so much signal, the amplifier distorts, a condition we could call overload distortion.

A transient can stop as suddenly as it starts. Since a speaker cone has inertia, it may continue its movement, thereby producing sound when no sound should exist. And so transient distortion can exist right at the last moment, at the speaker output (Fig. 6).

There are many kinds of distortion, other than transient, and the extent to which a sound reproducing system can avoid them is an indication of its right to claim the label "high fidelity."

Frequency Distortion

Sounds produced by the human voice and musical instruments range from a low of around 16 Hz, or possibly a little lower, to around 18,000 Hz, or somewhat higher. The piano has a range of about 26 cycles to 4,096 cycles, with almost all musical instruments coming within this spectrum. And, since the end keys of the piano are rarely used, the range is really narrower than indicated. The piccolo is an exception and can get up beyond the high notes of the piano, but the organ is really the tonal master. It extends from a low 16 cycles to 16,384 cycles.

What we are talking about here are fundamental tones. But each of these tones is accompanied by overtones, some of which are 20 times the frequency of the fundamental. And so, if we're talking about a fundamental of 3,000 cycles, the 20th harmonic would be $20 \times 3{,}000 = 60{,}000$, well outside human hearing range, regardless of age, sex or musical training. The third overtone of a 5,000 cycle tone gets very close to the auditory limit for most people.

While we may refer to 16 Hz to 18,000 Hz as the audible range, it doesn't follow that this is *your* range. What you can hear depends on your state of health, the condition of your hearing apparatus, your sex, your age, and quite possibly your brain or mental attitudes. Further, you have no assurance that you hear equally well with both ears. However, high-fidelity equipment is designed with the assumption that your auditory response is perfect.

However, sound reproducing systems, like human beings, are also not perfect. If a music system is incapable of responding to and amplifying equally well all of the sounds—the wide gamut from low to high frequencies—it is guilty of frequency distortion. Oddly enough, both amplifiers and human hearing are capable of improvements—the electronic system through better design and the human through more careful listening, musical education and experience. If your hi fi doesn't sound as good today as it did originally, then it's possible you have improved, assuming no deterioration in your gear.

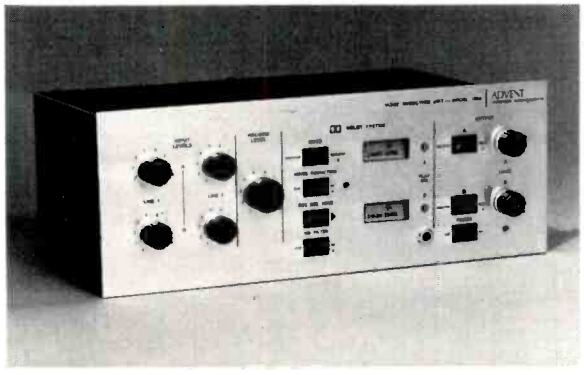
Frequency distortion doesn't start at any particular place. It may begin with the first transducer, the microphone, or the pickup unit of your record player, or your speakers. Frequency distrortion often consists of a roll off at the low and high ends of the sound range. Less often, it consists of higher or lower than normal amplification in the midrange.

Harmonic Distortion

A pure sine wave contains no harmonics and is a single frequency waveform. Its strength can be varied but this does

Some Clear Information on the Newest Product Using the Dolby System.

For more than two years, the Advent Model 100 Noise Reduction Unit has been the fullest and most flexible version of the Dolby System for home use. Now, new uses for the Dolby process have prompted us to make a new model, the 100A, with unspectacular but important engineering changes designed to match it to every likely Dolby application now and in the future. If you are a demanding listener and recordist, the changes are worth understanding.



The Advent Model 100A Noise Reduction Unit $250
The Advent MPR-1 Microphone Preamp (not shown) $25

The Dolby System Now

Originally designed to improve master tapes (and by extension the records made from them), the Dolby Noise Reduction System was next applied to consumer tape recording (both for home tapes and commercially recorded cassettes), and most recently to FM broadcasting. Identical "B-Type" Dolby circuitry now applies both to consumer tape and FM, and its tenfold reduction of high-frequency noise and interference effects produces striking improvements in sound quality—which have been well documented by listeners and critics. As dramatic as the improvements have been in tape quality, the change in FM signal quality may prove even more so, since Dolby-processed broadcasting can bring in many formerly unlistenable FM signals free of distortion and noise. Experimental Dolby broadcasts already have led WQXR in New York to use the process full-time.

The 100A

The changes designed into the Model 100A are intended to help the listener make every use of the Dolby process without having to switch interconnecting cables or fumble with temporary solutions to different needs. No other product provides for regular use of all of the following functions:

- Playing *and* taping Dolby-encoded FM broadcasts simultaneously.
- Dubbing Dolby recordings from any source.
- Making sound-on-sound Dolby recordings.
- Making genuine source-tape comparisons of Dolby-processed signals.

Making "Live" Dolby Recordings

The 100A is a recording center of enormous versatility which takes over the recording control functions of a tape machine and performs them more precisely and repeatably. Its four individually controlled line inputs provide signal-mixing capabilities that only professional recorders can duplicate. When combined with an Advent MPR-1 low-noise microphone preamp, the Model 100A makes it possible to use balanced microphone connections for running long mike cables on location without hum pickup. Two MPR-1's (which can both be powered by the 100A) make it possible to mix four balanced mikes. All of which may not matter until you get seriously into "live" taping—when it will matter a great deal.

There Is More

The Model 100A is just versatile enough to make a full explanation impossible in this space. If you would like complete information on the 100A, please write us at the address below. Thank you.

Advent Corporation, 195 Albany Street, Cambridge, Massachusetts 02139.

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not change (or should not) its frequency. A harmonic can be an odd or even multiple of the fundamental. If the fundamental is 440 Hz, the second harmonic is twice this or 880 Hz. Since the second harmonic has a frequency twice that of the fundamental sine wave, it is one octave removed from it. A fourth harmonic would be 4 × 440 = 1,760 Hz. Both the second and fourth harmonics are also known as even-order harmonics. The third harmonic is 3 × 440 = 1,320 Hz and the fifth is 5 × 440 Hz = 2,200 Hz.

A fundamental plus a single harmonic, the second, combines to form a complex wave (Fig. 7). The appearance of this wave depends directly on the time of starting and stopping of the two waves, and their strengths relative to each other. Just a simple shift in amplitude or the time at which they both reach zero can result in a tremendous number of different complex waves. The problem is further complicated when higher-order harmonics are involved. Harmonic distortion involves the changing of the time or amplitude relationships of harmonics to the fundamental.

Harmonic distortion takes place when additional frequencies are produced—frequencies which are multiples of the fundamental. If a fundamental wave having a frequency of 440 Hz becomes distorted, the distorted wave can be resolved back into a fundamental, but not a fundamental alone. It will be a fundamental plus one or more harmonics, all of which are sine waves. Whether these harmonics will be annoying will depend on their amplitude and frequency. Harmonic distortion may cause reproduced music to sound artificial. Total harmonic distortion, THD, is the sum of all the harmonics produced by a distorting element. Harmonic distortion can be evaluated by feeding a pure sine wave into an audio system, measuring the amplitude of harmonics produced with relation to the amplitude of the fundamental, and expressing this as a percentage. Thus, 1% harmonic distortion means that the amplitude of the harmonic is 1/100 of the original pure sine wave input.

Intermodulation Distortion

Intermodulation distortion, or IM, another type of distortion, takes place when two or more waveforms travel through an electronic device at the same time, and this is usually the case. Assume a wave of 440 Hz and 1,000 Hz are being amplified simultaneously, and that the lower frequency is quite strong, so much so that it causes the amplifier to act in a nonlinear manner—that is, it will not amplify without distorting. The 440 Hz wave has its greatest strength during the times of its positive and negative peaks, and so it may be only during these intervals that the amplifier distorts. But the higher frequency wave—the 1,000 Hz wave—will have a number of positive and negative peaks during the time of distortion and so this will become distorted.

The result will be a variation of the 1,000 Hz wave at a 440 Hz rate. The term intermodulation distortion refers to the fact that one wave modulates or changes the waveform of another. But whenever a waveform is made to change its shape, new harmonics are produced. And since these harmonics are not supposed to be present, they are called distortion products.

IM distortion is evaluated by a testing device designed to receive two signal inputs, a low- and a higher-frequency signal. At the output, the amount of low-frequency signal contained in the high-frequency signal is measured and expressed as a percentage. Thus, 2% IM distortion means that 2% of the low-frequency signal has become part of the higher-frequency wave. IM distortion is considered much more serious than harmonic distortion since its effects are more noticeable and annoying.

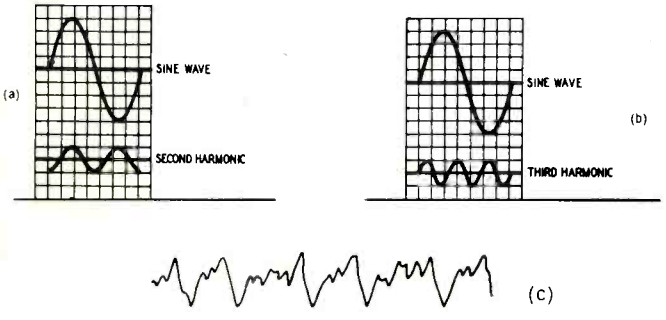

Fig. 7—Complex waves consist of fundamentals plus related harmonics. The combination of these waves results in a complex waveform that has very little resemblance to a sine wave, (a) sine wave and its second harmonic; (b) sine wave ...hird harmonic; (c) complex waveform of a violin tone. ...orm can be resolved into a sine wave plus a number ...also sine waves.

Phase Distortion

Waves do not always start and stop at the same time, any more than you would expect all the trains in a depot to pull out simultaneously. The time separation between pairs of waves is called phase. If two waves begin at exactly the same time, and they rise and fall in step, they are in phase; if not, they are out of phase.

Waves do not travel through electronic equipment with the same speed. Electronic parts may favor the passage of some frequencies while temporarily barring others. As a result, waves of different frequencies which may enter electronic equipment simultaneously, or which may be only slightly separated in time, may have their phase differences increased. This change in time separation is called phase distortion, but it is ordinarily not noticeable. Phase distortion isn't one of the terms you will usually find in manufacturers' specs. Phase becomes important in connecting speakers or may become noticeable in speaker systems.

Voltage

When a transducer such as a microphone, changes sound energy, the result is a corresponding wave, but in electrical form. The wave is actually a voltage with the sine wave sometimes referred to as a voltage sine wave. Another name for voltage is electromotive force or emf. While the basic unit is the volt, we are often concerned with much smaller amounts such as the millivolt, or thousandth of a volt, and microvolt, or millionth of a volt. The signal picked up by an FM antenna is in the order of microvolts. It would take an amplification of one million to increase the microvolt to a volt, something easily done by modern equipment.

What's Next

We started with something quite simple—the sine wave, but soon made matters complicated, for we don't listen to sine waves, but to complex waves—combinations of sine waves and harmonics. We've already indicated some of the dangers that await the complex wave in its travels through electronic components, but that is just the beginning of the story. We must somehow manage to get the sound to your home, either by broadcasting it or by recording it on disc or tape. All during these operations the wave is in constant danger of change. Part of the problem stems from the fact that no wave is an island unto itself. It must coexist with other waves, joining with them, but not altering them, nor permitting itself to be altered. The whole concept is known as high fidelity.

The next step is to consider electronic parts—the parts we use to hold our waves, amplify them, and deliver them in augmented form, but not distorted. And that's coming next!

The Dual 1219.

Still the favorite of the purist who insists upon a full-size professional turntable.

Ever since its introduction two years ago, the 1219 has been widely acclaimed and accepted as the "no-compromise" automatic turntable.

Today, it is still the favorite of the more serious music lovers, those purists who are never quite satisfied unless every component in their system is "state-of-the-art."

From years of listening, these record lovers know that on a Dual, any Dual, records are preserved indefinitely and continue to sound as good as new no matter how often played. Yet over the years, they have purchased more "high-end" Duals than any other model. Readers of the largest music magazine, for example, have purchased more 1219's than any other turntable at any price. That is quite a tribute for a turntable that sells for $185.00.

The reasons for the 1219's continued popularity vary from purist to purist. To many, it's the tonearm, centered and balanced within the two concentric rings of a gyroscopic gimbal. With horizontal bearing friction less than fifteen thousandths of a gram. When a cartridge actually arrives that can track at a quarter of a gram, this tonearm will do it full justice.

To others, the 1219's platter is important. It's a full-size 12 inches in diameter, cast in one piece non-magnetic zinc alloy, and individually dynamically balanced. To drive this massive seven pound platter, there is a powerful continuous-pole motor that brings it up to full speed in less than half a revolution. Then the motor's synchronous element takes over to hold speed at absolute constancy.

We find that most people interested in a turntable of the 1219's caliber use it primarily in its single-play mode. So the tonearm was specifically engineered to perform precisely as a manual tonearm: parallel to the record instead of tilting down. This is accomplished by the Mode Selector which lowers the entire tonearm base for the single-play mode. And raises it for the multiple-play mode.

To the purist, all of the 1219's many precision features are important. But in the end he buys this Dual for the same reason a non-purist buys it. For its uncompromised performance and absolute reliability.

If you'd like to know what the independent test labs say about the 1219, we'll send you complete reprints of their reports. Plus a reprint of an article from this magazine that tells you what to look for in record playing equipment.

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A simple Matrix-Type Unit for the Dynaquad Four-Dimensional System

Erno Borbely

THE FOUR-DIMENSIONAL SYSTEM described by David Hafler in AUDIO Magazine (July, 1970) is based on adding additional information to the two stereo channels in such a way that multichannel reproduction can be approximated. The Hafler system is completely compatible with present broadcasting, recording, and playback techniques. In this system the four sound sources appear in a diamond format and are called left (L), right (R), front (F) and back (B) (see Fig. 1). Any of these sound sources may of course be a composite from several microphones arranged so as to pick up sounds from that particular side of the hall. The four sound sources are combined in such a way that we have L+F+B on one channel and R+F+B on the other channel. In other words the two stereo channels will now contain the conventional left and right information, as well as added front information which is in phase in both channels, and back information which is out of phase in the two channels.

Using the suggested playback arrangement, where the four speakers are placed in the diamond format, Fig. 2, the left and right speakers receive L+F+B and R+F-B signals respectively. The front speaker receives the sum of the two channels, or L+R+2F (the "B" portion is cancelled). The back speaker is fed with the difference information, or L-R+2B, with the "F" signal cancelled.

The straight addition of the two channels can be accomplished by simple summing networks, using operational amplifiers. The basic operational amplifier circuit is shown in Fig. 3. The output voltage is given by:

$$e_0 = -\left(e_1 \frac{R}{R_1} + e_2 \frac{R}{R_2} + e_3 \frac{R}{R_3} + \cdots e_n \frac{R}{R_n}\right)$$

If we make $R_1 = R_2 = R_3 = \ldots R_n = R$, the output voltage becomes:

$e_0 = -(e_1 + e_2 + e_3 + \ldots e_n)$

which means a straight summation. The minus sign before the parentheses indicates a phase inversion, but the phase relationship between the signals is not changed. The (+) or non-inverting amplifier input has so far not been utilized. If we apply a signal to this input, it will appear at the output out of phase with the signals on the (-) input. Figure 4 shows this arrangement. The gain from the (+) input is given by:

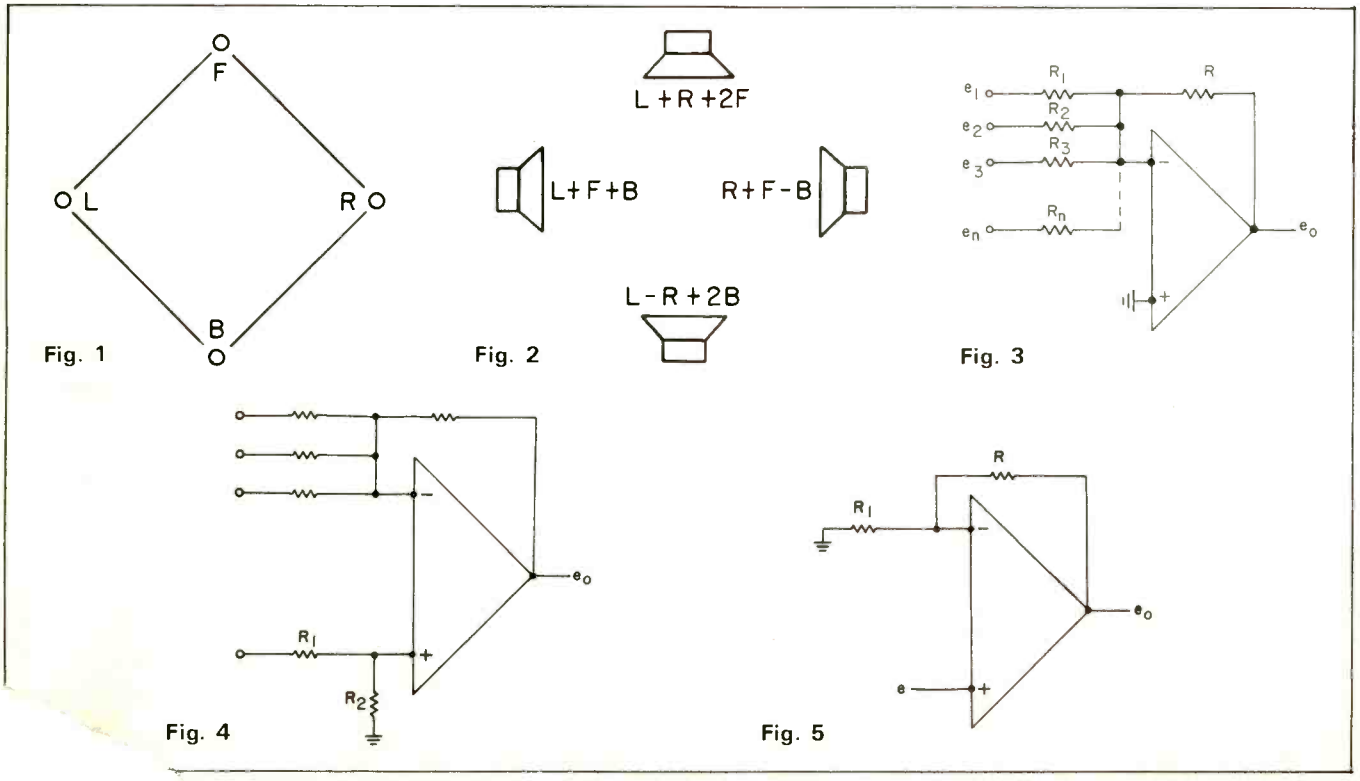
$$e_0 = e\,\frac{R + R_1}{R_1} = e\left(\frac{R}{R_1} + 1\right)$$

If we use n input resistors at the (-) input, as in Fig. 3, and assume again that $R_1 = R_2 = R_3 = \ldots R_n = R$, the gain from the (+) input will be:

$$e_0 = e\,\frac{R + \frac{R}{n}}{\frac{R}{n}} = e\,(n + 1)$$

If we also want to make the gain unity from the (+) input, all we need to do is to divide e by (n+1). This can be done by a resistive divider at the (+) input, see Fig. 5. Since the attenuation is given by $R_1 + R_2 \div R_2$, it simply means that $R_1 = n\,R_2$. Normally R_1 is made equal to the input resistors at the (-) input, so that $R_2 = R \div n$.

Before we describe a practical mixer circuit, based on available IC operational amplifiers, we must remember that the gain formulae mentioned



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with an incredibly gentle tone arm to protect your stylus and record

Getting in the groove—making sure that the stylus really does make contact with the diametrically opposite parts of the groove—isn't just hip talk. A lot of engineering goes into making it happen correctly in the ELAC 50H MARK II.

Imagine an automatic tonearm that lowers so slowly, so lightly to your records that you can hardly tell when it touches the groove. You certainly can't hear it. At your command, a touch of the exclusive pushbutton control picks the arm up automatically and a silicone-damped piston lowers it lighter than a floating feather to your record. It's the ultimate in protection.

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Play your instrument along with records — you can vary turntable speed by plus/minus 3%. Then return it to its precise original speed thanks to a built-in illuminated stroboscopic speed indicator. And no matter how your power-line voltage fluctuates, the exclusive hysteresis-synchronous motor insures constant, locked-in speed.

When you're ready to groove it —listen to the ELAC 50H MARK II.

ELAC

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earlier are based on a zero source impedance; otherwise, this impedance must be included in the circuit impedances while computing the gain. Fortunately modern operational amplifiers have high input impedance, allowing us to use high value resistors in the summing networks.

The following circuit is based on the assumption that R_g = 600 ohms, which means that the mixer can be used with standard 600 ohm circuitry. If high impedance volume controls (up to 50K ohms) must be included, a simple emitter-follower will give the necessary matching to the inputs.

The National Semiconductor type LM301A integrated circuit has been chosen for the mixer. This is a second generation general purpose operational amplifier available in an 8-lead TO-5 or 8-lead mini-DIP package. As compared to the first generation 709, the 301A has the advantage of being short-circuit protected. Another advantage is the complete lack of crossover distortion, even with a 600 ohm load. The frequency response can be optimized using a two pole compensation technique giving a minimum power bandwidth of 15 kHz. Figure 6 shows a practical mixer circuit, where the available outputs are L+F+B and R+F–B. By using a plus-minus supply the inputs can be direct-coupled unless the sources have an offset voltage of more than a few hundred millivolts. Remember that any d.c. voltages present at the inputs will also be summed and thus can limit the output swing capability of the mixer.

With zero offset voltage from the sources, the output of the mixer will also stay quite close to the 0 Vd.c.—usually within a few millivolts. Normally, therefore, the output can also be direct-coupled to the load. If for any reason a d.c. blocking capacitor is required, it should be a non-polarized type, since there is no d.c. voltage at the output to polarize it in the proper direction.

The harmonic distortion is shown as a function of the frequency in Fig. 7. Figure 7a shows the distortion for the upper mixer, one input driven, the other two grounded. Maximum output voltage into 600 ohms is equal to or greater than 18 dbm (6.2 volts rms). Distortion is less than 0.1% between 50 Hz and 15 kHz @ +18 dbm. Figure 7b shows the distortion for the lower mixer, driven at the non-inverting input, with the two inverting inputs grounded. Distortion is below 0.2% between 50 Hz and 15 kHz @ +18 dbm.

Many of the four channel recordings available on tape are in the rectangular format shown in Fig. 8, rather than in the diamond format. This arrangement can also be easily matrixed into the two transmission channels.

If we define the front sound as a+b, the left side as a+c, the right side as b+d, and the rear as c–d, we can use the same conversion David Hafler used for converting the diamond format into two channels: one channel will be left plus front plus rear, and the other is right plus front minus rear. Algebraically:

(L+F+B) = 2a + b + 2c – d

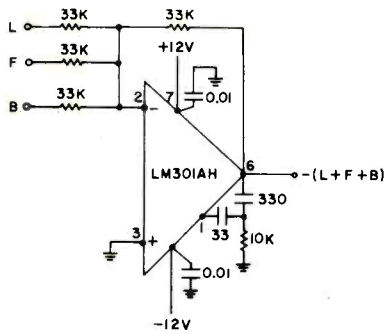
(R+F-B) = a + 2b - c + 2d

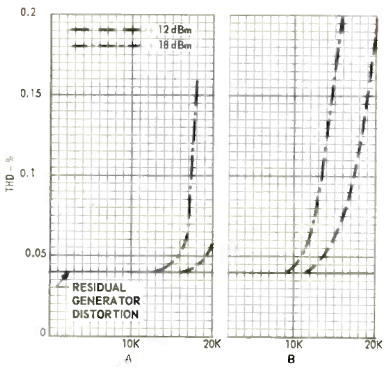
If the transmission uses the above, we can play it back in the diamond format shown in Fig. 2. We establish the front information by addition and the rear by subtraction while the two sides use the direct information. The sum and difference will give a significant shift of energy between front and rear:

Front: 3a + 3b + c + d

Rear: a – b + 3c – 3d

The same two channels can also be played back in the rectangular (four





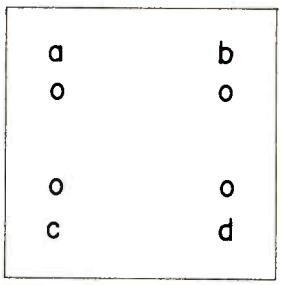


Fig. 8

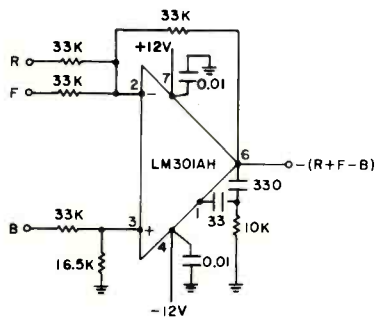


Fig. 6

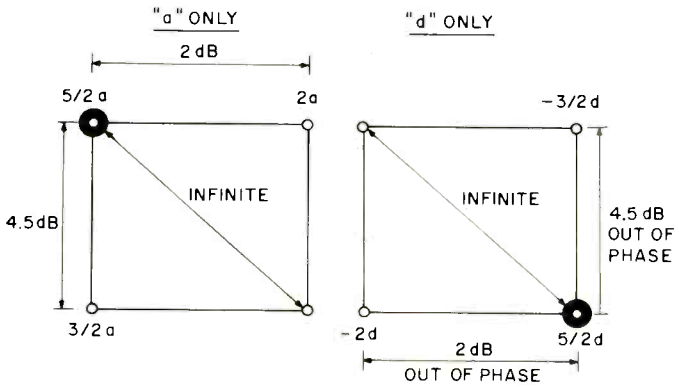


Fig. 9

We invite you to see the BSR McDonald

810

Transcription Series Automatic Turntable

Only your personal inspection of the 810 can reveal its overall excellence. From its Sequential Cam System that antiquates the conventional noisy cam gear and swinging plate to its Synchronous Power Unit, the BSR McDonald 810 is designed to match or exceed the performance of any automatic turntable currently available.

Some other highlights of the 810 include a Variable Pitch Control, a 12" dynamically balanced turntable platter, a viscous-damped cue and pause control with an exclusive friction Cue Clutch to keep the tone arm cued over the exact groove, an automatic tone arm lock to eliminate accidental damage to the stylus or record, a Concentric Gimbal Arm Mount and featherweight push-button operation featuring the widest selection of operating modes.

But again we must suggest a personal inspection. Your BSR dealer will be pleased to arrange one.

The 810 will sell for $149.50. Yes, $149.50. From BSR. The world's largest manufacturer of automatic turntables.

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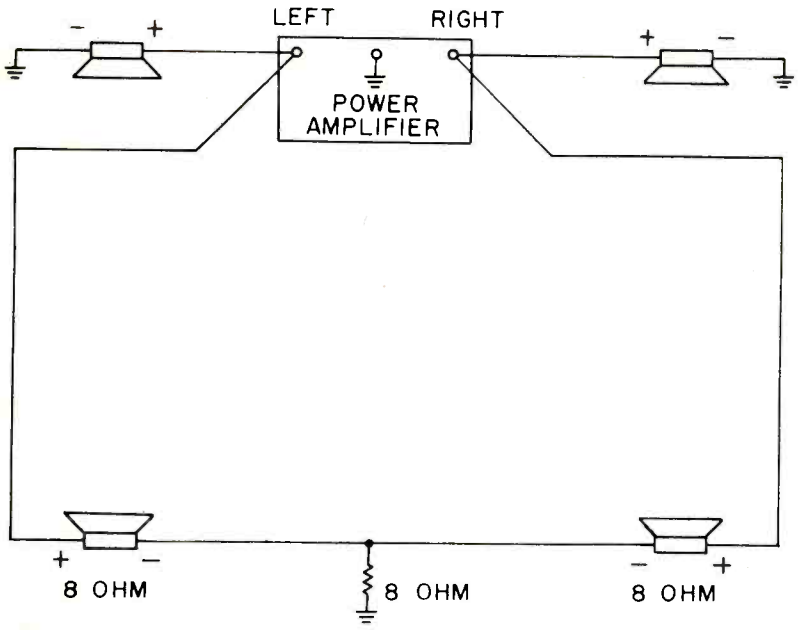


Fig. 10

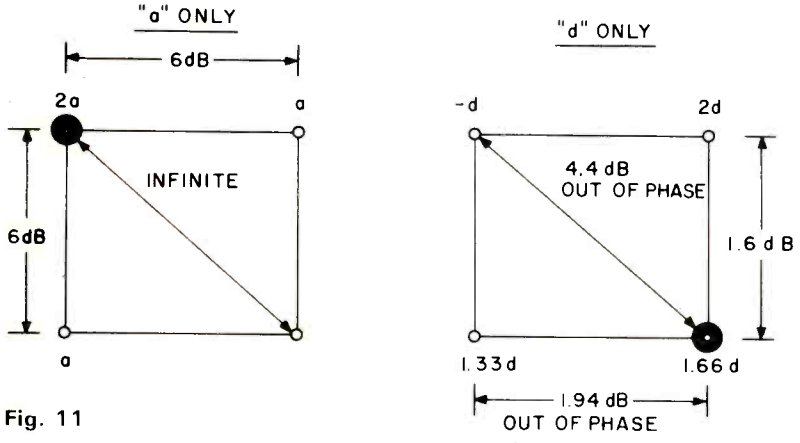
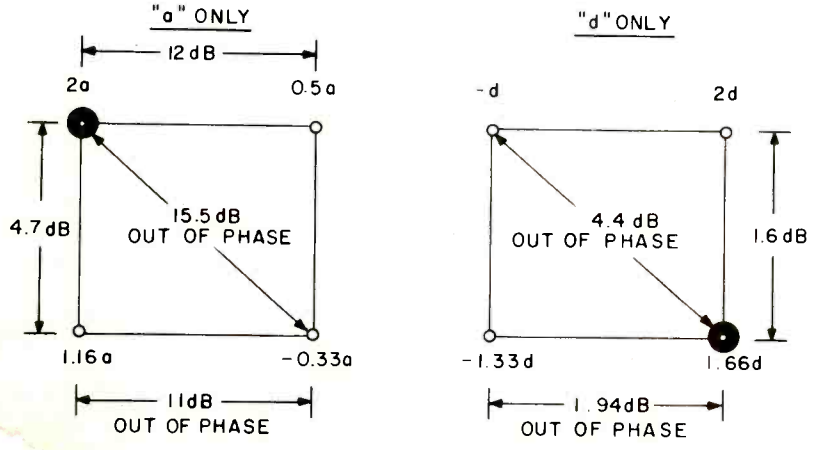


Fig. 11



corner) format. There are some options here, which enable maximum utilization of the front-to-back directionality, or maximum left-to-right separation, or a compromise. The options must take into account relative freedom of listener placement, recording allowances made to provide compatibility with monophonic and two-channel stereo playback as well, plus the available flexibility of the playback (pre) amplifier. These options involve choosing to use, or not to use positive cross-feed or blending, as well as negative (anti-) blending in varying amounts.

