

AUDIO

NOVEMBER
1971 60c

The Authoritative Magazine About High Fidelity® A



Christmas Buying
Guide

Build a Tone Burst Generator
The Legend of Caruso
The Listening Room



When you go 4 channel...



go Scott 443 Quadrant® 4 channel

It's Got The Features You Want. The 443 AM-FM Quadrant Receiver makes its own 4 channel programs from any 2 channel source using Scott's exclusive DvR matrixing circuitry. And Scott's flexibility allows combining 4 outputs into 2 for doubled output power when the 443 is used for conventional 2 channel listening. You may select 4 x 18 or 2 x 35 watts by a convenient front panel control.

The 443 receiver also reproduces discrete 4 channel programs from live or recorded sources. And its detector output/multiplex input jacks will accept an adapter to receive 4 channel broadcasts when the FCC establishes a format.

It's Got The Quality You Demand. The 443 uses Scott's FET front end, silver plated tuner, solderless "tension-wrap" connections, quick-change Modutron® circuit boards, direct coupled, all-silicon output stages, plus Scott's traditional 100% American design and manufacture.

It's Got The Value-For-The-Price You Deserve. The 443 receiver offers 4 channels and 72 conservative Scott continuous (RMS) watts into 8 ohms for \$319.90, which is in the price range of most 2 channel receivers of similar features and power ratings.

Want More Performance And Features? Try the Scott 444 AM-FM Quadrant Receiver. It's got all the quality features of the 443 plus separate signal strength and center channel tuning meters, slide type volume controls and switching for up to 16 speakers. At a power rating of 4 x 25 or 2 x 50 watts, it's also a value-for-the-price leader at \$449.90.

Interested In 4 Channel Amplification Only? Scott offers a choice of two integrated control amplifiers. There's the 495 at 4 x 25 or 2 x 50 watts at \$349.90. Then, there's the powerhouse 499 with which Scott officially started the whole 4 channel industry in 1969. It puts out a conservative 40 watts per channel into 8 ohms for \$459.90.



When you go 4 channel, remember that H.H. Scott offers more models and more performance per dollar than any other manufacturer. We needn't say more.

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

Check No. 100 on Reader Service Card



remember PANDORA'S BOX?

Remember the lady whom Zeus sent down to earth with a little box full of plagues and troubles? Next time you buy a tape cassette remember Pandora's box; unless it says TDK on top, you never know what problems you are bargaining for. Sticking. Jamming. Tape tangling and breakage. Wavering pitch due to uneven speed. Noise. Signal dropouts. One way or another, the sounds you want to capture and keep are spoiled or irretrievably lost.



Only with a TDK Super Dynamic cassette can you be sure, sure that you have a cassette that will never let you down.

And that gives you ultra-wide frequency response, high output and extended dynamic range, negligible noise and distortion and, overall, the world's finest quality.

Next time you buy cassettes think of Pandora's box—and buy a box of TDK. Reliability is no hit-or-myth proposition.

TDK offers Super Dynamic, Deluxe Low Noise, Maverick Cassette and Super Dynamic reel-to-reel recording tape



TDK® World's leader in tape technology.
TDK ELECTRONICS CORP.
LONG ISLAND CITY, NEW YORK 11103

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That's all!

That's what Sharpe Stereophones are all about. We make them in the best possible way so that you get the best possible listening. Not just regular listening. The Sharpe kind of listening. The two are worlds apart.

That's because Sharpe units are true scientific instruments. That's where we leave the others behind. We care all the way from research to delivery to you. There's a Sharpe model for every kind of music lover and for every budget.

Models that are guaranteed for life, listed top-rated, make best introductory or advanced listening buys. For your nearest dealer and literature, check the reader service card.

SHARPE AUDIO DIVISION
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Postmaster: Send Form 3579 to the above address

UNANIMOUS ACCLAIM!

First test reports on the Zero 100 by the industry's leading reviewers

Brief excerpts reprinted below. Let us send you the full reports.

HIGH FIDELITY Sept. 1971

Altogether, this new arm strikes us as an excellent piece of engineering; it probably is the best arm yet offered as an integral part of an automatic player. □ Operation is simple, quiet, and reliable. □ All told, we feel that Garrard has come up with a real winner in the Zero 100. Even without the tangent-tracking feature of the arm, this would be an excellent machine at a competitive price. With the novel (and effective) arm, the Zero 100 becomes a very desirable "superchanger" with, of course, manual options.

AUDIO July, 1971

The Zero-100 performed just about as we expected after reading the specifications. Wow measured .08 per cent—that is in the band from 0.5 to 6 Hz. Flutter, in the band from 6 to 250 Hz, measured .03 per cent, both of which are excellent. □ Thus, the Garrard Zero 100 is certainly the finest in a long line of automatic turntables which have been around for over 50 years. □ We think you will like it.

Stereo Review July, 1971

Indeed, everything worked smoothly, quietly, and just as it was meant to. If there were any "bugs" in the Zero 100, we didn't find them. □ Garrard's Zero 100, in basic performance, easily ranks with the finest automatic turntables on the market. Its novel arm—which really works as claimed—and its other unique design features suggest that a great deal of development time, plus sheer imagination, went into its creation. In our view, the results were well worth the effort.

Popular Electronics August, 1971

Our lab measurements essentially confirmed the claims made by Garrard for the Zero 100. We used a special protractor with an angular resolution of about 0.5°, and the observed tracking error was always less than this detectable amount. The tracking force calibration was accurate, within 0.1 gram over its full range. □ The Garrard Zero 100 operated smoothly and without any mechanical "bugs."

ROLLING STONE Sept. 16, 1971

This unit has every imaginable gadget and gewgaw one might possibly desire, and it works. And considering how much it does, and how well it does it, at 190 bucks it doesn't even seem expensive. The changer has so much in it that an analysis of its innards is almost a case study in record player design.

The GRAMOPHONE August, 1971

Reproduction quality was excellent with no detectable wow, flutter or rumble under stringent listening conditions. End of side distortion, which is always a possibility with pivoted arms, was virtually absent, due no doubt to the tangential tracking arm.

HI-FI Fall, 1971

One could go on cataloguing the virtues of the Zero 100 indefinitely.



For 8-page test reports booklet and a 12-page brochure on the Zero 100 and the entire Garrard series mail to British Industries Company, Dept. K 11, Westbury, N. Y. 11590.

Name _____
Address _____
City _____
State _____ Zip _____



A genuine step upward in automatic turntables

GARRARD ZERO 100

The only automatic turntable with Zero Tracking Error

\$189.50

less base and cartridge

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

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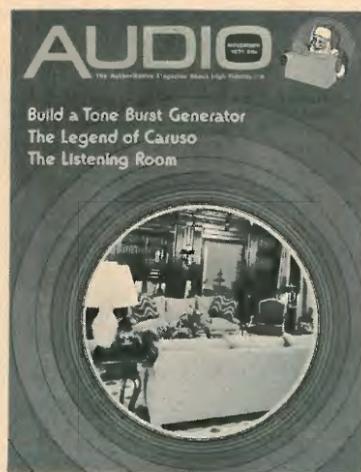
Coming In December

Special Headphone Number—

Articles include a stereo crossfeed unit and a headphone amplifier

Equipment Reviews Include:
Soundcraftsmen 20-12 equalizer
Heath AR-1500 receiver

Plus—
Record and tape reviews and all the regular features



About the Cover: This shows the listening room of Charles Price of Kansas City. JBL S-7 speakers are concealed behind the bookcase and above the doorway. The HF horns are angled slightly inward to give the optimum stereo image. The installation, which includes JBL Lancers and LE 14's in other rooms plus LE 8's on the patio, was made by David Beatty. Amplifiers and tuner are McIntosh (FM MX 112 and 250 power amp).

Audioclinic

JOSEPH GIOVANELLI

Center-Channel Amplifier

Q. I am interested in finding a mono amplifier to use as a center-channel driving source with my Marantz 33 pre-amplifier. The center-channel speaker will probably be some inefficient book-shelf type. Can you make any suggestions as to what I can use?—Corrado J. Bendotti, Bronx, N.Y.

A. As for the kind of amplifier to use for your center-channel driving source, most now are stereo these days. Of course, you actually need just mono. I think you will be forced to obtain a stereo amplifier but you will use just one channel. The actual amplifier will not matter too much, just so long as it has enough power to drive the speakers you plan to use. Your preamplifier must have some means of adjusting the volume of this center-channel amplifier in the event that the power amplifier you ultimately obtain does not have a volume control of its own. Further, the amplifier's minimum input voltage requirement must be at least equal to that which your preamplifier provides at its center-channel output.

If you buy a stereo amplifier, it might be nice if it was the same make as your main amplifier. This way its phase characteristics will match those of your present equipment.

The other channel of your new amplifier will, of course, be unused for the time being. However, you will be prepared for four-channel sound at such time as you wish to enter this interesting phase of our hobby.

Locating a.c. Ground

Q. How can I determine the ground side of an a.c. receptacle?—Joseph P. Laronda, Cheshire, Conn.

A. It is possible to obtain neon lamp testers designed to sense the presence of 117 V a.c. or d.c. They take the form of a neon lamp, mounted in a housing. Protruding from the housing are two leads. If the ends of the leads are inserted into the wall socket, the neon lamp will glow. If one of the leads is inserted into the socket and the other lead is touched to the screw which holds the outlet cover, you may get a light from the tester. Try both socket connections till you find the one which produces a light in the tester when the other terminal is touched to the socket cover retaining screw. Under these conditions, the lead which is inserted in the socket is the "hot" lead; the other one is ground.

The reason I suggest that you try both socket connections before coming to a definite conclusion is simply that I have found that in some old buildings, the box in which the socket is mounted, and hence, the cover retaining screw, is not grounded. In that case, neither socket terminal will cause a glow in the test lamp. In that case, you must use a radiator or waterpipe as the ground connection.

If you do not have one of these testers, anything will work. If you have an ordinary light socket on hand, connect wires to it and insert an ordinary incandescent lamp into it. Then proceed as above.

Amplifier Reserve Power

Q. What is the benefit of using an amplifier which provides 80-80 watts rms when a speaker might use only a tiny fraction of that power?—Ed Hannes, Great Neck, N.Y.

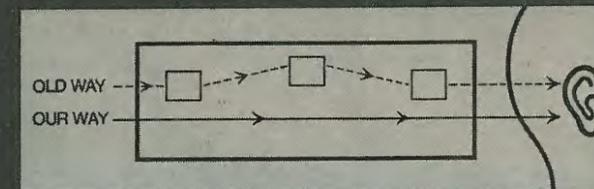
A. Many speakers today are rather inefficient. Therefore, it is necessary to drive them with amplifiers capable of delivering large amounts of power. If you do really loud listening, especially to organ music, you will easily run your amplifier at full power output if you are using one of these inefficient speakers. If your speakers are efficient, you will not need the full amount of power of which the amplifier is capable.

When tubes were used in high fidelity equipment, it was common practice to use amplifiers capable of delivering more power than was necessary. This was helpful because distortion rose slowly in such amplifiers till the power output maximum was reached. After this distortion rose rapidly, of course. Now that solid state devices have replaced tubes, the situation is different. Distortion remains more or less constant until full output is reached. Again, after this point, distortion will rise rapidly—far more so than tube gear.

All of this means that, with an efficient speaker, you can use an amplifier capable of only 10 to 15 watts per channel rms and have all the level and sound quality you could ever need.

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.

We've shortened the distance between you and the music.



Now you can really snuggle up to Schumann. When you get next to our new stereo receiver, the SA-6500.

Because we cut down the distortion. By cutting out the input transformer and the output capacitor. So instead of putting your music through a whole electronic maze, we put it right through. Via direct coupling. With less than 0.5% distortion. And an amplifier frequency response of 10 to 100,000 Hz—1dB.

And because the signal doesn't get capacited and transformer to death, you get something else. Full 200 watts of power (IHF) all the time.

The music is more than just

close, it's sharp. Because we've got 1.8 μ V sensitivity on FM from two 4-pole MOS FET's that can pull in your favorite broadcast next door. Even if it's coming from the next state.

We also have selectivity. Because of two RF stages, a four-section tuning capacitor, four tuned circuits and an IF stage with a crystal filter and integrated circuit.

Having brought you closer to the music, we also bring you closer to absolute control. With linear sliding controls for bass and treble. Low Filter, High

Filter, and Loudness switches to shape the sound. An FM Muting switch to eliminate annoying inter-station noise. And pushbutton audio controls.

There's even more. Like a linear FM dial scale with maximum station separation, for easier tuning. And dual tuning meters to measure FM/AM signal strength and pinpoint FM stations. Plus Lumina-Band tuning to light them up. A full range of input and output jacks. Even a rich walnut cabinet.

Now that our SA-6500 has shortened the distance between you and the music, all you have to do is shorten the distance between you and your nearest Panasonic Hi-Fi dealer.



PANASONIC
just slightly ahead of our time.

200 Park Avenue, N.Y. 10017. For your nearest Panasonic Hi-Fi dealer, call 800 631-4299. In N.J., 800 962-2803. We pay for the call. Ask about Model SA-6500. Check No. 5 on Reader Service Card

Tape Guide

HERMAN BURSTEIN

Recorder for an Auto

Q. I would like to play my 7" stereo reels in my automobile at 1 7/8, 3 3/4, and 7 1/2 ips. Is this possible? Is there equipment on the market for this? Is there a portable deck available which would play the tapes mentioned?—David E. Benford, New York City, N.Y.

A. If it is a portable, battery-operated tape machine that you are seeking, I don't specifically know of any that accommodate reels larger than 5" and at the same time meet your other requirements. I suggest that you consult the audio stores in your locality. A possibility you might care to explore, particularly if you wish high quality performance, is to employ an a.c. operated tape machine and power it from a converter that plugs into the cigarette lighter unit of your car. Again, consult your audio dealer on this.

Quality of Reproduction

Q. I bought two tape decks while overseas, planning to use them to play pre-recorded tapes. I have been disappointed in the quality of such tapes, finding that the hiss and other noise is quite a bit more audible than that on FM stereo or on discs. Given the state of the art, what medium of reproduction has the highest fidelity—FM stereo, disc, or tape?

I am still planning to continue the use of tape for off-the-air recording. Would having my machine adjusted for low-noise tape substantially improve the quality of reproduction?

I am considering the purchase of a Revox A-77 or Tandberg 64X. I haven't heard these machines yet, but the specs surpass what I have now. With either of these machines, could I achieve fidelity equal to the original FM-stereo broadcast?—Bob Kellogg, Winston-Salem, N.C.

A. If the broadcast is of live music (or other live material) and if the FM station employs good equipment properly aligned and properly used, then FM probably offers the highest fidelity. Next I would place discs because I think the average high fidelity disc still tends to be better than the average high fidelity prerecorded tape; however, there is probably little to choose between the very best discs and the very best tapes.

Converting your machine to use with low-noise tape, which requires changes

in bias current, equalization and audio drive current for optimum results, would probably tend to improve matters so far as noise is concerned.

I am sorry, but I cannot comment on the tape machines you are considering for purchase inasmuch as the policy of AUDIO prohibits me from doing so.

Left-Channel Static

Q. I have used my Sony TC-200 tape recorder for about four years. For the past several months I have been picking up annoying static electricity on the left channel. My tapes do not produce any static when they are played on other recorders. When I pull back the pressure pads, the quantity of static is cut down but is not eliminated. After cleaning the heads, guides, and pressure pads and after demagnetizing the heads, the static is eliminated for only an hour or two of playing time. Are there any other ways to reduce or eliminate this static electricity?—V. Gary Taylor, Williamsburg, Va.

A. The only possibility that occurs to me is that the playback head of your machine is not properly grounded. Check the grounding carefully.

Proper Choice of Speed

Q. For home use, is 3 3/4 or 7 1/2 ips the best speed? My recordings will be from discs, off the air, and from other tapes. Should a different speed be used for each special instance, or the same speed for all of one's tapes?—Avery L. Puckett, APO San Francisco, Calif.

A. For home use, and assuming you want really high fidelity, 7 1/2 is still the preferred speed. If you employ a high quality machine, you may, however, find that the deterioration in performance between 7 1/2 and 3 3/4 ips is so small or even unnoticeable as to permit you to do your recordings at the lower speed. The only way to tell is to try. Should you find that 3 3/4 ips is truly satisfactory, then stay with that speed for all purposes. But if you find that 7 1/2 ips offers a worthwhile improvement, I suggest you use this for sources offering good quality, and shift to 3 3/4 ips for sources of lesser quality. Again, you will have to experiment to arrive at a final course.

Crosstalk

Q. I seem to be having trouble with crosstalk on my tapes, that is, when tracks 1 and 3 are playing, tracks 2 and 4 are

clearly audible in the background playing backwards. Needless to say I find this somewhat disturbing as I thought the tape I was using was supposed to be excellent. When I bought the tapes I was afraid that I might have trouble with leakage or crosstalk, but was assured that with good equipment there would be no difficulty. Using Scotch 290 (1/2 mil tape), I find that the half of the reel nearest to the center of the reel never winds smoothly, although some tapes wind more smoothly than others. This is also the portion of the tape that gives me the most trouble with crosstalk. I have no problems with winding or crosstalk when I use Scotch 203 (1 mil).

I realize that when using thin tape, things of this sort are more likely to happen. The crosstalk occurs soon after recording (within 24 hours). The tapes are not subjected to excess humidity and are kept at room temperature. I am wondering if there is anything wrong with my equipment or if I have defective tape. If it is just that the tape is too thin, which tape would you recommend so that I could get the greatest amount of playing time with least crosstalk?—Alan Koslow, Clayton, Missouri

A. One might think that your crosstalk problem is due to vertical mispositioning of the tape head. But since it occurs only with certain tapes, it does appear that the tape is at fault. I am not sure I can explain why. It's almost as though print-through occurred, not from one layer to the next, but from one track to the next. You may be experiencing a form of "adjacent channel spill-over." Another possibility is that layer-to-layer print-through occurs; and that lack of smooth winding permits tracks 2 and 4 to approach the position of tracks 1 and 3 more nearly than if winding were smooth.

The policy of AUDIO magazine prohibits me from recommending specific items of audio equipment, including tape. Therefore I can only suggest that you try various tapes until you find the one closest to your needs. I might add that the NAB standards suggest staying away from 1/2-mil tape for high quality recording.

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.

NO BEATS, TWEETS, BIRDIES, GABBLES, OR GROANS...



The tweets and birdies that happen when the high frequencies in your input signal beat against the bias frequency can't happen in our new cassette deck F-107. Because its bias frequency is so high — 100 kHz —

that even beat frequencies are too high to be audible. And you won't get the speed-up gabble or the slow-down groan that means your recorder taped something at one speed but is playing it back at another. That's because our hysteresis synchronous motor drive assures precise, uniform speed at all times, despite those power fluctuations that are so common these days.

The beats, tweets, birdies, gabbles and groans, you don't get.

What you do get is 30-13,000 Hz response, a 47dB signal-to-noise

ratio, and less than 0.2% wow and flutter.

Plus features like the dual bias tape selector that we pioneered, Endmatic automatic stop that saves transport and tape wear, and all the controls that you could wish for (even a mono-stereo switch). Just \$149.79. Concord Division, Benjamin Electronic Sound Corp., Farmingdale, N.Y. 11735/subsidiary of Instrument Systems Corp.

CONCORD F-107

Prices subject to change without notice.

**BENJAMIN
CONCORD**

Check No. 7 on Reader Service Card

What's New in Audio



Leader LAG-25 generator

This solid state sine/square wave generator features a 20 Hz to 200 kHz range in four decades, with a low distortion sine wave and fast-rise square wave. Calibration accuracy is said to be $\pm 3\%$ ($+2\text{Hz}$) and is direct reading. Drift is rated at less than 1% with $\pm 5\%$ change in line voltage. The unit will generate complex waves for IM distortion checks and synchronize frequency from any external standard source. Price: \$99.50.

Check No. 8 on Reader Service Card



Kenwood KW-5066 recorder

This reel-to-reel machine has a claimed response of 25 to 20,000 Hz ± 3 dB. A front-panel bias adjustment allows the user to setup the machine for a wider than normal variety of tapes. Other features include echo, sound on sound, full-track erase, and noise filter. Price: \$259.95.

Check No. 10 on Reader Service Card



Pioneer PL-41D turntable

Less than 0.07% wow and flutter is claimed for this unit which uses an eight-pole hysteresis synchronous motor, to drive the 12 $\frac{1}{4}$ -in. 4.6-lb. diecast platter by means of a polished polyurethane belt. The belt drive also features a lock mechanism which is said to prevent deformation of the belt when the speed is changed. Tracking force range is 0.4 to 12 grams, while tracking error is specified at 0.17 degrees/cm. Price: \$220.00.

Check No. 37 on Reader Service Card

Catalogs

Xcelite has issued bulletin/price list 671L, covering a series of magnetic nutdrivers which use Alnico magnets and come in a variety of styles and sizes.

Gotham Audio offers a four-color, six-page brochure on the Delta-Tau Model 101 audio signal delay unit, which digitally processes audio signals. Several applications are described.

Howard W. Sams & Co., Inc. has made available copies of its current catalog of technical and scientific books.

Olson Electronics' latest catalog, 771, offers a wide variety of equipment and accessories, from receivers, speakers, and microphones, to noise filters, test leads, and cassette storage cabinets. Price: 25¢ from Olson Electronics, 260A So. Forge St., Akron, Ohio 44308.



Novasound Kaleidophone

The Model A Kaleidophone is an electronic music synthesizer which can be used as a live performance instrument, a teaching aid, or sound effects generator. The unit does not require signal generator modules or patch cords, though inputs from an electric guitar or turntable can be used. Price: \$1,296.00.

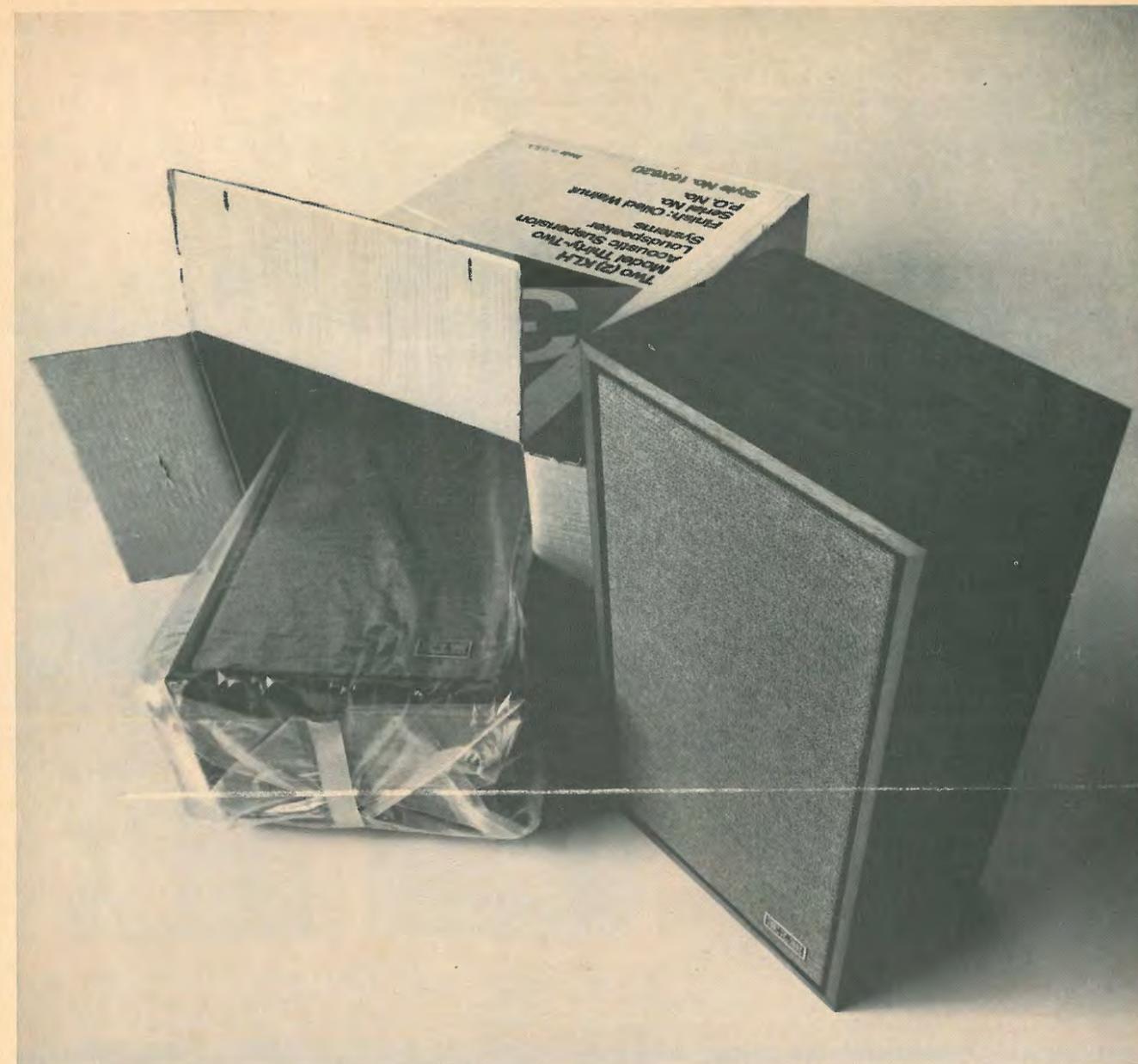
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Russound/FMP IMP-1 Impedaverter

This solid state electronic impedance converting amplifier terminates medium and high impedance microphones properly, yet allows the use of cables up to 500 feet in length. Gain and phase switching is provided, as are paralleled $\frac{1}{4}$ -in. phone and RCA-type phono jacks at both input and output.

Check No. 11 on Reader Service Card



The \$95 Misunderstanding.

It seems there's been some confusion about the price that appeared in our first ad for the new KLH Model Thirty-Two loudspeakers. To clear up any misunderstanding, the price is, indeed, \$95 the pair (\$47.50 each).†

If you're wondering how we could make a KLH loudspeaker for \$47.50, it's really quite simple.

We had two choices.

Either we could make a fair speaker and a lot of profit. Or we could make a lot of speaker and a fair profit.

We chose the latter. We always do. That's why KLH speakers sound like KLH speakers.

Of course our Model Thirty-Two won't deliver as

much bass response as, say, our Model Seventeen. But the basic listening quality of the new KLH Model Thirty-Two is superb by any standard. In fact, we'll match the Thirty-Two against any speaker in its price class: even against most speakers costing twice its price. For when it comes to making reasonably-priced speakers that deliver an inordinate amount of sound, that's really what KLH is all about.

And about that, there can be no misunderstanding.

For more information on the Model Thirty-Two, write to KLH Research and Development, 30 Cross St., Cambridge, Mass. 02139. Or visit your KLH dealer.



KLH RESEARCH AND DEVELOPMENT
A Division of The Singer Company

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

Check No. 12 on Reader Service Card

Christmas Buying Guide



Under \$10.00

A. How about a case for carrying records? The Duotone RC-50 (as its name implies) has room for 50 LP discs and costs only \$9.95. It is finished in black leatherette and has extra strong locks. The address of Duotone is P. O. Box 1168, South Miami, Fla. 33143.

Interested in FM DXing? The Univ. of Wisconsin has an atlas available which lists nearly 300 FM stations in the U.S. and Canada. It costs \$2.00 (postpaid) from Dr. Bruce F. Elving, WUWM Radio, Univ. of Wisconsin, Milwaukee, Wisc. 53201.

B. Here is something for the home constructor: adhesive copper tape for making circuit boards. It costs \$1.00 for a 1/16-in.-by-12-ft. roll and \$2.00 for a 1/8-in.-by-12-ft. roll. From Tape-A-Circuit, P.O. Box 3268, Scottsdale, Ariz. 85281.

Under \$35.00

C. The Staticmaster record cleaning brush features a polonium cartridge which is claimed to neutralize static charges by sending out a stream of alpha particles. The cartridge is said to be replaceable—which is strange because the half-life of polonium is about 626 years. Still, you never know. . . . Makers of the Staticmaster are: Nuclear Products, 2519 N. Merced Ave., So. El Monte, Calif. 91733.

D. The Display Media cases are described as "a cure for

cartridge clutter" and the cassette case holds 20 tapes and costs \$9.95. The larger version, which has room for 40 8-track cartridges, is fitted with a lazy susan base and costs \$19.95. Both models are made of solid walnut. Display Media, 120 Laura Dr., Addison, Ill. 60101.

E. Why not buy another pair of stereo phones—either for another member of the family or for your own personal use. The Pioneer SE-120 shown here have a very wide frequency range and are unusually light at a mere seven ounces or so. Price: \$29.95.

F. A lot of good music is now available on cassettes but many people have 8-track players—especially in their cars. The solution to the problem is simple—use an adaptor. Two recently released are the Toyo 680, which costs \$29.95, and the Muradaptor at \$34.95.

Under \$120.00

G. Changing to four-channel? There is now a wide selection of decoders including Sansui, Denon, EV, Sony-CBS, Toshiba, Heathkit, and Dyna. Shown here is the Metrotec version of the EV Stereo-4 and it features independent decode control of front and rear channels as well as front/rear balance control. It costs \$69.95, but you can save \$20.00 if you assemble it yourself.



H. Those rear speakers could pose certain domestic problems in some households and one compromise is to use coffee-table speakers like the Empire 6000's (\$119.95). The tops are solid marble, not plastic. Another possibility are the small 3M Co. A-1050's, which are priced at \$75.00 a pair. Among the more conventional systems worthy of consideration are the new JansZen 108's which use an electrostatic treble unit with an 8-in. bass speaker. They measure just 20 by 10 by 10 in. (approx.) and cost \$99.95 each.

Under \$300.00

I. Audio equalizers which give a frequency control by octaves cannot make a poor loudspeaker sound like a good one, but they can often effect a dramatic improvement. They can also help to reduce standing wave peaks in poor listening rooms. Among those available are the Advent, Metrotec, SAE, and Soundcraftsmen. The model shown here is the Soundcraftsmen 20-12, which gives separate channel control with a 24 dB range for each of 10 octave bands. Price: \$299.50.

J. Another solution to quadraphonic conversions is a combined decoder-amplifier and the addition of such a unit will enable you to play discrete 4-channel tapes, matrix discs, as well as producing a surround sound from ordinary two-channel stereo sources. A typical decoder-amplifier is the Sansui

QS-100, which produces 15 watts per channel (rms, 8 ohms) and is priced at about \$200.00. QS-1 shown.

Expensive

K. Need more power? How about investing in a Marantz 500, a state-of-the-art power amplifier giving an output of 500 healthy watts per channel? That's right—a total punch of one kilowatt! But, after all, this is really only about 10 dB higher than a modest 50 watts per channel. Model 500 will mount on standard racks without adaptors and sells for \$1200. There is a three-year parts and service guarantee.

L. Here are two other items that could give pleasure to the whole family (or commune?). The first is the new Musonics Sonic V Synthesizer which has a four octave keyboard and comes complete with built-in speakers ready to play for \$895.00. No patch cords are used, and it measures only 34 inches wide by 21 inches deep and 13 inches high. Makers are Musonics, Inc., P. O. Box 131, Academy St., Williams-ville, N.Y. 14221.

M. The second item is a complete closed circuit TV and intercom system at the remarkable price of \$370.00. The monitor has a 5-in. screen and the camera, which has a F:1.6 lens, is said to pick up a good picture under poor lighting conditions. Obtainable from Olson Electronics, 260 S. Forge St., Akron, Ohio 44308.

BEHIND THE SCENES

BERT WHYTE

EARLY IN SEPTEMBER I was in London, visiting with Dr. Ray Dolby and his charming wife, Dagmar. I was also privileged to see the inner workings of Dolby Laboratories, about which I'll report on in the near future.

While in London, I had the opportunity to hear a demonstration of the CBS SQ four-channel disc. The indefatigable Ben Bauer of CBS Laboratories was on hand to explain the workings of the SQ disc to a large assembly of British audio enthusiasts, including quite a few members of the British hi-fi press. The venue was a largish room in the Grosvenor House, measuring approximately 35 feet wide by 50 feet deep, with 11 foot ceilings. As Mr. Bauer pointed out, a room this size is just about the limit for demonstrating four-channel sound.

At each corner of the room there was a huge studio monitor speaker, and in between the front speakers a Studer four-channel stereo tape deck, conventional disc playback equipment, and of course, four-channel stereo amplification. There was also remote switching equipment and an illuminated glass display panel to indicate what mode the sound system was in during A-B tests. It was possible to switch between the master tape and the SQ four-channel disc, the SQ disc plus electronic logic (a special feature of the CBS system), the switching allowed the SQ disc to be played in conventional two-channel stereo mode, and finally, monophonically. As with most of these demonstrations, the room was jam-packed, so that many of the auditors (including yours truly) were poorly situated for optimum evaluation. Add to this the fact that these studio monitor speakers are highly directional and the optimum listening area becomes even more circumscribed. In regard to this symmetrically "ideal" listening area, I respectfully must disagree with Mr. Bauer that quadrphony per se "frees" the listener from the "center of the room" spot. The type of speakers used has a great deal to do with the shape of a quadrasonic sound field, with wide dispersion of high frequencies a de-

sirable characteristic. But I submit that even with theoretically "ideal" speakers, a person who has gone to the expense and trouble of setting up a four-channel stereo system wants optimum results, and invariably in my experience, this is the intersection of the four sound fields in the approximate center of the room.

At this point, a description of the CBS SQ system would be in order. However, I have not yet been to Mr. Bauer's laboratories for really intensive listening and discussion. Plus the fact that Mr. Bauer has written an article for AUDIO explaining his system, which appeared in the October issue. Nonetheless there are several aspects of the SQ system which are purported to be different from other matrix systems, and these should be mentioned. The system is said to possess "omnidirectional stereo fidelity," which means that if a constant signal is panned around the encoder, the total sound power delivered to the *stereophonic* loudspeakers should remain constant regardless of the angle of the pan. To quote Mr. Bauer, "the system also displays omnidirectional *quadrasonic* fidelity—with a signal panned into the encoder around a 360 degree angle, the total encoded energy applied to the four loudspeakers should remain constant." The aforementioned "electronic logic," is described as a circuit which recognizes back channel sounds as side-effect sounds (as interaction between front and back channel pairs) because of their equal strength and phase relationship, and causes the gain of the back channel amplifiers to be diminished. In this manner, the complete illusion of the full orchestral span is preserved regardless of listener orientation. When there is an orchestral pause in the music you are listening to, the reverberent sounds carry on and the logic causes full restoration of the back channel amplifier gain so as to reproduce accurately the reverberent effects.

