Converting To Quadraphonics

AUDIO

JULY 1972 60c

The Authoritative Magazine About High Fidelity ® A

23602

Quadraphonic Progress Report

Add-on-Amplifier-Decoders

New Sansui "20dB" System

Discrete Matrix Discs

Scott's unmatched

for purists who believe separate components are best

The Scott 431 AM-FM stereo tuner is the performance-for-the-price leader among separate component tuners. It's an all new model, but it has a storied and reliable history in the Scott 312 FM-only tuner which was the industry leader from 1964 to 1970.

For the 431, Scott engineers used a silver plated tuner with a cascode FET front end. The result is IHF sensitivity of 1.7 μV which is great in itself but not particularly important, since hardly anybody listens to FM under IHF conditions. What is important is the steepness of the sensitivity curve, which drops sharply, reaching a signal to noise ratio of better than 60 dB at a signal level of around 10 μV. What this buys you is essentially noise-free reception, even in suburban or fringe areas, of practically any station with enough signal strength to budge the panel meter.

Not only does the Scott circuitry achieve full limiting on weak signals (like 4 to 5 μV), but it also has plenty of headroom to prevent overload distortion when you tune to an unusually strong station nearby. The 431 tuner uses two six-pole LC filters in its integrated circuit IF strip. These give better skirt selectivity than highly touted crystal types, and this means you won't be troubled by interference from alternate channels.

The 431 is the only tuner we know of that gives you a multipath distortion meter to check your antenna position for best reception, and a 75 Ω antenna socket for professional or community antenna applications. Scott engineers have included a high quality AM tuner section for listeners who like to tune in an AM program occasionally. Other features include a front panel tape recorder output jack, function lights, and even a panel light dimmer.

The Scott 431 AM-FM stereo tuner sells for $219.90 which is considerably less than the price of the FM-only tuner it replaces. We believe you'll find it an outstanding value, particularly after you've seen and heard all the others.

The Scott 490 integrated stereo control amplifier is the 431's non-identical twin. It puts out 70 watts of continuous (RMS) power with both channels driven into 8 Ω over the frequency range 15 Hz to 20 kHz with less than 0.5% distortion. But where it really overpowers its competition is with single 4 Ω speakers or parallel combinations of 8 Ω speakers where it delivers a conservative 120 watts per channel with both channels driven. Speaker connections for up to three stereo pairs are provided and any two pairs may be used simultaneously without overloading the power supply or degrading performance. Active electronic protection circuitry plus fuses and circuit breaker protect both amplifier and speakers against faults.

Individual left and right channel VU meters with range switching allow power output monitoring on both loud and quiet program material. Tape recorder, microphone, and headphone jacks are placed on the front panel for convenient access. A second tape recorder may be connected at the rear for multiple recording or program production.

The 490 integrated stereo control amplifier outpoints its competition and at $299.90 is another performance-for-the-price leader.

Both the 431 tuner and 490 amplifier feature Scott's quick-change Modutron circuit boards, full two-year parts and labor warranty, and Scott's traditional 100% American design and manufacture. Before you buy separate components, see and hear the 431 and 490 "unmatched pair" at your Scott dealer's.

H.H. SCOTT®
where innovation is a tradition
H.H. Scott, Inc., 111 Powdermill Road, Maynard, Mass. 01754

Check No. 100 on Reader Service Card

pair

AUDIO

JULY 1972 *Successor to* RADIO *Est. 1917* Vol. 56, No. 7

FEATURE ARTICLES

18 Discrete vs. SQ Matrix Quadraphonic Discs — *Ben Bauer*
28 Good News Ahead For Record Buyers — *Harry Maynard*
30 Why the Four-Channel War Need Not Take Place — *Leonard Feldman*
34 Dollars For Tape Contest
56 Audio ETC — *Edward Tatnall Canby*

QUADRAPHONIC NEWS

36 Questions & Answers
36 How To Convert
38 New Sansui "20 dB" system
40 Test Reports: Two Decoder Amplifiers
40 *Lafayette 524*
42 *Sansui QS-100*

EQUIPMENT PROFILES

44 Fisher AM/FM Quadraphonic Receiver — *Model 801*
48 Dynaco 4-D Amplifier — *Model SCA-80Q*
52 Lenco Turntable — *Model L-75*
53 Audio Dynamics Corp. Phono Cartridge — *Model XLM*

RECORD REVIEWS

60 Classical Record Reviews — *Edward Tatnall Canby*
64 Canby's Capsules — *Edward Tatnall Canby*
64 Weingarten Looks At. . . . — *Sherwood L. Weingarten*
66 Jazz & Blues — *Martha Sanders Gilmore*

AUDIO IN GENERAL

4 Coming In August
4 What's New In Audio
6 Audioclinic *Joseph Giovanelli*
8 Tape Guide *Herman Burstein*
10 Dear Editor
12 Behind The Scenes *Bert Whyte*
16 Editor's Review
67 Classified Advertising
72 Advertising Index

EDITOR *George W. Tillett*
ASSOCIATE EDITOR *Edward Tatnall Canby*
ASSISTANT EDITOR *Eugene Pitts*
DESIGN *Barbara Long*
PUBLISHER *Jay L. Butler*
MARKETING DIRECTOR *Sanford L. Cahn*
COVER DESIGN *John Kwasizur*
SUBSCRIPTION MANAGER *Jean Davis*

ADVERTISING PRODUCTION *Sharon Mancini*

CONTRIBUTING EDITORS: *Herman Burstein, Leonard Feldman, Richard Freed, Joseph Giovanelli, C.G. McProud, H.E. Maynard, Alex Rosner, S.L. Weingarten, Bert Whyte*

AUDIO (title registered U.S. Pat. Off.) is published by North American Publishing Co., Irvin J. Borowsky, President; Frank Nemeyer and Roger Damio, Vice Presidents; R. Kenneth Baxter, Vice President/Production; Nate Rosenblatt, Promotion Director; Mary Claffey, Circulation Director.

RATES—U.S. Possessions, Canada, and Mexico, $5.00 for one year; $9.00 for two years; all other countries, $8.00 per year. Printed in U.S.A. at Columbus, Ohio. Second class postage paid at Philadelphia, Pa., and additional mailing office. Back issues, $2.00 each.

REGIONAL SALES OFFICES: Jay L. Butler, Publisher, and Sanford L. Cahn, Marketing Director, 41 East 42nd St., New York, N.Y. 10017, telephone (212) 687-8924.
Jay Martin, 15010 Ventura Blvd., Sherman Oaks, Calif. 91403, telephone (213) 981-7852.

REPRESENTATIVES, United Kingdom: Overseas Newspapers (Agencies) Limited, Cromwell House, Fulwood Place, London W.C.1, telephone 01-242-0661, cables, WESNEWS, London PS4.
Continental Europe: John Ashcraft, 12 Bear St., Leicester Square, London W.C. 2, telephone 930-0525. For Benelux and Germany, W.J.M. Saunders, Mgr., Herengracht 365, Amsterdam, Holland, telephone 24.09.08.
Japan: Japan Printing News Co., Ltd., No. 13, 2 Chome Ginza Higasi, Chuo-ku, Tokyo, telephone 541-5795.

AUDIO Editorial and Publishing Offices, 134 N. 13th St., Philadelphia, Penna. 19107
Postmaster: Send Form 3579 to the above address

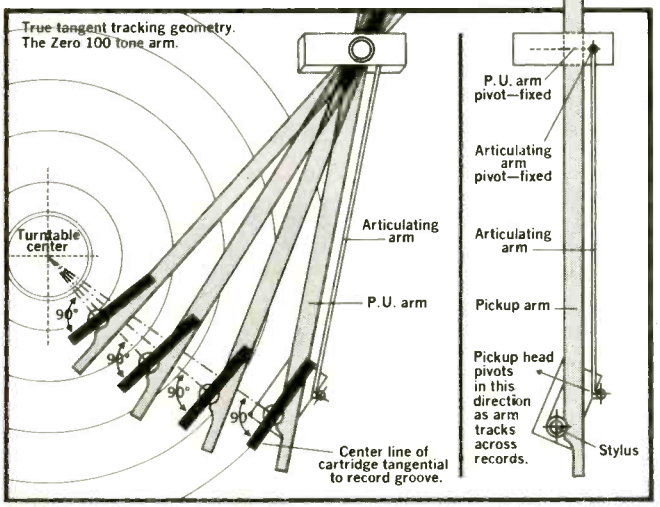
MUSIC GOES ON A RECORD AT A PERFECT TANGENT. NOW IT COMES OFF AT A PERFECT TANGENT.

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. G12, Westbury, New York 11590.

GARRARD ZERO 100

The only automatic turntable with Zero Tracking Error.

$199.95

less base and cartridge

Mfg. by Plessey Ltd. Dist. by British Industries Company
Circle No. 3 on Reader Service Card

Check No. 3 on Reader Service Card

coming in August

- **Q's & A's on Phono Cartridges**—A guide for Beginners
- **Phono Cartridge Testing**—John Bubbers
- **Language of Hi-Fi**—Part III of Martin Clifford's Series of 12 Articles

Equipment Reviews Include:
- Sony 277-4 Quadraphonic Tape Recorder
- Pioneer CS-E400 Loudspeaker
- Sennheiser HD 414 Headphones

About The Cover: This shows Matie Patterson reclining on a Rojan tiger skin rug, surrounded by four loudspeakers. Matie is one of our artists and is responsible for some of the funny cartoons that find their way into AUDIO. Matie is unmarried, age 25, and sympathetic. The rug is

What's New in Audio

Marantz quadraphonic components

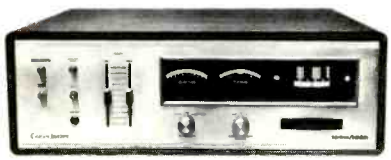
Five units, including two receivers, two control amplifiers, and an adaptor-amplifier, make up this new line. Featured is Vari-Matrix, which allows compatibility with all matrixing systems. Both the SQ decoding system and the JVC/RCA discrete disc system can be used with these units. Top of the line is the Model 4430 AM/FM stereo receiver. Its controls include MODE, with positions for mono, two channel, discrete, Vari-Matrix, external decoder, and four-channel, and three BALANCE controls, two side-side, and one front-rear. Power is 120 watts rms. Price: $599.95.

Check No. 105 on Reader Service Card

Harman-Kardon Citation tuners

The Citation 14 (shown) and 15 tuners use phase locked-loop multiplex circuitry which automatically adjusts for maximum stereo separation and minimum distortion when stations are tuned. A quieting meter, which replaces the conventional signal strength meter, reads for optimum S/N, rather than signal strength. Both tuners include a 400 Hz oscillator which permits tape recorders to be adjusted to the proper levels prior to taping broadcasts. The Citation 14 is also equipped with Dolby B noise reduction circuitry. Prices: Citation 14, $525.00; Citation 15, $395.00.

Check No. 106 on Reader Service Card



Toyo 591 cassette deck

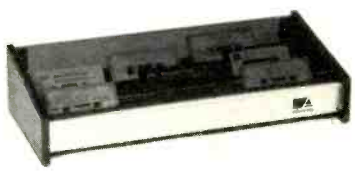
REPEAT and REVERSE functions are included in this unit, which also features an INSTANT REVERSE button, slide volume control, program indicator lights, etc. In the REPEAT mode, the tape will rewind automatically and play again until stopped. In REVERSE, the play or record heads automatically switch from one pair of tracks to the other when the end of the tape is reached, allowing the PLAY or RECORD function to go on uninterrupted for up to 3 hours. Maker's specifications include 50 dB S/N, 45 dB crosstalk at 1 kHz, 50 to 12,000 Hz response, and 0.3% wow and flutter. Price: $179.95.

Check No. 107 on Reader Service Card

Advocate cassette cabinets

These visible-storage cabinets will hold either 24 or 48 cassettes, dust free, on a series of tiers so that their titles are displayed. End panels are walnut-grained, and the smoked plexiglas cover is hinged at the rear. Prices: $14.95 for the 24 cassette size, and $29.95 for the 48 cassette size.

Check No. 108 on Reader Service Card



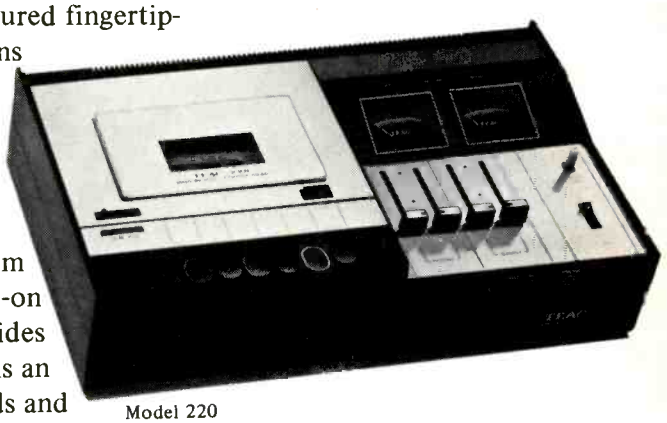
TEAC brings you the consummate in stereo cassette decks.

Here are three that sum up the best of TEAC technology.

Common to them all is a transport and hysteresis-synchronous drive motor so precise and fool-proof that they can hold their own with some of the best open-reel types. Beyond this, the differences begin. Each model has a package of add-ons for your particular needs.

Model 210

If all you need is a basic superior deck that can economically record and playback on conventional tape within a frequency response range of 30 – 12,500 Hz, you'll want to look into the 210. It's outer rotor drive motor holds wow and flutter down to a negligible 0.15%. Separate stop and eject buttons. Low-noise solid-state electronics. Contoured fingertip-control pushbuttons for all operational modes. Large VU meters. Sliding scale record-playback level controls. Standard phone jacks for professional-style 600-ohm mikes and 8-ohm headsets. Strobe-type running light.


Model 220

If you're looking for a deck that can handle the new chromium dioxide tapes, you should look into the TEAC 220. It has the add-on feature of a tape selector switch which in the CrO_2 position provides recording and playback frequency response of 30 – 16,000 Hz. As an added convenience, the 220 incorporates high density ferrite heads and separate record and output level controls.

But if you're looking for the definitive Dolby deck with everything you need for near-professional operation, only the 350 will do. It has TEAC's high-density ferrite heads. These "brown jewels" are so extraordinarily durable that we warranty them for the original owner's lifetime. Add to these a Type B Dolby System that improves the basic signal-to-noise ratio of the 350 by an additional 10dB.

You can count on superior performance from conventional, high-density/high energy, and chromium dioxide tapes. Add, too, the large expanded-scale VU meters and on-line peak level indicator for distortion-free recording at optimum levels and signal-to-noise ratios.

What it all adds up to is that each TEAC cassette deck is the finest available for your particular needs – whatever they are.

Model 350

TEAC

TEAC Corporation of America, 7733
TEAC Corporation, 1-
TEAC EUROPE
In Ca

Check No. 29 on Reader Service C

Audioclinic

Joseph Giovanelli

Input Impedance and Volume Setting

Q. I have seen it stated that a power amplifier's input impedance is "independent of level pot at input." How can this be?—M. Notkins, New York, N.Y.

A. You know that tube amplifiers have high impedance inputs. The impedance at the grid of an input circuit is high enough so that, even when the slider of pot to which it is connected was moved to its highest setting, this grid circuit will not appreciably load down the preamplifier's output circuit. See Fig. 1.

If a pot is wired in the same as a tube circuit, but using transistors, and if the impedance of the input transistor is very high, as compared to the resistance of the input pot, any change in loading will not significantly change the loading on the preamplifier's output. Of course, if you inject the input signal at the wiper of the pot, and if the pot is completely counterclockwise, the input impedance will be zero ohms because the pot presents a short to ground. See Fig. 2.

Any amplifier designed in this manner cannot meet the statement in your question. The input impedance varies between a maximum and zero ohms.

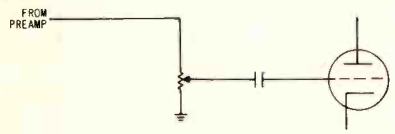


Fig. 1—Input potentiometer, conventional grid circuit.

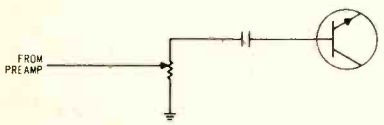


Fig. 2—Amplifier input circuit with signal fed into potentiometer wiper.

Four-Channel Sound

Q. *In a two-channel system of tape deck, turntable, four 80-watt speakers, and a 240-watt receiver, can a four-channel amplifier be satisfactorily integrated to produce four-channel sound effect? If so, what size (in watts) is recommended?*—Sp/4 James C. Gunter, [illegible] o-channel re- [illegible] do is to obtain an integrated two-channel amplifier. If it is of the same basic design as your receiver, so much the better because phase relationships will be preserved. You will not need as much power to drive the rear channels, at least for classical music listening. This may even be true of some "pop" material.

Where you are using four separate channels from tape right on out through speakers, however, I suggest that you have the same amount of amplifier power feeding the rear channels as feeds the front ones so that in the event there is primary information on any of the channels, including the rear, it can be recovered as it should be heard. In your case, therefore, each rear channel should be capable of 120 watts of amplifier power, for a total of 240 watts—equaling the power available from the front two amplifier channels. Where your speakers are very efficient or where you do not plan to do loud listening, you can settle for considerably less power in both the front and rear channels. In the event you already have your amplifier for the two front channels, you can, given the above conditions use less power in the rear channels. However, it seems to me that you might have some problems with phase relationships when using an amplifier whose design is different from that which you are using for the front channels.

The loudspeakers should have sufficient power so as to be capable of all the power you plan to deliver to them. How much power that actually represents will depend on such factors as your listening level preference and room acoustics. Speaker efficiency, too, can play a role.

Capacitor Life Span

Q. *Do mylar tubular capacitors and ceramics deteriorate with age? If so, is the deterioration gradual or is there usually a sudden failure? If gradual, what is the effect upon power amplifier performance? Is there an average life span for these components, beyond which replacement is advisable?*

Similar advice re electrolytic capacitors will be appreciated.—Walter Diehl, Great Neck, N.Y.

A. Tubular paper capacitors and ceramic units do not usually fail; their life span is indefinite. When they do fail, however, they will fail suddenly and completely. They will either completely short or they will open.

Electrolytics will fail after a time. I do not know if we can specify a definite life span for them, but perhaps ten years is about what can be expected of most of them. Some will last longer and others a shorter length of time. Electrolytic capacitors fail gradually, losing their capacitance little by little, Depending upon their location in a circuit this gradual decrease in capacitance can lead to loss of bass response, crosstalk between channels, leakage of signal even with the gain control turned down fully, motorboating, and hum.

As is true of paper and ceramic capacitors, electrolytics are also subject to catastrophic failure. Sometimes, too, the internal connections between the lugs and the foil can become defective, leading to intermittent operation of the capacitor.

If you have electrolytic capacitors in the "junk box," you may find that they deteriorated in another respect. Their breakdown voltage may become lower than their nominal rating. If you plan to use a capacitor which has been stored for long periods, you can take precautions to see that it does not fail when placed in service. You can reform the electrolytic coating. This requires the use of a variable voltage power supply. Connect the capacitor in series with a resistor whose value is in the order of 50K or 100K ohms, ten watts. Connect this series combination across the power supply, being careful of polarity. If the capacitor is rated at 450 V, start with approximately 200 volts. Over a period of several hours, gradually bring up the voltage to the rated value. You should allow at least 12 hours for this operation.

It is possible that the capacitor will short out during this reforming process. Of course, it must then be discarded. The resistor, therefore, is used to limit the current flowing in the circuit, thereby protecting the power supply from possible damage.

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.

The new ADC-XLM

Superb performance. Lowest mass. Unbeatable price. And it's guaranteed for 10 years.

If you're like most audiophiles, you've probably spent a great deal of time, effort and money looking for the "perfect" cartridge.

We know what you've been through. After all, we've been through it ourselves.

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.

The lighter, the better.

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.

A new solution for an old problem.

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.

Guaranteed reliability plus.

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.

But this unprecedented guarantee* involves something more than just an assurance of quality. It is also an expression of our conviction that the performance of this cartridge is so outstanding that it is not likely to be surpassed within the foreseeable future.

And something more.

In addition to the superb ADC-XLM, there is also a new low mass ADC-VLM, which is recommended for use in record players requiring tracking pressures of more than one gram. The cartridge body is identical for both units, and so is the guarantee. Only the stylus assemblies are different. Thus you can start out modestly and move up to the finest and still protect your investment.

And that brings us to the important question of price, which we are happy to say is significantly lower than what you might reasonably expect to pay for the finest. The suggested list price for the incomparable ADC-XLM is $50 and the runner-up ADC-VLM is only $40.

But no matter which low mass ADC you choose, you can be certain that they share the same outstanding characteristics... superb tracking, very low distortion and exceptionally smooth and extended frequency response.

*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.

ADC **Audio Dynamics Corpora**

Pickett District Road, New Milford, Co

Check No. 7 on Reader Servic

Tape Guide

Herman Burstein

Buying in Vietnam

Q. I am in the market for a complete stereo system, including tape components. I am presently in Vietnam and want to take advantage of the prices here. I'd like some advice from you on what to buy.—Benjamin Novak, APO San Francisco, Cal.

A. I cannot offer you advice on specific items of audio equipment. The only suggestion I can make is that whatever equipment you decide to buy (based on your own listening, on equipment reviews in audio journals, etc.), make sure that it is widely sold in the United States (if not made here) so that you will have no difficulty in getting this equipment serviced at a future date. I get quite a few letters from persons who have purchased foreign equipment at bargain prices, only to find on their return to the U.S. that their bargain disappears because of the difficulty of finding appropriate service.

S/N = Low Noise?

Q. I am looking for a low-noise tape deck. Just what is "low noise?" Is it right to assume that the higher the S/N ratio, the lower will be the tape hiss and other noise on playback and on record/playback? What is the truth about S/N ratio? One tape machine advertises 55 dB S/N, another advertises 62 dB, and still another advertises 78 dB! Yet all three are in the same price category. It seems to me that the tape head influences the S/N ratio more than anything else.—Dan Weller, Brewerton, Wash.

A. You are correct in that the higher the S/N ratio the lower is the noise. In comparing specifications of, say, two tape machines (assuming they both tell the truth), you have to be sure that they both use the same reference level. For home machines, the common reference level is a 400 Hz signal which results in 3% harmonic distortion on the tape in recording. Some machines, however, use a lower reference level, usually 1% harmonic distortion. Such a machine will claim S/N about 6 to 8 dB lower than a machine which employs the 3% reference. To illustrate, a machine which uses 1% as the reference nd claims 50 dB S/N is comparable achine which uses 3% as the bout 56 to 58

There are many factors, including the tape heads (particularly the playback head), which enter into the achievement of high S/N. In the case of the playback head, an important factor is the amount of signal it delivers, so that the signal may override noise produced by the tape machine electronics. Noise further depends on the quality of components in the tape electronics (resistors, transistors), on the design of the electronics, on the tape speed, and on the tape used.

15-Min. Dirt Build-Up?

Q. My problem concerns an 8-track stereo cartridge player, the Drexel Model 809. The playback head gets very dirty after a short period of playing, about 15 minutes. A dealer told me it could have been dirty tapes, but the problem happens with brand-new tapes. I have tried cleaning the head with alchohol and have used a tape cleaning cartridge, but nothing helps. If I let the unit play for about two or three tapes without cleaning the head, I can hardly distinguish what is being played. This problem has existed from the day I bought the unit. Any help would be greatly appreciated.—Clyde DePhillips, Jr., New Orleans, La.

A. The problem seems to be a built-in one, resulting from the design of your cartridge player. You may be getting excessive oxide deposits on the head due to too much pressure of the tape against the head, or perhaps as the result of the head not being sufficiently smooth. All heads require cleaning at intervals, but every 15 minutes is far too frequent. It seems you have a perfect right to complain to your audio dealer and to the manufacturer of the machine.

Equalization Change

Q. I have a Sony 355 3-head tape deck. I changed the bias to correspond to Scotch 203 tape. I found that I also had to change my equalization for proper playback. My question is what good is the NAB playback characteristic if the equalization must be changed when bias is changed? Is the recording characteristic supposed to be changed when bias is changed so that I can play back through the NAB characteristic?—Wayne Chew, Troy, N.Y.

A. You should **not** change playback equalization when changing from conventional to low-noise tape. Presumably your machine had correct NAB playback equalization before you made changes. This playback equalization implies a corresponding recording characteristic, not in the machine but **on the tape.** Depending on the kind of tape, bias and record equalization have to be adjusted. The test of the correct recording characteristic is whether you get flat response in playback. I suggest that you restore your machine's playback equalization to NAB response; this can be done by playing a test tape and adjusting playback equalization for flattest response. Then, using low-noise tape, adjust bias and record equalization (and audio drive current) in accordance with instructions provided by the manufacturer of the tape or of your machine; adjust record equalization for flattest record-playback response.

Miking A Meeting

Q. Can you advise me about a microphone for use in recording business meetings with a battery operated cassette recorder? Generally these meetings will involve only two or three people, but there could be as many as six or eight.—David R. McClurg, Mountain View, Calif.

A. I suggest that you buy one of the better ceramic microphones or one of the cheaper dynamic microphones. Something in the class of roughly $10 should serve your purpose nicely. The microphone should be of the omnidirectional type, as most inexpensive ones are, for your application.

Low-Noise Tape

Q. What tape companies put out low-noise tape so that you can record at lower speeds?—J. David Newman, Berrien Sprints, Mich.

A. Low-noise tape has nothing to do with recording at lower tape speeds. It is simply tape that, to the human ear, apparently produces less tape hiss and other tape noise than do conventional tapes.

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.

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.

Better yet, just pay a visit to your franchised United Audio dealer and ask him for a demonstration. Dual®

United Audio Products, Inc., 120 So. Columbus Ave., Mt. V
Exclusive U.S. Distribution Agency for Dual

Check No. 9 on Reader Service

Dear Editor □□□□

Lirpa History

Dear Sir:

I was quite pleased to find your article on Prof. I. Lirpa's speaker design in your April issue. This is the first time I've come across any reference to Lirpa in an American publication, and I thought you might appreciate knowing more about the professor. I came to know him at U.B. (Univ. of Bucharest) in the summer of 1953, and I was with him when he stumbled onto (literally) wickerwork, and its then unknown useful applications. In fact—and you will probably enjoy this little anecdote—he was expelled from school for making rude sounds in stereo while sitting in a wicker chair.

I believe, however, that your translation is in error, because in attempting to prove it out I re-translated the article back into Romanian, and it was unintelligible (at least, to the English-speaking world). But don't take that badly, I. Lirpa himself often spelled his name backwards.

Harold Bryman
Sherman Oaks, Calif.

The reason for Prof. Lirpa being comparatively unknown is because he was ostracized since a scandal in 1967 or thereabouts. I am not certain of the details but it involved a camel and the wicker basket. However, with the realization that one's private life should not detract from scientific achievements, Prof. Lirpa's works are again being published and the University is even naming a chair in his honor.—ED.

From the Soviet Union. . . .

Dear Sir:

I'm a reader of your magazine for some four years and enjoy the material published in it greatly. Since I'm a record collector and hi-fi enthusiast, your magazine is very helpful to me. Now I've decided to write to you and to ask for your help in establishing contacts between American and Soviet record collectors. I'd like to exchange records with anybody who might be interested in that. I can send records of world-famous Soviet performers, composers etc. I'd like to point out just [illegible] of Soviet records are [illegible] a lot of them, [illegible] a serious collector. Also such contact would be useful to bring our peoples closer together. If you'll find a possibility to publish my letter in "Letters to Editor" column, I hope to get in contact with some collectors.

Waldas J. Nenishkis,
Zirgo str. 3, apt. 14,
Antakalnis, Vilinius,
Lithuania, USSR.

And Czechoslovakia

Dear Sir:

Besides being an audiophile, I am an avid jazz music lover and records collector. Unfortunately, the American jazz records are not available here and cannot be ordered from abroad in a normal way. My only source of jazz records was a swapping of records with an American friend who after having moved to Hawaii is not able to continue our exchange. I would be very happy and grateful to you, if I could through your magazine find somebody willing to swap records with me. I hope that there can be somebody interested in Czech music released on our Supraphon whose complete catalog I am prepared to send. I understand that this would be an advantage on my side mainly, since Supraphon records are available in your country equipped with far better covers. The swapping of records could be eventually extended to an exchange of opinions on the subject of sound reproduction.

J. Burdych
Na Maninách 34/1106
Praha 7 Holešovice
Czechoslovakia

AM Buffs, Arise!

Dear Sir:

I have been a follower of AUDIO magazine since 1963, and I have always had the same disappointment. It isn't necessarily directed at your editorial policy, but at the "snobbish" attitude that is displayed towards AM broadcasting.

The manufacturers of high fidelity-stereo equipment seem to be the main culprits in this area. It is disgusting to see some of the outstanding tuners and receivers available that offer an AM section on an "also ran" basis. If the same people that design equipment as great as we know it can't also offer an AM standard any better than the "State of the Art of 1943," then the entire science is in great trouble.

Granted, AM radio does have a little noise, and some stations do not care if their signal could be compared to a "random noise source," but many broadcasters dilligently strive to broadcast a signal as perfect as our "state of the art" permits. It is not uncommon to find less distortion and better frequency response in a well maintained AM transmitting facility than in the modern phonograph disc. Signal quality is fundamental to the responsible broadcaster, because he realizes that is really all he has to offer to the public.

There are too many FM broadcasts that could be catagorized as random noise sources. It is not uncommon to find FM stations that transmit worse audio than their AM counterparts. Many times the financial makeup of FM broadcasting does not permit the engineering budgets necessary to maintain quality that AM service can offer.

It would do my heart good to see: 1. AM tuners with an i.f. bandwidth to 15 kHz., with the attendant 10 kHz. "whistle" filter. 2. Tuners with 2% or less harmonic distortion capability, as is now the standard in many AM transmitters. 3. All equipment reports on receivers or tuners with AM sections show frequency response, IHF sensitivity, i.f. bandwidth, and distortion. 4. More broadcasters promote their audio quality as "high fidelity" in every sense. All of these items are completely within the "state of the art" and would happen if enough enthusiasts desired them.

Granted, listening to AM will never compare to live performance listening, but I will never be convinced that cassettes and eight-track cartridges will either. How about some comments from your readers?

David P. Hebert
Chief Engineer, KXRO
Aberdeen, Wash.

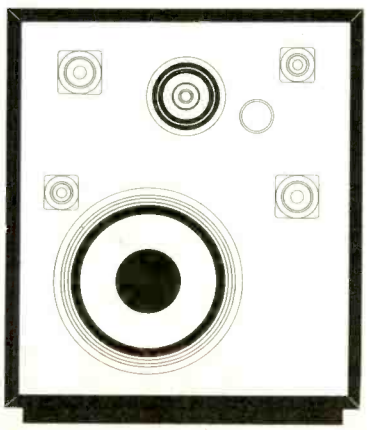
If there was a real demand for tuners with good AM performance, manufacturers would be only too pleased to make them—or so it seems to me. I believe the most urgent need is for ***FM stations*** *to improve their incredibly bad transmission standards—and how about some live broadcasts?* Ed.

Rectilinear answers the question most people ask about quadraphonic stereo:

"Do my rear-channel speakers have to be as good as my front-channel speakers?"

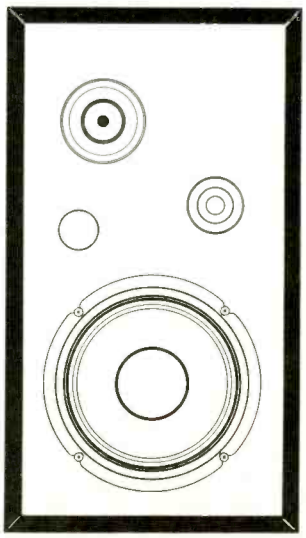
This is the question most people are asking today if they're getting ready to go four-channel. And we at **Rectilinear** would like to make it clear how we stand on the answer. Simply stated, we think that the rear speakers need to be of the same *quality* as the front ones, but not necessarily the same *size*.

Some people feel that you can stick a pair of "cheapies" in the back, as long as you have good speakers up front. Unfortunately, this won't work, because inexpensive, poorly-designed speakers have several inherent characteristics which make them totally useless for any quadraphonic system. (Some will even make you think that instruments are jumping around the room when they're not supposed to.)



So, if you're starting from scratch, we suggest you consider a pair of **Rectilinear III's** for your front channels, with a pair of **Rectilinear XII's** bringing up the rear. This way, you'll have up front the speakers that virtually every audio expert has been praising for over five years. (Remember, you'll still be listening to a lot of two-channel stereo.)

With the **Rectilinear XII's** in the rear, you'll have a pair of superb three-way speakers that thousands of people are using up front for regular stereo. The **XII's** will do a great job in reproducing the reflected "hall sound" in quadraphonic classical recordings, and will sound almost as good as the **III's** when you play pop or rock recordings with different musical material on each channel.



Of course, if you already have a pair of *top-grade* speakers, simply add a pair of **XII's** ($139.00 each) for the rear channels. But if your present speakers are only *good*, put them in the rear and get yourself a pair of **III's** for the front. Choose either the *original* **Rectilinear III,** at $279 each, or if you want to fling for our more sumptuous **lowboy** version, it'll cost you $40 more for the pair.

Just remember one thing: all four speakers must be as good as possible. Because in quadraphonic stereo, the worst thing you can do is cut corners.

(For more information, including detailed literature, see your audio dealer, or write to: Rectilinear Reserach Corp., 107 Bruckner Blvd., Bronx, N. Y. 10454. Canada: H. Roy Gray Co., Ltd. Markham, Ont. Overseas: Royal Sound Co., 409 N. Main St. Freeport N. Y. 11520.)

Rectilinear®

Engineering Excellence

Chec[illegible]

Behind The Scenes

Bert Whyte

Now that Audio's 25th anniversary has been duly noted and celebrated and we have finished our saunter "down memory lane," it's time to get back to the present and perhaps sneak a few looks at the future. As I write this, it is on the eve of my departure for the Los Angeles AES convention, which in addition to the usual interest of the audio papers and exhibits, will have the added stimulus of much that is new in quadraphonics. My report on these activities will appear in due time. By the time you read this I will be at the sixth annual audio seminar at Brigham Young University in Provo, Utah. This year the four-day seminar will be devoted entirely to four-channel stereo. As an exciting added attraction this year, at the conclusion of the seminar a chartered plane will fly a group of participants to Los Angeles for actual working quadraphonic sessions at Bill Putnam's United Recording studios. At the seminar I will have the pleasure of presenting the opening lecture, to be followed by lectures and demonstrations by such quad-sound luminaries as John Eargle of Altec; Jim Cunningham of Sound Market Recording; Dr. Duane H. Cooper of the University of Illinois; Bill Putnam of United Recording and his Chief Engineer, Jerry Feree; John Neal of Glen Glenn Sound, and Bill Robinson of William L. Robinson & Assoc. Among the subjects to be covered will be quadraphonic live recording, quadraphonic dub-down, matrix systems, quadraphonic disc mastering, control room engineering, and quadraphonic recording hardware. As you can see, that brash young upstart, four-channel stereo, is now thoroughly entrenched in the audio scene. I expect some really exciting quadraphonic developments at this seminar and a full report will be forthcoming.

Last year in the pages of Audio, Dr. Duane Cooper of the University of Illinois presented a two-part article on the construction of an acoustical delay line. The article aroused considerable interest, but although Dr. Cooper gave excellently detailed instructions on the fabrication of his unit, it was still a rather formidable task, I think many people [illegible] unit. The device was certainly beyond my resources of time and skill, and I remember thinking somewhat wistfully how I'd like to have one for its obvious uses in quadraphonic synthesis.

Among those who were impressed and fascinated by Dr. Cooper's delay unit was Bill Putnam of United Recording in Hollywood. Bill contacted Dr. Cooper and after a thorough evaluation of the delay unit, he was convinced of the basic soundness of the design. Further discussions with Dr. Cooper resulted in a decision to undertake some developmental work on the device at Bill's United Recording Electronics Industries, with a view towards eventual commercial production. After months of experimentation a practical unit evolved and Bill decided to run off a few proto-types to farm out to various interested parties for their reactions. Newly christened the "Cooper Time Cube," Bill was kind enough to send me one, which I have been using and testing for weeks now, and I am completely enthralled by the device. The "Time Cube" is now a standard UREI production unit and consists of a grey-finished plywood housing, 24x24x9 in., which contains two coiled acoustical delay lines with their respective transducers, plus a 3½x19 in. rack-mounting electronics chassis containing a power supply, four UA 1109 card-type amplifiers, equalizing networks, VU meter, and operating controls. Also furnished are two standard 25 ft. microphone extension cables with XLR-3 type connectors for interconnecting the chassis to the housing.

In Dr. Cooper's original design, the acoustical delay lines were made of copper. In the production unit the delay lines are made of rigid-walled polyethelene tubing. This has the advantage of light weight and extremely smooth bore as well as freedom from ringing. When the delay coils are placed in the housing, the housing is then filled with styrofoam pellets in sufficient quantity to produce a very high density pack around the coils. This serves to protect and isolate the coils, as well as furnish acoustic damping.

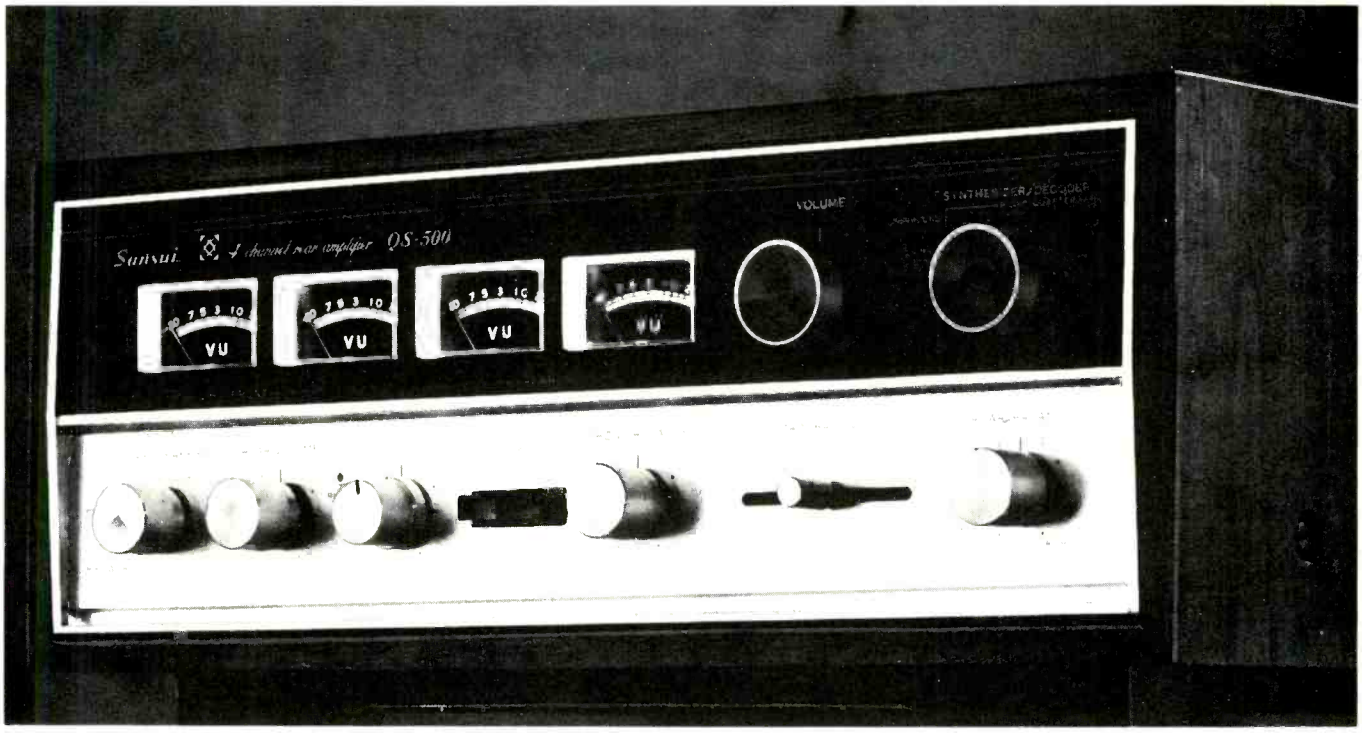
The Cooper Time Cube is described as a dual-channel audio delay-line system, with channel A having a delay of 16 milliseconds, and channel B 14 mS. The two channels may be cascaded for a single delay of 30 mS. The reason for the slightly differing delay times is to avoid comb-filter effects, and it is felt that in using the unit for quadraphonic synthesis, the differing delays help to produce a better ambient sound field. At this point, a word about how this acoustical delay system works would be in order, and this is very well described in the literature that accompanies the Time Cube.

