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How to Solve Hi-Fi Decor Problems

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See Page 21



Scott components in a compact stereo system?

(THERE'S A SOUND REASON.)

There are plenty of "stereos" on the market, but only a Scott *component* stereo music system gives you the true Scott sound. Here, in one neat package, is a best-selling Scott stereo receiver and a professional automatic turntable with magnetic cartridge and diamond stylus. Flanked by a pair of Scott Controlled Impedance speakers, this complete system turns out the

kind of sound that's made Scott the byword among audio professionals. You get separate Bass, Treble, and Volume controls for *each* channel, plus an accurate tuning meter, and connections for microphone, guitar, earphones, extra speakers,

tape recorder, and tape cartridge player. Scott makes a whole range of compact stereo music systems, in AM/FM, FM stereo, or phono models. Prices run from \$249.95 to \$469.95. See them all at your Scott dealer. (Model 2504, FM stereo system shown.)



"GREAT
SCOTT"

Scott... where innovation is a tradition



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AUDIO

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Successor to **RADIO**, Est. 1917

Number 50 in a series of discussions
by Electro-Voice engineers



THE VENTILATED WOOFER

JOHN R. GILLIOM
Chief Engineer,
Loudspeakers

The smaller the woofer employed in a high quality speaker system, the greater the need for critical analysis of speaker performance if satisfactory results are to be obtained. Some details of speaker construction that are handled routinely in larger, more efficient speakers can become acute problems as a result of size reduction.

A case in point is the need for dust-proofing the voice coil mechanism to assure lasting, trouble-free performance. Conventional design practice sets no limit on the location of the dust barrier, and often it is located quite close to the voice coil itself so that the volume of air surrounding the voice coil is relatively small. Since on large, high-efficiency speakers, voice coil excursion is modest (perhaps 1/16") displacement of this air is slight and no problems arise.

However, a small (6") high-compliance woofer such as the one used in the new E-V EIGHT speaker system may have as much as 1/2" excursion when operated at maximum volume. When the voice coil is sealed in a small volume of air, as is typical of speakers of this size, the pressures developed within this cavity will rise to appreciable levels, first on one side of the coil, and then on the other.

This results in air moving at high velocity through the narrow gap past the voice coil, creating a "whistle" that has no harmonic relationship to the incoming signal. Two steps can be taken to reduce this effect: First, the volume of air can be increased, and second, the pressure difference on opposite sides of the voice coil can be reduced.

In designing the E-V EIGHT woofer, we found the most effective means to reduce air pressure in the voice coil gap was to vent the entire area into the speaker enclosure. The metal dust barrier normally employed was discarded, and cloth screens were provided to filter the air entering behind the voice coil. In effect, the outside of the voice coil mechanism operates in free air.

However, this afforded only a partial solution to the problem, as air was still trapped under the dust dome inside the voice coil, and was being pumped at high velocity in and out of this area during heavy excursions of the woofer.

To relieve this area of high pressure, six holes were punched in the voice coil form, permitting free movement of air through the form itself, and reducing the air pressure developed at this point.

The result is a woofer capable of extremely wide excursions yet completely free of the disturbing whistle often heard in small speakers of this class at high listening levels. The improvement was effected without reduction in protection against dust, and with little or no increase in manufacturing cost or complexity.

In addition, lowering the pressure around the voice coil resulted in reduced acoustic resistance, and provided an increase in efficiency of about 2 db near resonance over an unvented woofer. This increase was particularly welcome since ultra-compact speakers such as the E-V EIGHT are often coupled to amplifiers of modest power capabilities.

For technical data on any E-V product, write:
ELECTRO-VOICE, INC., Dept. 1173A
602 Cecil St., Buchanan, Michigan 49107

Electro-Voice
SETTING NEW STANDARDS IN SOUND

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Coming in December

SPECIAL TAPE RECORDER ISSUE

Roundup of Tape Recorders — Specifications and details of the latest hi-fi audio and video tape recorders.

Tape Recorder Buying Checkpoints — Herman Burstein's article could well have been titled, "Why pay \$500 or more for a tape recorder when for \$200 or less you can buy one that looks pretty much the same and does about the same things?" The author analyzes features, performance, and reliability in exploring variances of recorders in different price categories.

Build a Mixer-Meter Amplifier — A home recording session's requirements sparked construction of the 4-position mixer described by Hal Magargle.

... and more.

Also:

Microphones for Sound Reinforcement Systems — Arthur Davis and Don Davis collaborate here to detail the role of microphones in achieving performance goals of sound reinforcement systems.

Annual Article Index — A reference guide to all feature articles and equipment reviews published in Audio Magazine during 1967. Arranged by subject and by author.

Plus: Equipment reviews, record and recorded tape reviews, ABZs of FM, Audioclinic, and other regular monthly departments.

ABOUT THE COVER: A hi-fier's stereo high-fidelity installation underscores how top-quality sound-reproducing equipment can be blended handsomely into a home. See how the system appears with cabinet doors closed, the way it generally looks, on page 21.

AUDIOCLINIC

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.

JOSEPH GIOVANELLI

What Shall I Buy?

Q. I am confused about purchasing a speaker system. I have purchased the following components: Dual 1009 SK, Shure V-15 II, Dyna PAS-3X, Dyna stereo 70.

I would appreciate your first and second choice of a speaker system and a tape deck to go with this set. I like to play music which goes from quiet passages to full orchestral climaxes. I like to play it at full room volume, free from distortion. My living room measures 17 feet by 15 feet.—Name withheld

A. I wish I could be of real help to you. However, I have found that it is better for me to deal with general areas concerning audio rather than with subjective product preferences.

What I like in terms of overall sound quality may well be what you do not like. I can only suggest, therefore, that you listen to as many speakers and tape decks as possible. Examine them carefully for individual differences in terms of features and decor. Then you can judge whether or not you wish to purchase a given piece of equipment. You are the only judge of what you like or do not like. You listen with your own ears and not those of friends or family.

I have had many questions on this topic of product selection, I am, therefore, printing yours as an explanation of my position to other readers.

78's with a stereo system

Q. I want to play my old 78's dating back to 1915 on my stereo system. My problem is that I cannot find a monophonic cartridge.

When using a monophonic cartridge with stereo equipment, can both grounds be attached to the single

ground clip and both "hot" sides to the other?—W. C. Britt, Yakima, Washington

A. Quite a few manufacturers of stereo cartridges offer a stylus which will play 78-rpm discs. You need only order the cartridge with such a stylus installed. It will have a 3-mil tip radius.

When connecting a monophonic cartridge into your stereo system, you can connect it in the manner described in your letter. However, if you are to be absolutely correct in terms of loading, you should connect just one channel of your system to the cartridge and set your equipment for monophonic operation. This will allow the one channel to feed both speaker systems.

Stylus Diameter?

Q. I have just added a stereo system. I want to be able to play my stereo records on my old, monophonic system which uses a Garrard RC80 and an old GE variable reluctance cartridge. I've been told that the LP diamond stylus will damage stereo records and that I should get a new (0.7 mil?) stylus for stereo. The problem is that I cannot locate such a stylus. There used to be a firm which made diamond replacements to order. I got my diamond stylus by sending them my sapphire-tipped one. They put on a diamond for LP's. I long since lost the address. Can you help me? All that I need is a stylus having the correct tip for stereo.—W. R. Loundes, Berkeley, California

A. I definitely suggest that you obtain a stereo cartridge for your monophonic system. It is not merely a matter of the stylus diameter which determines the amount of record wear. (In fact, the earliest stereo cartridges were equipped with styli having 1 mil tip radii.) The problem with using a monophonic cartridge on stereo records is the lack of vertical compliance of such a cartridge. The stylus was made to be very stiff in the vertical direction to eliminate rumble. Therefore, you will safeguard your investment in records by getting a good stereophonic cartridge.

You will find that your monophonic system really "comes to life." It will sound much better with a stereo cartridge than with the monophonic one. You can hardly imagine the tremendous advances which have taken place in cartridge design since the introduction of stereo discs.

FM Squelch

Q. I plan to add a squelch to my tube-equipped FM tuner to cut down

*Garrard's top model, the SL 95
synchronous and superlatively new,
above and below the turntable*



You are looking at the newest and finest automatic transcription turntable in a precedent-breaking new group of models from Garrard—the SYNCHRO-LAB SERIES™. An engineering triumph from top to bottom, its ultra-low mass, dynamically balanced tone arm of Afrormosia wood floats within gyroscopically gimbaled needle pivots. Above the unit plate is a full complement of Garrard refinements: the patented sliding weight anti-skating control, the built-in calibrated stylus pressure gauge with ¼ gram click settings, the beautifully simple controls governing all automatic and manual-cueing-pause features—while, almost invisible (because it telescopes into the unit plate when not in use) is a new positive safety platform that assures gentle handling of records in automatic play.

But below the unit plate is where the SL 95 is really extraordinary. There you will find the outstanding innovation that gives the Series its name—the SYNCHRO-LAB MOTOR™—providing the matchless benefits of absolutely constant, synchronous record speed, plus an induction section for instant starting power and high torque. It marks a revolutionary advancement in high fidelity record reproduction! There is a complete range of synchronous SYNCHRO-LAB models, headed by the magnificent SL 95 at \$129.50. For a complimentary 20-page Comparator Guide showing all the new models, write to: Garrard, Dept. AS-1, Westbury, N.Y. 11590.

Garrard[®]
World's Finest

**A full explanation of the Synchro-Lab Motor and the improvement it makes
in actual performance will be found on page 51 of this issue.**

the interstation rushing noise on the FM band. It does not matter if one or two distant stations are no longer obtainable after this addition because these stations are of no program value and are never listened to by this household.

How can I make this addition? —
T. Best, Richvale, Ontario, Canada

A. This is the basic experimental method using tubes. A similar method, however, is possible using transistors.

Let us first discuss the manner in which a squelch circuit works. Then you can experiment with various approaches. One form of squelch derives its action from the grid of the first limiter. When there is no signal, the grid is at near zero potential with respect to ground. When a signal is applied, this grid goes negative by at least a volt and more.

What you must do is to take a tube such as a 12AT7 and place a relay in the plate circuit of one section. The input of the tube goes through a potentiometer, wired in the manner of a volume control. This volume control is fed by the signal appearing on the limiter grid. The normal contacts on the relay—those which are made when the relay is in its rest position—are

placed in series with the audio output. The down contacts of the relay—those which come into play when the relay is pulled in—are so arranged that the audio output is shorted out.

With no signal applied to the limiter grid, the tube will conduct heavily enough to keep the relay closed and the audio shorted out; no hiss will be heard. When a signal does appear, the tube's plate current is cut off by virtue of the negative signal being applied to its control grid. The relay, therefore, opens, restoring the tuner's audio circuit to normal operation. The maximum sensitivity of this circuit is controlled by the cathode bias resistor in the relay tube; the minimum sensitivity is controlled by the setting of the potentiometer. This arrangement provides you with a variable squelch which can be set to reject all but the strongest signals or can be adjusted so that even weak signals can be heard. If for some reason you wish to hear weak signals, you probably will have to compromise. You see, the setting which provides weak-signal sensitivity often is triggered by random noise pulses as well as the desired signal.