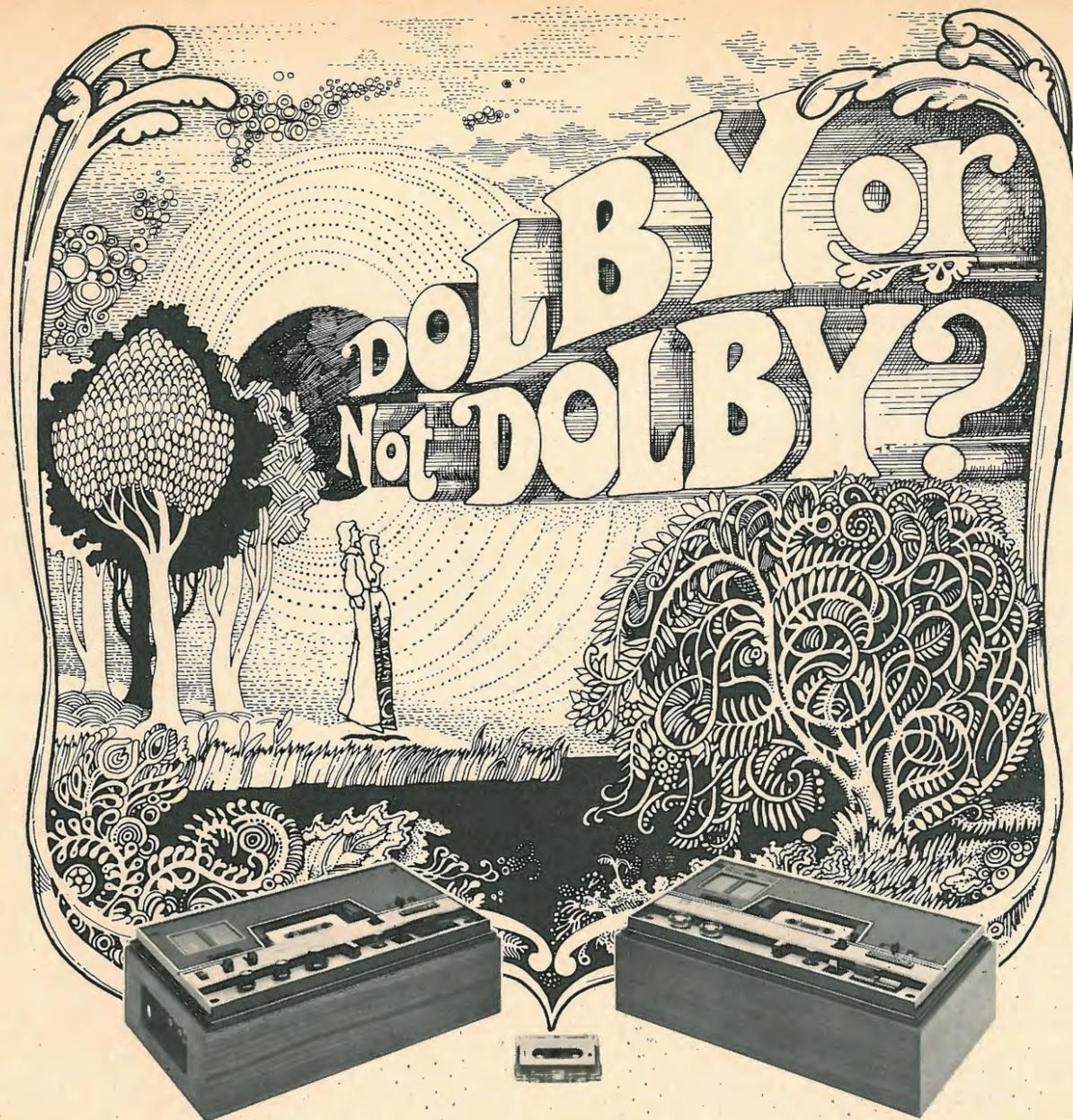
As for the demonstration itself, a four-channel SQ disc was played with an introductory narrative by the urbane Mr. David Frost, interspersed with

musical examples. There were the usual cornball (but quite legitimate) "effects"—Frost's voice moving around the four speakers and the very eerie, chilling howls of a circling wolf pack! Then a four-channel master tape and an SQ disc cut from the master were played synchronously and A-B testing commenced. The pop music was a varied bag of rock, mood, and show stuff, all typical mix-downs from 8- and 16-track material. Classical music was the ubiquitous Walter Carlos' "Switched On Bach," some of the Gabrielli Canzoni, and the merest snippet of the finale of Tchaikovsky's 4th Symphony.

How did our British cousins react to the demonstration? How did I like it? The first comments from some people I talked to didn't surprise me. Their first concern was not with four-channel stereo, but with the sounds of the studio monitor speakers. In short, they utterly loathed them. Said one irate chap, "Blasted things can drill a hole right through one!" If you know the British propensity for understatement, you can understand why they felt this way about these hyper-bright "presence-peaked" speakers. As to four-channel stereo per se, or at least to the matrixed disc kind that they heard, reactions were mixed. Some of the keener types I spoke to were enthusiastic, not merely because of the demonstration they had heard but for the whole idea of multi-dimensional sound and another step towards the concert hall experience. Still others dismissed the whole thing as a fad or a gimmick, and opined that they didn't think four-channel stereo would get very far. A few were outright condemnatory, stating they heard all sorts of distortion, and "you just don't hear music this way" and it was just a plot by the damn yankees to sell more speakers and amplifiers. Gad! From my less than ideal spot, I thought the presentation was good and allowing for the speakers, the sound was clean and well-balanced. The A-B tests between the tape and the SQ with logic were quite

(Continued on page 14)

AUDIO • NOVEMBER 1971



Which of these two new Wollensak stereo cassette decks is worthy of your sound system?

One is Dolby. One is not.

The one on the left is the Wollensak 4760 cassette deck featuring the new Dolby System® of noise suppression. It reduces the level of background tape hiss by 10 db at 4,000 Hz or above, while greatly increasing dynamic range. To enhance fidelity, bias for both standard and high performance tapes can be selected by a tape selection switch. Frequency response of the Model 4760 is 35-15,000 Hz plus or minus 2 db. This deck is the ultimate in cassette decks; the finest you will ever buy. It is equal

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to the best and most expensive open reel recorders.

For the man who wants many of the same high qualities of the 4760 without the attributes of the Dolby System, we have also invented the Wollensak 4755 cassette deck. Both of these unique decks feature a massive, counter-balanced bi-peripheral drive responsible for one of the lowest wow and flutter characteristics you'll find anywhere. The precise heavy-duty tape transport mechanism is considered the finest by many audio experts. This mechanism includes the only full-size flywheel and capstan available to assure constant tape

speeds. Fast-forward and rewind speeds are about twice as fast as any other. Interlocked controls allow you to go from one function to another without first going through a stop or neutral mode. End-of-tape sensing stops the cassette, disengages the mechanism and prevents unnecessary wear. The "Cassette Guardian" automatically rejects a stalled cassette in play or record position.

Either the Wollensak 4760 or the 4755 can complement your present component system with cassette advantages. Hear them both at your nearby dealer. Then answer the question: Dolby or not Dolby?

Either way...it's worth it **Wollensak 3M**

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- Left and right channel volume controls.
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- Model PEP-77C complete system, price . . . \$99.

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SUPEREX
 ELECTRONICS CORP.
 151 Ludlow St., Yonkers, N.Y. 10705

Behind the Scenes

(Continued from page 12)

effective. However, I am bound to say (and not snidely) that the music that was presented was all of the equal amplitude "surround" variety, even including the classical selections with the exception of the few brief seconds of the Tchaikovsky 4th. You must remember that the "Switched On Bach" is strictly an electronic studio product, while the Gabrielli is in the category of the Berlioz Requiem . . . one of the few pieces written for antiphonal front-to-rear effects. As I have observed with all matrixed discs, when true rear channel ambient information is presented and A-B tested against a discrete master, invariably you perceive that when you switch from the discrete to the matrix, the sound field seems to "collapse" in front of you. It sounds almost like an out-of-phase condition and becomes very amorphous and vague, with little separation or directional qualities to anchor your auditory senses. Thus I personally will have to wait until my visit to CBS Labs and hear the SQ system with classical material with ambient information, before I can state unequivocally that I could not hear any difference between master tape and disc.

It was interesting to note that when members of the audience were given the opportunity to use the remote switching control, they were inclined to spend more time switching between the SQ four-channel and conventional two-channel stereo, rather than between four-channel tape and disc. I questioned a few people about this and they stated that they were more interested in what they might be missing on going from four- to two-channel, inasmuch as they doubted they would ever be able to afford discrete four-channel stereo tape. In the after demo question session, there seemed to be more concern about compatibility than is evidenced by American audiences. Nevertheless there were some very intelligent questions and poor Ben was I think rather "baited" by one chap, described later to me as "half mad-half genius," who was prepared with two metal hoops with which to argue and illustrate the complex permutations of the four-channel matrix.

All in all, I think our British friends were impressed. Percy Wilson, the grand old man of British audio, was there and he summed up things to me quite aptly. "My dear Bert, you know it took us a great deal of time to switch from monophonic to stereo sound. I hesitate to think what is going to happen in the

four-channel era. And I especially dread how we are going to cope with the ladies." It is noteworthy to me that this spry octogenarian thinks there will be a "four-channel era." I look forward to visiting with Mr. Bauer at CBS labs for a full exposure to his most interesting SQ disc.

* * *

I have reported to you in several columns about demagnetization and the unique products of the R.B. Annis Co. The super demagnetizer I mentioned, with the 400 oersted strength at the probe end, has arrived and works like a charm. I measured a value of 3 gauss on the capstan of one of my tape machines with the Annis pocket magnetometer. A few moments application of the Han-d-Mag degausser and then the meter registered zero. Incidentally, the field is so strong that it is only necessary to hold the probe end within a quarter-inch of the heads or guides and capstans . . . not actually touching the parts to effect demagnetization.



The "hot" flush end of the Han-d-Mag is about 700 oersteds and can be used very easily to bulk erase cassettes. A double note of caution is in order . . . on inexpensive tape machines with low quality VU meters it is prudent to keep the probe end of the unit about two inches away from the meters. On higher quality machines one inch spacing is sufficient to prevent damage. A kind note from an engineer at CBS Labs states that a field strength of 350-400 oersteds might damage input transistors and FET's of modern tape machines. Cause would be possible transformer action between degaussing devices and tape head windings which might develop voltages which would destroy solid state devices or at worst degrade operating noise figures. I have checked a number of engineers on this and some state that it is of no concern, while others say maybe. On professional machines, there is no reason to worry. In any case, we are following this up and will report to you as soon as we know the score on the problem.

In the current Module competition we enter the Garrard thoroughbred... complete ready to play...at only **\$9950**

SLX-3

Synchronous 3-speed automatic turntable with magnetic cartridge, base, and dust cover.



Complete with these Blue Ribbon Features

Synchro-Lab synchronous motor for absolutely constant speed

Dynamically-balanced tubular aluminum tone arm

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Interchangeable spindles for manual and auto play

This superb instrument, the finest of its class, combines the dependability and professional features of the top Garrard automatic turntables, with the special convenience of Garrard's pre-assembled modules. The SLX-3 comes equipped with a full range magnetic cartridge, high compliance elliptical diamond stylus, coordinated base and dust cover — and is packed and delivered pre-assembled, ready to plug into any TV, radio, tape or cassette system with appropriate preamp.

SLX-3 is one of four Garrard Modules, designed for every taste and budget. Starting at \$39.50, the entire series reflects the highest standards of Garrard construction and performance. For color literature, see your dealer, or write to British Industries Company, Dept. 11K, Westbury, N. Y. 11590.

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Editor's Review

OCCASIONALLY, I MANAGE to abandon the Editorial Chair for two or three days so I can visit various manufacturers to see what is going on behind the scenes in the labs, so to speak. Many of the new products I have seen during the past few months are still under wraps but there are a number of items I can mention. One is, the new AR loudspeaker system which is mainly intended for studio use. It is based on the standard AR-3a but has four mid-range and four HF domes in addition to the 12-inch bass unit. The domes are mounted to "fire" from the two angled sides as well as from the front so the net result is a wide dispersion. Cubic capacity of the enclosure is the same as the AR-3a, so the bass performance is almost identical. The sound has an uncolored, spacious quality, and I am sure these AR systems—which by the way are called LST's—will find a place in many homes as well as studios. Not far away from the AR plant is a competitor, KLH, and here I was impressed with a new modular system which was demonstrated by Mr. Von Sacken, the Marketing Manager. This was the Model 35 and it comprises a 40-watt (rms) AM/FM receiver, a Dual record changer, plus two Model 6 loudspeakers. Styling was typical KLH and performance, as might be expected, was above average. Price is \$550.00.

Can you imagine a color TV picture about six feet by five feet? Well, that is what I saw at Advent, and the elaborate three-gun projection system is the pet project of Henry Kloss. Henry is also very much occupied with tape recorders. He is very enthusiastic about chromium dioxide tape for cassettes and a demonstration of the low noise level achieved was certainly most convincing. The next call was at H. H. Scott and this pioneer company has an impressive range of products. It was evident that the VP of Engineering, Victor Brociner, and Chief Engineer, Dan Recklinghausen, are giving a great deal of thought to the potential of four-channel stereo. Epicure has moved from the Boston area to Newburyport, a few miles north, and here they are settling into a brand-new factory complete (or so the brochure says) with ping-pong table! I did not see this *pièce de résistance*—but I did see stacks of speakers ready for dispatch. Other visits took me to Bozak where future plans—Top Secret—were discussed with Saul Marantz. A few weeks before this found me down at Benton Harbor, Michigan, at the giant Heathkit plant. Highlight of this visit was a look at the new computerized stacking machine in the immense storehouse. Insertion of a punched card in

the control unit would send the stacking device down the rails to the programmed stop, where it would raise itself to the right level and pick up the required box of resistors or what-have-you's. Heathkit's president, David Nurse, told me that the robot nearly wrecked the storehouse during the first few weeks but now it has been tamed and everything is under control. The Chief Engineer, Gene Fibich, showed me a recent innovation—a large, well-equipped lab which is not used for research or design but for quality control. Here, the new prototypes are sent for a thorough analysis, life testing, and so on before being finally approved. I was interested to see that the new AR-1500 receiver was undergoing its final tests—this is the "second generation" version of the popular AR-15 and we hope to review one of the first models very soon. At the British plant evaluation was always performed by a group working away from the engineering labs but we never graduated to a QC lab on *this* scale!

Hi-Fi For Beginners

I am always being asked "What book on hi-fi would be suitable for beginners?" The trouble is, most of the great books of a few years ago are now a little dated, but here is a new one that can be highly recommended. It is *Hi-Fi in the Home* and it is written by John Crabbe, Editor of the British *Hi-Fi News & Record Review*. No, I am not biased on *this* account but I have to agree with the reviewer who said, "This book is the most up-to-date and comprehensive treatment of domestic hi-fi in print." It can be obtained from Transatlantic Arts, Inc., North Village Green, Levittown, N.Y. 11756. Price is \$9.16 postpaid.

Humor in Advertising

From a press release: Say it with music has become a means for spreading the word for H. B. Fuller. The adhesive product manufacturer has just released a 45 rpm record entitled "Someone is Glueing Your World Together." The words are "Living is taking the shape of tomorrow. It's not far to that world. Someone is gluing your world together, making it a better, Fuller world." Ouch! Of course, advertising with records is not new; more than 50 years ago a candy company made one which was quite popular. It was much better than the Fuller disc as it was made of chocolate, so that after one tired of the music the sticky mess could be eaten—for a fuller inside. G.W.T.

We didn't say this about our new electrostatic headset.

"The really important 'proof of the pudding' is in listening, and here the Isophase showed up as superb. If one were ever skeptical about the use of phones, these should cure him. Lows were solid like those from a large theatre-type speaker system, and highs were smooth and silky, with no raspiness and no harshness. In addition to sounding so good, the Isophase headset was comfortable to wear, even with glasses, for a long period of listening. The kid-like vinyl covering for the circumaural foam pads was as soft as a

maiden's kiss—one of those things you can't hardly ever get any more. Sure, we kicked out the circuit breakers several times, but we simply wanted to see how loud the phones would play. Loud enough, certainly, and even louder than one would consider adequate for comfortable listening. Operation was restored immediately by depressing the circuit-breaker reset buttons on the front panel of the polarizer. On the whole, these phones were well worth waiting for."

C. G. McProud

Audio Magazine did.



The Stanton Mark III Isophase Electrostatic Headset System offers frequency response from 20-18,000 Hz \pm 2dB, and is designed to work from speaker output terminals of any amplifier of at least 10 watts rms rating. Headphones weigh only 15 ounces. Polarizer and headphones: \$159.95. STANTON Magnetics Inc., Terminal Drive, Plainview, New York 11803

The Loudspeaker/Living Room System

Roy F. Allison*

“What do people actually hear when they put on a record and sit in their favorite chairs, and why do they hear what they do?”

AS PART OF A RESEARCH project on loudspeaker measurement techniques, Acoustic Research recently measured the “frequency response” of the sound fields produced by loudspeakers in normal listening rooms. We wanted objective field data on real-life listening situations: what do people who buy high-fidelity loudspeakers, and put them where they will fit best in their living rooms, actually hear when they put on a record and sit in their favorite chairs? And (just as important for our purpose) *why* do they hear what they do? Which aspects of a loudspeaker system’s performance are significant in determining the perceived frequency response, and which (if any) are not?

These questions arise, of course, because of the very significant differences in results obtained when loudspeaker systems are tested in different ways. The “frequency response” depends on the environment into which the speakers of the system radiate, the angle from the system at which the measurement is made, the distance of the microphone from the system, and even the time (relative to the input signal) of the measurement. It is not surprising that there is misunderstanding and controversy whenever loudspeaker measurements are discussed. Some of these differences may be clarified by the illustrations that follow. They show the results of tests on one particular model of speaker system under various conditions, with comments on each type of test. (To answer the obvious question in advance, it is an AR-3a system).

Tests made in an anechoic environment—either outdoors or in a chamber with completely sound-absorbing treatment on the walls—provide information on the direct radiation from the system but only at one angle from it at a time. Figure 1 shows the anechoic response of the individual speakers in the system, taken through the crossover network, at three angles: 0° (directly in front), 30° off the axis and 60° off the axis. The low-frequency part of the woofer curve was taken outdoors, since anechoic chambers are not perfectly sound-absorbent at very low frequencies. The mid-range and tweeter curves were taken in an anechoic chamber but with the speakers on large flat baffles to eliminate diffraction effects.

Figure 1 is only a starting point. This kind of response is never heard as direct radiation from a speaker system, because at and near the crossover frequencies there are two speakers, physically separated in the cabinet, radiating simultaneously. Their phase relationship for rays of direct radiation changes with the angle of the ray, reinforcing or cancelling in the region of overlap. This interference effect is shown in Fig. 2. These are anechoic chamber curves of all three speakers of the system, remounted in the cabinet and operating together. The cabinet’s molding has been removed and the speaker mounting plate extended by a flat baffle. Response is shown at the same three angles as for Fig. 1. It should be realized, however, that while the curves in Figure 1 are typical of those that would be obtained for rays at the same angles in all planes, this is not true for the system curves in Fig. 2. The interference effects

*Vice President, Acoustic Research, Inc., Cambridge, Mass.

would be different for similar angles in different planes around the cabinet.

The first sound that reaches a listener’s ears, regardless of the listening environment, is represented accurately by a response curve taken under the conditions that apply for Fig. 2. The exact curve that would apply depends on the angle of the listener with respect to the cabinet, of course. But this relatively simple situation does not last very long.

After a period of somewhat less than one millisecond, diffraction effects—reflections from the grille cloth molding and the cabinet edges—cause further perturbations in the response at any particular angle. This can still be considered “direct radiation” because, even though it is the result of reflections, it is caused by the cabinet and it is independent of the listening environment. Diffraction effects are visible in Figure

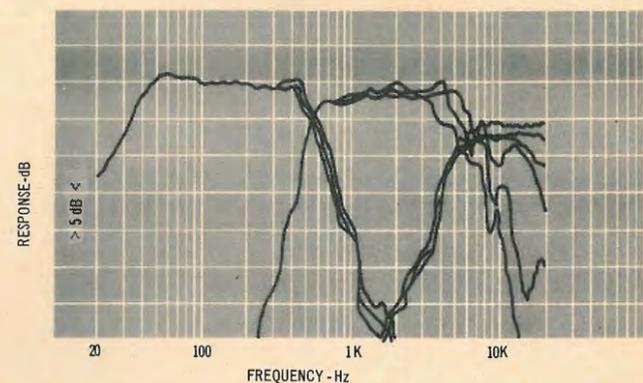


Fig. 1—Flat-baffle anechoic response of each of three speakers in the system, taken at angles of 0, 30, and 60 degrees.

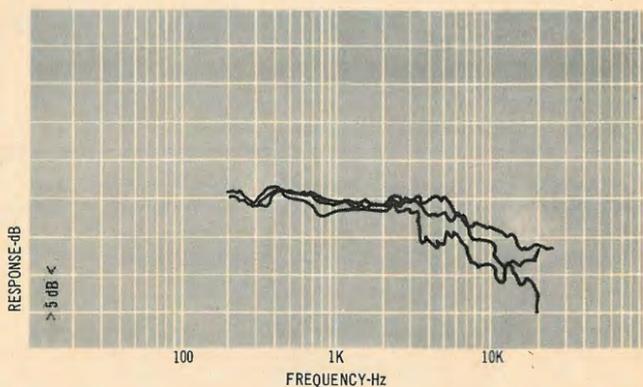
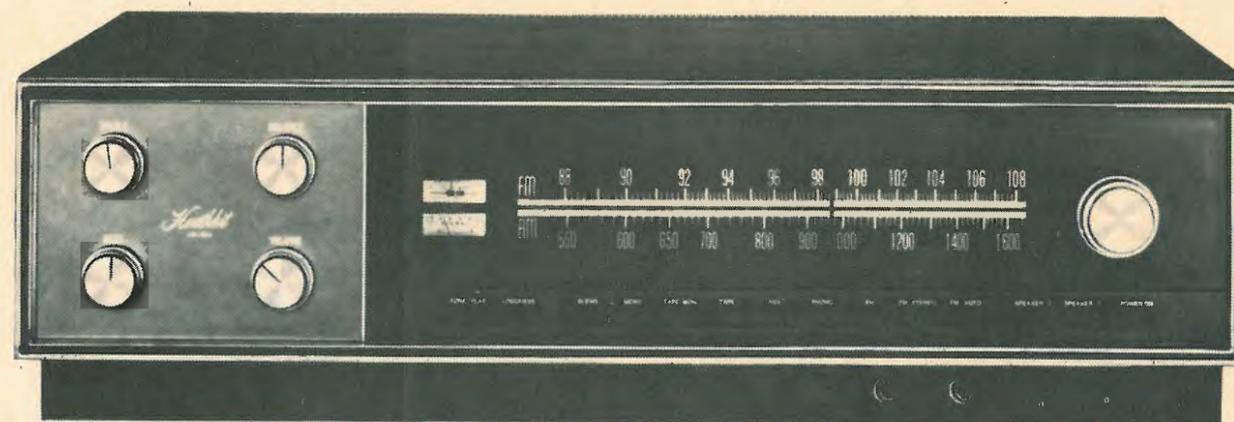


Fig. 2—Anechoic response of complete system in cabinet, but with grille cloth molding removed to minimize diffraction, at angles of 0, 30, and 60 degrees.

The new Heathkit AR-1500 surpasses our famous AR-15 in everything but price



In 1967 we introduced the Heathkit AR-15, a receiver that opened new horizons in stereo and FM/stereo circuitry. Experts agreed it was the most advanced receiver on the market, and customers by the thousands praised it as the best buy in stereo. Now meet the AR-1500, successor to the AR-15, with impressive improvements in every critical area, yet no increase in price! If you’re going to improve upon a classic, that’s the way to do it.

180 Watts Dynamic Music Power, 90 watts per channel (8 ohm load); 120 watts dynamic music power per channel under 4 ohm load, with less than .2% intermod distortion, less than .25% harmonic distortion. The 14-lb. power transformer and massive output transistor heat sink make this definitive statement on power in the Heath tradition of conservative ratings. Direct coupled output and drive transistors are protected by limiting circuitry that electronically monitors voltage and current.

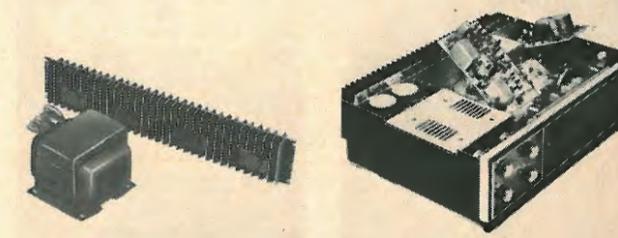
FM Selectivity greater than 80 dB, better phase linearity, separation and less distortion are made possible by two computer-designed 5-pole LC Filters. The improved 4-gang 6-tuned circuit front-end gives better stability, 1.8 uV sensitivity, 1.5 dB capture ratio, and 100 dB image and IF rejection. Four IC’s are used, three in the IF, one in the Multiplex. Patented automatic FM squelch is both noise and deviation activated, fully adjustable for sensitivity.

Vastly Superior AM, an “also ran” with many other receivers, has two dual-gate MOSFETS in the RF and Mixer stages, one J-FET in the oscillator, 12-pole LC Filter in the IF, and broad-band detector. Better overload characteristics, better AGC action, and no IF alignment.

Famous Heath “Black Magic” Lighting hides tuning scales and meters when the AR-1500 is not in use. You’ll appreciate such niceties as velvet-smooth single-knob flywheel tuning for FM and AM, function pushbuttons, chrome-plated die cast panel and knobs. And there are outputs for two separate speaker systems, bi-amplification (separable preamps and amps); oscilloscope monitoring of FM multipath. Inputs for phono, tape, tape monitor and auxiliary sources—all with individual level controls.

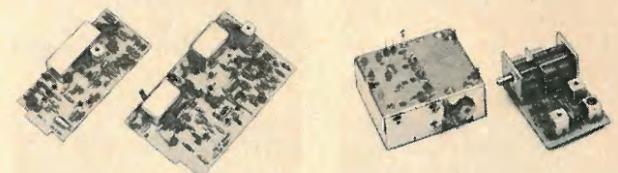
If you can build a kit, you can build an AR-1500! Ten plug-in circuit boards, two wiring harnesses and extensive use of pre-cut wiring with installed clip connectors make the AR-1500 a kit-builder’s dream. Built-in test circuitry uses signal meter to make resistance and voltage checks before operation. Install in the new low-profile walnut cabinet, in a wall or use the black-finish dust-cover included in the kit. The coupon at right is your order blank. Or, if you still can’t believe the AR-15 was just a beginning, send for more information on the new Heathkit AR-1500.

Kit AR-1500, less cabinet, 42 lbs., mailable\$349.95*
ARA-1500-1, walnut cabinet, 6 lbs., mailable\$24.95*



Massive transformer, and output transistors with heat sink across the full length of the back panel, are mute testimony to the power at your command.

Hinged circuit boards for FM IF, AM IF, Multiplex and Phono Preamp sections—six plug-in boards for all other major circuitry.



Printed plug-in boards for AM and FM IF sections contribute to error-free building. FM circuitry has two LC filters, three IC’s. Even the AM has an LC filter for superior reception.

Completely new AM tuner circuitry mounts easily on printed circuit board—includes two dual-gate MOSFETS and J-FET mixer. FM tuner is preassembled ready to install.

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3. These curves correspond to the ones in Fig. 2 except that the grille cloth molding has been reinstalled. Such curves represent accurately the sound field at listeners' ears during the time interval between the onset of diffraction (less than one millisecond) and the arrival of the first room reflections (3 milliseconds or so).

The room reflections build up in density (that is, the time intervals between individual reflections become shorter) and increase in total intensity, then fade away as the sound energy is absorbed by successive bounces from the walls and room furnishings. This reverberant field energy exists in significant amplitude for a period of 1/4 to one second, depending on the reverberation time of the room and upon the original intensity. During this interval hundreds of reflections will occur, each of which affects the "response" of the instantaneous sound field at the listeners' ears. The sound pressure level of the reverberant field is quite uniform throughout the room. If the listener is more than four or five feet away from the speaker system, the reverberant field is significantly greater in amplitude than the direct field for most frequencies, regardless of the direction in which the speaker is "aimed."

The reverberant field is composed of sound energy that originates as radiation from the speaker system in *all* directions—not just the rays sent directly toward listeners. Therefore its "frequency response" is really the sum of the output at all angles (the acoustic power response of the speaker system), as modified by the frequency characteristics of the room itself.

How does the room modify the reverberant field response? Figure 4 shows the unmodified acoustic power response of this speaker system, with mid-range and tweeter level controls at maximum settings. This curve was obtained in a reverberant chamber—a small room deliberately made as reflective as possible, with minimum sound absorption. Its frequency characteristic is known and compensated in the measurement system, so that Fig. 4 is an accurate representation of the system's true power output vs. frequency. The room is not reliable below about 700 Hz, but the system is known to be omnidirectional below that frequency; thus its anechoic output at low frequencies can be considered to be representative of its acoustic power output. By comparing Fig. 4 with the results of the same kind of measurements made in actual rooms, therefore, the effects of the room can be seen.

We made such measurements at several locations in each of eight real-life rooms. They were the music listening rooms—the living rooms or recreation rooms—of eight AR-3a owners in the Greater Boston area. Neither the speaker systems nor the furniture was moved for these tests; the only thing we changed was the level control settings for the mid-range and tweeter units. They were turned to maximum for the tests, so that the results could be compared directly. The rooms varied substantially in size, shape, and "liveness."

Figure 5 is one set of curves for one of these rooms. The microphone for this test was placed eight feet from the left-channel speaker system and directly in front of it. Figure 5A is the curve obtained with the speaker cabinet in its normal position, facing the mike; 5B is the curve obtained by rotating the speaker cabinet 30°; 5C is the curve obtained with the speaker cabinet rotated 60°. Turning the cabinet, rather than moving the microphone, minimized the effect of room mode differences that would occur at different room locations. In this way we could change the frequency response of direct radiation reaching the microphone (as demonstrated in Figs. 2 and 3) and evaluate the effect on the total sound field in the room at the microphone location. The great similarity of the three curves of Figure 5 show clearly that the field at the location of the microphone is primarily reverberant—that the amplitude of direct radiation from the speaker system is far below the amplitude of the reverberant field. This was true for all normal listener locations in all the rooms.

Figure 6 is a curve obtained at another listening location in the same room, with both speaker systems operating and in normal physical orientation. This is a typical curve, about average in over-all shape and with a little more roughness than average. In general, we found that there were no sharp peaks or dips caused by room modes above 1 kHz. Whatever correction in general slope might be desirable could be done

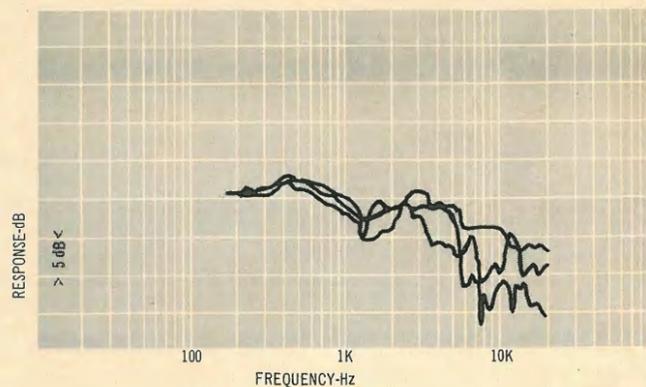


Fig. 3—Anechoic response of complete system in cabinet, with grille cloth molding, at angles of 0, 30, and 60 degrees. Diffraction would produce elevated output in 1.5-kHz region at some other angles.

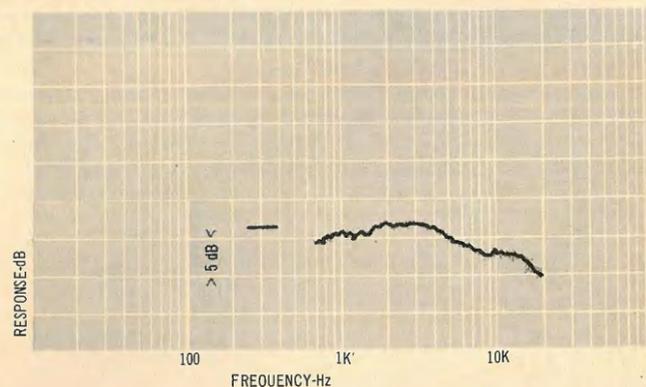


Fig. 4—Acoustic power response of the speaker system, measured in a reverberant chamber. Straight line at left shows relative woofer level.

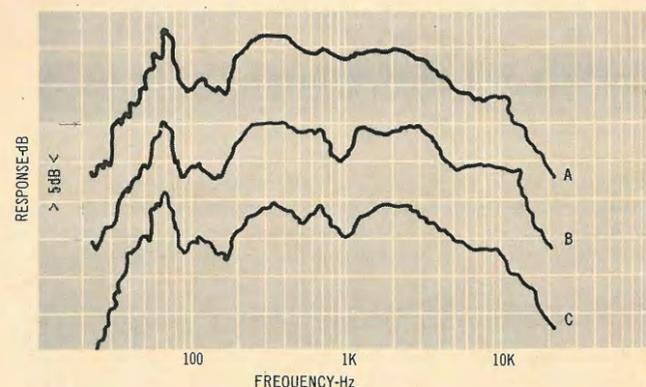


Fig. 5—A, Frequency response of loudspeaker and room at location eight feet from speaker system, with speaker aimed directly at microphone; B, same with speaker cabinet rotated 30 degrees, and C, same with speaker cabinet rotated 60 degrees.

A new concept in tape decks: Superior Sound/Low Noise

They're so good, TEAC heads carry a life-time guarantee.

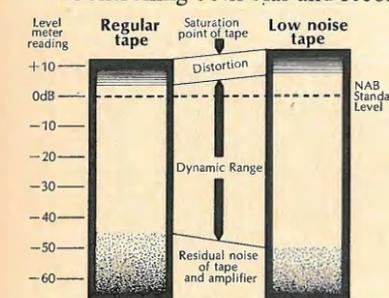
Meet the revolutionary Superior Sound/Low Noise (SL) Series by TEAC, the only tape decks in the world designed to fully exploit the superior recording characteristics of the new low noise/high output tapes. As such, they are the most advanced, most professional tape decks that money can buy.

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Controlling both bias and recording equalization, this front panel switch reduces



(Relation of noise to recording tape)

Run your favorite tape through an SL Series decks and you'll notice a vast improvement in performance.