"Delay is accomplished by utilizing the relatively slow velocity of sound wave transmission through air, as compared to the speed of electro-magnetic waves or electric current through a conductor; speed of sound in air is 1130 feet per second . . . speed of light or electricity is 186,000 *miles* per second. Therefore, the delay of sound through air, with respect to electronic signals through conductors can be approximated at 0.884 milliseconds per foot. In the Cooper Time Cube an input signal to channel A is amplified and pre-equalized, then used to energize a dynamic transducer at one end of a coiled, rigid polyethelene tube containing one atmosphere air pressure. At the other end of the coiled tube is a special coupling assembly in which another transducer reconverts the acoustical signal to an electronic signal equivalent to the input, but delayed by the 16-mS acoustical length of the sound column. This signal is then post-equalized and re-amplified to line level. An input to channel B is similarly processed through the second acoustical transmission line having a delay of 14 mS."

Acoustic delay lines are, of course, nothing really new. But up to now their drawbacks have always been restricted usable bandwidth and poor transfer characteristics due to acoustic reflections in the transmission line. Dr. Cooper's ingenious design solved these problems and subsequent improvements by Bill Putnam in acoustical equalizing techniques produced an even flatter frequency response and wider bandwidth. The Time Cube is unique as compared to earlier acoustical delay lines, in that distortion is very low, THD being on the order of less than 0.5% and with a signal-to-noise ratio greater than 70 dB.

The applications for a high quality acoustical delay line are almost the

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.

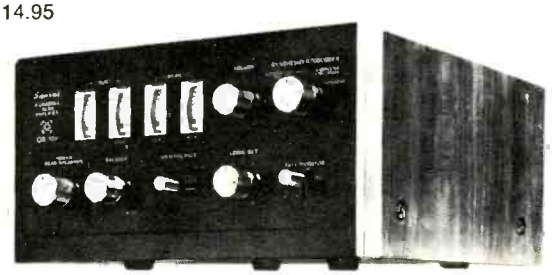
The Sansui QS500 and QS100 converters are complete Four-Channel Synthesizer-Decoder-Rear-Amplifier-and-Control-Center combinations that transform standard two-channel stereo totally. The only other equipment you need is another pair of speakers.

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



Sansui

SANSUI ELECTRONICS CORP.

Woodside, New York 11377 • Gardena, California 90247
ELECTRONIC DISTRIBUTORS (Canada), Vancouver 9
SANSUI ELECTRIC CO., LTD., Tokyo, Japan •

Check No. 13 on Reader Service Car

same as for the Delta T digital delay unit discussed here several months ago, the main difference being that the Delta T has delays up to 320 mS which gives it an edge over the Time Cube in sound re-inforcement work. The Time Cube can be used to "synthesize" quadraphonic sound from two-channel stereo material, to spatially enhance stereo or quadraphonic recordings, in loudness enhancement, and by delaying the "send" to reverberation chambers, or plates, to improve the illusion of a large room by approximating the longer dimension of the first order reflected sound (early sound) preceding the onset of reverberation.

My principal interest in the Time Cube is in the quadraphonic synthesis of regular stereo material whether it be on tape or disc. Now you can't call the Time Cube a stereo device, but the fact that it has *dual channels* is a great aid in creating the spatial ambience of the non-coherent "room sound." With the Time Cube we once again have the Haas precedence effect working for us. Haas, Madsen, and others have shown that the spatial enhancement created by the delay, can be effected by delays as short as 2 mS, and that when the delay reaches approximately 35 mS (some scientists believe it can go as high as 50 mS), sound "fusion" ceases and the delayed sound may be heard as a discernible echo of the original sound source. Thus the 16 and 14 mS delays were chosen to keep them well within the limit of sound fusion.

The Time Cube is very easy to set up for quadraphonic simulation. The tape output of your front pre-amplifier is fed into the front panel input jacks on the Time Cube electronics chassis. The output of the electronics is fed into a high level input on the rear channel pre-amplifier. The Time Cube's chassis has a mike cable leading to the delay line housing and feeding input signals. The output signal of the delay line feeds into the chassis via another mike cable. The VU meter on the chassis is of the switchable variety and there are two control pots. Each source, whether it be disc or any form of tape, must have available a level signal for initial set-up. This can be had in the form of various test discs and tapes. The Time Cube is adjusted to the particular source by having the signal of the disc or tapes brought up to "0" VU on the meter by use of the input pots. Once adjusted, nothing further is necessary until you change the nature of your source. After everything is set up, you just "dial" into your rear channels the level of ambience you desire. Needless to say, this quad synthesizing works best for classical music, but interesting effects can be created with pop material. If your source is of really good quality, the results can be quite spectacular. Most dramatic of all is to play 15 ips Dolby "A" stereo tapes of classical works made in a good hall. The rear ambience you create with the delay give an astonishing "roundness" and a great sense of "liveness" and increased presence to the overall sound, and the absence of noise in either the front or rear heightens the feeling of "on-the-spot" realism.

The Time Cube is a professional product for the recording studio and considering the fact that it has two channels of delay, the $850 price tag is reasonable. I noted that the card amplifiers in the unit and other circuits used discrete components. There are some obvious places where IC's could be used and the price of the unit reduced considerably. In a recent chat with Bill Putnam, he gave a few hints that ultimately there might be an audiophile model. I certainly hope so, for once you have had one of the Time Cubes in your home and have become used to that wonderfully increased realism of your normal two-channel stereo material, you are not very keen on going back to so-called "normal" listening. Æ

In Memoriam

Dr. Frederick V. Hunt

Dr. Frederick V. Hunt, formerly Gordon McKay Professor of Applied Physics and Rumford Professor of Physics at Harvard University, died of a heart attack early on April 21 while attending the meeting of the Acoustical Society of America in Buffalo.

Ted Hunt combined the theoretical knowledge of the physicist with the practicality of the engineer and the wisdom of an educator. Only the evening before his death, at a committee meeting chaired by one of his former students, he was urging the advantages of a general educational background in [illegible] compared with early [illegible] of its branches. [illegible] Acoustical Society of America in 1951-2, received its Pioneers in Underwater Acoustics Medal in 1965 and its Gold Medal in 1969. In 1954 he received the Emile Berliner Award of the Audio Engineering Society "for an outstanding achievement in the field of audio engineering," and in 1965 the John H. Potts Memorial Award "for outstanding achievement in tracing distortion encountered in disc reproduction." He served as President of the AES in 1969-70. In 1947 he received the Presidential Medal of Merit for his work in sonar and torpedoes as Director of the wartime Harvard Underwater Sound Laboratory, and in 1970 the Navy awarded him their Distinguished Public Service Medal at the time of his retirement from Harvard. He then moved to California where he continued his work, as a research associate at the Scripps Institute of Oceanography.

In the world of audio Professor Hunt was particularly known for his work on pick-ups and loudspeakers. With J. A. Pierce, also of Harvard, he described a pick-up "with unbelievable response, flat within plus or minus 3dB from 30 to 18,000 cycles" and a 5 gram needle pressure, in the March, 1938 issue of *Electronics,* and the physical principles underlying it in the *Journal of the Acoustical Society* in July, 1938. His October, 1962 paper in the *Journal of the Audio Engineering Society* on "The Rational Design of Phonograph Pick-ups" is regarded as a classic, and he was at the time of his death planning a new edition of his book "Electroacoustics" (now out of print but available in facsimile from University Microfilms).

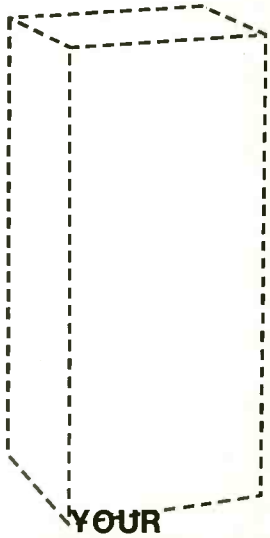
He will be sorely missed by his many friends and colleagues in all branches of acoustics. *G.L.W.*

Twelve years — Five major advances

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.

NATICK, MA. 01760 BOSE®

* Patents issued and applied for

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

Check No. 15 on Reader Service C...

Editor's Review

MUCH HAS HAPPENED since our Quadraphonic issue last October: Electro-Voice has come to terms with CBS, matrix records have been released (over 400,000 SQ discs sold up to May), and companies such as Kenwood, Superscope, Pioneer, and Harman-Kardon have joined Sony on the SQ bandwagon. On the discrete side, RCA has announced the imminent release of several discs using the JVC multiplex system and they are supported by JVC and Panasonic with an impressive range of playing equipment. The straightforward confrontation between discrete and matrix is complicated by the SQ and E-V gain-riding logic modifications and by the recent appearance of the Sansui phase-controlled matrix which gives separation comparable with discrete—see page 36. It is possible (technically, that is) for RCA to use a matrix for recording their discrete system so the discs could be played via a decoder or a JVC type modulator but whether RCA will actually do this is anybody's guess. . . . Meanwhile most manufacturers such Fisher, Pioneer, Marantz, Kenwood, and Sherwood are fitting their receivers with switches to take care of discrete systems or any kind of matrix arrangement.

• • •

According to Peter "Matrix" Scheiber, over 1 million decoders in one form or another have been sold. This estimate was given by Peter at the recent AES convention—which was notable for some rather stormy scenes between matrix and discrete protagonists! At about the same time, another conference was being held in Acapulco (who picks these places?). This was organized by the International Music Industry Conference (IMIC) and here RCA made a presentation of their system in company with executives from Panasonic, Motorola, JVC, and Quadracast. RCA's Rocco Laginestra said "By this time next year, all RCA records will be made in a compatible discrete format." JVC announced that they will introduce a cartridge using the Shibata stylus in July at about $69.95 and a modulator-decoder at $99.95. Panasonic will also have a modulator available by September and the price with cartridge is expected to be $134.95. We hope to make an assessment of the RCA discs in the very near future—early JVC discs suffered from a restricted dynamic range, low signal-to-noise and reduced [illegible] it is claimed that some of these [illegible] apply.

The RIAA has just announced the 1971 sales figures for tapes and records. Cassettes were up $96 million from $77 million and 8-track up to $385 million from $378 last year. Reel-to-reel sales fell to $12 million from $18 million. Record sales increased to $1,251 billion from the previous year's $1,182 billion—a gain of 5.8%.

• • •

Calling All Antique Phonograph Collectors

Looking at our cover reminds me that there is a Society for Collectors of Old Phonographs. The name is the American Phonograph Society and it publishes a quarterly journal. The address is: P.O. Box 5046, Berkeley, Calif. 94705.

• • •

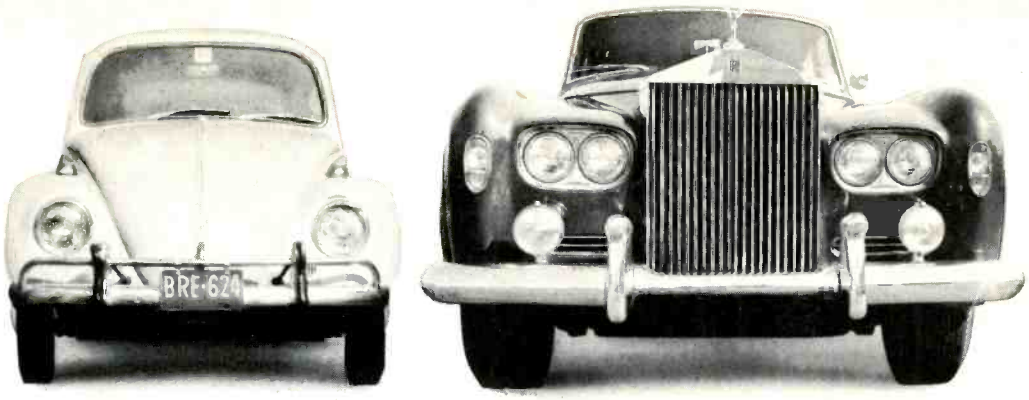
My appearance in a Pioneer advertisement should not be taken as a specific endorsement of Pioneer products by me or by AUDIO magazine. Our unbiased, factual opinions of equipment can be found in the review pages.

• • •

I wonder how many people were actually privileged to hear the music of Bach, Brahms, and Beethoven before the advent of recording. Or how many travelled much beyond the confines of their own village just 200 years ago? These thoughts were prompted by reading Earl Lifshey's column in the *Home Furnishings Daily* (known to its devoted readers as *HFD*). Well, Earl quoted the late Adlai Stevenson as saying "Every new technological development wraps another fine stainless steel wire around our souls." A trite observation, but with some degree of truth—especially considered from the standpoint of pollution and chemical "food." But the truth is, most of us take technological advances for granted, and I am reminded of a debate which took place some years ago. One of the speakers was a Thoreau Back-To-Nature enthusiast and after he had held forth about the joys of a Simple Life, the other speaker asked him a simple question: What did you do after getting up this morning? After some prodding, the B.T.N. speaker confessed he had used the bathroom, made a phone call, put on his mass-produced suit, got his breakfast from the refrigerator, read his newspaper, and got into his car—but before he reached that point his voice was drowned by a sea of uproarious laughter from the audience.

Humor In Advertising

Seen in the window of a Philadelphia store, "Come in for a discreet quadraphonic demonstration." With Go-Go Girls? *G.W.T.*



Choosing the wrong cartridge for a record player is like putting the wrong motor in these cars.

Each of these cars has its own fine motor.

But, it would be unwise to expect the lower horsepower engine to efficiently drive the larger vehicle. And, it would be silly to use the higher horsepower engine for the smaller car.

It's the same with cartridges. In fact, a cartridge that's great for one record player *could be disastrous for another.* How then can you be certain you are playing your records with the right cartridge? The answer is simple.

There is a Pickering XV-15 DCF-Rated Cartridge for the most simple to the most complex playback equipment! We have taken virtually every high fidelity record player and pre-analyzed the vital engineering variables affecting cartridge design, so that no matter what equipment you own or plan to purchase, you can get an XV-15 cartridge exactly right for it.

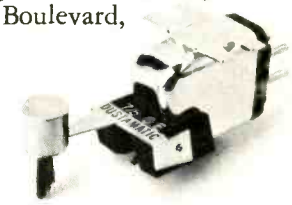
If you're concerned about improving your reproduction, we refer you to our handy DCF guide shown below (Why not clip it out for handy reference?)

Every Pickering XV-15 cartridge features the exclusive DUSTAMATIC® brush that sweeps record grooves clean to insure cleanest sound.

If you'd like a DCF guide for a friend or additional information on Pickering cartridges, write Pickering & Company, Inc., 101 Sunnyside Boulevard, Plainview, N.Y. 11803.

PICKERING

"for those who can hear the difference"



Cut out this handy DCF Guide.

IF YOU OWN	MODEL NUMBER	Use a Pickering XV-15 cartridge with this DCF Number ELLIPTICAL	SPHERICAL
Acoustic Research	XA	750, 400	350
Benjamin Miracord	50H, 750, 770H	750	350
	40H, 40A, 40, 630, 620, 610, 18H, 10, 10F, 10H	400	
Dual (United Audio)	1219, 1209, 1019, 1215, 1015, 1015F, 1218	750	350
	1009SK, 1009F, 1009	400	
	1212, 1010A, 1010	200	150
Fisher	502, 402	750, 400	350
	302	200	150
Garrard (British Industries)	SL95B, SL95, SL75B, Zero 100	750, 400	350
	SL75, LAB80MK11, LAB80	400	350
	SL72B, 70MK11, A70, 60MK11, SL65B, SL65, SL55B, SL55, SP20B, SP20, A, AT60, AT6	200	150
	40, 40B, 50MK11, 50, 40MK11	140	100
Lenco	L-75	750, 400	350
McDonald (BSR)	810	750, 400	350
	600, 610, 500A	200	150
	510, 500, 400, 310	140	100
Pioneer	PL-30	750	350
	PL-25, PLA-25, PL-41C, PL40F, PL-41A	400	
Perpetuum-Ebner	PE-2018, PE-2038, PE-2020, PE-2040	750, 400	350
Rabco	ST-4	750, 400	350
Sony	TTS 3000, FS 1800A	750, 400	350
Thorens	TD 125	750	350
	TD 150AB, TD 124	400	

All Pickering cartridges are designed for use with *all* two and four-channel matrix

Check No. 17 on Reader Service Card

Discrete VS. SQ Matrix Quadraphonic Disc

An address before the 1972 Midwest Acoustics Conference April 15, 1972

Benjamin B. Bauer*

THE PRESENT-DAY MULTIPLICITY of contradictory proposals and extraordinary efforts by many people directed to the problem of offering four-channel sound on a disc record reminds me of the legend of three friends lost in a jungle. Said one, "This calls for the direct approach: Let us clear a path with our machetes which will lead us out of this jungle." So they hacked furiously ahead for several hours and finally gave up exhausted. Then the second said, "Let's sit down and wait; 'they' surely will send a search party after us, and eventually they will find us." After several days of waiting, the three friends were starved and drenched and in a desperate mood. Then, the third one had an idea; he climbed the tallest tree, got an overview of the jungle, and at once saw the route that would lead them out. Since I have the privilege of being the first speaker at this symposium, it is appropriate that I try to take such an overview; and I can do this best by reviewing just two of the several quadraphonic disc projects we have conducted at CBS Laboratories during the past years, one of the "discrete" or "carrier" variety and the other involving "matrices." Out of this review I trust you will understand our reasons for adopting the SQ matrix record system, rather than continuing to hack straight ahead with a carrier approach or to just sit and wait for someone else to solve the problem. And, I also hope that our experiences with carrier systems may prove valuable to those who are still working on this alternate route.

But first, let me engage in a brief philosophical observation: Modern science opens up numerous options to the engineer—a heady potion if not taken with thoughtful moderation. It is easy to become lured by technological sophistications and lose sight of the need to develop products that truly serve the larger public interest. Since we are meeting in the Chicago ... I can't help but remember the admonition of Paul ... ed a convocation of the Institute of Radio Engineers, right here, over three decades ago: What he said was "you engineers should remember to serve not your own vanity, but the needs of the public." And, with this motto, he proceeded to build a great industrial enterprise. Today this motto is more applicable than ever. Let me paraphrase it and apply it to the quadraphonic disc record by reminding all of us that our ultimate objective in this area should be to provide an excellent quadraphonic experience to millions of listeners utilizing, rather than outmoding, the investment they have made in record players and FM multiplex receivers, and not merely demonstrating the technical feasibility of a quadraphonic approach that will be available to but a few. The four-channel market will not be significant for the artist, the hardware manufacturer, the broadcaster, or for the record company unless, through an appropriately designed disc medium selected to serve as a solid foundation for future progress, it can also become a *mass market* for all to enjoy.

Compatibility

All of this brings us to consideration of compatibility. The owners of record players simply have too great an investment in equipment and records to allow us to disregard their interests. Thus, early in the game we decided that we had to insist that our quadraphonic records be fully compatible with current equipment. This concept of compatibility has many dimensions. For example, we decided that our compatible record should not just produce pleasing sound on existing mono and stereo phonographs, but also that it would have to perform flawlessly thereon. And this high quality of performance would have to extend to all operating characteristics including: recording time and level; signal-to-noise ratio; frequency response and stereophonic space perspective. All these must be equal or superior to those produced by the existing stereophonic records. And, to be truly compatible, it should be suitable for transmitting quadraphonically over existing FM/multiplex systems, as well as in the monophonic mode over existing AM radio systems.

With the above requirements in mind, we can now take an overview of carrier and matrix quadraphonic record technology.

Carrier-Type Quadraphonic Record Technology

The direct approach for placing four independent audio signals on a two-channel medium is by time-division multiplexing or by using carrier methods. When we began our carrier efforts we were aware of the potential capabilities and

4 channel sound.

Metrotec makes it easy! Just add 2 speakers.

Universal Decoder/Rear Channel Amplifier
Model SD4A-Q wired only, $149.95

Universal matrix system decodes all the new SQ and EV 4 channel records and FM broadcasts plus synthesizes quad sound from any 2 channel source.

Metrotec engineers have designed matrix/phase shift decoding circuits which will decode all types of the new 4 channel records and FM broadcasts. Just a flick of a switch gives the exact phase shifts and coefficients to match the program material. Featured are . . . a front to back balance control which eliminates the need to adjust the volume controls on separate amplifiers . . . a master volume control which adjusts the volume on all 4 channels simultaneously . . . tape monitor switch . . . and a source selector switch. In addition to precisely reproducing the 4 channels as they appear on the new 4 channel records, synthesized quad sound can be generated from any 2 channel source. This unique circuit separates the ambiance information that would otherwise be lost and mixes it into the rear channels.

The Model SD4A-Q includes a powerful 30 watt rear channel amplifier with all controls on a single panel. All you add are the two rear speakers.

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.

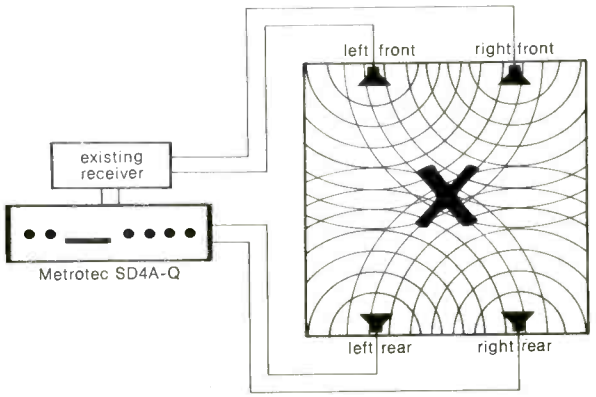
Model SDW-Q wired $69.95
Model SDK-Q kit $54.95

If your equipment consists of separate preamp/basic combination, all you need is another basic amplifier and a Metrotec SDW-Q.

The heart of the Metrotec 4 channel system is a new universal 4 channel matrix/phase shift decoder. This amazing break thru in electronics and recording allows 4 channels of information to be put on records, tapes and FM broadcasting. No special turntables, cartridges or FM tuners are required. The matrix decoder analyzes the information and separates it into 4 separate channels. Recordings are made using as many as 16 microphones. This allows for reproduction of all separate, direct, indirect, complex phase and reflected acoustic signals. The startling 4 channel sound is far more dramatic than anything you have ever heard. The sense of special distribution adds a new and important dimension to realism.

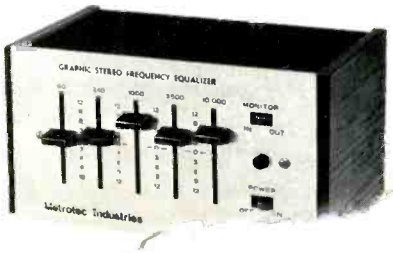
A great deal of this complex information already exists on many stereo records. It goes undetected because the standard 2 speaker stereo system cannot reproduce multi-dimensional signals. Your entire 2 channel collection has sound that you have never heard before. Try it.

The matrix coefficients have been designed and constructed in such a way that they can be modified should changes be required at a future date. This special care in engineering will make these products valuable for many years.



Frequency Equalizer

Be sure to look into the Metrotec Stereo Frequency Equalizer. Match the speakers to your room. Guaranteed to improve any stereo system. You've got to hear it to believe it.



Metrotec Electronics, Inc.

33 Cain Drive, Plainview, N.Y. 11803 • Telephone: (516) 293-2520
in Canada: GOULD MARKETING CO., LTD.
9429 Côte de Liesse Road • Montréal 760, Que. • (514) 636-0220 TELEX: 01-2

Check No. 19 on Reader Service C

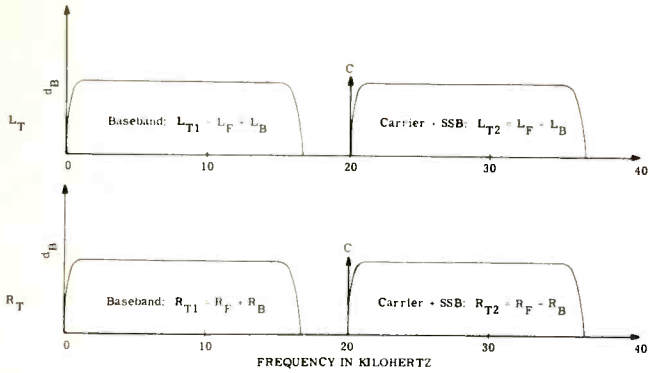


Fig. 1—Matrixing arrangement, experimental SSB quadraphonic disc system.

pitfalls of this approach, having had an occasion about a decade earlier to master a stereophonic test record, the STR 120, which spanned the frequency range of 10 Hz to 50,000 Hz. (The STR 120 is currently unavailable for sale since all the metal parts for stamping this record have been exhausted.) Since even the most advanced disc cutters do not operate efficiently above 20 kHz, it is necessary to slow down the recording turntables in order to scale down the frequencies; which in turn creates trouble at the bass end, and requires the use of specially lapped styli with miniscule burnishing facets for the shortened wavelengths, which tend to produce a noisier lacquer than conventional styli and to fracture unexpectedly in the middle of a cut. Nevertheless, despite this prior information, it was our contention that carrier methods should not go unexplored and thus our initial work on quadraphonic disc systems at CBS Laboratories was based on the use of carriers. As shown in Fig. 1 each disc channel was provided with a baseband of 20-15,000 Hz, and to this we added a 20 kHz carrier, single-sideband modulated (SSB) from 20,000 to 35,000 Hz. In this manner four independent channels, L_{T1} and R_{T1} on the baseband and L_{T2} and R_{T2} on the carriers, each with a capacity of 20-15,000 Hz, were obtained. On these we recorded a linear combination or "matrix" of four input signals, L_F (Left-Front), R_F (Right-Front), L_B (Left-Back) and R_B (Right-Back), in the following manner:

$$L_{T1} = L_F + 0 + L_B + 0 \quad (1)$$
$$R_{T1} = 0 + R_F + 0 + R_B \quad (2)$$
$$L_{T2} = L_F + 0 - L_B - 0 \quad (3)$$
$$R_{T2} = 0 + R_F - 0 - R_B \quad (4)$$

Upon replay and detection, we recover the four left-hand side signals of Equations 1-4. The original four signals can now be obtained as follows:

$$L_F = (\tfrac{1}{2})(L_{T1} + L_{T2}) \quad (5)$$
$$R_F = (\tfrac{1}{2})(R_{T1} + R_{T2}) \quad (6)$$
$$L_B = (\tfrac{1}{2})(L_{T1} - L_{T2}) \quad (7)$$
$$R_B = (\tfrac{1}{2})(R_{T1} - R_{T2}) \quad (8)$$

It should be noted that this "discrete" disc is not naturally discrete but is responsive to a matrix action: "Discreteness" is attempted by signal cancellation, which at no time is ideal. Moreover, we found that the matrix according to Equations (1) and (2) presents an inadequate stereophonic portrayal of the quadraphonic field. Constant power distribution around the quadraphonic circuit results in a concentration of energy in the extreme position of the stereophonic field with diminished center fill, resulting in a ping-pong type presentation; motion between side channels, of course, is lost. Now we [illegible] much better matrixes are available for the baseband [illegible]ing the SQ matrix later to be de[illegible] at this time, however, is that no matter what mixture of four original signals is employed with a system which has four independent channels, it is always possible to recover the original signals identically as long as the matrix equations are non-trivial and are linearly independent. If the solution is carried out by means of Cramer's rule[1], this means that the determinant of coefficients in Equations (1)-(4) must not vanish.

We were fully aware, of course, that a 15,000 Hz top end in the system depicted in Fig. 1 would not meet the needs of high-fidelity reproduction, but our view was that we should begin by working within this range and look for further improvement later if the approach proved out. We knew we were already stretching the limits of available technology and any greater demands upon the system simply would compound its difficulties. And the difficulties were many. In addition to the technical recording problems enumerated above, we knew in advance that a linearization process would be required for the baseband and the carrier signals, to minimize distortion. The record player required the use of costly filters to separate the basebands from the carriers, and two detectors were needed, followed by the de-matrixing circuit. Furthermore, previous experiments had alerted us to the fact that even with the costliest of pickups, high frequency response beyond 20 kHz would leave much to be desired.[2] This situation continues to be prevalent even today as exemplified by the graph in Fig. 2.

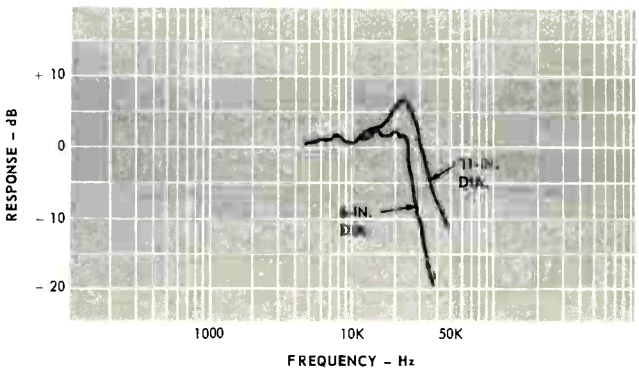


Fig. 2—Replay of stereophonic pickup on STR-120 record.

This exhibit shows the performance of the best (from the point of view of high-frequency response) currently available phonograph pickup cartridge, with 0.7 x 0.25 mil diamond stylus, retailing for upward of $100, measured at 1½ gram force on the 11½ in. and 6-in. radius grooves of the STR-120 record. The curves show that, while response extends to approximately 35,000 Hz at the 11-in. diameter groove, it does not go much beyond 27,000 Hz at 6 in. Thus, one cannot count on being able to recover much beyond 7,000 Hz from the 20 kHz carrier channel toward the end of the disc, even if one does not record all the way into the center of the record. While the restricted frequency range of the pickup, in theory at least, can be improved with future refinements, other related problems do not appear to be amenable to conceptually simple solutions. Fig. 3 depicts the baseband modulation at high-frequency as a solid curve produced by the cutter (triangle at left) and replayed with a 0.2 x 0.7-mil elliptical stylus (ellipse at right). The maximum modulation angle we encounter in records is 45°—(actually less than that on the negative modulation slopes because of the "smearing" action of the burnishing facet which gives rise to modulation noise). Let's superimpose a carrier shown in dash-line upon the base-

Our new SX-727. So much for so little.

If you think that value is an abstraction, you'll change your mind when you see and hear the new Pioneer SX-727 AM-FM stereo receiver. Comparison proves it has greater power, performance, precision, features and versatility than any similar priced receiver.

Looking behind its power rating — 195 watts IHF, 40 + 40 watts RMS at 8 ohms, both channels driven — you find a direct-coupled amplifier and dual power supplies. The results consistent power throughout the 20-20,000 Hz bandwidth for improved transient, damping and frequency responses, with low, low distortion.

You're in complete command of the FM dial, even in congested areas. New and advanced FET/IC circuitry has substantially improved sensitivity and selectivity. Reception is crystal clear and free of interference.

There's a wide range of connections for turntables, tape decks, headphones, microphones, and even 4-channel. You can connect three speakers, which are protected against damage by an exclusive, new Pioneer safeguard system. Additional features include loudness contour, high & low filters, FM and audio muting, click-stop tone controls, ultra wide FM tuning dial, dual tuning meters, mode lights and an oiled walnut cabinet.

Sensibly priced at $349.95, the SX-727 is one of Pioneer's new line of four 'margin of extra value' receivers. The others are SX-828, SX-626 and SX-525, designed for both more luxurious and more modest budgets. Hear them all at your Pioneer dealer today.

U.S. Pioneer Electronics Corp., 178 Commerce Road, Carlstadt, New Jersey 07072
West: 13300 S. Estrella Ave., Los Angeles, Calif. 90248
Canada: S. H. Parker Co., Ontario

PIONEER
when you want something better

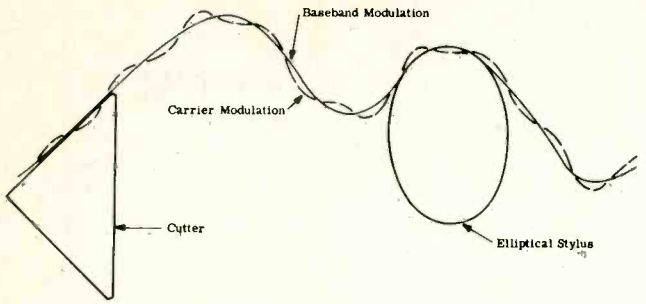


Fig. 3—Portrayal of recording and playback limitations, carrier-type disc.

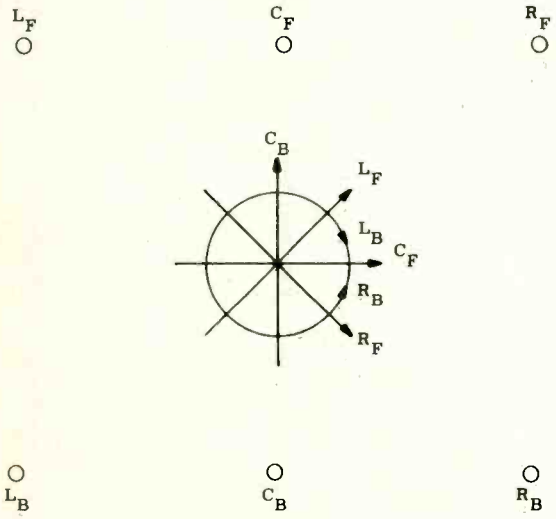


Fig. 4—Six principal modulations of the SQ matrix system.

band. The lateral velocity of the carrier as defined by its slope is of the same order of magnitude as that of the baseband; its radius of curvature actually may be considerably smaller. Therefore, the aforementioned carrier takes up as much or more "modulation space" as the baseband itself. In order to cut the composite wave on the lacquer disc, the magnitude of the combination has to be diminished, say, by a factor of ½, or 6 dB. This is precisely what we had to do with our experimental carrier discs to obtain a quiet cut and to avoid excessive distortion. Even with the above-mentioned reduction in level, the pickup with elliptical stylus was unable to recover the ultrasonic signals at diameters below 6 in. This appears to be tied-in with the elasticity of the groove material which results in a high-frequency cutoff as predicted by Miller[3]. Thus, it became clear to us, as our experiments proceeded, that the carrier disc approaches would neither meet the compatibility requirements enumerated earlier, nor always fulfill their discrete promise because:

A) The signal level, frequency response, distortion, and signal-to-noise ratio were marginal.

B) The special pickup and complicated decoder were too costly to satisfy the needs of the mass market.

C) Playing time per side was inadequate for the repertoire.

D) FM multiplex quadraphonic transmission problem remained unsolved.

[illegible] problems were exacerbated by the vagaries [illegible] ultrasonic frequencies often resulting [illegible] ration.

Recent Carrier Disc Developments

Improvements and implementations of carrier disc technology have been reported last year by Inoue and his associates[4], and more recently by Shiga and Cooper[5]. As we review their findings, we conclude that even the advances they have reported do not substantially change our conclusions. To review briefly:

1. Inoue uses a 15 kHz baseband, as we did, but with a 30 kHz carrier which is FM-PM modulated over a swing of 20-45 kHz. Thus, his system like our early one, is limited to the 15 kHz capability. While it has been reported that pickups suitable for Inoue's method are now available for the top line of players, there is historical experience for doubting that they will reach the mass market any time in the near future. Unfortunately, the FM-PM modulation method is extremely sensitive to turntable speed; and any pickup response cutoff earlier than 40 kHz will cause a dis-symmetrical carrier recovery, generating distortion. Also, Inoue uses a compression-expansion scheme to diminish carrier noise which further increases playback equipment complexity and cost, and raises added channel separation problems.

2. Shiga and Cooper, we understand, have simplified the carrier problem by adopting a lowered carrier frequency and modulation range to achieve discrete or semi-discrete performance in the lower 3 kHz portion of the baseband, returning to pure matrix performance at frequencies above 3 kHz. While, on the one hand, this results in a commendable simplification of the recording problem, on the other, it builds in an unalterable quality limitation in the system.

Thus, of the three carrier methods discussed above, we think the SSB approach we chose, with all its problems, in the end might have resulted in the best compromise. However, this is not the place to debate the specific sub-issues. The key point to be made here is that the optimum carrier system parameters have not as yet been evolved as witnessed by the diverse problems and solutions we have described, and the carrier disc technology will require considerably more time and effort before it can seriously be considered as a mass market product for the home. And, even if it were to be fully developed, it still will include certain limitations—such as incompatibility with stereo multiplex broadcasting—that will make its widespread adoption undesirable.

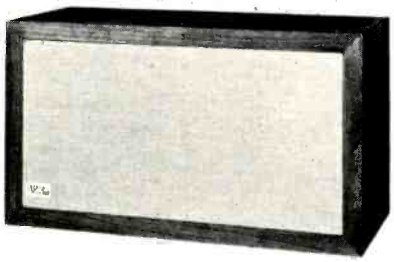
SQ Quadraphonic Matrix System

Knowing all the carrier-disc complexities discussed above, we concentrated our efforts on pure matrix systems which resulted in the development of the SQ matrix which, as it turns out, provides a viable method of quadraphonic recording and reproduction without the use of carriers.

The first important attribute, and the source of total stereophonic compatibility of the SQ matrix is that, for the front signals of a hexaphonic array of sound sources, it retains precisely the same modulation format as normally found in a stereophonic disc. The L_F and R_F signals form 45° and -45° modulations, respectively, as shown in Fig. 4, and the matrixed center-front channel (C_F) forms a lateral modulation. Our problem was how to provide the same capability for the back channel signals. Time and space do not permit reviewing all the possibilities we explored before coming up with the final solution. In the SQ system the cardinal back channels are inscribed with a circular motion of the cutter in such manner that the left-back (L_B) modulation produces a clockwise helix and the right-back (R_B) modulation produces a counter-clockwise helix. The phases between the helixes are arranged so that the center-back (C_B) signal results in a vertical modulation.[6]

The helical modulations are formed by the expedient of passing each back-channel signal through a pair of all-pass phase-shift networks ("psi-networks") producing a phase-

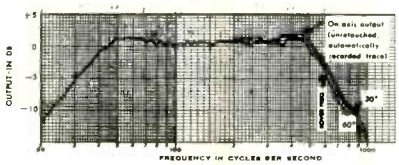
"Many professional audio people, including our reviewer, use the AR-3a as a standard by which to judge other speaker systems." *Electronics Illustrated, March 1972*



From the beginning, AR speaker systems have been characterized by independent reviewers as embodying the state of the art in home music reproduction.

Standard of performance

Soon after the AR-1 was introduced, as AR's first "top-of-the-line" speaker system, the *Audio League Report* stated, "We do not specifically know of any other speaker system which is comparable to [the AR-1] from the standpoint of extended low frequency response, flatness of response, and most of all, low distortion."



Frequency response of the AR-3a 12-inch woofer, radiating into a 360° solid angle (hemisphere).