One possible choice which provides maximum isolation of diagonally opposite signals, and thus may be considered in one sense to provide maximum separation, achieves the following:

Left + 1/2 Right: 5/2a + 2b + 3/2c [Speaker a]
Right + 1/2 Left: 2a + 5/2b - 3/2d [Speaker b]
Left - 1/2 Right: 3/2 a + 5/2c - 2d [Speaker c]
Right - 1/2 Left: 3/2b + 5/2d - 2c [Speaker d]

Figure 9 shows the energy distribution between loudspeakers with "a only" and "d only" signals for the above arrangement. This system limits the left-to-right separation, although discrete directionality is still apparent to a listener positioned toward the rear of the listening area.

An alternative and simplified decoding system uses the direct signals to feed the left-front and right-front speakers while the rear speakers c and d are driven with 2/3L - 1/3R and 2/3R - 1/3L signals respectively. This can be accomplished with matching rear speakers by using a ground return resistor of the same value as the nominal impedance of one of the back speakers. The speaker connections for this system are shown in Fig. 10. (*Note:* A commercial version of this circuit with added convenience features is marketed as the Dynaco Quadaptor and the Lafayette Dynaquad adapter for under $30.00.) Figure 11 shows energy distribution between loudspeakers with "a only" and "d only" signals for this configuration. Note the increased separation between the front speakers with "a only" signal.

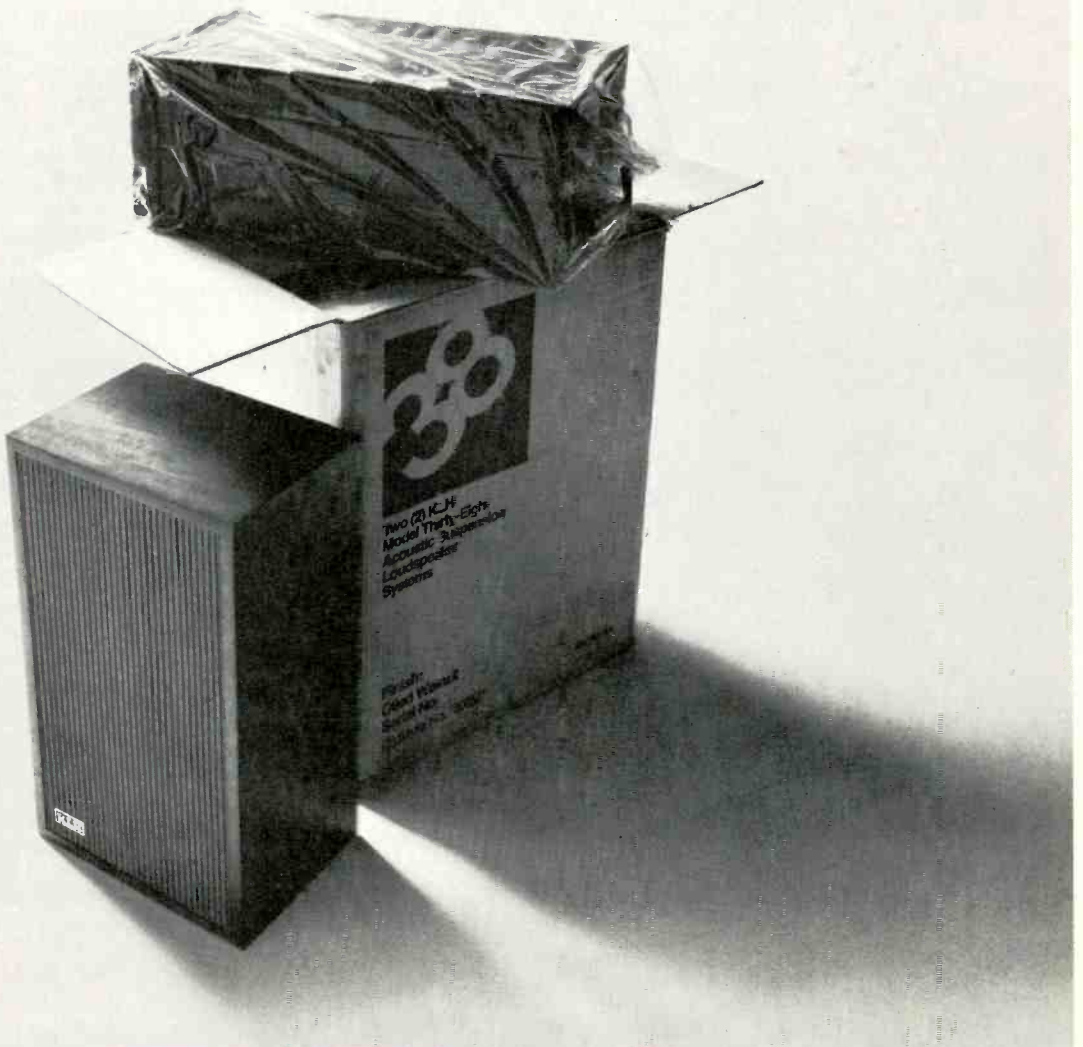
This decoding system has a further virtue in that a 5th speaker identical to the back speakers may be substituted for the ground return resistor as shown in Fig. 10. This speaker reproduces the sum information (L+R) and thus is an ideal center speaker, or it may be used

We doubt that anyone will be overly surprised to learn that our newest loudspeaker sounds terrific. Most people really expect KLH to make terrific sounding things. But at $62.50† a piece, our new Model Thirty-Eight delivers an amount and quality of sound that we think will astonish even our most avid fans. The bass response is absolutely staggering; the transient response is flawless; and the Thirty-Eight's overall smoothness matches anything we've ever heard. Most important, you can use a pair of Thirty-Eights with virtually any modestly priced receiver. (What good is an inexpensive pair of loudspeakers that need a $400 receiver to effectively drive them?)

The Thirty-Eights are at your KLH dealer now. After hearing them, we think you'd pay $125 for just one. But $125 buys you *two*. Which has got to make the Thirty-Eights the biggest stereo bargain since ears.

For more information, visit your KLH dealer or write to KLH Research and Development, 30 Cross Street, Cambridge, Mass. 02139.

The New KLH Model Thirty-Eight. Two for $125.†



KLH RESEARCH AND DEVELOPMENT
A Division of the Singer Company

†Suggested east coast retail price. Slightly higher in the south and west. *A trademark of The Singer Company.

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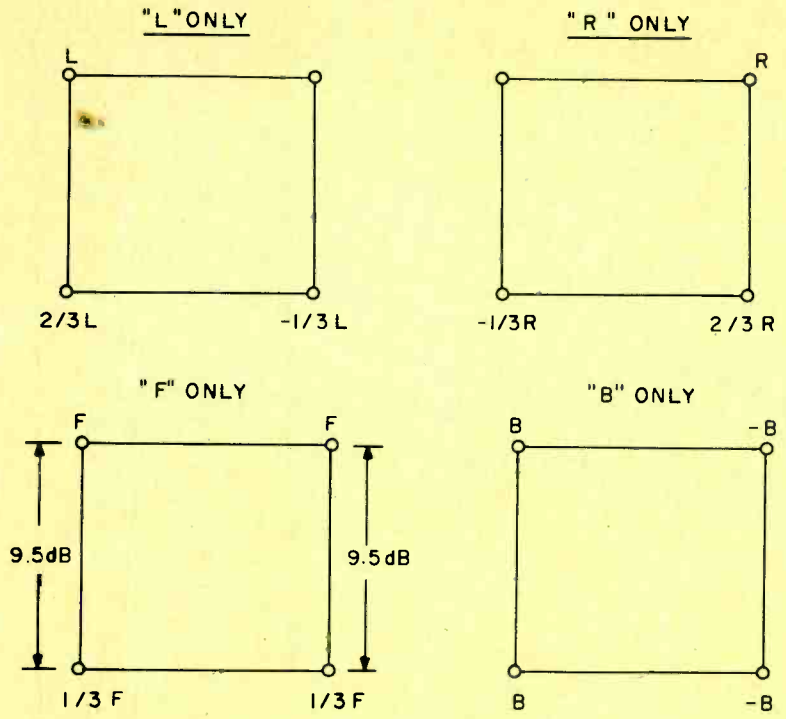

Fig. 13

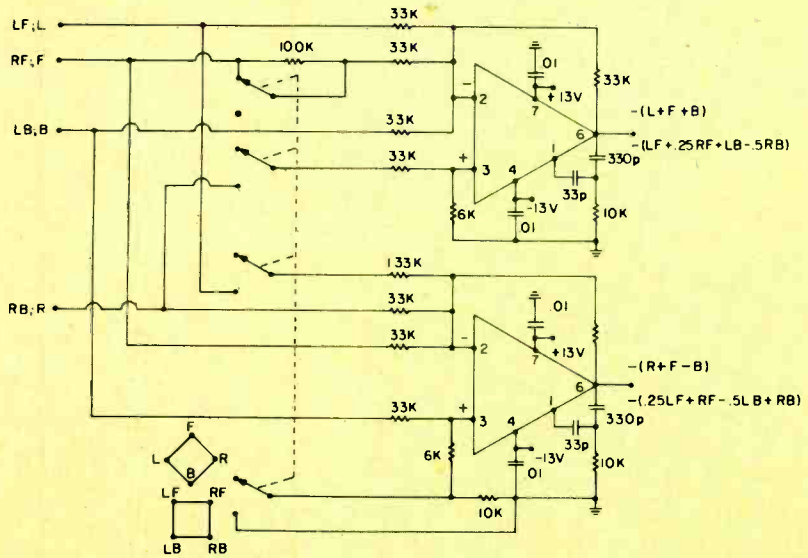

Fig. 14

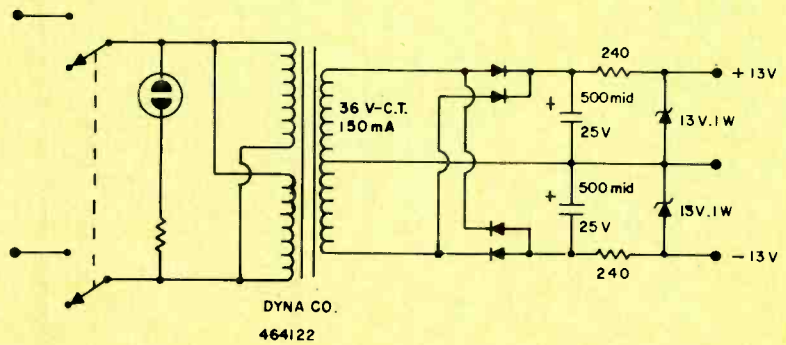

Fig. 15

as a mono extension speaker in a remote location.

If we now assume that the above-described decoding is the simplest and most practical way to play back four-dimensional information, then the question arises of a more suitable recording matrix to achieve optimum results overall. Although the infinite diagonal separation with an "a only" signal will give correct directionality with "a" predominant, the 50% crossfeed between a and b (6 dB separation) will provide a rather narrow spread for the listener who uses only the two conventional stereo playback channels. Decreasing the front crossfeed to 25% provides 12 dB separation for normal two-channel playback, which is more than adequate for proper stereo localization. This gives the following:

Left: 2a + 1/2b + 2c - d

Right: 1/2a + 2b - c + 2d

Using these two signals directly for the front a and b speakers and decoding with the Quadaptor for c and d will give the energy distribution shown in Fig. 12 with "a only" and "d only" signals. We can see that with an "a only" signal, now that the front left-to-right separation has been increased to 12 dB, the left front-to-back separation is reduced to 4.7 dB, which means that the localization of a normal left channel source is moved slightly toward the left rear speaker. This can be compensated for by reducing the volume of the rear speakers, depending on the listener's position.

While the majority of listeners will find that the rectangular speaker placement will conform to more room layouts, there is no need to limit microphone pickups to this pattern because of the compatibility of the two systems. In fact, most musical presentations will fit the diamond microphone pattern more effectively, with the front microphone providing the soloist pickup as at present in most recordings, and the back microphone provides the "hall sound" or ambience information. Decoded through the Quadaptor for the four corner speaker arrangement, this system will provide correct directionality for left, right and front signals, and give a non-directional back or ambience signal. Figure 13 shows the energy distribution for this combination with isolated left, right, front and back signals.

A mixer which offers the facility of recording or broadcasting in either the diamond or four-corner microphone configuration is schematically shown in Fig. 14. It has unity gain in both diamond and rectangular formats and operates at line levels. A simple zener-stabilized power supply is shown in Fig. 15. Æ

Our new 60-watt receiver. For people who want more power than a 100-watt receiver.

It isn't hard for some high fidelity companies to turn a 40-watt receiver into a 100-watt receiver. All they have to do is overestimate their own power.

Instead of testing their receivers at every audible frequency, for instance, they use one easy-to-reproduce frequency. Or they use "peak power" or "IHF" watts instead of true RMS watts. Or omit distortion figures.

This is similar to computing a golf score by counting only the best holes. The results look terrific but they don't correspond with reality.

You can avoid this sort of inflation by buying the new Harman-Kardon 630 receiver.

The 630 produces 30/30 RMS watts at less than 0.5% total harmonic distortion from 20Hz to 20kHz, both channels driven simultaneously into an 8-ohm noninductive load at standard line voltage.

Which is more than many 100-watt receivers can say, and that's why they don't. (If the power rating of a receiver isn't phrased exactly this way, you owe it to yourself to be suspicious.)

But the 630 not only gives you more power than so-called 100-watt receivers; it makes better use of the power.

The 630, like our 90-watt receiver (the 930), uses a unique system called "twin power."

Other receivers have only one power source, which lets them function perfectly well with quiet musical passages. But when a sudden tone burst comes along, one channel robs the extra power it needs from the other channel—weakening both and creating distortion in the process.

The 630 eliminates this in-fighting between channels by having an independent power supply for each. So no matter how difficult the musical passage, both channels can handle it flawlessly.

Of course, all of this has a price. Fortunately, it's a moderate one: $299.95.

For that, you can buy a receiver with more watts than ours. But you can't buy one with more power.

For more information, write us: Harman-Kardon Incorporated, 55 Ames Court, Plainview, L.I., N.Y. 11803.

harman/kardon
The Music Company

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The most sophisticated components

The Heathkit "Computer Tuner" — the most significant breakthrough in FM stereo since solid state

With the new AJ-1510 "Computer Tuner", Heath engineers bring you a new generation of tuner design — essentially a digital computer programmed to receive FM stereo. A design solidly based on computer technology — encompassing digital logic, scalers, dividers, decoders, programmers, counters and registers. Result — the most significant breakthrough in audio technology since the advent of solid-state — and a tuner squarely aimed at the discriminating audiophile who judges his electronics in terms of brilliant performance and personal convenience.

Advanced design. The "Computer Tuner" is the most sophisticated tuner design in stereo, employing new devices and digital circuitry to achieve a level of performance unobtainable before. Examples: 55 integrated circuits. A digital frequency synthesizer employing phase-lock-loop techniques does the station tuning, with channel frequency accuracy better than 0.005%. An inductorless digital frequency discriminator of the pulse counting (averaging) type follows two fixed-tuned five-pole LC IF filters, eliminating all IF and discriminator adjustments while achieving distortion levels of 0.1%. The preassembled varactor FM RF tuning unit (front end) uses FETs for better than 1.8 uV sensitivity and low cross modulation with no overload on strong local station signals. What all this advanced circuitry means is simply this. If you live in a large metropolitan area, finding that weaker FM station is no longer a hit-or-miss situation. The AJ-1510 will pick it out and bring it to your speakers free of distortion — regardless of strong adjacent stations. If you live in a rural area, relying on distant weaker signals for your stereo enjoyment, the 1510 will seek out your station and present it with such clarity and fidelity you'll think the transmitter is next door.

Keyboard tuning . . . another Heathkit exclusive in the "Computer Tuner." A light touch of the keys brings you your favorite station, instantly. And four glowing numerals indicate the frequency. A touch of the reset button and you're ready to program another station. Gone is the frustrating dial "tweaking" to satisfy "signal" and "tune" meters. The "Computer Tuner" is always center tuned — precisely.

Automatic band-scanning, too. Another touch of a button sends the synthesizer on a continuous sweep cycle of the entire FM band, with the readout displaying every available FM frequency — from 107.9 MHz through 88.1 MHz — and stopping at each station with a listenable signal. Or, push the stereo-only button, and the synthesizer stops only at those stations broadcasting in stereo. Depress the "by-pass" button and the synthesizer resumes scanning.

Or pre-program your favorite stations with computer card memory. Selector buttons give you instant access to any of three pre-programmed stations on computer-type punchcards that can be inserted and left behind the hinged front panel. "A", "B" and "C" buttons on the main panel give instant access to these pre-programmed frequencies. Extra cards are provided so you'll have one for each of your preferred FM stations.

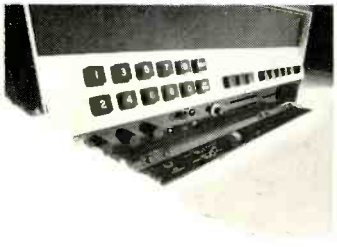
Total-control capability. Also behind the hinged front panel are secondary controls for AGC and noise squelch that can be independently set to cut-out or bypass stations of an unacceptable quality — or the squelch can be circumvented by simply pushing a main-panel button. There's a switch for selecting mono, stereo or blend listening modes. A light test button for checking the readout tube condition. A sweep-speed control. And a meter switch that converts the signal-strength meter to a multipath indicator for optimum antenna alignment.

The best there is, built by you. The Heathkit "Computer Tuner" will be one of the most interesting and satisfying kits you've ever built — and certainly the most exciting audio instrument you'll ever own. It utilizes computer-type devices: 55 ICs, plus more than 50 discrete transistors and diodes. Computer modularity: 10 modules, with 7 plugging into a master board, and an extender board to facilitate assembly and in-circuit adjustments and service. Computer readout: four seven-segment display tubes driven by three decoder-driver ICs. The end result is a tuner with specs you have to hear to believe: selectivity and IF rejection better than 95 dB. Image and spurious rejection better than 90 dB; signal-to-noise ratio better than 65 dB; channel separation conservatively specified 40 dB at 1000 Hz, 30 dB at 80 Hz, 30 dB at 10 kHz, 25 dB at 15 kHz. In short, with its three convenient, lightning-fast tuning capabilities, unprecedented specifications and computer-age technology, the Heathkit AJ-1510 "Computer Tuner" stands unique and alone as today's most advanced audio instrument. But let the "Computer Tuner" speak to you for itself. Order yours, today.

Kit AJ-1510, tuner less cabinet, 23 lbs. **$539.95***

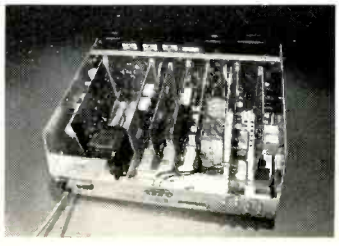
AJA-1510, pecan cabinet, 6 lbs. **24.95***

AJ-1510 SPECIFICATIONS — MONOPHONIC — Exact tuning range: 88.1 to 107.9 MHz. **Tuning:** Digitally synthesized. **Intermediate frequency:** 10.7 MHz. **Antenna.** 75 or 300 ohm. **Frequency response: Discriminator:** 10-60,000 Hz, ±0.5 dB. Audio: 20-15,000 Hz, ±1 dB. **Sensitivity:** Less than 1.8 uV. **Selectivity (alternate channel):*** Greater than 95 dB. **Capture ratio:*** Less than 1.5 dB. **Harmonic distortion:*** Less than 0.3%. **Intermodulation distortion:*** Less than 0.1%. **Image rejection:*** Greater than 90 dB. **IF rejection:*** Greater than 95 dB. **Spurious rejection:*** Greater than 90 dB. **Signal-to-noise*** ratio (100% mod.): Greater than 65 dB. **AM suppression:*** Greater than 60 dB. **Channel frequency accuracy:** Better than .005%. **STEREOPHONIC — Channel separation:** 1,000 Hz, 40 dB; 80 Hz, 25 dB; 10 kHz, 25 dB; 15 kHz, 20 dB. **Harmonic distortion* (100% mod.):** 0.35%. **Frequency response** (±1 dB): 20 to 15,000 Hz. **19 kHz and 38 kHz suppression:** Greater than 60 dB. **SCA suppression:** Greater than 60 dB. **AUDIO OUTPUT — Audio output level: (fixed):** 1.2 V rms nominal (with 100% mod.). **Output impedance (fixed):** Approx. 4,700 ohms. **GENERAL — Power requirements:** 120/240 VAC, 50/60 Hz, 50 W. **AC outlet socket:** Unswitched, 350 W Max. **Dimensions:** 6″ H x 16⅜″ W x 14¾″ D. Weight 23 lbs. (less cabinet).
*IHF



Punchcard programming

Modular design



Varactor tuner

in the audio world are kits

You can see them all in the free Heathkit Catalog

Digital circuitry, 4-channel matrixing, acoustical equalizers . . . "Hi-fi" has come a long way since it first began turning music lovers into electronic tinkerers and vice-versa. Back then, getting there was half the fun. Today, the super-sophisticated state of the art sends most would-be do-it-yourselfers to the shelter of the stereo supermarket. With Heath, audio still is a hobby for the individual, offering a very personal sense of challenge, discovery and satisfaction. We produce some of the most advanced and consistently praised equipment in the industry — and we let you in on the fun.

Our free Catalog tells the whole story. Heathkit receivers, 4-channel equipment, tuners, amps, speaker systems. All kits. With all the old magic, but none of the mystery.

The Heathkit 4-Channel Integrated Amplifier — with flexibility to meet your every mode

The new AA-2004 puts you right in the middle of the 4-channel excitement — without obsoleting all the stereo gear you already own. It serves up a blockbusting 200 watts through four channels, with control versatility that lets you put the power into any format — mono, stereo, matrixed 4-channel, discrete 4-channel. No lightweight "fill-in" between stereo and 4-channel, the AA-2004 is the amplifier you'll want to own years from now.

Improves what you already own. Thanks to built-in matrix circuitry that decodes matrixed 4-channel recordings and 4-channel broadcasts, the AA-2004 lets you use your present turntable, tape equipment or tuner. Also, the decoder enhances your present record & tape library, and conventional 2-channel FM broadcasts by feeding the "hidden presence" to the rear speakers for an extremely satisfying 4-channel effect.

Puts you ahead of tomorrow's developments. As discrete 4-channel media becomes more prevalent, the AA-2004 is ready. Four conservatively rated and fully protected amplifiers produce 260 watts into 4 ohms (4x65), 200 watts into 8 ohms (4x50), 120 watts into 16 ohms (4x30). Controls are provided for every source, mode and installation. Amplifier sections are controlled in pairs with one complete stereo system for left & right front speakers and another for left & right rear — so your AA-2004 can be used to power two separate stereo systems if desired. With outputs for both main and remote speaker systems, it can be used to power two 4-channel systems (up to 8 speakers). Duplicate controls are provided for front and rear bass, treble, balance and volume; phono, tuner, aux, tape & tape monitor inputs. Mode switches select mono, stereo, matrixed 4-channel or discrete 4-channel. And 20 input level adjustments — enough for five separate 4-channel sources — can be reached from the bottom of the chassis. Separate rear-panel jacks give direct access to preamp outputs & power amp inputs, permitting biamplification by simply adding a crossover network.

Performance specs you'd expect from Heath. Make your own comparison of the AA-2004's impressive specifications. Power bandwidth on all channels from less than 5 Hz to more than 45 kHz for 0.25% total harmonic distortion. IM distortion less than 0.2%. Damping factor greater than 100. Hum and noise — 65 dB for phono — 75 dB for tape and aux.

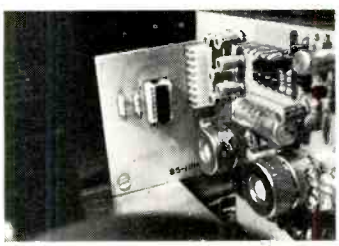
Goes together with traditional Heathkit simplicity. Plug-in circuit boards and preassembled wiring harnesses reduce point-to-point wiring — make the AA-2004 as much fun to build as it is to use. Add the preassembled, prefinished pecan cabinet — and you have the most attractive, as well as the most practical, approach to the fascinating new world of 4-channel sound. Get with it . . . today.

Kit AA-2004, 39 lbs., less cabinet **349.95***

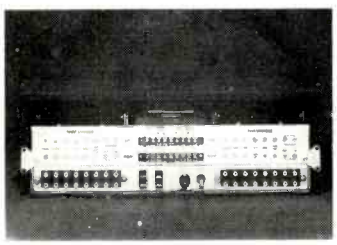
AAA-2004, pecan cabinet, 7 lbs. **24.95***

AA-2004 SPECIFICATIONS — Dynamic power output per channel: 50 W (8 ohm load), 65 W (4 ohm), 30 W (16 ohm). **Continuous power output per channel:** 35 W (8 ohm load)*, 35 W (4 ohm), 25 W (16 ohm). **Power bandwidth for constant 0.25% total harmonic distortion:** Less than 5 Hz greater than 45 kHz.* **Frequency response (1 W level):** —1 dB, 7 Hz to 50 kHz, —3 dB, 4 Hz to 90 kHz. **Harmonic distortion:** Less than 0.25% from 20 Hz to 20 kHz @ 35 W output. Less than 0.1% @ 1000 Hz with 1 W output. **Intermodulation distortion:** Less than 0.2% with 35 W output, using 60 and 7,000 Hz mixed 4:1. Less than 0.1% @ 1 W output. **Damping factor:** Greater than 100. **Input sensitivity: Phono:** 2.2 mV. Tuner, Aux, Tape, Tape Mon: 180 mV. **Input Overload:** Phono: 155 mV. Tuner, Aux, Tape, Tape Mon: Greater than 10 V. **Tape output:** 1.4 V output with 0.2 V input. **Hum and noise:** Phono (10 mV reference: —65 dB. Tuner, Aux, Tape, Tape Mon (0.25 V reference): —75 dB. Volume control in minimum position: —90 dB referred to rated output. **Channel separation:** Phono: 50 dB. Tuner, Aux, Tape, Tape Mon: 55 dB or better. **Recommended speaker impedance (each channel):** 4 through 16 ohm. **Tape output impedance:** Approx. 50 ohm. **Input impedance:** Phono: 49 k ohm (RIAA equalized). Tuner, Aux, Tape and Tape Mon: 100 k ohm.

*Rated IHF (Institute of High Fidelity) Standards.

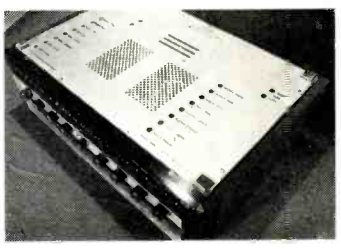


Matrixed-4 decoder board



Rear panel inputs

Plug-in amp sections



Input level controls

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See and hear the Heathkit "Computer Tuner" and 4-Channel Amplifier at your nearest Heathkit Electronic Center. For complete specs on both, send for your free '72 Catalog.

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The "OPEN-AIRE" Principle in High Fidelity Headphones

Friedrich Warning*

DURING THE LAST DECADE, stereo headphones have become increasingly popular. Everyone who experiences headphone sound for the first time is amazed at the almost unbelievable difference in sound quality as compared to loudspeaker reproduction.

However, early headphone designs were not without their drawbacks. Conventional units, for example, required an airtight seal between phone and ear to achieve good low-frequency reproduction, for with the slightest leak, bass tones seemed to "drain" from program content. While the seal produced some possibly desirable effects, such as isolating the listener from his surroundings, some side effects made this a mixed blessing.

For one thing, the sense of isolation, except in special applications, often proved uncomfortable. To see why, one only need hold up a glass or cup to the ear. After a relatively short period of time, the constant pressure and lack of airflow generally proves annoying. Another problem is that the seal prevents ever-present body heat and moisture, as well as bass energy, from escaping, producing a warm and often humid environment that can quickly become uncomfortable, particularly on sticky days.

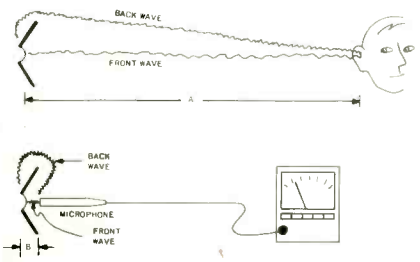
The headphone construction techniques required for this type of design also had some drawbacks; as some manufacturers produced increasingly heavy and more soundproof enclosures, some headphones became rather monstrous in size and weight. For the majority of listening situations, smaller size and weight are of definite importance, particularly for prolonged periods of time.

*Sennheiser Electronic

Getting Back to Basics

Because the "open-aire" approach to headphone design depends on a number of basic transducer phenomena, it might be well to review some of the principles originally discovered in loudspeaker research. Figure 1 shows the cone of an ordinary loudspeaker suspended in free air.

Early loudspeaker designers found that, at normal listening distances (A and beyond, Figure 1A), free-standing speakers are relatively inefficient at low frequencies. This is, of course, because sound waves generated by the *rear* of the speaker arrive at the ear



1—Close to the speaker, phase ion is minimal, even at low

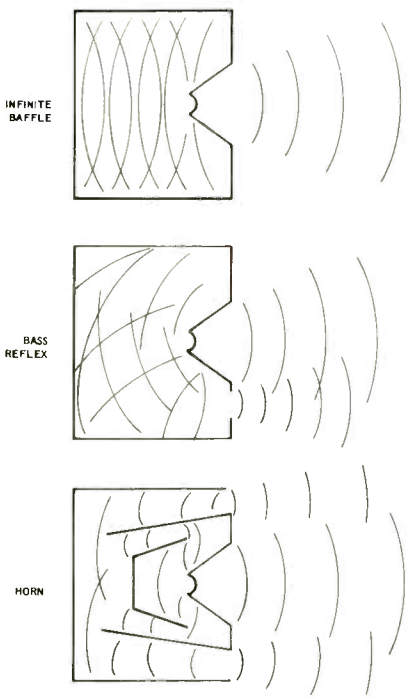


Fig. 2—Various speaker enclosures which eliminate, attenuate, or rephase back waves.