Care must be exercised in this circuit in terms of isolating it from the

limiter stage. You may need to isolate the control stage from the limiter portion of the circuit as is done in AVC circuits. Failure to do this will degrade the performance of the limiter.

Power for the relay tube can be taken from the tuner's power supply.

Other circuit arrangements are possible, using electronic switching rather than employing a mechanical relay. Such devices act to turn a tube or transistor "on" or "off." Usually, this is accomplished by allowing a signal to overcome a delay bias of some kind. Sometimes this switching effect is aided by the use of a neon tube in the plate circuit of the control tube. The ionizing of the neon lamp will result in a definite "on" condition. The extinguishing of the lamp will result in a very positive "off" state.

There are even more sophisticated arrangements possible which involve the use of noise-cancelling amplifiers which are designed to discriminate between wanted signal and random noise. I have yet to see such circuits employed in FM tuners designed for the home market, but they are used in mobile communications equipment where random noise is very often a problem. *AE*

HERE IS THE BLACK BOX YOU'VE BEEN WAITING FOR



The Hammond M-100
Condenser Microphone
from England

Now a sensibly priced condenser microphone capable of matching the wide range of today's professional recorders. Extremely sensitive with a smooth, extended frequency response. The high output level of the nuvistator cathode follower (50 ohms up) can make a significant improvement in the signal/noise ratio of your recorder. Storage of all components in the compact AC power unit.

The sensible prices:

Stereo model	\$229.50
Mono model	\$149.50

with a unique extended warranty

May we send you a brochure?

The Microsound Company

Box 4591 B
Colorado Springs, Colo. 80909

We have nothing to say about our TR100X receiver.

High Fidelity said: Solid-state design can be credited with offering a lot in a little space, and this new Bogen is a case in point. Easy to look at, easy to use, and easy to listen to.

Hirsch-Houck Labs said: (in Electronics World) Excellent sensitivity and audio quality. Combines operating simplicity with ample control flexibility for most users, and at a moderate price.

American Record Guide said: It enables the purchaser with relatively limited funds to get a high quality product. It represents some of the best current design philosophy in its circuitry. And, since it is a "second generation" unit, it combines the virtues of good sound and near-indestructibility. The more I used this unit — the more I came to respect it.

FM Guide said: The Bogen TR100X is a solid state AM/FM stereo receiver with a difference. Bogen has shown unusual ingenuity in

using printed circuits. For its price, the Bogen TR100X is exceptional. The TR100X is true high fidelity equipment. It will give you more sound for your money than almost any other equipment purchase.

We add only this: The TR100X is priced at \$249.95. We also make the TF100, identical to the TR100X, but without AM, for \$234.95. Both slightly higher in the West. Cabinet optional extra. Write for our complete catalog.

Specifications: Output power: (IHF) 60 watts • Frequency response ± 1 dB: 20-50,000 Hz • Hum and noise: -70 dB • FM sensitivity (IHF): 2.7 μ v. • FM distortion: 0.7% • FM Hum and noise level: -60 dB.

The critics have said it all!



THE LIVE SOUND OF **BOGEN**

LEAR SIEGLER, INC.

BOGEN COMMUNICATIONS DIVISION
PARAMUS, N. J. 07652
Dept. 1311

WHAT'S NEW IN AUDIO

Two 90-Watt Scott receivers

Integrated circuit i.f. strips and field-effect transistors mark some of the features of H. H. Scott's new 90-watt solid-state receivers, Models 384 AM-FM stereo (\$439.95) and 344C FM stereo (\$399.95). Performance of both receivers is identical: 1.9 μ V FM sensitivity, 90 dB cross-modulation rejection, 2.2 dB capture ratio, 46 dB selectivity, and 36 dB stereo separa-



tion. Automatic stereo switching (electronic) includes noise-identification to avoid false triggering. Automatic stereo switching (electronic) operates when a 19-kHz multiplex pilot signal is present. Other features include: interstation muting; tape monitoring facilities; speaker switches for operation of main, remote, or both sets of speakers; front-panel headphone jack; built-in noise filter; and pushbutton switches.

Check 105

AKG two-way mike

Norelco announces a new two-way microphone, AKG's Model D-200E. The cardioid dynamic microphone incorporates two coaxially-mounted elements with 500-Hz crossover network. Each element is designed for independent reproduction of low and high frequencies; compensating windings cancel stray magnetic fields. The system is isolated mechanically against

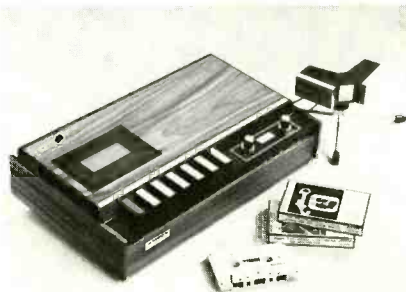


severe shocks by a floating suspension system.

Specifications are as follows. frequency range, 30 Hz to 15 kHz \pm 3 dB; sensitivity, -55 dB referred to 1 mW/10 dynes/cm², 0.16 mV/ μ bar; impedance, 200 ohms. The 7 $\frac{3}{16}$ -in. long \times 1 $\frac{5}{8}$ -in. diameter microphone's net price is \$69.00. Check 106

Ampex cassette players/recorders

Ampex, long-known for its reel-to-reel audio and video tape recorders, introduces a line of cassette players and recorders for home and portable use. Called the *Micro Series*, they include the following models: Micro 20, a combination a.c./d.c. battery-powered portable mono recorder with remote control microphone. The 12 $\frac{1}{2}$ in. \times 8 in. \times 2 $\frac{3}{4}$ in. recorder weighs 6 lbs. \$99.95. Micro 50 (shown here), a walnut-encased stereo player/recorder deck designed for use with stereo systems, features push-button operation, a digital counter, VU meter, pause and record level controls. The solid-state unit, which incorporates preamplifiers, includes connecting cables for console or components. \$139.95. Micro 85, a complete system, including walnut-encased player/recorder with dual power amp-



lifiers, matching walnut speakers and two omni-directional microphones, includes the controls featured in the Micro 50, plus volume, tone, and balance controls. \$199.95. Check 107

Integrated-circuit control console

Electrodyne introduces Model ACC-1204 audio control console for professional recording, educational, and motion-picture sound stories. The console uses integrated circuit amplifier modules throughout for high reliability. Completely self-contained, it features 12 microphone or line inputs using straight-line attenuators, four main output channels with illuminated VU meters, illuminated pushbutton channel and cue switching, six-position

equalization with echo-send and cue on each input channel, four echo-return controls, four straight-line sub-masters,



four-ganged straight-line master attenuator, four-ganged monitor control, talkback microphone mode switch for direct or tape-output monitors. Optional provisions include up to six more microphone or line inputs, stop clock control, remote tape control, headset monitor, and a pan potentiometer, among others. \$11,200.

Check 108

Battery-operated mixer bows

Switchcraft's new "Studio MixMASTER" Model 307TR was designed specifically for studio, remote and home high-fidelity use, according to its manufacturer. The solid-state, stereo-mono mixer-amplifier has a myriad of uses. It can be employed with turntables (it's equalized for magnetic pickups), tape recorders, microphones, and/or electronic instruments. It permits recording sound-on-sound, fades music and voices, records voice over music or mixes voice and program sources. Powered by standard "D" batteries, the unit gives added versatility.

Distortion is 1% maximum, 0.5% typical, at 1.5-Volts output. Frequency response is 20 Hz to 20 kHz, with a minimum signal-to-noise ratio of 60 dB (referred to 1 mV input).



The "Studio MixMASTER" can accept from one to four mono input signals or up to two stereo input signals. Each program input level is controlled individually by a separate gain control or simultaneously by a master gain control. Broadcast-type control knobs are numbered for error-free settings. Other controls include an on-off switch, phono equalization, and stereo-mono switches. Includes both low- and high-impedance mike inputs. Various inputs are standard phone-jack types.

The 4 $\frac{1}{2}$ lb. unit measures 3 $\frac{1}{2}$ in. high, 12 in. wide, 7 $\frac{1}{4}$ in. deep. \$145.

Check 109



Exposed for what it really is... The World's Finest Speaker System

EMPIRE'S 9000M GRENADIER

Consider it from the bottom up. The 9000M Grenadier builds perfect sound from a 20-Hz. foundation. Deep, pure, total bass. Boomless, growl-free, undistorted bass that reproduces even Mahler and Wagner with concert-hall fidelity and power.

We deliver it through a 15" high-compliance woofer built around a uniquely powerful magnet—an 18-pound ceramic magnet structure that controls a 4" voice coil flawlessly.

The woofer faces *downward*—not out. It distributes low frequencies through a complete circle. It puts the bottom *on* the bottom, then spreads it across the room like a carpet of sound.

We bring in our mid-range direct radiator at 450 Hz, and our ultrasonic domed tweeter at 5000 Hz. They provide uncolored, crystal-



clear sonic responses up to 20,000 Hz. Close your eyes and Landowska, La Scala, Segovia or a string quartet are live in your living room.

We achieve this matchless sound through superb speakers *plus*.

The *plus* is a patented wide-angle acoustic lens. This lens *disperses* even the narrowest overtones through a 140-degree arc. No 'beaming.' No X-marks-the-stereo-spot listening chair. Just clean, perfect mid- and high-frequency distribution throughout the room.

Listen to it. Walk around it. Feed it a full 100 watts and try to catch the faintest edge of distortion.

Compare it to *any* speaker for absolute fidelity and total transparency. Then see if you can live with anything else. **\$299.95**

EMPIRE

SCIENTIFIC CORPORATION, 645 STEWART AVENUE, GARDEN CITY, L.I., N.Y. 11530

Thorens' newest turntable with more freedom of choice!

THORENS, the world's leading transcription turntable manufacturer, has developed a new turntable — the TD-150. It offers the serious music lover a Thorens quality precision turntable, and it gives him freedom to select or change over conveniently to any tone arm or cartridge his system requires.

And because of its price, the TD-150 permits you to place your emphasis on the tone arm and cartridge — which is where it should be. For knowledgeable hi-fi enthusiasts know that the total performance of a record-playing system is no better than the tone arm and cartridge which track the disc.

Yet the TD-150 sacrifices nothing of Thorens' world-famous quality. Its features include:

- 12-inch, 7½-pound precision balanced non-magnetic platter.
- Two low-speed synchronous 16-pole motors on one rotor shaft to assure constant and smooth in-phase perfect speed.