Seventeen years later

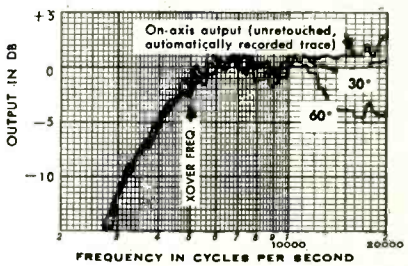
In a recent review of the AR-3a, published in *Stereo Review*, Hirsch-Houck Laboratories made the following observation:

"For the benefit of newcomers to the audio world, the AR-3a is the direct descendant of the AR-1, the first acoustic suspension speaker system, which AR introduced in 1954. The AR-1 upset many previously held notions about the size required for a speaker to be capable of reproducing the lowest audible frequencies. The 'bookshelf'-size AR speakers set new standards for low distortion, low-frequency reproduction, and in our view have never been surpassed in this respect."

Durability of accomplishment

AR's research program is aimed at producing the most accurate loudspeaker that the state of the art permits, without regard to size or price. *Consumer Guide* recently confirmed the effectiveness of this approach, stating that "AR is the manufacturer with the best track record in producing consistently high-quality speakers," and summarized their feelings this way:

"The AR-3a was judged by our listening panelists to be the ultimate in performance."



Frequency response of AR-3a tweeter: top curve measured on axis, middle and lower curves measured 30° and 60° off axis, respectively.

The AR-3a is the best home speaker system that AR knows how to make. At a price of $250 (in oiled walnut), the AR-3a represents what *Audio* magazine recently called "a new high standard of performance at what must be considered a bargain price."

AU 7

Please send detailed information on the AR-3a speaker system to

Name _____

Address _____

_____

AR

Acoustic Research, Inc.
24 Thorndike St., Cambridge, Massachusetts

Check No. 23 on Reader Service Card

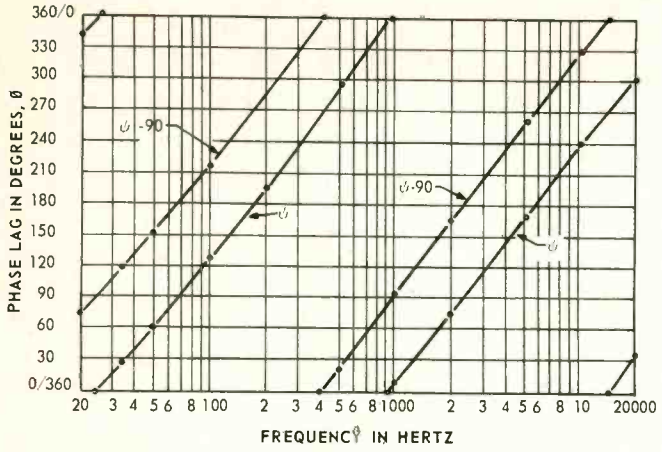


Fig. 5—Phase-shift functions used in SQ matrix encoding.

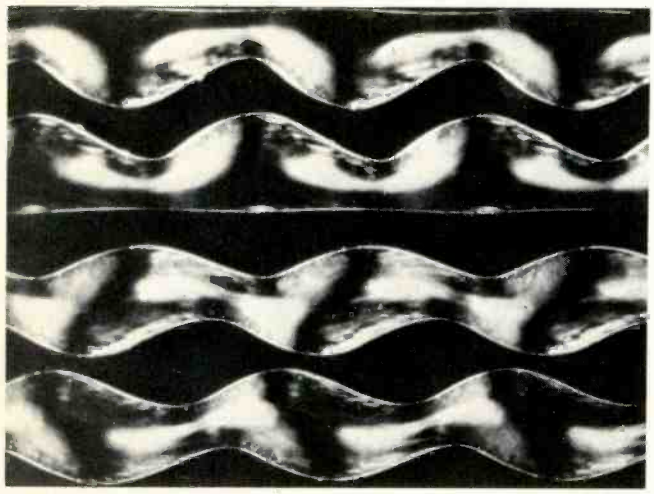


Fig. 6—Photomicrograph showing groove modulations of SQ record.

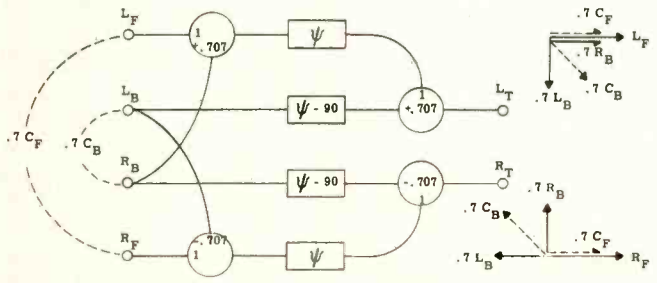


Fig. 7—Block diagram, SQ encoder.

quadrature relationship between the two signals at all frequencies. The functions used in the SQ record are shown in Fig. 5. In the frequency range of 20-20,000 Hz, the phase differential is held within 1° of arc and the transmission characteristics are maintained within ¼ dB. A microphotograph of the four corner modulations is shown in Fig. 6 which clearly shows two helixes through the reflection of light from the groove. The preferred method of producing the SQ matrix is the encoder circuit shown in Fig. 7. This circuit not only produces the proper phasor relationships, but also conveys a constant power to the stereo system for either of the six principal modulations, or for a signal panned around a 360° circle using a conventional sin-cos potentiometer.

The spatial distribution of the SQ encoded signal displayed on a two-loudspeaker stereophonic system is shown in Fig. 8. The two front channels, L_F and R_F and the derived channel, C_F, are, of course, displayed precisely in the same manner as with a conventional stereophonic disc. The back corner signals appear as virtual images at the appropriate sides approximately ⅓ of the distance from the center to the corner loudspeakers. This is as it should be because of a psychoacoustic phenomenon called the back image contraction[6] which causes the angle subtended by the signals from the back loudspeakers to diminish to about ⅓ of its geometric value, as perceived by the forwardly oriented observer. The directions of arrival of the corner-back signal sensed by the listeners are the same as if they had been reflected from the front wall, as shown in dash lines. This is the optimum method of "folding" four channels into two.

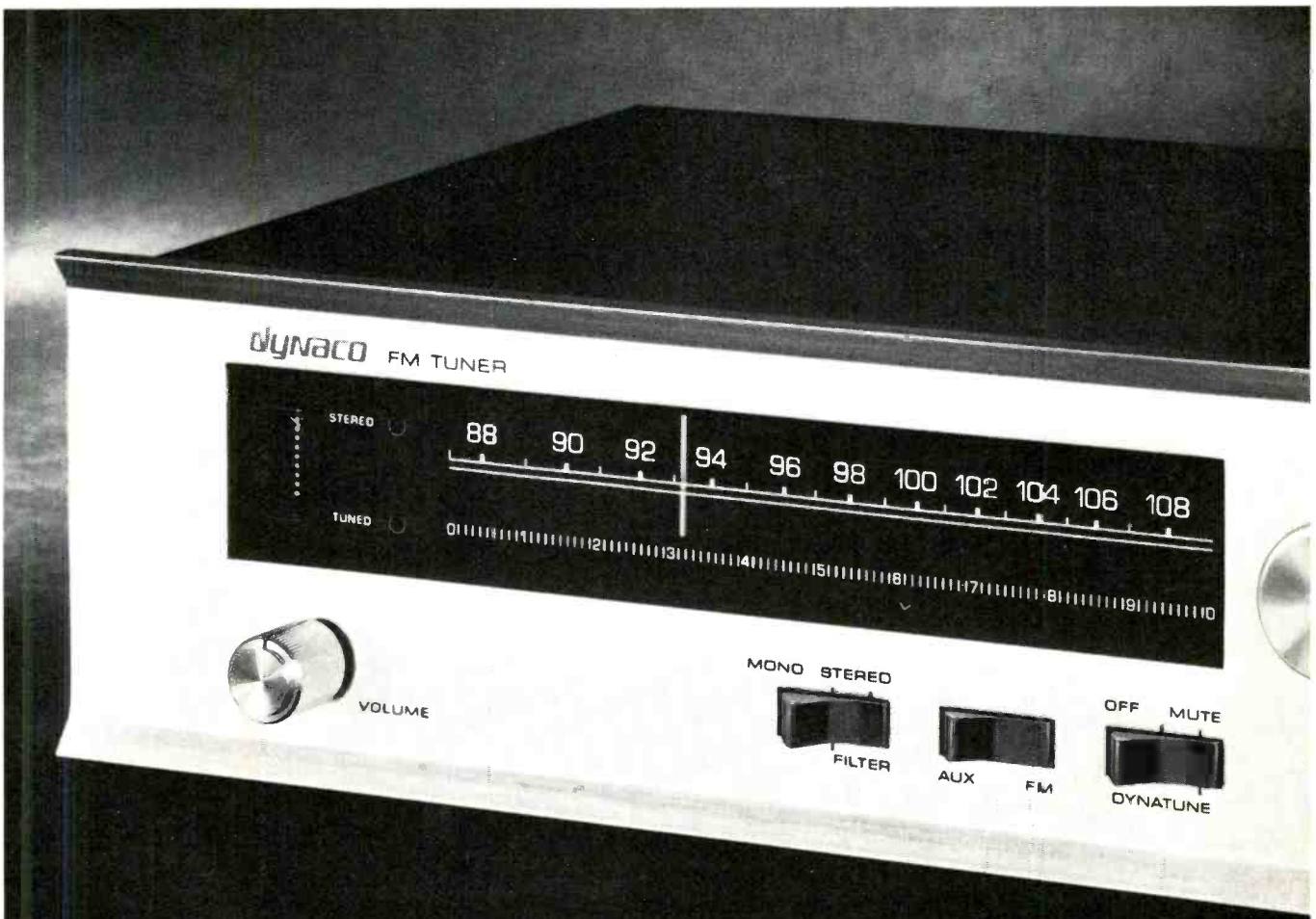
An SQ encoded record offers no significant transmission problems when played or broadcast over AM radio in the monophonic mode. The four corner channels are transmitted with equal strength. The center-front channel is increased by 3 dB, as with conventional stereo. The center-back channel is not transmitted, and hence this position should not be used for soloists. It may be shown by analysis that the relative magnitudes of side signals with monophonic transmission are somewhat altered; however, their total power (as with reverberatory sounds) is fully and correctly portrayed.

Decoding the SQ Record

The decoder which converts the encoded L_T and R_T signals into a quadraphonic array is almost the inverse of an encoder, except that the psi-networks can be of considerably simpler and cheaper variety. As shown in Fig. 9 each of the signals L_T and R_T from a stereo pickup playing an SQ record, after suitable amplification, is applied to the decoder and thence split into two branches, containing a reference psi network and a psi-plus-quadrature network. The emerging L_T and R_T signals are conveyed to the output terminals, unaltered, to form L_F' and R_F' outputs, while an appropriate combination of the four phase-shifted signals produces L'_B and R'_B outputs. The first pair of outputs contains dominant L_F and R_F components which are completely isolated from each other; and, therefore, have infinite channel separation. The second pair of outputs contain dominant L_B and R_B signals which also are completely isolated from each other, and thus exhibit infinite channel separation. Portions of signals from the front channels are transferred to the back channels, and vice-versa as a result of the matrix action. Thus, the above-mentioned circuit, which characterizes the basic SQ decoding function, provides completely discrete front and back channel performance with partial signal transfer between front and back pairs.

Various decoder modifications have been devised to best utilize the basic decoding principle in particular circuit applications. Among the most sophisticated is the addition of electronic logic circuits to attenuate the transferred signals resulting in greatly enhanced front-back channel separation. A simpler and very effective option is to provide a 10% and 40% blend, respectively, in the decoded front and back channels. This allows the decoder to retain a 20 dB front channel separation, an 8 dB back channel separation, and results in a 6 dB gain in center-front-to-center-back channel separation.

The basic decoder capable of these various modifications currently is available in the form of an integrated chip. The appropriate values of blend are obtained with two resistors connected across the respective sets of front and back terminals.



dynaco fm-5 tuner kit

Excellence—the FM stereo tuner you'd expect from Dynaco. Traditional value is evident in unsurpassed performance, consummate operating ease, unparalleled versatility, easiest kit construction at modest cost.

Ideal tuner operation is achieved for the first time: Every station in **exact** tune for lowest distortion, or just absolute silence. Automatically, the DYNATUNE logic circuit zeros in on the **precise** center of channel more accurately than any other tuner. Off station, you are treated to the smoothest, quietest, most sophisticated muting circuit extant. High sensitivity (1.75 μv) plus exceptional phase integrity anc lowest distortion in all signal modes, provides superior 4-Dimensional stereo reception. See and hear it at your Dynaco dealer.

$149.95 kit; $249.95 assembled

dynaco INC. 3060 Jefferson Street, Philadelphia, Pa. 19121

IN CANADA WRITE: Dynaco of Canada, Ltd. 9429 Cote de Liesse Road, Montreal 760, Quebec,

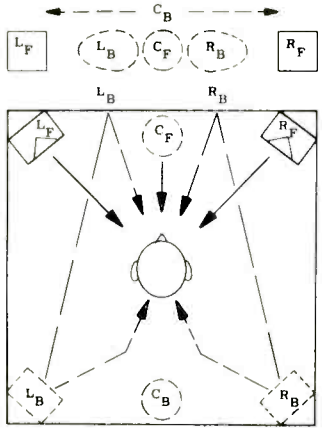


Fig. 8—Image formation. SQ encoded record played on a stereophonic system.

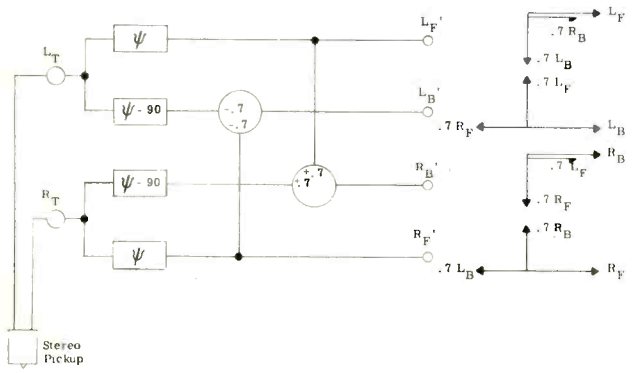


Fig. 9—Block schematic diagram, basic SQ decoder.

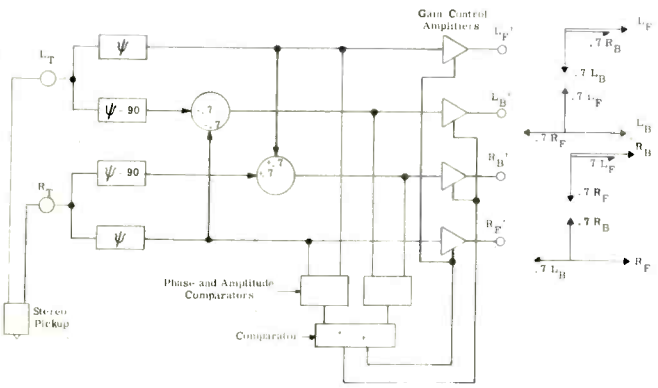


Fig. 10—Block schematic diagram, SQ matrix decoder with logic added.

Logic Directed Decoder

Our ultimate goal, however, was to provide matrix system performance which would be indistinguishable from that obtained with the discrete system. It is possible to achieve this goal by virtue of three remarkable psychoacoustics phenomena we have all experienced:

[illegible]ation that in a normal living room there is [illegible]ion so that a source of a continuous steady-[illegible]ith ease.

2. The finding that a varying source of sound, such as speech and music can be readily localized.

3. The precedence or Haas effect,[7] which teaches us that when two or more similar sources are present, the ear credits the one heard first with being the source of sound. Thus, if we can provide an electronic logic to instantaneously enhance the relative strengths of the dominant sources produced by the matrix, and similarly attenuate weaker sounds, we should be able to give the listener the complete experience of four discrete channels.

The control function performed by the SQ logic is shown diagrammatically in Fig. 10. While the matrix portion is identical to that in Fig. 9, the output amplifiers have voltage-controlled gain characteristics responding to pre-ordained amplitude and phase positions of the transferred signals, as sensed by the logic. For example, the existence of one of the front channel signals results in the generation of two signals transferred to the back channels which have identical amplitudes and which are in a precise quadrature orientation. The comparator senses this relationship and causes the front channel gains instantly to be enhanced, while the back channels are rapidly attenuated. Thus, the listener hears only the appropriate front channel signal regardless of his orientation in the room. By contrast, if one of the back channel signals is momentarily predominant, the reverse effect takes place; the front channels are attenuated and the back channels enhanced. The resulting quadraphonic field provides a total awareness of the four independent channels of the master tape. With single channel signals present, the logic maintains the appropriate channel constantly "open," and greatly attenuates the transferred signals relative to the main signal; thus, transmitting substantially discrete channels of information.

Recording Procedures

Every competent artist and producer learns how to obtain best results from a particular medium, and SQ is not an exception: Caution should be exercised to maintain phase integrity of common "panned" signals. Panning across the diagonals or splitting a signal four ways between the channels requires a special encoder connection (on newer encoders available with a switch). Ordinarily, signals panned to center-back will be heard only in the quadraphonic and stereophonic modes, and if they are to be present in a monophonic display special circuit arrangements are needed—so it is best to avoid the center-back soloists.

Some producers, who strive for special effects, find it desirable to "mix" the SQ program using an encoder-decoder combination in the monitor circuit until they develop a "feel" of the system.

However, with the vast majority of instrumental and orchestral performances, the original quadraphonic master tape is simply converted into the SQ record by connecting it to the input channels of the encoder and conveying the encoder output to the conventional disc recording chain. Decoding either with the SQ matrix or matrix/logic decoder produces a realistic and faithful reproduction of the quadraphonic master tape.

Conclusion

As we conclude our review of quadraphonic disc developments, I would like to leave you one last thought: There is much more to quadraphonic high fidelity than may be expressed by any single performance parameter: Frequency response, output level, signal-to-noise ratio, playing time, precision of directional localization, transmission through AM radio systems, equipment cost and complexity, and

(Continued on page 55)

Rise above the FM traffic jam

Urban overcrowding isn't confined to apartments and automobiles. FM stations are jammed pretty close together, too. So what do you do if your favorite, all-Vivaldi station is nestled next to an all-Joe Cocker station that has 10 times the power?

What you do is get yourself a Sony STR-6045 stereo receiver. It's FET front end uses passive RF circuitry so that strong, but undesired signals can't overload the input and swamp your favorite station.

The ability of the moderately-priced 6045 to bring in even the weakest stations is attested to by it's impressive specifications: 2.6uV sensitivity, 80 dB selectivity, 100 dB spurious signal rejection, 70 dB signal-to-noise ratio, and a 1.5 dB capture ratio.

And once the clean signal is in, the amplifier section gives you the best sound your speakers are capable of reproducing. Its dual power supply, direct coupled approach delivers the full damping factor at all frequencies and perfect transfer of all 75 watts dynamic power output* (25+25W continuous RMS power, both channels driven into 8 ohms) at only 0.5% distortion.

We'll let High Fidelity Magazine tell you the rest: *"The STR-6045 must be rated as a top receiver in the moderate cost field, and one that should be considered carefully even by purchasers who can afford to spend more."* The price is a most moderate $249.50** at your Sony dealer. Sony Corporation of Amer
47-47 Van Dam St., Long Island City, N.Y. 11101.

SONY® 6045 FM stereo/FM-AM rece

* IHF standard constant supply method ** Suggested retail price, subject to Fair T

Check No. 27 on Reader Service C

GOOD NEWS AHEAD for Record Buyers

Harry Maynard

THE DEVELOPMENT of four-channel sound keeps bringing good news for record buyers and radio listeners. Yes, even for those of you who have decided you'll never go for four-channel stereo, these may be your famous last words! Four-channel sound has pushed forward the state of the art for both the software manufacturer *and* the hardware manufacturer.

Having participated in and closely followed the state of quadraphonic listening, I see a lot of happy fallouts for the listener. One reason for this —every system proposed for the *disc* is essentially compatible with two-channel listening.

I'll go out on a limb and predict that five years from now it will be just as hard to buy a two-channel disc as it now is to buy a monophonic record. How can I make such a prediction? Because the technology is already here. RCA has just announced that its four-channel discrete disc will sell for the same price as its two-channel discs, and the first releases are being made as I write this in early May.

The challenge of developing this disc is an exciting story, which I'm sure will be told in the pages of this magazine in coming months. RCA and JVC repeat that we can look forward to:

1. Quieter record surfaces as a result of a new resin mix.
2. A better wearing record with better anti-static qualities, attracting less dust and dirt.
3. More refined techniques of cutting master discs that give better high end response.
4. Better styli, having better interface with the record. RCA and JVC claim a five-fold increase in record life, less inner groove distortion, less groove deformation, and improved signal-to-noise ratio, together with better mechanical resonance.
5. Improved phonograph cartridges with better high end response.

The matrix four-channel camp has also brought us some goodies. The most basic improvement has been better sound from our regular stereo discs. Just listening through four speakers helps, and, of course, there are the especially processed matrix four-channel discs. But consider the tremendous investment most people have in their current library of two-channel recordings. Now all of these existing discs can be significantly enhanced with a matrix decoder.

The matrix systems are an excellent bridge to the more refined, expensive, and complex discrete systems, which I—for one—am willing to grant are the state of the art of four-channel listening. However, from present indications, we are several years away from having a system of broadcasting discrete four-channel transmissions from a single station adopted by the FCC.

In the meantime, stereo FM—the demonstration booth of the record industry—can broadcast matrix quadraphonic sound with no extra investment in hardware, and the listener can get enhanced listening by using his matrix decoder. Some of these units are now universal decoders and will handle any matrix system, of both conventional stereo broadcasts and especially encoded four-channel sound. All the listener need do is make a moderate investment in decoder, amplifier, and extra speakers.

Many audiophiles have been reluctant to admit the virtues of four-channel sound, including some of America's leading audio critics. Listen to Julian Hirsch of the Hirsch-Houck Laboratory:

"We had been highly skeptical of the early claims that four-channel sound was as much of an improvement over two-channel listening as the latter was over mono. *At this point we are ready to eat crow.* Going back to two channels after listening to four channel is like going back to mono. . . . It generates a sense of involvement with sound which is so easy to accept that after awhile one is unaware of its existence. On many an occasion we switched off the rear speakers and the contrast was most striking. It can only be compared to turning off most of the lights in a well-lit room after one has become adjusted to a high ambient light level."

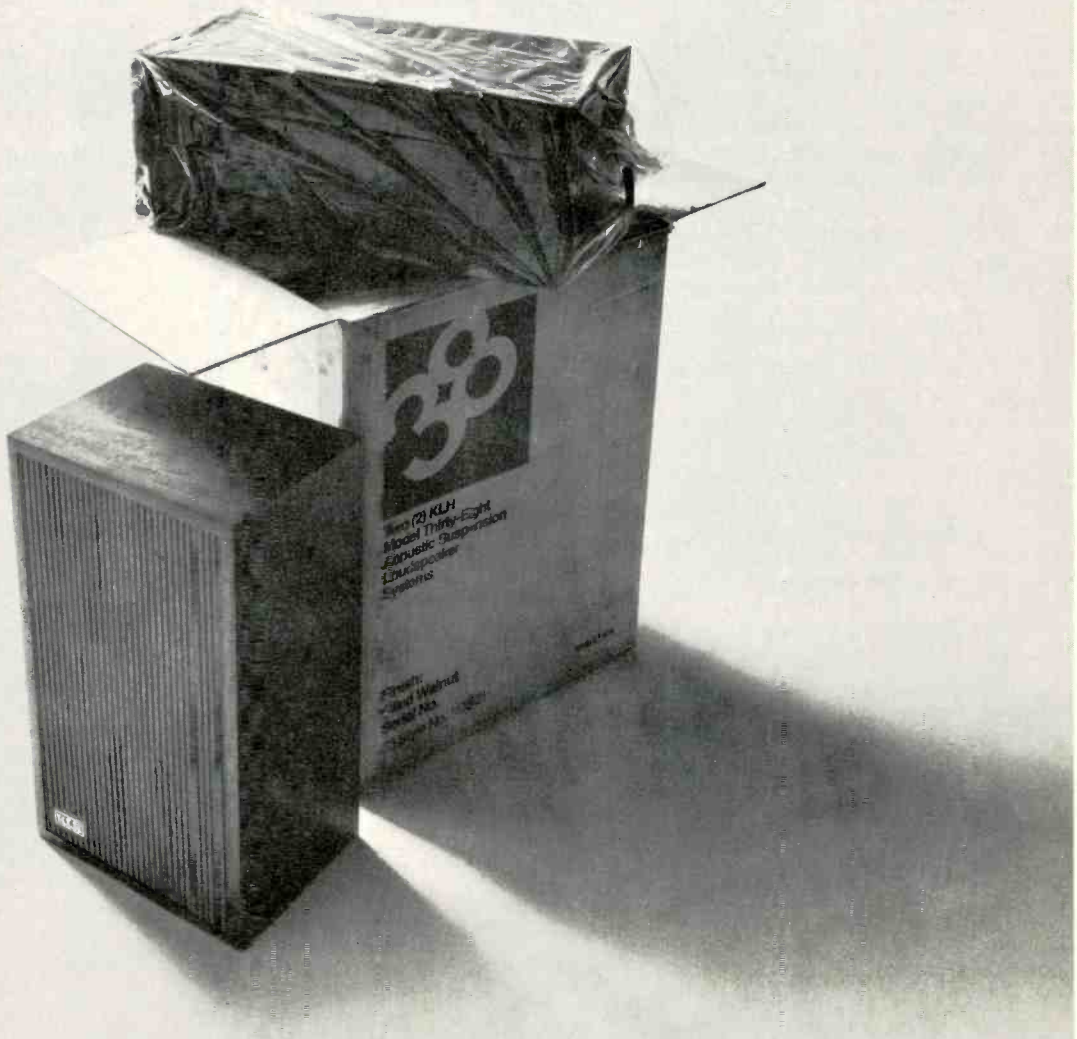
Brave and well said, Mr. Hirsch! These are my sentiments too. Four-channel sound is well on its way to creating a revolution in both hardware and software at least as big as the one created by two-channel stereo. You and I, the listeners, have only begun to taste in hardware and recordings the serendipitous goodies which will result from four channel's evolution. Æ

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

Check No. 31 on Reader Service Card

Why the FOUR-CHANNEL WAR Need not take place

Leonard Feldman

WITH THE INTRODUCTION of discrete four-channel discs in May, 1972 by RCA and the growing number of other record manufacturers opting for a "matrix" system of four-channel disc production, it becomes clear that the record buying public may once more be subjected to a "war of the discs" such as occurred many years earlier when, after the introduction by CBS of the Long-Playing disc, RCA quickly followed with the 45-RPM disc of its own design. In the case of the 33 versus 45 war, matters were more or less resolved by the hardware producers. Ultimately, three and even four-speed turntables were developed, and adapter discs and/or plug-on spindles were developed to handle the "big-hole" discs placed on conventional spindles intended for the "small hole" variety. To this date, in fact, both types of discs have co-existed in a relatively peaceful manner.

In the case of the RCA discrete disc versus the CBS-SQ, E-V Stereo-4, Sansui, et al matrix systems, the differences in technology, as presently proposed, are so great that in their present forms, matrix discs and discrete discs are totally incompatible insofar as common hardware is concerned.

Faced with the fact that both discrete discs and matrix discs are now available and the additional fact that totally different equipment is needed to reproduce each type, what is the high fidelity enthusiast to do? Should he buy a matrix decoder now, aware that the possible eventual dominance of discrete discs may make his decoder obsolete? Should he equip himself with a discrete demodulator and a new cartridge and deprive himself of the joys of listening to the ever growing number of well produced matrix discs? Must he invest in *two* set-ups *now*, to avail himself of the benefits of matrix as well as discrete discs? Faced with this problem, many consumers are likely to just sit back and wait till the "war is over" and such an attitude is likely to hurt [illegible] of the high fidelity

There Is A Way Out

What we are proposing here (See also Edward T. Canby's *Audio ETC* article, page 64, June, 1972.) is a rather obvious way out of the dilemma. Suppose we could produce a disc with the following attributes:

1. It can be played as a compatible stereo disc (or even monophonically).
2. It can be played via a matrix decoder and will achieve the four-channel effects inherent in the matrix system.
3. It can be played via a matrix decoder plus gain riding logic, with the improved separation inherent in such a configuration.
4. It can be played via a "discrete system demodulator" (using a suitable cartridge) and four *discrete* channels will be recovered.

With such a disc standard, each potential four-channel listener could decide just how much he cares to spend for the new medium. Further, if he decides to start with a simple matrix set-up and later on elects to go the "full route" towards discrete reproduction, the very same discs which he might have amassed over the years could be replayed using the discrete four-channel equipment.

Why Not Matrix The Discrete Disc?

The discrete disc has the capability of accepting four different audio signals (two conventionally cut and two as FM modulation of two sub-carriers). Suppose that instead of applying $L_f + L_b$ and $R_f + R_b$ as the conventional groove modulation, we apply the L_t and R_t signals of either the E-V system or the CBS-SQ system. Suppose further that the modulation used to FM modulate the sub-carriers of the discrete disc consists of newly derived mixtures of all four signals such that subsequent algebraic manipulation would make it possible to extract completely separate L_f, L_b, R_f and R_b signals (as opposed to the $L_f - L_b$ and $R_f - R_b$ signals now proposed by RCA). Note, that we have said that *any* matrix system could be so applied and, while we favor the E-V parameters in terms of their "matrix" playback effects, the present scheme need not be confined to any particular matrix format. That aspect of the problem is one which could be left to the public for ultimate resolution.

To illustrate the idea in more concrete mathematical terms, let us take both the E-V and the CBS-SQ matrix systems in turn and develop the proper "mix" of signals for application to the high frequency sub-carriers of the discrete disc as FM modulation.

E-V Stereo-4/Discrete Disc

The normal left and right groove wall "cuts" should consist of:

$$L_t = L_f + 0.3R_f + L_b - 0.5R_b$$

and

$$R_t = R_f + 0.3L_f + R_b - 0.5L_b$$

In addition, let us create the following signals for use in modulating the super-audible 30 kHz sub-carrier of the discrete disc:

$$L_{sub} = L_f - L_b - 0.3R_f + 0.5R_b$$

and

$$R_{sub} = R_f - R_b - 0.3L_f + 0.5L_b$$

A suitable demodulator-decoder, in addition to recovering the L_{sub} and R_{sub} information from the high-frequency sub-carriers, must perform the following algebraic manipulations to recover discrete signals:

$$L_f = 0.5\,(L_t + L_{sub})$$
$$R_f = 0.5\,(R_t + R_{sub})$$
$$L_b = 0.667\,(0.85L_t - 1.15L_{sub} - 0.8R_{sub} + 0.2R_t)$$
$$R_b = 0.667\,(0.85R_t - 1.15R_{sub} - 0.8L_{sub} + 0.2L_t)$$

If these last four equations are expanded into their individual L_f, L_b, R_f and R_b components, it will be found that all but the desired term will cancel, and unity L_f, R_f, L_b, and R_b will result. This is because, unlike the simple 4-2-4 matrix techniques, we are now dealing with four *different* equations, each containing all four signals in varying amounts. With such a condition present, it is possible to

7-DAY HOME TRIAL OFFER (expires 7-31-72)

The greatest advancement you can make in your present system is to plug this Equalizer into your Tape Monitor input-output jacks. That's how easy it is to create your own Audio Engineering Console.

Determine for yourself the tremendous performance capabilities of this extraordinarily flexible new instrument. See your participating dealer **now**— (or write or phone Soundcraftsmen).

Soundcraftsmen presents the new 1972

RECORD and PLAYBACK AUDIO FREQUENCY EQUALIZERS

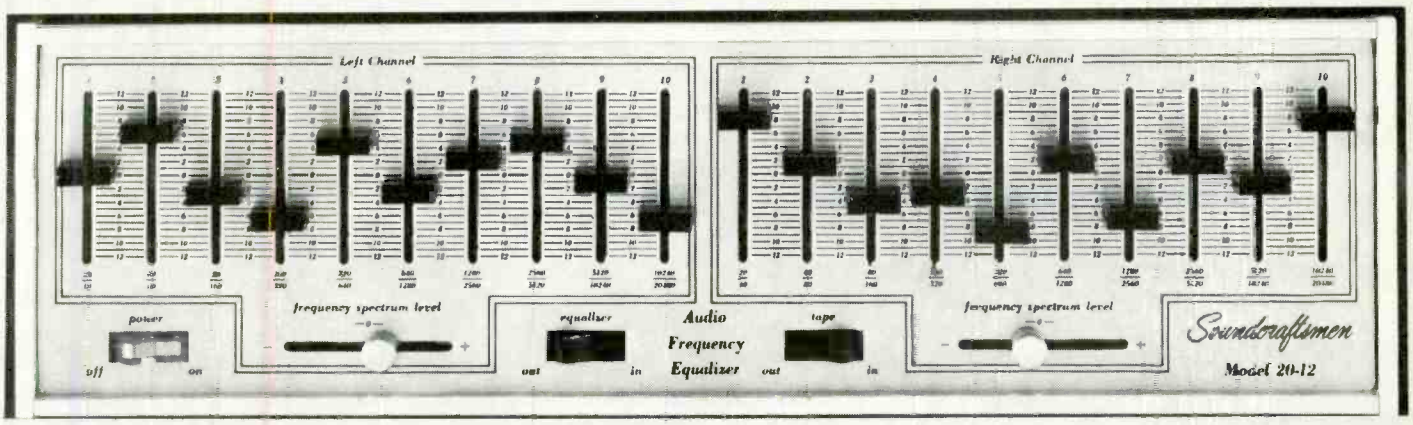
PERFECT tailoring of octave-wide bands... Infinitely variable adjustment flexibility ... Special Effects programming ... Instant re-setting via Computone-Charts

Now, in a few minutes, you can accurately "tune" the frequency response of your stereo system and room environment to a flat ±2 db! All you need are your own ears and the 20-12 (with its step-by-step instruction record) to transform any stereo system and room environment into an acoustically-perfect concert hall! Or, to provide any special acoustical effects you desire! The 20-12 enables you to instantly compensate for frequency response variations, in system and room.

STEREO 20-12 ..... $299.50

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

SAME AS 20-12, EXCEPT HAS 600 OHM OUTPUT

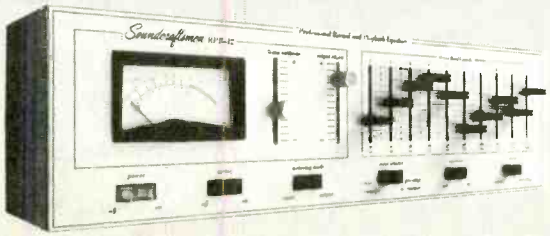


Recording Studios • Audiophiles • Night Clubs • Performers • Theatres Churches • Gyms • Auditoriums • Hi-Speed Duplicating • Musical Groups

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:
IM DISTORTION: Less than .08% @ 2V, .05% @ 1V. Typ: .01% @
SIGNAL-TO-NOISE RATIO: Better than 90 dB below 2V
INPUT IMPEDANCE: 100K ohms — (Operable fro
any Mixer, HiFi Preamp, Receiver or Tape Re
OUTPUT IMPEDANCE: 600 ohms — (Op
Receiver or Tape Re
INSERTION LOSS:
set so that "In
MAXIMUM OU
SIZE: Wal

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

Check No. 28 on Reader Service

provide the necessary de-matrixing coefficients and polarities to reproduce the four discrete original signals.

The CBS-SQ/Discrete Disc

While the introduction of phase shift (the "j" terms) in a matrix system, such as the CBS-SQ System, makes the algebra a bit tougher (and the number of components required considerably greater), the same principles can be applied to this form of matrix system. The required left-wall and right-wall groove cuts in the SQ disc consist of:

$$L_t = L_f - j.7L_b + .7R_b$$

and

$$R_t = R_f - .7L_b + j.7R_b$$

If these "mixtures" are applied to the disc as the conventional left and right cuts, the following signals must be added to them as modulation of the high-frequency sub-carriers:

$$L_{sub} = L_f + j.7L_b - .7R_b$$

and

$$R_{sub} = R_f + .7L_b - j.7R_b$$

Again, once these signals have been recovered by the demodulator, they must be combined with the conventional L_t and R_t signals in the following four equations:

$$L_f = L_t + L_{sub}$$

$$R_f = R_t + R_{sub}$$

$$L_b = -.707(-jL_t + R_t) + .707(-jL_{sub} + R_{sub})$$

$$R_b = .707(L_t - jR_t) - .707(L_{sub} - jR_{sub})$$

Expanding these terms once more (in terms of original L_f, R_f, L_b and R_b) in these equations will result in complete cancellation of all undesired channel components and only the desired L_f, R_f, L_b or R_b signals will be left at the appropriate outputs of such a combination demodulator-decoder.

Conclusion

While we have used specific matrix encoding coefficients to demonstrate the feasibility of this matrix-matrix/logic-discrete form of disc, it should be clear that any series of encoding coefficients for a matrix system can be accompanied by a corresponding set of encoding coefficients for the sub-channel portion of the program-complex, and a suitable series of four dematrixing equations can also be derived which will always result in the recovery of the original signals. We have given this idea serious thought and can think of no valid reason why the two "giants" in the record business should not see in this proposal a ready means whereby immediate stability can return to the record industry—before the war really gets going. In the long run, this can only benefit "them" —and "us." AE

NOT ALL CHROMIUM DIOXIDE CASSETTES ARE EQUAL...

ONE IS MORE EQUAL THAN THE OTHERS

KR™

Krom·O₂

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 make the difference; after all, it was TDK that created the famous Super-Dynamic cassette. Yes, not all chromium dioxide cassettes are alike.

Of course the KROM-O_2 is the cassette that gives you the widest frequency response, the wide dynamic range and the complete reliability for which TDK is already famous. However, all these advantages will only truly benefit you if you have a cassette machine that can properly be biased for chromium dioxide. If your equipment has only standard bias you may be better off using one of the other TDK superior tapes and cassettes, either the Low-Noise or the Super-Dynamic.

Remember, TDK cassettes are just a little more equal than the others.

Purity in sound.

World's leader in tape technology.

TDK ELECTRONICS CORP.
LONG ISLAND CITY, NEW YORK 11103

TDK®

Check No. 33 on Reader Service Card

Dollars for Tapes

WINNER OF THIS MONTH'S contest is *Richard J. Ball* of St. Anselm's College, Manchester, N.H., for his recording of the Vienna Chamber Orchestra, which gave a performance at the College church recently. Conductor was Ernst Maerzendorfer, and the works played included Haydn's Symphony No. 42, the Cassation in F major, and Mozart's six Country Dances. The recorder was a Tandberg 64X, and four E-V mikes and two Shure M-67 mixers were used. The stereo image is extremely good and the overall sound very satisfying.

Second prize of $25 goes to *Guy Preston* for a recording of several local jazz groups, including the Johnny Martel Trio, Louie Knipp Quartet, the Carter Lanning Combo, and the Comtempos. Guy used a Sony TC-650 recorder with Philips EL 6040 and E-V RE-15 mikes plus a Sony mixer. Recordings were all made in clubs and auditoriums, but in general the sound quality is excellent with a good stereo image.

Consolation prizes of Maxell low-noise tape go to the following:

Roy W. Corum of Culver City, Calif., for three very entertaining tapes recorded from radio, TV, and discs. The collection was particularly interesting because of the various earthy, good-humored, comments between each selection. Mr. Corum (ex-W60Z) says he "was in wireless" in 1909, which is a long time ago! And Mr. C—I must tell you that our woofers *did* handle those low notes without difficulty!