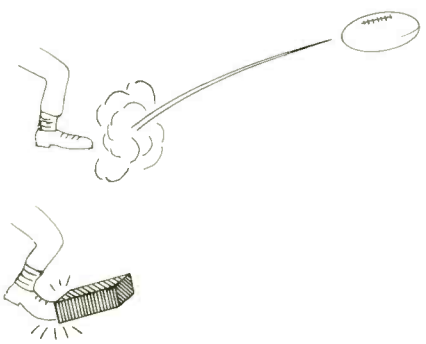
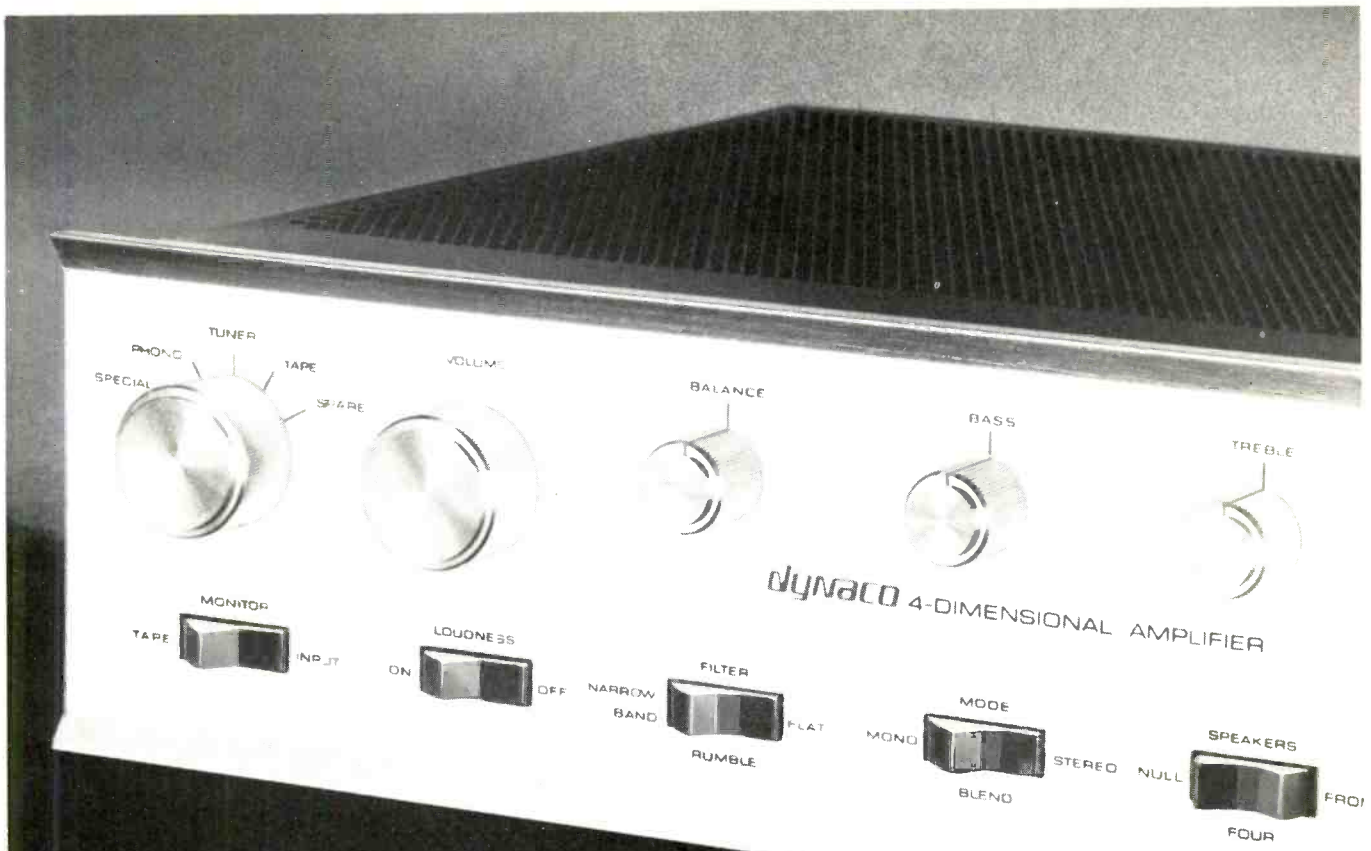


Fig. 3—An object with low mass moves easier and further when a force is applied.



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with amplitudes nearly equal to those arriving from the *front* of the speaker. Since, at low frequencies, the wavelengths are relatively long, sound energy from the rear of the speaker arrives almost perfectly out of phase with energy from the front of the speaker, resulting in a high degree of cancellation and poor or nonexistant bass.

However, when the speaker's response is measured at distance B, which is close to the front side of the cone (actually, a distance less than the cone's diameter), much better bass response is measured. This is because, the front wave travels a very short distance, the back wave's path is, relatively speaking, much longer. And when you consider that sound, like any form of energy, dissipates in intensity with the *square* of the distance between source and listener, the cancellation produced at B between front wave and back wave is negligible.

Of course, with a speaker system, it is impractical to move the listener to point B. To get around this problem, various types of enclosures were developed—infinite baffle, bass reflex, horn, etc. But all utilized the same basic principle, attenuate or eliminate the speaker's back wave (see Fig. 2). As the many excellent speakers on the market demonstrate, this has been successfully achieved.

But this was not done, however, without some compromise. Restricting the air-flow behind a speaker generally raises its resonance point which is not especially critical in a speaker system (since transducers may be readily made large and heavy enough to have low resonances even when enclosed), but quite another situation occurs when transducers are small, as in headphones.

When headphones are enclosed at the rear of the diaphragm, substantial increases must often be made in diaphragm size and/or mass, to reattain low resonance frequency. Unfortunately, as moving mass increases, so does inertia. This can have detrimental effects on transient response, since higher masses require greater forces to move them (or longer time to get moving with equal applied force—see Fig. 3). Thus, with conventional headphone designs, it may be necessary to trade off transient response for better bass response (or vice versa).

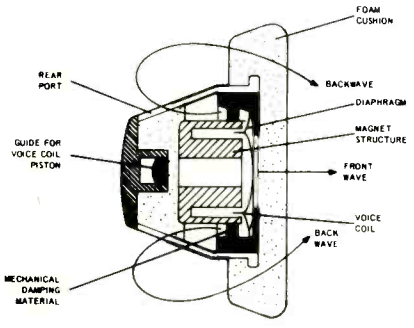

Fig. 4—Cross-section of "open-aire" headphone.

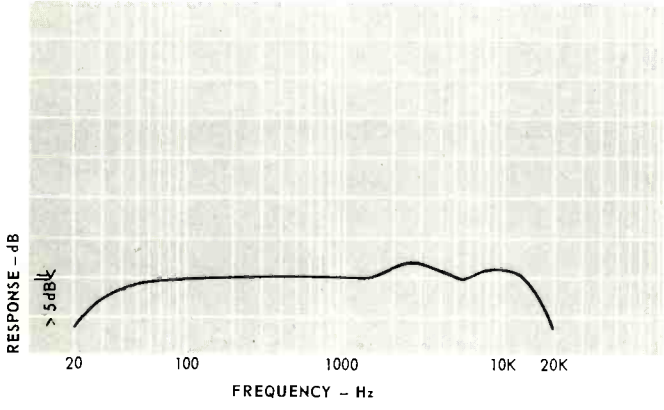

Fig. 5—Response of Sennheiser HD 414 "open-aire" headphones.

The "Open-Aire" Design

Going back to Fig. 1B, we see that there are few response problems if the listener is relatively close to the speaker diaphragm. In fact, if distance "B" is less than the diameter of the cone (or diaphragm), we can *ignore the nullifying effect* of the back waves for all practical purposes. And if this is achievable, there is no longer any need to "bottle up" or attenuate the back wave, with associated resonance and transient response problems.

Now consider, for a moment, the ear's location with respect to the diaphragm of a headphone. You see the point—without resorting to a huge diaphragm, the ear is still less than half-a-diameter away from the diaphragm. It is precisely this "free-air" principle that is responsible for the excellent frequency and transient response of the "open-aire" design.

Figure 4 illustrates the cross-section of an "open-aire" headphone. A moving coil system is coupled to a diaphragm in the normal way. However, the housing at the rear of the driver element is perforated, to allow unrestricted passage of the sound generated by the rear of the moving diaphragm. There is no trapped air behind the diaphragm to raise resonance or inhibit transient response. So, with a diaphragm of proper weight, elasticity, and diameter, it is possible to obtain good low-frequency response combined with excellent performance in tone-burst tests.

Ear as a Resonant Cavity

Even though "open-aire" headphones do not seal the *rear* of the transducer, they could be constructed in a manner that eliminates all outside sounds by providing the *front* of the diaphragm with an airtight coupling to the ear cavity. However, besides the comfort problems raised earlier, two acoustic problems could result.

First, a sealed cavity in *front* of the diaphragm would have precisely the same injurious effects on frequency and transient response as one behind it, raised resonance and all its results.

Second, tests have shown that several disturbing resonances can occur be-

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tween the outer ear and a flat surface close to it—a phenomenon not uncommon with conventional headphones. In the "open-aire" design, a soft, lightweight cushion of porous foam spans the opening of the outer ear. The damping effect of this cellular material prevents dips and peaks in the frequency response. Figure 5 illustrates the response of a typical "open-aire" headphone, the Sennheiser Model HD 414. The intentional response rise at 2.5 KHz corresponds to the natural increase in sound pressure at this frequency caused by the dimensional properties of the head of an average person.

Psychological Factors

While our discussion of the "open-aire" design is primarily an acoustical one, it would be incomplete without mentioning some relevant psychological factors. As the intentional response peak mentioned above indicates, our consideration of creating "optimum" sound has gone beyond the restricted environment between diaphragm and ear because any reproducing transducer should not aim at some theoretical norm (e.g., idealized "headphone" sound, "speaker" sound, etc.), but rather at verisimilitude, a lifelike-as-possible recreation of the original performance.

Thus, we have included a response peak, to duplicate the apparent sound perceived by the *ear* in an open-air listening environment.

For similar reasons, tests have shown the "free-space" feeling of the "open-aire" design are critical to the "naturalness" of using headphones. Some subjects, in fact, reported that at mid and high frequencies, the sound actually seemed to be coming from "beyond" the headphones: a fact which later tests determined was due to the *positive* effects of miniscule backwave leakage that occurred at these frequencies.

Also, many subjects indicated a preference for the relative lack of isolation from outside sounds provided by the headphones. Responses ranged from the practical ("I know if the phone is ringing or the baby crying") to the musically-oriented ("I feel like I'm at a live performance rather than in an artificial environment"). However, objective tests revealed that, even though the headphones cannot be "heard" well by nearby individuals (even when played at high levels), wearers could achieve a feeling of total isolation, when desired, simply by advancing the volume control. AE

Men of Hi-Fi

The following is the second in a series of transcripts from Contributing Editor Harry Maynard's *Men of Hi Fi* program, which is presented on New York City radio station WNYC-FM, 93.9, on Sundays at 10:00 p.m. His guests for this program were Thomas Lott, president of Quadracasting Systems; Jerry Orbach, marketing manager of JVC America, and William Halstead, vice president of R.T.V. International.

Maynard: Good evening, ladies and gentlemen. We are going to give you a special report on the status of discrete four-channel stereo broadcasting. My guests are Tom Lott, who's president of Quadracasting Systems, Inc., San Mateo, Calif.; Bill Halstead, vice president of R.T.V. International, sometimes called "Mr. Multiplex" in this industry since he's been through the whole stereo broadcasting bag, and Jerry Orbach, marketing manager of JVC, the people who developed the first discrete four-channel record. Tom, tell us where the Dorren quadraplex system stands right now? You've done some experimental broadcasts at K-101, San Francisco, and I want to remind our audience that we are going to play some off-the-air tapes from two radio stations. I don't want you folks out there to get disoriented and think you've suddenly been transported to Toronto, Canada, or San Francisco, because we play these off-the-air tapes showing you how this system worked. You can hear it in two-channel stereo only, of course, but you will be able to determine its compatibility and get some idea of the quality. But tell us where things stand, Tom.

Lott: We conducted tests on K-101 in San Francisco just over a year ago with special permission from the FCC. We ran tests for 60 days, making all sorts of measurements and broadcasting music to allow listeners to see whether they could detect any deterioration or change in their normal stereo reception. The whole point of the Dorren system is that it is fully compatible with existing equipment. The stereo listener gets the full stereo, just as he does now, and does not lose any of the two-channel material.

Maynard: K-101 even ran ads in San Francisco newspapers and asked the listeners of this broadcast to determine if there was any change in quality or whether they noticed any differences.

Lott: We also had some very interesting results in the tests, which I concluded in Toronto, where I flew from just yesterday. With the permission of the Canadian government, we ran tests on CHFI, which is a 420,000 watt station in Toronto. Two sets of tests really, one at night for the benefit of the Canadian government monitoring stations which were taking all sorts of measurements on the system and are going to give us a report which apparently from the initial indications from them is very favorable. They confirm what we have said, that the system does not take up any more bandwidth than a standard two-channel stereo system. In actual fact, it takes up a little less.

Maynard: Can you tell us how the Dorren system works basically?

Lott: Well, it's really a simple extension of existing two-channel stereo. The existing two-channel stereo had a 19 kHz pilot signal and a 38 kHz suppressed carrier double side-band signal, giving you the difference information. The 38 kHz signal carries the left minus right, and by simple mixing processes of addition and subtraction, you can then separate left and right.

Maynard: This is sort of a synchronus quadrature in a certain sense, isn't it? Instead of breaking the signal up into two parts, you break it up into four parts?

Lott: Right, we take the left-front and left-rear, the right-front and right-rear, and we broadcast all four added together as the main channel so that the mono listener gets full mono. He hears the sum of the four. On the 38 kHz subcarrier, which is the same in standard stereo, we broadcast the two sets of difference information. We actually put two sets of information in quadrature with each other on the 38 kHz, and the fourth set of information we put on a 76 kHz suppressed subcarrier double sideband transmission, but at 76 kHz locked to the 19 kHz pilot, just the same as the 38 kHz is locked to the pilot. So the stereo listener gets his full stereo and the four-channel listener can receive all four channels with a separation up to 45 or more dB from any one channel to any other.

Maynard: What about bandwidth? Does it take up any more bandwidth than an ordinary stereo transmission?

Lott: No. The initial reports from the Canadian government monitoring station confirm what we have been saying quite a long time—that we do not take up any more bandwidth. In fact, that it's very much the same as when stations went from mono to stereo, and people found that interference between adjacent stations went down, not up. People say that with stereo having all this information, you are going to have more adjacent channel interference, and this turns out not to be so. Technically, it's very complex because of modulation indexes and I don't want to get into things that technical here since it would take a lot of mathematical explanation. We did however produce as a result of the 60 days of testing in San Francisco a very comprehensive report, which is not quite as large as a Manhattan telephone directory and certainly as large as the San Francisco directory. It showed a compilation of 50,000 pages of computer print-out where we had all the different bandwidths for mono signals, stereo signals, and four-channel stereo signals under every possible condition of modulation.

Maynard: What feedback did you get from the ordinary listener, who obviously had to listen to this in two-channel stereo?

Lott: In San Francisco and especially in Canada (because the tests conducted Tuesday night used equipment which had been improved over the equipment we used at K-101 a year ago), we had calls from all over the place saying that their stereo had never been so good. We had a call from almost 150 miles away from cable TV system operators who said that the stereo quality and the separation was the best that they had ever heard. It was so good that they had put it on their cable system and told their listeners to listen to it.

Maynard: We are getting this sort of feedback ourselves when we broadca four-channel matrixed sound Jerry Orbach here calls ps

channel. Jerry, what's happening in Japan? Are the Japanese doing any experimental broadcasting using the Dorren system?

Orbach: Well, not at this time. But the Victor Company of Japan, which is the parent company of JVC, is in very close contact with Tom and Lou Dorren. It looks as though we are going to get permission to make an experimental broadcast in Osaka, Japan, very, very shortly.

Maynard: Good. I want to remind our listeners that if all goes according to plan, in March, through an arrangement with WKCR, the Columbia University station which is also non-profit, both stations are going to hook up and for that month give you discrete four-channel broadcasts at 9:30 p.m. every Monday evening for 25 minutes. Then we are going to do a broadcast at 2:00 p.m. every Tuesday afternoon so that the many people who can't find an extra stereo receiver can go to their favorite hi-fi dealer, who ought to have an inventory of at least two stereo receivers, and you will be able to listen to four-channel stereo there. The last time we did this two and a half years ago, over 80 hi-fi stores in greater Manhattan tied in and used it as a traffic builder to get people interested in four channel to come in and hear it. This will, however, not be using the Dorren system which comes right off one trasmitter. Bill, you were involved with me in the early discrete four-channel broadcast. We were the first ever to do it in the United States. Boston had done it, but only broadcast the two front channels. What was your reaction when we did this broadcast, Bill?

Halstead: I of course listened at the station and the impression was, and all the engineers there agreed with me, that the improvement brought about with the use of four channels was just so great that there was no comparison with what we were getting in two channels. My family was listening at home and we simply had our normal two-channel receiving equipment plus two simple portable units and the minute we added those two extra channels by means of the portables, everyone heard a very great improvement, not only in terms of quality but in terms of location.

Maynard: As a matter of fact, a lot of people just got a simple mono FM tuner and tuned in WKCR for the rear of the broadcast and noted tremendous improvement. I had heard four-channel stereo demonstrated before, and you can go down to the Acoustic Research [illegible]m in Grand Central and hear it—[illegible] effective. But I think four [illegible]ntimate, that it works best in an intimate environment where you don't have a lot of people competing with it. This is why, for example, when your friend Jim Gabbert of K-101 broadcast your system at the National Association of Broadcasters meeting, it was the usual impossible demonstration. Not that there was anything technically wrong with it, but the room was filled with 400 people, all turning around, standing on chairs, etc., making more noise than a herd of mating elephants. The first time I ever heard four channel correctly was off the original broadcast we did here when I took a small stereo FM portable receiver and put it in the rear of the room. And I knew that I was not suffering from auto hypnosis when we got over 100 letters, everyone of them a rave, talking about how superior it was to their ordinary two channel. Has that been the impact on the West Coast too with the people who heard it?

Lott: Yes, Harry, very much so, especially when they have heard it under ideal conditions in the living room and not in a large hall. The difference between the two channel and the four channel and the four-channel discrete and four-channel matrix shows up very strongly with some materials. Of course, some of the material when matrixed sounds pretty good in four channel, but some things you can only do with a discrete broadcast.

Maynard: What are those things, Tom?

Lott: Well, certain types of music, which they are deliberately writing now, where they want people in the middle of the instruments. Some of the rock music.

Maynard: Or theater in the round. Basically, it's where they want a separate, clearly defined voice on each channel. (General assent.)

Halstead: What I would like to bring out, and I think it's probably important that it be developed, is that we have a problem with the FCC. Going back to the development of ordinary stereo, the first tests were run in 1950. The improvement in quality that we obtained with the two channels was just tremendous, just as the difference is today with four channels. But the Commission, when I went down to talk with them and ask that we be given a grant for normal use, said, "Well, this is going to take four or five years, because we have treaty obligations and things of this sort." Actually, it *did* take five years from 1950 when the first stereo was tested here in New York to the first grant of SCA (Subsidiary Communications Authorizations for background music service—that was in 1955), then it took another five or six years before stereo was approved by the FCC because they had to test different systems, make evaluations, and finally the FCC had to act. And I'm afraid we are going to have the same problem here.

Maynard: Good, I think this is an excellent point. This is why I feel that the fight between matrixed four channel and discrete four channel is an artificial one. I believe that for the next three or four years matrixed four-channel sound is a big enough improvement over two-channel sound and is a natural bridge to four discrete channels, that I don't want to go without the benefits of matrixed four channel for that period until the FCC finally does make up its mind whether it's the Dorren system of quadraplexing or some other. I want to have the benefit and the added improvement of four-channel stereo in the interim. But my question, Tom, is how soon is the FCC going to act on this, in your opinion?

Lott: Well, as you know, with a government department, it's very difficult to say. They are very restricted in their budgets, and the time it takes to get something done is very difficult to predict. However, I don't think it's going to take quite as long as last time, because last time we started off with about 17 systems, then it was gradually weeded down to six.

Maynard: I am wondering if right now there may be some bright guy like Lou Dorren out there who has got an alternative system of discrete four-channel broadcasting. Frankly, when I talked to a prominent FCC official about this, he said, "We are going to close the door. We want to get as many different proposals as possible as to how to broadcast discrete four channel." But as we demonstrated on this show with the broadcast using the Scheiber method, there are no unfortunate side effects. Therefore, from now on, everybody's broadcasting matrixed four-channel sound without calling up the FCC and getting approval. The official did say that if we freeze this now, how do we know there won't be some new system that may even be better than the Dorren system, even though the Dorren system might have proved itself to be a very satisfactory system. And what does your system do when a station wants to continue to use its subcarrier and derive some commercial income from it?

Lott: Part of our large report, which I mentioned that we had submitted to the FCC, suggested a possible solution to this problem. I don't know how many of our listeners are aware but any station with an SCA system on it cannot give you really good stereo, because the third harmonic of the 19 kHz pilot—57 kHz—beats with the 67 kHz of the SCA and gives you a 10 kHz whistle. So that if anyone listening to a stereo station with SCA on it has to have a

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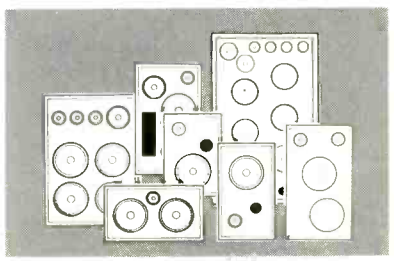

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filter on his set which cuts out everything above 10 kHz and he will not get really good stereo. He's losing all the high frequency response so that the really good stereo stations are not running SCA as well.

Maynard: And the station has to back off about 10 per cent of its power, doesn't it?

Lott: Yes, you have to back off a little, but the main difficulties are the beats and interference caused by the SCA system to the stereo system. With our system, you cannot leave the SCA system where it is, but we have made suggestions as to how to solve not only the problems of putting SCA together with four channel but also as to how to solve the problems of existing SCA interference.

Maynard: Is this very complex to go into?

Lott: No, it's very simple. We simply move the SCA carrier up to 114 kHz and phase-lock it to the 19 kHz pilot. Because of the low modulation index up this far from the center carrier frequency, you do not cause as much adjacent channel interference as you might think from having something right out there.

Maynard: Do you have any comments, Bill?

Halstead: Having gone through the early problems with the SCA, I'd say that the people who use SCA for business, such as Muzak, will probably object to any arrangement of this type because it will require new receivers and this is a real problem in a large city, such as New York, where they would have to change 1,000 to 2,000 receivers to operate on a new frequency.

Maynard: Tom, you're shaking your head.

Lott: I was only thinking that it doesn't require new receivers. It requires a filter which is only a $4.00 or $5.00 item and usually a plug-in one. So it's not a major thing. We are not suggesting that they change the SCA frequency, but that they put in an additional one at 114 kHz so that those stations which want to go four channel can do so and still have SCA if they wish. What I am really suggesting is that most of the stations using SCA will not want to go four channel anyway.

Halstead: You're probably right.

Maynard: As a matter of fact, I did a study when I was editor of *FM Guide,* and I discovered that only four or five stations out of about 60 FM stations in the greater New York area were even using their subcarriers from Muzak. Another thing I discovered was that some of the better stations, such as WRFM and so forth, told me that they were going to stop using the subcarrier because now that FM has gotten quite successful, especially for stations such as WRFM, they were not going to give their listeners anything but top-rate stereo quality.

Lott: Our proposal for SCA would allow those stations who are really proud of a good stereo signal to put on an SCA subcarrier without any detrement to their quality. No filters, no nothing. I think this would enormously increase the usage of SCA. Jim Gabbert of K-101 said that under no circumstances for no amount of money would he ever put SCA on his station because of the interference to his stereo. But he would, he said, be happy to try the 114 kHz subcarrier because if tests and calculations are correct, this has no effect on existing stereo.

Maynard: Let's give our listeners some background on this tape we're going to hear now. There's going to be a Canadian announcer, so don't think you're in Canada or that you had some LSD thrown in your water system. What are we going to hear, Tom?

Lott: These are excerpts from a broadcast made January 18th, Tuesday, in Toronto, Canada.

Maynard: And how far away was the reception of this off-the-air tape?

Lott: About 15 or 16 miles away. This is a four-channel off-the-air recording which tonight's listeners will hear in two channels. The two left channels are mixed for left and the two right channels are mixed for right.

(Tape of broadcast played.)

Maynard: Now, Tom, you wanted to comment on this broadcast from Toronto, Canada, of which we just heard a tape?

Lott: I just wanted to say that we used the JVC record to provide part of the music for that program. The whole of four-channel stereo broadcasting, of course, is going to open up as records become more and more available, and we feel it's going to very shortly. Lou Dorren, who invented the four-channel broadcasting system, has also done some work and JVC has done considerable work on decoders for the record. And a lot of earlier problems with wear, separation, and things like that, have now been solved. I think that very shortly you are going to find that four-channel discrete discs are very much available. And this will give impetus to the broadcast field because so far the FCC has not been pushed for approval since they have a limited budget and there's no great pressure to provide a system because the software is not available. If we had the broadcast system today, what would we broadcast? There's some tape but not much. However with the coming of the disc, then we'll have something. Harry, you made a comment about the matrix system, which both Jerry and I want to rebutt. Our feeling on the matrix system is that it has a very valid place in four-channel stereo, which is to allow people to play their existing two-channel material and get some semblance of four channel out of them. They sound much better through a matrix decoder than they do played straight two channel. However, we strongly disagree with the broadcasting of it because we've done a number of experiments with different types of matrix discs and the system is not fully compatible with mono. If you listen to a matrix record which has material in the center-rear, this completely disappears in the mono. I have a record in my briefcase of Barbra Streisand with instruments in the center-rear. When listened to in mono, all those instruments disappear so that the mono listener wouldn't hear them.

Maynard: I just want to comment on this. We have been broadcasting four-channel matrix for over two years now and in the last six months, we have had 25 minutes every Monday night. We have never once gotten a letter and I challenge any listener who only listens in mono to send us a letter telling us that he has found any of the matrix four channel incompatible. Jerry, the microphone is yours.

Orbach: Well, of course, I agree wholeheartedly with Tom. I would say that probably more of your listeners have FM stereo at home and Tom's remark was more or less directed to the mono listener or that you probably have very few.

Maynard: You mean you want to protect minority groups. I know your type.

Orbach: And secondly, of course, unless you have heard the original recording, it's sometimes very difficult to know whether the sound you're hearing is degraded or the original sound. But I think that any so-called improvement should be an improvement and should not pull down this type of sound. Therefore if the customer realizes it or not, his sound should be as good as it might be.

Maynard: I think very candidly that this is a nit pick myself. If somebody who really cares about hi fi is listening monophonically, he can't make any A-B comparison anyway or he would have gone to stereo 20 years ago. As Ben Bauer said, you're going to have relatively fewer recordings where they are going to put a significant amount of material in the center-rear channel. The impression I got from the FCC official was that one of the reasons they wouldn't want to freeze it was they couldn't be certain. You proposed a

system for four-channel broadcasting, and both you and Lenny Feldman agreed that the Dorren system is the better system. We applied to the FCC to broadcast your four-channel system, and I remember both you and Feldman saying, "Well, they beat us. They've come up with a system that's better, it's more natural, it's simplier, it's more elegant, it's the economy of least effort. What's your comment on that, Tom?

Lott: My comment is that we would like to see any good system of four-channel discrete broadcasting adopted. We of course would prefer our own, but we feel we would like the FCC to at least put out a proposal asking for submissions for other systems. We don't feel we should sit there for another four or five years to see if anybody can come up with a system as good or better.

Maynard: Let's let our listeners hear some more four-channel sound. Once again taped off-the-air, isn't it?

Lott: This was picked up about 15 miles away from San Francisco station K-101, using a low-cost tuner fed into a small Dorren four-channel decoder and recorded with a Sony tape machine. Sorry about that, Jerry. At the time we didn't have one of the good JVC machines we now have. This was recorded in four channel, but you're going to have to listen to it in two, so you won't be able to tell the tremendous separation. There is one initial number where there are different groups of instruments coming from each of the four speakers. And you can hear them out of one speaker, but if you go and put your ear to the other three speakers, you cannot hear the instruments in the fourth speaker, the separation is so great.

(K-101 tape played.)

Maynard: I think there has to be one thing made clear, that four-channel stereo is not just an added gimmick or just a nice improvement. In my opinion, it's a bigger development over two than two was over one.

Orbach: There is no question about that. The only people that call it a gimmick are those who never heard it. Once you've heard it properly, there can be no question that it's the greatest improvement that's ever been developed in sound. It isn't even close to stereo and has nothing at all to do with mono. Once you've heard four channel, you cannot listen to anything else again and be satisfied.

Maynard: Everybody who has been to my living room has said, "This is going to cost me some money, Harry." That's what they have said, when they heard it demonstrated properly with some halfway decent demo material. Æ

Equipment Profiles

Pioneer Model SX-727 Solid State AM/FM Stereo Receiver

MANUFACTURER'S SPECIFICATIONS

POWER AMPLIFIER SECTION. IHF Music Power: 122 Watts @ 8 ohms; 195 Watts @ 4 ohms. **Continuous (rms) Power,** Both Channels Driven: 40 Watts/channel @ 8 ohms; 50 Watts/Channel @ 4 ohms. **Power Output Over Entire Audio Range** (20 to 20,000 Hz): 37 Watts/channel @ 8 ohms, both channels driven. **THD**: Less than 0.5% at rated output. **IM Distortion**: Less than 0.5% at rated output. **Power Bandwidth**: 10 Hz to 60 kHz. **Damping Factor**: 40 (at 8 ohms, 1 kHz). **Frequency Response**: 7 Hz to 80 kHz ± 1 dB. **Input Sensitivity**: 500 mV.