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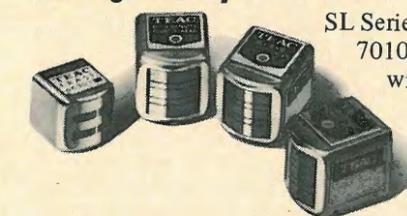
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SL Series tape decks (6010SL, 7010SL, 7030SL) are equipped with newly developed high density ferrite heads that are so good they carry an original-owner lifetime guarantee. Composed of an extremely hard ferrite

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New low noise preamplifiers

Designed for the low noise concept, SL Series tape decks incorporate new record and playback preamplifiers built to professional standards with wide dynamic margins of performance. Selected low noise IC and silicon transistors are used throughout to reduce residual noise to new lows.

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quite accurately with a treble tone control or the level controls on the speakers. As for the room modes at low frequencies, notice the differences below 1 kHz between Figs. 5 and 6: correction for one room location would make response worse at the other location. It is difficult to see any justification for resonant narrow-band "room equalizers" if the speaker systems are good to start with.

One might argue that the relative amplitudes of the direct and reverberant fields are of no consequence. The direct wave reaches the listener first. Since directional perception is undeniably carried on by detection of very small time differences between the direct waves from two speaker systems, isn't it probable that listeners base their judgments of spectral balance

☞ It is difficult to see any justification for resonant narrow-band 'room equalizers' if the speaker systems are good to start with. ☛

also on the first-arrival sound wave, and ignore the reverberant field's spectral balance?

The first argument in response to that proposition is a negative one. Frequency response of the first-arrival wave is not affected by the room. If the direct wave's spectral balance were the perceived spectral balance, therefore, a speaker system would sound the same in any room; an orchestra would sound the same in any hall. Experience tells us that this is not so. As a positive test, however, we made binaural recordings (using a dummy head, with microphones built into the ears) of music played through speakers in several of the rooms. We rotated the speaker cabinet several times during each recording, as we did for the response curves in Fig. 5, thereby changing the direct sound's frequency response substantially.

Listening to these recordings with stereo headphones we were unable to hear any differences in spectral balance between the 0°, 30°, and 60° cabinet angles for any normal listener location of the dummy head. Slight differences could be heard if the dummy head was brought to within three feet of the speaker cabinet. Conclusion: listeners base judgments of spectral balance on the sum of the direct and reverberant sound fields, and for all normal listener locations the reverberant field predominates in amplitude. Therefore, the acoustic power frequency response of a speaker system is of primary importance. The direct radiation at any particular angle is important only insofar as it affects the ratio of direct to reverberant sound at a particular listener location in the room. By the same token, wide, uniform dispersion of output at all frequencies is necessary to achieve maximum uniformity in the reverberant field and assure its predominance at locations close to the speaker systems.

Another important question is this: what is the proper spectral balance of the reverberant field—what should be its frequency response? The first impulsive answer would be, "Flat, of course." If the goal is maximum accuracy in reproducing the concert-listening experience, that is the wrong answer, at least for recordings as they are now made and for live broadcasts using present microphone techniques.

The main microphones for recording sessions and live broadcast are always set up quite close to the instruments. Often they are very close indeed, particularly for soloists on the stage. As a result these microphones are in the "near field"—the direct sound predominates, and the microphones receive a spectrum of energy that is either flat or with accentuated high frequencies.

A concert hall audience, on the other hand, is well within the area of reverberant field predominance. That is true even for small intimate halls. The reverberant field of the average concert hall has a spectral balance that slopes down at the high-frequency end much more severely than that of the average living room. To duplicate at home the spectral balance of the sound perceived at a live concert, therefore, the energy put into the room by the playback system must also slope down at

high frequencies. That slope should be tailored to make up the difference between high-frequency absorption in the hall and the home listening room.

Figure 7 contains two frequency response curves. One is a plot of the average spectral balance of four typical concert halls, measured (without audience) at orchestra-floor seats between 1/3 and 1/2 way back in the hall from the stage. The solid part of this curve is the actual empty-seat measurement; the dashed part shows the average result that would be expected with the audiences in place. The other curve is the average spectral balance we measured for 22 normal listener locations in eight living rooms with AR-3a speaker systems. It is clear that the best match would be obtained with both the mid-range

and tweeter levels turned down well below maximum, and with a small amount of bass tone control boost or placement of the speakers in positions more favorable for bass output. These are average curves, however, and should be interpreted only as a place from which to start. In view of the actual variations found in both concert halls and home listening rooms, maximum realism for each record can be obtained only if one is willing to recognize that these slope variations do exist and to make liberal use of tone controls to correct for them. **AE**

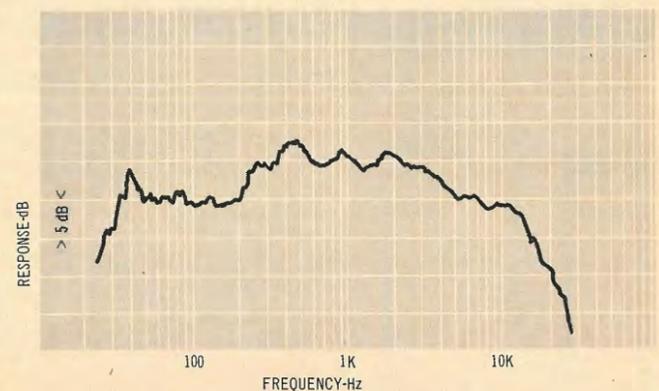


Fig. 6—Frequency response at another listening location, same room as Fig. 5, both speaker systems operating.

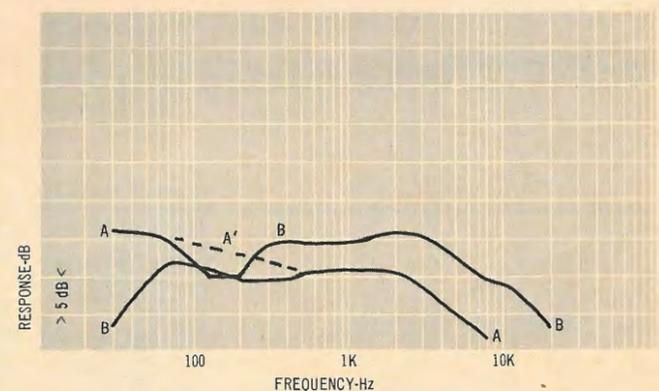


Fig. 7—A, Average spectral characteristic of concert halls, as actually measured without audience; A', predicted result with audience, and B, average spectral characteristic produced by AR-3a systems at 22 listening locations in eight living rooms.

We compared our new deluxe preamp to a 10¢ piece of wire.

First we ran a signal through a 10¢ length of shielded cable. What came out the other end was, of course, audibly identical to what went in. Then we ran the same signal through our new TA-2000F preamplifier, and ran an A-B comparison between its output and the wire's. Both were audibly identical. As we'd expected.

This is not to say that sufficiently precise instruments could not detect inaudible differences between our preamp's signal transmission and a wire's. Whereas a straight wire has no distortion whatsoever, we must admit to having some—three hundredths of one per cent harmonic, and five hundredths of one per cent intermodulation, maximum, at rated output. And whereas a wire theoretically does generate some noise, its signal-to-noise ratio is still somewhat better than the 73dB obtained through the TA-2000F's phono inputs, or even the 90dB obtained through our Aux, Tape and Tuner inputs.

But, as you'd expect, the big difference in price between our deluxe preamp and two feet of cable, buys a great deal more than just a pure, clean signal. As our preamp's 58 levers, switches, meters, knobs and jacks would indicate.

NEARLY 2,000 RESPONSE SETTINGS

Six of those controls are devoted to precise adjustment of frequency response. The calibrated, 2dB-per-step, bass and treble controls have switches that adjust their turnover frequencies, so you can choose how deeply the tone controls will affect—or not affect the midrange. Still another switch cuts the tone controls out of the circuit altogether. And a single knob controls the sharply-cutting, 12dB-per-octave, 50Hz and 9kHz filters. Together, these six controls give you a choice of 1,935 precisely repeatable response settings including flat (10Hz-100kHz, +0, -2dB) response.

The facilities for tape recording are exceptional and unique; you can record on two tape decks at once, monitoring either (or your program source) at the flick of a switch. You can dub from one machine directly to the other, without external patching or connections. For straight microphone recordings, there's a mic input position on the function

selector knob; for voice-over-music, there's a separate mic level control that diminishes all other input signals as it increases the microphone level.

And, of course, the two, front-panel VU meters, are as useful for testing as they are for monitoring record levels.

TOTAL INPUT AND OUTPUT FLEXIBILITY

The TA-2000F can feed two stereo amplifiers (and an additional monophonic or center-channel amp) at one time, at either a 1 volt or 300mV level. The second amplifier output could also be used for still another tape recorder, should you wish to use the ultra-versatile tone controls and filters in recording. The front-panel output jack feeds both high- and low-impedance headphones, or can be used as a tape output, by suitable adjustment of its independent level control; the same knob also controls the center-channel output.

Five of the 8 rear-panel stereo inputs have rear-panel level adjustments. A sixth—the Phono 1 input—has a switch that selects three separate input impedances at the normal 1.2mV sensitivity setting, and two more impedances at the 0.06mV setting that lets you use even the lowest-output cartridges.

96 TRANSISTORS VERSUS A SINGLE WIRE

But all these features merely make our TA-2000F more versatile than any wire. They don't explain how we can come so close to the wire's pure, unadulterated performance. That explanation will rest with our circuit designers, and with the 96 high voltage, and Field Effect transistors they used.

THE TA-3200F: AN AMPLIFIER TO TRULY COMPLEMENT OUR PREAMP

A preamplifier like the TA-2000F deserves, of course, its complement in a

power amplifier. Not too surprisingly, we make one: the Sony TA-3200F. Its fully direct-coupled circuitry produces 200 watts continuous (RMS) at 8 ohms, with power bandwidth from 5 to 35,000Hz. IHF Dynamic Power is rated at 320 watts into 8 ohms (and fully 500 watts into a 4 ohm load). Its distortion, at a listening level of one half watt, matches the preamplifier's at 0.03%; at full rated output, it is still a mere 0.1%. And the signal-to-noise ratio is 110dB.

Our amplifier's facilities nearly match our preamp's. The 3200F has controls you've rarely, if ever, seen on power amps before: switch-selected stereo input pairs; a speaker selector switch; a power limiter (which holds output down to 25 or 50 watts, should you so desire), and a rear-panel switch that lets you limit bass response below 30Hz., instead of letting it extend to 10Hz.

For further information, see your Sony dealer, or write us. Or wire. Sony Corporation of America, 47-47 Van Dam Street, Long Island City, N.Y. 11101.



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So we didn't just engineer our circuits and our switches. We human-engineered them. For instance, in normal FM-stereo operation, all the 6065's levers make a neat row, and all its knob indexes point straight up; any control that's out of place shows up immediately.

You, who have no doubt adjusted to the crotchets of your current equipment (and perhaps even love them), may not think this much. Julian Hirsch, who must re-adjust to every new component that he tests, commended it: "Most receivers and amplifiers are surprisingly deficient in ease of use. Sony is to be congratulated."

With performance this accessible, the 6065 had better perform. And it does: 2.2 uV IHF sensitivity ("1.9 uV," says Julian Hirsch) gets you the weak FM signals; an FET front end prevents overload from strong ones. And our high selec-

tivity makes tuning easier. If you find those stations easier to listen to, you might also credit our direct-coupled amplifier circuitry. It's supplied with both positive and negative voltages (not just positive and ground), so we don't have to put a coupling capacitor between the speakers and the amplifier. And, so that we can maintain full power (255 watts IHF, 160 watts RMS into 4 ohms; 220 watts IHF, 140 watts RMS at 8 ohms) or all the way down to 20 Hz at 50 watts RMS per channel.

Which brings up another way we made the 6065's performance more accessible to you: the price. And if its moderate price isn't accessible enough, we also make a lower-priced model, the 6055. Its power is a little less (145 watts rather than 255 watts) as is its rated sensitivity (2.6 uV instead of 2.2). But its otherwise almost identical.

So perhaps we can solve those family squabbles after all: a 6065 for yourself, and a 6055 for your son. Sony Corp. of America, 47-47 Van Dam St., Long Island City, N.Y.

SONY® 6065 / 6055

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IC Tone Burst Generator

Part 1: theory and outline of approach

Walter G. Jung

MODERN INTEGRATED CIRCUITS have opened up many new opportunities for circuit improvement in the audio field. We have already been witness to the penetration of the IC operational amplifier into audio circuits. Now other IC's are beginning to make their presence felt, in some areas opening up totally new concepts. Applying these devices to traditional problems can result in worthwhile economies as well as better per-

System Components

In simplest form, a tone burst unit could consist of an audio transmission path with a series switch (perhaps push-button activated) to make and break the audio path (Fig. 1). But of course this will suffice for only the most rudimentary experiments—it allows no control over relative ON and OFF times or ratio between ON and OFF voltage level. Control of these parameters is absolutely necessary of course, and when

microsecond speeds, it must not sacrifice any of the other parameters of an ideal switch, namely: linearity, isolation, frequency response and so forth (more on this in a moment).

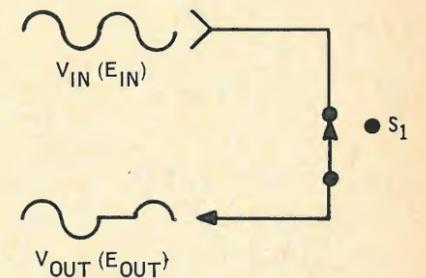


Fig. 1—S1 is a switch to interrupt the audio path.

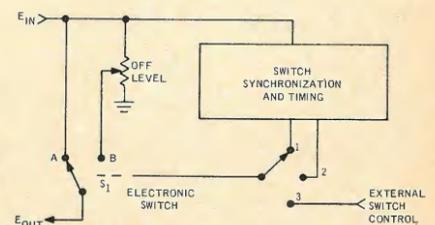


Fig. 2—Switching modes: 1, COUNTED; 2, TIMED, and 3, EXTERNAL.

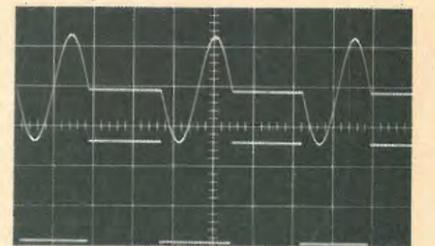


Fig. 3—Alternate single cycles of ON and OFF.

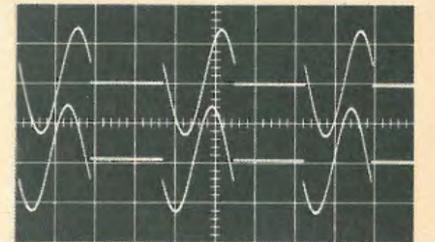


Fig. 4—The upper waveform advanced, the lower retarded, with switching waveform not shown.

Performance Specifications Of IC Tone Burst Generator

Input Signal:

Amplitude—Will operate properly with input signals within the range of 20 mV p-p and 10 V p-p (approximately -35 to +15 dBm in a 600 ohm system).

Frequency Range—10 Hz to 100 kHz.

Input Impedance—47K, unbalanced.

On-Off Timing:

General—Control of ON-OFF switching is via two internal modes of switch control, COUNTED or TIMED, or by external gating signal.

Counted Mode—Coherent ON-OFF timing in integral number of cycles of 1, 2, 4, or 8. Duty ratio of 50 percent.

Timed Mode—Coherent ON-OFF timing in any duration of ON or OFF, independently adjustable. Range of adjustment of ON-OFF periods 10 seconds to 10 microseconds.

Switching Phase—In both COUNTED and TIMED modes the starting point of switch closure is adjustable ± 90 degrees about 0 degrees or 180 degrees

with respect to input for total range of 360 degrees.

External Control—Control switch ON-OFF state available by external signal input. Levels are TTL compatible; equal to or less than 0.4 = ON; equal to or greater than 2.4 = OFF.

Output Signal:

General—Output signal is 1:1 replica of input in ON state, THD and noise 0.1 percent. OFF state of signal is adjustable from equal to ON level down to 80 dB below ON level.

Offset or Pedestal—Adjustable through zero.

Switching Time—50 nS or less.

Output Impedance—10 ohms, d.c. coupled.

Power Requirements:

Internal supplies of ± 12 and +5 V., regulated and protected. A.c. line power 105 to 129 V. a.c., 60-400 Hz, 15 watts.

Price: Less than \$50.00.

formance. An example of just such a useful application of IC's is a tone burst generator. Tone burst generators have been with us for years, but previously have been a sophisticated and expensive tool relegated to the laboratory. The availability of a wide variety of IC's at economical prices have now made the construction of a tone burst generator feasible to the dedicated audio experimenter. And that is what we'll be talking of in this article—how to build an IC tone burst generator using readily available state-of-the-art IC's. But before we get into the details of solder, nuts and bolts, let's first look at what a tone burst unit is comprised of and define how we'll go about building this model.

we begin to talk of how these things are to be accomplished, the simple ON-OFF push button rapidly develops. But let's see how and at the same time why. After all, you'll want some justification for glorifying a simple ON-OFF switch, won't you?

Basically the two main components of this tone burst system are the switch itself and the means of controlling this switch. This latter device we'll call a synchronizer. The switch is obviously more than a simple SPDT bat-handle or even the highest speed reed relay—it must be a completely electronic high speed switch under the control of the synchronizer. But even though it is an electronic switch and must operate at

Synchronization and Control

Consider the other element of our system, the synchronizing portion which controls the state (ON or OFF) of the switch. This device must control the timing of switch openings and closures in accordance with the phase of the incoming audio signal. It provides two basic control modes of switch control.

The first of these is to count out a predetermined number of cycles (1,2,4,8 or more) and generate a switch drive corresponding to the zero crossings of the audio signal. This is the "counted" mode, the simplest form of

control. It is illustrated by Fig. 3, showing alternate single cycles of ON and OFF, with the drive which commands the switch shown directly below the gated waveform. Note in this case the phase of the gating which is at the exact zero crossing of the sine wave. Phase control of the synchronizer allows two variations beyond this. A simple 180 degree reversal would interchange the position of the ON and OFF cycles. Another, more subtle form of phasing is provided by a vernier phase control which advances or retards the switch timing from the zero point. This is shown by

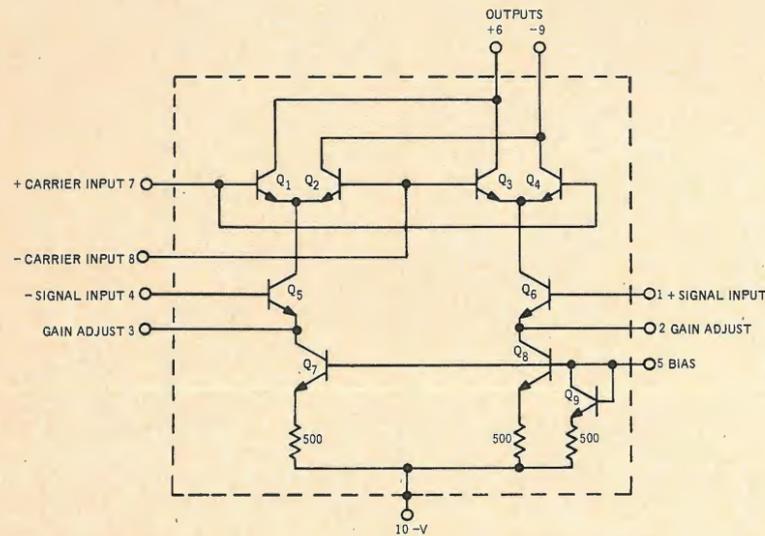


Fig. 5—Schematic of MC1496G balanced modulator/demodulator.

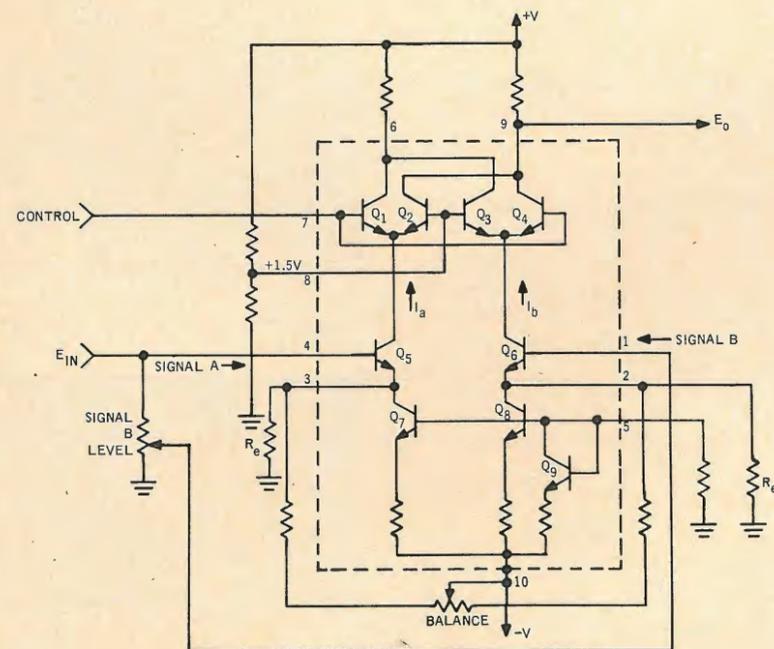


Fig. 6—The MC1496G connected up as a two-channel switch.

Fig. 4, the upper waveform advanced, the lower retarded (switching waveform not shown).

A second synchronizer mode of a more general nature is the TIMED mode. In this mode the switch control is of variable time length for both ON and OFF states. This is the more flexible of the two control modes, and with time constants of sufficient range can be programmed for duty cycles of any ratio. As an example, if the ON time is made of one cycle duration and the OFF time 9 times this, a 10% duty cycle results. Conversely, reversing the two ratios will result in a 90% duty factor. This form of switch control can accommodate variable duty cycle control over the complete audio range with suitable range of time constants.

A third mode of switch control is by means of external stimulus. This allows an external signal to gate the audio path, with the timing parameters determined elsewhere. Using this mode the tone burst unit can be used as a general purpose audio gate with defined ON and OFF states of the control signal.

The Electronic Switch

We have talked briefly above of the electronic switch, but not in any detail. This element is really the heart of the generator. And since the overall quality of the tone burst will be determined by the performance of this switch, let's talk now in terms of what is required of this element.

A conventional, manually operated switch is such a simple device that it is totally lacking in most of the detrimental factors which plague the electronic variety. No one thinks of a toggle switch as having d.c. offset, yet this is a common misery plaguing electronic switches. Switching transients are also much more prevalent in the electronic type, usually due to feed-through of the switch drive to the signal output. And of course, it is quite unheard of for a toggle switch to create distortion or to alter frequency response (at least within the audio frequency range). However, these are very real considerations in an electronic switch. But even though all of these problems are formidable, they are by no means insoluble. In fact this challenge is met quite well by one of the newer IC's we talked of in the introductory paragraphs. Now here is what it is and how it relates to our job of electronic switching.

The IC of which we speak is the MC1496G balanced modulator/demodulator, a schematic of it is Fig. 5. This IC is designed for communications applications of modulation and demodulation where the desired output voltage is to be a product of an input

When it comes to fine stereo systems... a Marantz is a Marantz is a Marantz.



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\$1285

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

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voltage (the signal) and a switching function (the carrier). The middle pair of transistors (Q5-Q6) constitute the signal input port and the upper pair(s) of differently connected switches constitute the carrier input port. Q7, Q8 and Q9 form a biasing network,

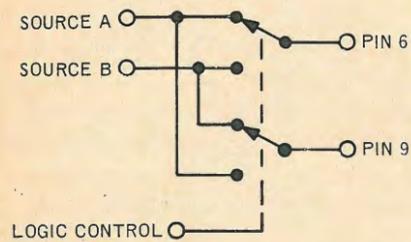


Fig. 7—The equivalent of the MC1496G as a DPDT switch.

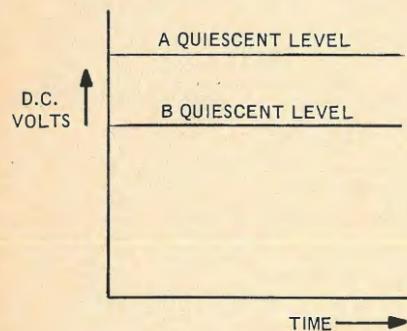


Fig. 8—Switching transients are due to the differences in the A and B quiescent levels.

providing a constant d.c. emitter current to Q5 and Q6 from the collectors of Q7 and Q8. All circuit nodes are brought outside the package to facilitate flexibility in external connection options.

Connected up as a two-channel switch, the MC1496G appears again in Fig. 6. Here we begin to see how the device really lends itself to our needs. In this application transistors Q5 and Q6 are linear common emitter amplifiers for input signals A and B. Signal A is an unattenuated version of the input signal E_{in} , signal B is a variable level version adjustable from 0 to the maximum value (the case where $B=A$). If the switch output consists of A channel we get the full amplitude of the input. This constitutes the BURST or ON state of the switch. The switch output in position B can be any ratio of the input from 0 to max. This is the OFF state, which allows maximum flexibility in the adjustment of the ratios between the A and B levels.

The actual switching between the two channels is done by the differential pairs Q1-Q2 and Q3-Q4. This is best understood by analyzing the output at pin 9 for the two states of the Q1-Q4 switches.

Q1-Q4 are controlled by a logic signal at pins 7 and 8 which switch the relative state of conduction between the pairs. With pin 8 held at a positive bias of 1.5 volts, a logic ZERO (not greater than 0.4V. d.c.) at pin 7 will turn on Q2-Q3 and a ONE (not less than 2.4V. d.c.) will turn on Q1-Q4. Thus only two transistors

of the Q1-Q4 set are on at one time, Q1 and Q4 or Q2 and Q3. Now look at the output (pin 9) in terms of the signals A and B and the logic control input. First, if pin 7 is low (a logic zero) both Q2 and Q3 are on. Pin 9 receives output from both Q2 and Q4, but in this case only Q2 is on. So the output at pin 9 is the output of Q2, which in turn is the output of Q5, or the "A" signal. Now, reverse the state of the logic signal at pin 7, make it high (a logic one), and follow the signal path to pin 9 for this condition. In this case Q1 and Q4 are held on by the logic one, and pin 9 receives the output of Q4. Q4's output consists of the current from Q6, or the "B" signal. So this is how the logic control at pin 7 selects either the A or B channel.

To simplify the explanation above we have purposely avoided discussing the state of the other output, pin 6. It can be analyzed in exactly the same manner and it will be found to be a complement of pin 9, always receiving an output which is the exact opposite. The operation of this switch is summarized in Table 1 and its equivalent as a DPDT switch illustrated by Fig. 7.

Control Input	Pin 6 Output	Pin 9 Output
High	Source A	Source B
Low	Source B	Source A

Table 1—Summary of the switch operation.

Since the differential pairs Q1-Q4 possess the capability of switching at nanosecond speeds, response time is hardly a limitation in applying this IC to audio usage. In the same sense, the transistors used in the MC1496G are VHF devices with characteristically low capacitance and wide bandwidth. These factors remove any restrictions on bandwidth due to the IC.

The biasing of the Q5 and Q6 amplifiers with current sources Q7 and Q8 provides excellent signal linearity. This allows the current output of those stages (Ia and Ib, Fig. 6) to be linearly proportional to the applied voltages A and B. The switching transistors Q1-Q4 have little effect on these signal currents from a distortion standpoint and serve only to pass or block the desired signal. As a result this switching configuration results in linear overall signal handling characteristics with distortion products below 0.1% of full scale in the ON state. Isolation of the switch in the OFF condition is on the order of 80 db.

Another serious problem common to electronic switches, which is handled

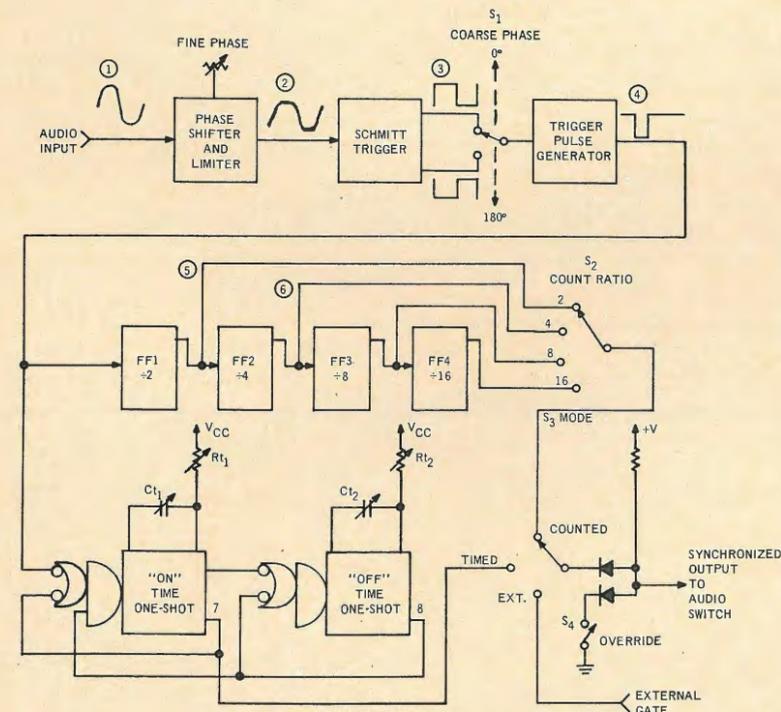
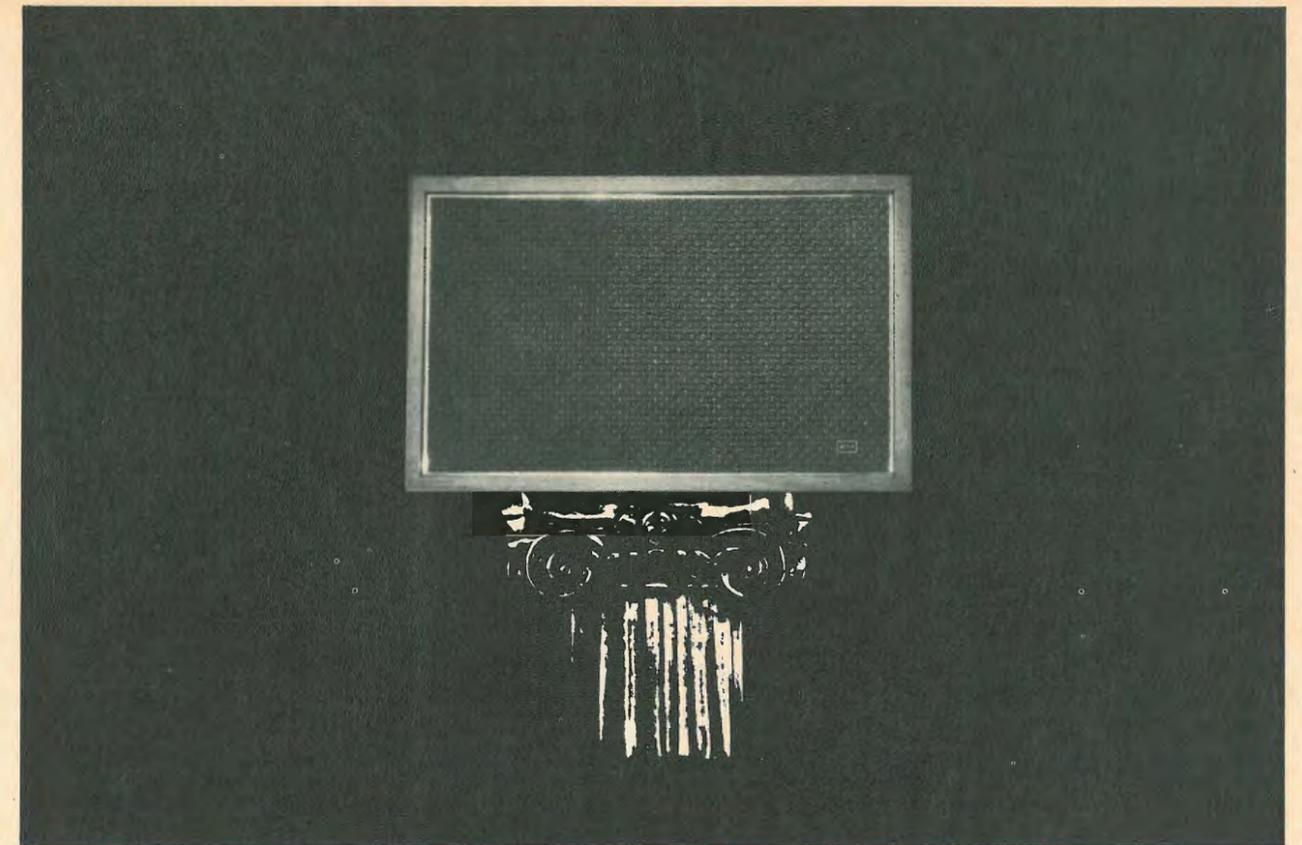


Fig. 9—Synchronizer block diagram.



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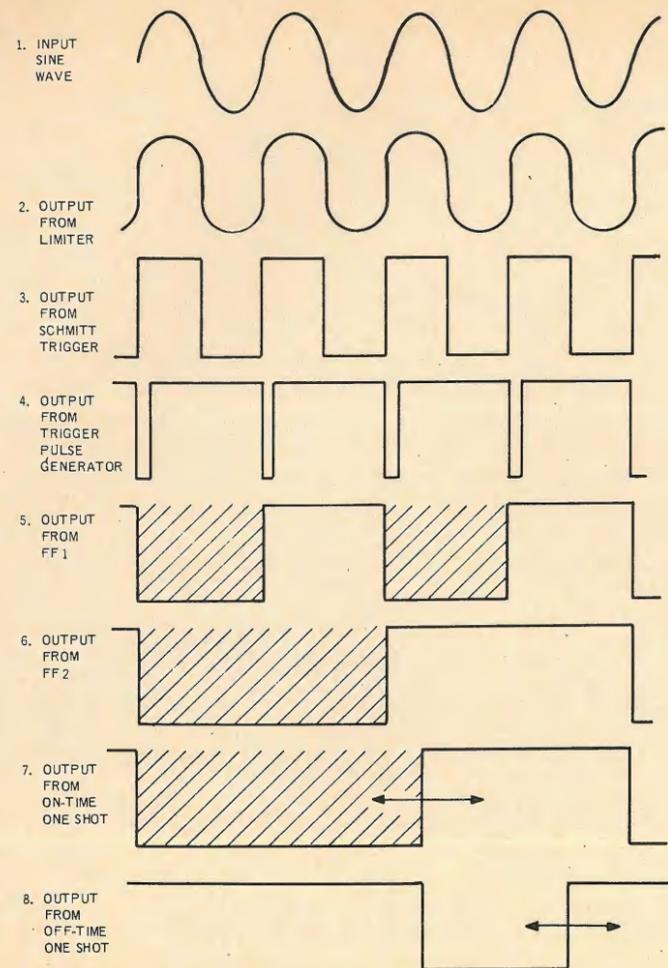


Fig. 10—Synchronizer timing waveforms.

very well by this IC, is the one of switching transients due to offsets. Ideally there should be no difference whatsoever in the quiescent d.c. level upon which the A and B signals ride. If there is, there will be a transient when the switch passes from one channel to the next.