- Uni-suspension — tone arm board and platter are a spring-loaded suspension system, minimizing vibrations and acoustic feed-back.
- Interchangeable tone arm mounting board.
- Dimensions: 15⅝" wide, 12⅞" deep, with a total height only 3¼".

If you wish to make no compromises in the sound of your record playback system, a Thorens transcription turntable should be your choice.

From the still unsurpassed TD-124 Series II, 4-speed transcription model at\$149.50 or the completely integrated TD-150AB (a BEST BUY) at.....\$99.75 to the new "Freedom-of-Choice" TD-150 (base and tone arm not included) at only\$85 there's a Thorens quality turntable for every need . . . and every budget.

Satin walnut base (WB 150SW)	\$10.00
Dust cover (TX22)	\$12.50

THORENS TD-150



See the complete line at any franchised dealer. And for the music lover who is concerned about record wear, let Elpa tell you *why you cannot afford an inexpensive* tone arm or turntable — why it is sound economy to get equipment designed for the job. **Send for the FREE, informative "Record Omnibook."**

ELPA MARKETING INDUSTRIES, INC., NEW HYDE PARK, N.Y. 11040

AUDIO NEWS

Industry moves:

Lawrence LeKashman to president of Bogen Communications Div. of Lear Siegler from vice president, marketing, of Electro-Voice □ Donald J. Plunkett to vice president, Professional Audio-Video Div. of Harvey Radio from president of Fairchild Recording Equipment □ James Noble to director of engineering from chief engineer for electronics, Altec Lansing □ Harold J. Schulman to executive vice president and director, United Audio Products, from executive vice president, Fisher Radio □ Ed Villchur to president of Foundation for Hearing Aid Research from president, Acoustic Research, Inc.

Hi-Fi in the sky

H. H. Scott will display its full console line in a special penthouse suite which is part of audio furniture manufacturer Toujay Designs' showroom, rather than a broad display in New York City dealers' stores. Participating dealers, who will have one Scott console on the floor, will refer customers to the Penthouse showroom to see the complete line. You'll need console "referral cards" to see and hear the console equipment, which is physically separated from Toujay's audio furniture.

Scott follows on the heels of AUDIO in marking its twentieth year in the audio field. One of the company's first products was a broadcast-model dynamic noise suppressor for radio broadcast stations, paving the way for development of a consumer counterpart. Congratulations, Hermon H. Scott.

Electro-Voice chief directs ham activities

Al Kahn, W8DUS, E-V president, acted as chief operator of the Boy Scout World Jamboree amateur station, K7WSJ. The international gathering, held in Farragut State Park, Idaho, drew over 10,000 scouts from 100 countries.

"Educators Guide to Media and Methods" Magazine

This journal joins North American Publishing Company, publishers of AUDIO Magazine. The monthly journal advises educators on use of modern teaching techniques, including implementation of audio and video equipment in the classroom. AE

A few words of caution about the new Fisher TX-1000 120-watt control amplifier.

The new TX-1000 control amplifier has 120 watts music power (IHF). It's virtually distortion-free. And it does make you want to push your speakers to the absolute limit.

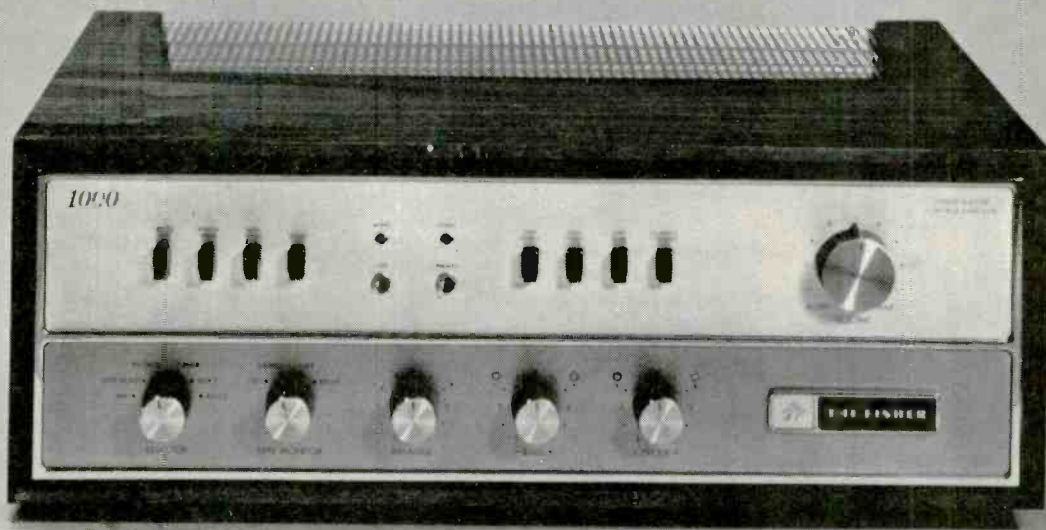
But that's no reason to ignore the responsibilities that go with owning it. It's not an excuse to turn up the volume and blast your neighbors out of their calm.

And it certainly doesn't give you license to neglect your family, friends or job just to spend hours playing with the pushbutton 5-position speaker selector, 3-position high filter and pushbutton loudness contour. Or with any of the myriad jacks, switches and controls which the amplifier includes.

Maybe the undistorted power output from 22 to 24,000 Hz is worth a demonstration to a few interested friends. Just to show them what 0.5% maximum harmonic distortion at full output and less than 0.8% IM distortion sound like.

But you'd better not turn the new Fisher TX-1000 up more than half way if you care about public opinion. You might have to listen to a few words of caution from your neighbors.

Price \$349.95 (cabinet \$24.95).



Mail this coupon for your free copy of The New Fisher Handbook, 1968 Edition. This 80-page reference guide to hi-fi and stereo also includes detailed information on all Fisher components.

Fisher Radio Corporation

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Long Island City, N. Y. 11101

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OVERSEAS AND CANADIAN RESIDENTS PLEASE WRITE TO FISHER RADIO INTERNATIONAL, INC., LONG ISLAND CITY, N. Y. 11101.

The Fisher

Tape Guide

HERMAN BURSTEIN

If you have a problem or question on audio, 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.

60 to 50 Hz conversion

Q. I recently purchased two tape recorders for use in Europe, and therefore ordered them for 50-Hz operation. However, I also want to use them here, and have therefore, but unsuccessfully, tried to purchase a converter to cut down from 60 to 50 Hz. Can you suggest a manufacturer who makes such a converter, or perhaps some other method of reducing speed without damaging my machines?

A. I don't know of a commercially made unit for converting from 60 to 50 Hz, although from time to time articles have appeared in the audio literature on constructing an amplifier to drive such items as a phonograph (and therefore presumably a tape recorder) at various speeds. Accordingly, you might want to peruse the indexes of various audio and electronic magazines to look up these articles.

However, I think your best course, if possible, is to return your machines to the manufacturer for conversion to 60-Hz operation, with the manufacturer providing an adaptor sleeve that goes over the motor shaft or over the capstan to step up tape speed when operating at 50 Hz.

Low-Z headphones

Q. I would like to purchase one of the new low impedance stereo headphones for use with my high fidelity system. My problem is that my tape recorder requires a load impedance of 50k to 100k Ohms at its headphone output, while my preamplifier requires a 2000-Ohm load. I have been shopping around for a matching transformer to adapt my low impedance headphones to my equipment. Now I would like to know if I could use this one transformer to match both impedances to the headphones. I am considering a transformer which presents an impedance of 10k Ohms. Would this work with my tape machine? Could I also use it with my preamp? These trans-

formers are not inexpensive, and I would prefer not to purchase two of them.

A. A transformer mismatch involves signal gain and distortion, and to some extent frequency response. If there is to be a mismatch, it is generally desirable that the mismatch be an upward one, looking from the source to the load. Therefore the transformer should present an impedance of 50K to 100K to the tape recorder. While you will probably obtain sufficient signal in your earphones when connected to the tape recorder via this transformer, I cannot promise you that you'll have enough signal when connected to the preamplifier. After all, connecting a load of, say, 50k-Ohms to a 2000-Ohm source is quite a mismatch from the viewpoint of power transfer. However, if the 'phones are fairly sensitive, you may get away with this mismatch.

Why don't you simply connect the earphones to the output of your power amplifier? (Use dropping resistors due to a phone's high sensitivity if you don't have a front-panel headphone jack.) Then you would need no matching transformer whatsoever.

Low VU readings

*Q. My stereo tape recorder, an ***, has only one VU meter, but with one meter it is difficult to balance the two channels when recording. Therefore I connected a second meter to the output of the machine. However, I then got a low reading and also a loss of bass. Could you tell me what to do?*

A. A VU meter when connected across a 600-ohm load requires 0.774 volts to drive it to a 0-VU indication. When connected in series with a 3600 ohm resistor, as it properly should be, it then requires 1.23 volts. Your particular tape recorder, however, has a rated output of only 1/2 volt. Therefore the low indication. When you connect a VU meter across the output jack and your selector switch is in the position for monitoring the line-input source, the meter you have added loads this source, possibly causing appreciable distortion and altered frequency response.

It seems your best course is to go inside the electronics and duplicate the existing VU arrangement, including the tube that amplifies and rectifies the recording signal which is fed to the meter. You would have to obtain from the tape recorder manufacturer or one of his service agencies a second meter the same as the present one; this is not a regular VU meter inasmuch as it does not incorporate its own rectifier.

Tape tension for storage

Q. Is there an ideal tension or optimum tension for tape to be stored on reels; and if so what are the reasons?

A. Ideally the tape should be wound on the reel with uniform, "moderate" tension, that is, not too loosely and not too tautly. Excessive tension may set up strains in the tape that cause it to acquire a "set," with consequent distortion. A winding which is too loose may allow the turns to acquire a deformity in the nature of cupping or curling. To avoid physical and therefore audible distortion, it is frequently advised that a tape be put through the normal operating mode, rather than the high-speed winding mode, just prior to storage. If a tape has been stored for an appreciable time after being rewound at high speed, strains set up in the tape can sometimes be relieved by putting the tape through the normal operating mode one or more times (this also has the benefit of reducing print-through).

Recorded mono tape source

Q. We wish to purchase several mono half-track tapes, 3.75 ips, containing patriotic, roller skating, and background music. We have been unable to locate a source of such tapes. Your recommendations would be appreciated.

A. You might try (1) Dubbing Electronics Corporation, 226 Franklin, Hewlitt, N. Y.; (2) Ampex Stereo Tapes, 2201 Lunt Avenue, Elk Grove Village, Illinois 60007.

Matching headphones

Q. I have a tape recorder connected to my hi-fi system and want to use headphones to listen directly from the tape machine's preamp. The machine's instruction manual says that the output impedance of each monitor jack is 270 Ohms. I have 8-Ohm headphones, however. I have asked a number of audio stores and friends about the matching problem, and have received conflicting answers. One said that the mismatch will damage the preamp. Another said that the mismatch will disturb the calibration of the machine and that I should get a pair of crystal phones of about 10,000 Ohms impedance. Please tell me who and what is right as I do not want to damage my recorder. I have been unable to get any information from the distributor of my machine.