Leonard Blanchard of Clayton, N.Y. sent in a rather unusual tape which was labelled "play in stereo or mono." it turned out that the recording was of birdsongs—Texas birds on one channel and New York contenders on the other. As Leonard says, in stereo the birds of Texas will sing along with the New York state birds, which has certainly never happened in real life—and probably not on tape either!

Mervin Tillinghurst of Eastport, N.Y., sent in a recording of a music box; sorry—Ye Olde Music Box! Recorder was a Revox A-77 and the microphones—two Shure 545's. Another A-77 was used for copying.

Donald Sullivan of Princeton, N.J., made a recording of no less than 60 Jimmy Lunceford selections at 3¾ ips. Unfortunately, no details were given other than the tape which was Sony Low-Noise.

Paul Anthony of Los Angeles used a Sony 650 recorder with MX-12 mixer and his tape (vocal and instrumental) is very clean with good dynamic range. Microphones were E-V, but it was not stated which models.

"Bomb Stomp" is the title of a tape made by *Sazza Voe Durbt* at the Rocky and the Helicopter Laboratory in Lindenhurst, N.J., and it is a "musique concrete" project which must have taken hours of work.

P. L. Oberholtzer sent in an exceptionally good recording of an Artisan organ—we could really *feel* those low notes. Recorder was an Eico RP-100 built from a kit and the microphones were two E-V 666's. The organ (see below) was also built from a kit and Mr. Oberholtzer says he chose the Artisan because it sounds the nearest to a pipe organ. Player was Steve Lang, who retired a few years ago. This tape would have won a prize but it was felt after much deliberation that greater expertise was required to record the jazz and orchestral groups. As it is, Mr. Oberholtzer will get a Maxell Low-Noise tape which I am certain he will put to good use! Æ

Silent Partners

If you're involved in the business of tape recording either professionally or simply for the love of it, we have an interesting proposition for you.

A couple of silent partners, who will work day and night, assure excellent results, let you maintain full control and be unfailingly reliable.

They're the new Revox/Dolby B tape recorder and the Beyer DT 480 headphones. And both of them come with excellent credentials.

The Revox/Dolby B is the most recent version of the critically acclaimed Revox A77, a machine which was described by the Stereophile magazine as, "Unquestionably the best tape recorder we have ever tested."

Listening to tapes made on the new Revox with its built-in Dolby Noise Reduction system is a revelatory experience. Tape hiss is virtually nonexistent. The music seems to emerge from a background of velvety silence. And at 3¾ i.p.s. the absence of extraneous noise is truly startling.

As for the Beyer DT 480 headphones, they are in a class by themselves. Their superb frequency response and enormous dynamic range permit you to critically monitor and evaluate recording quality and balance. Add featherweight comfort and an ingenious "ear seal" that effectively screens out ambient noise and you begin to understand why a modified version of the DT 480 was chosen as the European Din Standard in headphones.

Together or separately, our remarkable silent partners could open your ears to recording possibilities you never knew existed.

Your nearest Revox-Beyer dealer will be delighted to arrange an introduction.

We think once you've met them, you'll wonder how you ever did without them.

For additional information and complete technical specifications, write: Revox Corporation, 155 Michael Drive, Syosset, New York 11791.

California: 3637 Cahuenga Blvd. West, Hollywood 90068. Canada: Revox Sales and Service, Mo-

Check No. 35 on Reader Service Card

QUADRA

QUESTIONS & ANSWERS

Q. *I find it almost impossible to place my speakers in the four corners as recommended. What are the alternatives?*

A. This is a very common dilemma. Sometimes there is a certain domestic opposition to the capturing of the four corners—even if the rear speakers are disguised as coffee tables! And in many instances it is not convenient to have the listening position in the center of the room. Furthermore, corners are not necessarily the best positions anyway. One alternative placement is shown in Fig. 1. The rear speakers need not be placed in the corners but in any case the signal level should be somewhat lower than the front channels. Another possibility is reversing the rear speakers so they "fire" at the walls. Figure 2 shows the Sansui "Front 2+2" arrangement preferred by some people as it puts them *outside* the sound image.

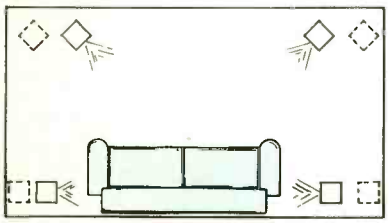


Fig. 1—Possible speaker placement for quadraphonics.

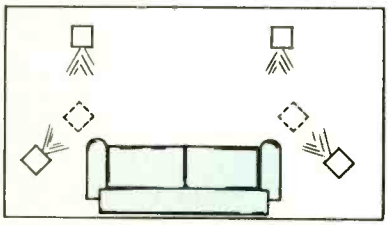


Fig. 2—Sansui "Front 2+2" speaker placement.

Q. *Do the rear speakers have to be identical with the front speakers?*

A. For the best results, yes. If you have to compromise, choose systems by the same manufacturer. For instance, if your main speakers are ADC 303AX's, use 404's; if they are AR 3a's, buy AR 4's or 5's. Irregularities in the frequency response will tend to cause image shifting.

Q. *Supposing I buy a receiver with built-in decoder now, such as the Fisher 801 or Lafayette LR-1500TA, what do I need to play discrete records when they eventually appear?*

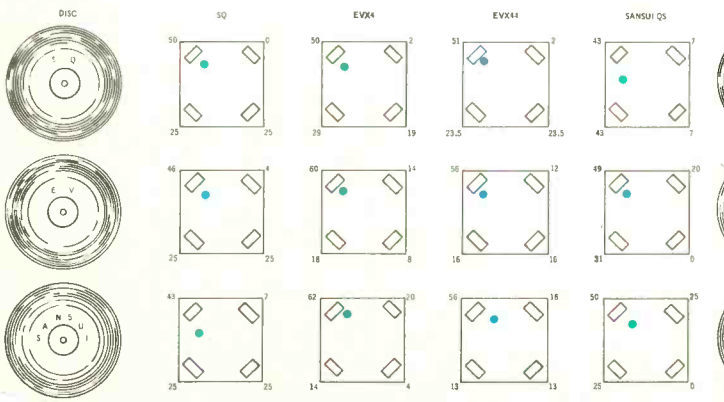
A. To play the RCA-JVC discs, you will need a discriminator type of decoder and possibly a suitable cartridge. Details of these should be available soon. It is possible, but unlikely, that some conventional cartridges will be able to play these discrete records without wiping out the 45 kHz signal—at least this is one of the objectives.

Q. *What is logic circuitry?*

A. This is sometimes called "gain riding," and the effect is to increase matrix separation. When a strong signal appears in one channel, the logic circuit senses it and automatically reduces the gain in the other three, significantly reducing the ghost images. It goes without saying that great care must be taken to avoid image shifting or other annoying effects. One of the first circuits to use gain riding was the original Scheiber, now used by Electro-Voice.

Q. *How compatible are the various matrix systems? Can I play an SQ record through a Sansui decoder, for instance?*

A. An article on compatibility and results of practical tests appeared in our March issue. Since then we have received more information on the new Electro-Voice EVX-44 decoder and we are indebted to Howard Durbin of E-V for the results tabulated below. Figure 3 shows the power distribution of the various systems when signals are applied to the LEFT-FRONT channel and Fig. 4 shows the distribution when signals are applied to the LEFT-REAR channel. It will be seen that front compatibility is better than the rear. As reported previously, most of the differences tend to be masked by room acoustics.



...2. Power distribution of the various systems when a ... to the Left-Front. The dot shows the apparent source.

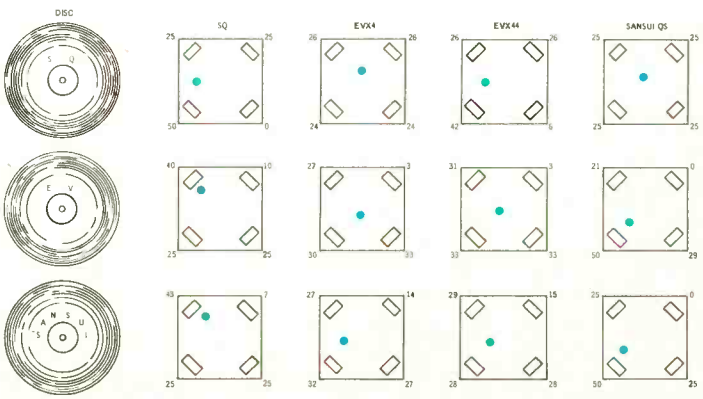


Fig. 4—Power distribution of the various systems when a signal is applied to the Left-Rear. The dot shows the apparent source.

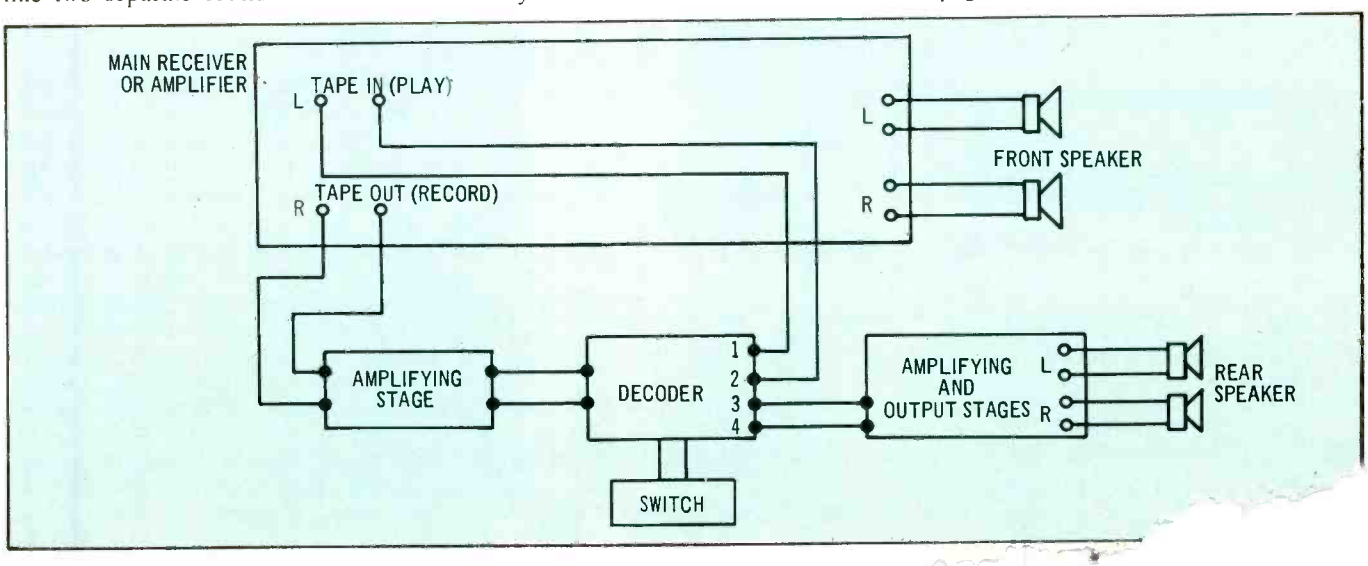
PHONICS

& HOW TO CONVERT

How to convert to quadraphonics? The easiest way is to buy a decoder-amplifier and two loudspeakers. The diagram shows the basic arrangement of a decoder-amplifier. Output from the tape sockets of the main amplifier or receiver is taken to the decoder which synthesizes the signal into four channels, two being taken back to the receiver and two amplified to some 10 to 20 watts or more for the rear speakers. A switch changes the type of matrix used or by-passes it for normal two-channel stereo or discrete four-channel tapes. The unit can be connected between the preamplifier and power amplifier if so desired. Note that phasing is important—not only between the front pair but between front and back. There is no guarantee that signals emerging from the rear amplifier will be the same phase as those at the front. As far as we know, no decoder-amplifiers are fitted with a phasing switch—which is a pity. Fortunately, it is not that difficult to check phasing and the best way is to feed in a mono signal to a rear channel and one front channel, adjust the balance control accordingly, and then test for phase in the usual manner. In other words, the signal should appear to come from a point midway between the speakers rather than sounding like two separate sound sources.

MAKER	MODEL	POWER rms, total	TONE CONTROLS	DECODE	PRICE	SPECIAL FEATURES
Electro-Voice	1244X	36	Yes	EV/SQ	149.95	
Fisher	TX420	50	Yes	Matrix	299.95	Includes 4-chan., 8-track tape player.
Kenwood	KSQ-400	50	Yes	SQ/Matrix	Under 170.00	
Lafayette	LA-524	40	Yes	SQ/Matrix	79.95	Loudness, filter.
Marantz	2440	40	Yes	Vari-Matrix	299.95	
Metrotec	SD4A-Q	30	Yes	EV/SQ/ Matrix	149.95	Front/back balance control.
Pioneer	QL-600	20	Yes	2 Matrix	199.95	4 meters
Sansui	QS-100	36	No	Sansui/ 2 Matrix	214.95	4 meters.
Sansui	QS-500	80	Yes	Sansui/ 2 Matrix	289.95	4 meters, 3 balance controls.
Sanyo	DCA1700X	40	Yes	2 Matrix	199.95	Loudness, filter.

Some units are fitted with tone controls, some have meters—take your choice. A list of those available appears here, but no doubt many others will be on the market before very long. Two models, the Sansui QS-100 and the Lafayette LA-524, are reviewed in this issue as well as the Dynaco SCA-80Q, which is a complete amplifier using the Hafler circuit to produce four separate channels from any two-channel source. Also reviewed is the Fisher 801—a complete four-channel receiver. (See page 44.)



The New Sansui "20 dB" Matrix

Crosstalk is an unavoidable consequence of any matrix system but separation can be increased by logic circuitry or *gain riding*. A high amplitude signal in one channel is increased at the same time the gain of the other channels is decreased, thus reducing "phantom images." Now Sansui has come up with an alternative system which they call the 20 dB system or Vario-Matrix. This varies the output signals by changing the matrix itself in terms of phase and amplitude. Control signals are produced by phase discriminators which detect the front-back and left-right distribution of the input signal. Figure 1 shows the output sound pressure response of a Sansui QS decoder when a signal is fed to LF. If the LB′ decoder matrix angle is altered as indicated by the arrow, the crosstalk of the LF signal contained in the LB′ decoder output gradually decreases. When the LB′ matrix angle finally coincides with the RB′ matrix angle, the separation between LF′ and LB′ becomes infinitely large. However, whatever signal exists in LB is only attenuated by –3 dB. Now, if the LB′ decoder gain is boosted by +3 dB simultaneously as the LB′ matrix angle is shifted to the RB′ position, then the LB signal will appear at the LB′ output terminal, minus any crosstalk from the LF signal. As the matrix is symmetrical, the variation will work in the same manner from signals in all 360 degrees. The variable matrix is controlled in the front-back direction in accordance with the following equations:

$$LF_1' = 1/\sqrt{2}\{(1+f)L+(1-f)R\}$$
$$RF_1' = 1/\sqrt{2}\{(1+f)R+(1-F)L\}$$
$$LB_1' = 1/\sqrt{2}\{(1+b)L-(1-b)R\}$$
$$RB_1' = 1/\sqrt{2}\{(1+b)R-(1-b)L\}$$

Similarly, it is controlled in the left-right direction according to these equations:

$$LF_2' = L+\ell R$$
$$LB_2' = L-\ell R$$
$$RF_2' = R+rL$$
$$RB_2' = R-rL$$

From the above two conditions, the matrix varies according to the following equations:

$$LF' = 1/\sqrt{2}\{(1+f+\sqrt{2})L+(1-f+\sqrt{2\ell})R\}$$
$$RF' = 1/\sqrt{2}\{(1+f+\sqrt{2})R+(1-f+\sqrt{2r})L\}$$
$$LB' = 1/\sqrt{2}\{(1+b+\sqrt{2})L-(1-b+\sqrt{2\ell})R\}$$
$$RB' = 1/\sqrt{2}\{(1+b+\sqrt{2})R-(1-b+\sqrt{2r})L\}$$

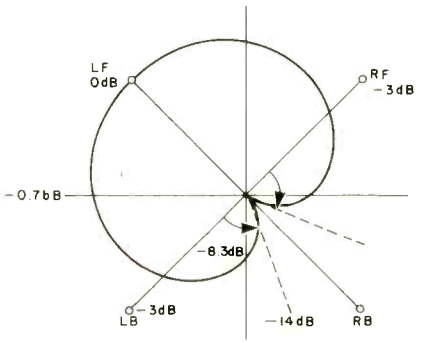
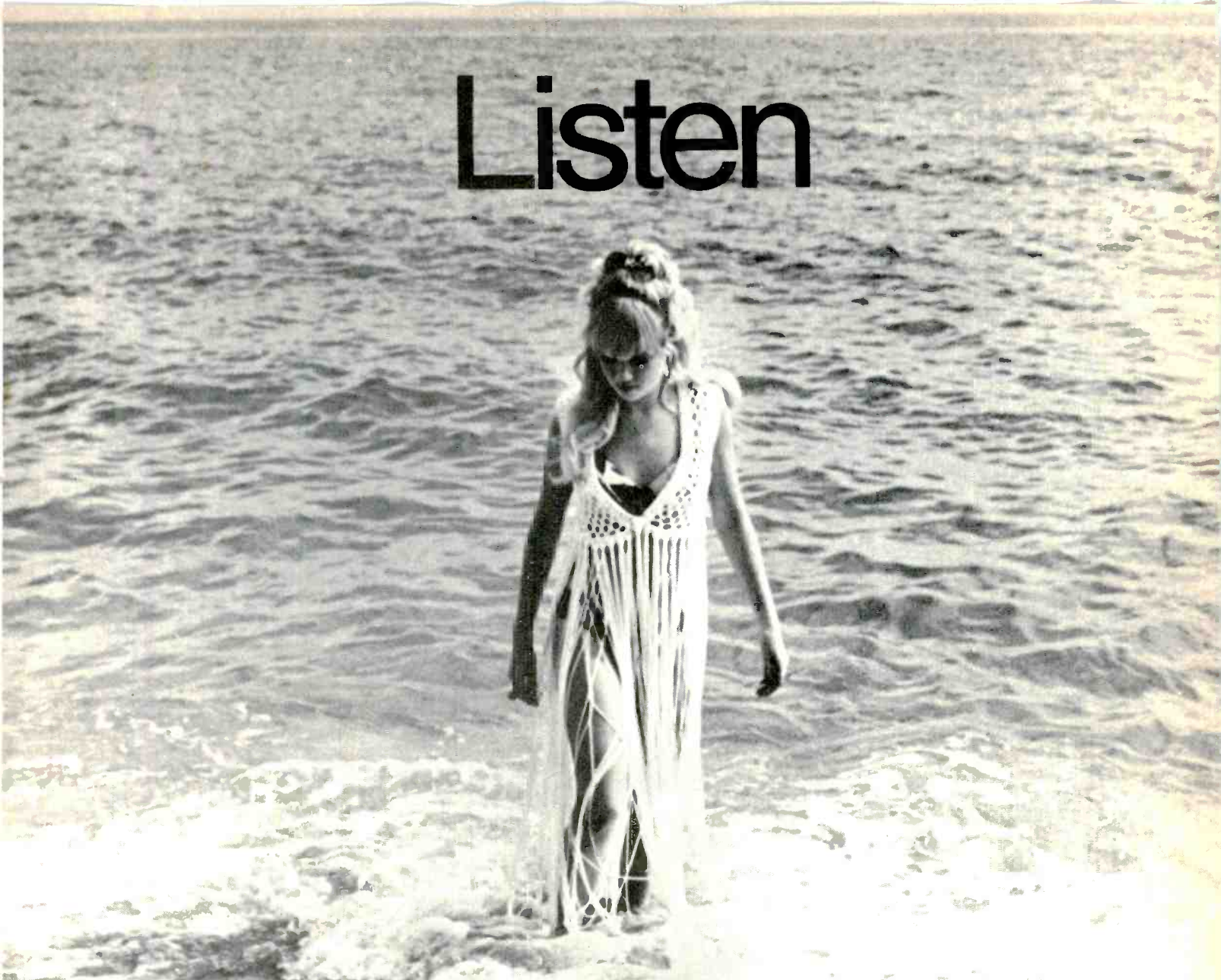


Figure 1

How does the Vario-Matrix work? I heard the system in Los Angeles and was very impressed. Separation was excellent with no sign of image shifting or irregularities produced by early logic circuits. My only criticism concerned the possible high cost but it was claimed that the use of IC chips would bring the cost down considerably. Moreover, a low priced version is feasible using only front/back control. The system is not compatible with the CBS SQ—a pity. *G.W.T.*

Listen



to the irresistible sound of Martin Speakers

The sound of Martin Speakers can be as quiet and irresistible as the gentle meeting of sand and surf. Or vibrant and deepthroated as the roar of thunder in the summer sky.

Martin Speakers. for people who are attuned to the irresistible sounds of the audible universe.

MARTIN SPEAKER SYSTEMS • A DIVISION OF EASTMAN SOUND MANUFACTURING

Harmony Road and Route 295
Mickleton, New Jersey
08056

Martin Speak

Check No. 37 on Reader Service

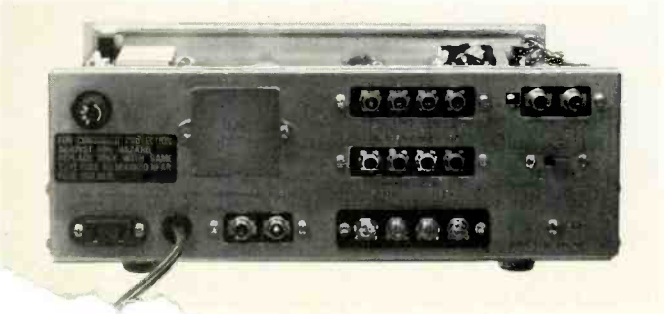
Two Decoder-Amplifiers

Lafayette LA-524 Quadnaural SQ Decoder/Auxiliary Amplifier

MANUFACTURER'S SPECIFICATIONS

Power Output: 60 watts total (IHF) at 4 ohms. **Distortion**: 0.1%. **Power Bandwidth**: 35 to 30,000 Hz. **Hum and Noise**: –70 dB. **Input Sensitivity**: 275 mV. **Facilities**: Bass and treble controls, loudness filter, high filter, mono-stereo switch, headphone jack. **Decoding**: CBS SQ and COMPOSER. **Price**: $79.95.

Model LA-524 is a remarkably compact decoder-amplifier and is probably the most inexpensive solution to the problem of quadraphonic conversions to date. Power output of over 20 watts per channel is ample for most requirements and there are both SQ and COMPOSER (ambience) facilities plus loudness, filter, and tone controls. The function switch on the left of the front panel has four positions: DISCRETE, SQ, COMPOSER, and F PLUS R (which parallels the left-front channel with the left-rear, and the right-front with the right-rear). Next comes the MASTER VOLUME control, BASS and TREBLE controls—all dual-concentric types. At the bottom of the panel is a phone jack and power switch plus four rocker switches for FILTER, STEREO-MONO, LOUDNESS, and REMOTE speakers. Figure 1 shows the rear panel with the various input and output sockets. On the right is a slide which increases the sensitivity by about 6 dB for use with higher gain receivers than Lafayette models, etc. This rear panel also contains an unswitched 400 watt a.c. convenience outlet, located in the lower left-hand corner. Just above it and to the right is a small inset and covered box containing the 1 amp speaker fuses. The remote speaker outlets are set up for standard phono plugs. Figure 2 shows the inside view.



rear panel.

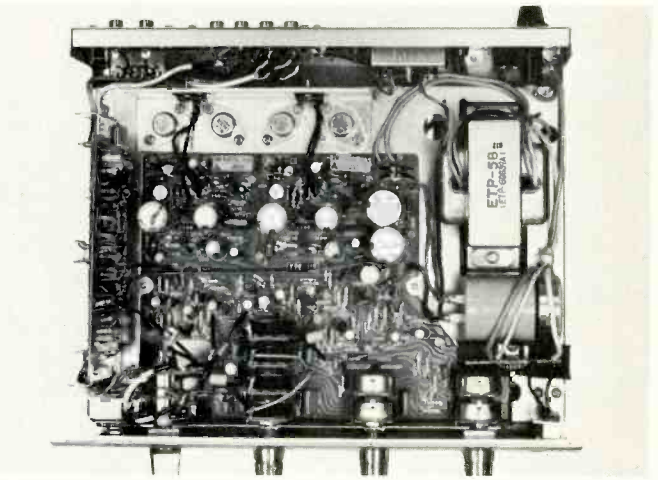


Fig. 2—Inside view.

Brief Circuit Description

A total of 11 transistors are used for the SQ and ambience circuits, then comes an amplifying stage, a Baxandall tone control arrangement, followed by the drivers and output stages which employ seven transistors for each channel. Speakers are capacitor coupled and the d.c. supply is 39 volts. Two transistors for each channel are used to amplify the front channel signals before feeding them back to the main amplifier. Altogether, no less than 33 transistors, 2 diodes, and 2 thermistors are used!

Figure 3 shows the THD and IM distortion and it will be seen that the rms equivalent power comes out at more than 25 watts per channel. Power bandwidth was 25 to 28,000 Hz, as shown in Fig. 4. Overall frequency response was –2 dB at 12 and 60,000 Hz—and only 4 dB down at 100 kHz as shown in Fig. 5, which also shows the effect of the low-pass filter. The loudness-control characteristics are shown in Fig. 6. The tone controls had a lift of 8 dB and cut of 10 dB at 10,000 Hz and a lift of 10 dB and cut of 13 dB at 40 Hz. Hum and noise was –60 dB under the worst conditions (volume

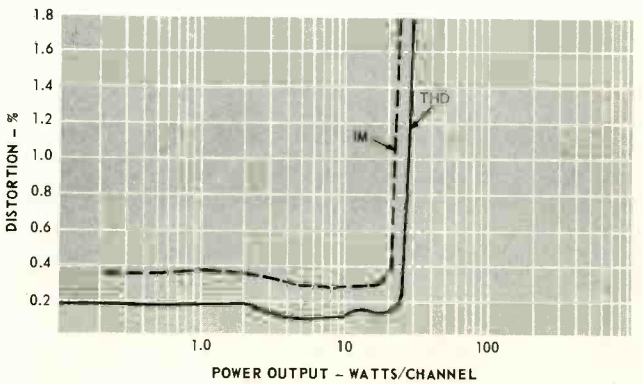


Fig. 3—Showing IM and THD distortion, both channels driven, 4 ohm load.

THE JAM SESSION IS DEAD.

The tape cassette has always had its obvious advantages.

Unfortunately, it's always had one, very not-so-obvious disadvantage.

Jamming.

After all, what good is a super-sensitive, super-faithful tape if it's going to get stuck on you just when you need it most?

Introducing the BASF jamproof cassette. The first tape cassette that's actually guaranteed against jamming or we'll replace it any time, free of charge.

You see, every BASF SK™, LH™ and Chromdioxid™ cassette now comes with a special kind of tape transport system that guides the tape through the cassette without its ever snagging or sticking. It's called Special Mechanics and only BASF cassettes have it.

Variable tension is practically non-existent. Which means you can also forget about things like wow and flutter.

And because it's the perfect tape transport system you can bet your sweet woofer there's an equally perfect tape inside.

For the BASF dealer nearest you, write BASF Systems, Inc., Bedford, Massachusetts 01730.

The BASF jamproof cassette. Because it'll never get stuck on you, you'll always be stuck on it.

Check No. 31 on Reader Service Card

control at maximum, sensitivity switch set for highest gain).

On test, the 524 was connected to the TAPE IN/OUT sockets of a Sony 1130 amplifier and the outputs taken to four Dyna A-10 loudspeakers. A few minutes was spent in balancing up and then a four-channel tape was played with the switch set to DISCRETE. No problems—no trace of hiss, hum or distortion. Then several SQ discs were played and again, results were completely satisfactory. Later, ordinary two-channel material from records and FM was played and it was found that the COMPOSER position occasionally gave better results, mainly when ambience only was required for the rear channels. However, after a few days, I found myself leaving the switch in the SQ position and adjusting the balance for best results. Summing up, the Lafayette 524 offers remarkable value for money and can be recommended to the attention of those who want to convert to four channel on a limited budget.

T.A.

Check No. 40 on Reader Service Card

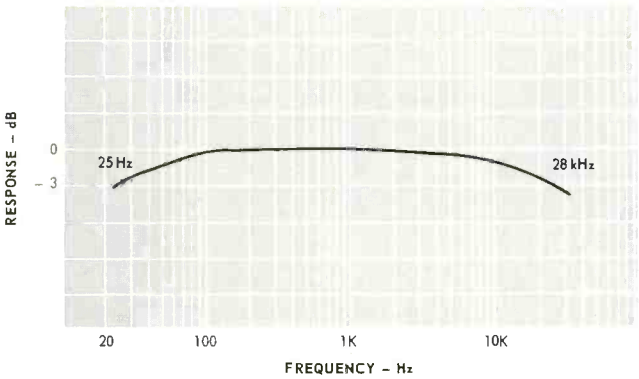


Fig. 4—Power bandwidth.

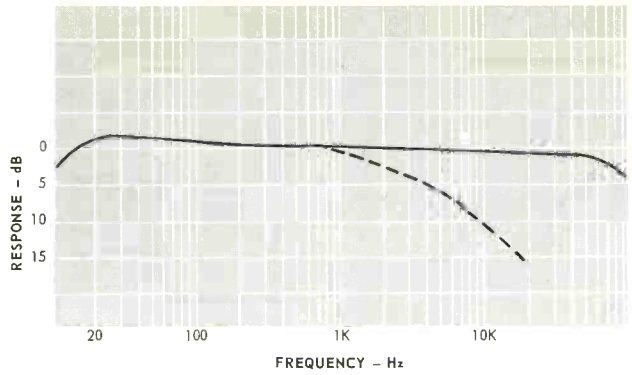


Fig. 5—Showing filter characteristics.

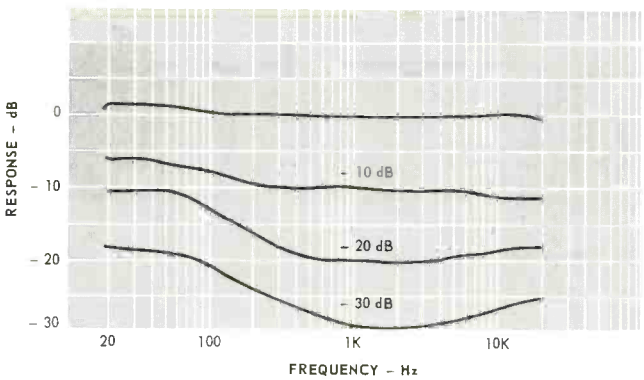


Fig. 6—Loudness control at –10, –20, and –30 dB.

Sansui QS-100 Four-Channel Rear Amplifier

MANUFACTURER'S SPECIFICATIONS

Input: 200 mV. **Output Level (front)**: 775 mV. **Recording Output** (two-channel): 200 mV, 30 mV DIB. **Frequency Response**: 20 to 20,000 ±1 dB. **Synthesization of Rear Channel Signals**: Sansui phase modulation and matrix. **Hum and Noise**: Less than –70 dB. **Power Output**: 18/18 W at 4 ohms. **THD**: Distortion less than 0.8%. **IM**: Less than 1.0%. **Power Bandwidth**: 25 to 40,000 Hz. **Dimensions**: 9 in. W by 5 in. H by 11 in. D. **Price**: $214.95.

Basically, the QS-100 comprises a Sansui decoder with a two-channel amplifier for the rear speakers, but it does offer many other features. For instance, there is provision for two other matrix arrangements for use with mono or two-nnel sources and there is a switch position for a second akers. Sansui advocates a position called e front in certain rooms (and with some kinds of music) and whatever the advantages might be, the switch certainly offers instant comparisons—assuming you have six loudspeakers handy! (See page 38.) The keen experimenter will find the four meters very useful and the extra price fully justified. Reading from left to right, the controls are as follows: Speaker and ON-OFF (Pair A, Pair B, and both), BALANCE control (left-right, front and rear simultaneously), then the MAIN BALANCE control in the center. This is a slide unit and it adjusts the balance between the front and rear channels. To the right is the LEVEL SET control, which adjusts the input signals, and above that is the VOLUME control, which operates on all four channels. At the extreme right is the SYNTHESIZER-DECODER switch with positions for two channel, two matrix positions called CONCERT HALL 1 and 2, then the Sansui decoder, and finally discrete four channel. The lever

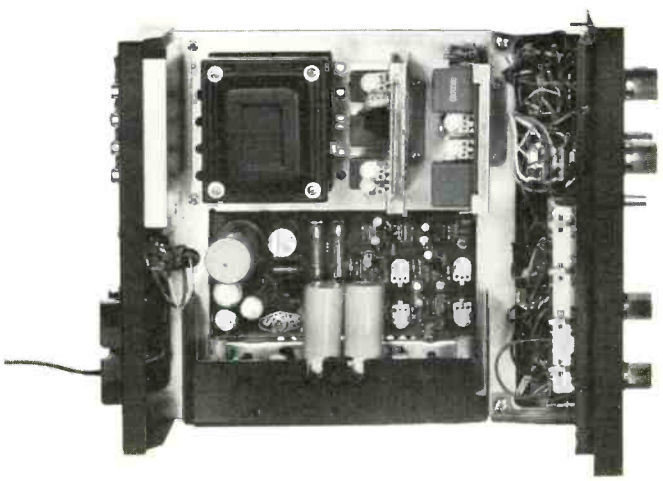


Fig. 1—Inside view.

switch underneath is for tape monitoring. Figure 1 shows an inside view and Fig. 2 shows the rear panel. The preset control is for adjusting the rear channel level, and above that is a standard DIN socket for a tape recorder. At the bottom, on the left is a voltage selector covering the 220-240 volt range as well as 110-117 volts.

Circuit Details

Front two-channel, or four-channel discrete signals are taken direct to a transistor stange and a meter amplifier and back to the output sockets of the receiver. Signals pass through the appropriate matrix or decoder circuits as selected by the switch. A total of four transistors, five modules, and 10 IC's are employed for these circuits. The power amplifiers use six transistors each in a fairly conventional circuit with a complementary pair driving a NPN output stage with capacitor coupling to the speaker. The stabilized power supply uses three more transistors and the unregulated output is about 45 volts.

Performance

Figure 3 shows the power output per channel with 4 ohm loads, both channels driven simultaneously. It will be seen that maximum output is about 20 watts per channel. Figure 4 shows the power bandwidth—slightly better than the specifications at 23 to 44,000 Hz. The frequency response was only 1.5 dB down at 10 Hz and 8.5 dB down at 100 kHz (see Fig. 5). Signal-to-noise ratio was -72 dB referred to 18 watts, which is excellent. Sensitivity came out at 150 mV for full output from the rear amplifiers, and the stage gain for the front signal was about 6 dB.

The four meters were found invaluable in setting up the QS-100—an operation which requires adjustment of the receiver volume control, preset control for the rear channels, and the unit's volume control. The balance controls are left in the center position and then adjusted last. A Sansui 5000X was used (the unit will work with any receiver, but it didn't seem fair to use my Sony 1130 amp!), and the QS-100 was connected between the tape in/out sockets in the normal manner. The first records to be played were two Sansui-encoded discs and they produced excellent results with good location and a very real sense of actually being there in the concert hall. A third Sansui disc was also played; this was Beverly Sills *Welcome To Vienna,* which has ambience only in the rear channels. Both the CONCERT HALL 1 and 2 matrix systems were tried here and both gave acceptable results, although not quite as effective as the decoder. However, some conventional two-channel records sounded better with the switch in one of the CONCERT HALL positions instead of DECODER—but this is a matter of personal taste. Sansui recommends the FRONT 2+2 speaker positions for solo performances, vocal numbers, and small band selections when using the CONCERT HALL matrix systems, but I found position B best for my particular room and also for CBS SQ records. As might be expected, SQ discs gave very good results with some mislocation. However, in most cases these deviations would go un-noticed—unless an SQ decoder was used for a comparison. Records that sounded particularly well, included the Bernstein *Petrushka, Switched-On Bach* of Walter Carlos, and Ray Stevens' *Greatest Hits.* Curiously enough, the new Boulez *Petrushka* sounded almost as good as the SQ Bernstein when played via the decoder! The execution is far superior—a personal view of course, but I can hardly wait for the quadraphonic version!

One word of warning; the speaker switch will select either pair A or pair B—*or both together,* so the rear speaker impedance must be 8 ohms, not 4.

Summing up, the Sansui QS-100 is a well-made unit which can be recommended to those who want a versatile conversion decoder-amplifier with extra facilities. At a price of $214.95, it represents good value for money. *T.A.*

Check No. 42 on Reader Service Card

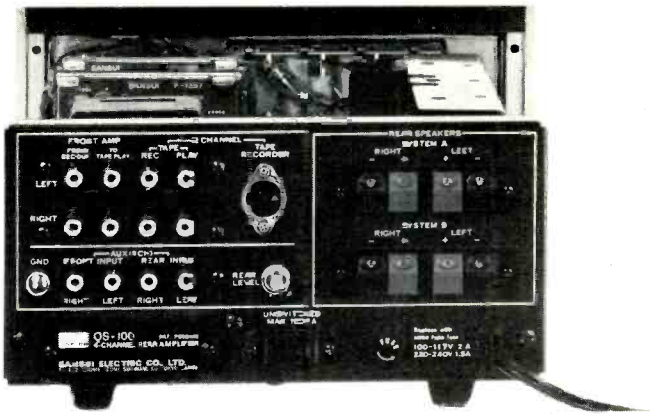


Fig. 2—Showing rear panel.

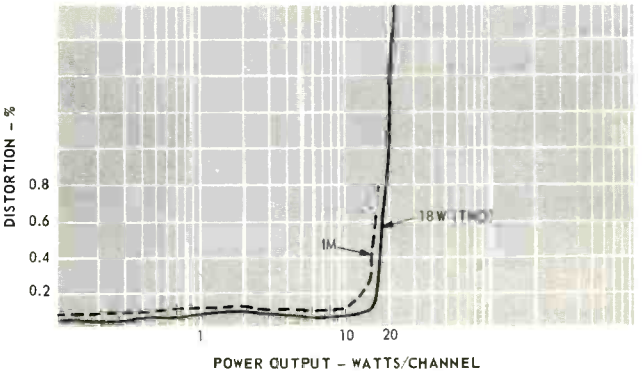


Fig. 3—Power output and distortion.

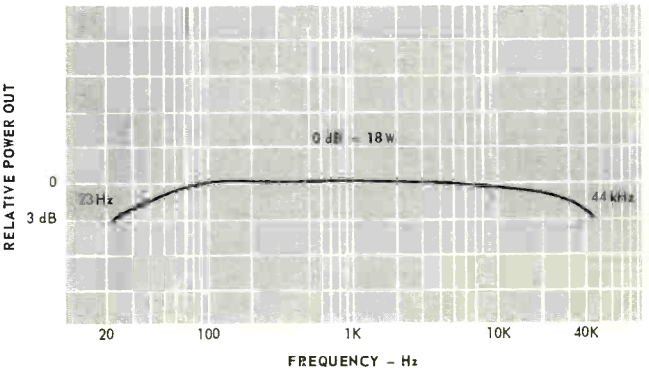


Fig. 4—Power bandwidth.

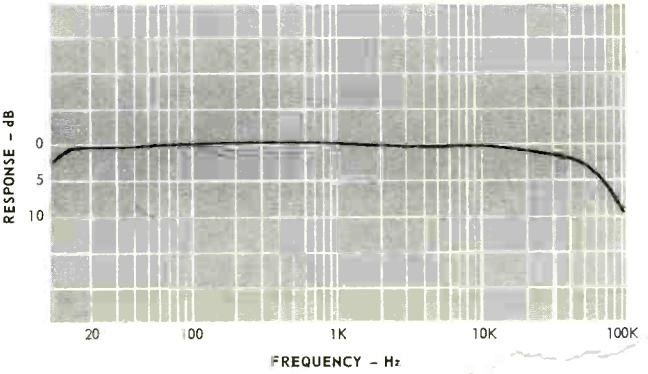


Fig. 5—Frequency response.