PREAMPLIFIER SECTION. THD: Less than 0.1% at rated output of 500 mV. **Frequency Response**: 10 Hz to 20 kHz, ±1 dB. **Input Sensitivity**: Phono 1 & 2, 3 mV; Mic, 2.7 mV; AUX, 200 mV; Tape Monitor and Tape Rec 1 & 2, 200 mV. **Bass and Treble Tone Control Range**: ±10 dB at 100 Hz and 10 kHz. **Muting Attenuator**: −20 dB. **Hum and Noise** (IHF): Phono, Better than 85 dB; AUX, Better than 95 dB.

FM TUNER SECTION. IHF Sensitivity: 1.8 μV. **Maximum S/N**: 70 dB. **IHF Selectivity**: Better than 70 dB. **THD**: Mono, less than 0.3%; Stereo, less than 0.5%. **Capture Ratio**: 2.0 dB. **Image Rejection**: Better than 85 dB. **I.F. Rejection**: Better than 100 dB. **Spurious Rejection**: Better than 90 dB. **Am Suppression**: 50 dB. **Stereo Separation**: Better than 40 dB @ 1 kHz. **SCA Rejection**: Better than 50 dB.

AM TUNER SECTION. IHF Usable Sensitivity: 10 μV. **IHF Selectivity**: Better than 35 dB. **Image Rejection**: 80 dB. **I.f. Rejection**: 75 dB. **S/N**: 50 dB.

GENERAL SPECIFICATIONS. Power Consumption: 270 watts, maximum. **Dimensions**: 19-1/16 in. W. x 5⅞ in. H. x 15⅜ in. D. **Weight**: 30 lbs., 14 oz. **Retail Price**: $349.95.

The "feature" that first impressed us about this good-looking medium-priced receiver from Pioneer was the very complete nature of the specifications listed by them and listed above. More and more, reputable manufacturers of the industry are beginning to tell the "whole story" in their spec sheets and, in our view, that can only help them in the long run—providing the "whole story" is told with complete honesty, as it is in the case of this receiver. After long years of trying to follow the vague methods of the "package console" mass producers, our high fidelity component people are finally realizing that their customers are knowledgeable and perceptive. We are particularly impressed with the statement regarding "continuous rms power from 20 to 20,000 Hz at rated THD." It is possible that very soon the Federal Trade Commission will force all purveyors of sound equipment to adopt similar factual statements, but until that happens, it's nice to know that "our" manufacturers have voluntarily taken the lead in this respect.

As for the receiver itself, the photo of the front panel layout shows that Pioneer has retained its familiar "look." The walnut cabinet is part of the package and, if it is removed for custom installations, the two walnut end-panels flanking the soft gold and black front panel make for a very rich looking unit. The large blacked-out dial area lights up in a soft blue when power is applied, and besides an expanded dial scale there are two signal meters and a series of illuminated words which light successively as the selector switch is rotated, indicating program source. The stereo FM light is also located in this line of lights, above the dial scale. The upper portion of the panel also contains the large tuning knob coupled to an effective flywheel. The "business" end of the panel is all arranged in a straight row across its bottom. Starting at the left, the power ON/OFF switch does double duty as a speaker selector switch and, since there is provision for three pairs of speaker systems on this receiver, available positions of the switch include SPEAKERS A, B, C, A+B and A+C as well as a SPEAKER OFF position when only the headphone jack, located alongside the switch, is used.

The dual BASS and dual TREBLE controls, which come next, employ a unique feature which we have only encountered on separate integrated amplifiers to date. Although the controls

themselves are continuously variable, "click-stops" have been included so that as you rotate the control for boost or cut, you can feel finite steps or stops (each worth about 2 dB of boost or cut at 100 Hz for the bass control and at 10 kHz for the treble control). This makes for easy resettability and gives the controls a very professional "switch" feel. The rear knobs (which control right channel tonal compensation) can be rotated separately, if desired, and they do not have the "click-stop" feature. When the front knobs are used to adjust tone of both channels simultaneously, however, the clutch action of the two-section controls insures that the increments of boost or attenuation are equal, with respect to left and right channels. Very clever indeed! There follow LOW and HIGH filter push-push switches, a BALANCE control, FM MUTING ON/OFF switch and a matching AUDIO MUTING switch which, when depressed, lowers volume level by precisely 20 dB. This feature is beginning to appear on many receivers and is useful if you're listening is interrupted (say, to answer a phone) and you want to temporarily lower the listening level but restore it later to a pre-set point without having to alter the master volume control setting. Our only argument with Pioneer has to do with their choice of nomenclature. The word "mute," to an audiophile, has come to mean "FM mute"—or dead silence, but this is of small concern once you know what the button does. The master VOLUME control comes next, followed by more push-push buttons for LOUDNESS, a pair of TAPE MONITOR facilities, and the stereo-mono MODE switch. A seven-position program-selector switch and a microphone jack complete the picture. We rather wish that Pioneer had provided a pair of mic jacks (for full stereo live recording) rather than having the single mic input feed both channels monophonically; no additional circuitry would have been required—just a slight change in switch wiring and another mic jack.

You may have noted that power amplifier and preamplifier specifications were quoted separately for this receiver. The reason for this becomes apparent as you examine the rear panel of the receiver, shown in Fig. 1. The small black "jumper block" at the right of the rows of input and output jacks connects PREAMP OUT jacks to MAIN AMP IN jacks. By removing this block, the unit can be considered as a separate preamplifier and amplifier, with all attendant advantages, such as the assembling of a multi-amp system with electronic crossover, etc. For those contemplating the addition of a four-channel decoder and extra amplifier, this makes for a nice place to "insert" the decoder and leaves both tape monitor systems available for use in tape monitoring! Besides the usual signal input jacks, antenna terminals (for both 75 and 300 ohm transmission lines), switched and unswitched convenience a.c. receptacles, line fuse, AM antenna bar, and DIN recorder connector, special note should be made once again of Pioneer's unique speaker connection method, which seems to be theirs alone. Three polarized receptacles (one for each pair of speaker systems with which the receiver can be used) appear on the bottom section of the rear panel. Each receptacle accepts two polarized plugs, which are supplied in an accessory envelope (six in all). Your speaker wires are connected to these plugs which contain a red dot next to one of the prongs to help you phase the speaker connections properly. Once you've got all the speaker wires wired to all the little plugs, you simply connect the plugs to the "left" and "right" portions of the chassis receptacles (they only go in one way) and you are assured of proper phasing. This may seem like much ado about very little the first time you make the connections, but wait till you want to move your system for cleaning, connecting other speakers, relocating of components, etc. All you then have to do is unplug the speaker plugs which remain as part of your speaker cables. When you're ready to

Fig. 1—Rear panel.

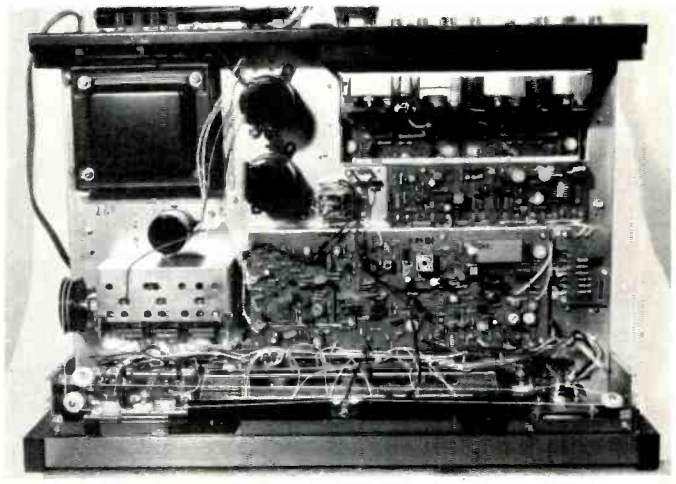


Fig. 2—Top view of chassis.

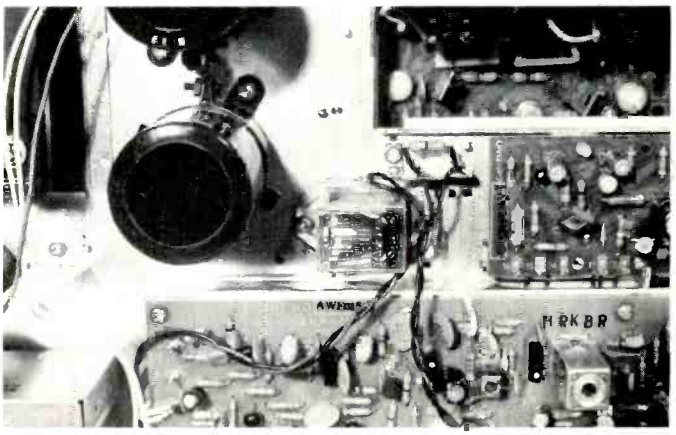


Fig. 3—Close-up view of chassis surface which shows relay forming part of protective circuit arrangement.

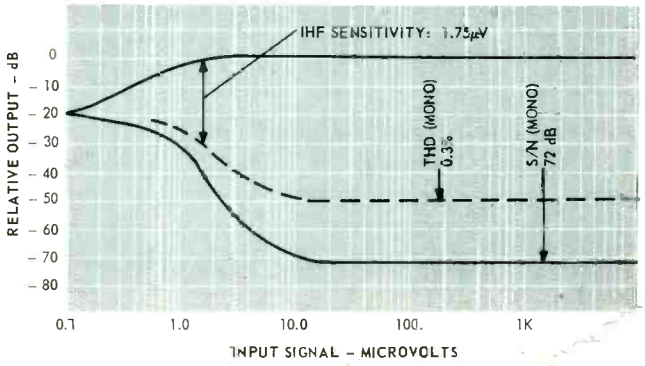


Fig. 4—Mono FM performance.

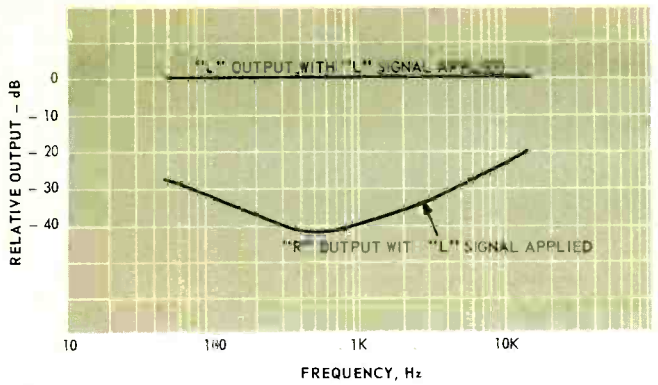


Fig. 5—Stereo separation.

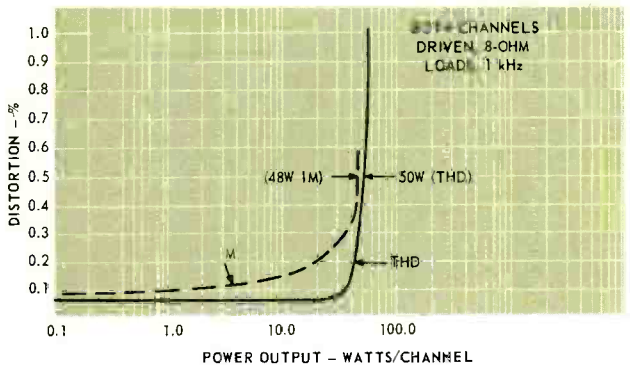


Fig. 6—THD and IM characteristics.

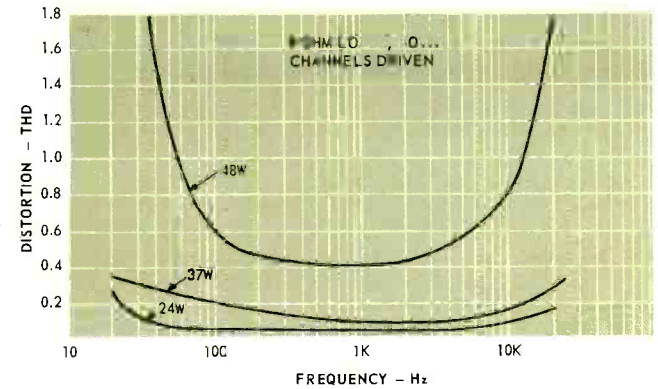
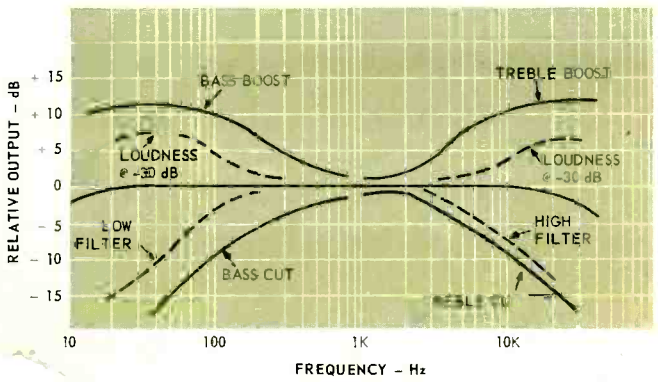


Fig. 7—Distortion vs. frequency at various power levels.



...one control range, filter, and loudness control

reconnect, just pop them back into their receptacles and you're "in phase" and all set to go once more.

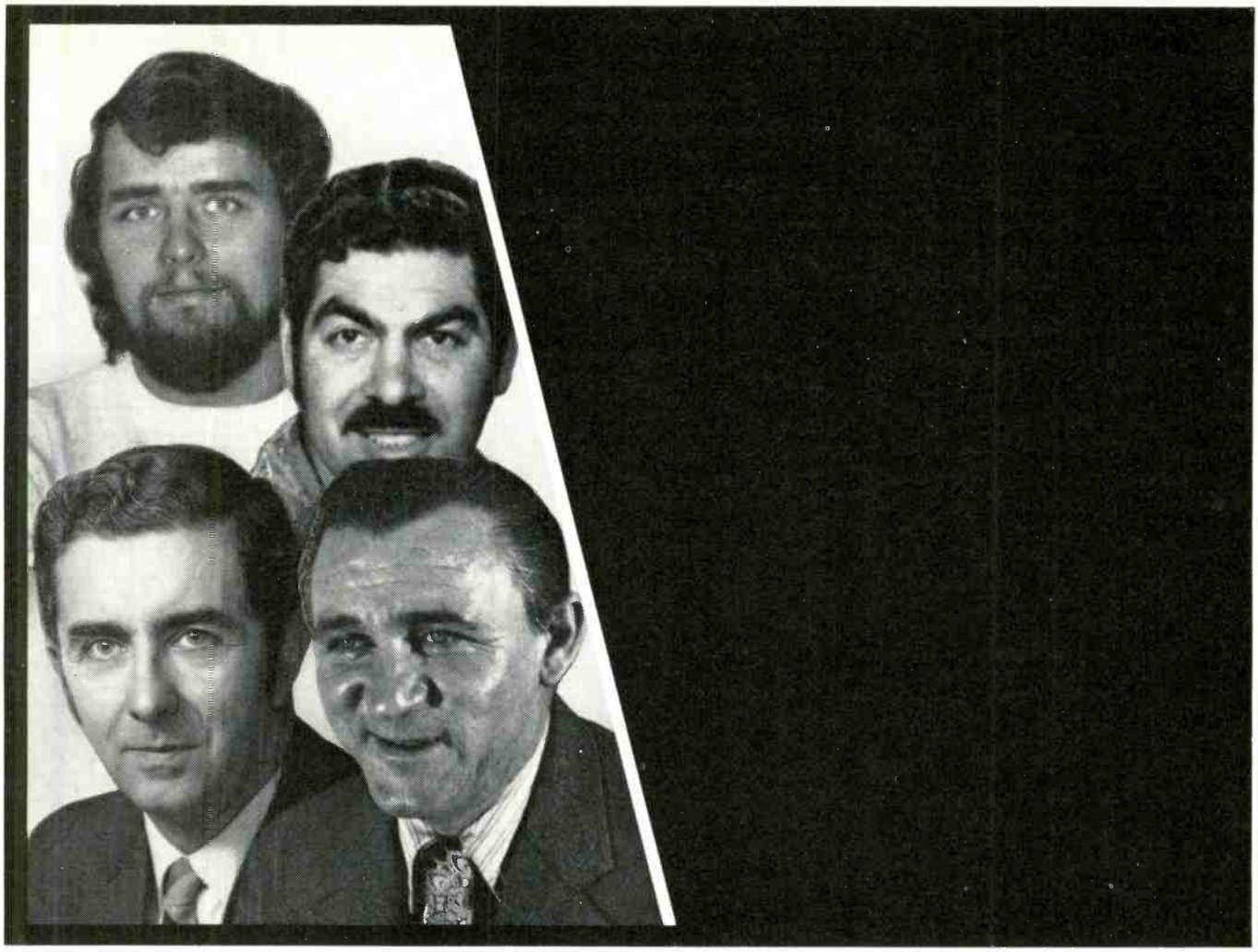
Performance Measurements

As usual, we took a look at the "innards" of the SX-727 before putting it through its paces, and a view of the top surface of the chassis is shown in Fig. 2. Well-laid-out modular p.c. construction is used throughout, and there are separate modules for the FM front-end, the AM and FM i.f. section, the preamplifier, the tone control and switching stages, the power amplifiers, a special output protective circuit, and the power supply parts. The protective circuit connects to a two-circuit relay, shown in the close-up view of Fig. 3. In addition to its "protective" function, this relay also delays connection to the speaker circuits for about two seconds when power is applied to the unit, effectively eliminating the "pops" or "thumps" associated with turn-on of many solid-state components. The FM front-end features a two-stage r.f. amplifier, of which the input stage is a FET. Ceramic filters and IC's are used in the FM i.f. section and an IC is used in the multiplex section as well. Tone controls are of the popular feedback type while the power amplifiers utilize negative and positive power supplies, facilitating direct coupling to the loudspeakers with no coupling capacitor required.

Performance

FM performance equalled or exceeded published specs in just about every area. IHF sensitivity was 1.75 μV, as shown in Fig. 4. Ultimate S/N reached 72 dB, as opposed to the 70 dB claimed but, more importantly, with an input signal of only 5 μV, quieting was already better than 60 dB. Muting threshold is factory adjusted at about 6 μV and is "go-no-go," with no transitional distortion in evidence. With the muting switch on, therefore, that means that any station that defeats the mute circuit will be heard with a quieting of better than 60 dB. THD in both mono and stereo measured 0.3% and 0.5% exactly as claimed and stereo separation measured 41 dB at mid-band, with the rest of the separation characteristics plotted in Fig. 5. All spurious response figures were within spec although limitations of our measuring equipment can confirm an i.f. rejection figure only up to 90 dB so we can't verify the 100 dB figure quoted.

Since Pioneer was nice enough to detail all those lovely power output specs the way they did, we figured we had better take plots under all the conditions quoted. Thus, in Fig. 6 you can see our usual mid-band plot of THD and IM versus power output. Rated THD was reached at 50 watts per channel, as opposed to the 48 claimed while related IM was reached at a power output of just a bit below 48 watts per channel. The plots of Fig. 7, taken at various power levels versus frequency disclose that, indeed, the SX-727 cannot rightly be called a "48 watts per channel amplifier" at all audible frequencies, since low-frequency distortion at that power figure is excessive. Bear in mind, however, that Pioneer only rates the amplifiers as being capable of 37 watts per channel "across the board," and that is a nice, conservative figure—for at that power output, the highest distortion we observed was only 0.35% (at 20 Hz) as opposed to the 0.5% limit imposed by the manufacturer. Reducing the power output to 24 watts (half power point) resulted in readings that, for the most part, were just about equal to our audio generator distortion (0.05% or so). Power bandwidth, shown in Fig. 8, extends down to 10 Hz, as claimed, but goes out to 70 kHz, better than the 60 kHz claimed by Pioneer. Tone control, filter, and loudness characteristics are all plotted in Fig. 9 and correspond nicely to published claims. We questioned the phono hum figure (85 dB) only in the sense that no reference input is given, nor do we know what "weighting" curve was used. In any case, using maximum input sensitivity (2 mV) as



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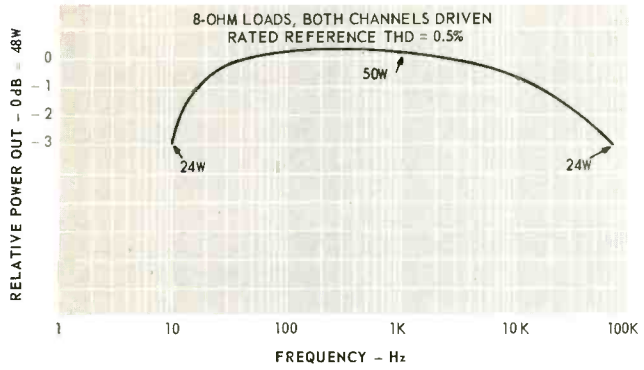

Fig. 9—Power bandwidth.

a reference, we came up with a figure of just slightly better than 70 dB for phono hum and noise—and that's about as good as we have ever seen, so there's no argument of performance here—just a question of terminology.

Listening Tests

Aside from our "FM station logging" tests, most of our listening was done using phonograph records and we can tell you that 37 watts per channel drove our low efficiency systems more than adequately. Even though Pioneer offers connections for three pairs of speaker systems, their switching wisely limits operation to only two out of three systems simultaneously. To do otherwise would tax the amplifier's power capability (we tried it), not to mention the problem of impedance matching. With speaker impedances varying greatly over the audible frequency range, you'll want to make sure that you are *at least* 8 ohms over the entire audio range if you plan to use two inefficient pairs as we did.

FM reception was all our measurements implied it would be. The center-tune meter was absolutely accurate in indicating proper center-of-channel tuning. This meter's lighting, by the way, is extinguished when you switch to AM, since the meter is of no use in that listening mode. Selectivity was excellent and with a bit of antenna rotating we picked up some 54 usable signals, of which 28 were broadcasting in stereo. With the mute switch engaged, this figure was reduced to 46, which means that we were previously receiving some 8 signals at strengths of less than 6 microvolts and still found them "listenable." Incidentally, we have had some comments about our "logging" numbers and hasten to point out that the absolute numbers from review to review are not always indicative of a set's sensitivity since, at various times of the day when we perform our tests, some of the low-powered educational stations occupying the lower portion of the FM band may or may not be broadcasting and this often affects our total markedly.

We understand that Pioneer has also introduced a higher-powered version of this receiver, called the SX-828. Not having seen this "top of the line" receiver, we can't readily say whether the higher power is worth the added expense—but this much we can say: Having put the Pioneer SX-727 through every test we can perform and having listened to it for some twenty hours or more, we find it to be a rugged, reliable instrument that certainly represents state-of-the art receiver technology in its design and performance. *Leonard Feldman*

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Miracord 50 H-II Automatic Turntable and Record Changer

MANUFACTURER'S SPECIFICATIONS

Speeds: Three, 33⅓, 45, 78 rpm. **Platter Diameter**: 12 in. **Wow**: 0.06%. **Flutter**: 0.02%. **Rumble (NAB)**: –40 dB. **Arm Type**: Balance and spring. **Arm Resonance**: Lower than 8 Hz. **Maximum Stack of Records**: 10. **Height above motor board**: 5⅝ in. **Clearance below motor board**: 3¾ in. **Dimensions**: (base) 18½ W., 14½ D.; overall, 10 in. H. **Weight**: 18 lbs. **Price**: $199.50.

The new Miracord 50 H-II follows in the tradition of the older 50H and incorporates a number of refinements which make it an excellent instrument for the playing of records. The unit itself measures 14½ × 12½, but to provide clearance for the counterweight at the rear of the arm it requires a minimum of 16½ inches in width if it is mounted in an existing space. The chassis rests on its base by means of four cone-shaped springs with plastic cups which fit into pre-drilled holes in the base. To dampen the springs against vibration, each is packed with foam rubber to cancel oscillations.

The rim of the platter is fitted with a plastic surround on which are the two stroboscope rings, illuminated from underneath the chassis by a neon lamp. The rim of the platter is chrome plated, and with the molded rubber mat and the highly polished center plate is most attractive. At the left front of the chassis is the three-position speed lever, and at the left rear is the vernier speed knob, calibrated in an equal number of divisions + and - to provide a speed variation of ±3 per cent. A chart in the instruction book shows the relation between the migration time of one stroboscope line and the percentage of speed variation—if such precision is desired by the particular user. The speed variation is caused by the usual method of moving the idler up or down on the slightly tapered motor shaft, each of the three steps being tapered accordingly.

The "Magic Wand" changer spindle, first developed with the initial Miracord changers in 1952, provides the means of dropping records, with its three fingers retracting to drop the bottom record of the stack while an expanding portion holds the rest of the records stationary. This is a time-proven device and is much improved over the earlier design. For single-play use, a fixed spindle is provided, and to permit rotation of the record without friction against the body of the spindle, a sleeve turns freely around the device along with the record.

The counterbalance weight is fitted with a plastic extension which is molded with a rack along its underside to engage with a pinion actuated by the balance-adjusting knob, making the adjustment a simple act of turning the knob with the fingers. Stylus force is set by a large knurled knob calibrated in ¼-gram divisions from ½ gram to 6 grams—in case anyone

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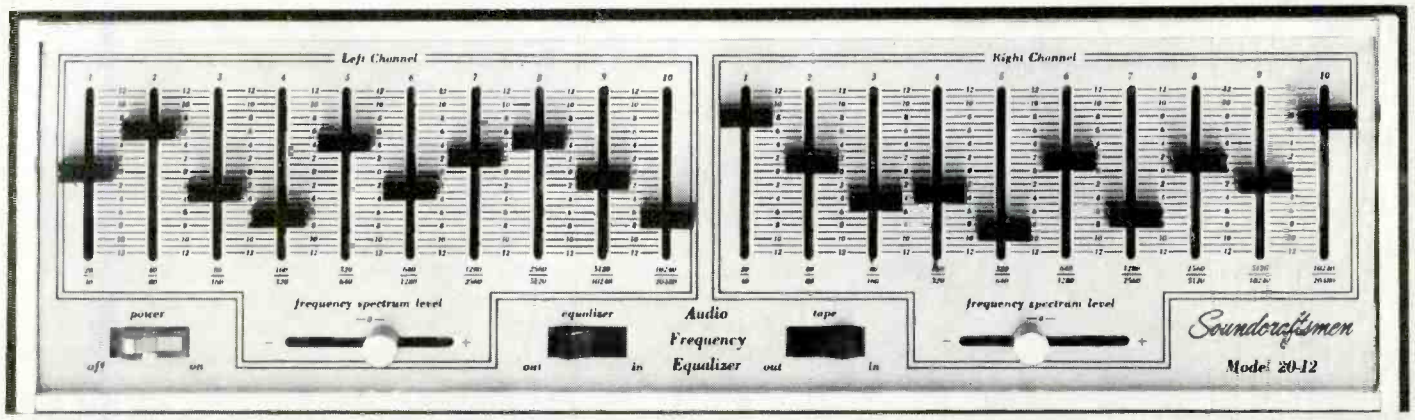
STEREO 20-12 ..... $299.50

20-12-600 ..... $349.50

SAME AS 20-12, EXCEPT HAS 600 OHM OUTPUT



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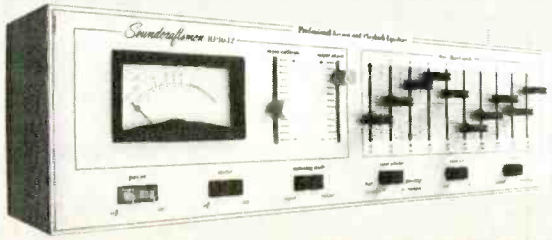
ROOM EQUALIZATION, SPECIAL EFFECTS, PLAYBACK and RECORDING

EQUALIZING FOR ROOM CHANGES: For example, here are some factors that would call for definite changes in your Equalizer settings: (1) Draperies open or closed. (2) Sliding glass door open or closed. (3) Room full of people. (4) Seating arrangements changed. (5) Major changes in furniture arrangement. (6) Relocation of speakers.... **EQUALIZATION OF RECORDS:** You can compensate for old 78 record deficiencies (surface noise, absence of highs or lows, etc.) or favorite recordings that have never sounded quite the way you felt they should sound.... **COMPENSATING FOR RADIO STATIONS:** Some stations are noted for excesses in either low or high frequencies. Make out a Computone Chart for each of your favorite stations so that you can easily achieve the ideal tonal response each time you change stations.... **EQUALIZING TAPES:** Compensating for pre-recorded, or home-recorded, tapes that are under or overemphasized in certain frequency areas.... **CHANGING OVERALL BALANCE:** You can make up for many deficiencies in recordings to more accurately duplicate the sounds of the original performance, or shape each curve to your own listening interests to greatly enhance your enjoyment of your recordings.... **SPECIAL EFFECTS:** You can boost or cut the loudness of a specific instrument or groups of instruments to obtain more pleasing instrumental balance or to add presence to a solo.... **IMPROVING RECORDING OF TAPES:** Use the Equalizer for tape dubbing, to create a near-perfect tape out of one that may have serious deficiencies. (Make your own corrected recording of records, station programming, or other tapes, and no further adjustment of the Equalizer will be needed for playback.) (See Operating Instructions).... **COMPUTONE CHARTS:** After you have achieved the equalization of sound that you prefer use the Computone Charts, supplied with each Equalizer, to mark the settings, so that you can duplicate the settings easily.