A. I don't think that connecting 8-Ohm phones to your 270-Ohm output will damage the tape machine, but this will very likely impair its audio quality



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Tape it with a Sony Solid-State Stereo 560

There's a world of beautiful music waiting for you and it's yours for the taping. Let Sony-superb 4-track stereo capture every note faithfully while you relax in your easy chair. Simply connect your stereo tuner to the Sony Solid-State 560, "Stereo Compact Portable," and tape your favorites off the air. Here is the nucleus of a complete stereo sound system with an ESP automatic reversing stereo tape recorder as its main component. The Sony-unique Stereo Control Center permits four separate stereo components to be connected to its stereo preamplifier and 20-watt music power amplifier. Push buttons select your component source for listening or recording. Individual input level controls balance output whenever you switch between components. Sony's revolutionary ESP Reverse electronic brain constantly scans and automatically senses the voice of music modulations on your recorded tapes. When these modulations stop, the ESP (Electronic Sensory Perceptor) automatically reverses the tape direction in 10 seconds. The Sony Solid-State 560 incorporates the most advanced electronic developments for sound-quality control. The Sony-exclusive Servo-Control Motor provides, among other things, the flexibility of AC/DC operation and variable musical pitch tuning. Non-Magnetizing Heads eliminate the most common cause of tape hiss. The exclusive Scrape Flutter Filter eliminates tape modulation distortion providing the purest recordings ever. An exclusive Noise Suppressor Switch eliminates any undesirable hiss that may exist on older recorded tape without affecting the sound quality. All of this is yours, with two Sony F-98 cardioid dynamic microphones for less than \$499.50! Check these Sony-exclusive features for luxury listening: ■ ESP Automatic Tape Reverse ■ Stereo Control Center ■ Scrap Flutter Filter ■ ServoControl Motor ■ Noise Suppressor Switch ■ Non-magnetizing Heads.



SONY'S PROOF OF QUALITY — A FULL ONE YEAR WARRANTY

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Sony Solid-State 560D ESP Automatic Reverse Stereo Tape Deck Recorder. If you already have components or a package stereo system, simply connect the Sony Solid-State 560D Stereo Tape Deck Recorder and add the incomparable advantage of stereo tape to your present stereo sound system. Here is the same superb ESP Reverse stereo tape deck that is the main component of the Sony 560. You will find every feature and the same advanced electronic developments for sound-quality control less the Stereo Control Center and speakers. Yet, mounted in its own handsome, low-profile walnut cabinet with recording amplifiers and playback preamplifiers, the Sony 560D sells for less than \$349.50!

NOW FREE!

STEREO INFORMATION

FM Station Directory

The directory lists 1571 FM stations in the United States and Canada. All the stations broadcasting in stereo are listed.

Test Reports

Test reports full of facts. The test reports were made by independent laboratories. Tests cover tuners, preamps, power amp/preamps. Read the facts from test experts.

Big 36-Page Catalog

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because of the severe loading presented by the phones. There should be a suitable transformer which you can connect between the tape machine and your phones in order to convert from 270 Ohms to 8 Ohms. I suggest that you write to the Engineering Consultant at one or more of the big catalog houses dealing in audio equipment; ask him to recommend a specific stepdown transformer carried by his company. Alternatively, as has been suggested, you can buy high-impedance phones.

Another possibility, if your tape machine has sufficient output and if your 8-Ohm phones are quite sensitive, is to put a 270-Ohm resistor in series with the phones. Reproducing quality would degenerate, however. Still another possibility is to connect the headphones to the output of your power amplifier (using resistors to reduce voltage); at the same time, you would install a switch to disconnect the speaker(s) and replace it (them) with a resistor equal to the speaker impedance.

Transformer connections

Q. (1) We have in our studio 4-track and 2-track professional recorders which are fed into a mixing console through isolation transformers. My question is whether there is any advantage in grounding the center tap on the output transformer of each tape recorder. Ours are grounded, and when by chance we have to feed an unbalanced source into the recorder, this naturally shorts out half the winding and fouls up the VU meter. I would just as soon unground these output transformers. What do you suggest? (2) What is your opinion on using isolation transformers between the recorders and the a.c. line? We have hum on playback. Hum and noise read about -50 dBm when the machine is on but not in motion. We think we may be picking some of this off the a.c. line. (3) Do you think it is better to feed into the tape recorders with the input in the "balanced" mode, or is it better to feed in an "unbalanced" signal? Our longest line in the control room is 20 feet.

A. (1) If your connections from the tape recorders to the mixing console are relatively short and no appreciable hum is encountered that requires a balanced line, you could omit grounding the center tap of the recorder output transformers. However, you do have a hum problem, which suggests a balanced line. On the other hand, if hum does not drop when using a balanced line, you can omit grounding the center

tap of the output transformers. And you will have to look elsewhere for the cure to your hum problem. (2) I understand that an isolation transformer will sometimes, but not necessarily, reduce hum. The only way to find out is to try. Whereas grounding audio equipment to a convenient ground is usually recommended and effective as a hum reduction measure, it may have the opposite effect in some buildings because the so-called ground is not actually a ground. In other words, be sure you have a true earth-ground. Possibly your isolation transformers between the tape recorders and the console are picking up hum. Try relocating them and/or shielding them in suitable material. (3) For a run of only 20 feet to the recording inputs, you would ordinarily have little to gain from a balanced line in the way of hum reduction. But the general rule does not always apply. It is best to experiment with both the balanced and unbalanced inputs.

Tape amplifier sources

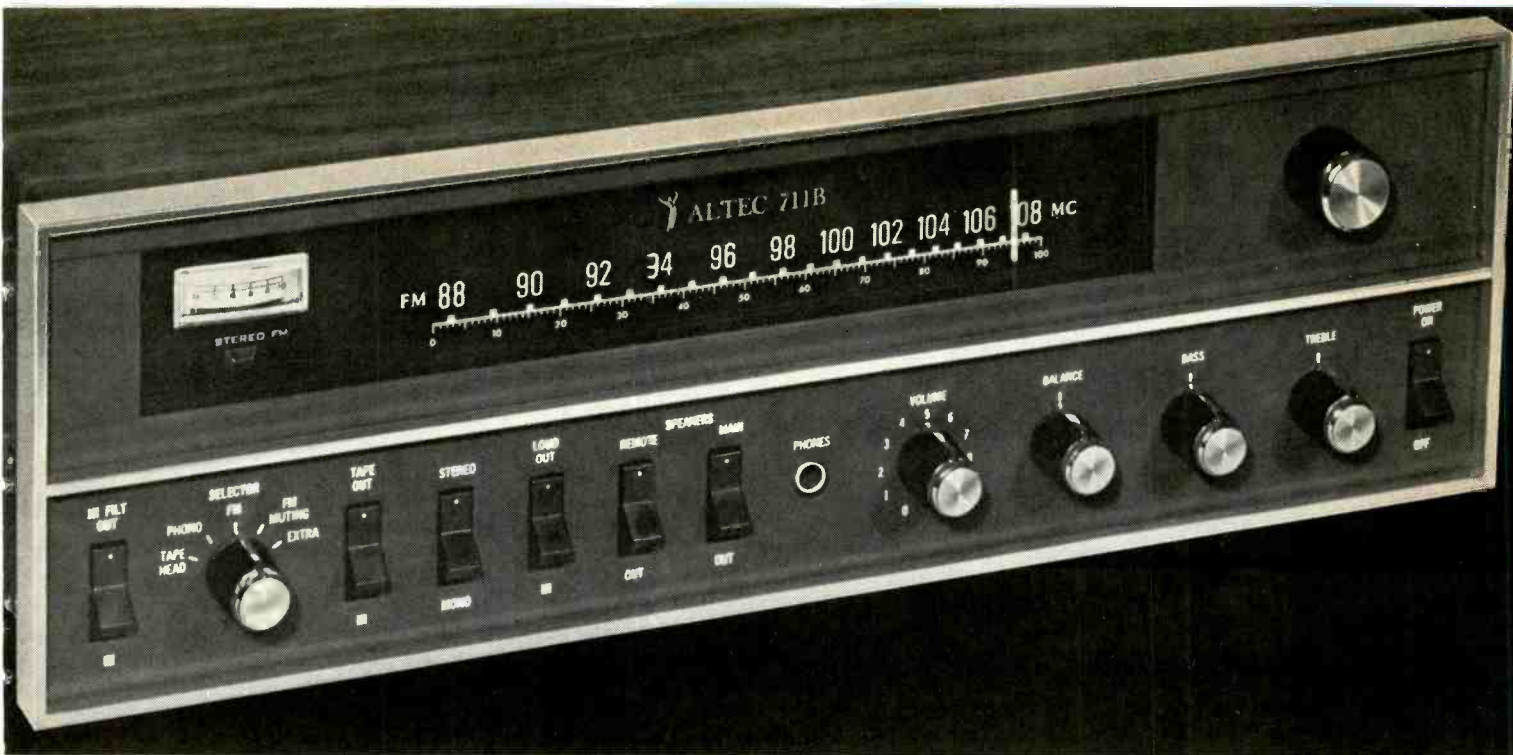
Q. I have a tape transport but no tape amplifier for it. Can you suggest where I can locate a tape amplifier or tape amplifier kit or suitable circuit (preferably solid state).

A. While the principal catalog houses (Allied and Lafayette) don't appear to show a tape amplifier or amplifier kit in their catalogs, you might write to them on the off-chance that they still have such a unit in stock. I suggest that you write to Viking of Minneapolis (9600 Aldrich Avenue South, Minneapolis, Minnesota) and to Nortronics (8101 W. 10th Avenue No., Minneapolis, Minnesota) to inquire about ready-made tape amplifiers. Also ask Nortronics about circuits, both tube and solid state. Consider also the Abajian-Jones circuit in the October 1964 issue of AUDIO. For mixing facilities, look up the article by Peter Stark in the October, 1963, issue of AUDIO.

Calling all Consultants

Q. Please provide a diagram for building a band-pass for 45 separate control frequencies in the range of 100 to 6000 Hz. Each filter is to activate an individual relay, it should be as inexpensive as possible, and it should use one amplifier. My project is to record 45 various signals in various sequences on magnetic tape, and these signals, after being bandpassed and amplified, are to trigger their respective relays.

A. I am sorry, but your question is outside the scope of the TAPE GUIDE. It is really in the realm of a capable design consultant.



Our new 711B has been influenced by the company it keeps.

Never underestimate the importance of good heredity. Or of good environment. Our 711B Stereo FM Receiver has both going for it.