Equipment Profiles

Fisher 801 AM/FM Quadraphonic Receiver . . . 44
Dynaco SCA-80Q 4-D Amplifier 48
Lenco L-75 Turntable 52
ADC XLM Phono Cartridge 53

Fisher 801 Four Channel
AM/FM Stereophonic Receiver

MANUFACTURER'S SPECIFICATIONS

FM TUNER SECTION. IHF Sensitivity: 1.7 μV. **Harmonic Distortion (Mono)**: Less than 0.35%. **S/N Ratio**: 60 dB. **Selectivity**: 60 dB. **Spurious Response Rejection**: 105 dB. **Image Rejection**: 70 dB. **I.f. Rejection**: 85 dB. **Capture Ratio**: 1.5 dB. **Stereo FM Separation**: 36 dB @ 400 Hz. **AM TUNER SECTION. Sensitivity**: 10 μV. **Selectivity**: 55 dB. **Image Rejection**: 45 dB. **I.f. Rejection**: 40 dB. **AMPLIFIER SECTION. Power Output**: 44 watts per channel at 4 ohms. **THD @ 1 kHz**: 0.5%. **IM**: 0.8%. **Power Bandwidth**: 20 to 25,000 Hz, 4 ohms. **Damping Factor at 4 ohms**: Greater than 10. **Input Sensitivity**: PHONO, 2.7 mV; AUX 1 & 2, 200 mV; TAPE MONITOR, 300 mV. **Hum and Noise**: PHONO (6 mV reference), 60 dB; AUX 1 & 2 (400 mV reference), 65 dB; volume at minimum, 90 dB. **Frequency Response**: PHONO, RIAA ±2 dB from 30 to 15,000 Hz; AUX 1 & 2, 20 to 25,000 Hz ±1.5 dB. **Maximum Input Signal for 1.0% THD**: PHONO, 50 mV; AUX 1 & 2, 3.5 V. **Bass and Treble Control Range**: 24 dB at 50 Hz and 10 kHz respectively. **Subsonic Filter**: 12 dB per octave below 10 Hz. **High Frequency Filter**: 12 dB per octave, with 5 kHz crossover point.

GENERAL. Dimensions: 17¾ in. W by 6 in. H by 16½ in. D. **Weight**: 35 lbs. **Maximum Power Consumption**: 320 watts. **Suggested Retail Price**: $749.95.

Just as we finalized our laboratory set-up with what we consider to be a most flexible, high-quality stereo electronic measurement set-up, along came the Fisher 801 four-channel receiver—requiring new standard load resistors, new input and output switching facilities, and a new approach to receiver evaluation. (As of this writing, we don't believe that Tektronix scopes come with "quadruple" traces—so we had to move the probes from front to rear channel outputs for the time being.)

In any case, the four-channel receivers are here—and if the Fisher 801 is any indication of what's to come, then manufacturers are going to have to use a lot of ingenuity to cram channels of amplification and control facilities into the ...rly occupied by just two channels of audio ...ication. That, however, is just what the Fisher engineers have managed to do, as is evidenced by the overall dimensions shown above. In the front panel view shown, the receiver seems to have no more controls than a conventional stereo receiver, but as you examine these controls carefully you realize that a few new ones have been added to take care of the new requirements of quadraphonic sound control. Considering the lower portion of the panel, we find a stereo phone jack at the extreme left. We wondered why, in a four-channel receiver, Fisher failed to include *double* phone jacks to take care of the variety of four-channel headphones which are rapidly appearing on the market. We discovered that, in fact, the stereo phone jack mixes front and rear channels together, so that when using conventional stereo phones, all program material is heard, rather than just "front only" or "rear only." Reading across from left to right we find a four-position tape-monitor switch (FRONT, REAR or FRONT-PLUS-REAR inputs can be put in the monitor mode), a program source selector switch, a mode switch with positions for MONO, STEREO, DISCRETE FOUR CHANNEL, a MATRIX setting for popular recordings and a MATRIX setting for classical recordings. More about the differences between these two matrix settings later. Dual concentric BASS and TREBLE controls come next, and the "dual concentricity" is used as a means for separately adjusting bass and treble for front and rear channels, rather than for left and right. A *dual* balance control (again, using concentric knobs) follows, as well as a five-position speaker selector switch which, in addition to its MAIN, REMOTE, MAIN-PLUS-REMOTE and PHONES-ONLY positions also includes a position for turning the entire receiver off. A series of five push-push buttons along the lower right of the front panel serves to activate HIGH filters for front and rear channels, MUTING of FM for interstation silence, and front and rear LOUDNESS compensation circuits.

The upper portion of the panel contains the usual AM and FM dial calibration and tuning knob for manual tuning. A dual-purpose meter serves as a signal-strength indicator and, when the Autoscan modes of tuning are used, the upper portion of the meter becomes illuminated, disclosing a miniature 88-108 MHz dial. Above the meter are four illuminated designations which correspond to the setting of the Mode switch (MONO, STEREO, 4-CH.) and denote the reception of a stereo FM signal. The upper right portion of the panel contains linear slide controls for adjusting front and rear volume and four more push-buttons associated with the Autoscan tuning modes. Depressing the first of these buttons transfers the tuning function from the manually rotated tuning knob to the electronic tuning circuits previously seen in other Fisher receivers. For continuous scanning of the dial (from low end towards high end), the second button is depressed. While held in the depressed position, the meter needle (now acting as a small dial scale) moves upwards denoting approximate frequency. As soon as the button is released, the electronic circuits "lock into" the next station up the scale. The next button acts in a similar fashion, except that the electronic circuits advance the tuning one station at a time, while the final button is used to apply AFC (Automatic Frequency Control) when tuning manually. (In the case of Autoscan,

AFC is not needed, a station lock-on is determined by the Autoscan circuits themselves).

It should be noted that the Fisher 801 comes equipped with a small hand-held, battery-operated remote control unit identified as Model WT-50. This device emits a superaudible frequency which is picked up by a suitable transducer on the front panel of the 801, activating the Autoscan circuits in much the same way as depressing the front panel continuous tuning Autoscan button. A more elaborate optional remote control device (RK-40) is available which duplicates both the CONTINUOUS and the ONE STATION buttons on the 801 Autoscan section, but this latter device must be connected to a corresponding socket on the rear of the receiver and is equipped with a 20-ft. cable for that purpose.

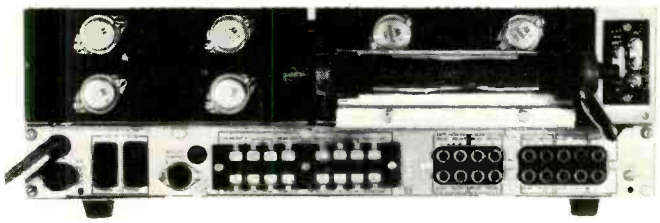


Fig. 1—Rear panel.

The rear panel of the 801 is shown in Fig. 1. A line fuse, two convenience a.c. outlets and the remote control socket are located at the lower left, adjacent to *eight* speaker output terminal pairs. The terminals are practically "short circuit proof," in that you need only depress each terminal (disclosing a small hole) and insert the stripped end of your speaker wire. Releasing the terminal clamps the wire in place so there is no danger of shorts from loose strands of wire. There are *four* TAPE MONITOR IN jacks and *four* RECORDER OUT jacks and four jacks each for AUX 1 and AUX 2 inputs. Finally, a pair of MAGNETIC PHONO INPUT jacks and a GROUND terminal complete the lower panel layout. The upper portion of the rear panel contains a massive ferrite antenna bar as well as screw terminals for connection of external FM and AM antennas. Shorting bars are used to connect internal FM and AM antennas, and these must be rotated out of the way if either outdoor AM or FM antennas are to be connected. Although our photo discloses six of the eight output transistors (two are obscured by the AM bar antenna), these devices are normally covered by the "cage" supplied with the receiver. We simply removed the cage to examine the layout of the receiver proper, a photo of which is shown in Fig. 2.

Identical stereo amplifier modules, each equipped with its own heat sink and output transistors can be seen in the photo of Fig. 2. The chassis surface is literally "filled to the brim" with other circuit modules and use is made of the popular "mother board" principle, in which sub-modules (such as the stereo multiplex section) are plugged right into more major modules (such as the AM-FM i.f. section, which is the largest single board module in the receiver.) Boards are even used to make interconnections from one major module to another, reducing conventional hand wiring to a minimum. The photo speaks for itself, as far as the "density of parts" of the 801 is concerned, and helps to explain how Fisher was able to get so much into such a small (relatively speaking) package.

While we, of course, were most interested in operating the 801 as a four-channel receiver (for both discrete and matrix source material), it should be pointed out that other interesting alternatives are available. For example, one could connect four speakers in one room, two speakers in a second room, and two more speakers in a third room. One could even connect stereo pairs of speakers in up to four rooms if four-channel reception is not the objective at the moment. By depressing only one (front or rear) tape monitor button, it is possible to reproduce taped sound in one location plus any other signal source (FM Stereo, AM, etc.) in another location, etc. All

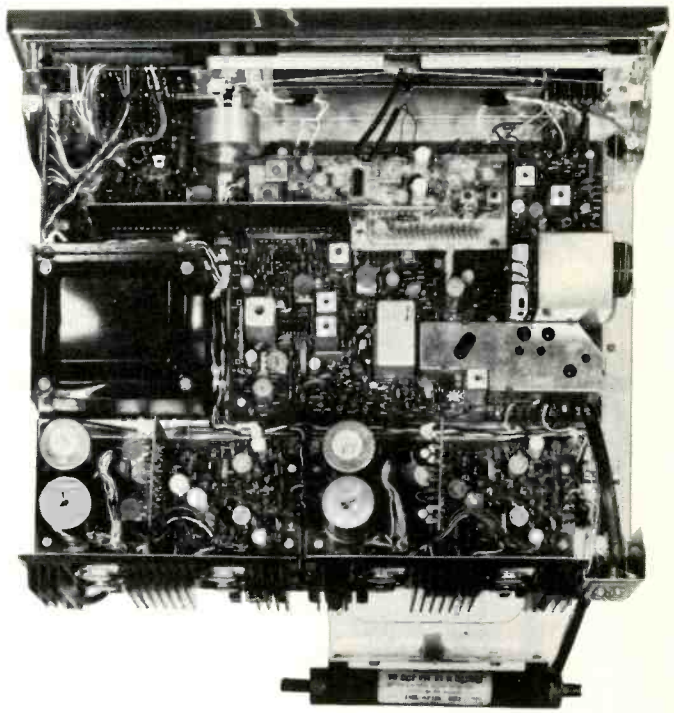


Fig. 2—View from the top.

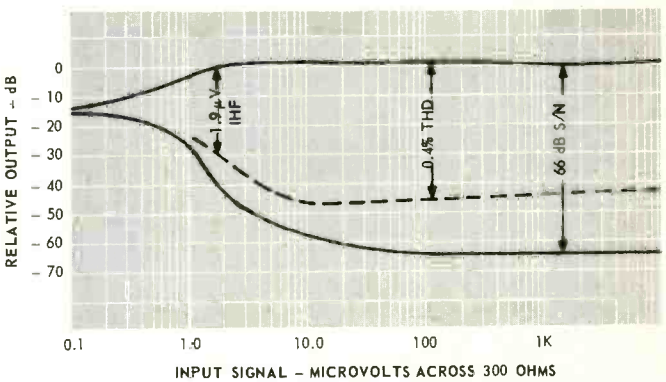


Fig. 3—Mono FM characteristics.

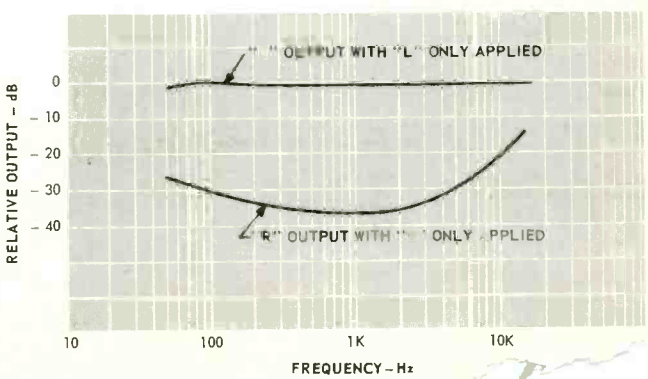


Fig. 4—Stereo FM separation.

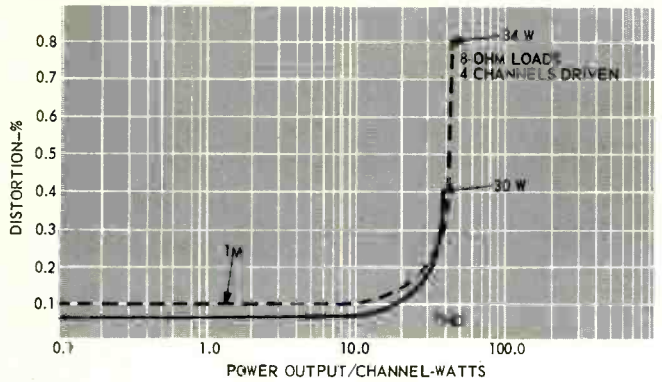


Fig. 5—THD and IM characteristics.

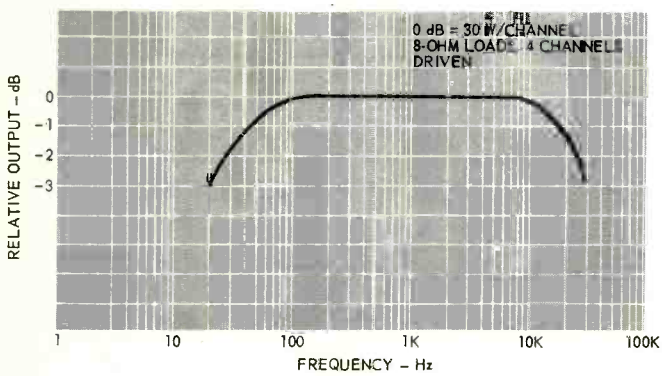


Fig. 6—Power bandwidth.

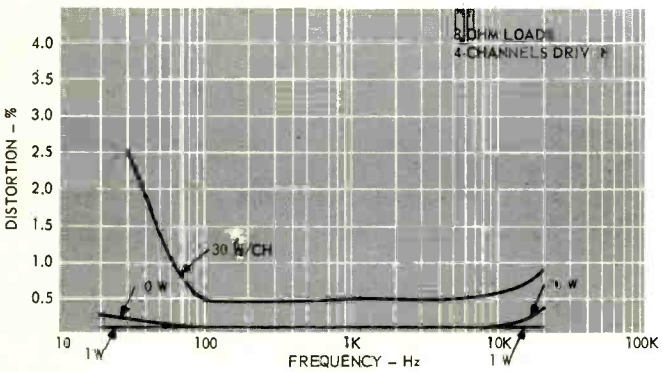
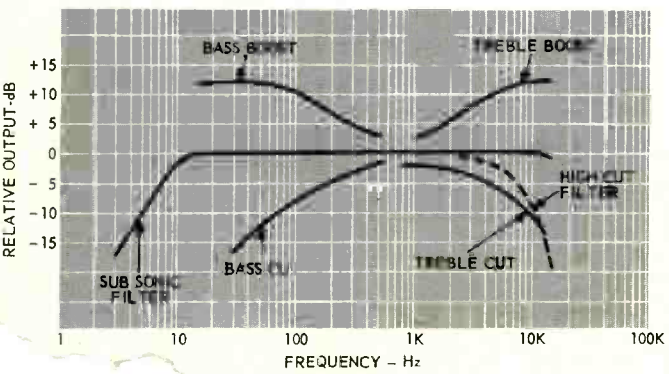


Fig. 7—THD vs. frequency at various power levels.



l and filter characteristics.

these possibilities (and there are several more) are clearly explained in the well written instruction manual that comes packed with the 801.

Performance Measurements

The FM tuner section's mono characteristics are shown in Fig. 3. IHF sensitivity fell just a bit short of the 1.7 μV claimed, coming in at 1.9 μV, while the ultimate S/N reached 66 dB at just over 50 μV. A very listenable 50 dB of S/N was reached at just under 4 μV (a very good figure indeed), while THD measured 0.4% in Mono and just over 0.7% in Stereo. While the muting button depressed, threshold for muting occurred at 8 μV, a bit higher than usual. As is true with other Fisher products we have tested, manual tuning is smooth and calibration is quite accurate.

Stereo separation characteristics are plotted in Fig. 4 and conform very nicely to stated separation figures. High end separation remains above 20 dB up to 10 kHz.

In the manufacturer's specs, all sorts of power figures are quoted; we didn't include the 250 watt $\pm$ 1 dB Music Power at 1 kHz, 4 ohms, nor the 200 watt IHF Dynamic Power rating at 4 ohms although they appear in Fisher's Operating Manual. In testing, we simply increased power output (all four channels driven) until we reached rated THD of 0.5%, and that occurred at 30 watts per channel, as shown in the graph of Fig. 5. With all four going full blast, this is 120 watts rms total. In the case of four-channel receivers, one might argue that driving all four channels simultaneously to make an rms power measurement is a bit unfair, but since the four-channel recordings we have heard so far have primary program material in all four channels most of the time and in view of the fact that under certain circumstances the receiver can be used as two stereo systems, we must adopt this course in reviewing the 801 and will do so in evaluating all future four-channel receivers which fall to us.

In any event, rated IM of 0.8% was reached at a power output level of 34 watts per channel, as is also shown in Fig. 5. Power bandwidth, shown in Fig. 6, extends from 20 Hz to 30 kHz, a bit better than claimed, but of course this is all referenced to our 30 watt per channel point.

Distortion versus frequency at power levels of 30 watts, 10 watts and 1 watt per channel are shown in Fig. 7 and, as can be seen, at 30 watts of output the THD remains reasonably low only down to about 50 Hz. At 10 watts per channel output, however, THD never exceeds 0.3% at any audible frequency and at a nominal 1 watt level, THD at all frequencies is essentially that of our audio generator.

Tone control and filter characteristics are depicted in Fig. 8, while square wave response at 40 Hz and 20 kHz is shown in Fig. 9.

Listening Tests

As usual, Fisher's tuner section performed flawlessly and the Autoscan features are very worthwhile. Including the "free" remote control was, we feel, a very good move on the part of the company, for, even though it performs only a station-changing function, the WT-50 is worth having and using. Incidentally, whether or not the muting button is depressed, once you elect to tune by Autoscan circuitry, there is no interstation noise while tuning takes place. We logged 46 listenable signals with one orientation of our 5-element outdoor Yagi array and of these, 24 were stereo signals. With muting added to the circuit, this number was reduced to 42 stations, indicating that 4 of the previously received stations were coming in at signal strengths of under 8 μV but were still acceptable.

In listening to the four channels of audio, utilizing the two "matrix" systems incorporated by Fisher Radio, we noted that,

the bare Fax

Meet the Wall of Sound, the superspeaker from Fairfax. In fact, look into it. What you see is what you hear, and every feature is a performance advantage.

Our unique multiple driver system, for example. You can see the complex electronics, but you'll have to hear how it reproduces the widest possible range of sound with less distortion than ever before possible. Outperforming speakers selling for two or three times the price, this unique parallel series network has crossover frequencies of 550, 1500, 5500 and 9000 Hz. And that's range.

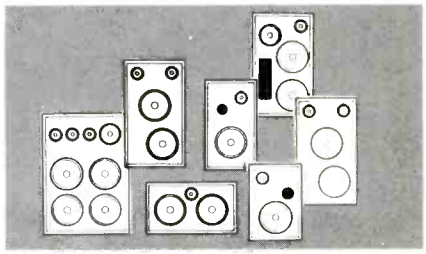
You can see the unusual height, too. Because of it, the baffle board is so big we call it the infinite baffle. You'll hear that advantage in the fantastic sound dispersion.

Then there's the unique "integrated cyclone" labyrinth system. You can't see it behind the speakers, but it's responsible for our superspeaker's remarkably low distortion, increased bass and improved transient response. To develop it, we redesigned the entire principle of horn-loaded speakers for side-to-side instead of front-to-back expansion. It's just one example of the engineering that makes the Wall of Sound the ultimate in speaker systems. You can put your money on that.

We did.

A limited number of franchised dealerships is available for the hi fi dealer who wishes to provide his customers with the utmost in value at any price.

FAIRFAX
INDUSTRIES INC.
900 PASSAIC AVE. EAST NEWARK, N.J. 07029



MORE IN THE 1972 FAIRFAX SUPERSOUND LINE
When it comes to more features and greater quality for your dollar, we have the proof, model for model. To see how an independent testing laboratory rates the Fairfax line against other leading speaker systems, send for your free, highly informative copy of our comprehensive test report.

SPECIALLY FABRICATED DOME TWEETERS
Two ultra-high frequency dome tweeters for clean, true highs—even with the high-energy harmonic structures that go beyond audibility. Listen to brushed cymbals.

SUPERIOR DIFFERENTIATION
Two 3½" mid-high speakers, perfectly balanced within our complex system for the smooth sound of clear, stable stereo images that let you pick out one instrument from another.

GREATER RESPONSE
Two 5" mid-range speakers for twice the response in the area most critical for "presence." No peaking. No "canned" sound. But wait 'till you hear those woodwinds.

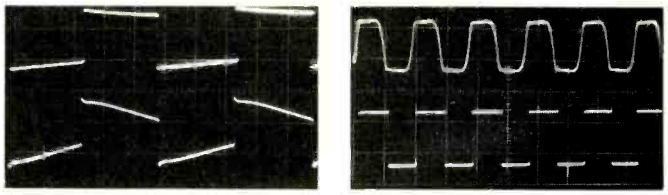
MORE WOOFERS FOR YOUR MONEY
Six, yes, six heavy-duty 8" woofers instead of the conventional single 12" or 15". For good reason. True fundamental sound is reproduced with greater efficiency and less distortion with our unique multiple driver design.

SIX SEPARATE SOUND CHAMBERS...
extending behind these three ports make a difference you'll have to hear to believe.

Check No. 47 on Reader Service Card

in general, synthesis of "four-channel" effects in the "pop" mode was very much akin to the synthesis obtained using the Electro-Voice Stereo-4 decoder system (as opposed to the CBS-SQ proposal) in that front-to-rear separation is quite extreme, with little separation obtained between rear-left and rear-right. In the classical mode, there seems to be a noticeable roll-off in highs in the rear channels—justified on the basis of the theory that a concert hall's reverberance and reflections usually contain fewer highs than the dominant or primary program material. The effects achieved with this built-in 2+2 decoder are quite good when using stereo source material. In the case of encoded four-channel material, our library of E-V encoded discs seemed to be reproduced more faithfully (per the intent of the original mix) than did the few SQ discs in our possession. Of course, when listening to four-channel tapes, the decoder circuitry is by-passed entirely and the totally satisfying experience of discrete four-channel listening cannot be denied. So much for the four-channel capabilities.

Considered from the point of view of amplifier quality versus price, we found that the amplifier sections were able to drive our low efficiency speakers with no audible distortion to fairly high levels. Since we do not have *eight* low efficiency speakers on hand, we connected four 8-ohm loads to the remote terminals and again listened to the four channels in our main listening area. Under these circumstances, certain highly dynamic passages of a four-channel SQ disc (classical, at that) seemed to strain the power handling ability of the amplifiers—particularly at the low end and most notably in the front channels (since dominant information was contained in front channels). Ordinarily, however, we doubt if a user would actually have two four-channel set-ups going full blast in two locations at the same time.



A B

Fig. 9—Square wave response at **A**, 40 Hz, and **B**, 20,000 Hz.

Fisher Radio is to be commended for their ingenuity in producing such a feature-packed receiver in such an attractive and compact package. While there are, of course, standard two-channel stereo amplifiers and receivers which might boast more power as well as tuners with better sensitivity or selectivity, the Fisher 801 does indeed provide 30x4 watts rms or 120 watts total, certainly good value for the price. The performance of the tuner section, of course, speaks for itself.

Summing up: The Fisher 801 can be recommended to those who desire good four-channel performance in a compact receiver together with a broad range of automatic tuning and remote speaker features. *Leonard Feldman*

Check No. 48 on Reader Service Card

Dynaco SCA-80Q Amplifier

MANUFACTURER'S SPECIFICATIONS

Power Output: 40 watts per channel, 8 ohm loads. **Total Harmonic Distortion**: Less than 0.5% from 20 to 20,000 Hz. **IM Distortion**: Less than 0.1% up to 40 watts. **Frequency Response**: ±0.5 dB from 15 to 50,000 Hz. **Noise**: Better than −80 dB, high level; better than −60 dB, phono. **Outputs**: Front speakers, 4 to 16 ohms; rear speakers, 8 ohms. **Size**: 13½ in. W by 4¼ in. H by 10 in. D. **Price**: $169.95, kit; $249.95 assembled.

Dynaco products have long had the reputation of being well-designed, with top performance, a minimum of "frills," and a rather simple styling. The SCA-80Q is no exception and as it can be obtained as a kit, substantial savings can be made into the bargain! It is described as a "4-d amplifier" which means that it has a built-in speaker-matrixing circuit to feed *difference* information to two rear speakers. The method was described at some length in our July, 1970 issue* and it is sufficient to say that out-of-phase information is recovered from the two channels and applied to the rear speakers. This information usually consists of hall reverberation or ambience and so this kind of simple matrixing can improve the realism of the reproduction—giving what Dynaco calls a four-dimensional effect. Not to be confused with the CBS SQ, EV or Sansui quadraphonic systems, but of course the 4-d does not need an additional amplifier. In any case, it is an optional facility and can be disregarded.

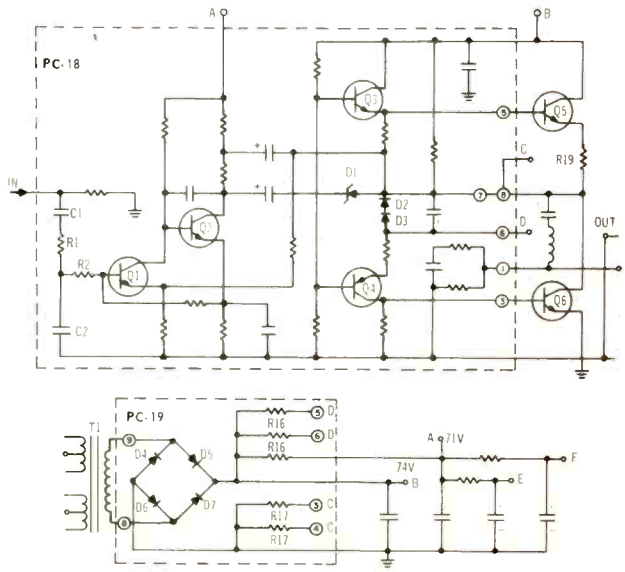


Fig. 1—Basic circuit of power amplifier stages.

*Borbely's article in the May, 1972 issue, *A Matrix Type Unit For* the arrangement of the connections.

Looking at the control panel, the selector switch is on the left, then the VOLUME, BALANCE and TONE controls, with the ON/OFF switch on the right. At the bottom are slide switches for TAPE MONITOR, LOUDNESS, FILTER, MODE, and SPEAKERS. Under the ON/OFF switch is a headphone socket—a must these days.

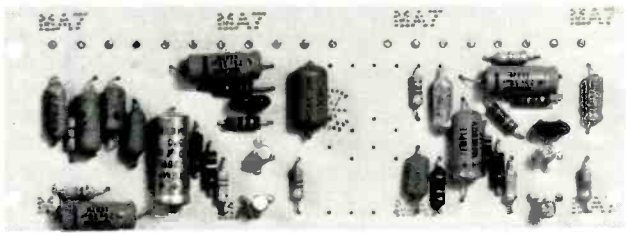


Fig. 2—Preamplifier board.

Circuit Descriptions

At first sight, the circuit arrangement looks very simple and straightforward, but there is an ingenious protection circuit which will be explained later. Two d.c.-coupled transistors are used in the preamplifier with phono input taken to the first one and equalizing applied by a feedback loop from the emitter of number one to the collector of number two in the usual manner. High level inputs—tape, tuner, and so on—are taken to the next stage via the volume and balance controls. This stage consists of another d.c.-coupled pair and the output is taken to a passive tone control network followed by the power amplifier. The basic circuit is shown in Fig. 1. Q1 and Q2 form a d.c.-coupled pair with a stabilizing feedback loop applied between the second emitter to the input base. Q3 and Q4 are a complementary pair driving the two output transistors. D1, D2, and D3 form part of the protection circuit and operate as follows: If the current in Q4 rises to equal that in R16 and R17, the diodes no longer conduct and the Zener D1 then conducts and effectively makes a short circuit between the input of Q3 and Q4 and the output from Q5 and Q6. Thus, excessive currents cannot be induced in the output and driver transistors. The protection circuit triggering point is determined by the reference voltage developed by the R16 and R17 bleed resistors. As I said before, an ingenious circuit which works, as I proved to my satisfaction. Power supply is taken from a conventional bridge rectifier and no-load voltage is about 74.

How It Went Together

Although the manual is not as detailed and elaborate as some others, those people with some technical knowledge will have no difficulty in following the instructions. All the boards with the exception of the power supply board are already assembled and so the biggest job is wiring and assembling the front panel controls and mounting the components. Total time I would estimate at 6 hours but it probably could be completed in less. Figure 2 shows a preamplifier and tone control board and Fig. 3 shows the driver stages. The output transistors are mounted on heat sinks which also serve as holders for the driver board. (See Fig. 4). Incidentally, the boards are pre-tested, so there is little chance that the amplifier will fail to meet specifications.

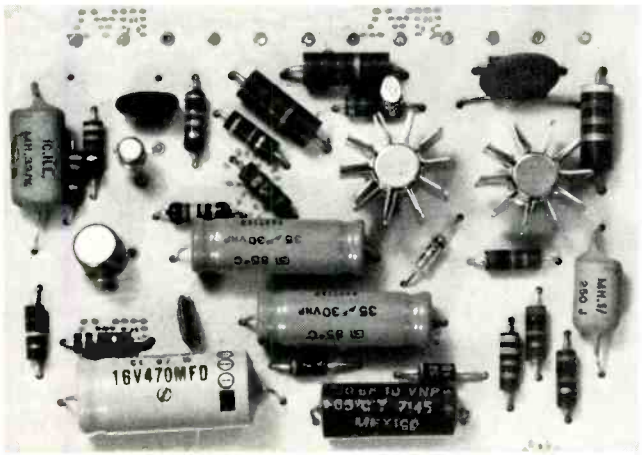


Fig. 3—Driver stages.

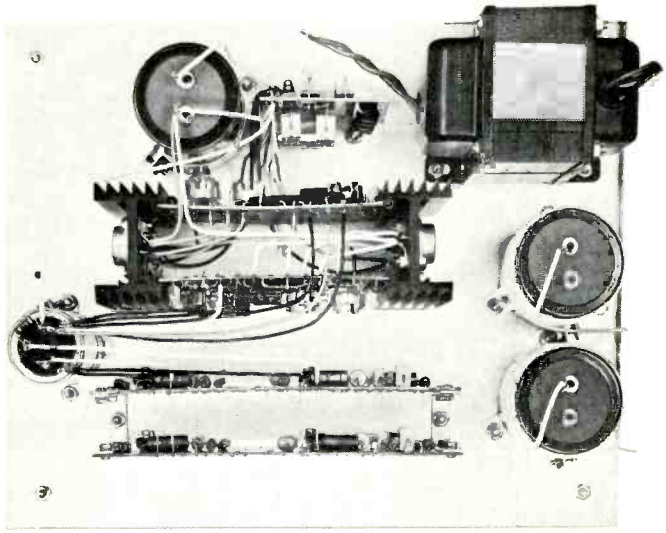


Fig. 4—View of partially completed unit.

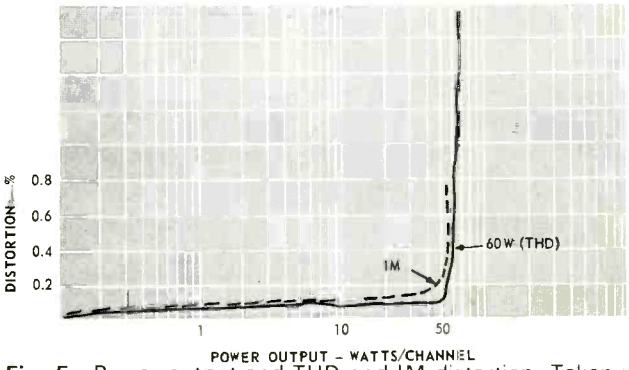


Fig. 5—Power output and THD and IM distortion. Taken with 4 ohm load, both channels driven simultaneously.

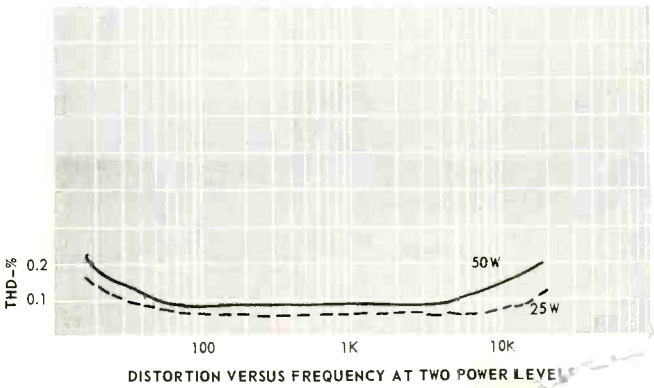


Fig. 6—Distortion versus frequency at two

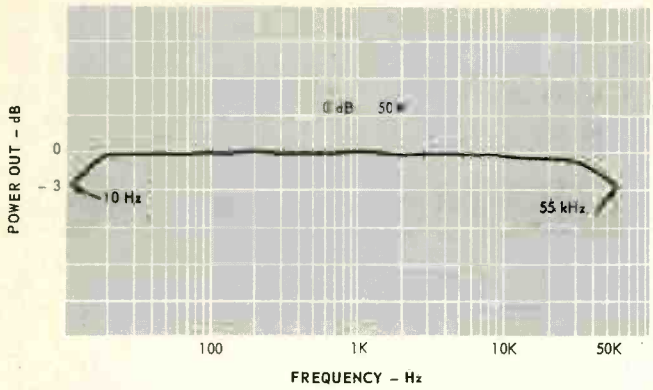


Fig. 7—Power bandwidth.

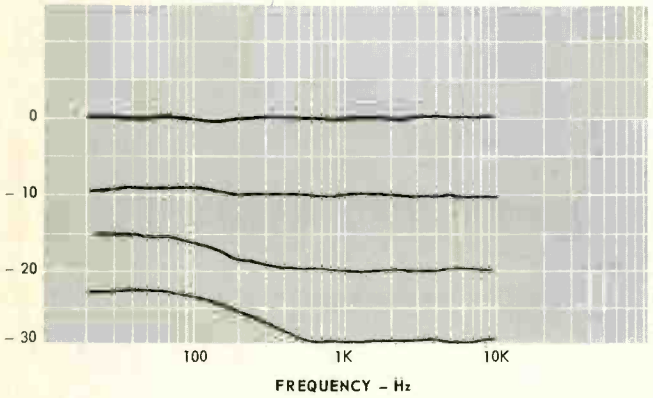


Fig. 8—Loudness control at three levels.

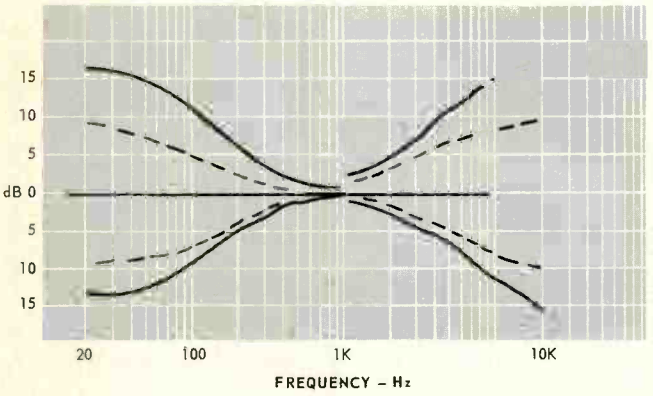


Fig. 9—Tone control characteristics.

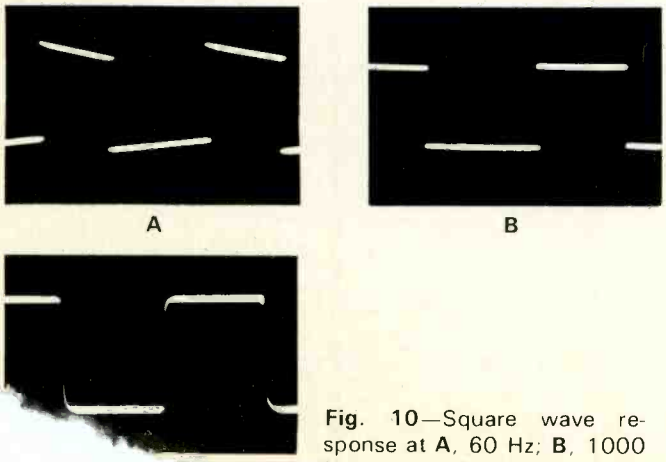


Fig. 10—Square wave response at **A**, 60 Hz; **B**, 1000 Hz, and **C**, 12,000 Hz.

Performance

Power output and distortion characteristics are shown in Fig. 5 and 6. It will be seen that the specifications are met with a comfortable margin. Power bandwidth came out at 10 Hz to just over 50 kHz as shown in Fig. 7. The loudness control gave a bass lift only as can be seen from Fig. 8. The tone control curves are shown in Fig. 9. Overall frequency response was excellent, being only 2 dB down at 10 Hz and 1.1 dB down at 100 kHz. This is reflected in the square wave performance as shown in the photos (Fig. 10). Sensitivity was 150 mV (for 56 W) for the high level inputs and 3.2 mV for phono inputs (there are two). Hum and noise was –82 dB for high level and –65 dB for phono. Separation came out at 55 dB at 1 kHz and 48 dB at 10 kHz. I have left the filters until last because the arrangement is a little unusual. The switch is a three-position rocker and the three choices are FLAT, RUMBLE, and NARROW BAND (See Fig. 11). Thus the low frequencies can be cut independently but if a top cut is required then the low frequencies are reduced also. Under some conditions this will undoubtedly give a tonal balance, but there are many occasions when a high frequency roll-off is required to remove distortion or that "chromium-plating" without affecting the bass response.

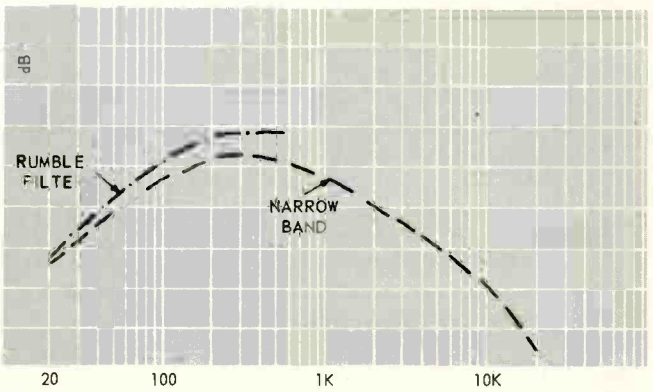


Fig. 11—Filter characteristics.