ALSO AVAILABLE, the **SINGLE CHANNEL PROFESSIONAL RP10-12 ..... $349.50**



VU METER: Precision ± .5% meter movement
FREQUENCY RESPONSE: ±¼ dB from 20-20,480 Hz, 1dB down @ 10Hz, ½ dB down @ 100 KHz.
HARMONIC DISTORTION: Less than: .08% @ 2V, .05% @ 1V. Typ: .01% @ 1V.
IM DISTORTION: Less than .08% @ 2V, .05% @ 1V. Typ: .01% @ 1V.
SIGNAL-TO-NOISE RATIO: Better than 90 dB below 2V output. Typ: 95 dB
INPUT IMPEDANCE: 100K ohms — (Operable from any source up to any Mixer, HiFi Preamp, Receiver or Tape Recorder).
OUTPUT IMPEDANCE: 600 ohms — (Operable into any Mixer Receiver or Tape Recorder).
INSERTION LOSS: Zero (slide controls centered, and "Output" set so that "Input" equals "Output."
MAXIMUM OUTPUT: 7 V in to hi-impedance, 3.5 V
SIZE: Walnut-grained wood case 5¼" x 18"

Soundcraftsmen: 1310 E. Wakeham Ave., Santa Ana, Cal. 92705 Ph: 714-836-8375

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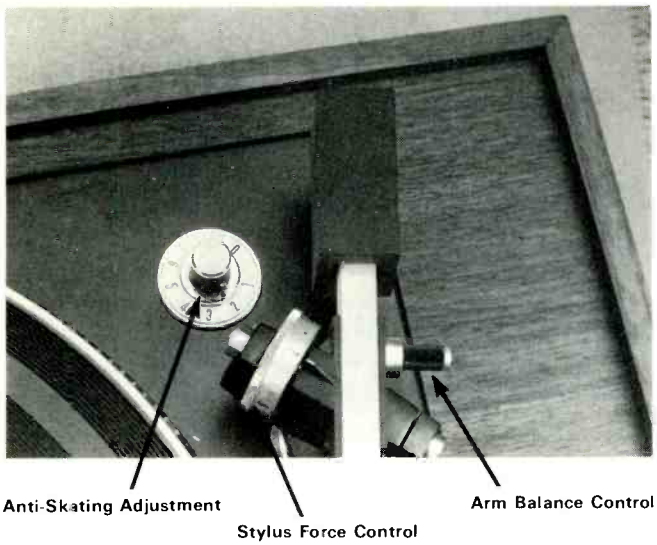

Fig. 1—Anti-skating control knob is located at the left of the arm mounting. The knob is set to number corresponding to the stylus force being used.

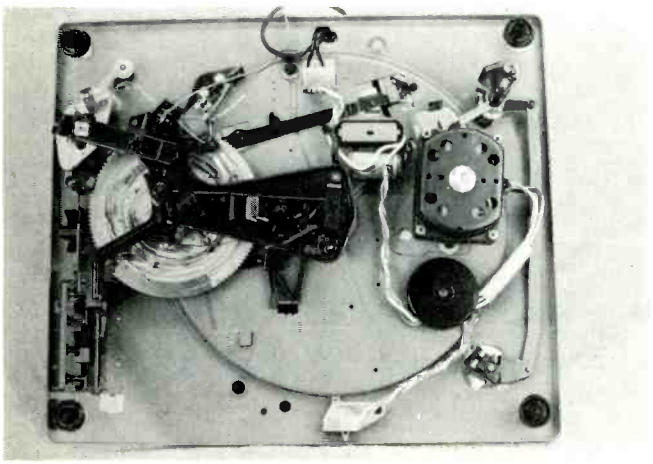

Fig. 2—The underside of the chassis is as neat as the top. Note the use of the die-cast metal operating arm.

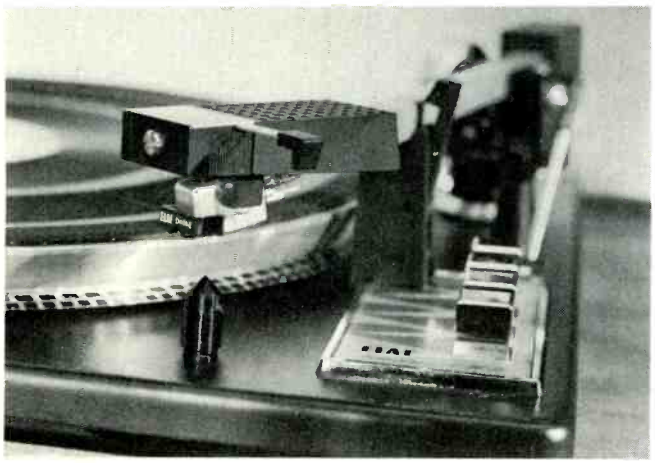

Fig. 3—Gauge for setting "overhang" raises to the level of stylus, while the screw on the front of the cartridge removes the cartridge backward or forward to center the stylus on the tip of the gauge.

wants to install an early Capehart pickup. Anti-skating is controlled by a knob just behind the arm mounting. This knob is set to the number of corresponding to the stylus force. The arm itself is a ⅜-in. square aluminum tube which may be locked onto its plastic rest when not in use.

The cartridge retainer is integral with the arm, and the cartridge insert plugs into the retainer, making the required four connections. One unusual feature is the means for adjusting the "overhang" of the stylus. While most cartridge holders depend on the use of a plastic jig for mounting the cartridge in the exact location for minimum tracking error, the 50 H-II uses a screw adjustment accessible from the front to move the cartridge backward or forward to the correct position, which is indicated by a gauge mounted on the chassis. This gauge—a plastic molding with a conical point at the top—is raised to come close to the stylus, and the screw is adjusted to move the stylus exactly over the gauge. Simple and effective, and most convenient if you change cartridges often. After setting the stylus overhang properly, the gauge is pushed down and a stylus brush—furnished as a standard accessory—is slipped over the gauge and adjusted in height so the stylus just rests on the tip of the brush when at rest.

Among the other "plus" features in the 50 H-II is the use of a die-cast metal cam which performs all the necessary mechanical movements of the arm—raising it, moving it over the desired groove, where silicone piston gently lowers it to the surface of the record at the start of a play, and raising it, moving it over to the rest to permit the next record to drop at the end of a play. All this, in addition to operating the drop function of the "Magic Wand" changer spindle. Another interesting feature is the ability of the unit to play a single record continuously, and this action is instituted by placing the single-play spindle in the opening *upside down*. Then the record will play repeatedly as long as desired.

The actuating controls of the 50 H-II are contained in a chrome panel at the right front of the chassis. Here are four square pushbuttons—the front three are to start the play at diameters of 7 in., 10 in., and 12 in., respectively. The fourth button serves to stop the play, resulting in the arm being returned to the rest and the motor stopped. All four buttons operate with a feather touch—so gentle that actuating any one of them will not affect the playing of the record by the slightest degree. This is a particularly delightful feature with the low stylus forces used in playing LP records, especially with high-quality cartridges.

The motor, which is a hysteresis/synchronous type, keeps speed as constant as the frequency of your power line, almost with no regard for the line voltage. We noted no change of speed at voltages as low as 85, while at 75 there was not enough power to go through a change cycle. Rarely are such variations noted in urban areas, although the voltage may drop during storms or "brownouts," though not likely as low as 75. Similar constancy of speed was noted at line voltages as high as 135—also a rarity in the average home.

Performance

We made the usual tests on the 50 H-II, using an Elac cartridge (as would be expected on an Elac-built Miracord)—the top-of-the-line STS-444-E. Flutter (5 to 250 Hz) was measured at a minimal 0.03%, while wow (in the range from 0.5 to 6 Hz) was measured as 0.08%. Range of the vernier speed control was measured using a Heathkit IB-101 digital counter and playing a 1000-Hz tone. At the minimum + position, the frequency of the tone went up to 1031 Hz; at the maximum - position, the indicated frequency was 968 Hz. These figures show that the variation available ranged from +3.1% to -3.2%, or a total of 6.3%.

The all-important rumble figure was measured with respect to a velocity of 3.54 cm/sec at 1000 Hz, which corresponds

closely to the specified 1.0 cm/sec velocity at 100 Hz. The output of the cartridge was passed through an RIAA-equalized preamp, which in turn was followed by a 1500-Hz low-pass filter. Then the stylus played a "silent" groove on the CBS BTR-150 broadcast test record and the output noted. It was 41 dB below the 1000-Hz level, which is very good indeed, since it results in practical inaudibility of the rumble frequencies. The same BTR-150 record was also used for flutter and wow measurements—using for the wow figure the results obtained from several playings to make sure that the record was not eccentrically placed on the spindle.

With the test cartridge we also measured the tracking of high-level grooves. At a stylus force of 0.75 grams, the cartridge was able to track a 100-Hz groove on the CBS STR-100 record which has an amplitude of 0.005 in, corresponding to a stylus velocity of 3.14 cm/sec. (An amplitude of 0.001 cm is equivalent to a stylus velocity of 0.628 cm/sec at 100 Hz.) This indicates that the turntable, with the test cartridge, was easily capable of tracking practically any LP record, in which low-frequency velocities should not exceed the test velocities.

Cycling time was a relatively slow 20 seconds, but when one considers the gentle handling of the records that is little enough price to pay for this sort of treatment.

Tracking error calculated close to the classic 0.5 deg. attained by the best offset-arm turntables. No arm resonance was noted down to 10 Hz, which was not unexpected considering the high compliance of the cartridge. On the whole, the 50 H-II Miracord is certainly the best of a long line of excellent automatic turntables, and should satisfy both the critical audio buff as completely as its appearance and ease of operation should please the distaff side of the household. The walnut base is an accessory item, as is the DCP-7 Operating Cover—a smoke plastic dust protector. The SSA-1 Power Control Adapter may be used in the base to turn off associated equipment with the last record on the stack is played—oftentimes a great convenience, especially if one likes to go to sleep to music.

C.G. McProud

Check No. 69 on Reader Service Card

Harman-Kardon Citation 13 Speaker System

MANUFACTURER'S SPECIFICATIONS

Components: Three 7-in. woofers; one 1½-in. dome mid-range, and two 1-in. tweeters. **Frequency Response:** 30 to 20,000 Hz. **Power Handling:** 60 watts rms. **Dispersion:** Essentially non-directional. **Impedance:** 6 ohms. **Acoustic Loading:** Dual chamber, triple vent reflex. **Weight:** 75 lbs. **Dimensions:** 20⅝ in. W., 14¾ in. D., 29½ in. H. **Price:** $295.00.

The Citation Thirteen loudspeaker is the latest entry in the Harman-Kardon premium component line. This new loudspeaker, besides having smooth and well-balanced sound, can boast excellent dispersion thanks of an ingenious scheme for reflecting sound. The walnut finished cabinet weighs 75 lbs., which testifies to the very rigid construction of the cabinet, and must be a new high for a cabinet of this size. According to the manufacturer, the cabinet interior is constructed of high-density, 1-in. particle board, using a bracing system to control panel resonance and flexing which, they note, is a common fault leading to loss of bass power and clarity. All six drivers are top mounted on a 14 degree sloping panel. This 14 degree angle brings the sound forward and establishes a firmer stereo image than is usually the case with reflecting speaker systems. The grille cloth is held in place by Velcro hooks and is user replaceable—a touch which is certain to be appreciated by the lady of the house and interior decorators as well.

The three 7-in. woofers drive a dual chamber reflex system which terminates in two unequal length tuning tubes, one for each chamber, thus stagger-tuning the system and extending as well as smoothing the low frequency response. The mid-range dome radiator comes in at 2500 to 3000 Hz, overlapped by two domed 1-in. supertweeters which enter at 7000 Hz. (See Fig. 1.) The crossover slopes are 6 dB per octave, causing minimum phase distortion and assuring smooth transition from driver to driver. (See Fig. 2.) A recess on the back of the enclosure holds a color-coded, five-way binding post, mid and high frequency balance controls, and last but not least, a speaker fuse—a feature which we would like to see adopted by more speaker manufacturers.

Measurements

The average impedance is a trifle over 6 ohms (see Fig. 3), essentially as claimed by the manufacturer. At 5000 Hz and above, the impedance drops to 4 ohms. Therefore, we would not recommend using a second speaker hooked up in parallel with the Citation Thirteen on the same amplifier tap unless the amplifier can deliver power into 3 ohms or so. Distortion figures, taken at 95 dB SPL with an 8 volt input, were commendably low. (See Table I.) Since the major part of the energy is reflected, we departed from our usual on- and off-axis measurement procedure and instead took seven curves, varying the distance and height of our measuring microphone relative to the loudspeaker. The input for this consisted of ⅓ octave pink noise. At the nominal impedance 2.5 volts equals 1 watt and gave 85 dB SPL, which is somewhat more efficient than most loudspeaker systems. All response curves were taken with mid and treble controls at maximum. (See Fig. 4.) From 800 to 16,000 Hz, the response was plus or minus 2.5 dB, which is excellent performance. Low

response extended to just below 30 Hz; in fact, the output at 30 Hz was remarkably high before doubling commenced. In this respect, the Citation Thirteen compared very favorably indeed with a system twice the size using a 15-in bass unit. White noise tests confirmed the excellent dispersion and low coloration—mostly confined to the lower-mid range. The low frequency disturbances are due to room effects and will change from room to room and even within the same room depending on speaker placement. The tone burst response was very good, as evident in the photos of Fig. 5.

Listening Tests

During our listening evaluation, we found that depending on listening distance we preferred anywhere from 3 to 5 dB of

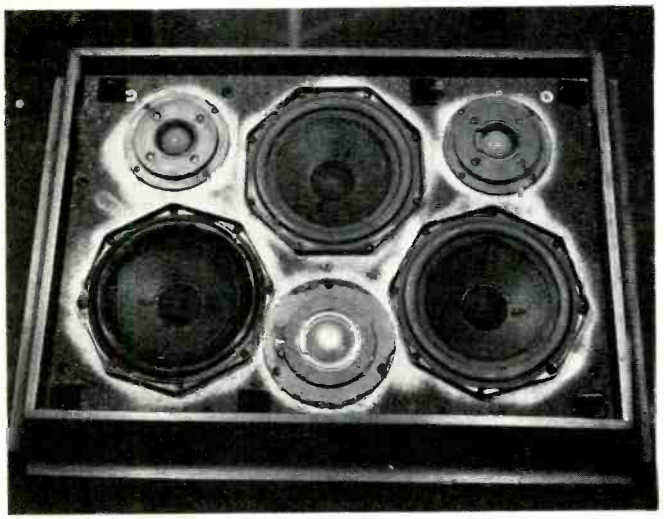

Fig. 1—Front view of the drivers, grille panel removed.

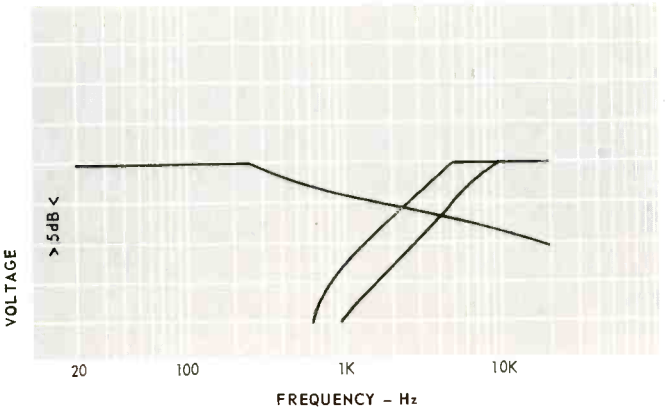

Fig. 2—Woofer, midrange, and tweeter response of the Citation Thirteen. Note the midrange and tweeter overlap. Voltages were taken at the voice coil of the drivers.

midrange and supertweeter cut. Not surprisingly we found the speaker to have smooth, well-dispersed sound with no trace of the vagueness in the stereo image so often associated with reflecting speaker systems. Likes and dislikes in speaker design, not to mention design in general, are matters of personal taste; we found the styling of the Citation Thirteen to be clean and functional, with handsome wood grain. As mentioned above, the grille cloth can be changed at the time of purchase to harmonize with most any decor. We can summarize this report by saying that the Citation Thirteen is a very successful design and a fitting companion to the Citation Twelve amplifier (which, incidentally, was reviewed in the May, 1970, issue).

Alex Rosner

Check No. 71 on Reader Service Card

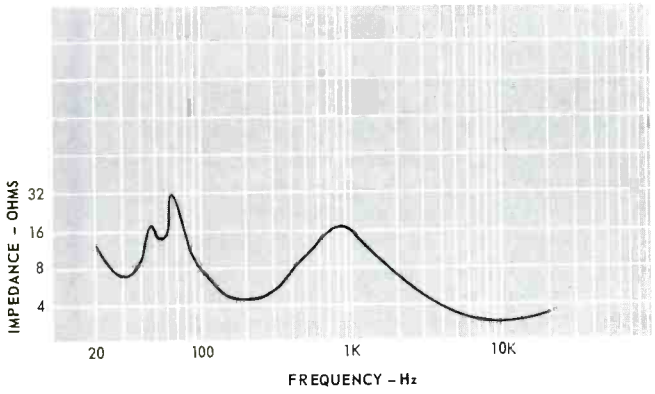

Fig. 3—Impedance curve. The peaks at 48 and 65 Hz are woofer and duct resonances.

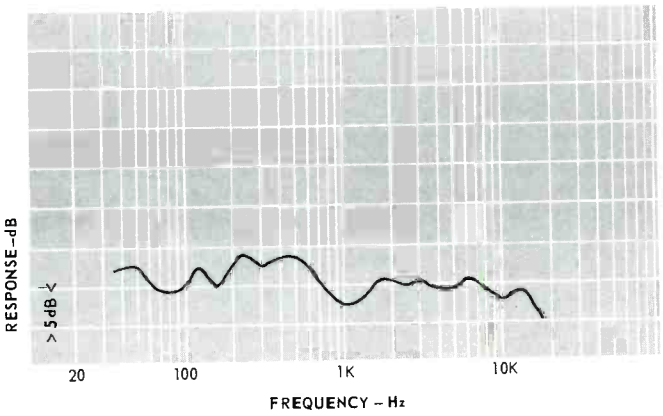

Fig. 4—Frequency response at ⅓ octave-band pink noise, averaged for seven microphone positions.

TABLE I

Second and third harmonic distortion of the Harman-Kardon Citation 13 at 10 watt input, for three test frequencies.

	Second Harmonic	Third Harmonic
50 Hz	2.7%	2.2%
100 Hz	0.4%	0.1%
500 Hz	0.8%	0.5%

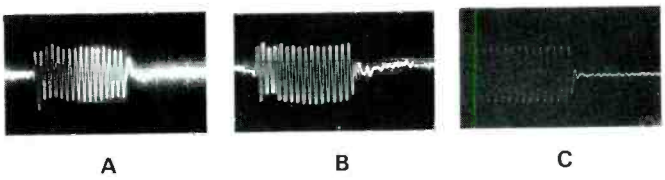

Fig. 5—Tone burst response at **A**, 100 Hz; **B**, 1000 Hz, and **C**, 10,000 Hz.

Heath Model AJ-1510 Digital FM/FM Stereo Tuner

MANUFACTURER'S SPECIFICATIONS

MONOPHONIC PERFORMANCE. IHF Sensitivity: Less than 1.8 μV. **Alternate Channel Selectivity**: Greater than 95 dB. **Capture Ratio**: Less than 1.5 dB. **Harmonic Distortion**: Less than 0.3%. **IM Distortion**: Less than 0.1%. **S/N Ratio**: Greater than 65 dB. **Image Rejection**: Greater than 95 dB. **I.f. Rejection**: Greater than 95 dB. **Spurious Rejection**: Greater than 95 dB. **AM Suppression**: Greater than 50 dB. **Channel Frequency Accuracy**: Better than 0.005%. **Frequency Response**: 20 to 15,000 Hz ±1 dB.

STEREOPHONIC PERFORMANCE. Channel Separation: 1000 Hz, 40 dB; 80 Hz, 25 dB; 10 kHz, 25 dB; 15 kHz, 20 dB. **Harmonic Distortion**: Less than 0.35%. **Frequency Response**: 20 to 15,000 Hz ±1 dB. **19 kHz and 38 kHz Suppression**: Greater than 55 dB. **SCA Suppression**: Greater than 55 dB.

GENERAL SPECIFICATIONS. Output Voltage: 1.2 volts nominal (at 100% modulation). **Output Impedance**: 4700 ohms. **Power Requirements**: 105-125 or 210-250 volts, 50/60 Hz a.c.; 50 watts maximum. **Overall Dimensions**: 16⅜ in. W., 6 in. H., 14¾ in. D. **Net Weight**: 15¾ lbs. **Suggested Retail Price**: $539.95, kit; optional pecan wood cabinet, $24.95.

Every decade or so, since the introduction of FM broadcasting on a commercial basis some 30 years ago, there comes upon the market a tuner which is destined to become "classic." Those of us who remember that far back will forget the old REL Precedent tuner which is pe

doing yeomen's duty as a monitor tuner in many a broadcast studio throughout the country.

The tuner which may well prove to be the "classic" of the 1970's is Heath's new AJ-1510 Digital FM Stereo Tuner. There is so much that's new and unique in this model that it would take a small volume to fully do it justice. (As a matter of fact, just about half of Heath's excellent 233 page manual is devoted to an excellent exposition of just what makes this unit tick.) We were privileged to have in our possession "Final Engineering Prototype #1"—well in advance of its announced distribution as an available model and, frankly, we intend to hold on to it until the Heath Company starts sending nasty dunning letters—it's that hard to part with it. The "ultimate" tuner? Well, if it isn't, it'll do until someone comes up with something better!

The front panel layout of the AJ-1510 is like no other tuner you've ever seen. It is of black and gold material and has a very "quiet" but elegant look to it. There is NO tuning knob and there is NO tuning dial or pointer, since all frequency indications are read from digital read-out tubes located at the upper left of the panel. The upper center of the panel contains a signal strength meter which also doubles as a multipath indicator and the upper right portion of the panel is devoted to such visual read-outs as STEREO, REPROGRAM notations and notations regarding the sometime UNLOCKED status of the frequency synthesizer, about which more in a moment. The middle area of the panel is the section with which the user will be most involved. At the left are ten keyboard buttons, numbered "1" through "0," as well as a re-set button (punched when you wish to "punch up" a new station frequency) and a button labelled BY-PASS (used to initiate the "auto-sweep" action which causes the tuner to sweep downward in frequency, automatically locking in on every available signal in your area).

At the center of the panel are three more buttons, labeled A, B and C. These are used to select three predetermined favorite stations. The buttons located at the right section of the center of the panel select KEYBOARD, AUTO-SWEEP, or PREPROGRAMMED mode of tuning, and there are additional buttons for SQUELCH DEFEAT and STEREO ONLY reception. If the STEREO ONLY button is depressed, only stations transmitting a stereo signal will be heard, regardless of which of the three tuning methods is in use. Finally, a matching power ON-OFF button completes this portion of the panel layout.

If you press gently upon the lower portion of the panel, this portion springs open to disclose some additional controls which are ordinarily used rather infrequently. These include a tiny test switch button which, when depressed, lights up all the elements of the digital readout tubes to insure that they are operative. There is also a rotary control which determines the speed at which the AUTO-TUNE action takes place, a noise squelch adjustment control, and an AGC squelch control. A slide switch changes the meter function from signal strength indication to multi-path indication and a second, three-position slide switch selects automatic stereo, partial stereo blend (for reduced noise in weak-signal stereo reception situations with some sacrifice in overall stereo separation, and mono-mix.

The right section behind the trap door contains three horizontal slots, labeled A, B and C. These slots correspond to the three PREPROGRAM selection buttons described earlier and, upon inserting three plastic cards no larger than a standard credit card, the buttons can be used to tune in your favorite stations which you easily program onto the cards yourself. One of these cards is illustrated in Fig. 2 and, as you can see, it is notched to select a specific frequency. Heath supplied us with about a dozen of these cards so you're really not limited to just three preselected favorite stations, but can insert other cards in the three slots as you see fit.

The rear panel of the AJ-1510 is pictured in Fig. 3 and contains antenna terminals for 300 ohm or 75 ohm transmission lines, a dual pair of output jacks as well as horizontal and vertical output jacks for connection to an oscilloscope for observing the nature and extent of any local multipath problems beyond what you can read on the dual purpose self-contained signal meter. A 0.5 amp fuse holder and an unswitched convenience a.c. receptacle complete the back panel layout.

While the unit supplied to us was fully wired, we were able to appreciate the amount of thoughtful engineering that went into this unit, both in terms of its performance as well as its kit feasibility. Recent Heathkits have increasingly stressed the modular approach and the AJ-1510 has carried this concept to its ultimate. There is a "master" or "mother" board into which are plugged seven circuit boards. Connectors are used throughout, which means that boards can be removed without having to unsolder or unwire a single connection. The keyboard p.c. module and the readout circuit board are mounted separately up against the inside of the front panel. An open view of the assembled chassis is shown in Fig. 3. The names of the seven major modules will give you a clue as to the sophistication inherent in this circuitry. They are: Tuner/Phase-Lock-Loop Circuit Board, Generator-Divider-Oscillator

Fig. 1—Front of AJ-1510 with trap door panel opened.

...ogram card.

Board, Programmer Board, Preload Decoder Circuit Board, I.f. Circuit Board, Multiplex Circuit Board, and Power Supply Board.

The heart of the non-mechanical tuning aspect of this unit lies in the voltage-tuned FM front-end, which is of the varactor-tuned type and contains no moving variable capacitor. Instead, a suitable d.c. voltage applied to the varactor diodes determines their effective capacitance. The keyboard, pre-programmed cards, or automatic sweep tuning methods all program a divider circuit. The divider circuit divides the tuner's local oscillator frequency and compares it to a crystal controlled reference frequency and the result of this comparison is the tuning voltage. Changing the divide ratio of the divider circuit changes the d.c. voltage applied to the tuner and a different station is tuned in. Simultaneously, a visual display of the station frequency is provided by the readout circuitry. Because of the crystal controlled reference frequency and the phase-lock-loop circuitry, however, the accuracy of the frequency tuned in is no longer dependent upon the drift-free characteristics of the FM front-end but will be as accurate as the reference crystal frequency and, in the case of the AJ-1510, that means at least 0.005% accuracy! Translated to frequency, that means a maximum error of no more than 5 kHz at a frequency of 100 MHz and that is not considered a significant error by anyone's standards.

Do not confuse this "digital readout" tuner with some units which have recently appeared on the market and simply replace the tuning dial with numeric readout devices. The latter variety guarantee no more tuning accuracy than their "dial pointer" counterparts. The Heath AJ-1510 is tuned *exactly* to 101.5 MHz when those readout tubes READ 101.5—and not to 101.54 or 101.47!

Performance Measurements

There is no doubt that the elaborate "computer" type circuitry incorporated in the Heath AJ-1510 must represent a fair percentage of its selling price, but even if you ignored it completely (or considered it as a welcome bonus), the tuner's performance as a tuner would justify its total price and then some. Normally, when we try to measure IHF sensitivity in our location, we usually try to pick frequencies which do not correspond to actual FM channels. Thus, for low end measurements, we often go down to 87.9 or 88.0 where there are no possible channels and for the mid-band measurement we try for an *even* number such as 98.0 or 98.2. Almost as if to reprimand us, when we punched up 87.9 MHz on the keyboard, a light lit up on the front panel and read REPROGRAM. (It could have said "please". . . .) Realizing that we weren't about to fool this unit, we settled for 88.3, 98.9 and 106.1. These chosen frequencies, together with our not-too-perfect "screen room" enabled us to read a sensitivity of 1.6 μV. Impressed, we decided that we weren't going to let this one get off so easily, so we tried to measure alternate channel selectivity and, as near as we could figure, it was just about 100 dB! The total quieting curve is shown in Fig. 4 and, along with it, you can interpolate the THD (mono) down to an incredible 0.18% for 100% modulation (as opposed to 0.3% claimed). Ultimate S/N is a very respectable 66 dB. Note, too, that quieting reaches a very usable 56 dB with a mere 5 μV of signal input.

In the stereo mode, we remeasured the THD and found that it was only 0.25% for 100% modulation (as against 0.35% claimed) and that, to us, represents a real breakthrough, since stereo THD is usually much higher than mono THD on most tuners and receivers we have measured in the past.

The stereo separation characteristics of the AJ-1510 are graphed in Fig. 5 and, again, the very conservatively stated

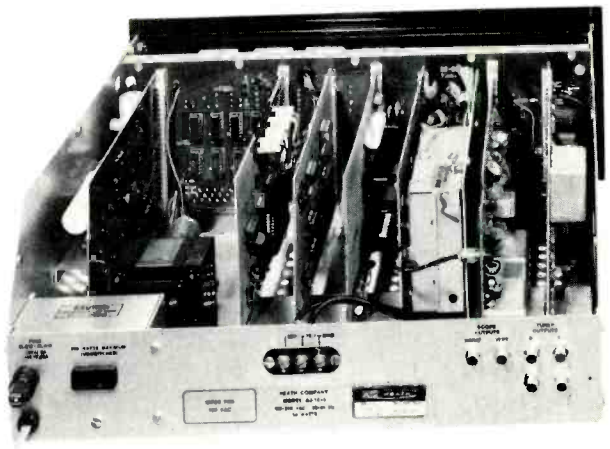

Fig. 3—Rear panel of the AJ-1510 also showing modular circuit board construction.

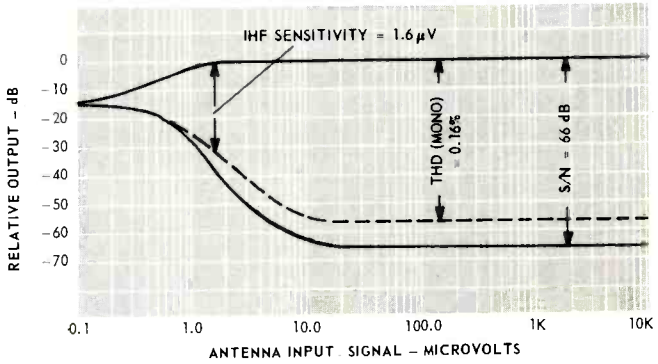

Fig. 4—Mono FM characteristics.