To visualize this condition, see Fig. 8 which illustrates the effect. This is a graph of the A and B channel quiescent levels. Note that to switch from one to the other a relatively large voltage difference (A-B) will be transmitted. To minimize this effect we would like the A and B d.c. levels to be as closely matched as possible and we'd also like to maintain this balance independent of temperature. In a discrete component amplifier this would be an impossible or at least impractical situation. But component matching is a natural thing for an IC, and the currents generated by Q7 and Q8 (which appear ultimately at the output) are not only initially well matched but will also track with temperature due a minimum of temperature differential between the two. All that need be provided is a means to adjust any slight residual d.c. imbalance (due

to production tolerances) to zero and this will eliminate any offset between Ia and Ib. This is provided by a differential current bleed from Q5-Q6 by the balance network and pot tied back to the negative supply. Under these balance conditions switching may be done at any rate between the A and B channels with no switching transients.

Synchronizer Block Diagram

Now if we turn to a block diagram of the synchronizer (Fig. 9) we'll see how it produces the signals necessary to control the switch we have just been discussing. There are several operations necessary to process the input sine wave into the timing pulses suitable to operate the switch. These will be taken in order as we progress through our diagram. Waveforms at each stage are shown in Fig. 10.

1. *Limiting and Shaping* is necessary to transform the input sine wave (waveform 1) into a square wave (waveform 2). The limiting (waveform 2) is necessary so that the synchronizer's output will be relatively independent of input signal level, and a stable switching signal will be available over a wide

range of input variations. The shaping into a square wave is necessary so the trigger circuits which follow will have a consistently sharp pulse from which to trigger, regardless of the frequency. This is particularly important at the lower frequency extreme where the rate of change (or slope) of the input is at its lowest or worst case condition.

2. *Phase Shift:* A second operation necessary is the phase shifting of the synchronizer timing waveform with respect to the input sinewave. Phase control is desired so the switch timing can be positioned to occur at any point on the waveform (as was shown by Fig. 4). This operation is accomplished in two steps, fine and coarse. The fine phase control has a range of ± 90 degrees and functionally is part of the limiting amplifier. The center of this control's range corresponds to the 0 degree or 180 degree phase reference for the fine phase. The combination of these two controls is arranged so the trigger pulse generator will generate a single pulse which can be positioned over a full 360 degrees of each individual input cycle. This range is also independent of frequency; that is 90 degrees at 100 Hz is the same as 90 degrees at 10 kHz and requires no readjustment of phasing if the frequency of the input is changed.

3. *Trigger Pulse Generator:* Now that we have a shaped and phase-controlled timing waveform at the output of the coarse phase switch, it is necessary to generate a single pulse corresponding to the position slope. This is accomplished by the trigger pulse generator which produces a single four-microsecond negative pulse each time its input goes positive. This pulse serves as the master timing pulse for the timing generation and is fed to both the counting circuit and the timer. It is shown on the timing diagram (Fig. 10) as waveform 4.

4. *Counter:* The counter divides the input frequency by fixed ratios of 2,4,8, and 16, independent of frequency. Any one of these frequency ratios may be selected by the count ratio switch S2. Flip-flops 1 through 4 make up this counter and are connected in a straightforward manner as a ripple counter. Waveforms 4 and 5 illustrate the sequence of stage one which divides the output of the trigger pulse generator by a factor of two, the output of FF1 changing state each time its input goes negative. The relationship of FF2 and FF1 can be regarded in a similar manner by noting waveforms 5 and 6. FF2 is driven by the output of FF1 and will change state each time FF1 goes negative. Since FF1 operates at $\frac{1}{2}$ the frequency of the main trigger pulse, FF2 will operate at $\frac{1}{2}$ FF1's frequency or $\frac{1}{4}$

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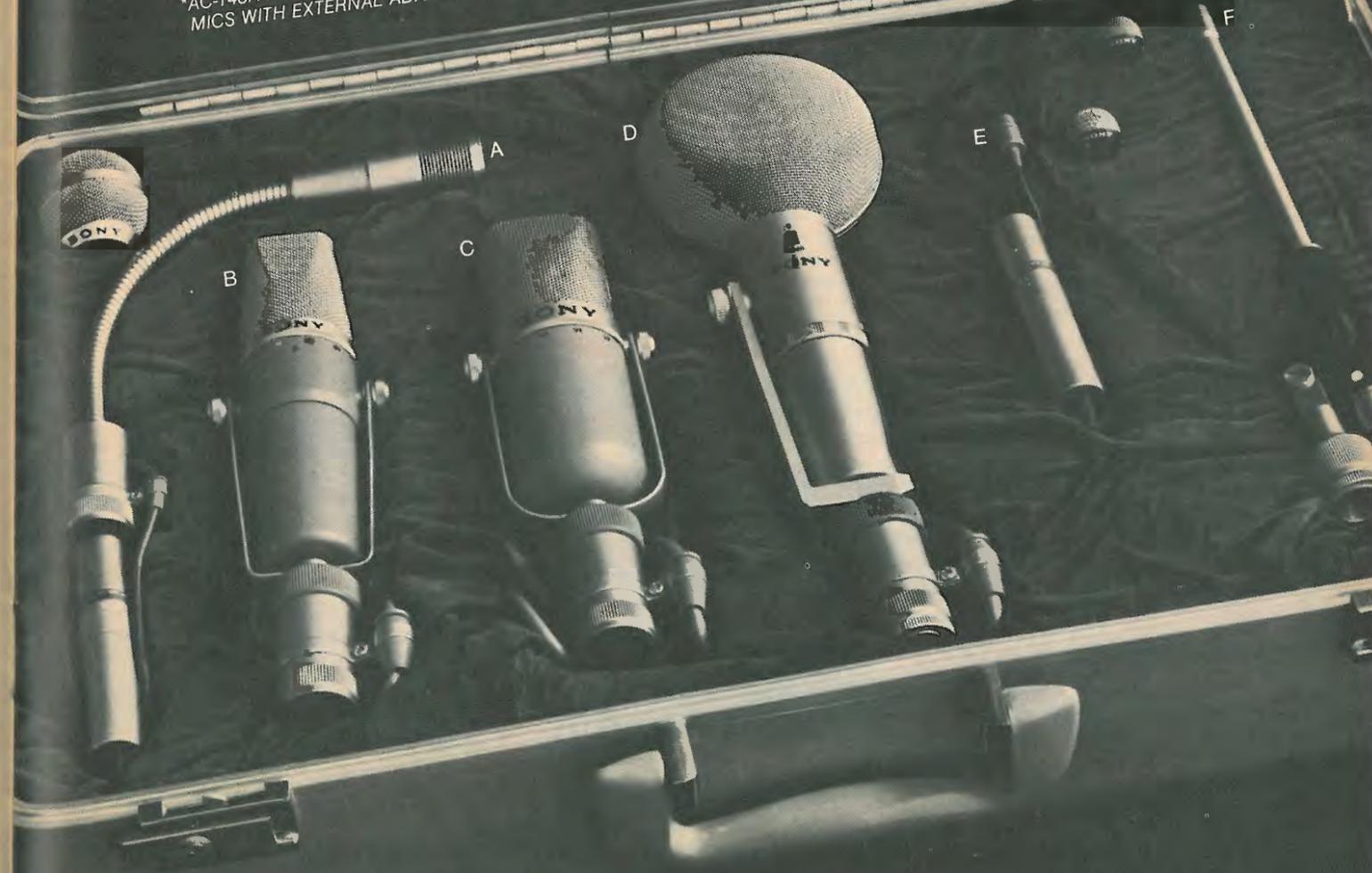
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the trigger frequency. This is division by 4. Flip-flops 3 and 4 perform in a similar manner, further dividing the input frequency by ratios of 8 and 16 respectively. With S3 in the COUNTED mode S2 may be operated to select the division ratio of the counter. The synchronizer output will close the audio switch whenever the output of S3 is low (a logic zero) and open it when the output is high (a logic one). On waveforms 5 and 6 this corresponds to the shaded portion.

5. *The Timer:* The variable timing generator allows the TIMED mode of operation. This mode is selected by S3 which connects the switch control to the output of two variable-period one-shot multivibrators. The delay times of both of these one shots are variable over an extremely wide range by the adjustable time constant Ct1 and Ct2 (switch selected for decade ranges) and Rt1-Rt2 for continuous adjustment.

The first one shot is triggered directly from the main trigger pulse and starts

its output timing pulse from this point (see waveform 7). This time is the ON time and will enable the audio switch through S3 for the duration of the time it is low (shaded portion). Since in an actual situation this time must be able to extend for a number of input cycles, the one-shot must be inhibited from triggering again from any additional input pulses while it is still in its timing cycle. Here this is accomplished by feedback from its output to an input gate which prevents false triggers during this cycle. In waveform 7 note that two additional input pulses are rejected by this action, as the time extends beyond the third trigger pulse.

With no additional hardware this timing cycle would begin again with the 4th input pulse which comes a short time later. But this would impose a serious limitation on the length of the OFF time, as it could only be a maximum of slightly less than one cycle under these conditions. So this is the reason behind the additional OFF-TIME one shot. This one shot is triggered from the trailing edge of the first and generates an additional variable length pulse which is used to inhibit the ON TIME one shot. This will allow any desired OFF TIME to be introduced before another ON period is begun. Wave form 8 illustrates the effect of this inhibit pulse which is fed back to the input gate of the first one shot. During the time this pulse is low input triggers will be blocked. When waveform 8 goes high, the ON TIME one shot is again enabled and will trigger on the next pulse. Waveforms 7 and 8 show the ON TIME one shot inhibited on the fourth trigger pulse, enabled shortly afterwards, and then triggering on the fifth pulse, starting a new cycle.

6. *Switch Control Logic and Override:* As was stated in the previous paragraphs, the switch control logic closes the audio switch to generate an output burst when the input signal is in the LOW state. This is true for either the COUNTED or TIMED modes and is also true in the case of an external gating signal. For convenience in use, an override switch (S4) is also provided which will close the audio switch at any time it is actuated. This is an aid to setup or as a quick check of the switch itself, since it will force the switch ON regardless of the setting of any other controls.

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Mathematics 4 Beginners

Part Three of a series by Norman H. Crowhurst

NEXT TIME George found Henry to ask his help with electronic calculations, he had just been having troubles like the ones which started their discussions. Only this time his mistake was one that all of us drift into at times, assuming a resistor's color code means *exactly* what it says. He had put together two resistors, each of which was coded 1.5k, on the assumption that they were both exactly the same and would add up (connected in series) to 3k.

Before George came to Henry, he had put the resistors in question on a bridge and measured them. One of them measured 1.4k, the other 1.64k. The total came to 3.04k, but they were considerably off being equal, which did not suit his purpose, which was to use them as a voltage divider.

Henry pointed out to George that a 1.5k resistor, with a silver band indicating 10% tolerance, could vary between 1.35k (1.5k-15%) and 1.65k (1.5k + 15%), so that both were within the tolerance their markings specified. But this did not solve George's problem. What could he do?

"Is it important that they both be 1.5k exactly, or can they simply be equal?" Henry wanted to know. George was not quite sure.

"If they only need to be the same, you can make *one* match the other," Henry went on, "but they must both be 1.5k exactly, then *both* of them must be changed to be as close to that value as you need to have them.

"To make the first one 1.5k, if its value is 1.4k, you could put a 100-ohm resistor in series," Henry again went on, as George seemed a little uncertain

what he meant. "But if making them the same as each other would do, a 240-ohm resistor will do, if you happen to have that value."

George nodded. "But if I make the 1.4k up to 1.5k with a 100-ohm resistor, how can I get the 1.64k down to 1.5k?"

"By picking a suitable parallel value instead of a series one," Henry suggested, "but first let us explore how tolerances affect series and parallel combinations. To make it easy, suppose you put 1000 ohms and 100 ohms in series. If the 1000-ohm resistor has 10% tolerance, it can vary from 900 to 1100 ohms. If the 100-ohm resistor has 10% tolerance, it can vary from 90 to 110 ohms."

"So if the 100-ohm resistor is used because the 1000-ohm resistor is 10% low," George picked up, "the result will be between 990 and 1010 ohms, which is within . . ." he thought a moment after making those additions, "1% isn't it?" "Correct," said Henry.

"Doesn't that mean that when you combine two resistors, and one of them is, as in this case, one tenth of the other, that the effect of its tolerance on the combined value, is divided by ten?" George asked.

"Strictly, that's not quite right," Henry responded. "Actually the 100 ohms represents one tenth of the total value. Thus if both resistors had been 1000 ohms, at 10%, then 10% variation of only one of them would affect the total value, which is nominally 2000 ohms, by 5%. But how does this work with parallel resistors?"

"Just what I was going to ask you," George said. "Let's see. Suppose I put

1000 ohms in parallel with 100 ohms," and he proceeded to put down the calculation, "this would make a resistance of about 91 ohms. Now what?"

"Well, try varying the 100-ohm resistor, from 90 to 110 ohms, which is the 10% tolerance," suggested Henry.

George did it and came up with values of 82.6 ohms and 99.1 ohms. "That's not far short of 10% on either side of 91 ohms," he said.

"All right, now try varying the 1000-ohm resistor by 10%," said Henry. George did this, and came up with 90 ohms and 91.7 ohms. "That's about 1% on either side of 91 ohms, isn't it?" George asked and Henry nodded in reply.

"So far, so good," George went on. "I see that the biggest resistor has the most effect in a series circuit, and the smaller resistor has the most effect in a parallel circuit. But how do I tailor these values to both come out 1.5k?"

"For this," Henry suggested, "you have to turn around the parallel resistance formula a bit, so you can get the 'spare resistor' as the solution to your equation," and he did the algebra to get the new expression.

"I see," George verbalized the final formula, "you take the value you have, multiply it by the value you want, and divide by the difference."

"Correct," Henry said, but George was already working on the values: 1.64k as what he had, 1.5k as what he wanted, and 140 ohms as the difference. He came up with 17.57k. "The nearest stock value is 18k," he suggested.

"So see how close that is likely to get you," Henry suggested.

"Let's see, an 18k could vary between

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16.2k and 19.8k, if it has 10% tolerance," said George, looking to Henry for confirmation.

He figured these results out, and came up with 1.49k and 1.515k. "Both within 1%," he commented.

Henry looked at George, who had done all this by long multiplication and division. "You know," he suggested, "unless you have a calculator handy, a sliderule would make those calculations much easier."

"I've often thought that, as I watched you use one," George replied. "Would you show me how to do it?"

Henry set the hairline of the cursor against the point representing 1.64 on the D scale, explaining to George why that point represented 1.64—one mark below the 1.65 mark—and slid the C scale so that 17.84 (found by adding 1.64 and 16.2), which is between marks, was also under the hairline. Now he moved the hairline to 162 on the C scale, and read off 149, representing 1.49k on the D scale.

"It certainly makes it look easy," said George, "but even if I could remember what to do, I'm not sure I'd get the decimal point in the right place. You know, I couldn't be certain whether it was 1.5k or 15k."

"That does take a little care," said Henry. "But it's not really difficult. And practice is what really helps, more than

anything. Here, see if you can figure the other one the same way."

George took the slide rule and carefully set the hairline back to the 164 on the D scale, then slid the C scale so that 2144 was also under the hairline. (That gave him a bit of trouble, because each small division is worth 0.02 there, instead of 0.01, so the final "4" is 1/5 of a large division, which Henry explained

to him.) Then George slid the hairline down to 198 on the C scale, which was easier, and read off the answer from the D scale, finding it halfway between the 151 and 152 markers, as 1515, representing 1.515k.

"It's certainly easier than I thought," George said. "Maybe with some practice, I could get to use a sliderule for things like that."

calculations

$$(1000 \times 100) \div (1000 + 100) = 91 \text{ (approx)}$$

$$(1000 \times 90) \div (1000 + 90) = 82.6$$

$$(1000 \times 110) \div (1000 + 110) = 99.1$$

$$(1.64 \times 1.5) \div (1.64 + 1.5) = 17.57k$$

$$(1.64 \times 16.2) \div (1.64 + 16.2) = 1.49k$$

$$(1.64 \times 19.8) \div (1.64 + 19.8) = 1.515k$$

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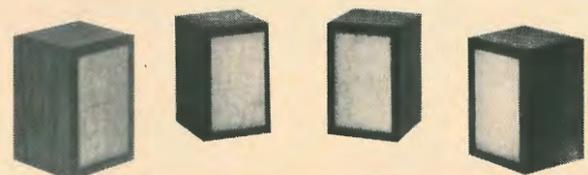
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The most logical choice for a compact, powerful control amplifier is the new Dynaco SCA-80Q. The SCA-80Q not only is a one-piece stereo preamplifier and power amplifier, but it includes built-in Quadaptor™ circuitry for 4-dimensional stereo. No decoder is required.

The SCA-80Q is the same price as the SCA-70 which already has established a reputation for unexcelled value. The SCA-80Q has all the features as its predecessor and exactly the same performance. And you can connect either two speakers to it for conventional stereo, or four speakers for 4-D sound now (or later).

The best results are obtained when the SCA-80Q is used with speakers that have small impedance variations. The most accurate front-to-back separation is achieved when the impedance of the back speakers remains as close as possible to 8 ohms.

All of the different Dynaco speakers have been designed for uniform impedance. They are a most sensible choice for 4-D playback with the SCA-80Q. Their similar efficiency and sonic characteristics permit them to be used together in the same 4-D system. The larger A-50 (\$179.95 each) as well as

the compact bookshelf types A-25 (\$79.95 each) and the new A-10 (\$99.95 the pair) are appropriate for the front. The compactness and light weight of the bookshelf models, particularly the A-10, render them ideal for unobtrusive mounting on a back wall.

A 4-D system including the SCA-80Q and four full-range Dynaco speakers is the most economical and compact way to realize the full potential of your existing stereo, library and FM stereo broadcasts. And as recordings made specifically in the 4-D format become more available, your enjoyment will be greatly increased.

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Enclosed is my check or money order for \$2.95. Please send me the new Dynaco/Vanguard 4-D demo record postpaid. Limited to USA residents only. Offer expires December 31, 1971

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Equipment Profiles

- Panasonic SA-6500 AM/FM Stereo Receiver 38
- Sherwood SEL-300 FM Tuner 44
- Rabco ST-4 Straight-Line Turntable 50



**Panasonic Model SA-6500
AM/FM Stereo Receiver**

MANUFACTURER'S SPECIFICATIONS

FM Tuner Section IHF Sensitivity: 1.8 μ V. **S/N Ratio:** 60 dB. **THD:** 0.4% (mono). **Selectivity:** 60 dB. **Spurious Response Rejection:** 75 dB. **IF Rejection:** 90 dB. **Image Rejection:** 80 dB. **Capture Ratio:** 1.5 dB. **Stereo Separation (1 kHz):** 40 dB.

AM Tuner Section. IHF Sensitivity: 15 μ V. **Selectivity:** 30 dB. **Image Rejection:** 70 dB. **IF Rejection:** 60 dB.

Amplifier Section. Power Output Music Power (IHF): 140 watts @ 8 ohms; 200 watts @ 4 ohms. **RMS Power:** 50 watts/channel @ 8 ohms; 70 watts/channel @ 4 ohms. **THD at Rated Output:** 0.5%. **IM:** 0.7%. **Power Bandwidth:** 7Hz to 60 kHz. **Frequency Response Overall:** 15 Hz to 65,000 Hz \pm 3 dB. **IHF Hum and Noise Level:** Phono (2 mV ref.), -70 dB; **AUX (170 mV ref.),** -80 dB. **Input Sensitivity:** Phono 1 & 2, 2 mV; **AUX & Tape Monitor,** 170 mV. **Damping Factor:** 50 (at 8 ohms).

Dimensions: 16 $\frac{7}{8}$ in. W. \times 5 $\frac{7}{8}$ in. H. \times 15 $\frac{1}{4}$ in. D. **Weight:** 34 lbs. **Price:** \$369.95 (includes walnut case).

If the name Panasonic has always conjured up visions of well-designed portable TV sets, first-quality table radios and cassette players, you'd better have another look—for Panasonic (the trade name used in the U.S. by Matsushita Electric Company) has entered the component stereo high fidelity market in a big way. Their top-of-the-line Model SA-6500 stereo receiver is as up-to-date in looks and performance as any equipment we've analyzed this year—and then some.

The aluminum and smoked plastic panel is almost entirely devoid of conventional rotary knobs. The two that are used are a tuning knob and the program source selector switch, at the right of the panel. The three push-buttons seen at the left of the panel are of the push-to-engage, push-to-release type and govern power ON-OFF and the selection of MAIN or REMOTE

pairs of stereo speaker systems. Four up-and-down slide controls take care of BASS, TREBLE, BALANCE and VOLUME settings. While we have seen this convenient form of control used on some of the more recently designed components, these are by far the smoothest sliding and most accurately calibrated controls we have run across. The O or FLAT settings of the tone and balance controls corresponded exactly with electrically flat settings as measured by instrumentation in our labs. Fully two-thirds of the entire panel is "blacked out" until power is applied, at which time an almost completely linear, well calibrated (every half MHz has its own mark) FM dial, a 0-100 logging scale and an AM dial scale are disclosed. Doing away with the conventional pointer, Panasonic utilizes a well illuminated green bar which gradually comes into view, becoming longer and longer as you tune from 88 to 108 MHz (or from 550 to 1600 KHz). This form of tuning indicator is reminiscent of the speedometer arrangement used for many years by the Buick line of General Motors automobiles and it is highly visible from great distances. It also demands extreme accuracy of calibration, since the line of demarcation between "green line" and blacked-out portion is precisely defined and there is no parallax error involved in viewing. In the case of the Panasonic SA-6500, the calibration was very much "equal to the task."

The blacked out area also contains two tuning meters—one for zero-center tuning of FM stations, the other for signal

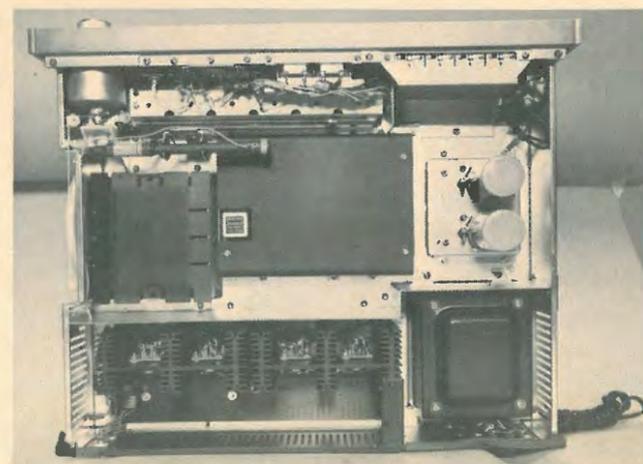


Fig. 1—Top view of Panasonic SA-6500 chassis.



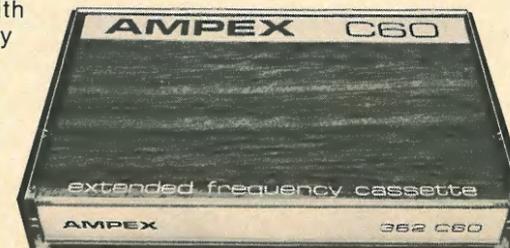
Introducing the Ampex Extended Frequency Cassette

Egad, what sound! What spectrum! What fidelity! At last, I can use the full range, the maximum frequency response of my magnificent stereo system. Yes, a medium to match my music. Absolutely smashing!

What's more, those clever rascals at Ampex have increased output with a smaller particle black oxide formula. They've reduced noise with super-smooth Ferrosheen® tape. They call it Extended Frequency. I call it marvelous. And, the packaging is so handsome it complements every piece of my fine equipment. Ah, quality sound with cassette convenience for just a bit more than two dollars each.

Ask your Ampex dealer to demonstrate the new Extended Frequency cassettes, another quality product in a full line of recording tapes; open reel, 8-track cartridges and standard cassettes.

But, don't wear your glasses.



AMPEX

Ampex Corporation
Magnetic Tape Division
401 Broadway,
Redwood City,
California 94063

strength indications in both FM and AM use. Illumination of the former is automatically extinguished when the selector switch is rotated to the AM position and both meters are darkened when the selector switch is set to non-radio positions such as AUX or PHONO. Separate illuminated words appear in the dial scale area to denote these latter program sources, and the word

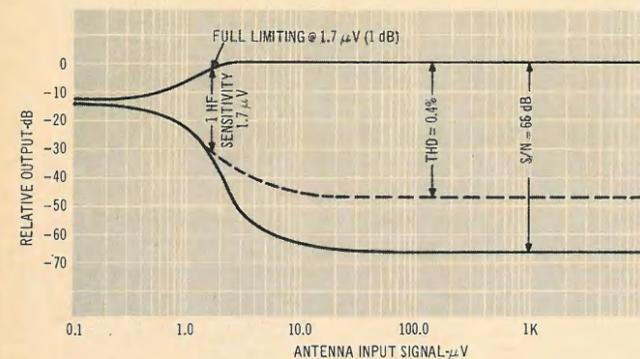


Fig. 2—Mono FM characteristics.

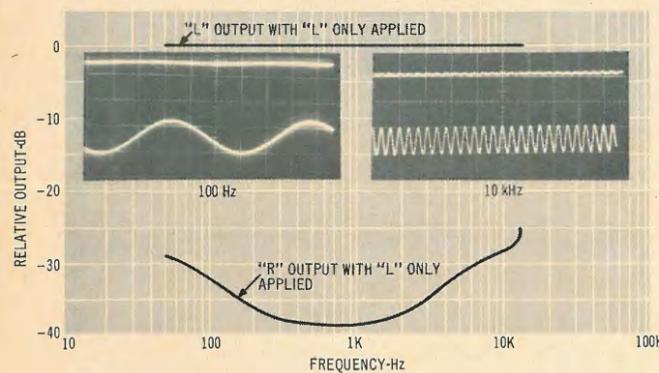


Fig. 3—Stereo FM separation.

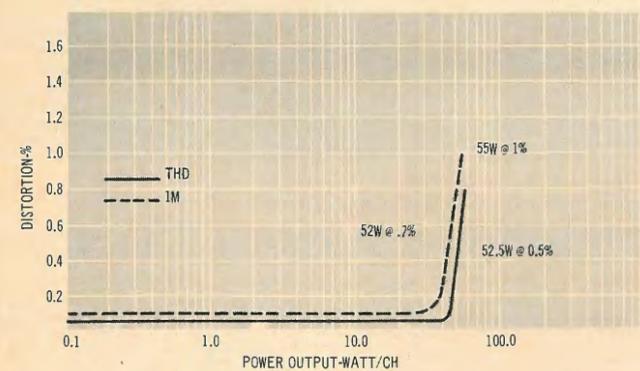


Fig. 4—THD and IM characteristics with 8 ohm loads.

STEREO, to the right of the two meters, is also illuminated in the presence of a stereo FM signal.

Below the dial scale area are a series of eight push-buttons which activate the LOUDNESS circuits, HIGH and LOW filters, multiplex high frequency blending (used when weak stereo FM reception causes noisy reception), interstation muting defeat, a MONO-STEREO button, tape monitor switch and a phono push

button which selects either the PHONO 1 or the PHONO 2 inputs. A stereo headphone jack at the lower left edge of the panel completes the front layout.

The rear-panel of the Panasonic SA-6500 discloses at the upper left antenna terminals for FM (300 ohms impedance) and AM. Along the bottom are a ground terminal, input and output jacks for phono, aux, tape and tape monitoring, a DIN receptacle for tape recorders equipped with this type of multiple pin plug, a pair of speaker protection fuses, terminals for connection of main and remote sets of speakers and one switched and one unswitched a.c. convenience outlet. Speaker connection terminals are spring-loaded and, when depressed, disclose a hole into which the stripped end of the speaker lead is inserted. Releasing the terminal locks the lead firmly in place. This type of connection is still the very best available and just about eliminates any possibility of shorts. At the upper right of the panel are a pair of jumpers which interconnect the pre-amp outputs and the power amp inputs. By removing these jumpers it is possible to treat the receiver as two independent components, interposing such devices as reverberation units, tonal equalizers, four-channel decoders, etc., without resorting to the use of the tape monitor jacks. The presence of this "circuit interruption" facility also enables you to use this receiver as part of a bi-amp or tri-amp sound system if you are so inclined.

Construction and Circuitry

The RF front end and the AM-FM-IF-MPX modules are covered with complete metal shield cans. The FM r.f. section includes two FET r.f. amplifiers and separate bi-polar devices for oscillator and mixer functions. An AM r.f. stage and a converter stage are also included in this module. FM i.f. circuitry includes three amplifying stages and two stages of limiting. A combination of crystal filtering and conventional interstage i.f. transformers are employed. The second and third i.f. stages are combined in a 14-pin monolithic IC (type AN-203). The AM section features two i.f. stages while the MPX section utilizes seven bi-polar transistors and four diodes in a bridge switching configuration. Ten transistors are used in the preamplifier module. The driver section features differential amplifier inputs and direct coupled power output stages made possible by separate positive and negative supplies of 38.5 volts each. Interconnections between the various modules seemed well planned and often utilize harnessing for consistency of layout and wiring. While parts density was fairly great, access to practically any part is easy and the chassis seems well thought out from a servicing point of view.

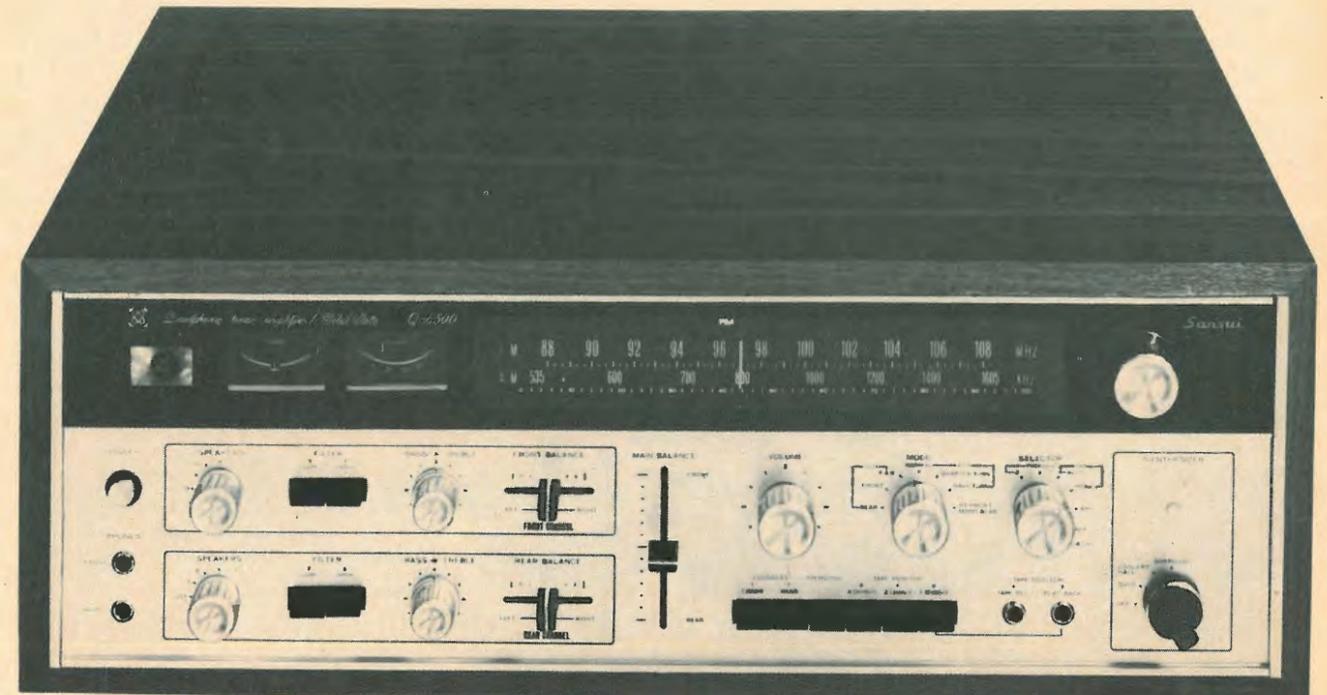
Measurements

IHF FM Sensitivity was a bit better than claimed, measuring 1.7 μ V. Perhaps more important is the fact that this exact reading is maintained from low end to high end of the FM band—indicating perfect alignment and excellent design of the FM front end. While Panasonic claims only 60 dB of ultimate S/N, we measured 66 dB. THD (mono) equalled the claim of 0.4% exactly, while in stereo the THD measured 0.6%, a very respectable figure for 100% modulation. Full limiting occurs at under 2 μ V, making the IHF sensitivity even more meaningful since, at 3 μ V of input the S/N ratio is already better than 50 dB—our own criterion for "listenability" in a practical situation.

Stereo FM separation measured 38 dB at mid-band frequencies. At least 30 dB of separation is maintained from 70 Hz all the way to 7 kHz with no reading of less than 25 dB obtained at any frequency in the FM audible range.

The audio control and amplifier sections meet or exceed their specs very nicely. Operating into 8-ohm loads, with both channels driven, we measured 52.5 watts/channel at rated distortion of 0.5%. At power levels below about 40 watts,

THE FOUR-CHANNEL EVERYTHING.



Sansui's Model QR6500

SANSUI BREAKS THE BOTTLENECK.

The "wait-and-see" period is over. You can go ahead and overwhelm yourself with the awesome power of the total four-channel sound field right now. And tomorrow too.

Sansui's QR6500 Four-Channel Stereo Receiver makes it possible. Actually it's an AM/FM Two-Channel and Four-Channel Stereo Receiver-Synthesizer-Decoder-Amplifier and Control Center. Add four speakers (you probably have two of them already) and live. That's all there is to it.

As a synthesizer, it can ferret out the ambient signals already present in most two-channel stereo recordings and broadcasts and process them for astonishingly realistic rear-channel reproduction. Enhancing this effect is Sansui's exclusive phase-modulation technique, which moves the sound about the listening area the same way nature propagates the live sound field.

As a decoder, it can accurately reproduce the four original channels of any compatibly matrixed four-channel recording or FM broadcast. And such discs and broadcasts are here now, past the experimental stage, becoming increasingly popular. In this mode, Sansui's original phase-shift circuitry prevents the sound dropouts and lost sound-source localization that plague many matrixed systems. And the phase modulators are also at work to build up that "live sound field."