Listening Tests

In operation, the SCA-80Q performed as well as the measurements indicated, transient response was good and the reproduction was clean with no sign of edginess due to crossover distortion. On an A-B comparison with a most respected tube amplifier (circa 1965), there was no question of the Dyna's superiority. Not only was the bass response tighter but the high frequencies were crisper and more natural sounding. The 4-d speaker positions were tired with mixed results. Some records sounded at least as good as with a SQ decoder—particularly those made by the MS microphone placement—but others did not. Volume level of the rear speakers is 6 dB lower than the front—which is fine for most material—or listening positions for that matter. As I said previously, this kind of simple matrix will not give the sound location of the more elaborate decoders used with encoded discs but it is surprising what a difference those two extra speakers can make. The sound has a more exciting, spacious quality and in many instances switching off the rear speakers will make the reproduction flat and un-natural. Incidentally, the speaker switch has a spring-return null position which enables the four speakers to be balanced accurately—Dyna thinks of everything!

The only real criticism I have concerns that filter switch but of course it can be modified quite easily by anyone who feels strongly enough about it. *T.A.*

Check No. 50 on Reader Service Card

Special Offer to Audio Readers & Subscribers . . .

Executive Discount Shopping Service

Wants you to try this Remarkable Chair & Matching Ottoman, in the Comfort of your Home or Office for the Next 15 Days

ABSOLUTELY FREE!

The beauty of contemporary design. . . The comfort of 2½" of luxurious foam-filling. . . . The durability of heavy gauge chrome-plated steel and fine quality Naugahyde makes the "SWINGER" Chair and Ottoman a beautiful addition at a price you can afford.
You'll marvel at the "Swinger's" unique reclining action. It tilts and reclines, utilizing only gravity. No moving parts to wear out and no effort on your part, to recline to any position.

TRY IT FREE FOR 15 DAYS AND IF YOU LIKE IT . . .
Pay only $119.50 plus a small shipping and handling charge, or charge it to your credit card.

AT HOME . . . . AT WORK . . . .
- Read in your Swinger while your body relaxes.
- Rest in your "Swinger." Take a break out of your daily routine and "recharge" yourself by spending a few minutes relaxing.
- Unwind from the office in your "Swinger!"
- Watch television in your "Swinger." Its unique design reduces body fatigue.
- Music is great when you listen to it in your "Swinger."

THE SWINGER FITS INTO EVERY ROOM!
It's perfect for a waiting room . . . a den . . . in front of the fireplace . . . in the living room . . . the family room . . . the office or study. And, the Swinger and matching Ottoman are available in your choice of vibrant decorator colors.
The luxurious swinger looks rich, feels rich . . . yet costs very little! But, before you even think about purchasing this remarkable new chair and ottoman, we would like you to try it for yourself.
Use it for 15 days and then decide if this fantastic chair and matching ottoman is worth the special Executive Discount Shopping Service price of only $119.50 plus shipping and handling.

YOU SAVE VALUABLE DOLLARS! (The Swinger and matching ottoman is now being sold in stores across the country for more than $149.50).

If you decide to keep the Swinger (and we know you will) Pay Cash & Save!

1. Pay the full cash price of only $119.50 by check or money order, and we'll pay all shipping and handling charges.

or . . .

2. Charge your "Swinger" to your Credit Card. Executive Discount Shopping Service is authorized to accept the following credit cards for payment.
   - American Express
   - Mastercharge
   - Diners Club

If you decide to return the Swinger for any reason at all, just slip into the original shipping carton and send it back to us. It's that simple! But, no matter what you decide, NOW's the time to take advantage of this great opportunity to examine the Swinger and matching Ottoman absolutely FREE with NO OBLIGATION TO PURCHASE!

MAIL THIS COUPON TODAY . . . We'll ship you a brand new Swinger in your choice of color immediately. Satisfaction guaranteed.

P.S. If you like the bearskin rug in the photo under the "Swinger", you can order that too! It's another great bargain from Executive Discount Shopping Service at only $98.50 plus nominal shipping charges and sales tax where applicable.

EXECUTIVE DISCOUNT SHOPPING SERVICE
1309 Cherry Street, Philadelphia, Pa. 19107

Please send me the "Swinger" Recliner with Ottoman for a 15 day free trial. I understand that if I am not completely satisfied, I may return the Swinger and Ottoman in 15 days and my money will be fully and promptly refunded.

Plan 1 . . . Save Money—Pay Cash, and we'll pay the costs of shipping and handling.
☐ I prefer to pay cash. I am enclosing my check or money order for $119.50 for each chair & hassock ordered.

Plan 2
☐ Please bill my credit card $119.50 plus $9.95 shipping and handling.

_____
☐ American Express ☐ Diners Club ☐ Master Charge

Choice of Color
☐ #3B3 Burnt Orange ☐ #3T8 Tan ☐ #3R8 Black
☐ #3A8 Avocado ☐ #3X8 Oxblood

Please ship my order to: ☐ Home ☐ Office

Name _____

Title _____

Company _____

Street _____ Tel. _____ (area code)

City _____ State _____ Zip _____

Signature _____
(Order must be signed)

Local Sales Tax where applicable will be added. Sorry, no merch can be shipped to a P.O. box.

P.S. I like the "Big As Life" Animal Skin Rugs. Please ship me the following products and charge my account only $98.50 ea. plus a slight additional shipping and handling charge.
Bear Rug (5' x 7') ☐ white ☐ brown ☐ black
☐ Leopard (5' x 9') ☐ Tiger (5' x 9')

☐ I prefer to pay cash. I am ... $98.50. (Ship prepaid)
☐ Please bill my cre... in credit card info or...

Lenco Variable-Speed Turntable, Model L-75

MANUFACTURER'S SPECIFICATIONS

Speeds: Continuously variable. **Motor:** 4-pole induction. **Platter diameter:** 12 in. **Platter weight:** 8.8 lbs. **Arm:** Integral, with counterbalance, stylus-force adjustment weight, and anti-skating provision. **Cartridge mounting:** Removable head. **Dimensions:** 17½ in. W by 13¾ in. D by 6⅛ in. H. **Weight:** 32 lbs. **Price:** $99.50.

While most of us are satisfied with turntables which operate at only three (or four) standard speeds, 78, 45, 33⅓, (and 16⅔) rpm, there are many applications where a continuously variable turntable speed is desirable. Not only the usual ±3% variation available on most of the better turntables, but anywhere throughout the entire range. Perhaps the user wants to dub a record with a complete change of pitch—rather more than the 3 per cent normally available. Perhaps he wants to create an effect by speeding up the tempo or lowering it to match a scene on his home movie film. Whatever the reason, some users need a wider range of speeds than they can obtain in the average turntable. Yet when he wishes to operate normally, he can do so without having to make a tiresome adjustment of the variable speed to arrive at the desired standard speeds.

Mechanically, the L-75 consists of a horizontally-mounted motor driving a long tapered shaft parallel to the turntable surface. An idler wheel, running on a similarly horizontal spindle and movable longitudinally throughout the entire length of the tapered motor shaft, contacts both the shaft and the machined underside of the turntable. As the idler is moved along the shaft, the rotational speed of the idler changes proportionally depending on the diameter of the shaft at the point of contact. At the same time, as the motor shaft increases in diameter, the idler is contacting a smaller radius of the platter which means that the motor shaft need not have so wide a ratio between its largest and smallest diameters. In fact, it is rather a neat problem to design the shaft and the travel of the idler to arrive at the desired speed range. The motor shaft tapers quite rapidly from a maximum diameter of 0.425 in. at the large end near the motor to about 0.200 in. over the range from above 78 rpm down to about 30 rpm, then steps down slightly and ends up with a diameter of about 0.100 in. at the 16-rpm end. The idler wheel travels the radius of the platter for a distance of 1.5 in. ap- ly. The movement is controlled by the speed-change t corner of the chassis. This lever moves through an arc of about 25 degrees, and to facilitate setting to the standard speeds there are adjustable notches into which the lever latches. These "notches" can be moved slightly by loosening a single screw for each one and sliding the notch to the exact position desired. Thus in addition to having a continuously variable speed when desired, the user can select the four standard speeds accurately whenever fixed-speed operation is desired.

At the right front of the chassis is the ON/OFF switch which in addition to applying power to the motor also moves the idler into contact with the tapered motor shaft and the underside of the platter.

The arm is completely counterbalanced with a large weight at the rear, and the stylus force is adjusted over the range from zero to 4 grams by a smaller weight on an offset rod which extends forward from the tubular arm just back of the vertical pivot. This rod is calibrated in half-gram steps for ease in adjusting stylus force to the required amount.

Another rod is mounted on the rotating arm mount and extends backward. This, too, is marked with a number of notches into one of which a loop of fine plastic "thread" is placed. This thread carries a small weight on the other end, and the thread is dropped in an adjacent loop of corkscrew-like rod also extending backward, but attached as a stationary part of the arm mounting. This provides for anti-skating

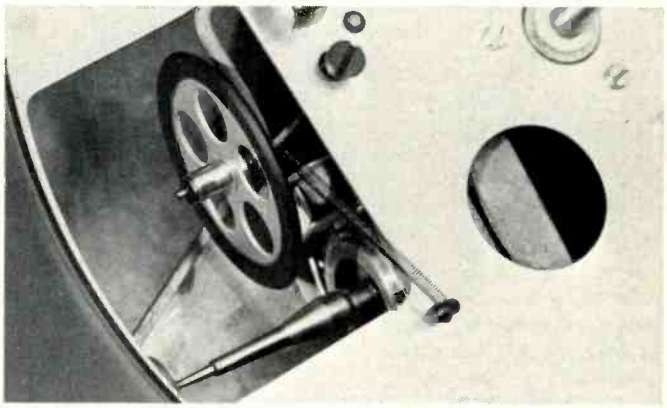


Fig. 1—Close-up of the idler retracted from the motor shaft. In operation, the idler contacts both the motor shaft and the underside of the platter.

Fig. 2—ON/OFF switch at the right-front corner of chassis, with the arm rest just back of it, followed by the cueing lever.

compensation, and with the two weights furnished any degree of compensation may be attained. Tables in the accompanying instruction booklet indicate the weight to be used and the notch into which the thread should be placed for the correct adjustment for the stylus force being used. The hole through the large counterweight is placed eccentrically to permit adjustment to compensate for the bent-arm design of the tonearm. The cartridge mounts in a removable shell which is held on the end of the arm by a locking ring.

A large curved lifter located between the arm mounting and the platter is raised or lowered by a lever just behind the ON/OFF switch. The forward end of the arm can be held on its arm rest—a plastic molding which holds the arm quite firmly.

The 8.8-lb platter is neatly machined on the underside where the idler contacts it, and it is dynamically balanced. A heavy molded pad completes the unit, and accommodates a stroboscope disc at its center, with discs being furnished for both 50 and 60 Hz.

The turntable chassis is solidly mounted to a base frame, neatly finished in walnut, and the frame itself is flexibly suspended on a particle-board baseplate, using damped springs for the mounting method. Thus the whole base is flexibly mounted, contributing additional mass and therefore considerably better silencing and isolation from external vibrations. The baseplate is restrained by two metal plates which are attached to the base frame by wood screws.

Performance

Putting the unit through the usual tests, we found that wow measured 0.08 per cent, with flutter somewhat less at a comfortable 0.06 per cent. Signal-to-noise was measured at 39 dB below a recorded level of 3.54 cm/sec at 1000 Hz, which is our standard method of making S/N measurements. Rated under the commonly used "ARLL" (audible rumble loudness level) figures, the *audible* rumble works out to be approximately −58 dB, while actually measured with the "A" network, rumble was noted as −56 dB, which is excellent.

One performance feature which is desirable but not always retained on automatic turntables is the accuracy with which the stylus lands in the groove from which it was lifted when the cue control is operated. Our reaction is that if a cue control is provided—as it usually is—it should drop the stylus down exactly into the groove from which it was lifted, and the Lenco L-75 does just that. Not all do.

The idler in this unit deserves a special mention because of its unique design. Most idlers used in phono turntables have a thickness of about 3/32 in. and when they contact the tapered motor pulley or shaft, there is likely to be a variation in speed because of the finite thickness of the idler. It could be contacting the motor shaft on its upper edge or on the lower edge, or anywhere in between, resulting in a small speed variation. In the Lenco L-75, the idler wheel surface is tapered to ensure contact only at the center of the idler's thickness, which means that the point of contact is relatively fixed when set, and the speed variation is therefore minimized. This is, in our opinion, a good feature, and worth mentioning.

Furnished with our test model was an Elac STS-344 cartridge, and with it we found that tracking remained effective down to a stylus force of ½ gram. The limitation appears to be in the cartridge rather than with the turntable and arm combination. For the user who wants complete flexibility in speed control, the Lenco L-75 is probably the only unit on the market which will provide a rotational speed of 34.87 rpm if the user should actually want that speed—or even 56.14 rpm, or any other speed between 15 and 83, for whatever reason a user might have for such un-standard values. It is attractive in appearance and effective in operation.

C. G. McProud

Check No. 53 on Reader Service Card

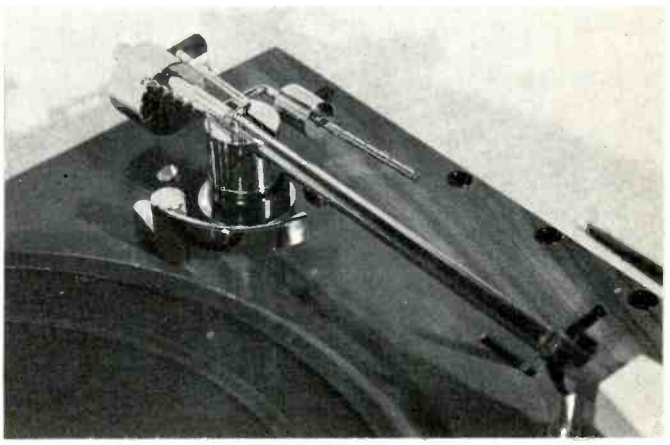


Fig. 3—The mounting of the Lenco arm, showing counterweight with its eccentric hole, stylus-force adjustment weight, fixed and moving arms for the anti-skating mechanism, and the curved cueing lift.

Audio Dynamics
XLM Stereo Cartridge

MANUFACTURER'S SPECIFICATIONS

Sensitivity: 3.5 mV at 5.5 cm/sec (nominal). **Suggested Tracking Force**: 0.6 grams. **Frequency Response**: 10 Hz to 20 kHz ±2 dB. **Channel Separation**: 25 dB, 50 Hz to 20 kHz (nominal). **Compliance**: 50×10^{-6} cm/dyne. **Stylus Tip Dimensions**: .0007" x .0003" (elliptical). **Price**: $50.00.

The new XLM stereo cartridge by Audio Dynamics differs considerably in construction from the design introduced with the ADC-25, principally in the stylus assembly. In the earlier model, the stylus was installed in a small plastic molding w[illegible] fitted onto the body of the cartridge, with the m[illegible] bedded in the cartridge body [illegible] the ind[illegible]

was transferred to the tiny soft iron collar on the "working" end of the stylus assembly—that is, the end opposite the stylus tip proper. In the XLM, the stylus assembly, which is similar to that of the earlier models in the stylus bar and its tiny soft iron collar, is mounted in a plastic saddle which slips onto the cartridge body, but the magnet itself is in the saddle, and thus closer to the generating element. It would appear that this creates a greater magnetic field, and thus requires a smaller coil to put out the required signal voltage. For example, the resistance of the 10E-Mk IV coil is 1025 ohms and the inductance is approximately 700 mH, which is just about the same as that in most other stereo cartridges. However, the XLM coil has a resistance of only 560 ohms and a much lower inductance of 260 mH. As everybody knows, presumably, the noise output from a transistor amplifier is related to the d.c. resistance of its driving source—not the 47,000 ohms into which practically all cartridges "look into," but the actual d.c. resistance of the source. This would seem to indicate that the XLM could be instrumental in lowering the input noise from the first stage of a modern transistor amplifier.

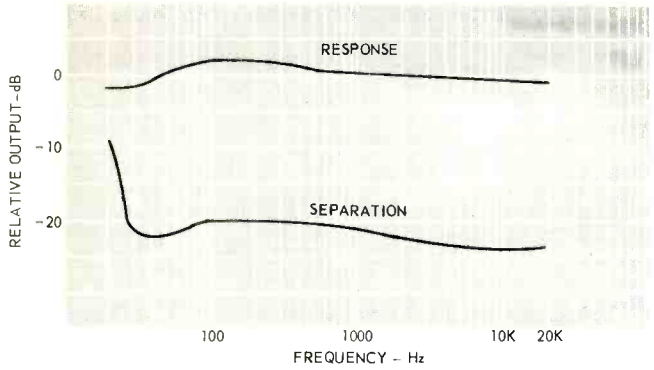


Fig. 1—Frequency response and separation curves for the XLM cartridge. A B&K QR-2009 record was used for the 20-20,000 Hz sweep and output was recorded on a graphic recorder with low-end equalization only.

Aside from that, the XLM has an extremely light stylus support—we used to call the member on which the stylus was mounted the "bar" but this seems inappropriate when the support is a thin hollow tube—and this tiny thin tube is "pivoted" in a flexible diaphragm just slightly off center so that the moment of inertia is minimized. In fact the mass of the stylus and the supporting section of the tube closely approximates the mass of the thin iron collar and its portion of the supporting tube. It is the iron collar which relays the magnetic field through the four pole pieces to produce the signal. And since the magnet itself is not mounted on the stylus support, the mass can be kept at a minimum. The "induced magnet" principle has been used by ADC since its introduction in the Model 25—itself an excellent cartridge.

The usual frequency runs were made with the B & K QR-2009 sweep record, and the output—after low-frequency equalization—was recorded, with the result shown in Fig. 1, along with the separation over the frequency range from 20 to 20,000 Hz. Note that response is within ±2 dB over the entire range, and that separation is better than 20 dB in the midrange and increases in the high end, rather than decreasing as with most cartridges we have measured.

The connecting cable between turntable and recorder has a capacitance of 200 pF, possible slightly lower than [illegible] in typical installations. To determine the

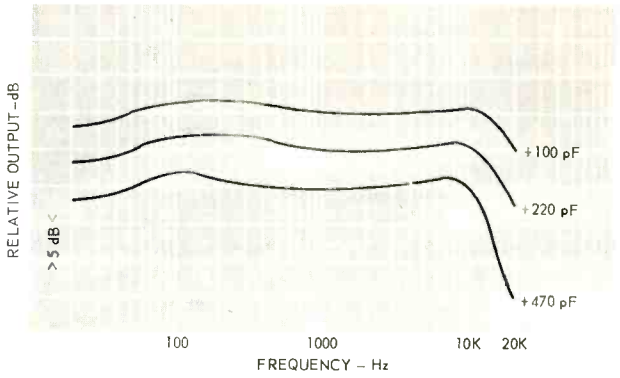


Fig. 2—The effects of 100 pF, 220 pF, and 470 pF capacitances on the response curve. Connecting cable has a capacitance of 200 μF.

effect of increased lead capacitance, additional runs were made with additional capacitances of 100, 220, and 470 pF added, and the results are also shown in Fig. 2. The increased value of 470 pF introduces a 2-dB peak at 7000 Hz followed by a dropoff to -12 dB at 20,000 Hz. An added value of 220 pF introduced a 2-dB peak at 8500 Hz and a rolloff to -8 dB at 20,000, while an extra 100 pF gave rise of 1 dB at 10,000 Hz with response down 5 dB at 20,000. So it really doesn't matter very much what capacitance your connecting cables have, because the slight rise—referred to above as a 2-dB "peak"—is not particularly noticeable, and with most equipment a droop of 8 dB, or even 12 dB, at 20,000 Hz is only of academic importance. We all like to have perfectly flat response from d.c. to Channel 4, as the saying goes, but then we dump the signal into a loudspeaker which is radiating in a room which may have heavy drapes and lots of overstuffed furniture, or there may be little furniture, no drapes, and no carpet. Let us say, therefore, that the XLM is capable of reproducing practically anything found on a phonograph record.

If you have read any of the company's advertising about the XLM, you are aware that the "LM" stands for low mass, and that there is also a VLM cartridge for use on turntables re-

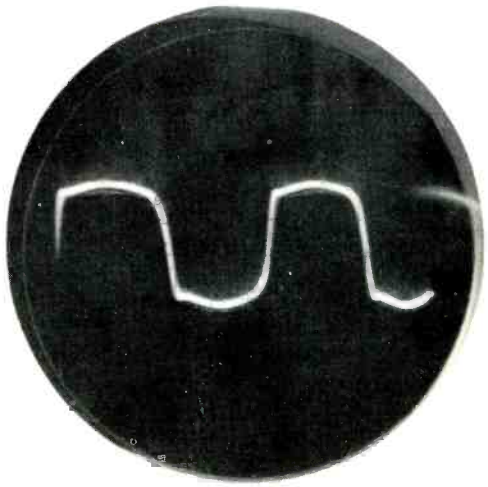


Fig. 3—Square-wave response from the XLM cartridge, using a CBS STR-111 test record with a flat preamplifier.

quiring a stylus force greater than one gram. The difference between the XLM and the VLM is solely in the stylus assembly —the bodies are identical. This means that you can buy the VLM for use with your present not-so-perfect turntable, and when you upgrade it next year, you can also upgrade the cartridge to the XLM by getting the "X" assembly and slipping it onto your present cartridge body. Not such a bad idea, since the body is guaranteed for ten years. The VLM lists at $40.00, so the difference you save now could well apply on the cost of the "X" stylus assembly when you upgrade the system.

It will be noticed from the response curve that there is practically no resonance peak in the upper range—in many it appears around 19 kHz. This is the result of the exceptionally low mass and the built-in electro-dynamic damping of the induced magnet system.

Measured output from the two channels from the 3.54 cm/sec band of 1000 Hz was 4.0 and 3.7 mV respectively, using the CBS BTR-150 broadcast test record—less than 1 dB difference. Those who have followed IM distortion measurements in these pages with respect to cartridges will recall that we report on the +9-dB band of lateral 200/4000 Hz, and the +6-dB band of vertical 200/400. (The CBS-STR-111 record has five levels of 400/4000, five levels of 200/4000, in the lateral mode, and three levels each of vertical 400/4000 and 200/4000—far too many to report on in every profile.) Lateral IM distortion measured 1.5% on the chosen band, and 3.0% in the vertical mode. These compare with 1.5% and 4.4% respectively for the ADC 25. This amount of lateral IM distortion is about par for stereo cartridges, but the vertical IM in most models ranged from 4.5% to 10%, so the XLM has remarkably low distortion in comparison with others.

Listening Tests

Tracking tests were made using the CBS STR-100 record, and viewing the output on a scope indicated that the XLM could track every band except the highest level at the recommended stylus force of 0.6 grams, and the highest band with a stylus force of 0.8 grams with no visible mistracking. Then, using a flat preamp and the ubiquitous scope, we looked at the square-wave output, as shown in Fig. 3. Only then did we listen to the cartridge to find that it sounds as good as it measures. Smooth, clean, and with no apparent peaks; good solid bass, and a minimum of noise.

We tried it on every possible type of music in our library and found complete satisfaction with its performance. Reducing stylus force to 0.4 grams made no appreciable difference in the quality of sound, but did show up an occasional mistracking on the very lowest notes. At the recommended 0.6 grams, however, none of this was noticed. On the whole, the XLM appears to be "state of the art," and priced as it is, it is a real bargain in cartridges. *C. G. McProud*

Check No. 55 on Reader Service Card

Discrete vs. SQ

(Continued from page 26)

compatibility with 100-million record players and FM-multiplex radios—all these must be considered. To do less would be an act of irresponsible engineering.

Much has been made of "discreteness" of quadraphonic carrier-type discs, and even our own initial developments used carriers. We found that while a carrier disc is able to approach discrete performance, it does so at the expense of other performance parameters, and only through a precarious balance of several complex processes, involving not only matrixing, but also compression, carrier modulation, ultrasonic disc recording and reproduction, demodulation, expansion, and reverse matrixing—often resulting in a troublesome and unstable action.

On the other hand, the SQ matrix provides us with a simple and competent quadraphonic system. The SQ encoder reorders the four corner signals from the original master tape into two pairs of orthogonal modulations and places them on the disc retaining all the qualities of the standard recording processes. Playback is done with standard stereophonic equipment followed by matrix decoding into four channels carrying predominantly the four corner signals, and within the front and back channel pairs retaining complete channel discreteness of the original master tape. Full 360° panning fidelity and compatibility with all phonographs and broadcast processes is retained. An electronic logic is provided to augment the front-back channel separation of the matrix, resulting in a performance which is difficult to distinguish from the original discrete four-channel master tape.

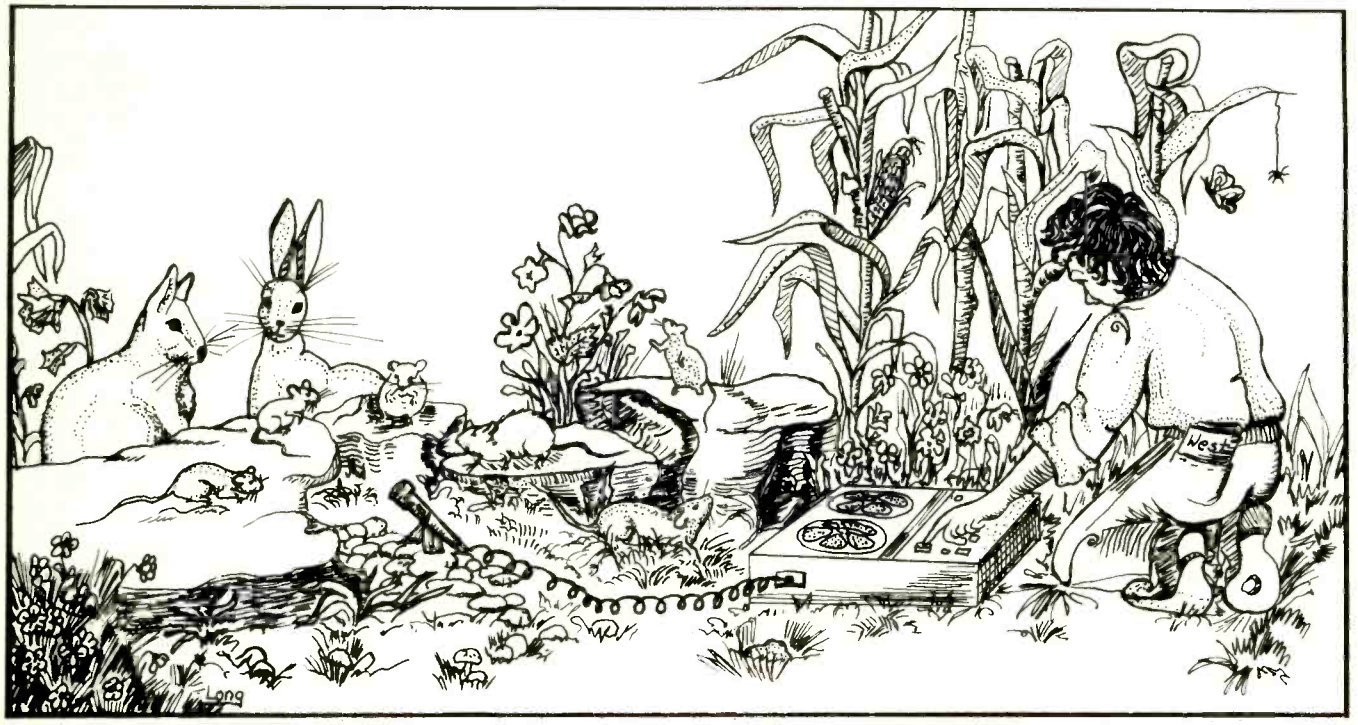
Since there appears to be no limit to human imagination and perseverance, we expect that experiments with carrier discs will continue—figuratively speaking—hacking in that direction against all odds. We observe that the choice of design parameters of the presently offered carrier discs does not appear to provide an optimum system configuration. Some optimization, indeed, appears to be feasible, and there even have been suggestions made about using the SQ matrix for the basebands of the carrier discs and of discrete broadcasting systems. While we encourage these approaches, we also commend to the attention of their proponents that the SQ logic-directed matrix, by itself, without the use of carriers, is a more efficacious and equally satisfying way of achieving a realistic, fully compatible, quadraphonic performance. Æ

References

1. See, for example, Robert E. Doherty and Ernest G. Keller, *Mathematics of Modern Engineering*, Vol. I; John Wiley & Sons, Inc., New York, 1936, p. 63.
2. Benjamin B. Bauer, Arnold Schwartz and Arthur J. Gust, "Transient Response and Intermodulation Studies in Phonograph Reproduction," *J. Audio Eng. Soc.*, 11, 2, pp. 110-114. (1963).
3. Frank G. Miller, "Stylus Groove Relationships in Phonograph Records." Acoustics Research Laboratories, Harvard University, Office of Naval Research, TM20, March, 1950.
4. T. Inoue, N. Takahashi, and I. Owaki, "A Discrete Four Channel Disc and Its Reproducing System," *J. Audio Eng. Soc.*, 19, 7, 576-583, July/Aug., 1971.
5. Takeo Shiga, Nippon Columbia Co. Ltd. and Duane Cooper, U. of Illinois. (Personal Communication).
6. Benajmin B. Bauer, Daniel W. Gravereaux, and Arthur J. Gust, "A Compatible Stereo-Quadraphonic (SQ) Record System," *J. Audio Eng. Soc.*, 19, 8, Sept. 1971, pp. 638-646.
7. H. Haas, "Uber den Einfluss eines Einfachechos auf die Hörsamke Von Sprache" (Effect of a Simple Echo on the Intelligibility of *Acoustica*, Vol. 1, No. 2, pp. 49-58 (1951), Translated in *J.* 20, 2, pp. 146-159 (1972).

Audio ETC

Edward Tatnall Canby



Midwest Safari

IT ISN'T OFTEN that I get out into the audio field. That sort of travel is for you reps and traveling salesmen and Vice Presidents in charge of . . . er, well, in charge of the field. I know how you hate traveling. I do sympathize. As for me, I stay at home. Must I fly to Indianapolis to hear RCA's latest pressings or to Germany to sample Deutsche Grammophon? Everything comes to me on a platter, the P.O. allowing. And so I stay put. But this spring I had a chance to go on audio safari, and it was good. I am bubbling. Out there in the grass roots, the high Midwest, I picked up more new ideas than I had in years.

I was asked to expound on one of my long-time favorite audio hobbies, binaural sound, at Madison, Wisconsin. The invitation came most unexpectedly from a new arm of public broadcasting, The National Center for Audio Experimention (NCAE) at the Univ. of Wisconsin, founded several years back as an outgrowth of the public broadcasting act. Wow! Travel! A working vacation. And a kindly fate pointed to Evanston, just outside of Chicago, where the very day before I could stop off at the Midwest Acoustic Conference, with all the top quadraphonics people [illegible] for heavy argument. Nice little finger also indicated Shure; but Shure's Evanston works were closed down. Saturday. (At Madison I caught up with a Shure Vice President in charge of Professional Products.) A fateful thumb extended in still another direction—Buchanan, Michigan. Good idea! So I stopped off at Electro-Voice in Buchanan en route home and almost ran into our Editor in Charge of Everything, who was doing his own safari thereabouts.

To my genuine astonishment, I found at Madison that binaural sound for headphone listening is already quite a big thing in the new area of public radio. I hadn't heard about this development (had you?); in fact, I still thought binaural sound was just one of my private hobbies, like stereo color pix and growing parsley indoors. Right now, something like 80 public radio stations are experimenting with FM multiplex binaural *broadcasts* directed, not towards loudspeakers, but to the ubiquitous "stereo" phones that are an adjunct to so many home systems. The credit for this definitely goes to NCAE and its present director, Ed Burrows, a long-time radio man whose level headed P.R. on behalf of the headphone idea is beginning to give the medium the place I have always thought it should have in our listening spectrum. Not just stereo through phones, but binaural recorded *specifically* for the headphone medium. More on binaural in a later article.

The first large object I saw at the Midwest Acoustic Conference in Evanston was Bert Whyte, in the very middle of the scene, the second being an enormous theater speaker on the stage, right in front of me, with three more set up several miles apart for the quadraphonic demos. Waste of time. Four-channel sound is *not* designed for reproduction in large halls with steep, overhanging balconies. So I will tell you nothing about what I heard. Bert Whyte, though, was the Magnecorder man who in 1952 shoved a PT-6 BIN binaural "Maggie" with staggered heads at me and thus made possible my first home-grown experiments in the binaural medium. He was then also heavily into "binaural" and has many first - class binaural - for - loudspeakers tapes in his library from that era which, no doubt, are now correctly classified as stereo. In 1952 we hadn't started using that term.

The Midwest Acoustic Conference was an all-day affair entirely devoted to quadraphonics and the roster of speakers was an impressive, well chosen balance between the top men who had their special causes to plead, for matrix,

discrete and so on, and those whose contribution was towards a solid practical/theoretical background on the subject. If there was not too much of startling newness revealed, it was merely because, these days, the quadraphonic principals are on perpetual tour, trailing each other from one public forum to the next, and the sensational can only appear once—the next time, it's the same old speech. E-V's Howard Durbin, in charge of all sorts of things including matrices, suggested they all hire a railroad car (with baggage car attached?) and take the grand tour cooperatively. He even offered me a compartment in the Pullman.

The real revelations for the press at such sessions, you see, tend to come out of the unstructured question periods after the formal talks. In Evanston, at the tail-end of the day, the assembled representatives of every important development in quadraphonics stood majestically on the stage together and got heckled for a fair-thee-well. Something to see and to hear. Miraculously, nobody got really mad, and that night they all set off for Provo, Utah—and intervening whistle stops—still friends.

In that one day, and again at Madison, I picked up some really new insights into the prevailing problems of quadraphonic recording and its vital relationship to the merits of the various reproducing systems. It was interesting to hear three very different philosophies for the mic set-up, along with practical realizations. Marvin Camras, a founder of our audio field, expounded the most theoretical philosophy, that of the phantom living room placed in the middle of a concert hall. An invisible box, its four sides represented by outward-facing microphones in four directions. Transport the box to your living room—i.e., replace the mics with speakers in the same position facing inwards—and you have created sonically transparent walls with time delay. The sound (in theory) just continues onwards from mics to speakers, recreating the original sound field. As the middle-aged will remember, this is a refinement of the old "curtain of sound" theory by which we explained stereo in its early days; infinite numbers of mics on one side of a curtain across the front of a stage, infinite numbers of speakers on the other side, and the sound goes right through. With delay by recording if desired.

Concepts like these are always fascinating for the roving audio mind, but they tend to infuriate the practical-minded recordist who has to work for his money with the mics themselves. And who wants a concert hall anyway? A lot of people were thinking in concert hall terms at Evanston and the influence of that idea is still obviously enormous. But plenty more people I met on this trip were vociferously anti-concert hall and for lively reasons. This was a major difference that came out again and again.

Milton Putnam, who to my delight turned out to have recorded the recent Stan Kenton two-disc quadraphonic "live concert" jazz album at the Univ. of Utah, was the next man; that album turns out to have been no concert at all, but a ten-hour heavy recording session with students invited to listen in and make appropriately natural background noises. Cleverly done, and the padded seats on hand were the type that equal a human body in sound absorbing, so the variable audience, coming and going, did not appreciably change the acoustic situation. No phantom box of mics here! The Utah mics soared gracefully upwards and outwards from the frontal stage area in two diagonal lines, at three distances, plus accents up front. When somebody tripped on a cable and the far mics went out, the tapes were fixed up later via a Cooper delay line so you can't tell the difference. Interesting.

What struck me as very significant in this highly expert big-time jazz recording session was that the set-up was definitely front-oriented, in a big, live "concert hall"—but in *playback,* which I had previously heard in my living room, you are surrounded and in the middle of a huge arena with students seemingly clapping and cheering all around you. It is important to understand that we can jockey our quadraphonic sound back and forth from front-oriented to surround sound after the fact, if surround sound is what we want.

But is it? Do we face front, or don't we, as we listen? That is the biggest question in present development, and it is clearly related to the concert-hall-or-no-concert-hall argument. It is possible, and often desirable, to record strictly in surround sound with no front, no rear, no sides—an even 360° distribution of sound sources, like theater in the round. Right now, that concept fascinates a great number of the more progressive and active recording engineers in many areas. Who knows, perhaps even concert-hall classical music will some day edge around to this format for our home reproduction? I'd go along. It is entirely possible. We are dealing with a new medium for old music remember, and —given time for adjustment—that medium will certainly develop its own best terms of presentation. It always has.

I get the feeling, then, that the recording people want the freedom to choose their own best route in these respects and I must say I can't disagree. We have seen enough changes in recording technique to know that even in classical, there will be plenty more. And audiences to go along with them.

Yet, don't underestimate the concert hall up-front usefulness. After all, we do have forward facing ears and heads and always will. The frontal concept, with sides and back, isn't likely to go away altogether—not until we sprout ears on the backs of our necks. And don't forget, too, that concert hall liveness or ambience is an enormously useful and, indeed, necessary tool in the recording of all music. It has long since, in effect, been divorced from the concert hall itself, as a free agent that may be used naturally or synthesized. I think that some engineers get unnecessarily het up about the "classical" bugbear. Classical recording, mind you, is already remarkably disembodied and into new techniques, far out and away from any literal concert-hall realism—even before we get down to quadraphonics. The classical sound in music such as Beethoven may still seem conservative to the far-out people and, to date, we have not tried to 16-track Beethoven. But we might. In terms of technique in the session, I'd say the classical people are not nearly as far away from the more advanced techniques as they might seem by the sound. We are all going in the same direction.

John Eargle is a musician, and his tricky circuit for converting three-channel master tapes into quadraphonic sound is a superb contribution to the art. His presentation at Evanston showed a definitely front-facing layout, and it was clearly ambient inclined too. Classical? Not necessarily. For one thing, he bends his performers into a half-round and puts two mics quite close together near them, aimed out at about 90 degrees. You can play with that sort of direct sound in your later mix down. For ambience, he goes out 25 feet or so with mics a dozen feet apart, more or less; he stresses the crutial adjustment is by trial, in every session, for a balance between direct and ambient sound. (Reminds me of the old Maxfield formula for maximum mono presence.) Accent mics too, when useful and where useful, according to varying need.

My impression was the Eargle thinking, seemingly classical, actually extends to all sorts of real-time recording and straight on into 16-track mix downs of the pop kind, where the musical elements are recorded separately in time and often in place. No matter! The tools will work. You can end up with front and back—*or* theater in the

It very soon became

Evanston and at Madison, where we had a potent little mini-session on quadraphonics, that the front-back idea vs. the equal-sound-all-around has become crucial to the whole matrix vs. discrete argument and, in particular, in the evaluation of Columbia's SQ.

SQ, I now see, is ever so clearly front-orientated in its basic approach. That system laudably preserves a full stereo frontal image which is virtually intact as compared with two-channel stereo. (Vanguard also has promoted this concept since the beginning of their quadraphonic recordings some years ago.) SQ also provides a laudably smooth extension of sound around the sides of your room and back towards the ambient rear. There is no split between "direct" and "reverb" sound. These things are via my own observations and I find them good, for much of the music I call my own. In terms of reverberent up-front music with a maximum of room sound, SQ is extremely well designed and highly musical.

However, and here's the rub, this smooth front-side configuration leaves a sharp out-of-phase "hole" at the center rear where, so to speak, the two sides meet in back. You cannot place a solo sound at that point; it bounces off to the sides and/or is cancelled by the phasing. *Does this matter?* That's the big argument.