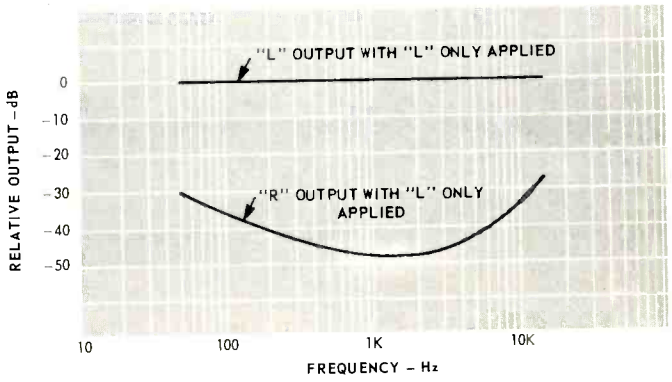

Fig. 5.—Stereo FM performance.

published specifications are exceeded. Here's a tuner that maintains at least 30 dB of separation from 50 Hz to 14 kHz and hits a mid-band separation figure of 46 dB! Both SCA and 19 and 38 kHz suppression were in excess of 60 dB, which means that SCA interference was absolutely inaudible. Capture ratio measured 1.35 dB as against 1.5 dB claimed. Our generator is only capable of measuring spurious responses up to 90 dB and since we couldn't detect any we'll have to say that Heath more than likely meets its 95 dB spec here too. In short, every spec was easily met or exceeded and if you compare published specs with the best of the "ready mades," you're not likely to come up with a finer set of readings anywhere. All through these measurements I had a hard time keeping in mind that the AJ-1510 is a tuner "kit"—you put it together yourself and realize these kinds of performance specs!

Listening Tests

After spending several hours playing with the keyboard, the automatic sweep, and the dozen or so cards which I prepared with the aid of a small pair of scissors, I got down to the serious business of logging stations. The automatic sweep mode proved best suited to this task, since all I had to do was sit there and punch the BYPASS button and watch the digits read down from 107.9. For these tests, the squelch control was reduced to its minimum setting. Normally, this control would be adjusted so that only stations having a desired quieting level or better would be allowed through, but I wanted to get a count of as many stations as I could. Would you believe 63, without having to rotate my antenna? Of these, I might have "rejected" about 7 or so as being too noisy, but that still leaves 56 *listenable* stations. I repeated the experiment with the stereo-only button depressed and came up with an impressive 32 stations, of which 5 were a bit too noisy. (One of the five was located at a known distance of 85 miles from my location.)

We also experimented with the MULTIPATH function of the signal meter and found (with the aid of a 'scope) that when it showed a null (as we rotated our outdoor antenna), the multipath (as shown on the 'scope) was truly at its minimum point.

Incidentally, in using the AUTOMATIC SWEEP method of tuning, if you keep the BYPASS button depressed you *do not* hear undesired stations as the read-out sweeps down from 107.9 to 88.1. Stations only "lock in" and become audible when you *release* the bypass button. Even if you adjust the "speed" of the automatic sweep sequence to its maximum, the stations will lock in accurately, without skipping, providing your own reaction time gets your finger off that button on time. For less agile fingers, the speed can be reduced to about one channel-width per second, which is slow enough for anyone's needs.

We enjoyed the crystal-clear, distortion-free reception we obtained in using the Heath AJ-1510, and we were always aware of the fine performance specs while using it. But perhaps the most gratifying thing about using the AJ-1510 is the certain knowledge that no matter what station we were tuned to, the frequency to which the unit was tuned was "right on." Even the best calibrated dial is subject to visual interpretation and even the finest center-of-channel meters are not always perfectly balanced or calibrated—but that phase-lock-loop comparator circuit of the Heath AJ-1510 has got to be the way all tuners of the future will be made. It's very nice to know that Heath has just brought that future into the present. In a way, we're sorry our unit came completely wired. Can you imagine what we would have thought about this much performance in a tuner if we had actually wired it ourselves?

Leonard Feldman

Check No. 74 on Reader Service Card

London Letter

Donald Aldous

"ALTHOUGH 1972 already accuses some distances from its birth, I risk it nevertheless to reiterate with intensification the best wishes for a successful, troublefree, and pleasure creating year. It represents, incidentally, the thirteenth year of UIPRE's existence. Therefore, it must be a happy one. Full of confidence we have chosen 'Papier Rose' for the receipt stamp offering it in exchange to the active members who will clear their membership fee 1972 . . . . With these thirteen years we are definitely in advance of British people, who—as statistics seem to prove—face only 12 years of their life their television screen!

"1972 has too the quality of increasing the distance from Emperor Nero's reign (you remember the incendiary at Rome). This money-voracious person had introduced a special taxation based on the protuberance of human's belly (I suppose pregnant women excluded); the more prominent, the higher the tax! . . . But the UIPRE is "rounding" its belly without hesitation."

No, this is not the quaint language seen in some English translations of Japanese, but appears in the official Bulletin No. 133, January, 1972, issued by Mr. Karl Pinsker, General Secretary, *Union Internationale de la Presse Radiotechnique et Electronique* (UIPRE).

I wanted to start this letter on a cheerful note, and Karl, as a person is as delightful and friendly as his eccentric English suggests. His puns on English words and phrases have to be heard to be believed, but his contribution to keeping the UIPRE organization running is notable and, in my view, irreplaceable.

In case you are not familiar with this association of editors, publishers, and contributors to radiotechnical and electronic periodicals, the objects of the body are to achieve close communication between members in their professional capacity and to promote mutual understanding by personal contact, to assist in the dissemination of reliable technical information on relevant subjects, and to give mutual help in solving professional problems. As many professional audio engineers and authors must read this paper, if you are not a member, why not get details from: Mr. Karl Pinsker, UIPRE, CH. 4002, Basel, Switzerland, P.O. B. 1027.

* * *

Most television receivers in this country make no provision for taking off a sound signal safely from the circuit, and in consequence many owners of hi-fi equipment have been unable to take advantage of the high quality sound that is transmitted these days by the BBC and ITV (Independent Television companies) in the UK. There are, of course, acoustic and technical studio problems associated with TV sound and picture transmissions that are not present in purely sound transmissions by radio, but it is estimated that the sound quality of about 95% of British television receivers is comparable only to the performance for this parameter of a medium-wave portable radio set.

Sound, as the poor relation of the TV medium, was debated vigorously at a recent discussion evening in London, organized by The Royal Television Society. Obviously, much of the problem revolves around the limitations inherent in 7-x-5-in. or 5-x-3-in. loudspeakers and output stages of 1 or 2 watts.

Now that Great Britain has substantially nation-wide coverage with TV signals from UHF transmitters (using the PAL color system common in Europe), Continental and Japanese manufacturers are casting eyes at t British market. Some of these 62 UHF receivers have feat

DONALD ALDOUS was voted British Hi-Fi Journalist of 1971 and was awarded an Adler portable typewriter and a check for 100 British Pounds ($260). Gerry Adler, managing directer of Eagle International, the sponsoring organization, made the award, which will be given annually.

unknown in British TV sets, such as, large loudspeakers (two or more), tone controls, and higher undistorted power outputs. To be fair, some British companies are recognizing this need, and, for example, Decca has models with double-wound a.c. transformers, tone controls for main amplifier, and a low-level output signal at low impedance to feed to any hi-fi system.

Despite the fact that most British TV sets are now transistorized or hybrid types (tubes and transistors), the circuits are still a.c./d.c. principle, and are not fitted with an isolating transformer, so it is unsafe to attach external leads for loudspeakers or hi-fi feeds. A few so-called audio adaptor units have been marketed here, which incorporate double-wound isolating transformers, but the answer to this problem may well be in a new device (one version of which is called Telefi) which by utilizing stray emissions from the TV receivers, obtains a clean sound signal largely unaffected by the quality of the TV circuitry.

More precisely, this technique depends on the presence in the vicinity of UHF sets (or the UHF section of a dual 405/625 line set) of electromagnetic radiation from the intercarrier sound i.f. signal. This is at a frequency, in the UK, of 6MHz. The magnetic component of this field can be picked up on an induction coil (or probe) affixed to the outside of the TV cabinet by sticky tape, for example, and the signal is then fed to the radio or auxiliary sockets of the hi-fi equipment.

This method means that there is complete safety, as there are no direct electrical connections to TV chassis nor modifications to the TV set, and hence makers' guarantees are not invalidated nor are rental agreements on hired TV sets. In some tests we have done, the encapsulated probe coil (to which is attached a length of screened cable, up to 30 ft. long) was located near to the back cover of the set, as close to the sound i.f. amplifier as possible, and on the receiver we employed the field was so great that position was not critical for good results.

The audio output of the unit is adjustable between 100mV and 1 V by a preset, and the output impedance is 2,000 ohms. Distortion is stated to be less than 1%. The Telefi costs about £24 in UK, or $62.65 approx., and is manufactured by Dinosaur Electronics Ltd., 85 Victoria Street, Windsor, Berkshire.

There are other approaches to this problem, including a Swedish system which converts their 5.5 MHz intercarrier sound i.f. to a frequency of 10.7 MHz thus permitting it to be fed into the i.f. section of a normal FM tuner, but a friend and colleague of mine, Gordon King, one of the most prolific technical writers on audio and electronics in the world, was actively experimenting with these methods as far back as early 1967.

Gordon's method was to demodulate the sound signal from the intercarrier signal, then to process it and apply it to an FM very low level VHF oscillator producing a signal at a frequency corresponding to a quiet spot on Band II. The little unit was battery-powered and there was no physical connection between the TV set and the FM tuner. Indeed, there were no controls, other than an ON/OFF switch, and the neat box was merely placed on the top, side or back of the TV set for optimum intercarrier pickup, that is, best S/N ratio, and the FM tuner adjusted to the FM carrier from the low-level oscillator. successful in past years. On the Continent, the Paris *Festival du Son* was due to be held between March 9th and 14th

but, at time of writing, no venue announced. Some 50 brand names were

Alas, when the Radio Services Department of the British Post Office was approached to discover the legality of such a device (a mini-transmitter), it was ruled that the device would require a license as it would involve the use of "wireless telegraphy" and such a license would be unlikely to be granted, even at such low powers. It was permissible to transmit the FM television signal via a coaxial cable link, but since this would have required a diplexer (to introduce the normal FM aerial), radiation problems might still exist. So the system was not produced commercially, but Gordon's work is worthy of going on record, I think. It would be interesting to know whether any similar devices have been marketed in America.

* * *

Springtime produces its crop of audio exhibitions, and March saw the public address and sound reinforcement show, organized by the Association of Public Address Engineers, and Sonex '72, both held in London, with the latter at the Skyway Hotel, near London's Heathrow Airport. This might seem an odd venue, but in fact the rooms are well soundproofed and the exhibition has been down to take part in the Sonex '72 show, and a series of Sound Seminars were being arranged by myself and colleague Frank Jones. Yes, there's a boom in hi-fi in Great Britain at present, and the audio scene looks set fair for quite a while.

This letter is being compiled before any of these exhibitions, so much detail of new products or developments is not yet released. However, I can mention that Radford's new range of loudspeakers, mentioned in passing in last feature (October, 1971), including the novel 360° mini-model, will be released, together with new speaker designs from Rola-Celestion and B & W. This latter model is known as the DM2 and has been two years in gestation. It has a very high standard in terms of frequency linearity, freedom from coloration, and is capable of handling relatively high powers. In fact, John Bowers tells me that it has been created as an international product, aimed at the Canadian and American markets, with their high power handling requirements.

I am however, able to release some news of a new cartridge from Decca, christened "The London." This model is the result of five years research to produce a virtually hum-free cartridge using the so-called "positive scan" (no cantilever) technique used in the well-known Decca *ffss* pickup heads.

Hum pickup from the fields around turntable motors, transformers, motor switches, and main leads has represented a problem with earlier Decca cartridges, and the new design incorporates a revolutionary type of magnetic material used in the magnetic circuit. The manufacturing technique includes super-cooling the armature in liquid nitrogen at minus 196°C. to produce an outstandingly flat response and stable overall performance. The design has also brought about a significant reduction in the cartridge mass, from about 14 grams to less than 4 grams. The output of the cartridge is also increased to around 7½ mV at 5 cm/secs.

Lastly, an important tid-bit of quadraphonic news in the UK—EMI, the giant record and electronics combine, has joined forces with CBS to produce stereo/quadraphonic LPs using the Columbia SQ technique. These compatible disc records will be released, in a small number, around Sonex '72 period, and tape cartridges using the same system will be issued at roughly the same time. AE

WHY ARE AUDIO PEOPLE 'A SPECIAL BREED OF CAT?'

Norman H. Crowhurst

AS MANY readers of AUDIO know, I have been associated with this field for some 40 years. During that time I have often asked myself, "Is there something unique about people in this profession, different from other branches of engineering, or from other professions and, if so, why?"

They Are?

Several hundred readers of AUDIO are also on my special mailing list, that I started a few years ago, because so many people wrote to me anyway. The thing that amazes me, since I started this, is something I suspected, but refused to believe, before that. Most, if not all, of these people, have common interests outside of audio (besides sex)!

Do other professions find this? Or other branches of this one? Here's one thought. We are living in an age of socialization, in which the value of the individual is submerged in something vaguely referred to as "the good of society." Audio people, without exception it seems, value the individual; they are individualists.

Since I left college, I have had two professions, engineering and education. If you take the education profession collectively, and compare it with audio, in the attitudes of the people who comprise each, they are poles apart. Most educators struggle hard to deny individuality. Their idea of scientific method regards each child as a human unit, like every other human unit, subject only to what his environment makes him.

The concession they make to individuality is a professed endeavor to help each individual to achieve his maximum personal potential. But the method of maximization leaves much to be desired. We hear of personalized or individualized instruction. All that ever means in the educator's vocabulary is that each student is allowed to learn the same stuff at his own rate.

If you speak of matching the presentation to individual personality needs, you are beyond most educators' comprehension right there. If they have any idea what you mean, they will tell you it's impractical and beyond their capability, without billions of dollars, enough to provide every student with several personal teachers exclusively for [illegible] and even more billions for highly [illegible] training!

True, not all educators hold this kind of view, although the majority do. But find one who has the kind of view that you and I have, and who can *do* what we are talking about in the classroom, and odds on, this one will have an interest in or some affiliation with the audio field, too.

This is what I have been discovering during the past year. So it cuts both ways. Audio people are unique. You can spot them, without having them previously identified!

Frankly, I resisted this conclusion for a long while. I thought to myself, "But every professional group has its own camaraderie that sets it apart from the rest, if only by the professional jargon they use." Over the years, I have had the opportunity to mix with various groups, and whether my momentary realm is social, religious, or political, the audio people keep popping out. The conclusion is irresistible.

So what makes them different? And a more important question follows this one.

Why?

For the moment, let's take a look at what may be regarded as the opposite side of the coin, which also puzzled me for quite a while. A person who has been deprived of his hearing is quite different in his attitudes toward others, from a person deprived of some other sense, such as sight. (Incidentally, I am surprised how many audio people are also camera buffs. But back to the question.)

Psychologists explain that there is a reason why deaf people have a more difficult problem "adjusting" than blind people do. Deaf people are deprived of far more elemental a piece of communication with their fellow human beings. They have less opportunity, by far, to interact with the rest of us.

Reverse this coin and you have the opposite fact. Audio people are, more than any other group, concerned with the creation of human interactions. Without realizing it, they are probably more concerned as a group than are psychologists and psychiatrists. And if you want a group of professionals whose viewpoints cover the waterfront, try the Psychology Department!

Audio people have initiative, to an extent not found in other professions. They are more stimulated. You have to go a long way to find a psychologist as stimulated to find his own answers as audio people commonly are. For the most part, a psychologist seeks to identify his patient's ills against some prescribed chart of patterns. This patient has this or that syndrome.

Where To?

At this stage in history, society, led mainly by educators, is taking a curious turn. Technology is providing "answers" like never before in human history, that promise to liberate us from the chores of life, so we can devote our energies to creativity—thinking up ideas that we can use machines to implement for us. Yet educators seek to compartmentize as never before, with vocational education, career education, and so forth.

Their effort is concentrating on training toward specific skills and jobs, many of which will be obsolete by the time students graduate. The so-called "3-Rs" of yesteryear were certainly inadequate for today's world. But the way education has moved *from* those rote-learned subjects has been the wrong way, proving even more destructive of any creativity that students may possess.

The possible exception to this generalization is to be found in art and music classes. That is good, but it represents only one form of creativity—expression. Creativity, in the sense of generating ideas, is something about which educators know little or nothing. Find one who does and odds on, he's an audio man.

For What?

There is a cry for leaders, to help straighten up the mess. Today a leader is defined as one who can read well and find the answers he needs in books. The kind of leaders that stood out in bygone years do not seem to exist any more. The nearest thing to a born leader today is an audio man (or woman—I'm not sexist!). Because of the capacity to which I have referred in the foregoing, audio people are singularly suited for some of the major tasks ahead.

The educational profession, as well as various industries and occupational groups, are really hep on AV—audio-visual. With that industry's devotion to providing service, we have varieties

of AV coming out our ears! There has been no lack of creativity in producing the hardware to make AV available to anyone who wants it.

But what about the software? That, we tend to think, crediting others with as much common sense as we have ourselves (which is an admirable trait), is best left to the experts in the field for which it is required. So what do we find happening? AV being used merely to "translate" good (and sometimes not so good) text and reference books into a new medium. Nothing more!

The various wonders that AV creativity has produced in the hardware department offer opportunities for creativity never before dreamed of, in the software department too. Not just to indoctrinate or instruct, in the limited specifics that have become customary in every branch of education, but to get the recipients thinking creatively, moving ahead into the new role that human beings can occupy now that technology will do all the chores.

How?

Today, in other fields, the emphasis has moved to service. You go to a distant city and all kinds of service are laid on for you, from secretaries to automobiles. All you have to do is sign for them—and pay later. Why cannot audio people move in that direction? We have the brains and initiative. Let's not be bashful, because we have always occupied a sort of back seat, turning knobs when the stars wanted them turned.

Let us analyze what makes creativity. Isn't it based on individual thinking? Notice that all the subheads for this article are questions? Properly used questions open minds, get them active. I say "properly used," because I have said this same thing to educators and then watched what happened. So they too use questions. Instead of saying "Pick up your pencil, Johnny!" they say "Wouldn't it be a good idea to pick up your pencil?" Thus Johnny is encouraged to think that picking up the pencil was his idea!

The important difference in the usage of questions is that the ones that open minds do not have obvious answers. They promote thought. Do not be afraid of asking too "big" a question. If the first question is too big, so the listener doesn't know where to begin thinking about the answer, follow it with another question that will direct him a little, such as, "Where would you look for that answer?"

Now, perhaps, you will be asking me where you can find out how to do the things I am hinting at here. Where will you look for the answer? How about starting by finding out what's inside your own head? Æ

Audio ETC

Edward Tatnall Canby

TO MY INTENSE astonishment, I discover that I am the only remaining active participant of the original team that was involved in our memorable First Issue, back in May of 1947. To be sure, I didn't have much to do with it—but I was there. And to be sure, C. G. McProud, our guiding light for so many years, is still with us, checking out enticing new audio items for our Equipment Profiles. But he officially is retired; and it is the way all good engineers should retire, he continues working. So that leaves me.

Back in 1947, C.G. McProud was the possessor of a brand-new FM tuner and the managing editor of a new magazine. I was the purveyor, since 1943, of a local New York FM radio program (and still am). McProud tuned in Canby. Aha! There's the man for our new record review department, he said. And since the McProud apartment was right around the corner from me in Greenwich Village, we quickly came to an informal agreement, amid siamese cats and other hi fi gear. I was to write reviews with an audio-ish slant. And so I did—pages of them, done up in microscopic small print.

John Potts, for whom the Award was later named, was then editor. The office was somewhere comfortably cubbyholed in New York's midtown region, where I could drop in to chew the rag whenever my copy was ready for delivery. I often did, and I view our present distant Philadelphia headquarters with a jaundiced eye.

My only real problem, then, was weight. Not my own (135) but that of the enormous packages of 78 rpm records that so persistently arrived, and had to be lifted. I had a top floor in an old Village brick house, with neither doorman nor super. When the postman arrived with 100 pounds of shellac records, nobody would be at home. The inevitable notice would be left at the door, discovered by me on my return five minutes later. So I would resignedly set off to walk the fifteen-odd blocks down to the P.O. (we *walk* to the P.O. in New York)—only to find that the package was still out on the truck, and come back tomorrow. Fifteen later, I would arrive home, to notice, for a second package, under my door. A couple of years of *that* and I had to move out.

Fortunately, we suffered only about a year of the exclusive 78 shellac. In 1948 the LP arrived and by 1950 there were no more of the breakable heavyweights to tax my lifting powers. In 1949, those cute little RCA 45 classical albums appeared. I still have a few of them on display, as souvenirs. On my back shelf is the gadget they sent me to play them with, the Treasure Chest. That was RCA's high-style mahogany 45 changer. Right next to it is RCA's high-style mahogany 8-track player, another lovely souvenir. Oddly, it played 8-track pop tapes nicely but tore up two Beethoven Concertos and a Symphony, one right after the other. I keep *them* as souvenirs too.

As for the 45, it soon retired into the 200-play traveling-crane jukebox, where it has lived happily ever after to the tune of billions. And the 8-track is neatly ensconced in a million automobiles and thousands of boats, snowmobiles and the like. So our classical reviews have been simplified and my life with them. They're still based on the LP disc, whether one-channel, two or four. On points, the LP remains the best purveyor of real classical music.

I long ago retailed the story of how I "fell" into audio, out of music and record reviewing. In the early days I quickly discovered that in the very presence of real, honest-to-God audio equipment I simply could not write merely about music. Audio, with music as its main reproductive goal, was just too interesting *not* to write about. So my department fell into two parts, the second half being named, on the spur of the moment, "Audio, E.T.C.," a designation happily revived for me by our present editor. I have been learning about audio ever since, and I quail at the thought of how little I knew, not to mention how much I still don't know. But as they say, capacity to learn is what really matters in this world. I have worked hard, over these 25 years, especially during those big moments when audio has moved on to something new, like stereo or our present quadraphonic sound. My teachers were the best brains in the business—thank the Lord, as I always say. My job has been to digest, interpret, and hopefully to add a bit to our perspective at the interface, the crucial wave-front, where audio and music work together.

I think this 25th year of our publication has in this respect been the toughest I can remember. Don't talk to me of the Battle of the Matrices! It was *my* Battle of the Matrix, and I haven't won it mathematically yet to my entire satisfaction. After all, I flunked out of math, as a kid, just when we got to sines and cosines and angles of geometry—and here I am swallowing quantities of phasing geometrics of a sort that would have turned me pale in college. Little did I know that music would lead me to trig like a horse to water, and make me drink too. So much for continuing education! It keeps one alive.

As a survivor of our modest 1947 beginnings, I suppose I should now promulgate words of wisdom for all you chillun' who read our magazine today. Well, I have 'em all right. I have invented a Constant. It's something. It ranks with such enormous ponderables as $e = mc^2$ and—of course—Planck's Constant. As a special 25th Anniversary bonus, I hereby present it to you, no strings.

The Canby Constant helps explain why there is such an oddly diminishing distance, for you charter subscribers, between our successive Anniversary Issues, which come regularly every five years. They seem to get closer and closer, seems I barely finished writing for the last one. But my Constant takes you a lot further. It also explains why Methuselah, if that's how he spelled it, didn't live any longer than 1000 years and Moses had to give up at—was it?—800. According to my theory, these gentry were approaching a mathematical time infinity, just as a small baby is leaving one, at the other end of life. Infinities are total barriers. You can't get past them. The Canby Constant says that for each of us, our personal sense of time begins and ends in infinity. An awesome idea, if I do say so.

Let me be specific. My better instincts tell me that I should avoid reduction of the Constant to algebra, that being my traditional bête moire, but, this being our 25th, I'll wax reckless and give it a try. So hold on tight now, while I venture onto thin ice:

Er, hmmmm. Let's see . . . have to

have an x or something, don't I? Or on second thought, maybe not, since I'm not looking for an unknown. Forget about x. What I need is symmetry—for the eye. How about, say, $L_e = m \div c$? Not thick enough. Maybe $C_{xq} = m^2 \div l_e$? That's heftier. Nope, don't like it. Not aesthetic. My Constant has to *look* right, and damn the torpedoes. I've got it! $LI = FE^2$. That's good—an acronym. Suggestive. Can't have algebra that isn't suggestive, these days. $LI = FE^2$! That's what I'm talking about. Not to mention some species of iron oxide in that FE^2 business. But does it all make sense? Maybe I'd just better revert to my special *forte* and give it to you in good old words.

The Canby Constant says that the *apparently perceived* length of your past life, stretching back from the present to your earliest recollections, *remains always precisely the same*—no matter how old or young you are. A fixed time span. And, as a corollary, the element that changes is the length of the included time units—the days, months, years that have passed and continue to pass. They get shorter. And shorter. Geometrically.

Now that's some idea, isn't it. Worth thinking about. It's like the horizon as you drive across a flat plain, seemingly never closer; the miles look shorter in the background as you drive on; they're longer in the foreground. Life is the same reversed. The nearby years are the shortest, and keep getting shorter.

Or, if you wish, it's like a reversed VU meter with its fixed scale running the wrong direction. The volume units are spread out at the left end (your early years) and all bunched up geometrically at the right end (the present). The length of the meter scale is fixed. Only the length of the equal units change on the scale, from one end to the other.

To a seven year old, life seems just as long, looking back, as it does to you looking back. To him, a year is an age. He can scarcely remember last year, one seventh of a lifetime back! Second graders do not even speak to first graders. Siblings born a year or so apart live in different childhood worlds though in old age they are as twins. It's all a matter of proportion.

Twins born ten minutes apart are half-a-lifetime separated in those first twenty minutes. The childhood term "grown-up" reflects the vast stretches of inconceivable time to come, for the childish mind unused to proportional thinking. Even the 18 year old sees a 24 year old as a grown up. The college freshman bows to the senior, four long years beyond him, almost a quarter of his life. Listen to your own ten year

old, talking so wisely about his day, his gravely experienced years, already so very far into things as they are. *He* has lived just as long a life as you—he *feels* that way inside. Only his time units are different. Much bigger.

At the other end of life, those units get smaller and smaller. Days go by at an increasingly dizzy speed, summer and winter blur together—where does it end? At infinity! When you are 70, you'll be 80 in no time at all. No wonder Moses had to quit. And no wonder, the other way, that your own recollections at age 3 or 4 are so unreliable. Too close to an infinity of time-length. Time was so enormous, at that stage, that you can no longer relate your present lings to any reasonable facsimile of ou were too close to your own nning, back at the moment of birth, or maybe, conception. Phew! Imagine a lifetime looking back five minutes.

The Canby Time Constant is ultra-simple, like all great Constants. From now back to babyhood, every elapsed lifetime remains always of a size, year after year, as the time units go by and recede into the distance, faster and faster. As for me, 25 years with this magazine does seem quite awhile, but not really *that* long. My perspective goes on back still further, you see. That quarter century is merely the latter half of my life, which in geometric terms, the diminishing size of the year, means maybe at the last quarter or less. That's how it feels. Time is *proportion*, as we preceive it. Time is like pitch, which is also preceived in proportions, not numerically. The only personal Time-Constant is the unchanging life-stretch. . . .

Well, if I'm around for our 50th, I'll have to type terribly fast to get to the printers before the 75th flashes up for me. But in that year, 2022, Audio will surely still be popping along, full of the latest info on centaphonic sound, 100-channel and spread all over your walls like activated wallpaper. Each 2022 speaker unit will of course be A/V, a combined solid-state sound emanator and a light-emitting semi-conductor laser, for an integrated reproduction of sound and picture together, out of recordings (mini-cartridges?) and via broadcast. I mean it. I can hardly wait. It's no joke, this. Real life.

But, alas, by that time infinity will have caught up with me, and so I'll have to skip it. Æ

Two Verdi Requiems; G&S Encores

Richard Freed

BOTH OF THESE recordings were released at the same time, quite a few months ago. No one can hope to keep up with all that comes from the various companies every month, but both of these versions of the *Requiem* are too interesting to pass by without even a nod, so, even at this late date, they are worth discussing.

"Interesting" is certainly the word for them, perhaps even "fascinating," though I doubt that any two recorded performances of this work can be more different from each other than these two, and I doubt, too, that either of them would be a first-choice for most listeners with deep-seated ideas about how they like this music to sound. Either or both of these sets would more likely appeal to the really devoted Verdi buff, who might select one of them as a complement to his "standard" version (probably Solti or Giulini), or perhaps even take both, as foils for each other.

Since these sets were issued shortly after Barbirolli's death, it is hard to avoid the obvious observation that he left a very appropriate memorial to himself in the form of one of the most revered of musical obsequies. The performance, in fact, does represent Barbirolli's art at its most characteristic, realizing the drama inherent in a basically dramatic (in contradistinction to a basically devotional) work, but realizing it in terms of compassion more than heroics. This is not to suggest there is any shortage of fervor, by any means, but the general approach is one of uncommon gentleness and warmth.

Bernstein, as one might expect, is much more brilliant, more in line with the admittedly theatrical tradition of blazing, apocalyptic visions, and yet there is nothing hectic or headlong about his approach, either. In fact, some of his basic tempi are actually slower than Barbirolli's. Bernstein's interpretation embraces great contrasts, from incredible tenderness to downright terror; it is an interpretation as personal and deeply felt on a consciously monumental scale as Barbirolli's is on a more intimate, consolatory one.

Verdi: Requiem. *Montserrat Caballé soprano; Fiorenza Cossotto, mezzo; Jon Vickers, tenor; Ruggero Raimondi, bass; New Philharmonia Chorus and Orchestra conducted by Sir John Barbirolli.* **Angel SB-3757,** *$11.98.*

Verdi: Requiem. *Martina Arroyo, Josephine Veasey, Placido Domingo, Ruggero Raimondi, London Symphony Orchestra and Chorus under Leonard Bernstein.* **Columbia M2-30060,** *$11.98.*

"The Best of Gilbert & Sullivan" *(excerpts from The Mikado, Iolanthe, H.M.S. Pinafore, The Pirates of Penzance, The Yeoman of the Guard). George Baker, Geraint Evans, Elsie Morison, Marjorie Thomas, Monica Sinclair, Richard Lewis, John Cameron, Owen Brannigan, with Sir Malcolm Sargent conducting the Glyndebourne Festival Chorus and the Pro Arte Orchestra.* **Seraphim S-60149,** *$2.98.*

As for the seven singers in the two solo quartets, both the greatest strengths and the greatest weakness are found in the Angel set, in which Caballé and Cossotto particularly distinguish themselves. Jon Vickers, a great artist who has given so much pleasure in the past, seems to have been a bit off his form in this recording, as in the recent *Carmen* under Frühbeck. He pushes a little too hard, and the "Ingemisco" has little of the virile dignity we know it can have; it is as if Vickers were consciously afraid of being too simple and straightforward in his approach, when in fact that is precisely what one wants in that music.