As a straight-through four-channel stereo center, it can handle open-reel or cartridge four-channel tapes, or any other discrete four-channel source. It features 280 watts of total IHF music power (50 watts continuous per channel at 4 ohms; 37 watts continuous per channel at 8 ohms). Normal-level response is 20 to 30,000 Hz \pm 1 dB. Distortion at rated output is less than 0.5%. IHF sensitivity of the high-performance FET FM tuner is 1.8 microvolts.

It has slide controls for front-rear and right-left balance, illuminated digital indicators for two- and four-channel modes, and a full complement of controls and accessory circuits for any two-or four-channel function you can think of. You can even "dial" the best speaker arrangement — four-corner style, front 2-2, or what have you.

It's Sansui's embodiment of the four-channel era. Model QR6500.

Sansui

SANSUI ELECTRONICS CORP.

Woodside, New York 11377 • Gardena, California 90274
SANSUI ELECTRIC CO., LTD., Tokyo, Japan • Sansui Audio Europe S. A., Antwerp, Belgium

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THD was well below 0.1%, readings being limited only by our own audio generator which is known to put about 0.05% THD. IM Distortion reached rated value (0.7%) at an output power of 52 watts/channel and was well below 0.1% for all levels below about 30 watts/channel. Power bandwidth extended from 6 Hz to 60 kHz—a really incredible range due, in part, to the advantages gained through d.c. coupled output stages which eliminate the need for low-frequency limiting coupling capacitors.

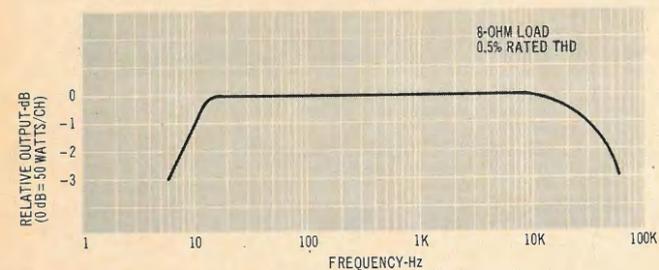


Fig. 5—Power bandwidth.

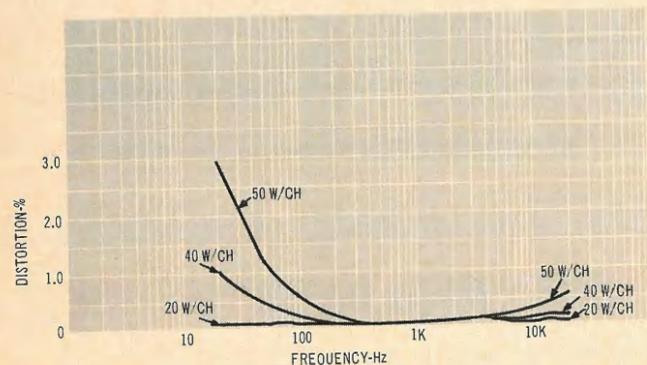


Fig. 6—THD versus frequency at 20, 40, and 50 watts/channel levels.

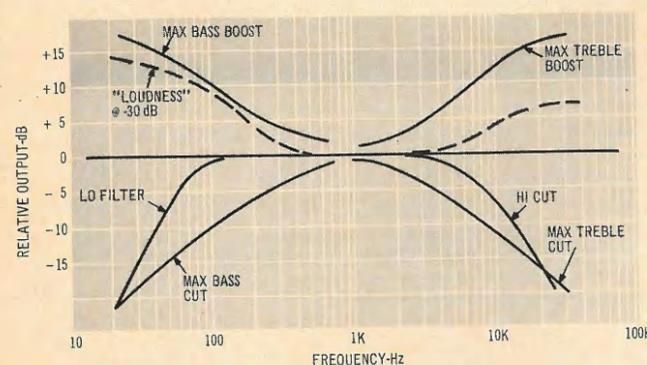


Fig. 7—Tone, filter, and loudness control characteristics.

A fairly recent addition to our normal set of measurements of amplifier sections are the THD figures for all meaningful audio frequencies at various power levels. In the case of this Panasonic receiver we chose power levels of 50 watts/channel, 40 watts/channel and 20 watts/channel. At the 40 watt level, distortion at 20 Hz is only 1.0% while at the high end, even 50 watts of power/channel is possible with THD never exceeding the "rated" figure of 0.5%.

We have often berated manufacturers for including so-called "low filters" and "high filters" which did little more than follow the nominal 6 dB per octave curves of the ordinary tone controls and were therefore no more effective as filters than are ordinary tone controls. A look at the curves shown will let you know how we feel "it should be done." Notice that with the "low" filter in-circuit an attenuation of better than 20 dB is obtained at 20 Hz while the response at 70 Hz is down only three dB. To obtain the same attenuation using the bass tone control would mean the "cutting out" of vital information contained in the range from 200 Hz down, with almost 10 dB of attenuation at 100 Hz! The same applies, of course, for the "high" filter as compared with the treble cut settings of the treble control. By incorporating 12 dB/octave slopes on the two filters, Panasonic has made them useful and significant—and highly effective. Loudness control action at a -30 dB setting on the volume control is also shown, and Panasonic has opted to provide a bit of treble compensation as well as the more common bass boost in its version of the "loudness control."

Listening Tests

The Panasonic SA-6500 Receiver is one of those units that seems to deliver more power than its specs would indicate. Perhaps it is a combination of total stability (the unit was stable from no-load to capacitive loads of up to 10 μ F and inductive loads up to 1 H) and extremely wide band response, but no amount of "driving" could produce anything but clean, crisp transients and tight, hangover-free bass reproduction limited only by the quality of the loudspeaker systems with which it is to be used. Noise and hum level in the PHONO settings are remarkably low (we measured better than the 70 dB claimed with reference to a 2 mV input). Since our cartridge puts out about 4 mV with a standard test record, we really had a dynamic range capability of nearly 78 dB in phono operation!

As for FM reception, it was about as good as the best we have seen. Some 54 stations were logged with our outdoor directional antenna and of these 22 were broadcasting in stereo. The muting action is very effective, adjusted at the factory to work at between 4 and 6 μ V. It exhibits no "marginal" effects—that is, the station either comes in or it doesn't—there are no "partial" situations which could lead to distorted FM reception. Interestingly, we lost about six stations when the mute switch was in the "on" position, indicating that these stations had been received acceptably before at signal strengths of less than, say, 5 μ V. The steepness of the noise-rejection curve referred to earlier comes into play advantageously with that order of signal strength. Stereo indication is also positive and there is no random lighting of the stereo indicator on noise impulses or interstation wide-band noise.

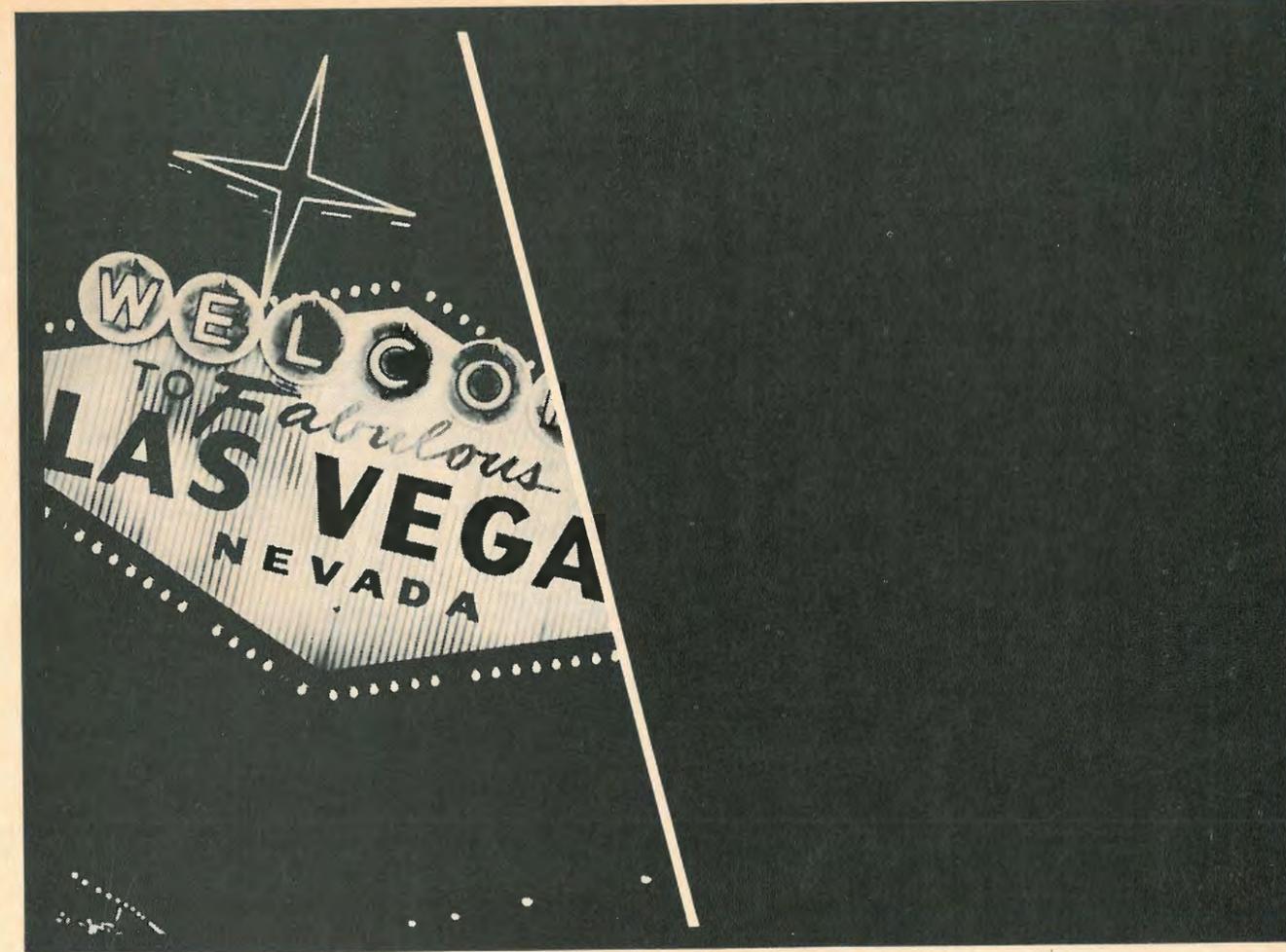
The AM section deserves a mention here, for while we don't ordinarily devote much space (or testing time) to AM, in the case of the Panasonic SA-6500 the extra RF stage seems to make the difference as compared with "run-of-the-mill" AM circuits normally found in many receivers. Selectivity of the AM section was particularly good, as we were able to listen to dozens of stations even at night without the usual adjacent channel bleeding, whistles, etc. With the addition of an outdoor AM antenna, this unit could probably delight such AM DX-ers as are still to be found amongst the high-fidelity fraternity.

It is obvious that Matsushita Electric Company did not enter this specialized component field without first devoting a great deal of attention to thoughtful engineering, cosmetics, and a thorough understanding of the features that most buyers demand in an under \$400.00 receiver. With the introduction of this receiver, Panasonic successfully enters "our" market. Welcome!

Leonard Feldman

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The sun never sets in our town, nor do our microphones and sound systems get any rest. "Our town" is the mecca for sound specialists, and here, Shure Microphones and Vocal Master Sound Systems handle it all: you'll hear them in hotel show rooms and lounges used by famous professional entertainers whose livelihoods depend on sound excellence; you'll hear them in hotel convention halls, in club after club, in casino after casino; and you'll hear them 'round-the-clock as keno scores are announced. Why? Because the predictability and reliability of Shure microphones and sound systems simply make everyone's job a lot easier. The Shure sound is the Las Vegas sound — and we're proud of it.

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Sherwood Model SEL 300
Digital Readout Stereo FM Tuner

MANUFACTURER'S SPECIFICATIONS

IHF Sensitivity: 1.5 μ V. FM Quieting: 0.9 μ V for -20 dB; 3.0 μ V for -50 dB. Alternate Channel Selectivity: -85 dB. S/N Ratio: -70 dB. AM Suppression: -65 dB. THD: 0.15% at 100% modulation (mono). Spurious Response Rejection: -100 dB. Image Rejection: -80 dB. IF Rejection: -110 dB. Stereo Separation: -40 dB @ 1 kHz. Frequency Response: (mono) 20 to 20 kHz \pm 1 dB; (stereo) 20 to 15 kHz \pm 1 dB. Size: 5 1/4 in. H. \times 16 1/4 in. W. \times 14 in. D. Shipping Weight: 25 lbs. Retail Price: \$579.00.

The new Sherwood SEL 300 Tuner is truly the embodiment of "an idea whose time has come." While not the first high fidelity component to utilize "digital readout tuning," it is the first such unit which we have had an opportunity to analyze and measure and, as such, provided us with a whole new series of performance features which cannot, for the moment,

be compared with any other similar units. In one sense, it is almost a pity that the "digital readout" features predominate in all of Sherwood's promotional material and advertising, for in point of fact this new tuner has so very much to commend it from a performance standpoint. More about that in a moment.

As can be seen in the front panel view, the tuner has no familiar dial scale. Instead, the upper left portion of the gold and black panel has four readout tubes mounted behind it. The tubes themselves are normally not visible since this portion of the panel is constructed of smoked plastic. Only the incandescent-illuminated digits themselves are visible when the tuner is powered. Sherwood indicates in its instruction manual that the life expectancy of these display tubes is 100,000 hours. Even if you're a 12-hour-per day FM buff, that works out to about 25 years! Alongside the digital readout area are two meters—one for center-of-channel tuning, the other for indicating relative signal strength and for aiding in antenna orientation. There follows a good sized tuning knob, coupled to an effective flywheel (and we must confess that it takes a bit of

To local oscillator
(98.2 MHz to 119.2 MHz)

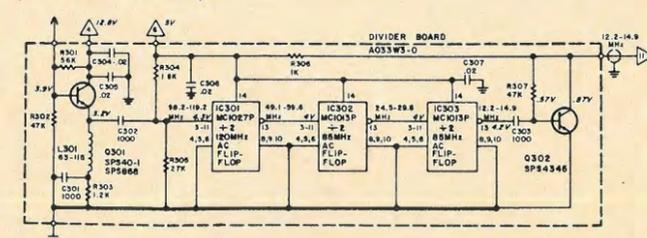


Fig. 1—First logic module in digital read-out circuitry divides local oscillator frequency by eight.

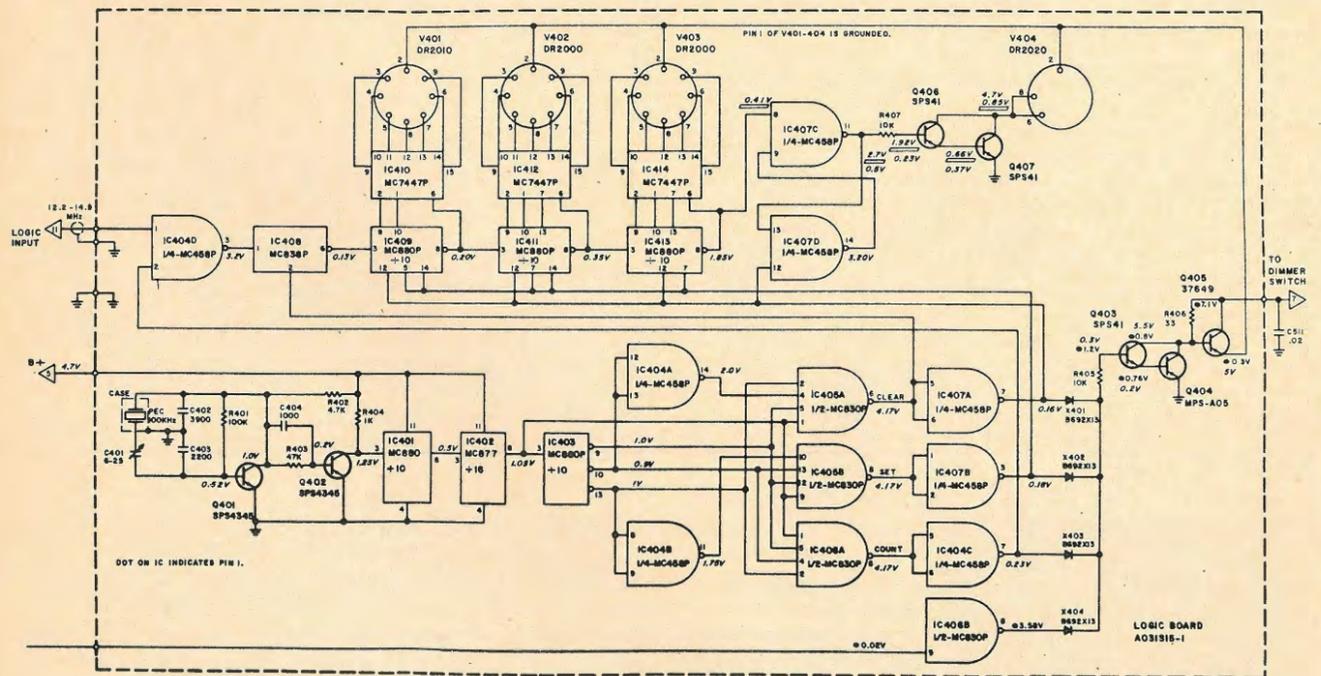


Fig. 2—Major logic module contains 100 kHz reference, or "clock" frequency crystal oscillator, further divides IC's and the necessary logic "gates" to drive the segments of the numeric read-out tubes.

The new Revox A77 Mk III.



It's still not perfect.

Nothing is.

But the new A77 Mark III is certainly the best recorder Revox has ever made. And that's saying something.

The Mark III is an improved version of our critically acclaimed A77. The recorder that The Stereophile magazine (1-71) described as, "Unquestionably the best tape recorder we have ever tested..."

And that judgement is as true now as it was then.

However, at Revox we've never been content to rest on our laurels. We thought we should make the best even better.

But in bringing out a new model, we

didn't discard all of the time tested features and superior performance that distinguished the original A77.

Instead, we made only those changes which would meaningfully improve performance and reliability.

Not a radical transformation, but a program of rational development.

As a result, you have to examine the new A77 Mark III rather closely before you see any external differences at all.

On the other hand, from the moment you start to use the new Revox, you'll begin to appreciate the changes we've made inside.

For example, we've designed a new oscillator circuit for greater efficiency and lower distortion. Modified and strengthened the self-adjusting braking system. Devised a new hardening process to reduce capstan wear. Improved tape handling and spooling. And made a number of other changes. A total of eighteen... some major, some minor.

All in all, we haven't created a revolution.

We've just done what we set out to do... that is carry the art and science of tape recording a few steps closer to perfection.

And, in the process, we've given you eighteen more reasons why...

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delivers what all the rest only promise.
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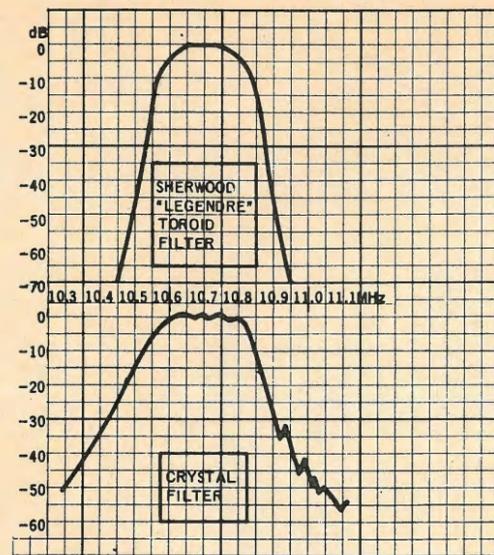


Fig. 3—Sherwood's published comparison between its i.f. bandpass response using multipole filters and "inferior" crystal filters. I.f. systems using conventional tuned interstage transformers would probably suffer even more by comparison.

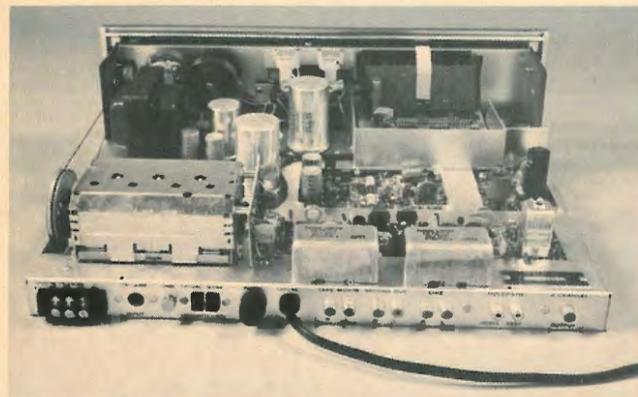


Fig. 4—Rear view of the SEL 300 chassis.

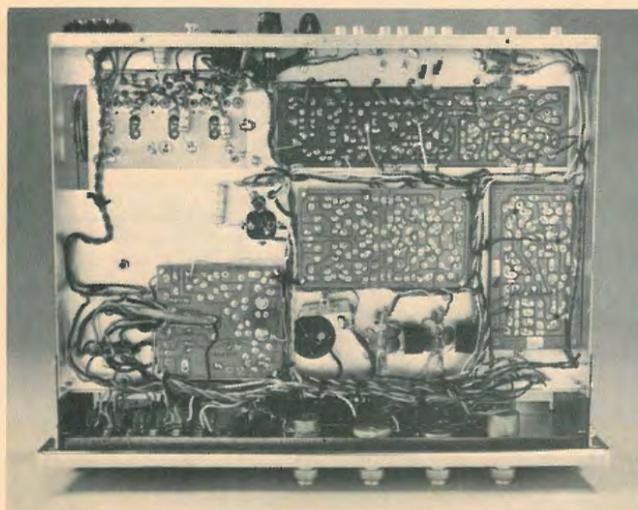


Fig. 5—Bottom view of the SEL 300 chassis.

getting used to, to spin the tuning knob and see only rapidly changing digits instead of the usual travelling dial pointer). A step-switch attenuator offers precise settings of output from +4 VU to -63 VU and an OFF position in ten discrete settings. Along the bottom half of the panel are a power ON-OFF switch, a HUSH control (Sherwood's name for its muting circuit), a BRIGHTNESS control for the readout tubes (they can be extinguished entirely or set to three levels of brightness), a VOLUME control for the adjacent stereo phone jack (yes, the phones can be directly powered from a built-in low powered pair of audio amplifier channels), a tape dubbing jack and a series of six push-push button switches. These switches take care of the tape monitor function, the mute on/off action, FM-mono/stereo switching (used only when a stereo station is too noisy and distant to be received satisfactorily in the stereo mode), a high frequency noise filter (for reducing background noise with only moderate reduction in frequency response and high frequency stereo separation) and two more buttons which require a bit of explanation.

A stereo-only button, when depressed, acts to "mute" all monophonic stations, allowing only stereo programming to reach the various output jacks. The last button is identified as interstation readout blankout and, as the name implies, it causes the readout tubes to light *only* when a station is received. It should be noted that all readouts are in increments of 200 kHz, corresponding to actual FM station frequency allocations. Thus, the digit beyond the decimal point reads only 1, 3, 5, 7 or 9. Thus, in tuning for a given station, say 96.3, the reading will remain constant from 96.200 MHz all the way to 96.399 MHz. This suggests that based upon the digital readout only, a user might be mistuned by as much as 100 kHz and still get a "correct" digital readout. It is for this reason that the center-of-channel tuning meter is still a "must" in this system.

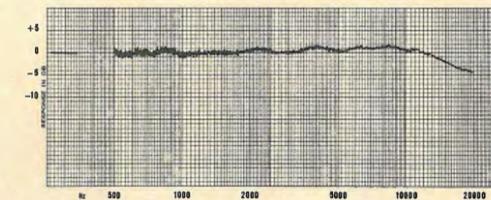
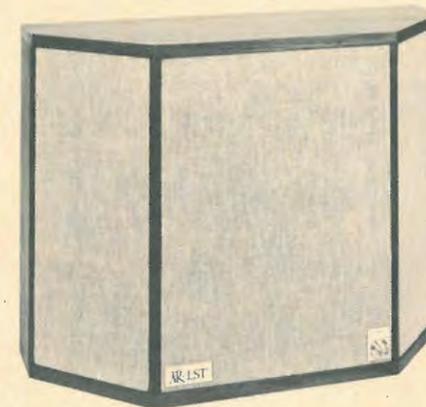
The rear panel has terminals for connection of either a 75-ohm or 300-ohm transmission line. There is also a 75-ohm antenna jack which accommodates a standard Motorola-type coaxial plug. Pairs of outputs are available for tape monitor, record output and line output. In addition, there are a pair of outputs intended for connection to the horizontal and vertical deflection plates of an oscilloscope and a "4-channel output" jack. The latter jack is a takeoff point at the discriminator (detector) of the tuner i.f. system and anticipates the future possibility of FCC approval of a discrete system of "four-channel" broadcasting. Talk about "non-obsolescence"! The rear panel layout also includes a ground terminal, a line fuse and an unswitched convenience a.c. receptacle.

Naturally, the most intriguing part of the circuitry of the SEL 300 tuner has to do with the digital read-outs, and the two portions of the schematic diagram relating to this function are shown in Figs. 1 and 2. Essentially, the circuit operates much like any commercially available frequency counter. What is "counted" in this instance is the frequency of the local oscillator, which is always 10.7 MHz higher than the incoming frequency. Figure 1 shows a series of "divide by two" logic IC's which reduce the oscillator frequency to a range of 12.2 to 14.9 MHz (a total division by eight). In Fig. 2 a 100 kHz reference crystal acts as a "clock" frequency against which the further divided incoming oscillator frequency is compared in a series of logic IC's which ultimately trigger and fire the various segments of the four read-out tubes. Readers familiar with digital electronic techniques will have no trouble following the "logic" of these circuits. Those readers who can think only in "analog" terms will have to take our word for it—the circuit works, and works very well indeed.

Of equal (or perhaps greater) interest to us was the rest of the circuitry—that part of the tuner which enables us to *hear* clean, noise free, undistorted FM at its best. A *pair* of FET r.f. amplifiers in cascade, followed by an FET converter

The AR Laboratory Standard Transducer

A speaker for professional use
from Acoustic Research



ACCURACY AND FLEXIBILITY: The AR-LST offers a total of six different energy profiles—all accurately known and repeatable at the turn of a switch, which is located on the front of the cabinet. This permits a degree of control and precision that is usually found only in electronic equipment.

FLAT ENERGY CAPABILITY: The AR-LST is capable of a flat energy output characteristic that, in our judgement, establishes a new state of the art. The graph shown above represents the acoustic power output produced by the AR-LST with its control set to the "flat" position. The horizontal line below 500 Hz indicates the relative woofer level.

LOW DISTORTION: As with the AR-3a, harmonic distortion measurements down to the lowest audible frequencies are, to the best of our knowledge, the lowest of any loudspeaker system available.

WIDE DISPERSION: AR's hemispherical dome tweeters produce exceptionally smooth, wide dispersion of midrange and high frequencies, even in room or studios that are acoustically rather dead.

POWER HANDLING: Multiple drivers for midrange and high frequencies enable the AR-LST to handle power levels significantly higher than AR's finest speakers designed primarily for home use.

Detailed information on the AR-LST is available on request. Mail the coupon below.



Acoustic Research, Inc.

24 Thorndike Street
Cambridge, Massachusetts 02141, Dept. AU-11

Please send the booklet describing the AR-LST to

NAME _____

ADDRESS _____

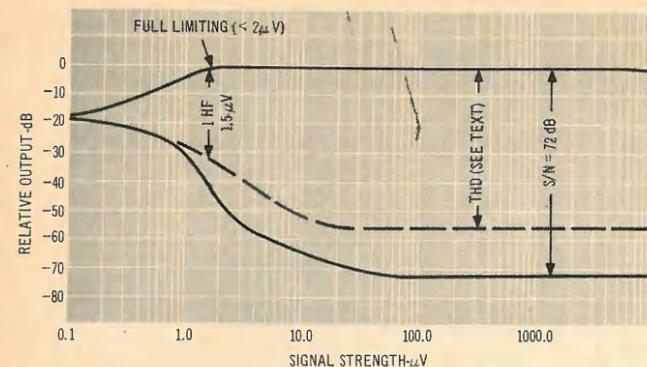


Fig. 6—FM characteristics.

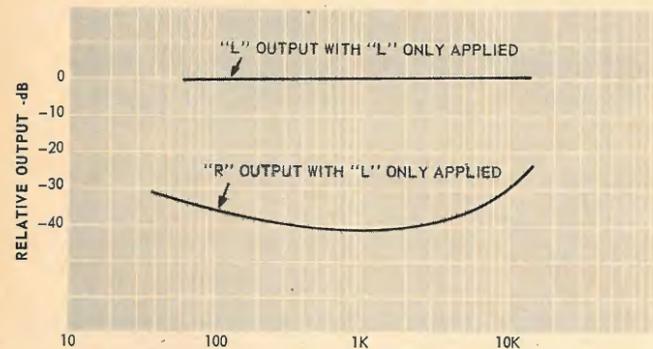


Fig. 7—Stereo FM separation characteristics.

stage and a 3-IC i.f. system which remains in perfect alignment thanks to a pair of multi-pole "Le Gendre" type toroidal filters as well as a *real* Foster-Seeley discriminator circuit, yield sensitivity figures that are unequivocally the *best* we have checked to date and selectivity characteristics which were so good that we were able to tune in *several* channels which were only 200 kHz removed from strong, local stations. It goes without saying that alternate channels (400 kHz apart) were the rule, all over the band, rather than the exception. As a matter of interest, Fig. 3 (taken from Sherwood's instruction manual) shows the excellent i.f. bandpass characteristic of the SEL 300 as compared with crystal filter arrangements which Sherwood obviously feels are inferior to the multi-pole filter approach—and we tend to agree.

Multiplex circuitry is fairly conventional and is the usual "bridge demodulator" automatic switching type. We found this portion of the circuitry to be in perfect alignment, giving the separation results claimed by the manufacturer. Views of the internal construction of the chassis are shown in Figs. 4 and 5.

Measurements

We have, in the past, stressed the importance of early limiting and "steep" quieting characteristics in a good FM tuner. While the Sherwood SEL 300's IHF sensitivity of $1.5 \mu\text{V}$ is impressive enough in itself, Fig. 6 discloses the fact that full limiting is actually achieved at an input level of less than $2 \mu\text{V}$, while 50 dB of signal-to-noise ratio is attained with an input of $3 \mu\text{V}$. (Actually, we measured S/N of 53 dB at this low input level). Ultimate S/N reached 72 dB as opposed to the 70 dB claimed by the manufacturer. As for THD, very frankly we have to take the manufacturer's word at 0.15%. Our FM generator itself is *known* to produce about 0.25% THD and that is exactly what we read when trying to measure the mono THD of the SEL 300. (Anyone want to buy a slightly used FM generator in excellent condition?)

The stereo separation characteristics of the SEL 300 are shown in Fig. 7 and are seen to be every bit as good as FCC transmitter requirements (at least 30 dB from 50 Hz to 15 kHz). At mid-frequencies we read 40 dB, as claimed, though the tuner may well be doing a bit better since, again, that is about the reliable limit of our stereo generator's separation capability. (Anyone want to buy a slightly used stereo generator in excellent condition?)

Other pertinent facts we learned about the SEL 300 are that the hush control may be set as low as a $2.5 \mu\text{V}$ threshold and all interstation noise will be eliminated. We wonder, in fact, why Sherwood offers so much front-panel range for this control. If, as is the case, 3 microvolt signals are perfectly listenable, why would anyone want to block signals of, say, less than $10 \mu\text{V}$? The station read-out sensitivity is just under $4 \mu\text{V}$, which means that it is possible to listen to a few very weak signals which are not strong enough to trigger the readout tubes when the INTERSTATION READOUT BLANKING button is depressed. Of course, if such a situation exists in your area you have but to release this button to read the received frequency. With this button released, all frequencies are read, regardless of whether a station is being received at the particular frequency or not.

Listening Tests

Without using our antenna rotator (and allowing the antenna to face due west, towards New York City, some 20 miles from our location), we did not miss a single alternate channel from 92.3 MHz to 107.9 MHz. That is, every 400 kHz we heard a listenable signal. Below 92.3 we received only four additional stations (this is the "non-commercial" or educational segment of the FM band) and that was simply because some of the lesser educational stations are not on the air all the time. Thus, with no antenna reorientation we received 45 usable signals, of which 28 were broadcasting in stereo. Reorientation of our antenna by means of our rotator brought in an additional 15 stations from the north and northeast, for a grand total of 60 different signals. More importantly, this last experimentation enabled us to really check the aural significance of a selectivity specification in excess of 80 dB. It is, indeed, highly significant, for we were dealing with *adjacent* channels (only 200 kHz apart) in this last phase of our tests—and some of the adjacent channels involved were adjacent to local signals with measured signal strengths at our antenna of more than 10,000 μV !

We also utilized the "multipath" scope jacks on the rear of the tuner to orient our antenna properly for those signals which did exhibit significant amounts of multipath interference and were able to clean up all but about three. Invariably, the least multipath interference occurred when we directed the antenna to points *other* than the "maximum signal strength" point, as indicated on the meter alone. Anyone fortunate enough to own this tuner will not be doing it justice unless he avails himself (even if on a borrowed basis) of an oscilloscope with which to record the "least multipath" antenna positions for his favorite stations. We realize that the SEL 300 might have cost considerably more had it been provided with a built-in scope tube, such as is supplied by some of the high-priced competition, but it just might have been worth it.

As for our reaction to the digital readout feature, in a word, it's "comforting"—comforting to know that we really *have* tuned to the station of our choice without having to wait for a station identification. If that were the biggest selling point of this "over \$500 tuner" we would seriously question its merit. But, confronted with a tuner that *performs* like the Sherwood SEL 300 we can only wish that the digital readout innovation helps Sherwood sell a lot of them, so that discriminating FM listeners will have an opportunity to judge it as an FM tuner—not as an eye-catching "gimmick."

Leonard Feldman

Check No. 48 on Reader Service Card

The new Pioneer SX-9000 is the only AM-FM stereo receiver with a built-in reverberation amplifier... microphone mixing...inputs for 2 turntables, 2 tape recorders, 2 headsets, 2 microphones, 2 auxiliaries... 4-position tone selector...outputs for 3 pairs of speakers...240 watts (IHF). And it's all in just one oiled walnut cabinet.

We had to stop somewhere.