From concept to production line, it's shared the attention and concern of the same hands and minds that produced other fine Altec audio equipment. Equipment which has already made its mark in the world, in professional recording studios such as Paramount Pictures, ABC-TV, Disney Studios, and others. As well as in entertainment centers like the Los Angeles Music Center, Lincoln Center's Philharmonic Hall, Dallas Music Hall, the Houston Astrodome.

Matter of fact, Altec probably supplies more professional audio equipment for recording and broadcast studios, concert halls, stadiums and similar centers, than any other manufacturer in the field.

As a result, what's new to others is pretty old hat to us. Solid state, for example. We pioneered in the use of transistors for audio circuits over 10 years ago, developing special amplifiers that are used by telephone companies throughout the country, to give you better service.

With a background like this, it stands to reason the 711B would be something special. That it would have an FET front end and integrated circuits as a matter of course. (Fact is, there are two of them in the IF strip, each replacing 10 transistors for outstanding selectivity.) And the capture

ratio is an impressive 2.5 dB.

In the amplifier section, the 711B provides 100 watts of all-silicon transistor power with a frequency response of ± 1 dB, 15-25,000 Hz. Automatically resetting circuit breakers protect the components, and a built-in FM muting circuit provides noise-free tuning.

Obviously, the 711B has the latest of everything. We wouldn't consider anything less.

Take a look at it soon, at your Altec dealer's. And while you're there, ask for your copy of our new 24-page folder on stereo components and systems. Or write directly to us.

The 711B is yours for \$399.50. And if you want to hear it at its best, choose a pair of matching Altec speaker systems. That way, you'll all be in good company.



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AUDIO, ETC.

EDWARD TATNALL CANBY

The Mono Phase-Out

I AM FRANKLY DELIGHTED THAT our long-time stereo-mono duplication in discs is at last on the way out. It's time.

I always did suppose, of course, that the early stereo years would require a lot of duplication—assuming that stereo got a foothold. But it didn't seem likely that it could last very long.

How long did the 33-45-78 triplicate releases last? That phase was over in months. The stereo disc was already so compatible with mono in major respects, identical with the mono in the most outward aspects, that it seemed merely a matter of a short period during which we would adjust the stylus problem and add that "second channel" for stereo (as though it would allow you be something you hooked onto your old arrangement). But it wasn't this simple.

There were, after all, millions of mono cartridges in use in 1959 and more being made, whereas stereo cartridges dribbled out in handfuls and complete stereo systems, much advertised, were seldom heard "in the flesh." (Remember, the industry was taken by surprise in respect to stereo disc. It came sooner than anyone had expected.)

So, for a time, mono remained king. And as stereo progressed, slowly, it became entirely reasonable to hitch the two systems together in record production. Just as the stereo system itself featured two slightly different channels for one musical sound, so the mono-stereo releases became twins, two slightly different types of disc for each musical item in the catalogue. Logical, sensible, economical, absolutely necessary—for a time. *But for how long?*

Almost a full decade! Who would

have believed it. Of course we all know that, in our day, frequent changes to new systems tend to end up in compromise, both new and old finding a proper place in an even more complex technological world.

Thus, the 45 challenged the 33 and neither won outright; both continue to exist, in considerable harmony. Tape challenged disc; twin-track tape challenged full-track tape and both were challenged by four-track—and the whole shooting match is now challenged by cartridge-cassette, which in turn consists of a range of competing systems which are at this very moment sorting themselves out, with no 100 per cent victory yet in sight!

New techniques influence the stereo-mono balance. Transistors, for instance—what a difference they have made in the size, price, and convenience of stereo equipment! They have enormously favored stereo, for purely technical-economic reasons.

And what about stereo broadcasting? The need for stereo discs on the air is at last breaking down the biggest mono holdout against stereo disc, the 45 single. Have you listened to those absurd FM multiplex disc jockey broadcasts, disc after disc in "full stereo" and every single one of them mono? Some use for an expensive multiplexing installation, if you ask me! It can't last. We'll soon get stereo 45s, if only for DJs. (But also for the new simpler, cheaper, smaller kid-stuff portable record players, where millions of 45s end up.)

These are technological factors of change. There are big human factors interlocked, though, to muddy the picture. The old mono machines, for one. They refuse to vanish. They continue to require mono discs.

The public has it firmly in mind that there is only one choice. Either you play mono and buy mono discs, or you convert to stereo and buy stereo. If that is a gross oversimplification, it can't be helped. The idea has ruled our feelings these many years and still determines most people's course of action, or inaction.

And yet it *is* an oversimplification. That is why we are now at last taking the final steps to eliminate the mono disc forever. Look at some of the changing factors, which should be better known than they are, even if *we*, you and I, are familiar enough with them.

First, take the simplest factor of all—the stylus. From the beginnings of stereo we have dinned into the public

the warning that one must *never* play a stereo disc on a mono player. Ruins the record. Distorts, too.

But, as Gilbert & Sullivan put it—well, *hardly* ever. And that qualification has changed progressively straight through these many years. The plain, slippery fact is that though *some* mono cartridges are ruinous to the vertical groove contours of the stereo disc, others are less so and some are quite OK. The favorable percentage has steadily increased, more or less as the numbers of mono cartridges in use have decreased. It's a matter of vertical compliance, which can and does vary from cartridge to cartridge.

Even in the pre-stereo era there were some cartridges which, more or less by accident, had enough vertical compliance to accommodate a stereo disc (playing it mono) without serious wear and distortion. More important, as stereo began to spread and the significance of vertical compliance grew, the cartridge makers began to build it into all their cartridges. Why not? In most cases, it was no insurmountable problem, and became less so as the stereo configuration became standard.

The mono cartridge itself, compliant or otherwise, began to be phased out, even for mono machines. It became an economic drop-out, so to speak. Might as well build for stereo in the first place, except maybe in the very cheapest and most mass-produced cartridge lines.

So, you see, this vital element was constantly changing, from 1959 straight through, though the rules have remained officially the same. If all the older mono machines could have been eliminated, say, on January 1, 1965, we could forget incompatibility at this point. Virtually any phonograph pickup, if I am right, would now play a stereo disc with reasonable safety. (Miniature battery portables are not supposed to treat 45 discs with supreme elegance, in the manner of a super-hi-fi component installation.)

Planned obsolescence?

But two other big elements in the stereo-mono balance of forces have held things back. First, of course, the older mono machines. We talk a great deal of planned obsolescence, but in this case the equipment industry didn't plan well enough. The darned mono phonographs keep right on playing. They won't die.

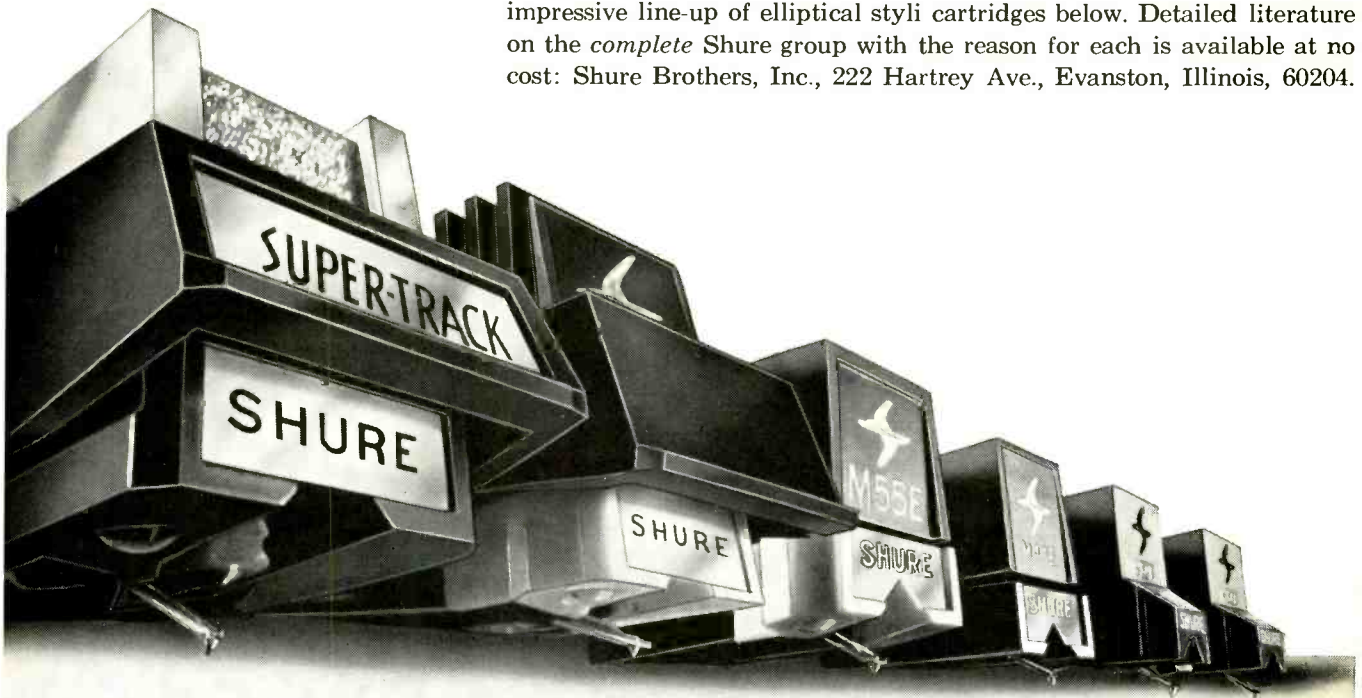
That means that the old true-mono machines, that is, those which really

Now...in every price range, every tracking force range

from \$67.50 to \$25.00...

from $\frac{3}{4}$ grams to 5 grams

With the introduction of our extremely low cost new M32E elliptical stylus cartridge (\$25.00 net, $2\frac{1}{2}$ to 5 gms. tracking, 20 to 17,500 Hz), and M31E elliptical stylus cartridge (\$27.50 net, 1 to 2 gms. tracking, 20 to 18,000 Hz), you can now get Shure quality in the broadest possible spectrum of prices and specifications. Given our "druthers", we would prefer you bought the Shure V-15 Type II Super Trackability cartridge at \$67.50. We feel it's the world's finest cartridge, and independent critics the world over agree with us. However, if your equipment or your exchequer dictates another cartridge, be assured that Shure makes a really complete line of best-in-their-price-class cartridges. Note for instance, the impressive line-up of elliptical styli cartridges below. Detailed literature on the *complete* Shure group with the reason for each is available at no cost: Shure Brothers, Inc., 222 Hartrey Ave., Evanston, Illinois, 60204.



V-15 TYPE II
\$67.50
 $\frac{3}{4}$ to $1\frac{1}{2}$ gms.

M75E
\$39.50
 $\frac{3}{4}$ to $1\frac{1}{2}$ gms.

M55E
\$35.50
 $\frac{3}{4}$ to $1\frac{1}{2}$ gms.

M44E
\$34.50
 $1\frac{1}{4}$ to 4 gms.