If I prefer Caballé to Arroyo, the preference is a slight one. Arroyo is widely regarded as the finest all-round Verdi soprano active today, and she too rises magnificently to the challenges and opportunities of what in this case might be called a great "rôle." Josephine Veasey (the Dido in Colin Davis's complete *Les Troyens* for Philips) is on a par with Cossotto interpretively, but lacks the extra strength at the low end which makes Cossotto the phenomenon she is. Placido Domingo gives what is generally a very winning performance, except for a certain tendency to overproduce—which is one of those things that bothers some listeners less than others.

The young bass Ruggero Raimondi is the one factor common to both recordings, and one of the conspicuous assets of both. His voice has a really majestic quality, and his use of it suggests spontaneity, effortlessness, and a great intuitive feeling for the music. I feel he is more effective under Barbirolli than under Bernstein, especially in his first appearance (in the *Kyrie*), but I know many others feel otherwise. In any event, his contribution is distinguished in both sets.

Neither set, I'm afraid, is very distinguished sonically. One of the engineers who took part in the Barbirolli sessions told me a few months ago that he was more than disappointed in the sound of the American Angel pressings, which according to him is vastly different from that of the English discs. I haven't heard the English pressings, but the domestic issue does seem murky and ill-defined. The Columbia recording, on the other hand, has a harshness about it that makes listening less pleasurable than it might have been. The very opening of the work is not really audible: an exaggeration on Bernstein's part, perhaps, with which the engineers just couldn't deal without readjustments in the level as the work progressed. A pity, for there is no uncertainty as to the point at which the *Requiem* begins in any of its other recordings.

Nevertheless, between these two sets, even with the glorious singing of Caballé and Cossotto under Barbirolli, I would choose Bernstein, simply because I like the greater sense of drama. Another plus for Columbia, in my book, is its presentation of the Bernstein in manual sequence and ir

saving gatefold album. Angel puts its two discs—laid out for automatic changer—in a box, less convenient to handle and requiring three times as much shelf space. There is plenty of room for Robert Jacobson's excellent annotation and the complete text on the inner panels of the Columbia gatefold, a format I wish all record companies would adopt for their two-disc sets.

My preference for Bernstein over Barbirolli does not mean I'd put it at the top of the list of available recordings of the Verdi *Requiem*. Although I do think these two sets have the strongest female soloists, I think I'd choose Solti over both of them. He conducts the Vienna Philharmonic, with Sutherland, Horne, Pavarotti and Talvela, in London OSA-1275, and on balance—considering overall excellence of interpretation, individual contributions, and the quality of the recorded sound—that's the version that emerges as No. 1. I'd rate Bernstein and Barbirolli just below that set, though, and then Giulini on Angel (SB-3649, with Schwarzkopf, Ludwig, Gedda, Ghiaurov and the Philharmonia) and Leinsdorf on RCA (LSC-7040, in which Carlo Bergonzi gives the best tenor performance of all, with Nilsson, Chookasian, Flagello and the Boston Symphony).

Should RCA decide to reissue the Reiner version, the order of preference might be dramatically altered. In the meantime, for those who will settle for less than contemporary sound and less than outstanding soloists, the performances conducted by Toscanini (RCA LM-6018) and Markevitch (Turnabout TV-34210/211) are both very special.

* * *

Everyone who cares for G & S at all may have his own ideas about what constitutes "the best," and the real *aficionado*, of course, will settle for nothing less than complete recordings of the various operettas. Those content with a sampling, however, will find this a handsome one. No fewer than 18 gems have been collected from the complete recordings of the respective works on Angel, comprising the expected highlights and perhaps a surprise or two. Some of the finest singers active in Britain in the late 50s took part in these recordings, and this disc would be worth its price for the final item alone, an unforgettable performance of the duet "I have a song to sing, O" (Yeoman of the Guard) by Elsie Morison and Geraint Evans. A lovely record, and a natural partner for the Angel disc of G & S overtures under the late Sir Malcolm, drawn from the same source (S-35929).

Classical Record Reviews

Edward Tatnall Canby

R. Strauss: Der Rosenkavalier. Christa Ludwig, Gwyneth Jones, Walter Berry, *et al.*, Chorus Vienna State Opera, Vienna Philharmonic, Bernstein. **Columbia M4X 30652,** stereo, 4 discs, $25.00.

Curious how much this opera has in common with *Die Meistersinger*—also newly recorded. Both are large-scale semi-comedies, yet with abundantly serious overtones; the lush orchestral textures, the constantly recurring musical themes, the fast-paced conversations, the numerous scenes involving quantities of people and much complicated vocalizing, all are similar, if the music, even in the same tradition, is very different. *Rosenkavalier* is a sort of feminine *Meistersinger*, full of lovely Viennese sentiment and human interest; *Meistersinger* itself has far more human characterization than in most Wagner, with its endless heroes, gods, noble females, and all the rest.

On records, the non-specialist listener won't find *Rosenkavalier* as easy as *Meistersinger*. Action is fast, more subtle, more dependent on following the stage doings. (The script or libretto "reads" wonderfully easily—but you are lost in the actual sound if your attention wanders for a moment.) The four principals are most oddly set forth—the pair of young lovers are both sopranos, endlessly confusing when they sing together, which is very often, and worse, when they sing with the only slightly heavier soprano voice of the older "heroine," the Marshallin. There is an absolutely enormous quantity of text to get over, 50 pages' worth in the big booklet, which is in three languages. The music, moreover, has very few vocal "tunes" or arias, such as even "Meistersinger" contains in abundance, (though not, so to speak, officially); Strauss prefers sung *language*, wonderfully melodic fragments, with the more tuneful elements largely in the orchestra. Minus text with which to follow, then, "Rosenkavalier," unless you know it well, presents vast quantities of singing but few melodies to remember, nor many clues as to what all the vocal gymnastics are about in terms of the plot, and many listeners will soon wish for less voice and more orchestra. (Opera specialists will pardon me! We are not all *afficionados.*)

Though the performers are typically international and Bernstein has his own ideas, brought from outside, this is perforce a Viennese performance and close to the very tightly regulated tradition that governs the opera in Vienna. It is a good combination—the orchestra knows every note and, once accustomed to Bernstein, is very much in control of itself and utterly accurate; but the Bernstein touch adds an excitement which might well be missing in just another Viennese performance in Vienna. The singers are remarkably full of enthusiasm and that will, once again, to make this into a real "show," all for one, one for all. Which is all the more remarkable considering the dreadful time they had putting it together, with laryngitis and what-not disrupting the recording schedule—it is graphically described in the booklet.

The singers here are sonically more staged than in Angel's "Meistersinger," you hear them fairly close but definitely out there and in the same environment as the orchestra. "Meistersinger," with a degree of acoustic isolation for the soloists, does not get quite such a good over-all blend. On the other hand, the German texts are much more easily followed in the Wagner opera. That is partly Wagner's doing and partly because of a more solidly German cast, but it also has to do with the recording mics.

If you have the courage to acquire *both* these mammoth new albums, you will have in your living room an absolutely breathtaking array of German operatic expression and its musical tradition, enough (with those big booklets of accompanying comment and text) to keep you going for years.

Performance: A– Sound: B+

Cliburn

Rachmaninoff: Rhapsody on a Theme of Paganini. Liszt: Piano Concerto No. 2. Van Cliburn; Philadelphia Orch., Ormandy. **RCA LSC 3179,** stereo, $5.98.

Beethoven: Piano Concerto No. 3. Van Cliburn; Philadelphia Orch., Ormandy. **RCA LSC 3238,** stereo, $5.98

Van Cliburn—My Favorite Brahms. RCA LSC 3240, stereo, $5.98.

Van Cliburn remains a very serious, deliberate and sincere young man who, in spite of an obviously big piano talent, will not be rushed into any sort of

mere powerhouse, show-off brilliance. He belongs with the new younger pianists, whose ideals are high, who savor each note with Romantic fervor, hanging upon every detail, but tend to ignore the longer lines, the big shape. When Cliburn plays, I'm reminded of the dinner guest who is the last to finish, solemnly eating every scrap while the hostess gets nervous. He just will not gulp, like everybody else.

Sober is the best word. Never dull—just sober. And when the talent finally gets turned on, he can match anybody's show. In this Beethoven Concerto, the piano comes in first with an upward dash of an octave scale—most pianists pounce on it as a fine "entrance," tossed off in a flash, with one dramatic swipe at the keyboard. Not Van. He plays eight notes in a row, one after the other, as written. But he has musical virtues that others sadly lack. He has been impeccably trained in good phrasing, where so many virtuosi are merely crude. His perfect pedaling shows his very good ear for harmony. He likes to shape a melody, and he brings out inner lines, as they used to do a half century ago. Thoughtful. Above all, you know that he cares about the music. You can hear it in every note, and no great matter that as musical imaginations go, his is not the biggest.

The sheer physical talent is there and will not be denied. It comes out in triumph in the Rachmaninoff, a piece that is all keyboard pyrotechnics and gruesome death-harmonies. Cliburn plays it effortlessly and beautifully. This late work (1934) is a nominal theme and variations, a form that kept Rachmaninoff from his usual meanderings. It does the same for Cliburn's tendency to wanter into detailed piano introspections.

The Liszt No. 2 is a work I can't take. It has an ever-repeated series of harmonies that soon drive me nuts, no matter how they are played. Cliburn plays them slow, which doesn't help.

As for his Favorite Brahms, the record does honor to that old man on his home ground, in a properly introspective look at some of the loveliest of leisurely Romanticism. You can't rush Brahms—Cliburn doesn't want to. He relishes all those inner voices, the lush melodies and expressive harmonies, at long length. But even Brahms has shape—plenty—and the thread of continuity sometimes gets mighty thin, expecially in the middle areas of these late-Brahms pieces when the Cliburn nose, so to speak, gets closer and closer to the keyboard. In the bigger works, notably the two Op. 79 Rhapsodies, we are really lost in the underbush; will we ever get out? We do, but barely. A larger perspective is very much needed.

Excellent sound from RCA. It seems to have done RCA good to pull out of Symphony Hall in Boston and set up a new shop in Philadelphia, presumably with all-new equipment. The Philadelphia sound is marvelously clean and well balanced, the RCA piano tone as fine as any I have ever heard.

Performances: B+ Sound: A–

Morton Feldman: The Viola in my Life; False Relationships and the Extended Ending. Assorted Soloists. **CRI S 276,** stereo, $5.95.

Big, practical-looking Morton Feldman, who could be a used car salesman or maybe a prosperous insurance man as you look at him, writes elfin music of a revolutionary philosophy. It is

the recording engineer's nightmare; most of it is sheer silence, minutely measured, punctuated by tiny single sounds, or brief groups, faint squeaks on a violin, a breath or two on the flute, *pizzicati* plucks—now and then—from a cello, a barely audible *wonk* from a clarinet. A carefully lowered pair of piano hands brings out a distant dissonant chord. *Two* pianos; you'd never know it except for the directionality. And, of course, the viola. The one in his life. It is played by Karen Phillips, for whom he writes.

All together, there are a dozen-odd performers involved here (too many to list), including such well-known modernists as Anahid Ajamian, violin; Seymour Barab, cello; David Tudor, piano. No conductor, unless maybe Mr. Feldman is sitting on the sidelines, silently coaching. Could be.

It is not only the silence, carefully measured, that is unusual. More arresting, and more profound, is the deliberate breaking up of ordinary musical *continuity*, the normal adding-together of successive sounds to make shapes that exist, like language, in time clusterings. Feldman gets away from it. "Sounds do not progress, but merely heap up and accumulate in the same place." A nice idea and if your attention is acute enough, and your listening place quiet enough, you may well fall under the Feldman spell. It's real!

Performances: A? Sound: A!

Concertante

Mozart: Sinfonia Concertante in E Flat, K. 297b. Haydn: Sinfonia Concertante in B Flat, Op. 84. English Chamber Orch., Barenboim. **Angel S-36582,** stereo, $5.98.

Prokofiev: Sinfonia Concertante for Cello and Orch., Op. 125. Rostropovich; Royal Philharmonic, Sargeant. **Seraphim S-60171,** stereo, $2.98.

The sinfonia concertante ("concerto-ized symphony") was an outgrowth of the old Baroque idea of an orchestra of performers contrasted with soloists, singly or in groups—the Bach, Handel, Corelli and Vivaldi concerti being familiar examples. Styles changed, but the idea persisted, and it popped up again in new form in the 1770's under this fancy title. It hasn't died yet, as witness such works as the Brahms Double Concerto, the Bartók Concerto for Orchestra and a hundred modern works, including this Prokofiev with its explicit title, featuring a cello solo and much solo work among the orchestral musicians—hence concertante.

Mozart's "Concertante" (the usual short name) was composed, wistfully, to wow the Paris audiences of 1778 during his fateful trip to that city, at age 21. Concertantes were all the rage. But Mozart's was not even played; worse, the callous French authorities lost the music and it did not turn up until a half century later, in a somewhat altered copy. Haydn's Concertante was composed a dozen years later in England, where we may suppose that the concertante style had just arrived, with the usual delay occasioned by the English Channel. Both these works involve a quartet of mixed solo players, all winds in Mozart, strings and winds in Haydn. Both, in the concertante manner, are rather long-drawn-out concerti complete with written-out cadenzas for the entire solo group playing together.

The Barenboim performances are, I would say, impeccably so-so. A good polish to both, especially in the solo playing (and particularly in the horn); but beyond that, there is a blandness, a lack of the shaping and musical tension that both works demand. Frankly, I don't think Barenboim has got the idea at all, in spite of his frequent playings and leadings of such music. The Mozart here just goes along, ever so accurately and colorlessly. The Haydn has too much of the old and unlamented "Papa Haydn" approach, jolly good music, you know, but awfully superficial. To be sure, it is brittle music, carefully hiding its profundities in the usual Haydn manner. But the meaning is there, strong and sinewy in the very curve of the themes, in the sudden harmonic wrenches. Here, all is blandly uncolored, as though it didn't matter very much.

The big Prokofiev work is a reissue of a tape dating from the later 1950's, evidently made in stereo though my disc copy in 1958 (on Capitol-EMI) was mono. If this is, then, a disc-stereo first release, it is a good one. Few people will notice the minute evidences of age, the perceptible flatness of perspective (minimal microphoning?), the vague bit of distortion in the loudest parts. The music, Prokofiev's last, was composed for Rostropovich, who gives it here a definitive performance. It is long and thickly composed work but gets easier as it goes forward, thanks to the interesting variety of solo color in the orchestra that goes with the title. Try side 2 first. Sir Malcolm Sargent gives it all the strength of phrasing, rhythm and shaping that is deficient in the Barenboim Mozart and Haydn. Not only *right*, but an immense help in the listening.

Performances: B–, A Sound: B, B

Schubert & Brahms Lieder. Harold Enns, bass-baritone; Peggy Sheffield, piano. **Orion ORS 7040**, stereo, $5.98.

Romantic Music for Harp and Flute. Edward Vito, harp; Jean Roberts, flute. **Orion ORS 7039**, stereo, $5.98.

Two pairs of Orion artists here, and some good moments for listening. Not many Americans tackle those Germanic gods of song, Schubert and Brahms, on records—the competition from Germany is too hot. (On records it's one world.) Harold Enns is a grave, dignified American basso with a beautifully controlled voice, fine diction and pitch. His only stylistic problem here is too much of an American-type vibrato, alien to the sense of the music. His accompanist is fluent and lively if not always subtle in her pianism. She plays

as loud when he sings as when he doesn't. Her privilege, I guess.

The recording sounds oddly amateurish. A jangly Steinway, not quite in tune, badly microphoned (it's MS stereo, all from a point). A harsh sound in the loud parts, probably the disc cutting.

Edward Vito is a very musical and strong harpist and Jean Roberts is a fine French-style flutist. On the second of these discs, side 1 goes to Vito alone, side 2 to both artists together. Specialized flute-harp music, of course, but some of it makes good general listening. The Spohr Fantaisie for solo harp is outstanding and beautifully played. On side 2, a Sonata for harp and flute by the Russian A. Schaposhnikoff is the purest early Debussy or *very* early Ravel, say about 1904. It was composed in 1925! Nice, even so. A slow dance by the Belgian, J. Jongen inclines more to later Ravel, mildly. It might even be contemporary, since Jongen would be 99 if he were still operating now.

Again, so-so recording. The harp side starts off at a jarring high level, seems to improve as it goes on. The second side has nice acoustics, the flute at a reverberant distance, but once more there is an overloaded sound. More likely in the disc than in the tape, I'd guess.

Performances: B+, A– Sound: C+

Ars Antiqua First Recital. Phoenix Woodwind Quintet of New York; Hugo Noth, accordion. **Kaibala 20B01,** stereo, (*Box 512, Oreland, Pa. 19075.*)

Like paper books, the LP record brings us anything and everything. Surely, the greatest sound publishing medium ever devised! This one is a somewhat fuzzy oddity, looking two ways. Both have their points, though you can't split the disc down the middle if you like only one.

First side, a typical and very proficient young pro woodwind quintet, the standard flute, oboe, clarinet, horn and bassoon, who play seven Baroque-period items (and one earlier, Lassus), all of them transcribed for their special medium from various originals, and all played with precisely the same non-Baroque styling. After all, isn't the music for woodwind quintet? In these transcriptions—yes. But the original music does matter, for those who aren't woodwind specialists. The composers range from Bach and Handel to Rameau and Dandrieu in France, and all of it needs a continuo accompaniment to sound right—none is right for clarinet. So what, if you like the sound of good woodwind playing. Annoying if you like Handel, Bach, Rameau, Dandrieu, et al.

Side 2 offers a different kind of transcription—harpsichord Sonatas by D. Scarlatti, played by a young Swiss genius on the accordion! Excellent! His sense of Scarlatti style is perfect, he projects the music better than many harpsichordists. If you know Scarlatti, your mouth will drop in astonishment. Even the choice is well informed, a few well known Sonatas and a brace of unusual ones (there are more than 500 to choose from). The playing is flawless, not a note wrong or missing, though how he gets all those buttons to produce Scarlatti I do not know.

Performances: B, A Sound: B+

(Continued from page 30)

manium transistors which were used in "early designs" in the early 60's are now used only rarely. Even silicon transistors are rivaled by the introduction of other solid state devices, such as field effect transistors and complete solid state circuits containing very complex assemblies.

In the months and years ahead, change will continue, with rapid advancements in technology permitting even greater achievements. Evidence of change is present now in high fidelity sound reproduction. We will witness more multi-channel sound-particularly four-channel sound. Much progress in this area is evident already in tapes, discs, and equipment. In the near future, we will have available commercial broadcasting in four-channel sound from single FM stations.

Other developments are difficult to predict. However, all of us are sure that the improvement and innovation in sound recording, reproduction, and the required equipment of all kinds will continue. The end result of this continued effort on the part of our industry will, as usual, benefit the user.

At H. H. Scott, Inc. we are proud to have been one of the pioneering companies in this great industry and to have made many significant and major contributions. We shall continue to devote our efforts toward added contributions in the years ahead, for at H. H. Scott innovation is truly a tradition.

S. N. Shure
President
Shure Bros., Inc.

The editor of AUDIO has asked me to make a prophecy, and as an inducement he has stated that I will not be asked to make another one until 1997.

A prophecy is a divine inspiration, according to several dictionaries. I cannot lay claim to such a "gift of the gods." However, to set a goal for the future and then work to attain it—that is within the province of humans.

In the late 19th century the microphone came into existence—very crude in form and operation but sound in concept. In the intervening years, microphones became much more sophisticated in design and application. But even today, when compared to the human ear, the microphone is still a primitive instrument. It has no power of concentration. It cannot by either human command or its own volition reject vanted sounds, except in a very sense. Tied by an umbilical cord to a massive fixed system, it has little mobility—unlike the human ear which is part of a readily mobile system. Attempts to sever that cord have resulted in a loss of reliability or fidelity, or both.

By the year 1997, I believe we will have made significant progress towards the goal of a microphone that can emulate the human ear. That microphone will "listen" and be more selective. It will be able to concentrate (tune out undesired sounds). While retaining the essential feature of reliability and fidelity, it will have greatly extended mobility without an umbilical cord.

I believe that the microphone will then play an even more important role in man's efforts to communicate . . . to understand . . . to teach . . . and to live in peace.

S. Mabuchi
Vice President/Engineering
Sony Corp. of America

Since 1967, when AUDIO Magazine published its 20th anniversary issue, there has been considerable progress in the audio art. While audio componentry has reached a high degree of perfection, there is still much to come.

New devices and innovations will play a large role in bringing the audio art even closer to the ultimate in reproduction of sound. Already we are in an era of innovation with various types of video devices. Theater type entertainment in the home is very close to us now, and therefore we cannot neglect the video art when we discuss the future of the audio art. These two arts will go along hand in hand from now on.

Mass communication in the form of audio was originated by the invention of the telephone, followed by the phonograph, radio, and later the magnetic tape recorder. Since then these devices have made tremendous progress, and as a result, we now have the stereo phonograph, stereo tape recorder, four-channel phonograph, four-channel tape recorder, FM multiplex stereo, etc., which are indispensable products to present-day home entertainment and education. The field of video art was originated by photography, and was in turn followed by silent motion pictures, and then motion pictures with sound, color photography and color motion pictures, black and white television, color television and color motion pictures with multi-channel audio, etc. Already we have video recording and playback devices within our reach which enable us to play and enjoy a program at a command. Recently in Japan, television audio in two-channel stereo was shown, and it is, of course, possible to have four-channel audio for TV.

What is the least advanced area in the audio field? This is the technology speaker systems. We have made satisfactory progress in the electronics area of audio. We already have developed good and reliable solid-state circuitry in these past ten years. The phonograph cartridge, turntable, and arm also have made good progress. Among the electromechanical audio devices, the microphone has made a remarkable advance. The electret condenser microphone, developed by Sony, should be counted as a major improvement in microphone technology. The role of the speaker as a component in the audio system is vital. The speaker, or speaker system, is the decisive device to deliver performance of the electronic and electromechanical devices to our hearing sense. I cannot suggest here what type of speaker will be the ultimate device because I, unfortunately, am not a specialist in this field. However, much energy will be devoted to improving the speaker during the next five or ten years.

The most promising innovation in the very, very near future is the digital FM tuner, or preferably FM/AM tuner, which has not only a visual attraction but ease and accuracy of tuning. This is the combined application of synthesizer, solid state filter, digital display device, digital IC, phase-lock-loop IC, non-volatile transistor memory, etc. Among these devices, Planetron digital display and non-volatile memory are the latest contributions by Sony. This non-volatile transistor memory can be applied to make the tuner memorize your favorite station. This station will always come in when you switch on the tuner unless you erase the memory.

The development of digital and linear ICs in the audio field will be the key

for future audio electronics improvement, by making products more sophisticated without increasing price.

Another beneficial development for the listener will be speaker systems, even with conventional types, which have built-in power amplifiers and specified *acoustic power output* indicated for the system. The specification of distortion and power output of the power amplifier itself does not mean too much from the user's point of view. The output of today's preamplifiers is good enough to drive this type of speaker system. This way we can eliminate the bulky and heavy power transformers from present receivers. Then we only need compact, integrated tuner-preamplifiers which can be located within easy reach.

I'd like to touch on the future of four-channel systems briefly. The most important point of four channel is compatibility from the marketing point of view. It is also very important that the encoded signal has the capability to demonstrate the most realistic simulated three-dimensional feeling, i.e. based on the most ingenious method of decoding, which may yet be in the future. In this respect, I believe the SQ system is the best available encoding method available today.

I have talked about possible progress in the field of audio. However, I feel very strongly that the ultimate status of the audio art in home entertainment and educational applications relies on a good combination with the visual art. The video equipment should have the best available audio capability. Four-channel audio can create the realism of the concert hall. However, if it is accompanied with the visual image of the player of the music or the concert hall, it will add more realism. The reverse is also true; a good visual image with good audio will create more realism than the visual image alone.

I strongly think that the future of home entertainment and education aid systems is a good combination of audio and video art.

Walter Goodman, Chairman of the IHF, has announced the appointment of C. G. McProud (above) as Technical Director of the Institute. His first project will be the complete revision of the "Introduction to High Fidelity" booklet. He will also prepare and coordinate weekly radio and newspaper features to educate the consumer about high fidelity.

Joseph S. Tushinsky,
President,
Superscope, Inc.

The home entertainment industry has enjoyed phenomenal growth over the past ten years, and we are happy to have been a part of that growth. At Superscope we have kept abreast of all innovations in our industry in order to provide the finest audio equipment possible to the greatest number of consumers.

The steady increase in acceptance and sales of our Marantz line of audio components and Sony tape equipment has been evidence of the broadening of the market for these electronic products. With the entrance of Superscope into worldwide distribution for Marantz products we have uncovered an expanded market in every country. By enlarging our Marantz line to include moderate priced components we have reached a larger group of audiophiles who want the best in equipment at a price they can afford.

This year, with our acquisition of 50% of Standard Radio Corporation of Japan, we are able to control the manufacture and shipment of Marantz models manufactured by that facility to our engineering specifications, thereby increasing the amount of product to be made available to the public.

New marketing concepts are being introduced every day by our Marketing and Sales Divisions. With a network of over 5,000 dealers throughout the United States, as well as our distribution in Europe, Africa, Asia and the Middle East, we are steadily working to continue improving product and merchandising methods.

In keeping with our tradition of responsible, long-range planning for the industry, we are constantly involved in developing new products, and advancing technologically to keep pace with anticipated consumer demands.

We are proud to be a part of this industry. We have been involved in the tape recorder area since 1954, and entered the audio component field in 1964 with the acquisition of the Marantz Company. In keeping with our desire to provide the consumer with a full range of home entertainment products, we will be introducing a complete new line before the end of this year, bearing our trade name—Superscope. The line will augment our Sony tape recorder line and Marantz audio component products. It will cover the full range of home entertainment products in the low to moderate priced field. We anticipate continued growth of sales in the United States and worldwide for audio and visual products and it is our intention to continue growing and adding new and exciting products to our lines. In addition to our association with Standard Radio Corporation and our continued representation of the Sony line of tape recorders and tapes, we will be entering joint ventures in countries where the quality Marantz and Superscope lines have not yet been introduced. Our European subsidiary, Marantz International S.A. in Brussells, Belgium, has set up a network of distributors throughout Europe and the United Kingdom, and has already proven a ready market for Marantz components in those areas.

As long as the economy remains stable, the market will continue to grow, and Superscope will continue to provide the best and most advanced audio equipment for the consumer.

Weingarten Scans the Field

Sherwood L. Weingarten

SUNFIGHTER (Grunt, FTR-1002) is another Jefferson Airplane offshot. The RCA-distributed recording takes off where Paul Kantner and Grace Slick's Starship album halted; it's all about the hope for a brave new world, sociologically and ecologically. The package includes a dozen cuts, with one instrumental ("Titanic"), and a libretto booklet. The super-session includes backup musicians and vocalists such as Jerry Garcia, David Crosby, Graham Nash, Papa John Creach, Jack Casady, Joey Covington and the Edwin Hawkins Singers. The title tune, dedicated to Airplaner Marty Balin, includes a summation of the LP's motion: "The sword of the Lord don't mean nothin' to me if he won't get down on the people makin' such a mess of the land and the sea all around us. . . ."

HOT ROCKS 1964-1971 (London, 2PS 606/7) is a "best of" album by The Rolling Stones. There's great stuff in the double-disc package, but only for those who don't have all the Stones' previous LPs.

ARETHA'S GREATEST HITS (Atlantic, SD8295) shows why Miss Franklin remains queen of soul. The 14 tracks are all winners, but the best are "Spanish Harlem," "Chain of Fools," "I Say a Little Prayer," "Dr. Feelgood," "Let It Be," "Bridge Over Troubled Water," "Respect," and "Call Me."

VERY YOUNG AND EARLY SONGS (Deram-London, DES 18061) contains the voice vitality foreshadowing the greatness of Cat Stevens. Many say that Rod Stewart's music insists that you move around, that you just can't stay still while listening; the same applies to Stevens, who here offers 10 of his own pieces. Although these cuts have been heard in Britain, this is their first release stateside. Highlights include "Here Comes My Wife," a simple yet explosive ditty; "Lovely City," with an echo-chamber effect and singsong, childlike quality, playful yet meaningful lyrically, and "The Tramp," a heavy-beated opus.

TIGERS WILL SURVIVE (VEL 1010) features the folk-rock music of Ian Matthews, former leader of Southern Comfort and ex-lead singer of Fairport Convention. The disc, with 11 tunes (six of them penned by Matthews), spotlights lyrics that tend to be poetic and music that is mainly folky. Backed by 10 musicians, Matthews shows a high-pitched, interesting voice that *doesn't* have that fake blues quality so many pop singers are trying for nowadays. The album, Matthews' second for Vertigo, is distributed by Mercury.

STORIES (Asylum, SD 5052) is mis-titled, for it contains tunes that better might be called tone-poems. David Blue offers a lot of minor keys and minor themes, but he should become a major star. Blue, outstanding on vocals with his deep, rough Dylanesque voice that contains a sad quality, performs eight of his own compositions and accompanies himself on guitar and piano. The folk-blues material sounds on occasion like something from the mouth of Carl Sandburg, especially if you've ever heard the late poet doing the traditional "Hearse Song." The disc, distributed by Atlantic, includes such thoughtful material as the line from "Blues (All Night Long)" that declares, "Life sometimes is an endless sleep."

HOT BURRITO (A&M, SP 8070) reprises the Flying Burrito Bros., country-rock material. The 11 cuts form a "best of" LP despite an attempt at disclaiming that via liner notes. Personnel changes are frequent, a symptom of most modern groups' ego problems. Most interesting facet of album is the dustjacket, which opens to become a full-color poster.

AMERICAN PIE (United Artists, UAS 5535) is Don McLean's second album and it provides statements, musically, of what he's been thinking since his debut, "Tapestry." The whole

is greater than the parts, despite the title tune being such a chartbuster individually. McLean's a product of blues and folk and rock and jazz—and whatever else you can name. As a singer-poet-guitarist, he should be on top a long time.