It doesn't matter much to *my* ears, for most of the music I hear. I have no special desire to hear a soloist directly behind my head. On the other hand, it matters a great deal to me if in quadraphonic form, I find the vital front spread of stereo sound in *any* way contracted and less realistic. That's where the musical presence is, up front and very real. Direct side and rear sounds may occasionally be of exotic interest, of course. Berlioz brass in the back corners, big choruses, off at the diagonal. But dead center rear is not—to me—of any great importance.

This, I take it, is the Columbia viewpoint. Again and again Columbia says, *who wants a soloist at center rear?* Valid argument! From one point of view.

And yet a lot of people are shouting *I DO!* They want precise positioning all the way around, from every direction, equally, rear-center included. And again, they are likely to say, *who wants a concert hall?* They are, of course, right. It isn't *necessary* to think front and rear, and you should at your choice be able to avoid it, and also, if you wish, avoid the idea of the rear channels as mainly for ambience, reinforcing the front. So, you see, SQ has run straight into an elemental aesthetic argument. If I am right, the

other matrix people have variously coped with the center-rear so that you can, in fact, put a solo or direct sound source at that point, if you want, matrix it, and decode it at center-rear. In other words, the other matrices tend to be more practically orientated towards sound-in-the-round in their parameters than the SQ matrix. But remember, SQ goes along with the shape of our heads and the direction of our ears. Interesting divergence of outlook.

Space is flying and so I'll end (with much left to say) via an amusing bit of listening I did at Electro-Voice. One of Howard Durbin's colleagues had been experimenting with quadraphonic discrete taping to provide source material, I think, for matrix experiments. He set up a small dixieland band, brass, sax, guitar, drums, in a deadish studio, and took them down on half-inch professional tape, four channels, with the instruments discreetly distributed so there could be spatial juggling in the playback. The idea was to achieve a neutral sound-in-the-round, equal material in various directions, in order to evaluate matrix handling of the distribution.

We listened. Yep, there they were, each group of instruments clearly coming from a different direction, all around, and the guitar accompaniment squarely at center-rear, via mono in-phase feed to the two rear channels. That was SQ, natch.

Rear? What was I hearing? I thought this was to be equal sound-in-the-round? I had to laugh. All unconsciously, as far as I could tell, the man had put the *melody* instruments in two of the adjacent channels, to make a front, and the *accompaniment* instruments in the other two, for a rear. Ever so definitely there was a front and back, but the effect was entirely due to the musical sense itself.

I suggested we turn our chairs around and listen the other way. No question! The music was backwards. The main melodic sense was now behind us. The rhythm and chord accompaniment was up front. Crazy.

So you can begin to understand that the idea of equal sounds all around and the front-back idea are merely first cousins, related but no siblings. They can work together. And ambience, when you come down to it, is a neutral factor that can go either way too. Ambience to define a hall via the rear sound. Or ambience to define an all-around space with equal billing in any direction, and no front at all.

So—my Midwest safari was worth its weight in travel gold and I'm going to have to wangle a few more invitations like that. Just send 'em to me special delivery. AE

Classical Record Reviews

Edward Tatnall Canby

Mischa Levitzki plays Beethoven, Mendelssohn and Liszt. Klavier KS 116, stereo, $5.98.

There's been such a flood of player-piano recordings these last years that I reluctantly have put most of them aside—we mustn't fill all our pages reviewing them, though we could easily enough. They are always fascinating for the wide-ranging musical ear. This one, which I picked up almost at random one evening, just to see, turns out to be one of the finest I have ever heard. How much of this is the pianist himself, who flourished from 1914 through the thirties, and how much the Ampico mechanism, last and most sophisticated of the reproducer breed, I could not really say. That's what is fun.

The Beethoven "Appassionata" sonata, Op. 57, occupies all of Side A and it is one of the most interesting performances I know, very far from the routine of dozens of others, including some by big pianists. Amazing! This is an earlier Beethoven style than we are accustomed to, not the frowning master, full of passion, tensely controlled, but a grander, more relaxed, expansive Beethoven. It is a delight to hear! Nothing is missed, nothing is pushed or forced, as though in the terrible presence of Genius—this pianist is no high priest of the Beethoven cult but just a tremendous musician letting himself out for the sheer pleasure and glory of it, like a fine athlete with a smile on his face. Did I even hear a few slightly unfamiliar passages, maybe created by one Mischa Levitzki, to adorn the original? Don't have the score at hand, but no matter—it was often done a half century ago. The music is indubitably full of hesitations, slowings-down, lengthenings-out, in the plastic, late-Romantic style (which the new young pianists would like to imitate but can't). Even an untrained ear will notice it. Part of the approach, and it makes for much, much interest, even if no self-respecting pianist today could play in such an uninhibited fashion.

These reproducing systems were quite miraculous in their capture of a pianist's performing expression and personality, reduced to "digital" form on paper rolls. But nevertheless, for most professional ears today, the reproduced recordings tend still to have a certain thing—or lack it—which makes them ever so subtly, machine-like. I have never been able to pin it down, though I am mechanical-minded and can usually analyze a misfunction or inaccuracy into its factual elements. It is as though the pianist were playing just a bit too soon after an afternoon nap, or had taken a few too many sips of a cooling drink a few minutes beforehand. Nothing outward and obvious—just a kind of minute stumbling, barely appreciable, yet *there*.

Not in this recording. For the first time, it is to me a living, breathing pianist at the Steinway, playing in full modern stereo. Terrific. How come? Well—it must be a combination of the Ampico system, 'way back, and a very polished contemporary engineering job on the piano playback mechanism itself—which takes enormous know-how. In other words, the people who specialize in this sort of technical restoration are now really beginning to be *very* good, real artists in their profession. It was bound to happen. But it took awhile. The earlier restorations on discs are not nearly as impressive and some of them are downright preposterous—with wrong notes (tears in the paper?), missing tones and a generally false air. We may take the modern restored player-piano (reproducer-piano) performances with increasing artistic seriousness.

Side B runs on into some superb Mendelssohn, Liszt, Schumann, earlyish Debussy and a bit of a waltz by Stojowski (not to be confused with Stokowski).

Performances: A Sound: A–

Peter Mennin: Piano Concerto (1957); Richard Yardumian: Passacaglia, Recitatives and Fugue (1957). John Ogdon, pf.; Royal Philharmonic, Buketoff. **RCA LSC 3243**, stereo, $5.98

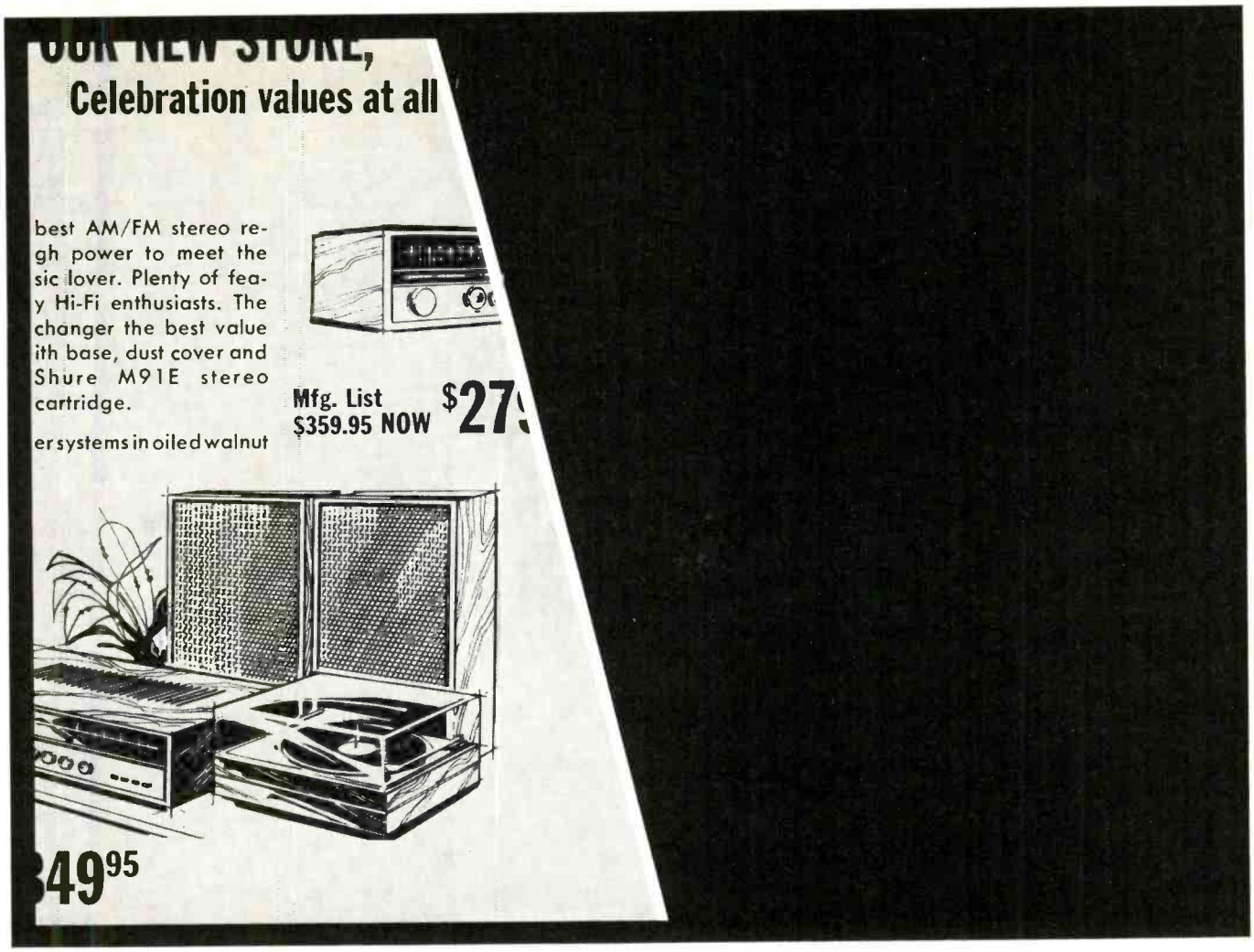
Well, here's what was happening in the upper regions of the American Symphony Orchestra World, back around 1957. Pretty much what's still happening. Composers with commissions—for big orchestra. Big orchestras with players—for big composers to use. And a lot of money that drains out of our affluent economy via quantities of foundations, academies, leagues, festivals and so on. It's a sort of economy within the economy, tax-free and, of course, wholly non-profit. It feeds wonderfully upon itself, as any good economy should do, and the product, as you see, is (a) Performances and (b) Recordings. They count 'em up like batting averages. But one question remains. Why should you and I listen—and buy? Is it in any way *our* business?? A real question.

Both these men are big in American music biz. Mennin's list of awards is much too long to put down, and he has been Prexy at the top-dog Juilliard, which assures him of *his* niche in musical fame. Yardumian, more a self-taught man, out of WW II, is a Philadelphia fixture with some 100 performances (*sic*) by the well known orchestra there. Both are experts at providing proper feed for virtuoso pros. (After all, an orchestra has to have notes to play, or it is completely helpless!) Both can butter up a bassoon and flatter a flute, both can blast the ornaments off the concert hall ceiling with stupendously difficult *tutti* for full orchestra. And both play the fingers off their willing pianist. That's what the biz is all about.

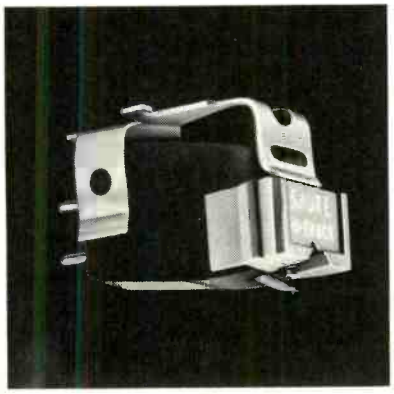
The Mennin Concerto is one of the most furious pieces I have ever listened to, even in this furious world. England's heavyweight powerhouse, John Ogdon, is put to it and just barely gets his way through the endless, frantic rushes of notes and dissonant chords, with never a pause for relief. The orchestra has its problems, too; I suspect that these Britishers were once more astonished at America's capacity for violence. The Mennin style is technically old fashioned, a sort of supercharged 1940s with Prokofieff in the piano, Hindemith in the orchestra and Bartók (but meaner and harder) in the over-all. It is an interesting work, if you don't mind a bit of blood and sweat and no tears.

Yardumian is much more old fashioned in the main, a descendent (in spite of his Armenian background) of the "modal" school of Holst and Vaughan Williams, some 50 years back. To be sure, there is more dissonance and a sharper edge, but the old putting-a-minor-chord-where-you-expect-a-major-chord is still very much in evidence. A sincere, well made and effective work which bored me .

Performances: B– Sound: B



How to read a hi-fi ad



Puzzle picture: find the clue that tells you how good the advertised system probably is. Our advice is to check the one component that is the *source* of the sound—the phono cartridge. We say this because we know that the dealer who's assembled a superior package at a fair price is going to complete it with a superior cartridge within the available price range. This dealer ad above, for example, includes a Shure M91E Hi-Track. Even if you weren't aware of the effortless way it meets your most rigorous trackability demands, you should know that it, as well as virtually every Shure cartridge, has been acclaimed by hi-fi critics and authorities as best in its class, or best for the cost. That's why you see so many of them teamed with "best-in-their-class" components, and why they invariably mean a more-for-the-money total system that's going to make you very happy.

Shure Brothers Inc.,
222 Hartrey Ave., Evanston, Ill. 60204

Check No. 61 on Reader Service Card

Weissenberg—Complete Rachmaninoff Preludes. RCA LSC 7069, two discs, stereo, $11.96.

Medtner: Sonata-Ballade; 3 Fantastic Improvisations; 4 Fairy Tales; 4 Pieces, Op. 4. Vladimir Pleshakov, piano. **Orion ORS 7019**, stereo, $5.98.

Rachmaninoff and Medtner were Russians of the same generation, both pianists, both permanent expatriots after the Revolution—Rachmaninoff in America, Medtner in England. Strange that whereas Rachmaninoff had long since reached top classical popularity, Medtner never made it and depended on fortunate handouts from an Eastern potentate to get his music into circulation. Yet he is a good composer of his very-late Romantic sort, an able writer for the piano, a transparently honest technician—almost a more discursive Schumann at the piano. He should have pleased.

Here we have six LP sides of solid musical argument for both cases—better than words by far. Suppose that both men were piano composers only. (Rachmaninoff obviously made much of his "rep" via his big piano concerti and his world-famous symphonies.) I think the modern term for an important difference would be simply that Rachmaninoff got it together. Medtner is diffuse, colorful, unstable in an ever-interesting way. Rachmaninoff's music drones on and on, not nearly as colorfully; but each Prelude (and the same with other works for piano solo) is crystal-clear in its chosen musical material, utterly consistent, if awfully longwinded (for most of today's ears, at least).

Medtner veers charmingly towards flashes of other composers—one moment he is pure Schumann, the next, we hear early-Stravinsky-type chords, or Grieg, Debussy. (The music dates from 1902 to 1923 on the Orion disc.) Moreover, Medtner has a Germanic preoccupation with counterpoint, a problem that never bothers Rachmaninoff for an instant. Thus—thick textures in Medtner, melody upon melody, fugal segments out of late Beethoven (but without the drama). This surely put the composer down among those who were tired of the academic approach!

Rachmaninoff, alas, has a dangerous way of putting me to sleep or into a non-listening reverie. His fascinations are mostly in piano technique. Medtner I found much easier, even at length, and you will enjoy his frankness and color, so very late-Romantic. So it goes! Up with the downtrodden.

Two excellent pianists, Pleshakov full of fire (presumably Russian), Weissenberg more of a powerhouse, using more pedal-blend.

Performances: A–, A–
Sound: B+, B+

Paganini: The 24 Caprices for Solo Violin. Paul Zukofsky. **Vanguard Cardinal VCS 10093/4** (two discs), stereo, $5.96.

Everybody knows the last of these, No. 24, in versions of one sort or another by Brahms, Schumann (who wrote piano accompaniments for all of them), Rachmaninoff and plenty more. Who's heard the original piece, for violin alone? Plenty of violin students! They are about the only ones who know the other 23 too. So—here they are, all of them, as originally composed by the devil-violinist, Niccolo himself.

Like all of Paganini's music, these are musically superficial but nevertheless charming and wholly *musical* in harmonies and melodies, much more than just exercises. As technical feats, the things are almost unbelievable—such tricks! But the music is what counts.

Alas, I would not recommend this monumental recording to any who are not professionally interested. Mr. Zukofsky does a glittering technical job with the pyrotechnics and, apparently, has made a good many innovations in approach too (I wouldn't know, not being a violinist nor an expert in fiddle music as such). But, justifiably or not, he plays out of tune much too frequently for my pleasure.

Now granted that these are fiendish pieces and anybody who can play them at all is some violinist! But, after all, I am a listener. And I see no particular reason why I should suffer from sour notes just because Paganini insisted on making things so difficult. Whether other violinists can do better, I cannot tell you—there is no other listed complete recording. But Ruggiero Ricci has done a single LP of these works for London—and I would trust his sense of pitch. Maybe you'd do better (at a higher price) to try him if you want to hear what Paganini had to say via his fabulous fiddle.

Performance: B– Sound: B+

Let's Be Real. Sing-In Boulder. Owl ORLP 21, stereo, $5.98.

This is a nice cross between pro and private recording. It is the third disc put out by the Boulder Colorado High School performers, out of their Folk Song Club (evidently formed back in the folky days before things went electric). I thought the last one really quite delightful, with real talent on the part of a batch of very wise but very youthful kids, giving their all. The recordings are done on a pro basis and the release is strictly pro for you and me, even listed in Schwann; a single 45 was sent along, too, with one item from the big disc, plus another not on it. So they aim high.

This one strikes me as a bit more pro, a bit slicker, than the other one I heard, perhaps because they pulled back a number of graduates who have gone on to bigger things via college. The "average" age-sound is older by a bit, the arrangements are fancier and the sound work is real studio stuff, maybe 16-tracked for all I know. (Audiocom Corp. Studios, Denver.) Lots of fancy reverb effects, layers on layers and the like. Done, of course, with the knowledge and cooperation of the students themselves, who know what they're about all right. Yet the fresh, accurate child voices are still there and the surprising sophistication of some of the arrangements, even though mostly "after" well known originals, is very revealing.

No doubt about it, when you think back a generation, the musical youth of today can find a remarkable complexity of expressive means. If a lot of it is still yeasty and frothy and half-baked, then think what junk our grandpas produced when *they* felt musical, what with Sweet Adeline and the Bullfrog on the Bank and Ivan Skevitsky Skevar—and no guitars, not even acoustic! These kids are a zillion miles further on the road to musical sophistication. AE

Weingarten Looks At Lily Tomlin

Sherwood L. Weingarten

BROODING *about high taxes, war, the drug scene? Feel you're a victim of future shock? Convinced ya gotta escape to Tahiti, stop the growin' wrinkles and prematurely gray hair? Well, brother, tell ya what I'm gonna do; I'll let ya in on the secret of a lifetime.*

My assistants, the record manufacturers, are out there stockin' up the stores with my tonic—laughter. For only a few inflated bucks, ya can travel the Yellow Brick Road, go through the Looking Glass. How, ya ask? Easy! Buy a comedy record. Somethin' for everyone? Sure. Try it, as the man on the box says, you'll like it. . . .

Close to laughter's mainstream is *Lily Tomlin's* second album, **AND THAT'S THE TRUTH** (Polydor, PD 5023), in which she uses, exclusively, her child-character, Edith.

Although the LP is not quite as good as her debut effort, the Grammy-winning "This Is a Recording . . .," it is highly amusing. Recorded live at the Ice House in Pasadena, California, the disc delves briefly into pollution, war, ecology, human foibles and X-rated movies. But its impact stems from the fact that Edith comes alive (you can envision, easily, your own child talking that way, or the kid next door), only slightly exaggerated.

Always, of course, there are antecedents; in Edith's case, they're probably "Eloise" and "Baby Snooks."

For those who can remember back to 1921, RCA has produced a "Vintage Series" disc that includes *Fanny Brice* in a bit called "I'm an Indian."

THE GOLDEN AGE OF COMEDY 580) is a pithy lesson in laughter, ety. It ranges from the Brice thing to a 1965 extract from a *Myron Cohen* performance. Sandwiched between are items by *Weber and Fields, Eddie Cantor, Amos 'n' Andy, Henny Youngman, Abbott & Costello, Judy Canova, Wally Cox, Bob and Ray,* and others.

If it's not a laugh a minute, it is pure fun—and nostalgia. Even the occasionally poor sound quality doesn't intrude on the enjoyment.

Prefer today's comedy? Try **FM & AM** (Little David, LD 7214), which showcases long-haired, bearded *George Carlin* with satire he penned himself. Recorded live at the Cellar Door in Washington, D.C., the LP is often hilarious (so much so that the audience reaction now and then gets in the way).

Carlin spoofs double standards in word usage, long hair, commercials (concentrating on sexual innuendos), drugs and birth control pills, disc jockeys, Top 40 radio programming, pop songs, couples on game shows, Ed Sullivan and newscasts. The "AM" side of the disc is more structured than the "FM" half. Distributed by Atlantic, it is not for the blue-nosed, however, and not for those easily offended by attacks on establishment viewpoints.

Another recording aimed at those with open minds is *Vaughn Meader's* **THE SECOND COMING . . .** (Kama Sutra, KSBS 2038), a playlet, in effect, that features Meader as Jesus Christ.

Although uneven, the LP *is* funny—although it probably becomes blasphemy to fundamentalists and the like.

Written mainly by Earle Doud, the record starts with a satirical glimpse at "Jesus Christ Superstar," then shows what might happen if Jesus returned to earth, landing in Harlem and performing miracles (such as "Nixon nominates a qualified man"). He becomes a protege to a Hollywood producer ("I'll make you famous"), is blasted by a member of Women's Lib ("Why weren't you the daughter of God?"), is given a patronizing view of psychiatry ("You're very together, Jesus. Are you into therapy or what?"), and is forced into participating in rock festivals, contests ("Win-a-Week With Jesus"), and Sesame Street ("One commandment, two commandments, three commandments . . .").

In a Presidential election year, political recordings can be expected to flood the record shops. Among the earliest to appear were **RICHARD NIXON SUPERSTAR** (Buddah, BDS 5097), starring mimic *David Frye,* and **POLITICS AND POPCORN** (Mercury, SRM 1-617), showcasing impersonator *Rich Little.*

The Frye outing, a spotty thing, contains a loose narrative telling of Nixon's history, an allegorical version, naturally. At birth, the doctor doesn't trust him; during school elections he calls for a "generation free from fear of chalk thieves;" on the football team in college he announces a secret plan to win the game, a plan he never discloses.

Frye includes voices of Nixon, LBJ, Humphrey, Fulbright, Muskie, Ted Kennedy, Kissinger, Wallace, Buckley, and others.

Little's vinyl, on which his jokes are not equal to the imitations, includes spoofs of the draft situation, the war, the Nixon-Agnew relationship, the trip to China and newscasts. The second side is devoted to lampooning cliche films.

He digs into his repertoire of 130

voices for this one, pulling out such stalwarts, in addition to the usual political figures, as Walter Cronkite, Kirk Douglas, Gregory Peck, Bing Crosby, John Wayne, Lionel Barrymore, Jack Benny and Rex Harrison.

Even more contemporary, if that's possible, is **CONCEPTIONLAND AND OTHER STATES OF MIND** (Cotillion, SD 9051), a disc on which four guys, collectively called *The Conception Corporation,* try to capitalize on the kind of humor popularized by The Firesign Theatre. Unfortunately, they're not as good.

Obviously geared toward turned-on youths, the record spoofs school, the generation gap, the judicial system, obituaries, legal abortions, Johnny Cash's prison appearances, the drug subculture, and Disneyland. (The entire flip side is a mock tour of an amusement park.)

Backed by occasional rock music, the gig evokes only a midget handful of laughs.

Classic humor, in contrast, may be found on **THE DECLASSIFIED JEAN SHEPHERD** (Mercury, SRM 1-615), **LENNY BRUCE AT THE CURRAN THEATER** (Fantasy, 34201) and **RETROSPECT** (Mercury, SRM 2-628).

The Shepherd record, subtitled "The People Have a Right to Know," includes electronic gimmickry and a lot of free-form material. There are one-liners ("Re-runs are the opiate of the people") but Shepherd, best when reminiscing a la Mark Twain, is funniest when he builds the comedy via sequential form (such as his relating Army experiences and dealing with training films).

The Bruce effort, a three-disc package recorded in San Francisco, is 2½ hours of rambling. He dealt mostly with his legal troubles, but also touched lightly on bigotry, ethnic solidarity, welfare inequities, the difficulty of changing, TV talk shows and Las Vegas sex shows, the legalization of pot, and loneliness. At times it's hilarious; at others, it's maudlin.

The third classic is a compilation, on two records, by Mike Nichols and Elaine May. There are a dozen cuts, each a comedy standard. Included are bits on the telephone company, adultery, name-dropping deejays, overbearing mothers, and doctors and nurses. But always the emphasis is on the one-to-one human relationships absurd in their complexities.

DEUCE (Atco, SD 7004) puts *Rory Gallagher* out front with 10 tunes he composed. Gallagher, supported by Gerry McAvoy on bass and Wilgar Campbell on drums and percussion (and backing himself on guitars and harmonica), has a gruff voice that is particularly appealing on the hard rock 'n' roll of the old school, Dylanesque country-rock, and pure blues.

JAZZ & BLUES

Martha Sanders Gilmore

Charles Mingus: *Town Hall Concert*
Musicians: Charles Mingus, bass; Eric Dolphy, bass clarinet; Clifford Jordan, tenor saxophone; Jaki Byard, piano; Dannie Richmond, drums, and Johnny Coles, trumpet.
Songs: *So Long, Eric,* and *Praying with Eric.*
Fantasy JWS 9, stereo, $4.98

The mercurial moods and modes of bassist Charles Mingus may be found mirrored in his music. Mingus, a vital and caring individual who is described by Nat Hentoff as a "protean force," puts his finger on the very pulse of music here in this fantastic live performance at the Tyrone Guthrie Theater in Minneapolis, originally released as one in Mingus' Jazz Workshop Series now distributed by Fantasy.

At 49, Mingus has courageously cut a path on bass as not only a leader and director—rare for a purveyor of this instrument—but as a composer and orchestrator, having written at least "a couple of hundred tunes" which gloriously defy category and definition by virtue of their daring and very richness. Mingus skillfully and tastefully combines the best of composed and improvised music.

It is true that the bassist has been in good company, having played with such greats as Charlie Parker, Bud Powell, Art Tatum, Lionel Hampton, Red Norvo, and Duke Ellington. And he has learned his lessons well, having contributed an immeasurable wealth to the annals of music in turn.

What strikes me most in this exciting 45 minutes of genius—there are only two ...d tracks, leaving a wide berth ...onment—is the impeccable bassist's tremendous inventiveness and probing stretches of the imagination which produce delightfully unpredictable and whimsical music flavored with humor that is orchestral and experimental in conception, earthy and colorful in nature.

Mingus' dynasty is far-reaching, embracing a vast spectrum of emotion disseminated through the blues, gospel, folk, and jazz idioms compounded with European borrowings as suggested by Debussy and Satie. Circling about the pivot and pulse of Mingus are shifting tempos propelled by drummer Dannie Richmond, who is hard-driving but compatible, and pianist Jacki Byard, at once percussive and soft-spoken and who seems to be able to play just about anything. Unabrasive atonalities and densities emerge successfully, succinctly, with Mingus under it all as fountain-head and counterpoint to the whole.

"So Long, Eric," a tribute to the late Eric Dolphy who died in 1964, is bluesy, bop-derived, and good fun, muscularly swinging and featuring Johnnie Coles out in front on trumpet, straight ahead and multi-noted. He could come through better—in live performances audio is at the mercy of stage managers and their sometimes ersatz crews. There are marvellous tenor saxophone honks by Clifford Jordan and persuasive unison brass comments, declining blues figures, two-timed double entendres, and Byard ringing out loud and clear on piano with shivering stride barroom rolls, stradding block cords "from a Gothic cathedral," as well as a door-knocking drum, and Mingus' judicious comping that extends far beyond the usual plucky walk. His bowing here is majestic.

Dannie Richmond on drums sports a military cadence, then fashions his set into a whiplash which coils about itself, hurrying things along. Richmond's drums, effective knockabouts, engage in cheerful banter with Mingus' bass, piquant and expending dotted eighths with Jordan wriggling up alongside on tenor, eel-like and squealing, spinning along like topsy, gaining momentum until it ends with an incisive thud on drums.

"Praying With Eric" conveys abstract expressionism but not too tormentingly so, remaining beautifully free and mobile, sectioned like grapefruit and almost programmatic in scope. Dolphy's flute work should not be missed as he soars stratospherically and sure of note in a Debussyesque dream sequence. Dolphy delivers dollops of sound: we hear bird calls, a cuckoo, with Mingus tawny and magnificent beneath, enhancing the texture. Most notable of all perhaps is Dolphy's bass clarinet work which is playful with a wide-open, quacking tone and technically masterful. Mingus, a songful melodist, quotes with wit from "When Johnny Comes Marching Home" against Byard's plinking piano, given to icycle-like octaves and permitting no accesses.

Tension: release: dimenuendo: crescendo: honks: jibes: excitement—all blossom into cheerful resolution and meditative calm in a music of contrasts, a chiaroscuro of sounds. Surrealistic undulating movement.

Sound: B+ Performance: A+

Classified

Rates: 25¢ per word per insertion for noncommercial advertisements; 50¢ per word for commercial advertisements. Frequency discounts as follows: 2 times, less 15%; 6 times, less 20%; 12 times, less 30%. Closing date is the FIRST of the second month preceding the date of issue. *Payment must accompany all orders under $10.00.* Use the handy self-addressed, postage paid card at the back of this issue. When replying to AUDIO box number ads, send letters c/o AUDIO, 134 No. 13th St., Phila., Pa. 19107. For more information about classified advertising, circle Reader Service Card # 135.

FOR SALE

WORLD'S LARGEST, DEEPEST, MOST POWERFUL SUB WOOFER SYSTEM can be had only at Music and Sound Ltd., 413 Johnson St., Jenkintown, Penna. 19046 215/885-4214. From $1,000.

CYLINDER RECORDS (large collection) 78's, 45's (many rare) recorded on high quality cassette. All types of music. 40¢-60¢ per selection. Catalog $1.00. Norman Rogers, 408½ So. Broad St., Albertville, Alabama 35950.

CROLYN C-90 CASSETTES, 4 for $10.50 plus 50¢ handling, or $29.00 per dozen, postpaid. Professional advice and booklet, "The Stereo Buying Guide," given free to all inquiries. Sound-Pro, P.O. Box 2417; West Lafayette, Indiana 47906.

AUDIO RESEARCH, Infinity, SAE, Decca, Transcriptors, Stax, Quad, Braun, and many others. The Stereo Set, 1737 Wisconsin Ave., Washington DC 20007 (202) 338-1493.

TDK - SD 1800' 10 rolls $50 postpaid. Vetrol Technical, Box 3488, Vero Beach, Fla. 32960

!!OUR RABCO SL-8E SOUNDS BETTER THAN YOUR SL-8E!! For $1.00 we'll convert "yours" to "ours". Professional Products Div., Music and Sound Ltd., 413 Johnson St., Jenkintown, Penna. 19046 215/885-4214.

SEND FOR LATEST STUDIO CLEARANCE sale list featuring microphones, tape recorders, equalizers, limiters, turntables, lathes, cutter heads, loudspeakers, mixing consoles, organs, and pianos. Only professional studio equipment listed. Wiegand Audio Laboratories, RD #3, Middlesburg, Pa. 17842 (717) 837-1444.

FREE TECHNICAL ASSISTANCE + ACOUSTICAL CONSULTATION with purchase of individually hand picked, guaranteed lab tested and aligned custom components from Audio Research Corp., A.K.G., Beyer, Crown, Decca, Gately, I.M.F., Infinity, JBL PROFESSIONAL, Otari, Quad, Rabco, Revox, Rogers, B.B.C. Monitor, SAE, Sound Systems International, Stax, Tandberg, Transtatic. We save you $$$ with FACSIMILE REPRODUCTION at Music and Sound Ltd., 413 Johnson Street, Jenkintown, Penna. 19046 (215) 885-4214.
Engineers, College Instructors, Musicians.

IMF STUDIOS AND MONITOR MARK III's THE INCOMPARABLE SPEAKERS; Decca "reference standard" cartridges stocked. Custom tube Futterman, 100 watt per channel, brand new and a true collector's piece—superb $395.00 Mint Marantz 22 Receiver $325.00. Superb Newcomb Classic 1500-R mono amplifier, good as new condition a prize for $115.00. We take trades. Audiocraft, South Rockwood, Michigan 48179. Telephone: (313) 379-9945.

FOR SALE

WORLD'S FINEST SPEAKERS—on demonstration—Audio Research 4 x 6 panels. Infinity SS1 (improved version), 8 Quad system, B&W 70's, trans static speakers, inquiries invited. Paul Heath, 81 Big Tree St., Livonia, N.Y. 14487, (716) 346-5630.

GET "MUSIC ONLY" FM Programs SCA Adaptor fits any FM tuner or receiver. Free list of Stations with order. Kit $14.50 (with Squelch $19.50) Wired and Tested $25.00 (with Squelch $29.95) All plus postage & insurance. Thousands Sold. SWTPC, Box 32040A, San Antonio, Texas 78284.

SCOTCH MAGNETIC TAPE, discount Box 167A, Orwigsburg, Pa.

HI FI FURNITURE? See Toujay Designs at SEE 70, Hi Fi Expo, 443-A, Park Ave. S., NYC, 10016, Tues. to Fri. 11-5, Sat 11-4. Full line brochure 25¢.

TAKE SOUND-OFF your Cassette or Cartridges with "ERASETTE"—our exclusive Electronic Wash (-65db 0-VU) gives you a like new Cassette or Cartridge in an instant. Less than 1-lb, self-contained, 4-"AA" battery powered. Send $12.50 (5% sales tax CA Res.) Postpaid. MAGNESONICS CORP. P.O. 127, Northridge, CA 91324.

MARANTZ MODEL 250 Power Amp (one month old), $395.00. Steve Metheny, 603 Lyncrest, Lincoln, Nebraska 68310. 402/489-6236

DISCOUNTS UNLIMITED in our 1972 price list. Send for your FREE copy to: Box 467, New Hampton, New Hampshire 03256.

MCINTOSH MR71 TUNER, $230. Metrotec Freq. Equalizer, $55. O'Connell, 22 Bremond St., Belleville, N.J. 07109

FOR SALE: New pair AR-LST, in boxes, warranty cards, used 2 hours. $400.00 each. Will prepay freight. Charles W. Phillips, P.O. Box 487, Gibsonville, N.C. 27249

HI-FI DISCOUNTS. Free catalog—Western Electronics, 7121 Rich Ave., Newark, Calif. 94560

CONDENSER MICROPHONES in easy to build kits. Free details. Write Electronic Enterprises, 3305 Pestana Way, Livermore, Calif. 94550.

FREE 64 PAGE CATALOG offers hundreds of recordings of rare renaissance, baroque and classical music. Some records priced as low as $1.00 each! All late recordings. In stereo only. Musical Heritage Society, Box 932-AU, New York, N.Y. 10023.

HEAVY DUTY 12" ANTI-STATIC TURNTABLE MAT. $4.95 postpaid. Creighton Audio labs, 740 Haven Pl., Linden, N.J. 07036.

FOR SALE

SOUND SYSTEM INTERNATIONAL presents a revolutionary radial track tone arm and turntable. Brochures available. Paul Heath, 81 Big Tree St., Livonia, N.Y. 14487 (716) 346-5630.

OPERA TAPES—Records "live" performances, broadcasts. Free catalog. Hathaway, 49 Merbrook Lane, Merion, Pa. 19066.

SHURE V15-11 improved, $47 and old cartridge. shipped prepaid. STEREO Shop, 1209 1st Ave. SE, Cedar Rapids, Iowa 52402.

LEARN WHILE ASLEEP. Hypnotize with your recorder, phono! Astonishing details, strange catalog 10¢. Sleep-Learning Association, Box 24-AZ, Olympia, Washington.

AR, KLH, ADVENT, DYNA OWNERS—low cost electronic equalization for your particular speakers overcomes limitations of bookshelf enclosures, provides full-range performance. Complete specifications from Norman Laboratories, 520 Highland Parkway, Norman, Oklahoma 73069.

"OVERSEAS MUSIC & NEWS Hallicrafters S-240 shortwave receiver w/tuner output $99.95 ppd USA AMRAD 1025 Harrison St., Oakland, Ca. 94607"

LOUDSPEAKER KITS, complete or cabinet only, original and published designs. Amplifier kits. Factory direct at great savings. Catalog 25¢. R.C.S. Co., P.O. Box 30312, Santa Barbara, Cal. 93105.

SOUNDCRAFTSMEN 20-12 Equalizer, $175; B-T Audio Baton, $35; Sony TC-8 track recorder, $65; all like new postpaid. Ovidio Alfaro, 2738 East Shore, Culver, Indiana—46511.

ACOUSTIC SUSPENSION SPEAKER KITS. Build your own . . . Save. 10¢. AudioCessories, 320 W. Edmonston, Rockville, Maryland. 20852.

IMF STUDIOS speakers in excellent condition asking $450 or best offer. Michael Stiuso 69 High St., Eatontown, New Jersey 07724 (201) 542-6705

ADVENT 201 Dolby Cassette Recorder, Pre/Amp, D/Cover, Tapes. $240. Lewes. Del. 302/645-9154

FLAME SPEAKERS FROM POLAND, B&W Ltd., I.M.F., Transtatic, Radford, Quad, Infinity, E.P.I., B&O, Decca, Citation, Otari, S.A.E., Braun, Sinclair, Keith Monk, Ge-Go, Transcriptor, Satin, Spendor, Philips, Hegeman, Revox, JBL Professional. Transcendental Audio, 1214 Walden Avenue, Buffalo, N.Y. 14211 716/897-3984

HEATH AJ-15 FM Stereo Tuner with walnut cabinet $165. Andy Winterbottom, 1867 McKelvey Hill Drive, Maryland Heights 63043

FOR SALE

BASF, MEMOREX, SCOTCH reels, cassettes, 8-tracks. Lowest prices. Satisfaction guaranteed. S&S Audio, Box 2065, Champaign, Ill. 61820.

PROTECT YOUR LPS. Poly sleeves for jackets 5¢ Inner sleeves 4¢ Poly lined paper sleeves 10¢ White jackets 25¢ Postage $1.00 House of Records, Hillburn, N.Y. 10931.

OPERA TAPES—Great performances of past 35 years. Free catalog. Ed Rosen, P.O. Box 97, Freeport, N.Y. 11520.

BRAINWAVE FEEDBACK. Electroencephalophone teaches alphawave control. J & J Enterprises. 24120 A 3rd West, Bothell, Wash. 98011.

WIRED, SELF-POWERED background music adaptor to use with your present FM—$25.00. Thieves Warehouse, P.O. Box 8057, Pensacola, Florida 32505.

FIRST BREAKTHROUGH IN RECORDING TAPE. Originally made by America's leading tape manufacturer 2400' mylar, 7" reel, $2.29, 1800' mylar, 7" reel, $1.69, 1200' acetate, 7" reel, $ .79. Write for quantity prices. AAE, 218 Columbia St., Utica, N.Y. 13502.

KLIPSCH, TANNOY, JBL, MARANTZ, THORENS, RABCO. No discounting. Superior Sound. 2780 Erie Boulevard East, Syracuse, New York 13224.

NAB HUB ADAPTERS—Fit Revox, Crown, TEAC, Roberts. $3/pair postpaid. No C.O.D. Quantity prices available. John Kountz, 1065 Van Dyke Dr., Laguna Beach, Calif. 92651.