M31E
\$27.50
1 to 2 gms.

M32E
\$25.00
 $2\frac{1}{2}$ to 5 gms.

Letters from Readers

Toscanini booster

■ I must say Edward Canby's criticism of Toscanini's "Treasury of Historic Broadcasts" [AUDIO, July 1967] has made me rather indignant. The review had all the earmarks of possibly being a first-class analysis. But that possibility was stifled by Mr. Canby's self-conscious attempts at individualism and iconoclasm. After all, Toscanini's "... GOOD! But not *that* good!" That is a rather smug, journalistic phrase, and I'm sure many knowledgeable people will say he is that good. ... It is generally known that Studio 8-H had terrible acoustics. It is also accepted that Toscanini was under acute pressure from publicity and bureaucracy when preparing for broadcasts in later years. It is also accepted that the NBC symphony orchestra was not the world's finest. Inevitably, as even Mr. Canby admits, less than perfect workmanship was expected. And, of course, there *were* no retakes, as Mr. Canby also admits. So why such a big fuss over ensemble imperfections in these instances.

MAURICE C. BARONE
East Lansing, Mich.

E.T.C. calls 'em as he sees 'em. In this case, the "generally-known" obstacles were deemed too great for even Toscanini to overcome—Ed.

Hearing loss

■ In the September issue of AUDIO H. J. Van Valzah comments on the 4,000 cycle loss of hearing I experienced while listening to a test record. It was interesting to note that the doctor attributes this hearing loss to continued exposure to excessive noise, either from industry or high-fidelity reproduction. He further mentions that this loss is common among adult males in industry. I believe the good doctor has hit the nail on the head. My occupation is that of a foundry manager. Anyone familiar with the operation of a foundry knows that noise is our constant companion. With pneumatic hammers, chipping guns, etc., blasting away all day, one's hearing is bound to be affected.

The cause of my loss of hearing the 4,000 cycle tone was right under my nose, and I thank Dr. Van Valzah for pointing it out to me.

DAVID A. TAYLOR
Braintree, Mass.

Setting the record straight

■ Audio Original's Model 101D equipment cabinet was incorrectly shown under the name of Toujay and vice versa in your August Product Preview issue.

LEWIS J. KELLEY
Audio Originals
Indianapolis, Ind.



Audio Originals



Toujay

This is the way the equipment cabinets should have been labeled.—Ed.

■ On page 78 [AUDIO, August 1967] the Shure Model 585SAV illustration was mislabeled.

N. A. HESSLINK, JR.
Shure Brothers Incorporated
Evanston, Ill.

■ The Transtech amplifier's power bandwidth of 2 Hz to 60 kHz was published in error under frequency response in your August issue.

E. VALENTINE
Transtech
Wappingers Falls, N. Y.

■ There are some areas of confusion in listings of our products in the August issue. The Gotham SE-200 Professional

(continued on page 67)

could not play a stereo disc safely—had to be supplied with mono discs, year after year, and the demand has fallen off only gradually.

I have no figures, but I suspect that their collective death has been—for the industry—agonizingly slow. I know from intimate experience with neighbors, relatives, friends from all over, how persistent a good mono phonograph can be when it is given a modicum of care and/or is used sparingly, as is often the case. My next-door neighbors got their components around 1955. So naturally it requires mono records. I can't even lend these people records from my library because I don't have enough monos on hand.

Ignorance is bliss. First impressions are often *only* impressions—especially when they are unfortunate, unfavorable. Millions have yet to hear good stereo at all. Thousands have heard it that one fatal time (maybe around November of 1960?) and never again, thank you. Too much ping pong, perhaps. Too violent a sales pitch and plenty of distortion thrown in. (We were pretty crude in our stereo selling, back then.) Or oppositely, there was no audible difference at all—so why bother? People still do not realize that we must *learn* to hear (that is, appreciate) stereo.

Worse still, perhaps that one experience was via one of those notorious early "popular" stereo models, with the stereo speakers placed all of a foot apart. Or perhaps via ineffective "satellite" speakers? It didn't take much to slow down stereo, in the first days of the stereo disc!

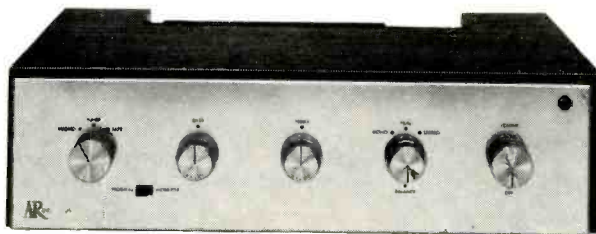
Call the repair man

Even today, when an elderly but playable mono phonograph system at last quits, when a resistor changes value, a capacitor fails, when a tube goes, the motor sticks, the changer gums up and won't change, when switches break down and amplifiers heat up, an astonishing number of people do *not* rush out and convert to stereo. Instead, they call the repair man.

If he can get a listenable squawk out of the old machine, at a reasonable cost, it usually stays. You salesmen for brand new stereo hi-fi may shake your fists in frustration, but it happens. And perhaps with a fairly sharp sense of values, too, on the part of the resistive non-buyer. From this conservative viewpoint, is the big changeover really worth it—yet? It is, of course. But many "holdouts" will wait until elimi-

(continued on page 79)

AR^{INC.} *amplifier*



Shown with optional oiled walnut wood cover.

Acoustic Research announces its first electronic product, *the AR amplifier*, an integrated stereo preamplifier/control and power amplifier, all silicon solid-state.

1. PERFORMANCE — The state of the art of electronic design has reached the point where it is possible to manufacture a nearly perfect amplifier. There are a few such now available. We believe the AR amplifier belongs in this select group.

2. PRICE — \$225, in black anodized aluminum case. Oiled walnut wood cover is \$15 extra and optional. The AR amplifier costs considerably less than the few amplifiers capable of similar performance. However, it should be judged by professional standards and on an absolute basis without consideration of price.

3. POWER OUTPUT* — Enough to drive with optimum results any high fidelity loudspeaker designed for use in the home.

4. GUARANTEE — Establishes a new standard for reliability and durability. The product guarantee for the AR amplifier is unmatched in the industry by any other electronic component regardless of price.



The AR amplifier is sold under a two year guarantee that includes all parts, labor, reimbursement of freight charges to and from the factory or nearest service station. Packaging is also free if necessary. Literature on other AR products — loudspeakers and turntables — will be sent on request.

*Power output, each channel, with both channels driven: 60 watts RMS, 4 ohms; 50 watts RMS, 8 ohms; 30 watts RMS, 16 ohms.

Distortion at any power output level up to and including full rated power; IM (60 & 7,000 Hz, 4:1), less than 0.25%; harmonic distortion, less than 0.5% from 20 Hz to 20 kHz. Distortion figures include phono preamplifier stages.

Frequency response: ± 1 db, 20 Hz to 20 kHz at indicated flat tone control settings, at full power or below.

Switched input circuits: magnetic phono; tuner; tape playback.

Outputs: Tape record; 4, 8 and 16-ohm speakers.

Damping factor: 8 to 20 for 4-ohm speakers; 16 to 40 for 8-ohm speakers; 32 to 80 for 16-ohm speakers. Lower figures apply at 20 Hz; higher figures apply from 75 Hz to 20 kHz. Measurements taken with AGC-3 speaker fuses in circuit.

ACOUSTIC RESEARCH, INC., 24 Thorndike Street, Cambridge, Massachusetts 02141

EDITOR'S REVIEW

FM's Pushing 40

That's not the number of years headlined here—it's the proportion of radios in the U.S. capable of receiving FM! The highest penetration FM has ever reached, 39.3 per cent of home radios in the U.S., speaks well for a medium that only accounted for a paltry 9.7 per cent of the U.S. market in 1961.

The introduction of FM multiplex in June, 1961 was no doubt responsible, in part, for the upsurge of FM. Indicative of the growth exhibited by FM, a recent survey made by RCA revealed that 588 FM radio stations are now authorized to broadcast stereo programs. The study disclosed that one or more FM stereo stations are located in 397 cities and towns. (California leads the states with 66 FM stereo stations.) That leaves $\frac{2}{3}$ or so of commercial FM stations without a FM stereo broadcast capability or broadcast authorization, so FM stereo is far from reaching a saturation point.

Speaking at the National Association of FM Broadcasters (NAB), Jack Wayman of the Electronic Industries Association (EIA) observed: "... a great influence in the return of radio has been the superior sound capabilities of FM and FM stereo transmission." He doffed his hat also to technology and styling. But he did not point out the influence of adult programming on FM as compared to AM. With a growing audience, FM is threatened with progressively poorer programming. In a way, it's fortunate that FM stations do not have the great broadcast range that AM stations have. It's insurance against the real big radio sponsors taking over completely; that is, pressuring broadcasters to lower program quality.

It was hoped that the FCC's separate programming ruling for owners of both AM and FM stations in cities with populations over 100,000 would maintain good, original fare. We hear, however, that it is not as effective as it should be. Some FM stations simply repeat AM programs 48 hours after they were

broadcast over the older medium. Even AM-only broadcasters are screaming "unfair competition."

Clearly, it isn't enough to have superior sound capability. FM must also maintain superior program quality over AM. In this way, it will continue to attract larger, high quality-oriented audiences.

Hip-Pocket Records

Philco-Ford announces a new concept in portable music—flexible, paper-thin, $3\frac{7}{8}$ -in. diameter, 45-rpm record discs. Designed for the "youth" market, the company expects to make available best-selling popular songs on its own label, Hip-Pocket Records. The 45-rpm HP discs have one selection on each side; suggested retail price is 69 cents. The company also plans to market a lightweight (one pound, three ounces), battery-powered radio-phono to accompany the discs, though the HP discs can be played on most single-play machines.

It is interesting to note that there are approximately 6000 new 45-rpm records issued each year, of which the top 100 records often equal total sales of the remaining ones. 70 per cent of 45-rpm record sales are made to pre-teens and teens. And 45-rpm record sales are estimated at about \$224,000,000 this year. So Philco-Ford has its sights on an interesting market. They evidently hope to capture youths who currently enjoy transistor radios as a personal ownership product. If the concept meets with any success, it may dissuade teeney-boppers from playing their "singles" on our hi-fi systems.

The Biggest Single Record Release in History

The Bible Voice Corp. of North Hollywood, California, has placed the entire Bible, unabridged on 51 12-inch LP records. That's 81 hours of playing time. The company had introduced the Bible on reel-to-reel and 8-track cartridges earlier, and won an award for having been the first single taped work to sell a total of 250,000 reels and cartridges. Looks like the Bible is a best seller in more than one medium.

'68 Hi-Fi Shows

Philadelphia and Detroit are scheduled to be hi-fi fun cities soon. Teresa Rogers will stage her second Philadelphia Hi-Fi Show at the Benjamin Franklin Hotel, February 16 through 18, and her first Detroit show, March 15 through 17.