JAMMING WITH EDWARD (Rolling Stone, COC, 39100) features seven cuts by Mick Jagger and The Stones' rhythm section. The LP, distributed by Atlantic, appears to be a quick cash-in job stemming from a rock 'n' roll jam session that didn't quite make it.

WILD LIFE (Apple, SW 3386) is Paul McCartney with his wife, Linda, and his new group, Wings (adding drummer Denny Seiwell and guitarist Denny Laine). There are eight cuts, the sum of which is not as good as the ex-Beatle's "Ram" outing (which wasn't that good itself).

LIVING (Elektra, EKS-75014) finds Judy Collins singing two of her own compositions plus melodies by Leonard Cohen, Joni Mitchell, Ian Tyson, and Dylan. She plays piano on three of the 10 cuts, guitar on the rest, and she sings a capella on "All Things Are Quiet Silent," an anti-draft song, the royalties of which will go to draft-resistors. Best are the hit single, "Song for Judith (Open the Door)," a contemporary soft-rock outing; the bright "Chelsea Morning" and the silky "Easy Times."

PEARL (Columbia, KC 30322) is blues as they should be sung, from someone who knew what they were all about. Janis Joplin, who despite popular acclaim as a vocalist filled her life with drug-induced torment (which eventually killed her), makes the listener glad he is himself. The old school of Bessie Smith and Billie Holliday come alive again as she rolls through Kris Kristofferson's "Me and Bobby McGee' and her own "Move Over" and "Mercedes Benz." And for those who'd like to compare where she was at just prior to her death and where she was at the San Francisco beginnings should pick up **BIG BROTHER & THE HOLDING COMPANY** (Columbia, C 30631), a reissue with 12 cuts from the West Coast period.

OVERDOG (Deram-London, DES 18057) spotlights zest, zest, zest by the Keef Hartley Band. It's an electric rock sound superimposed on avant-garde jazz, must listening for all but those who think anything stronger than Lawrence Welk is taboo.

B, S & T, 4 (Columbia, KC 30595) is the fourth LP by Blood, Sweat and Tears, a nine-man jazz-rock outfit that revolutionized the rock movement. Best of the dozen tracks are "John the Baptist (Holy John)," "High on a Mountain," and "Mama Gets High," the last of which, believe it or not, is Dixie-rock.

SOUL-TO-SOUL (Atlantic, SD 7207) is a disc with 10 cuts taken from the original soundtrack of the movie with the same name. Recorded in Accro, Ghana, at a soul festival, the anthology is highlighted by Ike and Tina Turner doing the title tune and "I Spell Trouble," and Roberta Flack rendering "Tryin' Times" and the traditional "Freedom Song," the latter recorded in mono on a portable machine in the dungeons of the old slave fortress in Cape Coast, Ghana. Also showcased are The Voices of East Harlem, Eddie Harris and Les McCann, The Staple Singers, and Wilson Pickett.

CLASSIC RUSH (Elektra, EKS-74062) offers 11 "best of" gigs by Tom Rush, folk-rock singer extraordinaire. The vocals are only half the enjoyment;

(Continued on page 94)

his guitar work also excels. Hear, particularly, "Joshua Gone Barbados," poignant and slow-moving; "The Circle Game," with appropriate contemporary art song treatment, and the medley of "No Regrets" and "Rockport Sunday."

JESUS CHRIST SUPERSTAR (RCA Camden, CASX-2481) is a low-priced interpretation of the rock opera by the Living Strings and Living Voices. Arranged and conducted by Johnny Douglas, nine selections from Andrew Lloyd Webber and Tim Rice's chart-busting creation are offered. Best are "Heaven on their Minds," "Everything's All Right," "I Don't Know How to Love Him," and "Superstar."

HISTORIC DEAD (Sunflower-MGM, SNF-5004) brings back four tracks by the defunct Grateful Dead. It's rock at the pinnacle of simplicity and repetitiveness (with, of course, a heavy blues influence). There are two longies, "Good Morning Little School Girl," 11:01, and "The Same Thing," 12:01, and two quickies, "Lindy," 2:49, and "Stealin'," 3:00.

THE BEST OF THE GUESS WHO (RCA Victor, LSPX-10004) includes a black light poster of the group. The poster's neat-o, as my seven-year-old daughter would say, but the music's better—if you like rock at all. Best of the 10 cuts are "American Woman," "Hang Onto Your Life," and a medley of "No Sugar Tonight" and "New Mother Nature."

THE RAIDERS' GREATEST HITS, VOL. II (Columbia, C 30386) contains 11 songs buffs of the group—and ye old general publik—must enjoy. Witness rockish evergreens such as "Do Unto Others, "Don't Take It So Hard," "I Had a Dream," and "We Gotta All Get Together."

HAIR (RCA, LSO 1170), this time, is another original cast album—Japanese. Eastern spice is interspersed with the original tribal rock flavor. The 17 cuts, in both English and Japanese, are pleasant, amusing—and good listening.

THE SILVER TONGUED DEVIL AND I (Columbia, Z 30679) shows to best advantage the husky, sorrowful voice of Kris Kristofferson, a guy filled with pathos and compassion and an ability to put both into his lyrics. Ten cuts—listen to 'em all.

ECHOES OF A ROCK ERA, THE EARLY YEARS (Roulette, RE-111) is one of three two-disc packages, this one covering the 1953-57 cycle. Included are The Penguins, Chuck Berry, Bo Diddley, The Moonglows, Sonny Till & The Orioles, The Nutmegs, The Cadillacs, Frankie Lyman, Jimmie Rodgers and Buddy Knox. With such evergreens as "Earth Angel," "Maybelline," "Sincerely," "Honeycomb," and "Kisses Sweeter Than Wine." **THE MIDDLE YEARS** (RE-112) and **THE LATER YEARS** (RE-113) complete the set.

FATS DOMINO (United Artists, UAS-9958), part of the company's "Legendary Masters Series," is a two-vinyl package of 28 oldies. Domino, one of rock 'n' roll's greats, performs such evergreens as "Blueberry Hill, "Ain't That a Shame," "I Hear You Knockin'" and "My Blue Heaven." Other two-disc entries in the series are **RICKY NELSON** (UAS-9960), with 26 songs (including "Travelin' Man"); **JAN & DEAN ANTHOLOGY ALBUM** (UAS-9961), with the circa 1958 "Jenny Lee" plus "Michelle" and "Hang On Sloopy," and **EDDIE COCHRAN** (UAS-9959), with 30 tunes (including "Blue Suede Shoes" and "Long Tall Sally").

CARRY IT ON (Vanguard, VSD-79313) is the soundtrack from the film telling the story of Joan Baez' wait for her draft-resisting husband, David Harris. There are 13 cuts, including three spoken segments in which Harris outlines his philosophy soapbox fashion. Highlights include the folk-singer's versions of "Oh Happy Day," "The Last Thing on My Mind," "Joe Hill," "I Shall Be Released," "Love Is Just a Four-Letter Word," "Suzanne," the title tune and, naturally, "We Shall Overcome."

BOONDOGGLE & BALDERDASH (Uni, 73121) are a pair of guys, John Herron and Rob McLerran respectively, who offer vitality and good humor in the form of country-rock. The former manipulates the keyboards, the latter picks at the guitar, and both sing. Together they penned all 10 tunes they play.

HANDS OF JACK THE RIPPER (Cotillion, SD 9049) puts the emphasis on Lord Sutch's non-thinking, stompin' kind of rock and roll. The disc, recorded live in London and distributed by Atlantic, contains eight tracks (including a medley featuring "Long Tall Sally" and "Tutti Fruitti"). Sutch digs deep into rock 'n' roll history and pulls out Chuck Berry's "Roll Over Beethoven" as well as "Good Golly Miss Molly," "Great Balls of Fire" and a combination cut of "Bye Bye Johnny/Johnny B. Goode." But the best is his own composition, the title tune that runs 9:15 and is replete with the sounds of street murder.

UNCLE JIM'S MUSIC (Kapp, KS-3661) is a better-than-average country-rock gig by a new quintet. The dozen cuts are highlighted by good vocal harmony, the ability to do loud and soft material equally well, and fine banjo work by Thomas Whitehorse

Dunstan. Uncle Jim is a welcome addition to the pop family.

KEITH EMERSON WITH THE NICE (Mercury, SRM 2 6500) is a two-disc package that combines rock with classical themes. Emerson plays keyboards on his own material and arrangements of Sibelius, Tchaikovsky, Bach, and Bob Dylan. Interesting, particularly because of Emerson's piano expertise, but the fish-*and*-fowl format is disturbing.

KEEP THE FAITH (Atco, SD 33-381) finds a sextet, Black Oak Arkansas, doing exciting new sounds. The group as a whole gets credit for penning all nine tunes.

BARCLAY JAMES HARVEST AND OTHER SHORT STORIES (Sire, SI 5904) is routine rock by the quartet (that becomes a trio on two of the nine cuts and a quintet on another). No matter what size the group, the disc, distributed by Polydor, misses.

SMACKWATER JACK (A&M, SP-3037) is a gas. Merging blues, rock, soul and jazz, Quincy Jones offers first a cookin' arrangement of Carole King's title tune, on which he sings, with character in his voice, a heretofore hidden talent. Jones then offers his "Ironside" theme, "Guitar Blues Odyssey: From Roots to Fruits," the theme from "The Anderson Tapes," and "Hickky-Burr" (a joint composition with Bill Cosby for the comic's videopus). If, however, you want to see how Jones' talent developed, pick up **NDEDA** (Mercury, SRM 2623), a two-disc set from the era when he was a youngster just learning about jazz. He wrote half of the 22 cuts on that one.

TIN LUCK (Polydor, PD5011) contains nine melodies, all but one written by Ron Cornelius, who showcases grass roots country-blues via vocals, guitar, and keyboard. Backed by Joe Davis on bass and Paul Distel on drums, Cornelius presents a voice that ranges from artificial-deep to squeaky-high, but usually manages to stay within the range of mediocrity.

AURA (Mercury, SRM 1-620) is an eight-man group headed by Al Latham. It gives vent to brassy electric rock, sort of a watered-down version of Blood, Sweat & Tears. But the eight tunes, often laden with Latin overtones, don't jell somehow, this time around anyway. *If* there's a next time, well. . . .

JUDY MAYHAN (Decca, DL 75287) sounds, now and then, like Buffy Ste. Marie, especially when there's a touch of tremolo in her voice. The singer-pianist, green but good, also mirrors Nina Simone (when the going gets bluesy) and Judy Collins at times. Worth a listen, particularly Dory Previn's "Mythical Kings and Iguanas" and Fred Neil's "Dolphins."

CASS ELLIOTT (RCA Victor, LSP-4619) in her debut on this label sheds, for the most part, the style that made her voice known via The Mammas and The Papas recordings. She sings mostly slow stuff, on 10 tracks, but it's not up to her past standards. Best are "I'll Be Home," "I Think It's Gonna Rain Today" and "All in the Game."

MUSIC FROM ACROSS THE WAY (Polydor, PD 5505) showcases James Last as arranger, producer and bandleader. He also is part-composer of the title tune, a hit single. The disc features a chorus, a la The Mike Curb Congregation, that *tries* to translate chartbusters for an older audience. Best are George Harrison's "Here Comes the Sun" and John Lennon's "Power to the People."

JEANNIE (Plantation, PLP-16) is more rockish than material usually found on LPs by Jeannie C. Riley. The country ace includes three vocal hits, "Oh Singer!" "Good Enough to Be Your Wife," and "Roses and Thorns."

MADMAN ACROSS THE WATER (Uni, 93120) is Elton John being pretentious despite an attempt at musical simplicity. Mostly soft rock, the LP's tunes (nine of them) are unimpressive except for "Levon," now a hit single. All were, of course, penned by John and his lyricist, Bernie Taupin.

MOTHER MOTOR (Polydor, PD 5016) stars the gravel-voiced Bobby Gosh, who also plays piano and organ, who produced the LP, and who wrote all 10 songs (with Jodi Wexler). Backed by a sextet, he is best on "All The Things You Didn't Do," reminiscent of a James Taylor opus, and the title tune, filled with humor, a rare commodity in rock.

TIME TO FLY (Decca, DL 7-5329) spotlights David Pomeranz, who sings and plays guitar, piano and percussion. There's a lot of introspective stuff, some of which has a flavor similar to Jerry Jeff Walker's. Of the 10 tracks (one of them a suite divided in two parts), standouts are "Father Thoughts," melancholy, poetic and pretty, and "Dagger," jazzy and bluesy.

RARE EARTH IN CONCERT (Rare Earth, R 534D) is a two-record package with eight cuts that'll blast you out of your living room. The highly electric six-man hard rock outfit substitutes decibels for quality, but their fans will probably flock to buy these live versions of "I Just Want to Celebrate," "Hey, Big Brother" and six more. "Get Ready" takes up a full side (23:38), while "Nice to Be With You," recorded at the Motown studios, is only 2:15.

Jazz & Blues

Martha Sanders Gilmore

Jimmy Rushing: The You and Me That Used to Be.

Musicians: Jimmy Rushing, vocals; Ray Nance, cornet and violin; Zoot Sims, tenor saxophone; Al Cohn, tenor saxophone; Budd Johnson, tenor and soprano saxophones; Dave Frishberg, piano; Milt Hinton, bass, and Mel Lewis, drums.
Songs: The You and Me That Used To Be, Fine And Mellow, When I Grow Too Old To Dream, I Surrender Dear, Linger Awhile, *Bei Mir Bist Du Schoen*, My Last Affair, All God's Chillun Got Rhythm, More Than You Know, Home, and Thanks a Million.
RCA Victor LSP-4566, stereo, $5.98.

Don Schlitten has produced a classic collection of songs sung by Jimmy Rushing, primarily from the thirties when he was singing with the Basie Band in Kansas City. These evergreens —ballads, bounces, and surprisingly only one blues—are successfully set in a period small-group format and feature such jazz greats as Ray Nance, Zoot Sims, Al Cohn, Budd Johnson, Milt Hinton, Mel Lewis, and on piano the dazzling Dave Frishberg, who also contrived the beautifully harmonic charts.

If you want to pick yourself up and shake yourself up, you'll enjoy this recording which is not only good wholesome fun with a bit of corn but excellent musicianship displayed by a cast which could scarcely miss. Take "Mr. Five By Five," Jimmy Rushing lives up to his reputation for being heard ten blocks away without a microphone (in those days, they used megaphones) with dynamics as near static as immovable as sardines in a can [illegible] a delivery full of conviction.

Place beside him Zoot Sims who slips about eel-like with his tenor saxophone transmitting a warm vibrato, add tenorist Al Cohn whose silky-smooth delivery does not admit of staccato and who treats eighth notes as ties, add pinch of Budd Johnson on soprano and tenor saxophones, several grinds of the peppermill by Ray Nance, a generous dose of pianist Dave Frishberg, garnish with a bouquet of bassist Milt Hinton and drummer Mel Lewis, and you have the recipe for a delicious aural *specialité de la maison.* What's more, this conception on RCA Victor brilliantly blends blues with jazz, leaving not a shadow of a doubt as to wherein jazz roots lie. Lacking only are summer-long sequences of development for which this listener has a yen.

Rushing used to sing "The You and Me That Used To Be" with Basie and gently swings with it here, striding in with his hoarse round tones with Cohn and Johnson following suit instrumentally.

"Fine and Mellow," a Billie Holiday blues, is a fine vehicle for Rushing and the most developed on the album. Ray Nance is featured on cornet *a la plunger,* with Frishberg tossing off sardonic Ellingtonian chords; Hinton plays blues on blues on bass, while Sims' low-keyed understatement sings, the entire menage striking a beautiful balance.

"When I Grow Too Old To Dream" brings to mind bouncing Sophie Tucker, Rushing rushing in fancy free and tipsy, singing with pursed lips after a violin introduction by Ray Nance which would challenge anybody's set. Lewis plays a rocking chair drum as Frishberg constructs an architectonic solo, Sims cooing and whimpering into his tenor saxophone, effortless and effervescent. Rushing and company will never grow too old to dream!

"I Surrender Dear" and "More Than You Know" convey the atmosphere of a caberet and are confined to Rushing singing along with Frishberg on piano. The pianist contrives a cool bluesy sound in "I Surrender" and seemingly steals some bars from Schubert's "Erlkönig" at one point. Rushing creates an introspective mood in "More Than You Know" and sustains it throughout.

Jump tunes include "Linger Awhile," inscribed with plenty of Mel Lewis sock cymbalizing coupled with muted and quick cornet work by Nance who darts in and about threadneedle, and a gasser "All God's Chillun Got Rhythm." Cohn tosses off riffs and creates a churning momentum, Rushing spreads joy, and they all conclude with a run-away finishing chorus. The unison horn passages throughout this LP are immaculately conceived as though beaten into stiff peaks of perfection.

Rushing remains an affirmative singer despite being a bluesman, ending his songs with soaring optimism as is evident in "Home" and the immortal "Thanks A Million." Frishberg scores two field goals in his arrangements here, especially in his ensemble writing for brass, and his very provocative and percussive keyboard attack.

The Lewis-Hinton rhythm section is as ever professional as Rushing renews our belief in him as a most able and powerful jazz/blues singer from the thirties to the seventies.

Paul Goodman has done a masterful job of engineering the set, which was recorded in two sessions, and has served up a delectable mixture.

Sound: A Performance: A-

The Memphis Blues Again, Vols. 1 and 2.

Musicians: Nathan Beauregard, guitar, vocal; Sam Clark, piano, vocal; Earl Bell, guitar, vocal; Marshall "Memphis Sonny Boy" Jones, harmonica; Mose Vinson, piano, vocal; "Sweet" Charlene Peeples, vocal; "Furry" Lewis, guitar, vocal; Joe Dobbins, piano, vocal; Gus Cannon, banjo, vocal; Dewey Corley, vocal, bass, kazoo; Willie Morris, guitar; Walter Miller, guitar; "Backwards" Sam Firk, guitar; Bukka White, guitar, vocal; "Sleepy" John Estes, guitar, vocal; Tom Gary, harmonica; Van Hunt, vocal; "Memphis Piano Red" John Williams, piano, and Richard "Hacksaw" Harney, guitar.

Songs: Nobody's Business But My Own; Lonesome To Myself; Sunnyland Train Blues; Catfish Blues; You Ain't Too Old; Bullfrog Blues; Tin Pan Alley; Scood Up Be Doop Day; Natural Born Eastman; New Turn Your Money Green; Basin Street Blues; Sweet Patricia; Mule Gallop; Dewey's Walkin' Blues; Step It Up And Go; Fried Chicken; New Stop And Listen Blues; My Good Woman Has Quit Me; Tell My Momma, Babe, On You; Hacksaw's Down South Blues; Can Can; I Don't Care What You Do; Me And My Pal; Drop Down Mama; Jelly Selling Woman, and Lonesome Road Blues.

Adelphi AD 1009s, AD1010s, stereo, $11.90.

Back in the twenties and thirties, the blues capital of the South was Memphis, Tennessee, the "industrial gateway to the Mississippi delta" where country folk came to the big city to try to make their fortunes and to sing their blues. You could find anything in Sin City; every vice and racket of the day took place there.

Adelphi has gathered a fascinating collection of blues onto two Lp's (but even that isn't enough of the folk-lyric wealth to satisfy this listener). The 19 blues artists are well-chosen and include popular personalities such as Furry Lewis, Bukka White, and Sleepy John Estes, as well as some lesser known talents who make their recording debuts here. It's a pleasure to discover pianist Sam Clark and Dewey Corley, who plays a one-string bass and a harmonically humming kazoo, together with other artists who are more or less indigenous to the southern landscape.

The sound quality is clear, alive, and well conceived except for a minor bit of record noise, and the collection is magnificently authentic—pure as only the blues can and should be.

These Memphis blues serve as a chronicle for a rural people at large in a big "wicked" city, as a town crier if you will, descrying politics and the rackets of metropolitan life. They are also a musical documentary of black life in the country. Listen for instance to Earl Bell's "Catfish Blues," a colorful, earthy blues that features "Memphis Sonny Boy" Jones on a whimpering harmonica. A forerunner of the blues and a vivid example of Negro folk music and medicine show humor is Gus Cannon's "Mule Gallop," a delightfully original conception for banjo, of Charlie, the mule's gaits, achieved through well-placed chords alternating with slaps with the palm of the hand. It's a classic!

Mose Vinson's "Bullfrog Blues" imparts a crackling humor. The somewhat accusatory lyrics delivered in Vinson's frog-in-the-well tones appear improvisatory against the tasteful guitar work of Backwards Sam Firk who plays second guitar throughout the anthology. Firk, a seeming darkhorse, plays splendidly always and our only gripe is that he is neglected in the biographical notes. His is a large role and he fills it well!

Nathan Beauregard, the oldest active blues singer until his death at around 100, sings one of the most powerful blues in the collection, a hypnotic "Lonesome To Myself" which sounds like a dirge. One envisions a funeral cortege winding its way to the graveyard. Beauregard simulates the "rumblin' way down in the ground" by patting his guitar and the contrast between the sharp precision of the instrument and his velvety meandering voice is a striking one.

Sweet Charlene Peeples is the youngest of the blues singers here represented and she's already made wide tracks, coming on strong with a marvelous entrance and acute sense of timing in "Tin Pan Alley," a haunting, gospelly low-down blues. Miss Peeples is thoroughly professional with obvious church training and betrays an expressive voice. She teams up with Vinson in a playful, nonsensical "Scoop Up Be Doop Day" where they take turns scatting.

One is continually struck by the great emphasis on the musicality of the blues as evidenced by the performers' command of their instruments. Notable also is the blues' relationship to jazz and popular songs of the thirties and forties. "Basin Street Blues," performed here by Joe Dobbins on a pedally piano, has never been done this way before and probably never will be again. "Sweet Patricia," a Dobbins composition, is straight out of the "Peg 'O My Heart" era and goes along at a rollicking bounce. Willie Morris plays a syncopated and jazzy "New Stop and Listen Blues," getting off an ostinato in a pizzacato percussive fashion and improvising as would a jazz musician. Certainly parallels can be drawn; influences can be felt.

One of the few instrumentals in the anthology is "Hacksaw's Down South Blues" which features Richard Harney on guitar. Harney makes his living tuning and repairing pianos and this is keep-moving-on music just like the man who plays it. Harney displays tremendous virtuosity and explores every level of his instrument.

Other jewels are the highly rhythmic "Natural Born Eastman" about the famous railroad engineer Casey Jones, captivatingly sung by Furry Lewis, and "Drop Down Mama" as done by Sleepy John Estes, a consummate artist. Estes develops "Mama," phrasing it in his inimitable way, while the work of Tom Gary on mouth harp speaks the whole truth, is almost painfully tortured, and is nothing short of spectacular. Estes' art moves and swirls like a Van Gogh landscape. It sounds totally extemporaneous and as fresh as a first edition.

In "Me and My Pal," Memphis Piano Red contrives a bass figure that is reminiscent of "One Mint Julep" of R and B days. One surmises that he must have listened to Jelly Roll Morton.

Van Hunt, the "matriarch of the blues" and mother of Sweet Charlene Peeples, proves her compositional ability in two tunes, "Jelly Roll Woman" and "Lonesome Road Blues" where she sings at the top of her range. Van is a blues shouter who once worked with Bessie Smith and used to have her own travelling show. She needs no microphone, sings from the heart, and opens out her great yawning voice like Mammoth Cave. Vinson's piano accompaniment is subtley intricate.

It seems as though I have reviewed so many outstanding recordings lately, but these are successful in almost every way. The notes are thoroughly detailed and informative with personal biographies of each performer and the package contains handsome photographs. Here is a palatable and pleasing Memphis-based cross-section of a sincere art form—musical folklore for the potential blues buff and well-seasoned specialist. Don't miss it! You'll be charmed.

Sound: A– Performance

Tape Reviews

Bert Whyte

Bernstein's Greatest Hits. Leonard Bernstein and Andre Kostelanetz conducting the New York Philharmonic Orch. **Columbia MR30304**, open reel, 7½ ips, $9.95.

This is a comp dium of works from that facile compos Leonard Bernstein. We are presented excerpts from such works as *On The Town, On The Waterfront, West Side Story, Candide*, and the whole of the *Fancy Free* ballet music. In Bernstein's distinctive fusion of jazz and symphonic idioms, his music has a bouncy "up-beat" quality which is very ingratiating. It also has a lyric quality, as exemplified by the Lovely "Maria" from West Side Story. Bernstein and Kostelanetz share the podium and do justice to the scores. I wish I could give this production top marks for sound, but it was evidently culled from a number of recordings made at different times, and the quality varies greatly. Some of it is as nice, clean, and well-balanced as you could want; other parts are very thin sounding and compressed, with some high level distortion audible in places. It is a question of priorities, what you like, with the type of sound depending on when your choice was recorded.

The Latin Splendor of Werner Muller. Ampex/London L74139, open reel, 7½ ips, $6.95.

Every once in while you run across a recording which is outstanding both technically and musically. This is one of those. . .and in spades! Frankly, the name Werner Muller meant nothing to me and the title certainly wasn't very prepossessing. But from the very beginning, this tape asserted itself as a large cut above the ordinary. Muller is obviously a man with an exceptional orchestra. . .the instrumentalists are pros to the man and really dig into some clever arrangements of such Latin standards as "Delicado," "Perfidia," "The Girl From Ipanema," and the like. The sonics are sensational. . .overall level is very high, brass really has bite, percussion very clean and rock-solid. The multi-miking is close-up, but clothed in just the right amount of reverb, the presence is almost palpable. This is one of the few pop tapes that Ampex has duped with their EX-Plus technique, and I must say the tape hiss is most pleasingly low, not as good as a Dolby tape, but exceptional for a "straight" tape. Play this at a substantial level on a top quality system and you will appreciate how good tape can be!

Stokowski's Greatest Hits. Leopold Stokowski conducting various orchestras. **RCA R8S5072**, 8-track cartridge, $9.95.

More of this "greatest hit" syndrome manifesting itself, this time with venerable maestro Stokowski. Here we have the familiar specialties . . . the "Pilgram's Chorus" from *Tannhauser, Der Moldau*, Bach's "Sheep May Safely Graze," Enesco's Roumanian Rhapsody, Handel's Largo, and others of similar persausion. They are performed in Stokowski's inimitable fashion, which according to your lights, you either passionately love or despise—there is no in between. One thing for certain, the maestro is never dull! In spite of the fact that these recordings were produced over a good many years, they are all very well recorded and easy on the ear.

The cartridge is especially well-engineered with little audible crosstalk or print-through, and hiss was surprisingly low considering the age of some of these recordings. This is the equivalent of two full LPs and as far as I am concerned, good value.

Pearl's Pearls. Pearl Bailey with Louis Bellson and his orch. **RCA P8S1743**, 8-track cartridge, $6.95.

If you are a Pearl Bailey fan, run, do not walk, to your nearest tape dealer and acquire this gem of a cartridge. What can one say about Pearly? She is unique and one of the all-time premier entertainers. Here she is in great voice, with great backing from Louis Bellson, and she sings some wonderful songs. The engineering is about as good as I've ever encountered on a cartridge. In short, a smash!

Dear Editor . . .

(Continued from page 18)

On the other hand, there are FM stations which are committed to quality FM service, and which maintain high standards in programming as well as signal characteristics. Many of these stations have expressed interest in the Dolby system because it serves these ends, others have already started Dolby broadcasting for limited periods and several others are considering full-time Dolby broadcasting.

Like other broadcasting developments, such as the availability of color TV transmissions, the Dolby system requires listener equipment changes only if the listener wishes to obtain the noise reduction benefit the system provides. Since Dolby and non-Dolby broadcasts are compatible, as in the color example, there need be no forced obsolescence. In fact, the Dolby-encoded FM signal is clearly and entirely within the FCC's fidelity standards.

Mr. Wade's final point is that the Dolby system's use "bypasses the reasons" for FCC transmitter power limits. This implies that there are reasons for these limits other than prevention of interference between services and stations. The power limits exist to protect quality, so does the Dolby system. Fortunately for listeners, one does not exclude the other.

Robert Berkovitz
Dolby Laboratories, Inc.
London

Viva *Audio ETC!*

Dear Sir:

Welcome back to "Audio ETC"! Every reader of AUDIO has missed Canby's incisive monthly commentary, and every writer in the field has yearned once again to savor his inimitable style. Canby can say more with his incomplete sentences and anomalous word use than do most of us who strive to polish our prose to the *n*th degree of grammatical rectitude.

Craig Stark
New York, N.Y.

Quadraphonics Issue

Dear Sir:

In the Editor's Review for December, 1971, you comment on some reader's reaction to October's quadraphonics coverage. That issue has to be the most informative and thorough coverage yet given to this subject. Although I am not terribly interested in quadraphonics, I certainly feel much better informed.

D. Ewart
Vancouver, B.C.

Classified

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Most major record companies are producing 4 channel records. Columbia, Project 3, and Ovation to mention a few already have over 50 selections with many more on their way. 4 channel is here to stay. Look into it.

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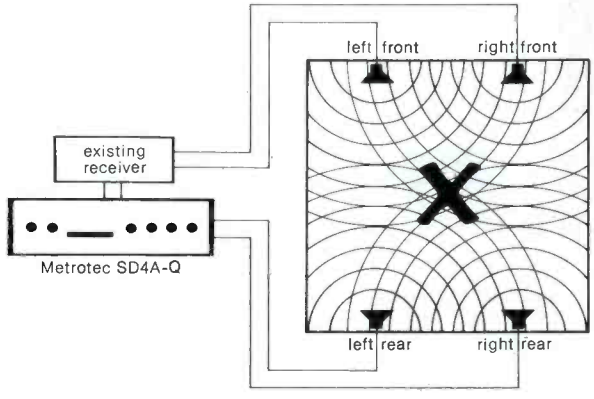

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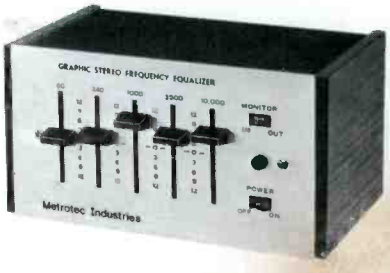

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