And if you want to get down to the nitty gritty, the SX-9000 has an FET front end with sensitivity at 1.6 microvolts to bring in the most fainthearted stations. There are 4 IC's in the IF; combined with a 1 dB capture ratio and 40dB selectivity, you can pinpoint stations on the most crowded

dial. Extra conveniences are afforded by the loudness contour and twin tuning meters. Visit your Pioneer dealer. He'll demonstrate the whole new world of enjoyment that's yours with the SX-9000 as a stereo listener or experimenter. \$499.95 (Excludes applicable surcharges).

Send for free reprint of Audio Magazine product review. U.S. Pioneer Electronics Corporation 178 Commerce Road Carlstadt, New Jersey 07072

PIONEER
when you want something better



**Rabco Model ST-4
Straight-Line Turntable**

MANUFACTURER'S SPECIFICATIONS

Turntable: Precision die-cast, driven by vibration-isolated synchronous motor. Either 45 or 33 rpm speed can be obtained by manually moving belt between two motor-pulley diameters. **Tracking Force:** 1/3 gram minimum. **Rumble:** -60 dB. **Tone-arm:** Driven by a mechanical bi-directional proportional servo system. The arm is provided with a "steering" wheel that rides on a constantly revolving shaft and keeps the arm at right angles to the shaft. Any deviation from true tangency to the record is immediately corrected. Automatic lift at end of record. Pushbutton cueing. **Pickup Mounting:** Cartridges with standard 1/2" spacing of mounting holes fasten with two screws. Cartridge holder can easily be adapted to any other spacing. Plug-in cartridge holders interchangeable. **Output Connections:** Standard, three-foot double-ended stereo cable is supplied. **Dimensions:** 15 1/2 x 18 x 5 in. with base — 15 1/2 x 18 x 6 in. with cover. **Weight:** 15 lbs. **Price:** \$159.00. DC-4 dust cover (optional), \$15.00. CH-4 plug-in cartridge holder (optional), \$10.00

When we profiled the original Rabco SL-8 Servo-Driven Tonearm in May, 1969, we said that "here is a phono cartridge tone arm for audio buffs who can put their money where their hearts are." Now comes the same idea combined with a turntable and automatic cueing, so the suggestion made two years

ago can well be repeated, this time in spades. The unit did what it was supposed to and did it well—that is, it carried the stylus along the radius of the record, keeping the cartridge always tangent to the groove.

The mechanism of the ST-4 differs appreciably from that of the SL-8—so much so, in fact, that it appears to be a whole new design when compared to the motor-driven tracking of the original unit. In the newer model, a highly polished steel shaft is rotated continuously by a belt drive from the turntable, and on this shaft rides a rubber wheel which is mounted within the arm. The rubber wheel actually supports the arm, positioned by two nylon guide wheels which keep it in place. As the arm is swiveled by the action of the stylus following the groove, the rubber wheel tends to achieve an equilibrium on the shaft, and so carries the entire tonearm with it. Not that it makes any difference with conventional records, but the unit would track records cut inside-out (as were early transcription discs) as well as it does the usual outside-in records.

As if the tracking mechanism were not of itself so unique, we must add that there is a cueing device which lowers or raises the stylus to or from the record at the touch of a button. Assuming the playing position of the cartridge, one presses the button and a second motor, completely isolated from the turntable motor, actuates a double-bar assembly which lifts the arm

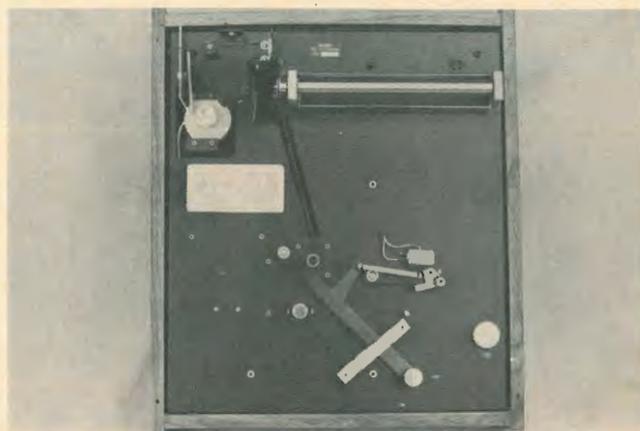


Fig. 2—Top view of the ST-4 with platter, arm, and mechanism cover removed to show the simplicity of the entire chassis.



Fig. 1—Underside of arm, showing nylon guide rollers, counterweight, and the four-contact plug carrying the pickup output. Plug inserts in matching receptacle on chassis, and four fine wires carry the signal from the cartridge with a minimum of drag on the arm.

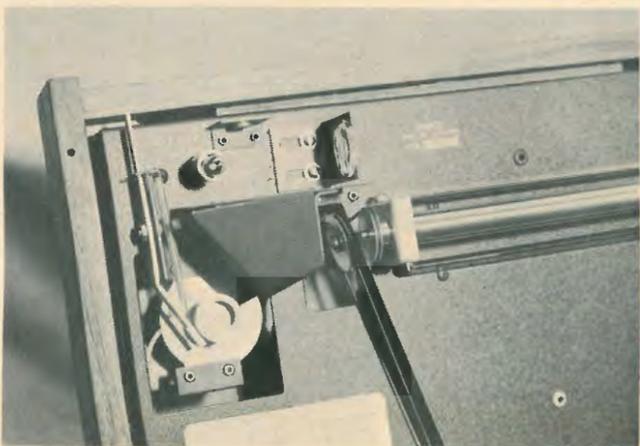


Fig. 3—Close-up of the drive mechanism, light source for end-of-record activation, and light-sensitive cell housing. (Note: current models do not have speed-shifting lever.)

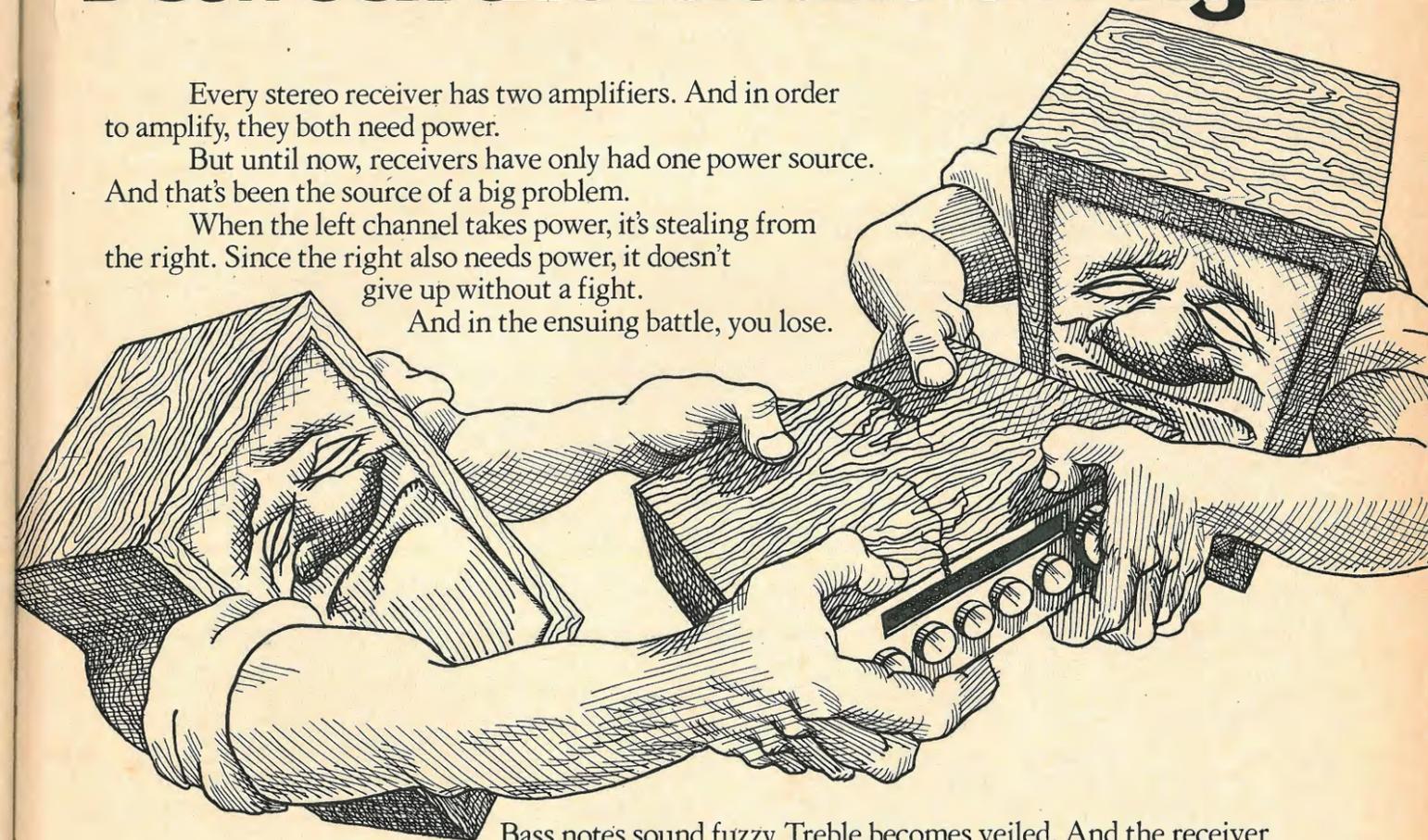
Announcing an end to the age-old power struggle between the left and the right.

Every stereo receiver has two amplifiers. And in order to amplify, they both need power.

But until now, receivers have only had one power source. And that's been the source of a big problem.

When the left channel takes power, it's stealing from the right. Since the right also needs power, it doesn't give up without a fight.

And in the ensuing battle, you lose.



Bass notes sound fuzzy. Treble becomes veiled. And the receiver tends to "break up" when you need it most—at high volume.

To put an end to the struggle, Harman-Kardon designed a new kind of receiver: the 930.

The 930 is the first receiver with twin power. It has two entirely separate power supplies: one for the left channel and one for the right. That way, they peacefully coexist.

When one channel needs power it simply takes what it needs—without affecting the other.

As a result, the 930 can handle enormous tone bursts at full volume without straining.

In fact, its distortion curve isn't even a curve. You can draw it with a straight edge.

(Total harmonic distortion remains below 0.5% from 20 Hz to 20,000 Hz—at full rated output, 45/45 watts RMS, both channels driven simultaneously into 8 ohms.)

The 930 costs \$369.95. Which is about what you'd pay for a good receiver without twin power.

So, the only question is which you'd rather have:

War or peace.

For complete information, write:

Harman-Kardon, Inc., 55 Ames Court,
Plainview, New York 11803.



A subsidiary of Jervis Corporation

The Harman-Kardon 930.
The first receiver with twin power.

Check No. 51 on Reader Service Card



upward. When the lifting bars have completed their cycle, a cam shuts off the motor. To start the play cycle, you simply position the stylus over the desired groove and press the button, holding it down for a couple of seconds, and the arm is lowered gently to position through the action of the double arms.

What happens when the stylus comes to the end of the record? There is another "invention" which takes over. As the stylus tries to follow the runout groove, the arm is swiveled too rapidly to permit the rubber wheel to catch up, so this third invention involves a small mirror on the rear portion of the arm, and it reflects a beam of light from a lamp in the mechanism housing to a light-sensitive cell to inaugurate the lift-cycling motor, thus raising the stylus from the record.

Turning to more mundane aspects of the ST-4, the motor (to drive the turntable) is synchronous, of the type usually referred to as a clock motor. It is fitted with a shaft with a pulley having two diameters for 45 or 33 1/2 rpm. A finely ground flat rubber belt rides on the selected diameter and around the outside of the heavy non-ferrous platter which rotates on a steel shaft riding in a bearing well mounted on the chassis, which is isolated from the base by damped spring mounts. The ON/OFF switch is actuated by a lever which controls a snap-action switch and at the same time applies a brake to the inside rim of the platter. The drive to the steel tracking shaft is by means of a thin round belt around a groove on the hub of the platter to a pulley on the shaft mechanism, and it in turn drives the shaft at a slower speed by another round belt. Early models of the ST-4 provided a speed-changing lever which moved the turntable-drive belt from one motor pulley to the other, but current models require moving the belt by hand in a more effective arrangement.

Stylus force is adjusted by a weight on the rear of the arm, with this weight being marked from 0 to 9 for fine adjustment, and one full turn of the counterweight will vary the stylus force

by only 1/4 gram. Mounting the cartridge to the arm is considerably simplified since the manufacturer supplies six pairs of 4-40 screws of different lengths to accommodate practically any known cartridge. In addition, two plastic shims are provided to position the cartridge so as to ensure that the arm is parallel to the record surface. The rubber mat on the platter is centered by the 45-rpm adapter, which turns over for the large-hole records.

Performance

We tried out the ST-4 using a number of different cartridges to determine if adjustments were adequate for all. They were. We found that suitable and reliable operation could be obtained with as little as one-half a gram, which is about as little as any cartridge will accept for reliable performance. Slots are provided in the arm so the stylus can be set accurately to the center of the spindle. On the whole, everything seems to be well thought out for optimum adjustment.

Wow and flutter measurements were made using the CBS BTR-150 Broadcast Test Record and with measurements made with a flutter meter calibrated to indicate rms wow and flutter—wow being in the range from 0.5 to 6 Hz, and flutter in the range from 6 to 250 Hz. Flutter was extremely low, measuring only .03 per cent, while wow was in the range from .05 to .06 per cent. Rumble measured by the old NAB standards was noted at -43 dB, unweighted, which approximates -61 dB weighted, about what one would expect as the ARLI figure.

On the whole, we found the Rabco ST-4 to be well made, and capable of excellent performance in every particular. It takes a little more time to set up and get into action than the usual turntable, but when it is in your system, you are sure to like it.

C. G. McProud

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STUDIO 4
makes
great sound
twice as
good!

Size: 3 7/8" high, 9 7/8" wide,
4 5/8" deep

STUDIO 4 AMBIENCE REGENERATOR

For complete information write:

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NET \$39.95

UTAH ELECTRONICS
1124 East Franklin Street
Huntington, Indiana 46750

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PIONEER AM/FM receiver w/reverb control, new, exc. cond. \$425 (217) 410-2111

FOR SALE: Two [redacted] speakers, hardly used. In original carton. Just purchased two FAIRFAX L-34A Speaker Systems. Call IN 7-3407.

SANSUI 500. Wharfedale 60D, Garrard many extras: 2 extra spkrs like \$450

SONY 1970 once \$125 deck \$51 SL-95 \$65

BOGEN [redacted]

old, exc. cond. \$350. (212) 739-3306

TWO [redacted] Speakers used 3 months. For sale or swap for two FAIRFAX FX-100. Call PC 7-3453, ask for Bob.

STEREOPHONIC stereo system. AM/FM receiver phono, 8 track tape

w/Wa

LARGE tape recorder, tapes, hc \$165. (1

#777

table: 1 yr. old; exc. \$300. Eves (513) 202-0012

Will trade two [redacted] Speakers, excellent condition for two FAIRFAX FE-8—even exchange—no money. I'll take loss. Call VA 3-3530 days only.

SCOTT compact stereo system, access turntable, amp; never used. \$350. stereo tape recorder (212) 271-

KENWO

FISHER changer; cond \$2

ALTEC

receiver w/walnut case; exc. cond. \$170. (212) CI 1-3511

TWO [redacted] Speakers for sale. No reasonable offer refused. Need money for FAIRFAX FTA's. CA-6-0571 after 6 PM.

FISHER 500TX-AM FM stereo receiver 200 watts; never used. \$350.

spk (516)

SCOTT 299, Fisher KM60; 601-1270

REALT

FAIRFAX must be doing something right!

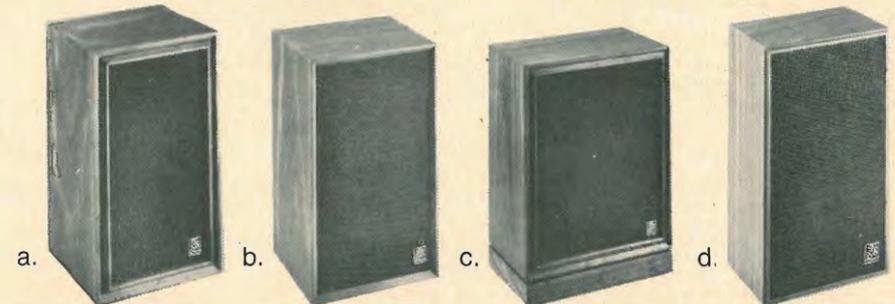
AND IT'S NO ACCIDENT! What greater compliment can audiophiles pay us than by trading in their present speakers for FAIRFAX Speaker Systems? And why not? Today's sophisticated listeners know what quality sound is... and they want the best and most for their money!

Ads like the ones above have been appearing in newspapers and magazines from coast to coast. Although the publisher has requested us to censor the manufacturers' names, the implication is clear: Because of their superior performance FAIRFAX Speaker Systems are in more demand today than ever before by more stereophiles and by more knowledgeable pro's for studio playback and other commercial applications.

WHAT MAKES FAIRFAX SUPERIOR?†

First they have the DIFFERENTIAL CIRCUITRY GATE*... an advanced and sophisticated engineering feature. Differential Circuitry Gate, a function of computer design technology, results in the only speaker systems in the industry to provide TRUE PITCH and ZERO OVERLAP. This means that there is a complete separation of all musical tones, subtle nuances, and timbre originally recorded and reproducing each individual sound in true undistorted fidelity. No other speaker manufacturer can make this statement!

† Comprehensive testing report by independent audio testing laboratory of actual listening comparison tests of FAIRFAX Speaker Systems against other well-known speakers is available upon request. This unbiased report is vitally important in helping you to make your purchasing decision.



a. FAIRFAX L-34A: Shelf-type; Differential Circuitry Gate; two 8" heavy-duty base drivers; one 4" mid-range driver; one 1" spherically-domed ultra-high tweeter; F/R: 20 Hz to beyond audible hearing range ±3 db; 24"H x 14"W x 12"D; \$199.50. **b.** FAIRFAX FTA: Shelf-type; Differential Circuitry Gate; high frequency 3-way, 4-speakers—two specially-designed 8" drivers; two 4" spherical-dome high dispersion tweeters; F/R: 24-20,000 Hz; 24"H x 14"W x 12"D; \$139.50. **c.** FAIRFAX FE-8: Floor-type; Differential Circuitry Gate; four 8" wide range bass drivers; four 4" spherical-dome type tweeters; 28 3/4"H x 20"W x 12"D; \$249.50. **d.** FAIRFAX FX-100: Differential Circuitry Gate; one 8" bass mid-range driver; one plastic-domed tweeter; 21"H x 12"W x 7 7/8"D; \$89.50. (prices are suggested retail).

FAIRFAX INDUSTRIES
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900 PASSAIC AVENUE, EAST NEWARK, N. J. 07029 (201) 485-5400

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DIRECTORY ADDENDA



TEAC 3300



Marantz Imperial V



Ampex AX300

Receivers

The Hitachi SR-300 has a power bandwidth of 30 to 20,000 Hz, and the firm's SR-100 receiver has a THD at rated power of 0.5%.

Manual Turntables and Arms

The correct length of the Hitachi PS-77 tonearm is 14-9/16 inches.

Address Directory

The new address of Sansui Electronics Corp. is 32-17 61 Street, Woodside, N.Y. 11377, while the address of Rabco is 11937 Tech Rd., Silver Spring, Md. 20904 and Hill Speaker Co., P.O. Box 457, Lawrence, Kansas 66044.

The TEAC Corp. of America is now located at 7733 Telegraph Road, Montebello, Calif. 90640.

Open-Reel Tape Recorders

The correct price for the Ampex AX300 tape recorder is \$599.95, rather than the \$899.95 as was listed in the September Directory. Ampex also notes that the price of the Model AX50 tape recorder has been reduced from \$249.95 to \$199.95.

The TEAC 3300 tape recorder is equipped with 10½-inch reels, rather than the 7-inch size as was specified in the Directory.

MANUFACTURER	Model	WOOFER				MID-RANGE		TWEETER		Overall Freq. Response, Hz to kHz	Ampl. Pwr. for Avg. Room, W	Crossover Frequency (RMS Cont) ± 1 dB	Impedance, ohms	Enclosure Dimensions, W x D x H, in.	Wood Finish	Grille Material	Weight, Lbs.	Price	SPECIAL FEATURES
		Diameter, In.	Resonance (in system), Hz	Enclosure Type	Diameter, In.	Type	Diameter, In.	Type											
MARANTZ	Imperial I	12	—	Inf. Baffle	(2) 4	Cone	(2) 2	Cone	20-20K	—	40	700	8	22 x 15 x 26	Lacq. Wal.	Cloth brn.	60	299.00	
	Imperial 4	8	—	Acous.	—	—	2	Cone	60-18K	—	30	2000	8	10¼ x 7½ x 18½	Wal.	Cloth brn.	14	59.00	
	Imperial 5	8	—	Ducted port	—	—	3½	Cone	50-15K ±3	5	40	2000	8	12 x 9½ x 23	Wal.	Cloth brn.	—	89.00	
	Imperial 6	10	—	Ducted port	—	—	2	Cone	40-18K ±5	—	100	3000	8	14¼ x 11½ x 25½	Wal.	Cloth brn.	—	129.00	

A violinmaker talks about the V-M Professionals.

Ken Warren of Ken Warren & Sons, Chicago, deals in treasured violins. At his workbenches are some of the few craftsmen whom the world's greatest violinists trust to restore and recondition a Stradivarius or Guarnerius, the world's more precious violins.

"The great crime of most equipment is distortion."

Our Model 1521 receiver delivers 40 watts a channel RMS, with extraordinarily low distortion and selectivity values, because we engineered it with 5-pole phase linear toroidal filters, ICs, printed board circuitry, MOSFETs, and more. It is awesomely powerful, dead quiet, and distortion-proof.

"Your automatic turntable is right in tune."

Ours not only play records per-

fectly but handle them beautifully. Records are lowered, onto a motionless turntable. Counterbalanced, anti-skate tone arm is longer for indiscernible tracking error. Beautifully isolated motors make Wow, Flutter, Rumble undetectable to the ear. All push-button controlled.

"This sounds very near a live performance."

Exactly what components are all about. You hear sound as recorded, not as interpreted by speakers. Our Model 93 uses domed tweeter, half-roll surround, self-contained mid-range, and acoustic suspension woofer. Inductive-capacitive crossover delivers seamless transitions.

If the Professionals can please Mr. Warren, sound and recording engineers, and musicians, people whose business is sound, we're confi-

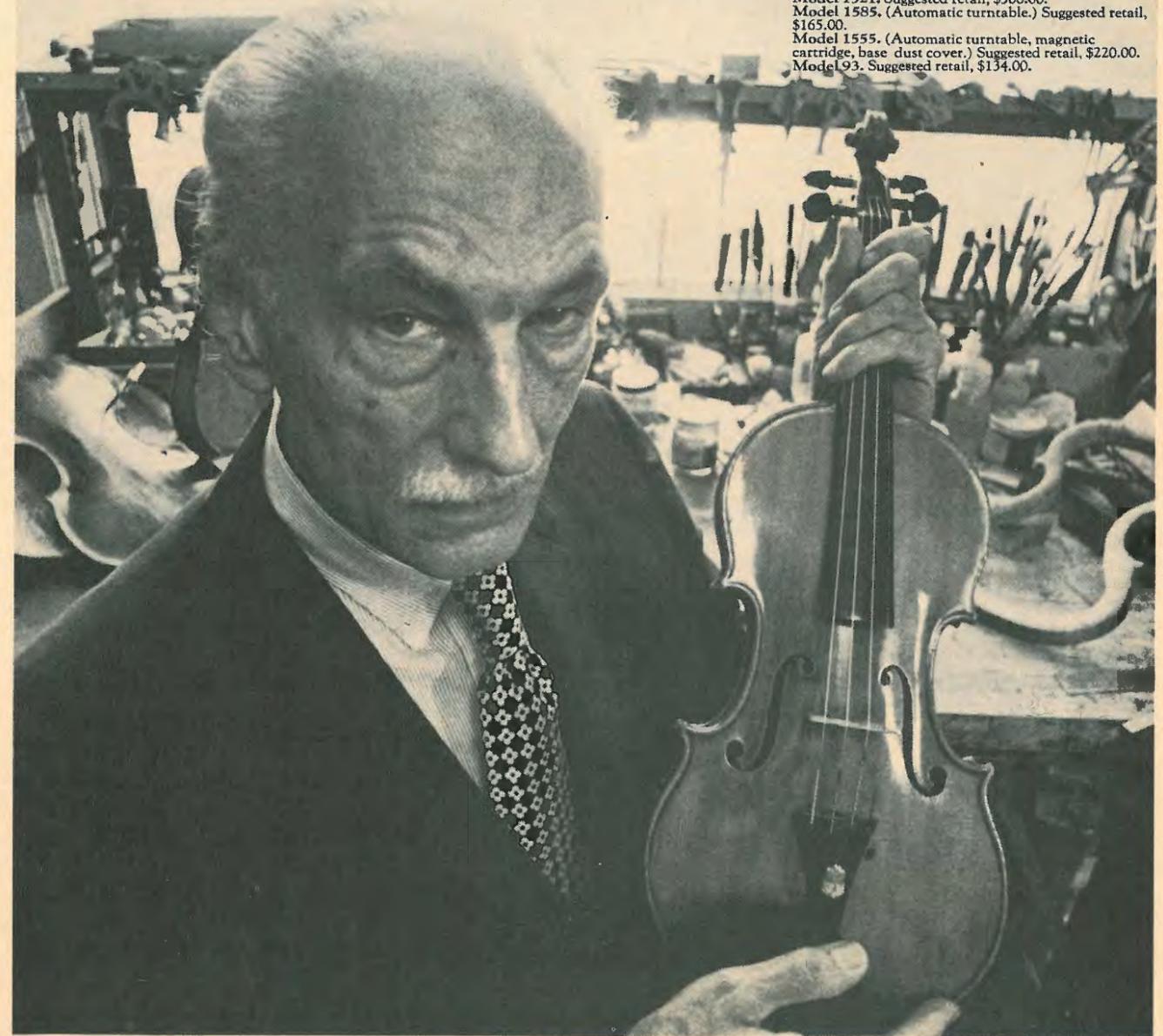
dent they can make you very happy, too. For all the facts and figures, write: Professional Series, Dept. 74, P.O. Box 1247, Benton Harbor, Michigan 49022.

Made in Benton Harbor, Michigan by V-M Corporation.

V-M Corporation

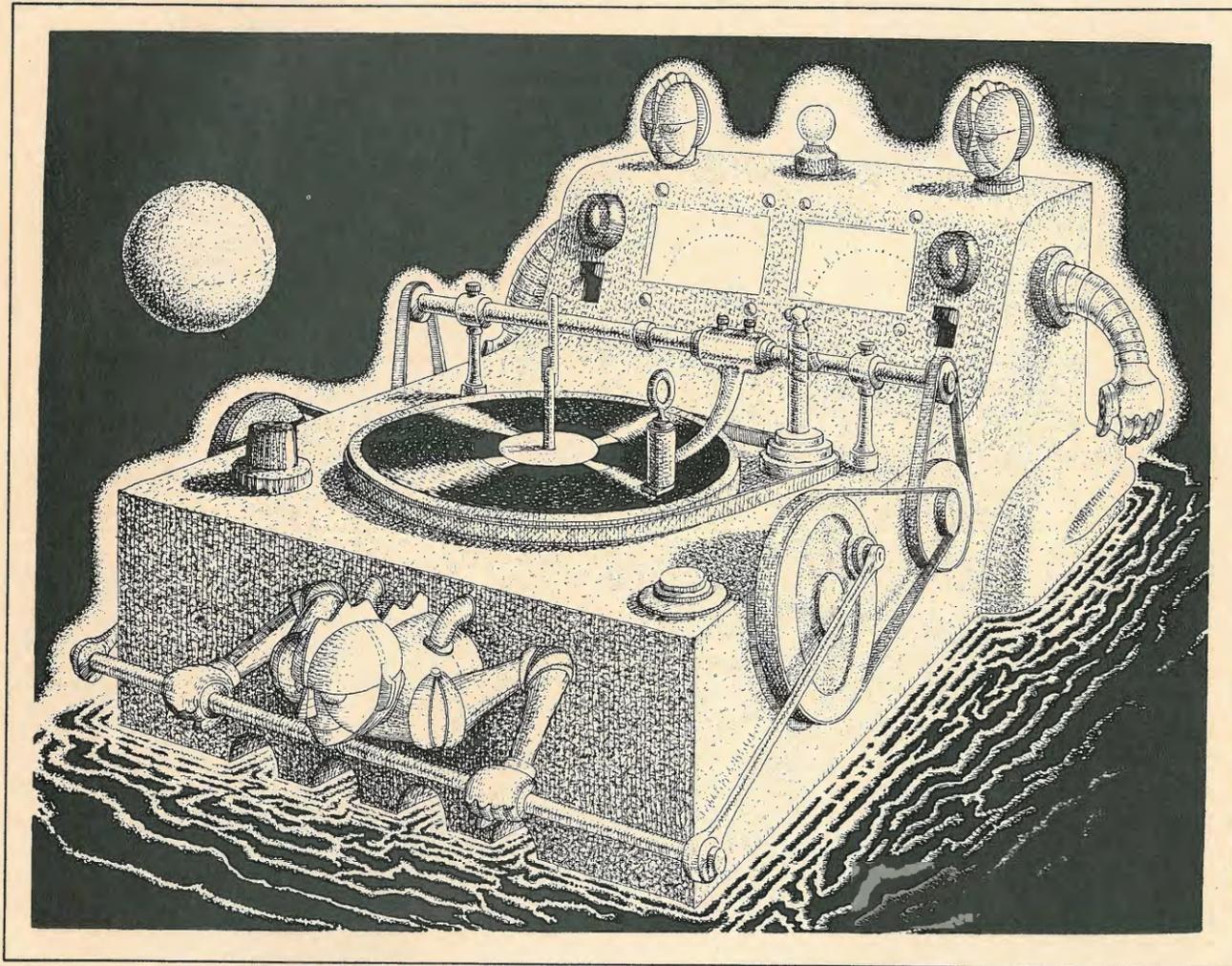


Model 1521. Suggested retail, \$500.00.
Model 1585. (Automatic turntable.) Suggested retail, \$165.00.
Model 1555. (Automatic turntable, magnetic cartridge, base dust cover.) Suggested retail, \$220.00.
Model 93. Suggested retail, \$134.00.



Latter-Day Gadgetry

EDWARD TATNALL CANBY



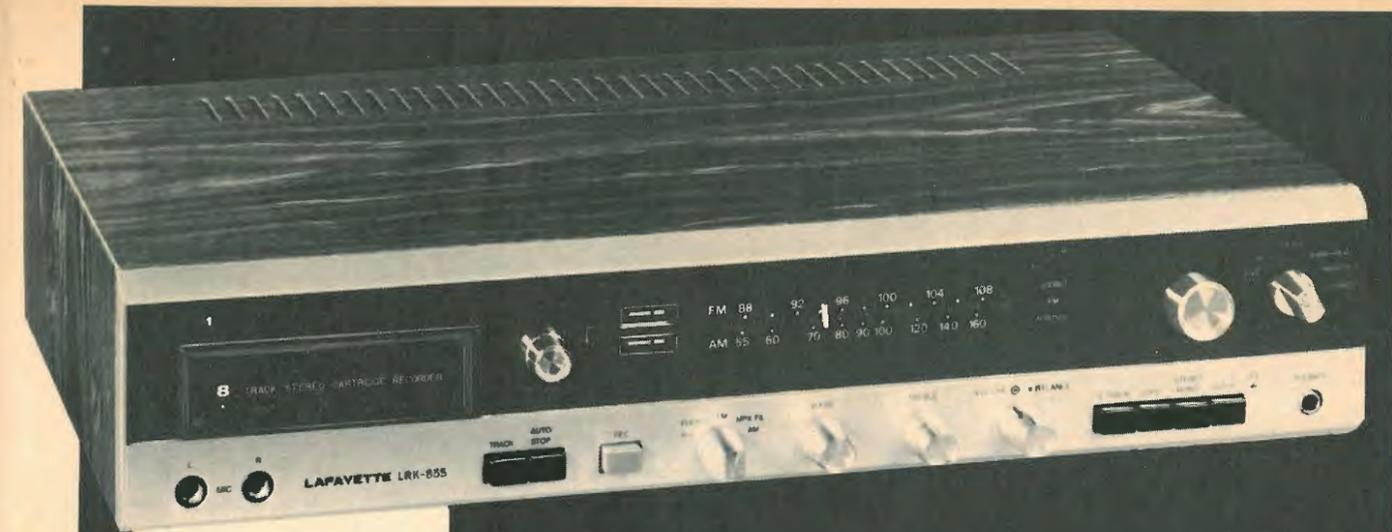
THE GADGET reigned supreme back in the days when this magazine first dipped its toe into the brand-new hi-fi field, some 25 years ago. It was a gadget world, in audio. You put together your system not from components but from parts of components. A speaker was a speaker, not a box full of glass wool, drivers and crossovers, ready-installed. A phono player was made up of an arm, a cartridge, a motor-turntable and something to hold it all together; you acquired each of these by itself—even the needle was sold separately. A gadgeteer's paradise, or purgatory, depending on how gadget minded you were.

I'd been involved in the same for a long while before, even to the point of building my own fat power amplifier out of a pair of 6L6's in push-pull. Not, of course, without guidance. I couldn't design a power amp any more than I could design an angel food cake. But I built it. I had to. In those pre-AUDIO days there wasn't anything for power except those sturdy PA amplifiers for skating rinks and school auditoriums, out of which the home hi-fi amp eventually developed. We started buying them up even before it dawned on the manufacturers that skating rinks weren't their only market.

Anybody around remember the Bogen PH-10? The Grommes LJ-1 ("Little

Jewel")? These were the first mini-historic "hi-fi" models, bottom-bracket style at around \$35.00 list, with input for crystal phono, in effect modified low-cost PA amps and they launched a new market in the home. A central gadget to be hooked into other gadgets, like speakers mounted in open Celotex boards (and set into a fireplace for BOOM bass). Believe it or not, my original Bogen amplifier, the PH-10, exactly as was, still is in daily use today (Bogen, please note), as the central element in a modest New York apartment installation. The lady in question hasn't converted to stereo yet.

My attic and shelves are full of ancient hi-fi appurtenances left over from these



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early put-it-together days. One favorite "prop" of mine was a 50¢, six-in. speaker mounted in a cardboard carton maybe eight inches square. Hooked up to a "hi-fi" amplifier this gadget produced what then was an astonishing blast of reasonably good sound, a lot better than "commercial" phonographs. Just showed what you could do, if you got into hi-fi. I have a monster collection of dead phono arms, their leads dismally trailing, their cartridges removed, and drawers full of cartridges, from the Astatic CQ (a wide-range miniature crystal for the early LP) and assorted models of the GE variable reluctance on to Fairchild's foursquare early-stereo SM-1 (two of them—how did I manage that?) and a brace of gold and silver Pickering's, the snub nosed model with the colored plastic insert, red, purple, blue, yellow. All this and much more. It was a gadgety world.