A list of exhibitors at the forthcoming IHF-sponsored Los Angeles High Fidelity Music Show, November 2 through November 5, is published in this issue.

A.P.S.



The X factor in the new Pickering XV-15.

The X in the new Pickering XV-15 stands for the numerical solution for correct "Engineered Application." We call it the Dynamic Coupling Factor (DCF).sm

DCF is an index of maximum stylus performance when a cartridge is related to a particular type of playback equipment. This resultant number is derived from a Dimensional Analysis of all the parameters involved.

For an ordinary record changer, the DCF is 100. For a transcription quality tonearm the DCF is 400. Like other complex engineering problems, such as

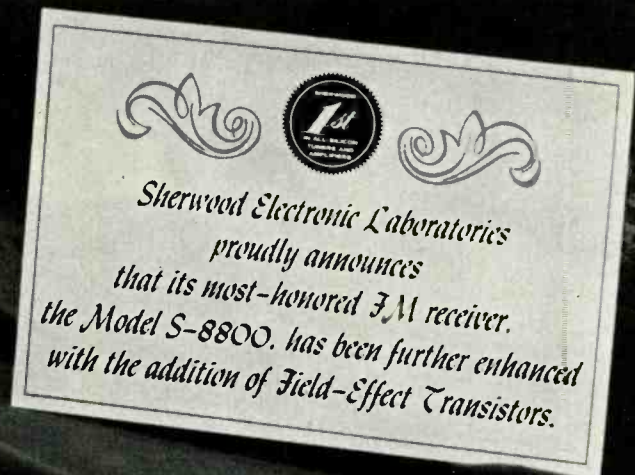
the egg, the end result can be presented quite simply. So can the superior performance of the XV-15 series. Its linear response assures 100% music power at all frequencies.

Lab measurements aside, this means all your favorite records, not just test records, will sound much cleaner and more open than ever before.

All five DCF-rated XV-15 models include the patented V-Guard stylus assembly and the Dustamatic brush.

For free literature, write to Pickering & Co., Plainview, L.I., N.Y.

Our most-honored receiver



Model S-8800 custom mounting \$369.50
Walnut leatherette case \$378.50
Hand-rubbed walnut cabinet \$397.50

The highly-rated Sherwood S-8800 now features Field Effect Transistors (FET's) in the RF and Mixer stages to prevent multiple responses when used with strong FM signals.

Among the Model S-8800's many useful features are two front-panel switches for independent or simultaneous operation of main and remote stereo speaker systems.

Visit your Sherwood dealer now for a demonstration of those features which make Sherwood's new Model S-8800-FET receiver so outstanding. With Sherwood, you also get the industry's longest warranty—3 years, including transistors.

Compare these Model S-8800 specs: 140 watts music power (4 ohms) • Distortion: 0.1% (under 10W.)
• FM sensitivity: 1.8 μ v (IHF) • Cross-modulation rejection: -95db • FM hum & noise -70db.

Sherwood
Sherwood Electronic Laboratories, Inc.,
4300 North California Avenue,
Chicago, Illinois 60618. Write Dept. 11A



Photo courtesy of David Beatty Hi-Fi and Stereo, Kansas City, Mo.

WALL-TO-WALL HI-FI—Mr. Gene Girten of Mission, Kansas has all his hi-fi equipment attractively ensconced in a wall cabinet. Equipment used includes: Thorens TD224 automatic turntable, Ortofon stereo cartridge with elliptical stylus, McIntosh MX110 tuner-preamp, eight J.B.L. speakers (including D130 woofers), and two J.B.L. crossover networks. Speakers are hidden behind grille doors, as can be seen here.



SOUND AND DECOR STYLES

JERRY JOSEPH

CAN WE RECONCILE OWNERSHIP of a fine quality stereo hi-fi component system with good looking and comfortable home interiors? Yes, and possession of a Fine Arts degree is not a prerequisite to accomplish this. All that's needed is a little imagination and some good taste.

Not too many years ago an audio buff was relegated to some far-off corner of the house, surrounded by his Gargantua-size audio gear. The

hi-fi enthusiast went on enjoying his solitude and sound. But a good thing doesn't stay private too long. The sweet sound emanating from that area reached other ears. Equipment became smaller, more sophisticated, better looking; the stepchild was beginning to receive recognition. In some homes components were being invited into living rooms!

Now that components began to emerge from dark corners, an un-



Photo courtesy of David Beatty Hi-Fi and Stereo, Kansas City, Mo.

THE CABINET WAY TO HI-FI—Another Kansan, Mr. Ernie Eichman, had his hi-fi rig installed in a J.B.L. floor-standing "Delphi". It holds a Miracord 10H automatic turntable, Marantz FM Tuner 10B, McIntosh MC240 power amplifier, Ampex 2070 and 4450 tape recorders. J.B.L. S-7 speaker systems are built into wall cabinets; two Maximus speakers are used for extension speaker applications.

HI-FI IN THE BEDROOM—One of the rooms designed for the IHF decor display on view at New York's National Design Center is called, appropriately, The Bedroom. A combination tuner-turntable module and a tape deck are within easy reach in bookcase storage niches on either side of the bed. Wall covering of soft felt increases reverberation time as well as serving as a headboard for the bed.

Mr. Walter Berry, Manager of the AR, Inc. Music Room in New York City, designed and built the audio setup shown here. Equipment includes: the ARXA manual turntable and tonearm, a Shure M-55E stereo cartridge, Dyna FM-3 tuner, Dyna PAS3X preamplifier, Dyna Stereo 35 power amplifier (located behind the bed), two AR4X speaker systems, and Koss "Stereophones."



HI-FI LOUNGE CHAIR—Called a "Stereo Lounge," the highly-styled lounge chair pictured here has sealed horn baffles hidden behind the fabric on either side. Each column terminates at a speaker. Separate controls are installed to control volume of each channel and to blend sound to modify stereo separation. The electrical input is connected to a jack located in the base of the chair. The Chair, produced by Harman-Kardon, is said to provide the listener with an extremely comfortable personal surrounding, partially isolated from the conventional room environment. Retail price is \$995, which includes the lounge and the upholstered ottoman. (Price excludes the compact music system shown here.)



AUDIO INVITES YOU

TO SEND IN PHOTOS AND
DETAILS ON YOUR HI-FI
SYSTEM. PAYMENT WILL
BE MADE FOR ALL
PUBLISHED MATERIAL.

Readers are welcome to submit decor problems to AUDIO for review of designs and cabinet layouts. Please enclose a stamped, self-addressed envelope.

happy realism became very obvious—our little electronic friends were still unfit to associate with satin and laces. Something had to be done. And something was.

Today, cabinets engineered for proper sound reproduction are available in contemporary, modern, traditional and provincial styles. There is little need to compromise with style if budget requirements are not too restrictive. It is not unusual to

spend as much for a fine piece of audio furniture as an average-price hi-fi outfit may cost.

Audio furniture can now be had in many sizes for different requirements. Home interiors, type of equipment, and minimum sound requirements are among the factors considered when choosing the proper piece of audio furniture. Wall-hanging units are popular, for example. Moderate in price, these units are

flexible, allowing an infinite variety of wall layouts. They're especially suitable for those hard-to-place bookshelf type speakers and in homes where floor space is at a premium.

Architectural wall units represent the acme in luxury decor for hi-fi. Naturally, they're among the most expensive type of audio furniture. They are available as built-ins or pre-assembled. The latter are more



WALL SHELVES SAVE FLOOR SPACE—

Mr. Dale Huston, Compton, Calif., uses a pole-type book and desk unit (discovered by him in Sears Roebuck & Company) to house his stereo hi-fi equipment. Equipment shown here includes the following: Garrard A-70 automatic turntable with Empire 880P stereo cartridge, Empire 398 Troubador manual turntable and 980 tone arm, plus a Shure M-55E stereo cartridge, Ampex 4450 4-track tape deck, Fisher X-202B 80-Watt stereo amplifier, and a Fisher R-200 AM-FM stereo tuner. The records and recorded tapes seen here are part of a 400+ LP record and 70 reels of magnetic tape (40 recorded, 30 off-the-air and "live") collection. In addition, a bevy of other components and accessories not seen here round out our hi-fier's system, including Koss PRO-4A stereo headphones, Parastat record cleaner, head demagnetizer, head cleaner, and "Q" tips, among others.

New Rochelle, N. Y. resident, William Verno, overcomes a space problem with shelves mounted on brackets which are attached to the wall. His hi-fi equipment and records are located on the shelves, while two floor speakers are placed underneath the shelves. Equipment includes: Rek-O-Kut R-34 manual turntable with Shure M-44 stereo cartridge, McIntosh MR71 stereo FM tuner, MA230 amplifier, and M13 performance indicator, Wharfedale 70 speaker systems, and a CDR rotor which operates a Finco antenna. A Rotron "Whisper Fan" cools tubed electronic equipment.



suitable to apartment-type dwelling, where the possibility of moving to another location in the future is likely. Aside from the dramatic quality of these units, the hi-fi listener can enjoy the advantage of unusual storage space. These wall units can house (and usually do) multiple turntable and tape decks, space for hundreds of tapes, records and many other accessories.

For the do-it-yourself fan there is

available an interesting and well-designed group of good-looking cabinets in kit form. Modest in cost, construction requires little skill. A screwdriver and a few hours of spare time each evening over the period of a week is all that's needed. The style of these cabinets leans more to the modern and contemporary rather than to traditional and provincial styles. Kits are usually restricted to an oil finish. Also on the market are

the K.D. units. This abbreviation (K.D.) is used by furniture manufacturers to denote pre-finished furniture that requires user assembly. This usually takes less than an hour's time. Once again, the use of a screwdriver is all that is needed. K.D.'s are usually low in cost.

Shown here are some ways in which audio gear can be integrated into the home. Æ

VIKING MEANS EXTRA VALUE IN HI-FI STEREO TAPE RECORDERS

Now, for the first time, you can enjoy the superior reproduction, the quality engineering of a full fidelity tape recorder with three-speed, three-motor drive and solid state electronics at surprisingly modest costs. New VIKING 423 and 433 recorders are exciting additions to your stereo system — exciting both inside and out. Unequaled for operating convenience, impeccably styled, expertly engineered, these new VIKINGS are ideal for both audiophiles and serious recordists.