FOR SALE

ATTENTION MIDWEST AUDIOPHILES—hear the Hegeman speaker, JansZen Electrostatics, Braun TG1000, and more, by appointment. Audiophile Systems, 851 West 44th, Indianapolis, Indiana 46208 (317) 283-5404

MAC1700; Marantz, 7T, 16; new Citation 12; PE2040, new Shure VIS. Sell, trade. Blair, 4584 Anderson, Cleveland, Ohio 44121

TRY RECORDING MUSIC from your car radio with your 4 or 8 track player. For plans of an easy to build and use $10.00 converter, send $2.00 to TAB, P.O. Box 31, Brenham, Texas 77833

CURRENT 8-TRACK STEREO TAPES for only $3.99. Send for your free Catalog today. Reply to Box AJUL2-2

FCC "TESTS-ANSWERS" . . . Original exam manual for F.C.C. First and Second Class License. —plus— "Self-Study Ability Test." Proven! $9.95. Satisfaction Guaranteed. Command, Box 26348-L, San Francisco 94126.

AMPEX 4-track recorder, 300 deck, 351 amps—self-sync—excellent condition; $2495. W. Connor, 815 N. Douglas St., Arlington Heights, Ill. 60004

PHASE LINEAR model 700, $779.00. Sent postpaid. DTR Sound, 2575 Main, Littleton, Colorado 80120.

AMPEX 602 Transport with ¼ Track Head Assembly Like new—$270. KLH 18 FM Tuner—$80. More—send for list. RDD, 1807 Elmcrest, Arlington, Texas 76012

FOR SALE

AUDIO RESEARCH, Radford, Quad, Decca, Infinity Trans-static, JBL, Braun, etc. Information available. Hartley Electronics, 2115 Symons, Richland WA. 99352, (509) 947-5026 after 5pm weekdays, allday, weekends.

METROTEC SDW-1 FOUR CHANNEL DECODER REGULAR $69.95 SALE PRICE $29.95 HENRY'S CAMERA & HI-FI CORP. DEPT. A. 516 W. 8th St., LOS ANGELES, CA. 90014

8 TRACK HOLDER—Compact, attractive walnut finish wood and masonite construction. Holds 48 cartridges. Lazy Susan swivel base. 9½"x9½"x 12½" high. Also available for cassettes. $14.95 postpaid. House of the Swanson, Box 808, E. Norwich, NY 11732.

AUDIO AND HIGH FIDELITY from 6-54 to date. $50 per set or $90 for both, 6708 Gude Ave., Takoma Pk, Md. 20012

FREE "Directory of U.S. Offices of Japanese Electronic Manufacturers". Send name & address. Electronics Div., Japan Light Machinery Information Center, 437 Fifth Avenue, New York, N.Y. 10016

ENGLAND'S LEADING MAIL ORDER AND DISCOUNT SPECIALIST OFFER:—SME IMF RADFORD QUAD TANNOY B & W TEAC KEF DUAL SANSUI AT VERY COMPETITIVE PRICE. PLEASE SEND FOR QUOTES. REPLY BY AIRMAIL. SHIPPED IMMEDIATELY. FREIGHT COLLECT. SOUTHERN AUDIO SERVICES LTD. 43, HIGH STREET, KINGSTON-ON-THAMES, SURREY.

CLASSIFIED ORDER FORM

Want to buy, trade or sell components? Looking for a rare piece of equipment? Want to offer or buy a service? Want a job in the audio field? If your answer is "yes" to any of these questions, your ad belongs in Audio Classified. Rates are comfortably low—readership is astoundingly high. Use this handy order form to include message in the next issue.

PLEASE CHECK ONE:

- ☐ For Sale
- ☐ Wanted to Buy or Trade
- ☐ Situation Wanted
- ☐ Help Wanted
- ☐ Services

Other_____

- ☐ Insert in next issue
- ☐ Insert in next 2 issues
- ☐ Insert in next 6 issues
- ☐ Insert in next 12 issues
- ☐ Assign box number (additional cost $1)

Mail To: Audio Magazine, 134 No. 13th St., Philadelphia, Penna. 19107. For further information, check #135 on the Reader Service Card.

RATES: Commercial, 50¢ per word; situation wanted or non-commercial, 25¢ per word. We reserve the right to determine classification as commercial or non-commercial. **Payment must accompany all orders under $10.00.**

Name _____

Address _____

☐ Office ☐ Residence

City _____

State _____ Zip _____

COPY FOR YOUR AD

FOR SALE

NATIONALLY advertised Audio Equipment, Cost Plus 10%. Stereo World, 3250 Duke Street, Alexandria, Virginia 22314.

PROTECT YOUR RECORDS. Cardboard replacement covers, plastic lined sleeves, 78 and 45, heavy sleeves, hinged record set boxes, 12", 10", 7". Cabco, A-2, 89 East Woodruff, Columbus, Ohio 43201.

THE FINEST STEREO SOUNDS—On demonstration, Audio Research's Magneplanar speakers and Dual 75 amplifier, QUAD ESL's, Infinity, Stax, Decca, Transcriptor, Thorens, Revox—D S Audio, 410 East Evergreen Road, Lebanon, Pennsylvania 17042 (717) 273-6314.

ORGAN OWNERS & BUILDERS GET THE FACTS about Electronic and Pipe Organs, kits and accessories. Send $2.00 for new book—"ORGAN BUILDING FOR FUN AND PROFIT" by Robert L. Eby. FREE Parts Catalog included. Newport Organs, Dept. A, 846 Production Pl., Newport Beach, Ca. 92660.

FREE 4-TRACK Stereo Tapes, 8-Track Cartridge, Cassette. Write Music, Box 27815, Los Angeles, Calif. 90027.

WHOLESALE! Professional Amplifiers, PA Systems, Guitars. Free Catalog. Carvin, Escondido, Calif. 92029.

TUBES "Oldies", latest. Lists free. Steinmetz, 7519-A Maplewood, Hammond, Indiana 46324.

AMPEX PRO TAPE by the carton. Send for prices. BKM Associates. Box 22 Wilmington, Mass. 01887.

BARCUS BERRY transducers for acoustic guitars, pianos, banjos, violins, and other stringed instruments.

- Amplify your acoustic guitar to sound like an acoustic guitar, with total isolation from noise.
- The smallest pianos give big sound through sound systems on your club dates.
- A valuable tool for recording where acoustics are less than optimum.
- Hi/lo impedance outputs from matching preamplifiers to music amps, tape recorders, and studio consoles.

Write or call: CATH-MAR RECORDING SERVICE
17113 Cambridge
Allen Park, Michigan 48101
(313) 278-2278

INFINITY SERVO STATIC one speaker system. Four (4) screens. Original "R.T.R." midrange modules. Walnut Finish (extra screens in rosewood). $1,500. (414) 961-0184. John W. Clark.

SCOTCH TAPE AT DEALER PRICES. Send for Price List. Federated Electronics Inc., 11824 W. Olympic Blvd., Los Angeles Ca. 90064.

SCHOEPS CMT-56 MICROPHONES—demonstrators. Three pattern type, Cardiod, Bidirectional, Omnidirectional, +48 volt powering $275. (cost new $377.) Gately Electronics 215-446-1415.

BUY DIRECT FROM ENGLAND'S HI-FI MAIL ORDER SPECIALISTS! Save on SME. Leak. Goldring, Decca. Tandberg. Revox. Gold Speakers. Garrard. Wharfedale. KEF. Celestion. Transcriptors. Cambridge etc. Insured shipping quotes free or send $2.00 bills for catalog ($4.00 air post) credited on first purchase over $100. Goodwin Ltd. 7 Broadway, Woodgreen, London N22. Visitors welcome to showrooms.

MARANTZ 10B Later model custom cabinet $750.00 1-503-282-9264

THORENS TD Mark II Good Condition, $100; Tandberg 6000x—M. Harris, Box 292, Fisk Univ., Nashville, Tenn. 37203

FOR SALE

ON DEMONSTRATION—Trans-static electrostatic transmissionline monitors, Super Quad speaker system, Audio Research Corp. D-75 amplifier, Phase Linear 700 and 400 amplifiers, Sound System International arm-turntable combination. Paul Heath, 81 Big Tree St., Livonia, N.Y., 14487 (716) 346-5630.

PSYCHEDELIC LIGHT—Box Kits—From $5.00! CarrCraft, Dept. 150, P.O. Box 1165, Yucalpa, Calif. 92399.

FREE literature and quotes on Hitachi stereo equipment. Write: Disco Electronics, Inc., P.O. Box 146, Springfield, New Jersey 07081.

RUBBER STAMPS. One line $1.00. Each additional line 50¢. Good quality. Prompt service. MOYERS, 3037 Montrose, Chicago, Ill. 60618.

STEREO CORNER will sell most major Audio Products at 20% off the advertised list price—Freight pre-paid. Send order with check to: Stereo Corner, 339 Park Ave. So., Winter Park, Fla. 32789. Check will be refunded by return mail if we are unable to fill order.

CAPITOL RECORDING TAPE—Open Reel—Cassettes—8 Track—Discount Prices. FORDHAM RADIO—265 East 149th, Bronx, N.Y. 10451, Dept. T.

TV & RADIO TUBES 36¢ EA. Free 48 page Color Catalog Cornell 4215 A University. San Diego, California 92105.

"PERFECTIONISTS" and discerning people can now get the amplifier that's "wiping out" all other amplifiers at test clinics across the country and is better than test equipment! Kit only $60. Send for Free Catalog SWTPC, Box 32040B, San Antonio, Texas 78284.

SCOTCH RECORDING TAPE, lowest prices, TAPE CENTER, Box 4305B, Washington, D.C. 20012.

B&W 70CA, PHASE LINEAR, THE WORLD'S FINEST SPEAKER AMPLIFIER COMBINATION. JVC 5011 super preamp. Transcriptor, EPI Tower, Quad, Electrostatic specialists. Finest, best equipped laboratory in the country. Formerly supplying to professionals only. Now you can benefit from the unique services of THE AUDIO-LAB, 146 French St., New Brunswick, N.J. 08901 (201) 249-9191.

ALPHAPHONE® headset—brainwave trainer. Free literature. Aquarius Electronics, Box 627-S, Mendocino, Ca. 95460.

QUAD, Radford, Bang & Olufsen Audio components of superb quality for the connoisseur. Audio Imports, 5557 Versaille Dr., Indianapolis, Ind. 46227.

INFINITY AND CROWN SYSTEMS—AKG microphones, UREI limiting, Fairchild equipment, Rabco, more. Finest reproduction possible. Barclay, 503 Haverford Ave., Narbeth, Pa. 215/MO 7-3048.

TUBE Headquarters of World! Send 10¢ for Catalog (tubes, semiconductors, equipment) Barry, 512 Broadway, N.Y.C. 10012.

LOW, LOW PRICES, on Audio Equipment, L.P. Records, and Tapes. All factory fresh, 1st quality items. Trained personnel at your disposal for audio consultation. We accept Master Charge. Write for FREE CATALOGS to Mr. A, Dept. AMO at SMG DISTRIBUTORS, INC., 46-35 54th Road, Maspeth, N.Y. 11378, or call (212) 786-3337.

EIGHT-TRACK HIGH-SPEED TAPE DUPLICATOR New Becht BE-5500. Regular price $1,295, sell $1,025. Immediate shipment. Kluge Recording Service, 1004 West Ninth Street, Grand Island, Nebraska 68801

FOR SALE

JAPAN HONG KONG DIRECTORY. World products information. $1.00 today. Sekai Shogyo Annai, Hillyard, Washington 99207.

LOWEST Prices Electronics Parts. Confidential Catalog Free. Knaco, 3174 8th Ave. S.W. Largo, Fla. 33540.

COUNTRY RECORDS and tape cartridges—fiddle tunes, blue grass, polkas. Free circular. Write Jim O'Neal, Box A50, Arcadia, Calif. 91006.

BIG BAND SOUNDS of the 20's 30's and 40's—swing and dixieland jazz. 5,000 performances from original recordings and broadcasts available reel to reel or cassette. Ed Jones, 5127 Bauman Ave., Omaha, Nebr. 68152

DIAMOND NEEDLES and Stereo Cartridges at Discount prices for Shure, Pickering, Stanton, Empire, Grado and ADC. Send for free catalog. All merchandise brand new and factory sealed. LYLE CARTRIDGES, Dept. A, P.O. Box 69, Kensington Station, Brooklyn, New York 11218.

FREE, discount price list. Nationally advertised components. Box 18123. Seattle, Wash. 98118.

!!DECCA MK. V!!, Repeat MK V. This is not a misprint. At long last the ultimate cartridge, hand picked and guaranteed from Music and Sound Ltd., 413 Johnson St., Jenkintown, Penna. 19046 215/885-4214

1800' NEW MYLAR TAPE IN HINGED BOXES; 12 reels for $15.00 postpaid. Send for other price lists to WIDE RESPONSE, 2926 Bentley Ave., Los Angeles, Calif. 90064.

CLAVICHORD KIT, caseless for easy construction, 4⅞ octaves. Ace Audio Co. 8 Garden St., Great Neck, N.Y. 11021.

POCKET MAGNETOMETERS enable serious recordists to determine when & if their equipment needs demagnetizing. Han-D-Mags enable you to do something about it. New Audiophile Han-D-Kits are now available. Send for bulletins—R.B. Annis Company 1103 N. Delaware Street Indianapolis, Indiana 46202

Kenwood, Sansui, JVC, Nikko, Akai, Crown, JansZen, PL, IMF, Citation, ESS, SAE, LDE, JBL, Beyer-Revox, Tandberg, Hegeman, Phasel, Braun. Others. US PX Pricing No catalog, quotes only, immediate domestic delivery. Audiofax—District of Columbia, Box 7961 Atlanta, Ga 30309.

CHICAGO'S AUDIO PERFECTIONISTS suggest you forget trips East or West or to small towns for state-of-the-art equipment. NO APPOINTMENT REQUIRED to hear and buy: **Audio Research** (Magneplanar, Dual 75, SP-3, Dyna Mod-kits), **B&O** (full line), **Crown** (Speakers, amps/pre-amps), **Decca** ("London" cartridges, International tone arm, Deccalifts, Microlifts, Kelly Ribbon tweeters), **E.S.S.** (Trans-Static I, etc.), **I.M.F.** (Speakers), **Infinity Systems** (Speakers), **Phase Linear, Quad** (demo of two, four, or "SuperQuad", 33/303, FM3, and AM3—stock), **Revox, Rogers** (phenomenal "BBC Monitor"), **Sheffield** (records, both), **Spendor** (new British speakers), **Stax** (both models electrostatic headphones—super unit is $225, the UA-7 Tone arm, Headphone amplifier), **Transcriptor** (both Hydraulic Reference and Saturn turntables, tone arms, accessory brushes, stylus-pressure gauge), as well as the **Syantific Audio** Record Cleaning Machine, at $595. OPEN DAILY, 10-6 (Mon & Thur to 9 pm), and Tues., Wednes., Fri., or Sat. Evenings by appointment. Ten minute walk north on Chicago's Loop, near Gold Coast hotels. We welcome Bank-Americard, MasterCharge, American Exp **THE AUDIOPHILE,** at 8 East Erie Street 60611. Telephone (312) 787-0750

FOR SALE

STEREO SYSTEMS, LOW PRICES! Write or call: Purchase Radio Co., 747 Main St., Buffalo, N.Y. 14203 (716) 854-2124.

AUTHORS

PUBLISH your book! Join our successful authors. All subjects invited. Send for free appraisal and detailed booklet. Carlton Press (Dept. VRG) 84 Fifth Avenue, New York 10011.

CARTOONING

Learn Cartooning at home. Free booklet. V.A. approved. Cartooning. Box 7069A0 Colorado Springs, Colorado 80907.

PLANS & KITS

INTEGRATED CIRCUIT KITS—Free catalog. FRAZER & ASSOCIATES, 3809 Surfwood Road, Malibu, California 90265.

MISCELLANEOUS

Don't Die without a will! Blank Will form protects your family. Only $2—guaranteed! Order today!! Campbell, 2079 Woodbourne, Dept. 1AU, Baltimore 21239.

STEREOS

COMPLETE LIST OF PRICES

FOR top manufacturers of stereo equipment. Write for quotations on all major brands of stereos.

STEREO COMPONENT CENTER
465 High St.,
Morgantown, West Virginia 26505

Check No. 70 on Reader Service Card

We Don't Have Gimmicks Just Low Prices

Southern Sound Wholesalers

Every Major Brand

Mail Order Discount Prices
Same Day Service

- •Memorex
- •Garrard
- •Dynaco
- •KLH
- •Scotch
- •Sherwood
- •Koss
- •ADC
- •A.R.
- •Harmon Kardon

To Mention a Few!

"Ask For A Quote"

206 A. East Ayre Street
Newport, Delaware 19804
Phone 302/994-6667

71 on Reader Service Card

INSTRUCTION & EDUCATION

FREE D.D—B.D.—M.D.—With Lifetime Ordination. Box 333 PM, Rillton, Pennsylvania 15678.

SIMPLIFIED Typing Course, 25¢. Tri-publications. 270—52nd St., Brooklyn, New York 11220.

EARN College degrees at home. Many subjects. Ministerial studies, High School Equivalency Diploma. Florida State Christian College, Post Office Box 1674, Fort Lauderdale, Florida 33302.

EARN A BRITISH DEGREE in Color. Philosophy, Biochemistry, Radionics, Homeopathy. 35 courses. Curricular free. Dept. A. Brantridge Forest School. "Highfield," Dane Hill, Haywards Heath, Sussex, England.

ELECTRO-OPTICS. The now technology. Free brochure. Epi, Education Dept., Box 413 Mountain View, Calif. 94040.

SERVICES

DON'T PAY the high mail order prices. Thieves Warehouse is coming to your area. Franchises available. Thieves Warehouse, P.O. Box 8057, Pensacola, Florida 32505.

RENT STEREO TAPES $1.50 week. Catalog 25¢ Tape Library, Box 8126, Washington, D.C. 20024.

CUSTOM RECORDING SERVICE. Tape and disc. Stereo and mono. Live and copies. Editing. Masters and pressings. High quality at reasonable rates Joseph Giovanelli, Audio-Tech Laboratories. 2819 Newkirk Ave., Brooklyn, N.Y. IN 9-7134.

LEARN Electronic Organ Servicing at home. All makes including transistors. Experimental kit—trouble-shooting. Accredited NHSC. Free Booklet. Niles Bryant School, 3631 Stockton, Dept. 1D, Sacramento, Calif. 95820.

TRADE STEREO TAPES, $1.25 each postpaid. Minimum three. Tapetrade. Box 2181, La Jolla, Calif. 92073.

HIGH FIDELITY SPEAKERS REPAIRED
AMPRITE SPEAKER SERVICE
655 Sixth Avenue, New York 10, N.Y.

RECORDS MADE FROM YOUR TAPES. Also, editing and mastering. Send for free brochure. Nashville Record Productions, Inc., Dept. AM, 204 19th Ave., So., Nashville, Tennessee 37203.

CUSTOM STYLUS and cartridge re-tipping, repairing. (Weathers, Ortofon, Edison, Shure, etc.) Box 322A, Tuckahoe, N.Y. 10707. 914-SP 9-1297.

GET EXCELLENT CREDIT NOW, no matter what your previous credit has been. Receive any credit card you wish in 30 days fast, easy WITHOUT INVESTIGATION, BARTON GENERAL PUBLISHERS, Box 4487-A, Jacksonville, Fla. 32201.

LIMITED NUMBER of tape recorder heads accepted for refinishing. Payment of $10.00 per head must accompany order. Postpaid within two weeks of receipt. E. Maher, 5 Evans Place, Orinda, California 94563.

ACOUSTECH AMPLIFIER REPAIR. Original performance or improved specifications. BKM Associates, Box 22, Wilmington, Mass. 01887.

MUSICIANS, COMPANIES, get your sound around on 8-track, cassette, open reel. Quality duplicates at super low rates. Write for quick quote. N.R.J. Custom Services, 5523 W. Race Ave., Chicago, Ill. 60644.

EQUIPMENT WANTED

CASH FOR YOUR unwanted LP's and prerecorded tapes. Record House, Hillburn, New York 10931.

OLD RECORDS WANTED. Rock and Roll. Late Fifties, early sixties. The Sound Gallery, Box 66. Woodbury, N.Y. 11797.

WANTED: Sony Pre-amp 2000A. State condition and price. A. Blanchard, Rt. 2, Box 495, Chapel Hill, N.C. 27514.

IONIC TWEETERS. J. Donovan, 3 Thompson, Marblehead, Mass.

REVERSIBLE PLAYBACK DECK. John DuBois, 1104 Austin, Pacific Grove, California.

WILL TRADE Fairchild compander & EVX4 decoder both units new. For Tandberg Recorder 6000X or equal (reel to reel) (only). Michael L. Rogersen 160 Jeniford Road Fairfield, Conn. 06430.

MARANTZ 10B, 8B, 7B or C, SLT-12 Peter Uzelac, Bovey, Mn. ph: 218-245-2421.

RADIO PROGRAMS

RADIO RERUNS, Complete broadcasts. 8¢ stamp for free catalog. Box 724-A, Redmond, Wash. 98052.

OLD RADIO PROGRAMS on Cassettes or Reels high quality, low prices thousands of your favorites live again, priced as low as $8.00 for 6 hours. Catalog 50¢. Remember Radio Inc., Box 2513, Norman, Okla. 73069.

OLD RADIO PROGRAMS. Reels or cassettes. Free catalog. Fred Berney, 5931 S.W. 8 Street, Miami, Fla. 33144.

OLD RADIO PROGRAMS at very low prices yet a large selection. Catalog 50¢. The Best of Radio, P.O. Box 1692, F.D.R. Sta., New York, N.Y. 10022.

OLD RADIO PROGRAMS. CATALOG $1.00 (refundable). The Radio Vault. Box 9032. Wyoming, Michigan. 49509.

FREE CATALOG. Radio Mysteries. Detective House, 218 Orangeview Lane, Lakeland, Fla. 33803.

MOST AMAZING SHOW ever produced for Radio; Ken Nordine, narrator, network cast. Introductory notes by show's creator-producer. Complete series, 19 Cassettes. Volume One, $3.98; subsequent releases, 3 for $10.00. Postpaid. Guaranteed. "Incredible, But, True!", Sawyer, Michigan 49125.

OLD RADIO PROGRAMS - would like to trade. Send list. Perry Roberts Route 2. Box 245K, Pinson, Alabama 35126.

OLD RADIO SHOWS on tape. Complete broadcasts. High quality professional duplication. "Free" catalog. Command, Box 26348-L, San Francisco 94126.

GOLDEN AGE RADIO—Your best source for radio tapes. Box 8404-D, Olivette, Missouri 63132.

OLD Radio Shows, Jazz/Big Band remotes, over 7000 selections, 650 reels, $8.00 for 6 hrs. Plus bonus reels for accumulated orders, $1.00 for catalog (refundable) McCoy's Recording, 1228 Lincoln Drive, Pasco, Washington 99301.

STAMP COLLECTING

CLOSEOUT: Stamps for collectors or to re-sell. Large assortment $1. High value packet $2. Schollmeyer, 436 N.Y. Ave., Brooklyn, N.Y. 11225.

TAPE RECORDINGS

RENT 4-TRACK open reel tapes—all major labels, 3,000 different. Free brochure. Stereo-Parti, 55 St. James Drive, Santa Rosa, Cal. 95401.

MEMOREX recording tape, audio & video lowest prices, write for free information BERGETZ SYSTEMS CO., Box 1181, Melrose Park, Ill. 60161.

STEREO TAPES, $4.95 postpaid. CAG, 3606 Nanton Place, Phila., Pa. 19154.

BIG BANDS of the Thirties & Forties, Originals, Cassettes 90 Minutes $6.00 Dale MC Clees Bx. 122C RR #4 Swanton, Ohio 43558.

CHINESE TRADITIONAL MUSIC on Cassette Tape. Send approximate postage for catalogs and details. Mark V Trading Company, P.O. Box 20321, HONG KONG.

AUDIOPHILES: Edit your tapes professionally write for free proven splicing tips discovered developing new improved splicing devices Nagy Research Products Box 289 McLean Va 22101.

RECORD YOUR OWN EIGHT TRACK TAPES. a new way to convert your eight track player to a player/recorder. Plans $3.00 SOUND FOUR, 4534 50th, San Diego, Ca. 92115.

RENT any Cassette, Cartridge, or Open Reel Prerecorded tape. All Labels. Catalog 75¢. Tape & Time, 1116 4th Ave. No., Sauk Rapids, Minn. 56379.

TAPE—Ampex, BASF, Sony, TDK, Memorex. From 52¢. Catalog 10¢. AudioCessories, 320 W. Edmonston, Rockville, Maryland 20852.

AMAZING OFFER! Unavailable popular artist's rock'n'roll recordings on cassette, 8-track or open reel. Limited supply on many! Free catalog. Rockpile Pub. Inc., Box 159, Brooklyn, N.Y. 11204

BUSINESS OPPORTUNITIES

PRECURSOR TO EXPERTISE: Explore business possibilities in: writing, mail order, surplus, coins, photography. $5 buys all. Sample one field for $1. Order from The Billou Enterprises, Inc., Room 1615, 220 Fifth Avenue, NYC, N.Y. 10001.

MAILORDER—Carry no stock. Companies will pack, ship under your label. One-man operation capable of $10,000-$20,000 year. Details Free! Distributors. Box 9-M, East Rockaway, New York 11518.

HOME portraits. Big money. Free information. "Photography", 5334-A Sunset, Hollywood 90027.

START small, highly profitable electronic production in your basement investment, knowledge unnecessary. Postcard brings facts. Barta-A.M.D., Box 248, Walnut Creek, California 94579.

SITUATION WANTED

TO PHILANTHROPISTS OF SPANISH CULTURE: University Professor wants to open a revolutionary, tuition-free Institute of International Learning in Spanish. He has a vast Library of books (6,000), records (4,000), plates (36,000), slides (18,000), and many other educational materials, including photographic, stereo components, and astronomical observatory. He needs: an appropriate big house for this enterprising goal as a donation. Will accept any state of the U.S. Reply Bos AJUL2-1

RECORDS

OLDIES—45 RPM original labels and represses over 5,000 from personal collection for sale. Reasonable prices. Try me for the ones you've given up hope in finding. Call or write, Robert Fenster, 1503 Ave. J, Brooklyn, N.Y. (212) 258-5121.

COLLECTORS JOURNAL—VALUABLE DATA, RECORD MART 12 issues $3.00—Record Research, 65 Grand Ave., Brooklyn, New York, 11205.

SHOW ALBUMS—Rare, Out-Of-Print LP's. Free large list. Broadway/Hollywood Recordings. Georgetown, Connecticut 06829.

OLDIES—45 RPM. Original hits. Catalog 50¢. C&S Record Sales, Box 197, Wampsville, N.Y. 13163.

CATALOGS. Broadcasts, soundtracks. Personalities of Thirties, Forties. Box 225, New York, N.Y. 10028.

RECORD COLLECTORS—Deleted, discontinued, "hard-to-find" LP's. Soundtracks, shows, classical our specialty. Send your want list to Dept. A, The Record House, Inc., 1101 Polk St., San Francisco, CA 94109.

DELETED L.P.'s? Get on my sales list. Vincent Scaparro, 904 Allerton Avenue, Bronx, N.Y. 10469.

POPULAR organ albums. Free catalog. Doric Records, Box 605-A72 Alamo, California 94507.

CHAPEL Records Club—Free catalog. 1000-B Richmond, China Lake, Calif. 93555.

Soundtracks, Hollywood, Broadway. Mint, sealed. Joseph Conan, Box 31161, El Paso, Texas 79931.

SOUNDTRACKS—FREE CATALOGUE. R.T.S., 1111 S. Benito, Suite F. Alhambra, California 91803

THE GREATEST R&R ALBUM. Two years in compilation. Available only thru the mail and released in the original mono form. 19 songs including Bopalena, House of Blue Lights, Guitar Boogie, Strange Love, Mr. Engineer and more. All songs are stylistic landmarks in R&R. Send $5.00 to Album, POB 1301 Studio City, Calif. 91604.

GOVERNMENT SURPLUS

JEEPS Typically From $53.90 . . . Trucks From $78.40 . . . Boats, Typewriters, Knives, Airplanes, Clothing, Multimeters, Oscilloscopes, Transceivers, Photographic, Electronics Equipment. Wide Variety, Condition 100,000 Bid Bargains Direct from Government Nationwide. Complete Sales Directory and Surplus Categories Catalog $1.00 (Deductible On Orders From Separate Included Catalog). Surplus Service, Box 820-AUD, Holland, Michigan 49423.

TRAVEL & RESORTS

FIVE COUNTRIES, nine day tour, low-cost: FIRST CLASS accommodation. Free brochure, WRITE: Holy Land Tour—Box 192—New Stanton, Pa. 15672.

COLOR SLIDES

SLIDES, ART-EDUCATIONAL-TRAVEL, 50,000 individually sold. Samples-Catalog $1.00 refundable. Visuals D21 440 N.W. 130 Street, Miami, Florida 33168.

Classified

(Continued from page 73)

HELP WANTED

Serious recordists to make records for five companies. We train, equip and provide protected franchised territories. Modest investment required. Send resume to Mr. Bloch, 418 N. Main St., Englewood, Ohio 45322.

PHOTOGRAPHY

SLIDES COME ALIVE when you add sound. Tape-slide synchronizing equipment and supplies. Free (extremely interesting) literature. S&S Supply, Box 12375M, North Kansas City, Missouri 64116.

INVENTIONS WANTED

FREE "DIRECTORY OF 500 CORPORATIONS Seeking New Products." For information regarding development, sale, licensing of your patented/unpatented invention. Write: Raymond Organization 230-AM Park Avenue, New 10017.

Advertising Index

Advertiser	Page
Acoustic Research, Inc. — AR-3a speaker system — Check No. 23 on Reader Service Card	23
Audio Dynamics Corp. — XLM phono cartridge — Check No. 7 on Reader Service Card	7
BASF Systems, Inc. — Magnetic tape — Check No. 42 on Reader Service Card	41
Bose Corp., The — Speaker systems — Check No. 15 on Reader Service Card	15
Bozak Co., The R. T. — Speaker systems — See Your Local Dealer	28
British Industries Corp. — Garrard Zero-100 turntable — Check No. 3 on Reader Service Card	3
Crown International — IC-150 preamp, D150 amp — Check No. 36 on Reader Service Card	38
Dual — 1219 turntable — Check No. 9 on Reader Service Card	9
Dynaco, Inc. — FM-5 tuner — See Your Local Dealer	25
Eastman Sound — Martin Speakers — Check No. 37 on Reader Service Card	39
Electro-Voice, Inc. — Custom speakers — Check No. 34 on Reader Service Card	34
Executive Discount Shopping Service — Swinger Chairs & ottomans — Please write direct	51
Fairfax Industries, Inc. — Speaker systems — Check No. 47 on Reader Service Card	47
Garrard — Zero 100 turntable — Check No. 3 on Reader Service Card	3
KLH Research & Development, Inc. — Model 38 loudspeakers — Check No. 31 on Reader Service Card	29
King Karol — Discount Records and Tapes — Check No. 72 on Reader Service Card	71
Linear Design Labs, Inc. — LDL 749 speaker system — Please write direct	65
Marantz Co. — Receivers — Check No. 43 on Reader Service Card	Cover III
Martin — Speaker systems — Check No. 37 on Reader Service Card	39
McIntosh Laboratory, Inc. — MX-112 tuner-preamplifier — Check No. 30 on Reader Service Card	32
Metrotec Electronics, Inc. — Decoder/amplifier and decoder — Check No. 19 on Reader Service Card	19
Mid-West Hi-Fi — Wholesale Price List & Catalog — Check No. 73 on Reader Service Card	71
Phase Linear — Power amplifier — Check No. 62 on Reader Service Card	62
Pickering & Co., Inc. — Phono Cartridges — Check No. 17 on Reader Service Card	17
Pioneer Electronics, Inc. — SX-727 receiver — See Your Local Dealer	21
Rectilinear Research Corp. — Speaker Systems — Check No. 11 on Reader Service Card	11
Revox Corp. — A77 recorder & Beyer headphones — Check No. 35 on Reader Service Card	35
Rogersound Labs — Speaker systems — Check No. 74 on Reader Service Card	72
Sansui Electronics — Decoder/amplifiers — Check No. 13 on Reader Service Card	13
Schwann Record & Tape Guide — Guide to current records & tapes — See Your Local Record Dealer	59
Scott, Inc., H. H. — Tuner & amplifier — Check No. 100 on Reader Service Card	Cover II, I
Sharpe Audio Div., Scintrex — Headphones — Check No. 2 on Reader Service Card	2
Shure Bros., Inc. — Phono cartridges — Check No. 61 on Reader Service Card	61
Sony Corp. of America — Model 6045 receiver — Check No. 27 on Reader Service Card	27
Sony/Superscope, Inc. — Magnetic tape — Check No. 63 on Reader Service Card	Cover IV
Soundcraftsmen — Frequency equalizer — Check No. 28 on Reader Service Card	31
Southern Sound Wholesalers — Mail-order discount prices — Check No. 71 on Reader Service Card	70
Stereo Component Center — Price list on top brands — Check No. 70 on Reader Service Card	70
Sun Stereo — Components & systems — Check No. 32 on Reader Service Card	32
TDK Electronics, Inc. — Magnetic tapes — Check No. 33 on Reader Service Card	33
TEAC Corp. of America — Cassette decks — Check No. 29 on Reader Service Card	5
United Audio Products — Dual 1219 turntable — Check No. 9 on Reader Service Card	9

When it comes to fine stereo receivers...

a Marantz is a Marantz is a Marantz.

That means Marantz not only makes the finest *most* expensive stereo equipment in the world, but also the finest *least* expensive stereo equipment. Take the Marantz Model 2215 FM/AM stereo receiver for only $249.95. You're getting 15 watts RMS per channel, and exclusive Gyro-Touch tuning. You're also getting the same Marantz prestige, the same craftsmanship, and the same Marantz quality offered in our most expensive equipment.

$249.95

If you're a purist and willing to pay for perfection, then you want the finest, most expensive stereo FM receiver in the world. The Marantz Model 19. Yes, it is $1200. It is the best stereo FM receiver money can buy. And will more than justify your investment.

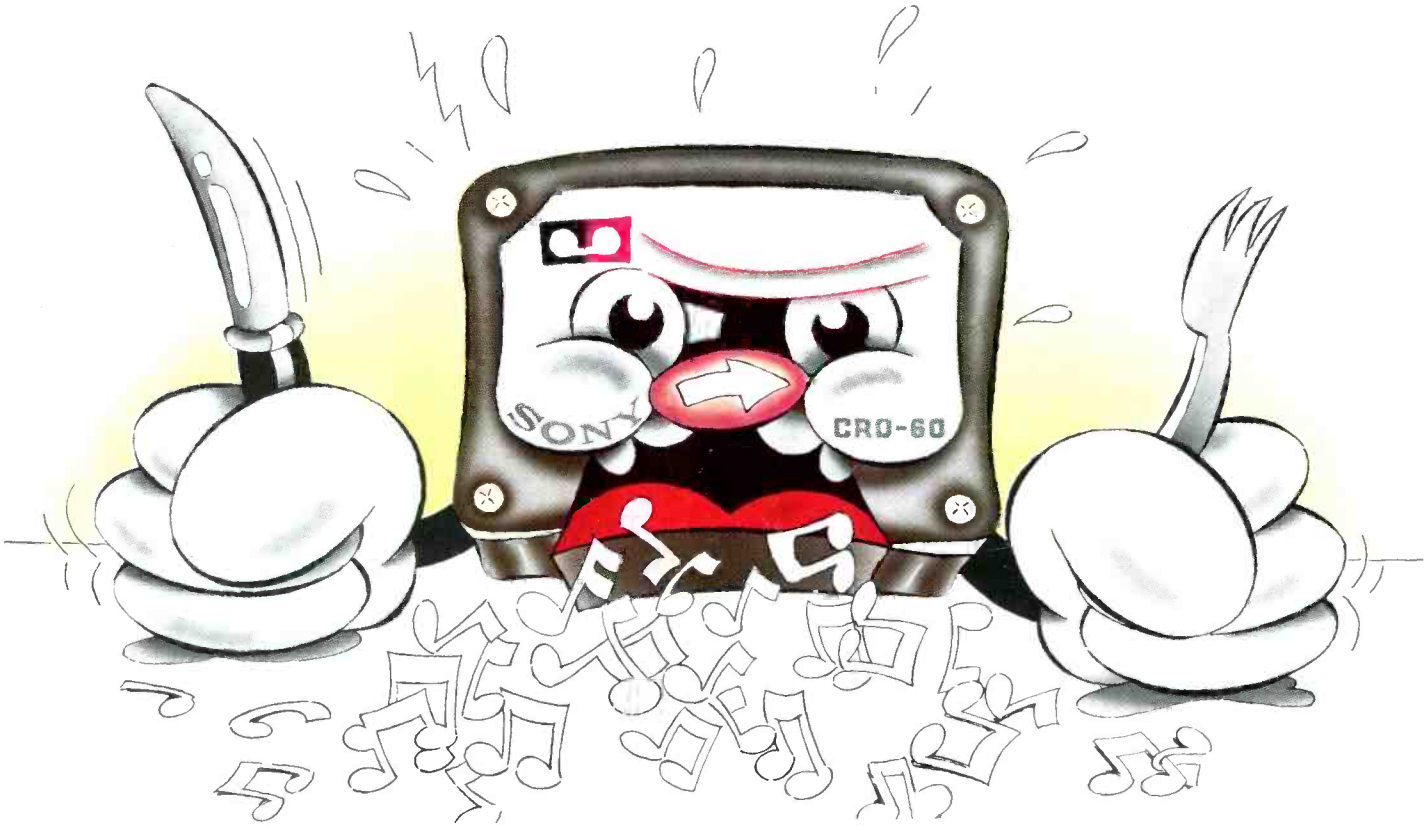
$1200

Same name, same quality—regardless of price. That's Marantz' superior quality, inherent in the full line of components priced from $1200.00 to as low as $149.95. And to complete your system, choose a Marantz Imperial speaker system.

marantz.
We sound better.

Check No. 43 on Reader Service Card

Sony's new chromium dioxide cassette tape is hungrier for high frequencies.



Sony chromium dioxide CRO-60 tape will record up to 50% more volume before you encounter distortion on playback. CRO-60 is hungrier than other tapes for high frequencies.

This means more recorded sound than standard cassette tapes before distortion sets in.

What you hear.

Far less distortion, a smoother frequency response, and a greater dynamic range than standard tape. Every aspect of the sound, especially the higher ranges, comes through with sparkling fidelity.

Sony CRO-60 gets it all together from bottom bass lows to high howlin' highs. And everything in between.

A Sony tape for every purpose.

The new Sony CRO-60 cassette tape becomes a member of a highly advanced line of tapes every recording requirement.

In addition to standard open reel, cassette, and 8-track cartridge tapes, Sony also offers the finest in high performance tape: SLH-180 Low-Noise High Output tape on 7" and 10½" reels, plus Ultra-High Fidelity Cassettes.

These high-performance tape configurations take advantage of the added performance of today's highly sophisticated recorders by providing wider dynamic range, greatly improved signal-to-noise ratio, extended frequency response, and reduced tape hiss.

How's your appetite?

Now if your appetite has been whetted and you're hungry for more information or a demonstration of CRO-60 or any other Sony tapes, get on down to your nearest Sony/Superscope dealer (he's listed in the yellow pages) and get an earful.

SONY SUPERSCOPE

You never heard it so good.®

Check No. 63 on Reader Service Card