It still is, but, oh, so differently. It wouldn't do at all to speak of our present basic hi-fi components as gadgets. They are much beyond that, in many ways, but principally in that they are now smoothly functional, complete overall pieces of equipment which perform, even for the uninitiated, the way automobiles do in the 1970s. Efficiently and without fancy explanations. Perhaps the Model A Ford was the last true gadget car, if you'll overlook the ubiquitous Beetle. Definitely not the present Ford LTD and its plush relatives! You can buy gadgetry to go with them, but they themselves exist in another plane, far removed from gadgetry. So it is with much of 1971's basic hi-fi.

All of which leads me to some items of latter-day gadgetry which have lately occupied my attentions. Let me take extremes. First, I've been playing with two fabulous gadget attractions which, unbelievably, manage to polish up the chrome plate on the famed gilded lily, and do it remarkably well at remarkable cost. Second, I've been window shopping in a fabulous low-price gadget catalogue (shall I say, a gadgetlogue), which has so many cheap enticements I could spend years trying them out. Some contrast.

Ever need to clean up your dirty LP discs? An old story that, and a prime source of gadgetry for a quarter century of progress. My Audiotex Accessory Catalogue goes to town, reflecting these many years of accumulating dirt and dust. Most of us, of course, ignore the groove-smog, piling our naked LPs in hideous, grinding stacks and treating the sonic overlay that results as merely so much innocuous background noise. The best preventative, if you want to

prevent, is simply to put your records back in their inner sleeves and restore them (with the opening to one side) to their proper cardboard jackets. But to supplement this unlikely sort of perfection, Audiotex has almost three pages of cleaning gadgetry, selling from 75¢ up, and mostly under a couple of bucks.

It's 95¢ for the Powder Puff record cleaner, with a strap over the top for a couple of guiding fingers as you wipe the LP surface. You can smear it with Record Satin Spray, pressurized; or maybe with Recor-De-Stat, from a small plastic bottle. (But don't get any Non-Slip fluid on it, out of a similar bottle—that might be disastrous!) Alternatively, you can try the Disk-O-Kleen antistatic record cleaning cloth (\$1.25) or the Disk Whisk, a two-pronged affair that clips over both sides of the disc and wipes 'em off with a quick turn. Then there's Stylus Kleen, in another bottle (95¢), to take off the lint and dirt from diamond, "sapphire," and steel needles—to quote the catalog. (Probably works even without the extra "p.") If you don't want to mess with liquids, there's always the bristle brush—Record Tone Arm Lift and Brush (\$1.00), to turn your ordinary cartridge into a you-know-which-brand. Or even cheaper (75¢), the Record Brush, to hook onto the cartridge end of the tone arm; or the Record Stylus Brush, which sits off to one side on a little post so that the stylus has to whisk across it when returning to rest.

But maybe the most useful gadget in this part of the catalog isn't a brush or a liquid—just a batch of polyethylene envelopes (15 for \$1.50) into which you can put your orphan discs, the ones that have lost their protective covering. After you've cleaned them up. One more. Kleen-O-Record (75¢) is a silicone impregnated cloth, anti-static and "repels dirt." All these, you see, under one minute category, if a potentially important one.

Audiotex has all the standard apurtenances, of course, including speakers (boxed, that is), soldering irons, 45 rpm adapters, wire strippers, speaker volume controls, headphones, mics (we used to say "mikes") from \$1.95 on up (up where? To \$39.95 for a "cardioid dynamic professional microphone" with built-in pop screen), plus stands and booms, phones, telephone pickups, a vast array of TV extras, etc., and a perfectly enormous display of connecting cables and adapters, to go from every imaginable plug or socket to every other imaginable one.

Am I for these last, even at a (relatively) stiff price! If you've ever made up your own connectors, you'll know

why. Much of the Audiotex connector equipment is of the sturdy molded plastic sort, a type that just isn't possible via home soldering. I can assure you after years of shorts, squawking broken grounds, dead signal leads and so on, that there is *no* substitute for the modern molded connector, unless it is those expensive pro connectors of large size that you see in recording studios and broadcast stations. Many of the Audiotex adapters are direct coupled. No cable, just two connectors back to back, so you can convert one end of a cable. A whole range of "Y" adapters too, a category I've found useful in going from stereo to mono and vice versa.

Plenty—you get the idea. You can get the catalogue (FR-71-A) and its successors from GC Electronics, Rockford, Ill. 61101. Or visit your local gadgetry.

I'd be remiss here if I didn't backtrack a bit, to the inexpensive record cleaning items, and mention the granddaddy of them all, the Watts Dust Bug. This one's not from Audiotex, but Elpa Marketing, and can usually be found in your local hi-fi or record store. This granddaddy bug is mounted on top of a suction cup-based pillar, which sits beside the turntable platter. At the end of a plastic arm are bristle and roller brushes, which skate inward while the record is playing, removing static and dust.



Now for the chrome-plated lily. So you *really* want to clean your records. The ultimate super-cleaning job, than which no other could conceivably be better? Can do. It will cost you \$595.00 plus tax. (A coin-operated version goes for \$629.00. Record stores take note.)

They used to say it took the Germans to do a methodical job of carrying things to the ultimate. I vote any day for the English, who, when they get their engineering minds onto some idea, just never give up until they have it right, done to a turn and "practical." This enormous cleaning gadget is British. I hesitate to call it state-of-the-art, but that's what it is. The Syantific Audio Cleaning Machine! That's the way it's spelled. You'd have to see it to believe it.

A big, fat, square metal box with a massive turntable mounted on top, like something out of a studio, and on it what seems to be a phono arm, though the "cartridge" looks a bit odd. Big paintbrush thing, five inches or so wide, mounted on a swinging "gantry" to

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Julian Hirsch says, "How does it sound? Great! The E-V system, especially with the added flexibility of the Metrotec unit works; adds a substantial amount of listening enjoyment. It convinced this skeptic."

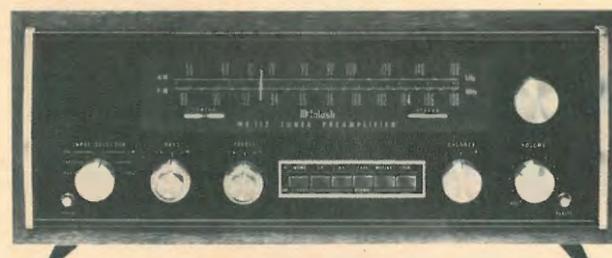
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one side, with plastic tube running down inside the box. Big, black elongated pushbutton on one side of the slanted control panel, a set of printed decal-style directions and, off to the other side, a pair of plastic lighted slide switches—VACUUM and TURNTABLE. Next to the table, a formidable black-japanned lifting handle, to lift the hefty top panel so you can get inside the box and renew the materials.

Phew! Motors, vacuum pump, bottles for fluid. A far cry from the inside of a phono player. There's even a long hank of green string, which has something to do with the vacuum and has to be renewed every so often. (Let's not get into *that*, yet.) The more you look at this incredible monster, the more unlikely does it appear, a sort of lumbering elephant of a device, out of a hospital operating room, with all those bottles and tubes. Smartly styled for the 1940's or so.

Put the filthy LP disc on the turntable. Push the slide switch—and it takes off, faster and faster. Around 80 rpm, after a gradual pickup. Then you push the red VACUUM switch. Chug—chug—chug, one of those fancy diaphragm pumps they have in laboratories and the like—no vacuum cleaner system here! With vacuum chugging heartily and table spinning merrily, you lift the brush up and turn it around so it drops down onto the disc. Push the big black button and a nasty, oozy glop floods out over the surface and is rapidly smeared by the brush. Smell of alcohol—odd, since the stuff seems so viscous. After due deliberation, you then pick up the "tone arm" and move it, against a rubbery detent, over to the center of the disc, then lower it to the record surface. Instantly it starts to move backwards, slowly, very slowly, towards the outside. The "stylus" is a little round tube into which the big vacuum pump now slowly sucks the glop, groove by groove. Slurp, slurp. Takes a long, long time as you watch, though actually it's around 30 seconds. Then the arm falls off the outer edge of the table and just sits. So you take the disc off, turn the other cheek, and do the whole thing over again, glop and all. Side two is now immaculate.

I had one little difficulty. Most of my records are brand-new and almost unused, so they really didn't need cleaning. I tried a few, dispiritedly, then had a bright idea. In no time, I pulled out of my back closet a pair of ancient one-sided, white-label test pressings, naked and unashamed, which had been lurking there in the dust and dirt ever since circa 1950. Concert Hall Society, one of the very early commercial LP releases. Some test! You could hardly see the surface for the dirt. I put these hideously encrusted objects straight on the Record

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Cleaning Machine to see what would happen. (It's a clean machine.)

Well, quite a bit happened. The vacuum pump made extra bubbling noises and the "tone arm" gave out with some very moist gurglings, as though it were a bit ill. But the dirt and the dust and the micro-pebbles dutifully disappeared, straight up the gullet of the sucking pipe. I gather that one of the big problems is to keep the machine's pipes open and unstrangled, regardless of the record's condition. (The string sort of eases the stuff on through, like dental floss or something.) They stayed open okay, for the first and then the second ancient side. Only one problem showed up—warping. These early LPs had the once-common strains and wavers due to inaccurate heat control in the pressing and, maybe, an uneven plastic mix. The sucking mechanism bounced over the broad warps, leaving some of the glop behind. But, after all, my genuine phono pickup, the real one, also bounced; so how much do you expect?

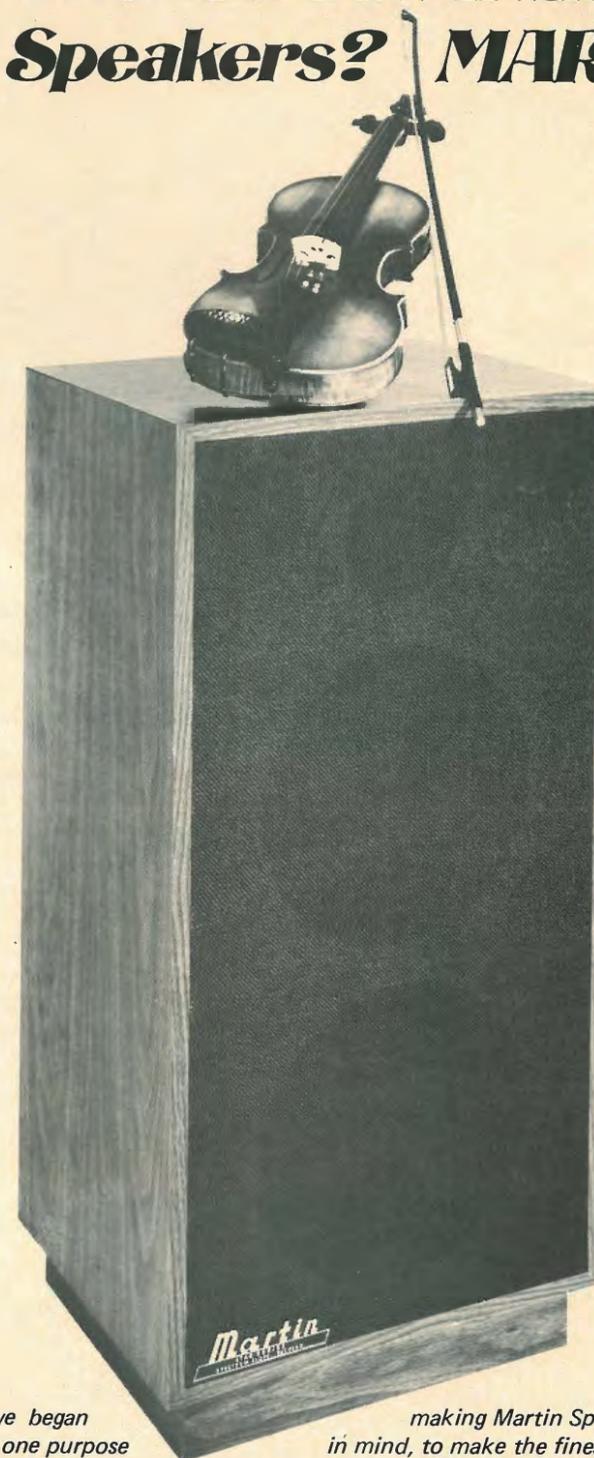
The machine couldn't do a thing for the multiple scratches and abrasions. Not even the British have solved that problem. But, warps aside, the old surfaces were indeed clean and reasonably playable. As you may guess, the monster is primarily intended for such as radio stations, where cleanliness is next to godliness and records get used heavily. So if you're a radio station guy, or equivalent, you can find out all about it from Metrorep, P.O. Box 782, Freehold, N.J. 07728, around the East, or direct from Anglo International, the importers, at 1100 W. Newport Pike, Wilmington, Del. 19804.

Before I leave this subject of record cleaners, let me add a word about a relatively new entry to this field—Discwasher, Inc., 13 So. Sixth St., Columbia, Mo. 65201. This is a fluid-brush combination, both of which the company claims are new departures in this field. The fluid is said to leave up to 16 times less residue than other products, more than three times less than even ordinary tap water. What's more, the fluid guards against fungus colonies, which the firm says grow on records and attack the surface of the discs, and is able to remove lipids, the fatty substance which accumulates when the fingers actually touch the grooves. The brush is of a fine, directed-pile fabric, which means that it uses a built-in grain to help pick up debris. The brush also tends to absorb, through capillary action, the gunk which has been put into solution by the fluid.

Before I quit, let me tell you of another lily-chroming gadget, a more sober affair and not nearly as expensive. For something over 100 bucks, you can

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touch up the tweeter end of your already-super-duper ultra hi-fi stereo loudspeaker system, for better dispersion. Just buy a pair of the little five sided Microstatic boxed tweeters, which sit on top of your big boxes and share the highs with the built-in tweets, spreading them out evenly over a widened angle. Instead of dropping off, as you walk over to the sides of the stereo listening area, your highs now stay put, far out. The side-position stereo image is rendered more accurate since more of the vital information reaches your ears.

The high quality Microstatic units are not, as the title implies, electrostatic speakers (cf. Janszen, et al.). Instead they are not unlike the tiny dome-shaped speakers already found in some of the top quality units for which the Microstatics are a supplement. The idea, as I get it, isn't so much an improvement in sound quality as in the dispersion, to 180 degrees, uniformly side to side (see their "poop sheets"); and in fact I found the quality of the sound remarkably unchanged on the A-B, or rather A vs. A & B, test on axis. It's the side listening that matters. And there I had a sort of dual reaction, quite specific, after a spell of close experiment.

Yes, if your listening area extends off axis, as most listening areas do, there is a clear difference. If you don't get too close to either of your speaker systems, if, say, you move about in a wide area at least five or six feet away from the speaker on each side, you will find a clear increase in stereo precision in the areas which are off at an angle. No doubt about it, and for good reason, with that 180 degrees of dispersion.

This is assuming an average speaker separation of say eight to ten feet in a medium-sized listening room. The larger the space, the more listening room you'll have. Depending on your habits and your furniture, you might well work up a considerable increase of listening versatility, so to speak, via the Microstatic additions.

On the other hand, there is an effect in some rooms, like mine, where space is less free and circumstances often bring the ears fairly close to one or the other of the pair of stereo speakers. If you have a couch near one speaker, an easy chair or a table just beyond the other, you may often find yourself listening from a highly lopsided position. In such a situation, the more limited (but still adequately wide) dispersion of highs in the standard speaker system may actually be an advantage in stereo. I call it the proximity effect.

The last thing you want to hear in stereo is the *point-source speaker it-*

self, as distinct from its speaker mate. In good stereo you do not hear the speakers—you hear the sound, spread out and from many apparent sources, at, between, and beyond the two actual speakers. Now as I walk over to the side and approach quite close to one of my speakers, I move off axis and the highs of the near speaker drop away—whereas the far speaker (aimed a bit inward) still radiates highs. Result: I can stand or sit right next to one speaker and yet *not hear it as a point source*; instead, I hear the more generalized stereo due to reflections.

No, that isn't "accurate" stereo. But it is definitely usable. I often sit on my couch, right next to one speaker, and enjoy the music; or stand near the other speaker, where my records play on a side shelf. It works. The proximity effect. The tailing off of the point-source highs as you come up close to the side of one speaker, thereby hiding that speaker as a separately perceived source. Good, and useful in many rooms.

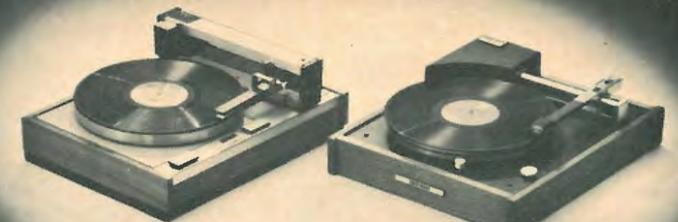
Now here the Microstatics cheerfully undo what the normal speaker does perform—and the results are not quite as intended. At close range, to one side, you distinctly hear the highs from the Microstatic that is nearest you as a point source, right under your nose. The other one, emitting the other channel across the room, no longer blends and thus the stereo, at this acute side-angle, is lost. So in this special situation, I found the stereo listening better without Microstatics.

But who, for goodness' sake, is worrying about a grotesquely small sliver of the total normal stereo listening area! Only a few of us will ever be concerned, due to the way our rooms are built and our walk-and-sit space is arranged. Like the people in the old Metropolitan Opera House, who sat in the side boxes and saw half the stage and most of the backstage where the next scene was being prepared, it's zany but interesting.

And strange! One night I sat on my couch and played mono pop music. Magic. The Microstatics were fine, even at close range. Probably because in mono the two channels are identical and blend all over the room. So put the proximity effect in the back of your mind, just in case.

My electronics assistant says the Microstatic people should find a grand market in updating a slew of sturdy old speaker systems, the kind that have splendid bass but sort of screechy highs. I can think of more than one pair of speakers I would like to update in this fashion, given a handy set of Microstatics at a good price. But then, this wouldn't be chroming the lily. **AE**

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The SL-8E

The ST-4

Here's What the Experts Say

Julian Hirsch
Stereo Review Magazine

It is probably the closest approach to perfection in a record-playing arm that has appeared to date. . . .

Tracking-angle error is essentially non-existent over the entire record surface, and distortion arising from this source is eliminated. Perhaps even more significant is the complete absence of "skating force" (an inherent problem with conventional pivoted tone arms), which eliminates the need for any form of anti-skating compensation. . . .

In our tests, the arm of the Rabco ST-4 worked exactly as intended. Both output channels of the phono cartridge had identical waveforms when playing very high-velocity test records (the true criterion for correct adjustment of the anti-skating compensation of a pivoted arm), which also confirmed the absence of significant lateral arm friction. . . .

The center of the rotating arm shaft (effectively the vertical-pivot axis of the arm) is almost exactly in the plane of the stylus and record, minimizing warp wow. . . .

In our experience the arm certainly is as good as anything we have used, and we never found a trace of degradation, noise, or any undesirable effect that might have been attributable to its unique design. . . .

In using the ST-4 we found that the arm mass was so low that it would track severely warped records without losing contact with the grooves. In this respect, it was better than practically all pivoted arms we have used, and almost as good as the Rabco SL-8 arm which is outstanding in this test. . . .

The mechanical servo-drive system of the ST-4 tone arm is so simple that one's reaction is likely to be "Why didn't someone think of that before?"

The ST-4 is not critical with respect to leveling; in fact we operated it at angles as great as 15° to the horizontal with no decided change in its performance. . . .

Gordon Holt
Stereophile

A beautifully designed and constructed arm to gladden the heart of any audio perfectionist. . . .

In short we don't expect to see this arm obsoleted for some years to come, and have adopted it as our new standard for subjective testing of universal type cartridges. . . .

Norman Eisenberg
High Fidelity Magazine

There is no doubt that this type of tracking does reduce playback distortion and can extend the life expectancy of both record and stylus. . . .

ARLL rumble figure way way down at -61 dB (this beats any of the popular automatics we've tested and puts the ST-4 in the top manual class). Flutter averaged a negligible 0.07 per cent.

As a manual record-playing ensemble it is at least as good as, and in some important ways better than, anything hitherto offered. . . .

If ever a product could be characterized as "state of the art" the new Rabco arm is it. In fact, you might even call it ahead of the state of the art. . . .

It moves a pickup across a record in a true radius, with virtually no friction, negligible resonance effects, unprecedented low tracking force, no skating effects, minimum groove wear, and minimum stylus wear. . . .

It is extremely well engineered.

After months of continuous use the SL-8 remains as responsive and fool-proof as when first installed. . . .

Audio Magazine

Without question, the Rabco arm does what it is supposed to do, and does it nicely. . . .

We know the principle is right, and we must admit that the embodiment of the finished product works perfectly, as far as we can see. It is a delightful device.



Makers of the only servo-driven straight line arm.

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The Legend of Enrico Caruso

Don Altobell

IT WAS NOVEMBER 23, 1903, and to open its 21st season, the Metropolitan Opera chose Verdi's *Rigoletto*. Mme. Marcella Sembrich appeared as Gilda, and the title role was sung by Antonio Scotti.

More than a few people, however, were eagerly in attendance to hear a new-ly signed Italian tenor named Caruso. As they took their seats, little did they realize that they were about to hear the American debut of the greatest of all tenors!



He sang the role of the Duke of Mantua. His opening act aria, "Questa Ouella," was the first thing the audience heard, and it set the hoorahs and huzzahs rattling off the rafters. Brr-rra-vo! Brr-rra-vo!

The critics of that day (and this day too!) were more reserved in their enthusiasm. Henry Krehbiel, of the *New York Tribune*, reported: "Signor Caruso has many of the Italian vocal affectations, and when he neglects to cover his tones, as he always does when he becomes strenuous, his voice becomes pallid." Krehbiel did admit, however, that Caruso "... is generally a manly singer, with a voice that is true, of fine quality, and marvellous endurance."

W.J. Henderson, of the *New York Sun*, had a bit more foresight. He said, "Mr. Caruso has a natural and free delivery, and his voice carries well without forcing. His clear and appealing high notes set the bravos wild with delight, but connoisseurs of singing saw more promise for the season in his mezzo voice."

In that first season with the Met, Caruso sang 25 times in eight different roles, and in the 17 seasons that followed, 29 more roles were sung, for a total of 607 performances. The tone mellowed, and the acting became more refined, the acclaim more exuberant from critic and gallery fan alike. The Caruso legend grew!

Caruso's voice was virtually unschooled for there is no record of his taking any formal training. As a youth he did spend one year as an observer of a maestro who taught young singers, but his intonation, breathing techniques, and the meticulous attention he gave to subtleties of interpretation were all his—all Caruso!

Yet he never became lazy about prac-

tice. Even with his many performances—often two or three per week—his daily routine always included scales and vocal exercises. Caruso's innate musicianship and honest appraisal of himself told him he was the best, and his fierce pride drove him to make the sacrifices necessary to stay at the top.

Caruso never let his repertoire become stale. In addition to the bountiful supply of old favorites (76 *Pagliacci's* and 64 *Aida's* at the Met), he introduced 12 new operas there. Toward the end of his career, older, more obscure roles were sought as Caruso vehicles, and five such were dusted off for him.

It was in one of these, as Eleazer in Halvey's *La Juive*, that he reached what many believe to be his dramatic zenith. The once slow-to-warm critic Krehbiel wrote of the performance, "Indeed, the greatest tenor has succeeded in giving perfect verisimilitude to a tragic impersonation. By it, he has raised himself a good notch higher in artistic stature. And he sang the music with passion, yet with a restraint which revealed only the more exquisitely his golden voice."

Ironically, it was in this role that Caruso sang his last performance, December 24, 1920.

Since then, great tenors like Martinelli and Gigli, and exciting tenors like Lauri-Volpi and Del Monaco have had their day in the sun... but there has been none like Caruso. Numberless "second Caruso's" have vanished from memory. And today it is Franco Corelli... but still no Caruso.

What was so different about his voice? So distinctive? His great breathing capacity, never-faltering power that could swell to full and glorious volume from a pianissimo without pause for breath, his tones of pure gold. Yes,

all these, but these are only words. You must listen to the voice and hear for yourself.

While the number of people still living who actually heard Caruso grows smaller each year, the memory of the Caruso voice is kept ever alive by his recordings, which are plentiful. They were made by the most primitive of means—he sang into a short, square horn connected to the recording machine. One man worked the machine from behind a partition, with the piano or orchestra behind Caruso at the back of the room. Their proximity determined their volume since there were no amplifiers. (If only he could have made a record—just one of today's audio quality! Or at least some magnetic recordings.)

With the advent of the LP and the LP collection, the Caruso voice became easily accessible. RCA Victor, for whom he made all his American recordings, has released a number of Caruso collections. These include a good number of the 234 original Caruso records listed in the discography of the book *Enrico Caruso, His Life and Death*, written by his wife, Dorothy.

In the more recent of these LP's, the RCA engineers have done a marvelous job of "de-ticking" many of the imperfections found in their time-worn masters. Some of the earlier LP's have been deleted from the catalog, but these weren't of today's high quality anyway. It is only to be hoped that RCA will re-do them.

Listed with this article are the names and numbers of the Caruso LP's available today, as noted in the Spring, 1971 Schwann Supplementary Record Guide. I hope you'll get one or two. Listen, just listen, and you may catch something of the voice behind the legend! Æ

discography

Before American Conquest (I)	Eterna 725	Recital (I)	Rococo 2
Canzone napoletana	RCA Int. LM-20080	Recital, Vol. II	Scala 854
Caruso (E, F, I, Sp)	2-Vic. LM-6056	Recital (I, with F. Tamagno)	Rococo 7
Enrico Caruso (I)	Rococo 5244	Recital (F, Sp)	Rococo 5275
Enrico Caruso	RCA Int. LM-20095	Re-Recordings (I)	Scala 825
Great Voices, Vol.3	Scala 872	Very Early—Circa 1902	Scala 884
Immortal Performances, 1904-06 (I)	Vic. VIC-1430	Voice of Century (E, F, I)	Vic. LM-2639
In Song (F, I, L)	Vic. LM-2778	Vol. 1, Zonofono/G&T, 1902	Olym. 301
Italian Songs (I)	Rococo 5294	Vol. 2, Milan G&Ts/Pathe H&Ds	Olym. 302
Neapolitan Songs (I)	Vic. LCT-1129	Vol. 3, 1st N.Y. Recordings, 1904/5	Olym. 303
Opera & Songs	Vic. LCT-1034	Vol 4, (I)	Scala 878
Operatic Arias (I, F)	Vic. LCT-1007	Vols. 5, 6	2-Olym. ORL-305/6
Operatic Rarities (I)	Vic. LM-2700	Young	Sera 60146

Handel: Ariodante. Steffan, Scutti, Partridge, Bogard, Greevy, Rintzler, Eder; Vienna Academy Chorus, Vienna Volksoper Orch., Simon. **RCA LSC 6200** (3 discs), stereo, \$17.96.

One of the musical phenomena of this time is the sudden—there is no other word for it—reappearance of the long-semi-unknown Handel operas, in full-length performances. For 200 years these operas have languished in the catalogues and libraries. Everybody knew they were there; everybody supposed they were great Handel. But only a handful of performances over the years made the attempt to realize them in actual stage presentation, though individual arias (like the famed “Largo”) were sung by a thousand singers, with inappropriate piano accompaniment, as if they were merely songs, unattached to any larger musical shape.

The LP record, of course, has made the difference, though staged Handel is now at last also becoming successful. In both cases (the LP is much the most practical), it is our increasing awareness that “grand” opera is not confined merely to “La Boheme,” “Il Trovatore,” “Aida,” and others of the sort, pleasing though they still may be to millions. In New York, Handel has been a sell-out. On discs, his operas proliferate, though there are plenty still left untouched. He turned out no less than *forty-six*, each one of them good for at least three LP discs, both sides! The present opus, *Ariodante*, rates as No. 35 in the astonishing series, and it is a whopper, full of enchanting music—once you catch onto the Handelian way of procedure, the normal operatic format of his time.

Familiar enough, now, to many of us. Recitative and aria, the semi-spoken sung recitative carrying quick bits of action, the long arias serving as static comment on the situation of the moment. The language is Italian, as was the practice (the opera came out of Italy), and the original singers were almost exclusively Italian. Most of the male leads were sung by castrati, either soprani or alti, and these today are sung by female singers (though if we had enough good countertenors, noncastrati, they would do a better job I should think). Thus, qualities of femininity and many a love duet between two ladies! One quickly gets used to it, for the characters of the males are potent enough to satisfy any idea of masculinity, except in the matter of pitch.

Ariodante is typical, and a high-level opera, no two ways about it. As in so many modern performances, the modern voices here are not well suited to the demanding music, full

Opera Enterprise

Classical Record Reviews



EDWARD TATNALL CANBY

sink a dozen music libraries; a repeat of a good tune could be a blessing for all concerned.

Performance: A— Sound: A—

Heliotrope Bouquet. Piano Rags by Turpin, Joplin, Lamb et al. William Bolcum, piano. **Nonesuch H 71257**, stereo, \$2.98.

Very interesting paradoxes here. The original ragtime music dates from before 1900, just about the first music (after Stephen Foster!) with a real American slant to it. It wasn't folk, but it did come, as might be expected, half-Black, out of a background of honky-tonk or what have you. As those of us who are old enough to dimly remember, this sort of music was heard on hard, metallic pianos, those stripped-down uprights, played by stolid men whose incredible flying fingers had the strength of steel springs—or played, of course, by pneumatic machinery in the same style from piano rolls. The “live” sound was the more impressive, the more powerful for sounding like the machine-made product. Fantastic rhythm and drive, all done with a certain deadpan quality, a truly American phenomenon.

Ah! But now. Ragtime has been rediscovered by the young, who do not remember. Researched avidly. And reconstructed into elegant modern grand pianos, impeccably tuned and voiced, recorded in sonorous stereo. Scott Joplin, the greatest of the rag men and a Black, is now (as the notes say on this record) “the Chopin of America”—and that is exactly how the music sounds! All gentle passionate gracefulness, well modulated, sophisti-

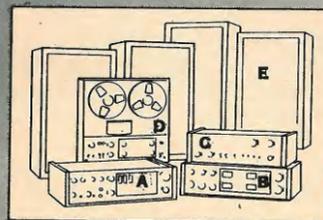
of instrumental-type rapid figures for which our singers simply are not trained. But good musicianship and musical fervor carry the day, especially in the two principals, the soprano Sofia Steffan, the (male) hero, and Graziella Scutti, who is the heroine and a most feminine one too. A typically international mixed bag of voices, non-Italian, including an excellent Carole Bogard as the (alto) lady in waiting, nevertheless show an earnestness and cohesiveness of expression that is made more and more clear as one listens to side after side of the long work, following (as one must inevitably) the libretto and its translation. It all adds up, as splendidly as Wagner himself, hour after hour.

One factor is moderately at fault. Stephen Simon is an uneven conductor of Handel and occasions some unpleasantness, notably in the rapid parts of the music, though the slower pieces go well throughout. A driving quality (is it New York?) pushes too hard, or holds back fussily, too slow; and one senses that the Vienna players, probably no more used to the music than most professionals, are not really helped to understand it. Exaggeratedly slowed endings smack of an outworn tradition best forgotten at this point.

Old Handellites will not be overly surprised to find a goodly portion of the Overture to this opera familiar as music from a long-favorite Handel Suite for Orchestra—is it the Water Music or one of the others? Handel, of course, re-used such material again and again, to the obvious pleasure of his audiences, who recognised the familiar tunes as we do. Why not? After all, he wrote enough “original” and/or new music to

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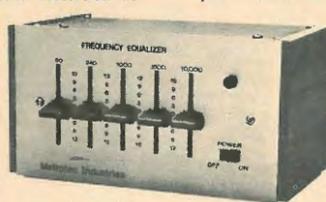
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cated, and never a harsh overtone. (Well, not many.)

The intention is straightforward. Scott and the others never had it good; so now let us put them where they would have liked to be, on the fanciest of modern grand pianos, played by serious, classically-trained pianist-composers. Where have we heard this argument before? Poor Bach, he didn't have a modern piano, nor did Mozart. So let's give him one.

I'm of a mixed mind. Stylistically, I think the idea is nuts. I like the old, hard, brassy, nail-head piano sound out of a beat-up upright. Making the best, miraculously, out of what was available. I can't believe that his music is rightly played like so much Chopin—even if Joplin would have marvelled at the idea.

And yet, it does bring out unexpected things. Mainly, how U.S. popular music is at heart very much grounded in European salon stuff (and still is, to this very day). Take away the hard, brassy sound and the driving mechanical rhythm, and you have European schmaltz. Not very good schmaltz, either. Chopin did it better, if you ask me. But Chopin could never have played a honky-tonk piano.

See also Joshua Rifkin's earlier None-such disc, recreating a brace of Joplin compositions in a similarly elegant salon-concert style.

Performance: B? Sound: B-

Menotti: The Medium. Regina Resnick, Judith Blegen; Opera Soc. of Washington, Jorge Mester. **Columbia MS 7387**, stereo, \$5.98.

I got to this very late—but enjoyed it thoroughly. This very American performance, all the singers sporting normal American voices, is precisely, it seems to me, what Menotti wanted.

The Medium was a great hit when it first came out. Would it carry the same impact today? It does! I was astonished, to tell the truth, for Menotti is not much as modernists go, nor is he in quite the big-league grand opera field. His basically are chamber operas.

Most peculiar. Menotti is so Italian, and so Americanized! Somehow, he, and he alone, has hit exactly the vein of American interest in a form that is basically alien; he writes precisely for those ardent, large-bosomed females with big voices and those others, including would-be Caruso types, who abound so marvelously in every American city in hundreds of local opera groups. Such energy! Opera is big here among those who want to sing it. What Menotti gets so right is the curious

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combination of the European singing voice, mainly Italian-style, and the plain old American speaking voice. He combines the two, so utterly opposite, with extraordinary skill.

Mme. Flora, the bosomy medium of the story here, is unique in opera. Her terrifying combination of half-sung, half-spoken expression is, if you ask me, a lot more effective than the famed *Sprechstimme* of Schoenberg; for it is in a peculiar way utterly natural. It is exactly what a big, trained singing voice would do if it were to break into agonized half-speech in ordinary American English.

Regina Resnick does this to perfection, and Judith Blegen as the daughter Monica is just as good in her own way. The others, the duped ones who think they see their dead loved ones and will not be persuaded that the whole seance is false, are excellent too, with just the right grave, earnest approach.

And so a tear-jerker, grotesque if done wrong, is done right once again, and once more it will probably bring a tear or two to your eyes.

Performance: A Sound: B+

Haydn and Mozart Arias. Dietrich Fischer-Dieskau; Vienna Haydn Orchestra, Reinhard Peters. **London OS 26182**, stereo, \$5.98.

A fascinating disc, this one, and much more than its title suggests. These are all "new" works, isolated pieces mostly composed either as individual solo or "concert" arias, or else for insertion in somebody else's opera, a common practice at the time. Some are from works that most of us Haydn-Mozart fans will not even have heard of. So you know your Mozart opera—did you ever run into Warnung, K. 433? First time I ever heard of it. An incomplete work.

Since Haydn's operatic works are much less known than Mozart's, the shock value of the Haydn pieces here, four of them on side 1, is less important than, simply, the value of some new good music by this genial composer. The seven Mozart works, though, are stunning—from the early aria out of *La finta giardiniera*, K. 196 (Mozart was 18) to the isolated *Mentre ti lascio*, K. 513, a late and very profound serious aria in the grand tragic manner. One delightful oddity is an alternative version of one of the most familiar bits in *le nozze*, the Marriage of Figaro, the tune set into a different orchestral background. If you are a Mozart man, you'll really sit up at this one.

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Canby's Capsules...

Grieg: Incidental Music to Peer Gynt. Sheila Armstrong, Ambrosian Singers; Halle Orch., Barbirolli. **Angle S 36531**, stereo, \$5.98.

The album with the lovely blue cover (a fjord) has all the music (except some accompaniment for spoken "melodrama") in original order, with soprano solo and one choral number. Much is familiar in old "music appreciation" Suites—but some is "new" and Grieg at youthful best. Nice, gentle, Romantic performance.

Ravel: Sonata. Grieg: Sonata, Op. 45. Wanda Wilkomirska, vl., Antonio Barbosa, pf. **Connoisseur Soc. CS 2048**, stereo, \$5.98.

Connoisseur's recording place (church, NYC) is real problem. Big, blurry reverb smears piano sound unmercifully, with curious "slap" wave effect, most unpleasant. Go elsewhere, I say! This pair of stalwarts is brilliant, not yet tops. Violin is expert, fine tones, but somehow monotonous, blank in style; piano is wham-bang energetic in loud parts. Skilled but musically unsubtle.

Symphonion Music Box Concert. Music Box Records (685 S. Roys Ave., Columbus, Ohio 43204).

One of those curious 19th C. German "disc" music boxes—a large brass disc, rotating slowly, a single piece each turn, via lengthwise slits in the disc. This recording has Sousa and other U.S. music on it—tailored for American Market? And when? Must've been a very late "release"!

The Worst of P.D.Q. Bach. With Prof. Peter Schickele. **Vanguard Twofer VSD 719/20** (two discs), stereo, \$5.98.

P. Schickele's plays on words outdo his total musical tricks—but the tricks are good; he is a competent musician and an ingenious composer of pseudo-old music. This pair of discs, 2 for 1, is surely the best of the wurst, out of the long-time P.D.Q. series.

On records, the old-type "concert" suite is replaced by the longer, more varied type, with much extra music. Good. The sound here is mellow, not too huge—right for Grieg's unpretentious early music.

Fischer-Dieskau is at his mature best in this kind of music. His voice for some reason is recorded with a slightly metallic edge—this would appear to be a recent job, not a reissued "oldie." The orchestra is lively, if a bit ragged here and there.

Performance: B+ Sound: B-

Francesco Antonio Rosetti: Six Sonatas for Harp, Op. 2. Susann McDonald. **Orion ORS 7144**, stereo, \$5.98.

Rosetti was no Italian—his real name was František Antonín Rössler and his home area was near Prague. But in the later 18th century the universal Italian style was at home in Prague, as in Vienna, Italian names were chic, and Italianate music taken for granted everywhere. These little Sonatas, each a group of short movements, are in style somewhere between Scarlatti and Joseph Haydn, pretty little melodic things with graceful trills and pleasant harmonies. Rössler-Rosetti, as he is sometimes called, wrote a good deal of very popular big stuff—symphonies, assorted concertos, oratorios—and these harp items are side products of a busy life.

Susann McDonald is a solid-technique young American harpist whose fingers shimmer over the strings at a great rate, forthrightly and efficiently. In the recording, the blur of harmonies is an impediment to the music, which should be set forth with no more than one chord audible at a time. Inherent in the harp, which has no dampers—but the hand and arm can damp out a lot and I wonder, myself, whether Susann just isn't listening to her own music well enough; or whether this is perhaps an accident of too-close microphoning, picking up more of the overlapping of chords than would be heard at a decent concert distance? All I know is—some harpists can seem to eliminate the sonic blur, just by the way they play, and wait. Even in recorded form.

Performance: B Sound: B

Mozart: Symphonies No. 21 in A, K. 134; No. 27 in G, K. 199. Munich Chamber Orch., Hans Stadlmair. **None-such H-71244**, stereo, \$2.98.

Mozart's "greatest" symphonies—undeniably great—were once nearly played to death, the Jupiter, Haffner, Prague, the G Minor, while the earlier symphonies remained unknown. With our broader interests today, and with the incomparable medium of the LP record, we turn more and more to these

equally lovely little works, just as "great" in their own less all-embracing fashion. These two, both very Italian-influenced, during Mozart's period of triumphal tours in Italy (just over the Alps from Salzburg) are essentially string symphonies with a pair of flutes added, (horns, too, occasionally) and no oboes, a sweet, spring-like sound, altogether ravishing if you are in the mood for it. I often am. The playing is really superb. Not spectacular or self-conscious. Just totally musical, relaxed, intent, beautifully balanced, thoughtful. The sound, from Barenreiter in Germany, is a bit on the muffled side, but that could merely be the acoustics of the recording place. Won't bother you a bit.

Performance: A- Sound: B

Parkening Plays Bach. Christopher Parkening, guitar. **Angel S 36041**, stereo, \$5.98.

When I wrote about young Parkening's first classical guitar recordings for Angel I was roundly sat upon, for failing to hail him as the new genius of the instrument. But what I said then still applies, I think, and you can hear it for yourself in this latest offering. Without a doubt, this favorite pupil and disciple of the great Segovia has a superb technique and a real musical soul, enough to put him in the top bracket of his profession. But he continues to be imitative. Of course old Segovia thinks him tops! He sounds like Segovia. That's a pardonable pride, found in most masters. Parkening is a gentler, less flamboyant Segovia, to be sure. But if you have followed the twenty-thousand-odd Segovia recordings over the last quarter century and more (I still have a ten-inch, 78 rpm, shellac Segovia), you will recognize the way of playing instantly. It is lovely, but by now a bit old fashioned and rather on the pretty side. (Much better than the woodenly mechanical plucking of some lesser "classical" guitarists!) There is nothing wrong with following in the footsteps of your own much-older teacher and master. But sooner or later a performer must be himself, and vigorously. Parkening has plenty of time to do that. He's just at the beginning.

A brace of ultra-familiar Bach pieces here, the ones that generally are heard in various transcriptions—for everything from piano and symphony orchestra to maybe musical glasses or Moog. A good many are Parkening's own and very well done.

Performance: B+ Sound: B

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Ray Conniff's Concert In Stereo. Columbia GR30122, open reel, 7 1/2 ips, \$7.95.

Here is another fine recording, just about the best I have ever heard made on location. This was a live pickup at the Sahara/Tahoe hotel in Nevada. You know, most examples of this kind of recording are usually pretty disappointing. . .acoustics are

bad, miking is haphazard, balances are poor. Not so here. Whoever did this job deserves a big hand. This is almost studio-like in quality. All elements are very clean, orchestra and chorus beautifully balanced, the stereo properties handled with taste, the overall presence remarkable. Musically this is a winner too, with Conniff giving us a neatly balanced program of oldies, show tunes, and contemporary stuff, which all add up to a tape that should become a best seller for Columbia.

Great Strauss Waltzes, Werner Muller and his Orchestra, London/Decca 5SP44039, Dolbyized Cassette, \$6.95.

As you may have noted, this is a London/Decca, not an Ampex/London cassette. As I pointed out several months ago, Ampex will still manufacture London tape products in this country, but English Decca will issue Dolbyized cassettes of different repertoire under their London label in the USA. This recording and a number of others will probably be available by the time this issue of AUDIO reaches you. In any case, this is a Dolby cassette that should find an enthusiastic audience. It has everything going for it . . . a potpourri of great Strauss waltzes including the "Blue Danube," "Wine, Women and Song," "Emperor Waltz," "Roses From The South," and others equally well-known. The arrangements are highly stylized and somewhat "Hollywood Epic" in nature, employing a chorus in addition to the orchestra. Of its type however, it is well executed. The sound is in general quite clean and well balanced, and there is little evidence of the high frequency distortion that plagues so many cassettes. The Dolby aspects were a joy to the ear. At my test level of 100 dB peak, there was a just discernible trace of hiss. In fact there was just enough so that when a number ended you could hear the noise cut-off. This is kind of surprising, since on tapes you rarely encounter the 5-6 seconds of silence that corresponds to the spiral between the cuts on a disc. Obviously at the lower level at which most people would play back this cassette, tape hiss would be inaudible. There was some modulation noise and some dropouts, but they were not too obvious and probably wouldn't be noticed by the average listener. All in all, one of the best Dolby cassettes thus far.

Hit Movie Themes, Enoch Light and his orchestra, Project Three PR4C-5051, four channel, open reel, 7 1/2 ips, \$14.95.

This is the sixth four-channel tape issued by Enoch Light, and it is in every respect an outstanding production. A

compendium of themes from such recent hit movies as "Airport," "Z," "M*A*S*H," "On A Clear Day," "The Out Of Towners," "Patton," and eight others of equal stature, this is sonically a real blockbuster. This production represents the quintessence of top quality multi-mike recording in the eight-channel master, and a virtuoso mix-down to four-channel stereo by Mr. Light. This tape is of the equal intensity "surround" type of four-channel stereo generally favored for pop music. I think it is time we stopped belaboring the point about the "musical aesthetics" involved in this approach. You take your choice and either love it or loath it! I can tell you that at all the hi fi shows I have been at in the past year, and including the recent Washington D.C. show, the majority of people attending enthusiastically endorsed this type of four-channel sound. Admittedly, a good portion of the crowds were neither musically literate nor technically oriented. But there were plenty of hard-nosed hi fi buffs who found this type of four-channel sound not only sonically exciting, but musically and emotionally stimulating as well.

The best number on the tape is the "Patton" theme, a clever, catchy piece of music of obvious martial aspect, which is recorded with sound of stunning impact. The crowds in Washington really flipped when they heard the sharp rattle of the snares, the hard clean punctuation of the tympani, the "feel" of the out-sized bass drum, the bright blare of brass and squeal of the fifes. The arrangement is very good and lends itself well to the tricky mix-down and disposition of the various musical elements among the four channels. The sound is excellent throughout the tape with the combination of close-miking and just the right amount of reverb affording outstanding presence. The other numbers on the tape are not quite as spectacular as the "Patton" theme, but they are all cleverly arranged and have their own particular sonic attractions. Four-channel stereo was relatively new to Washington . . . at least as far as public demonstrations were concerned. There is no doubt in my mind that this recording influenced a great many people—including plenty of skeptics—to a positive appreciation of the four-channel format.

A final footnote: The four-channel stereo recording I made of the mighty Wurlitzer organ in the old Brooklyn Paramount with organist Billy Nalle will be issued on Mr. Light's "Project Three" label, first as a conventional two-channel stereo disc, and later as a four-channel stereo open reel tape. It will be called, "Big, Bold and Billy."

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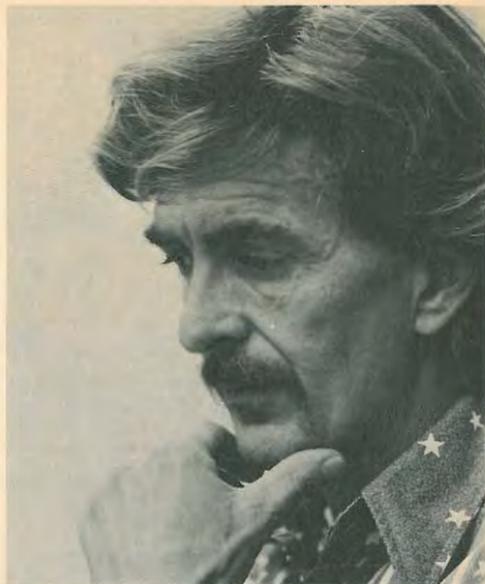
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Weingarten Looks At Tom Clay



TOM CLAY is an ex-disc jockey forced into success by his vigorous idea of what's right, the nation's horrible economic climate, a unique recording, and some luck.

Clay, who declined to compromise his principles while spinning vinyls on the West Coast and thereby found himself without a public turntable, in near-desperation tried his hand with a concept single. It clicked, and now it's the basis for an LP, also expected to sell well.

When the deejay found himself jobless, with more time than even he wanted to spend with his family and electronic gadgets, he conceived a plan to carry a message via the pop music arena. The result was an unusual 45 that combined music and dramatizations with news tapes to make a commentary on today's world. Enter the luck aspect. The youthful buyers who virtually monopolize what makes it in the singles field decided the message was the message. Voila, chartbuster!

And despite the length of the cut (six minutes, 10 seconds), it quickly gained heavy air play—partially as a novelty, in part as a salient playlet.

The single, now the lead item on **TOM CLAY'S WHAT THE WORLD NEEDS NOW IS LOVE** (Mowest, MW 103-L), opens with an announcer interviewing a tot, asking the boy if he knows what segregation, bigotry, and hatred are. The child says no, and the groundwork for what follows has been laid.

Message One: The negative values of societal living must be taught.

The Blackberries provide vocal accompaniment, initially, with the Hal David-Burt Bacharach evergreen "What

the World Needs Now is Love," and Army cadence counts and the bursts of machine-guns sharply contrast.

The chorus then quickly shifts into "Abraham, Martin, and John," and the speakers erupt with an on-the-spot tape of the John F. Kennedy assassination.

Next is the voice of Dr. Martin Luther King, Jr., saying he's "been to the mountaintop" and that, "like anybody, I'd like to live."

Bobby Kennedy's voice follows, ironically noting that "no one can be certain who next will suffer some senseless act of bloodshed." His own assassination, via another on-the-scene tape, then is superimposed on what obviously is, in the form of a song, Message Two: "What the world needs now is love, sweet love."

Then Ted Kennedy's eulogy for his slain brother, replete with broken voice and a citing of "times of danger and uncertainty," leads to the closing segment, a reprise of the announcer and the boy.

"What is prejudice?" asks the announcer at the conclusion. "I think it's when somebody's sick," replies the tot, succinctly offering Message Three.

The track, obviously the best of the 10 on the album (which is distributed by Motown), is shadowed by several other attempts at the same type of thing. "Whatever Happened to Love," for instance, is a narrative with choral amplification that reminisces about the lost purity of childhood pleasures. And "What's Going On," similar to an old gimmick used by Simon & Garfunkel on "Silent Night," superimposes a newscast, with all the vitriol and nega-

tives today can bring (with the emphasis on violence), on some cacophonous music.

"For Years" starts with Clay's daughters, Candy, Becky, and Kimmy singing the hymn, "Jesus Loves Me," then combines the sounds of strafing bullets and a speech about the Vietnam War, goes into a rendition of "My Country 'Tis of Thee," inserts more shell sounds—and poignantly ends in mid-air on the line "Land where my fathers died . . ."

Clay's "The Victors," in contrast and yet in the same vogue, is a mournful version of taps, via flute, and a recitation of young men (and children) who were killed in U.S. wars (on both sides), plus in the tragedies of Hiroshima and Nazi gas chambers.

The flip side of the disc, still keeping with uniqueness but turning in a different direction, consists of one long segue, a tone poem of sorts, a composite of music-and-word essay on what love really is. Narrative editorial comments are interspersed with such meaty (and sometimes banal) items as Jim Webb's "MacArthur Park," David-Bacharach's "This Guy's in Love with You," Holland-Dozier-Holland's "Baby, I Need Your Loving," Joni Mitchell's "Both Sides Now," and Paul Simon's "Bridge Over Troubled Water."

It's an interesting experiment even if not totally successful.

Taken as a whole, however, the LP should be a must for every audiophile—if only because it is innovative and challenging to the listener's mind.

It might have been called "the best of," but RCA decided instead to call

the record **ENCORE!** (LSPX-1005). What it is is a dozen tracks by soul singer-guitarist Jose Feliciano, all but two of which were culled from earlier LPs (the exceptions, "Life Is That Way" and "Wichita Lineman," were both previously available as singles).

Best of the package is an instrumental version of "Malaguena," recorded live but so impressive the audience is totally silent during the performance. Other live extracts are "Rain," the tune that singer Anne Murray imitated and turned into a hit; "California Dreamin'" and "Light My Fire."

But don't overlook "Hi-Heel Sneakers," "Pegao," "Susie-Q," "Hitchcock Railway," "Destiny," or "Nature Boy."

Tennessee Ernie Ford, whose deep voice retains all the resonance it ever had, appeals to the old-fashioned churchgoers and the new fashioned return-to-religion youth with **ABIDE WITH ME** (ST-730) a Capitol disc containing 10 hymns.

Backed by the Jimmy Joyce Singers, Ford is best on the title work and "God Bless Our Native Land," despite the latter being the kind of thing young rebels oppose vehemently as chauvinistic Establishment propaganda.

The cover, not incidentally, is adorned with a Norman Rockwell painting, "Freedom of Worship," that first appeared as a Saturday Evening Post cover illustration three decades ago.

Combining the sounds of The Mamas and The Papas plus the Beatles seems an impossible suggestion, yet The New Seekers come pretty close to doing just that. Witness the quintet's latest album, Elektra's **BEAUTIFUL PEOPLE** (EKS-74088), which showcases among its 12 cuts two chartbusters penned by Mellanie Safka, "Look What They've Done To My Song, Ma" and the title tune.

Eve Graham sings lead on both songs, and, in fact, on most of the Seekers' output, but each of the group (all of whom are in their 20s) now and then comes up front. The sound, always harmonious, always easy on the ears, is augmented nicely by an orchestra under the direction of Bill Shepherd that makes fine use of its string section.

Spotlighted are such items as Nilsson's "One," on which the lead position is sung by Peter Doyle; Doyle's own composition, "Cincinnati," a bluesy-country piece on which he again sings lead; Randy Newman's "I'll Be Home," with Lyn Paul coming on strong, and Delaney Bramlett's "Never Ending Song of Love," re-

produced in a mod-ern sing-along fashion.

Peter Bardens has a mind that flies all the way to the sun. His talent is evident on **THE ANSWER** (Verve Forecast, FTS-3088), a disc on which the composer (of all the six tunes on this LP) and pianist-organist, plus eight others, stresses music rather than lyrics.

Best of the fascinating album, recorded in London, is the title tune (which starts with a Baroque organ riff, moves into a soft vocal, progresses to a heavy electric guitar, and then goes with a soulful vocal).

But other highlights, and the listener's pleasure, like the proverbial cup, runneth over. Hear, for instance, "Don't Goof with a Spook," an eerie, electric, jazzy offering; "Let's Get It On," a frenzied, avant-garde suggestion of tomorrow, and "I Don't Want to go Home," with heavy use of percussion and flute, and with lyrics (the most expressive of any on the vinyl) that sound a bit like Donovan's.

Barbra Streisand shows great versatility on her newest LP, indicating that her growth as a singer is far from ended. The album, Columbia's **STONEY END** (KC 30378), neatly scatters ballads, blues numbers and rockers.

The thrush leans heavily on contemporary tunesmiths for the 11-cut disc, on which full orchestration, always slick, is immensely helpful.

Highlighting the effort, of course, is the title tune, the No. 1 chartbuster that showed that Barbra could swing with the best of 'em. Unfortunately the motif of the song, by Laura Nyro, is copied too closely in two other selections, also by Miss Nyro, "Hands off the Man (Flim Flam Man)" and "Time and Love."

If you ordinarily like Streisand, though, probably you'll love her renditions of Joni Mitchell's "I Don't Know Where I Stand," a soft mournful piece; Gordon Lightfoot's "If You Could Read My Mind," a mildly countrified winner; Randy Newman's "I'll Be Home," a melancholy number that indicates the songstress still is best with items filled with pathos; "Let Me Go," plus Harry Nilsson's "Maybe."

OLATUNJI (Roulette, SR 42063) is the last name of a guy whose first name is Babatunde. The Nigerian native uses African drums to portray that continent's culture on seven melodies. Samba-like rhythms stand out, and there is much jazz orientation. Vocals, for the most part, are chants (performed by six singers).

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JAZZ & BLUES



Martha Sanders Gilmore

Bill Evans: From Left to Right Musicians: Bill Evans, Steinway piano and Fender-Rhodes electric piano; Sam Brown, guitar; orchestra arranged and conducted by Michael Leonard; produced by Helen Keane. Songs: What Are You Doing the Rest of Your Life?, I'm All Smiles, Why Did I Choose You?, Soiree, The Dolphin (Before and After), Lullaby for Helene, Like Someone in Love, and Children's Play Song.

MGM SE4723, \$4.98.

One must immediately exclaim over the extraordinarily beautiful arranging and composing that resulted in this recording. This artistry, which seems to know no bounds, may be attributed to the melodic talents of Michael Leonard, who arranged and conducted the set, not to mention composing "I'm All Smiles" and "Why Did I Choose You?" When combined with the musicianship of the inimitable Bill Evans, music lovers are indeed twice blessed.

In the compatible collection of ballads which comprise this unique set, we recall Erroll Garner's "Other Voices," recorded some years back in which the piano bears a kind of concerto relationship to the orchestra.

Here, however, innuendos of French impressionism permeate the grooves, summoning forth picnics on the banks of the Seine, rain showers which tuck us away under the awnings of French cafes. A supreme delicacy exists, enhanced by the penmanship of Michel Legrand who composed "What Are You Doing the Rest of Your Life?" further vindication of a canvas tintured with an imitation of France.

I had the pleasure of catching Keith Jarrett live with the Miles Davis group this mid-winter. At that time, Jarrett expounded his considerable talents over dual keyboards, one electric, one acoustic. Now, a somewhat similar experience comes to me on record via the sensitivity and deft fingers of Bill Evans, pianist non-pareil, who stands

apart in jazz much as Picasso does in art, Shakespeare in literature—a musical genius without peer, in my view.

From left to right, from the Steinway to the Fender-Rhodes electric piano dance the Evans fingers, gliding with subtlety over far more than the usual 88 keys. Evans uses the pianos interchangeably, seemingly according to whim, but we know better. Often he states his theme on acoustic piano, increases his tempo, and goes on to develop his musical ideas on the electric keyboard which encourages its player to bend notes at will.

It is not only interesting to hear the way Evans utilizes the two instruments but to compare the timbres. One is struck by the resonance of the Steinway, replete with overtones. While the Fender-Rhodes piano does not resound and vibrate to the same extent, it, in contrast, possesses a flexibility and versatility of sound. Many times its hollow, mellow tone resembles that of a vibraphone superimposed on a piano. Evans obviously enjoys it as a vehicle to launch his talents. An existential quality prevails; one thinks of Francoise Sagan.

Eight of these nine tunes are ballads, tone poems which are so appropriate to Evans' rather spare and selective technique—the Gustave Flaubert of the keyboard! He chooses his notes carefully; his texts are lean.

Leonard employs flutes, strings, and percussion primarily in a beautifully orchestrated backdrop, cushioning Evans' notations. Piano and orchestra answer one another, commenting as a chorus.

In "What Are You Doing the Rest of Your Life?" a minor key sets the stage. We are reminded of grey skies over the banks of the Seine, trenchcoats. Evans' flights cascade like waterfalls. The entire set has a movie quality about it—a Cary Grant-Ingrid Bergmann scenario.

Evans' style, like Mel Torme's, another musician's musician, is well suited

to waltzes as "I'm All Smiles" and "Soiree." Sam Brown on guitar is empathetic throughout, opening out his guitar strings like a harp, projecting himself at exactly the right time, embracing the single notes of the piano with circular chords. We'd like to hear more of Sam Brown! "Soiree," reminiscent of Evans' album with Jim Hall entitled "Undercurrent," is a polished jewel of creativity.

We are permitted two takes of "Dolphin," the only non-ballad in the group, a bossa nova with scintillating rhythm and superb sound reproduction. We prefer the first take which features the trio alone. The second take is overdubbed by the orchestra whose strings flow in and out like an ocean wave. Much is happening. The flute passage is most striking.

Bill Evans' own "Children's Play Song" captures his style and technique perfectly. Cross rhythms abound, three blind mice configurations are stated in the left hand. The song is simple purity, a theme and variations which is masterfully resolved by the acoustic piano in the treble, the electric on the bass notes.

This album assuredly succeeds in what it sets out to do. Evans' fans will certainly want to add it to their collection. Glossy as cake frosting it is at times, but executed with the best of taste.

The arrangements are so magnificent that one tends to fasten on them rather than study the technique of playing two pianos at once. But maybe its success lies in this subtlety and lack of the obvious.

My major disappointment in the album lies in the dearth of development and improvisation for which jazz buffs yearn. Beautiful statements are made but we'd like more exploration. These are more or less vignettes to whet one's appetite; I wished the musicians would extend themselves further.

May the day come when the Evans-Leonard team makes a 2-record set composed and arranged by Leonard but

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consisting of only piano, bass, and guitar. Although this is beautifully orchestrated, they can soar even higher!

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Louisiana Blues

Musicians: Arthur "Guitar" Kelley, vocals and guitar; Silas Hogan, vocal and guitar; Henry Gray, vocals and piano; Moses "Whispering" Smith, harp; Clarence Edwards, guitar; Clarence Prophet, bass; Samuel Hogan, drums; Roy Lee Sheppard, guitar, and Gene Douzier, bass.

Songs: The Blues Won't Let Me Take My Rest; Lucky, Lucky Man; If I Ever Get Back Home; Talk To Me, Baby; I Got a Funny Feeling; Rats and Roaches in My Kitchen; Cold Chills; Hear That Rumbling; How Many More Years, and On The Dark Road Crying.

Arhoolie 1054, \$5.98.

Springing out of Louisiana farm communities which skirt the marshes and swamps alongside "61 Highway" of which Mississippi Fred McDowell sings, is a country-bred type of blues with a city flavor, a kind of blues come-to-town. Bluesmen such as Henry Gray, a pianist who played with Howlin' Wolf for some 12 years; Guitar Kelley, who makes his recording debut in this album; Silas Hogan, Clarence Edwards, and Moses "Whispering" Smith who talks

a mean harmonica, giggered around juke joints in the 1950's until they concluded that to be heard over the din would require some electronic assistance.

Thus, in this Arhoolie LP of 10 blues, we have everything from the plugged-in basses of Gene Douzier and Clarence Prophet and what appears to be an echo chamber in "Lucky, Lucky Man" to fade-outs, which occur in six of the 10 tunes. Unfortunately, the quality of reproduction is not what it should be.

The form is pure and simple a a b with the expected repetition and the recounting of hard times, vividly bold and purposefully exaggerated to shock as in "Rats and Roaches in My Kitchen," a Silas Hogan original.

Here are the pure and natural blues, bringing it all back home, wherein status symbols such as diamond rings and V-8 Fords abound. Subtle dialects spell out the message. The pronunciation indigenous to Baton Rouge and environs is gentle, rumbling, carried off with a twang - "rang" for "ring"; "susta" for "sister"; "kitchun" for "kitchen"; and syllables that require four notes to be annunciated.

Henry Gray growls into his notes vocally, chasing them up the scale, hissing the blues while accompanying himself on a barroom piano to end all barroom pianos. Gray attacks his instrument with sweeping glissandos, runs, and repeated trills. Although his voice is not picked up well at times he takes us back to rhythm and blues with a flair.

"On the Dark Road Crying" is our favorite blues of the set and features "Whispering" Smith vocally and on harp, incisive and warbling with a tremolo, displaying excellent control. This is essentially the only number in which the musicians expand and improvise and they are together and well rehearsed. However, the fade-out is anticlimactic.

Guitar Kelley's full barrel-like tones are low keyed as is his approach but he means what he says—that the "blues ain't nothin'" but a woman in love with a married man." Kelley utters asides as if to signal his fellow musicians to carry on and they do, with Gene Douzier on bass like a train.

"Talk to Me Baby" is successful, delivered with no strain by Kelley who executes octave leaps on guitar. If there are too many syllables to fit the picture, he simply omits one.

These more polished, mildly urbanized blues do not project the range and depth of feeling their precursors emoted and are not as interesting in our view. However, they will make you nostalgic for the rhythm and blues of the 50's.

Performance: B Sound: C

78

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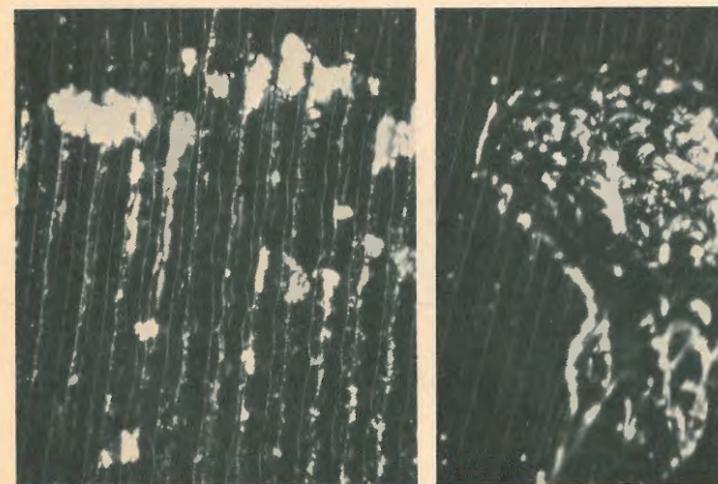
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(Continued on page 80)

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(Continued on page 82)

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(Continued from page 81)

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10. This item must be completed for all publications except those which do not carry advertising other than the publisher's own and which are named in Sections 132.231, 132.232 and 132.233, Postal Manual (Sections 4355a, 4355b, and 4356 of Title 39, United States Code).

Average no. copies each issue during preceding 12 months

Single issue nearest to filing date

A. Total no. copies printed (Net Press Run)	88,860	90,400
B. Paid circulation		
1. Sales through dealers and carriers, street vendors and counter sales	12,351	12,977
2. Mail Subscriptions	64,329	65,620
C. Total paid circulation	76,680	78,597
D. Free Distribution by Mail, Carrier or other means		
1. Samples, complimentary, and other free copies	1,182	1,230
2. Copies distributed to news agents, but not sold	9,554	9,563
E. Total distribution (Sum of C and D)	87,416	89,390
F. Office use, left-over unaccounted, spoiled after printing	1,444	1,010
G. Total (Sum of E and F—should equal net press run shown in A)	88,860	90,400

I certify that the statements made by me above are correct and complete.

JAY L. BUTLER, Publisher

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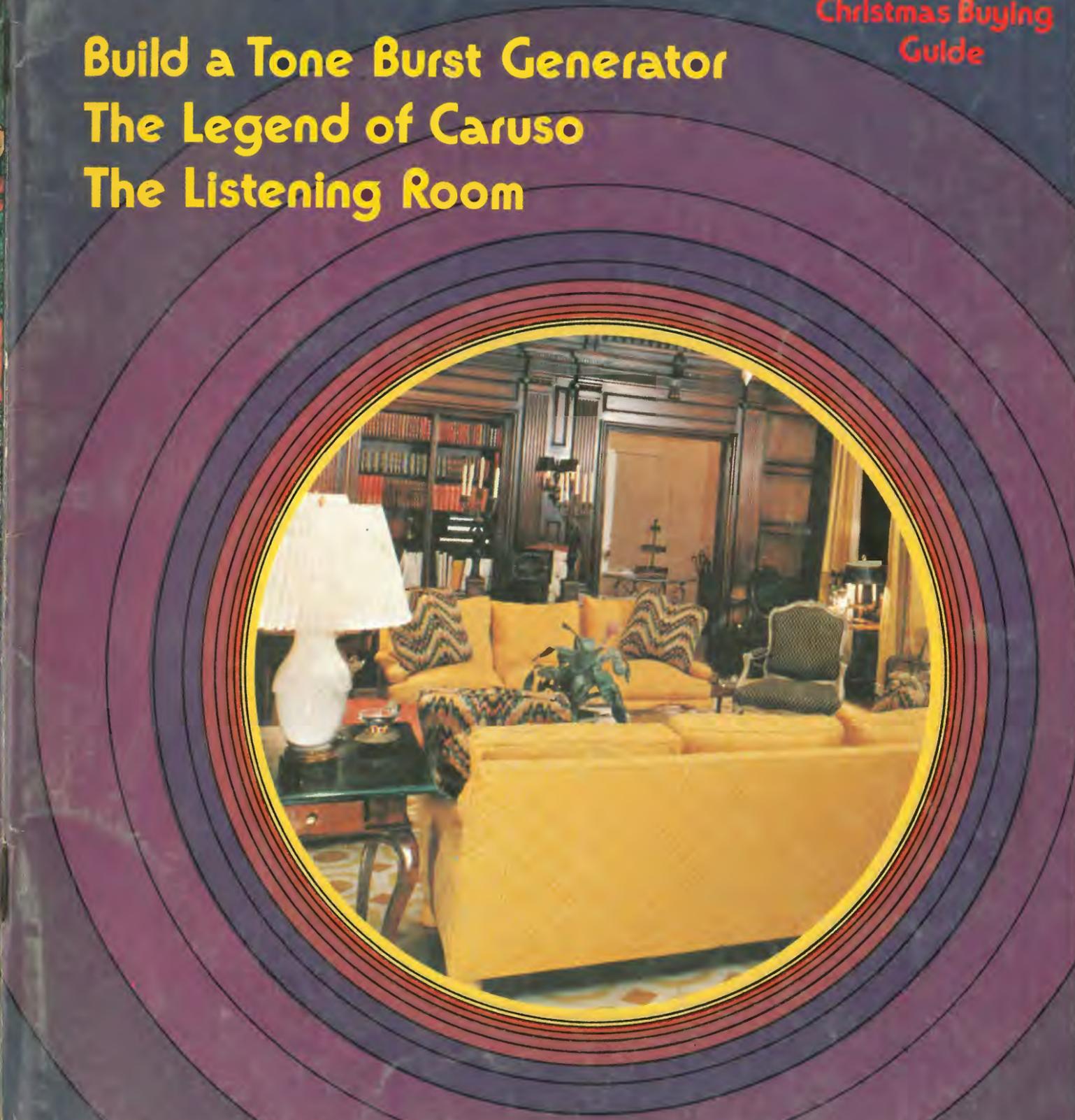
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