VIKING 433 Three speed, quarter-track stereo recorder with three separate hyperbolic tape heads, solid state record and playback electronics. Equipped with stereo headphone jack for monitoring; monitor gain controls for each channel. Eight-position function selector illuminates color-coded indicator windows. Three drive motors; mixing controls (for sound-on-sound editing), echo

switch, push-button counter, automatic shut-off, pause control, foolproof tape motion and record switch interlock. Optional remote pause control and walnut base . . . **under \$370.00**

VIKING 423 A solid, sensible, no-gimmicks unit with three speed, three motor drive and modern solid state electronics at an amazingly low price. Quarter track stereo; operates in vertical/horizontal position; built-in pause control; hyperbolic tape heads; push-button counter; directional control levers interlocked for foolproof operation; illuminated record meter, optional remote pause control and walnut base . . . **under \$250.00**

VIKING 433



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Convert Your Audio Analyzer to Stereo

WILLIAM B. FRASER

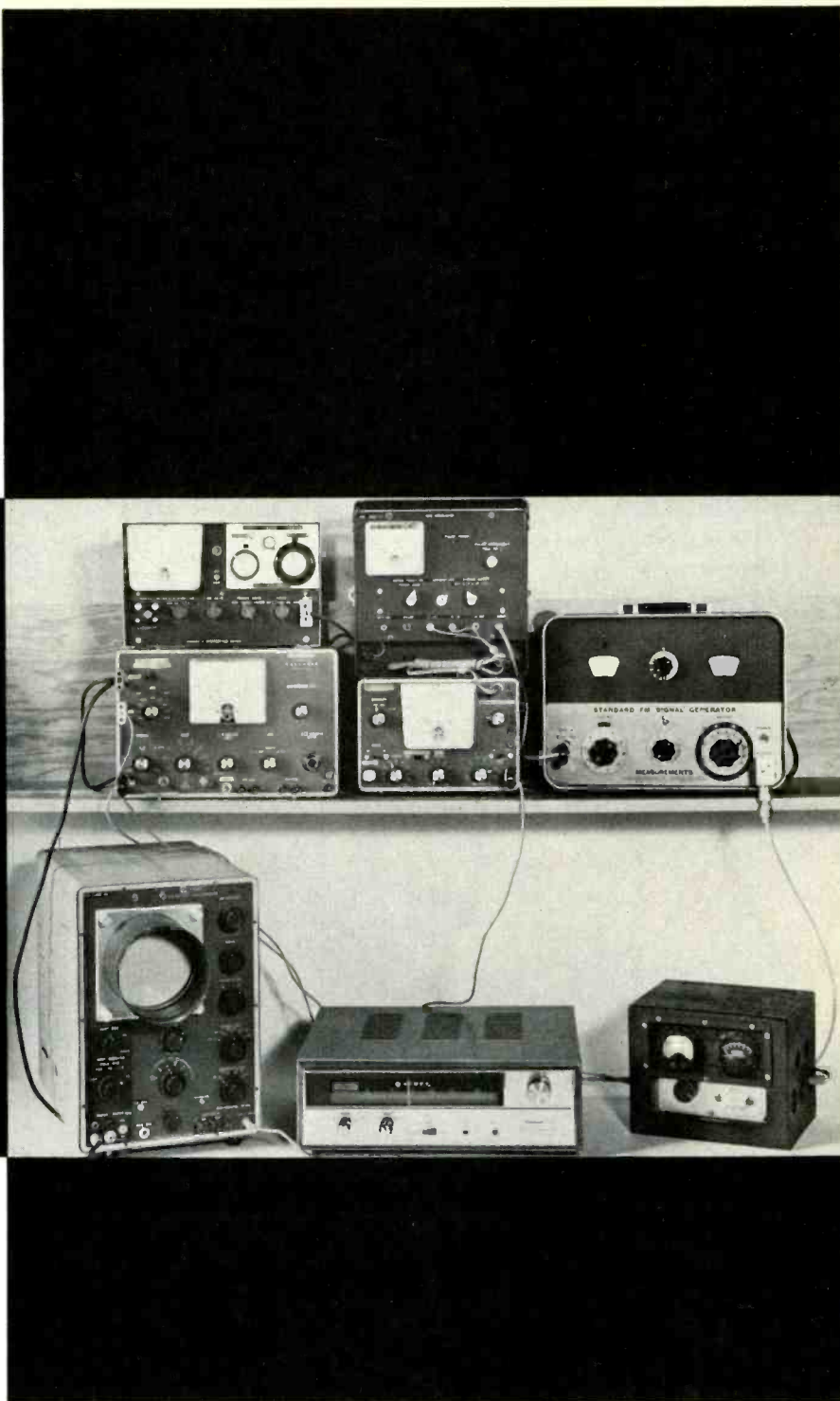


Fig. 1—Test setup with a variety of test equipment shows Heathkit audio analyzer (directly above oscilloscope) modified for stereo, as described in this article.

THE HEATHKIT IM-22 AUDIO ANALYZER and its electrically-identical predecessor, the AA-1 have been in production for several years, and are no doubt in the hands of many audio enthusiasts and professionals.

The instrument, which consists of four separate devices in a single cabinet (a.c. VTVM, a.c. Wattmeter, intermodulation distortion analyzer, and a set of four load re-

sistors), has a convenient switching arrangement to permit the devices to be used individually or in conjunction with each other. However, there is one noticeable inconvenience: it can accept a signal from only one channel at a time. Consequently, when stereo equipment is tested, there is considerable connecting and disconnecting of signal cables, as well as the need to pro-

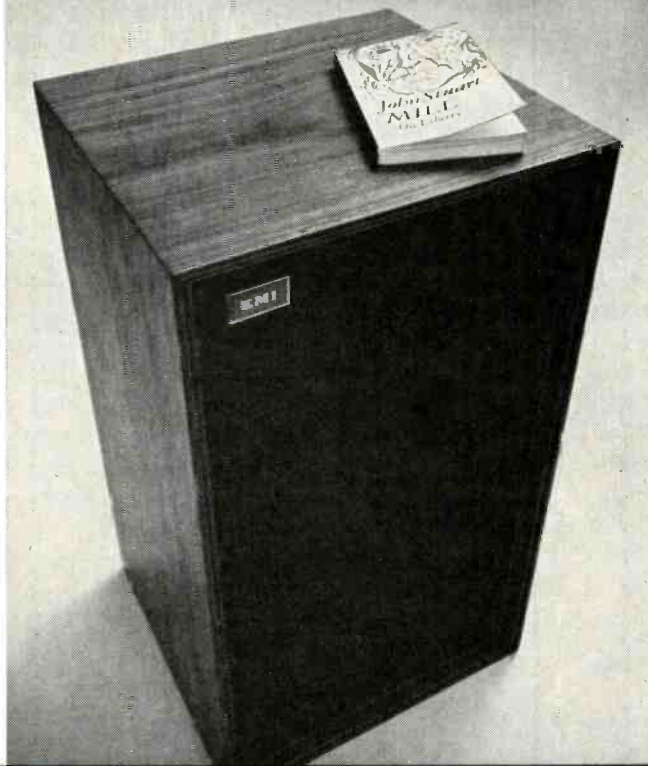
vide an additional load for an unused channel when power amplifiers or receivers are tested.

A relatively simple modification, costing about \$10 in parts, makes it possible to effect measurements of stereo gear without the noted inconveniences.

Four parts of the IM-22 will be modified. First, the front panel must be drilled to accept a toggle switch

Liberator.

New EMI DLS 629
the speaker that
frees your amplifier
to do a better job



Some of today's most popular speakers are of low-efficiency design. This simply means they take more power from your amplifier to produce the same level of sound in your living-room.

That's the problem. These speakers may sound fine, but what about your 20-watt-per-channel amplifier, forced to hover around its maximum output every time you listen to *Night on Bald Mountain*? It's generating far more distortion than it would if it had to put out only about 5 watts for the loudest sounds, which would also give you a 6-dB margin for peaks before the amplifier overloads.

So that's why we say the new EMI DLS 629 is "the speaker that frees your amplifier to do a better job." Among all its other virtues, it's also a more efficient transducer than most. It converts electrical power from your amplifier into sound power with less waste. Your amplifier doesn't need to work as hard, no matter how little or how much power it has.

If you're acquainted with our model 529 (the well-regarded "dangerous" loudspeaker) you'll be pleased to know that the EMI 629 has an 8-ohm nominal impedance instead of the 529's 4 ohms. This makes it especially desirable for use with modern, solid-state amplifiers.

In addition, we fitted the 629 woofer with a larger voice coil, increased the gap, and doubled the size of

the magnet — greatly increasing power-handling capacity. But we retained the unique elliptical woofer construction, with its rigid aluminum center cone and molded PVC (polyvinyl chloride) edge suspension, which contribute so much to the low frequency performance of EMI speakers.

Two damped 3½-inch cone tweeters provide smooth highs to the limits of audibility. A 3-position brilliance switch lets you tailor the response to the acoustics of your listening room. The crossover network is an inductance/capacitance type with 12-dB-per-octave slope. Tweeter and woofer have been electrically and acoustically matched to provide smooth integrated performance over the entire sound spectrum.

All this adds up to an efficient system that offers presence unmatched by any speaker in its price class. Sound is free, natural; does not have the constricted effect that some low-efficiency speakers exhibit in the mid-range. The handsome oil finish walnut cabinet 24½h x 13½w x 12¼d, has braced ¾-inch walls. All of this for \$164.50.

Visit your hi fi dealer and hear the new 629 and other fine EMI speaker systems starting at \$79.50. Ask for the "volume-control" test, it will prove our point about high-efficiency speakers. For brochure, write: Benjamin Electronic Sound, Farmingdale, New York 11735.

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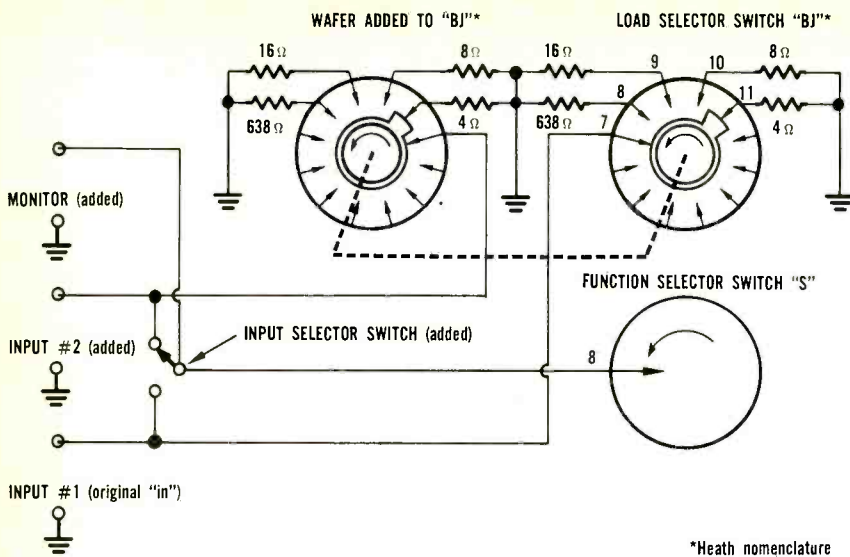


Fig. 2—Partial schematic of analyzer shows modifications required to convert tester for stereo use.

and two sets of jacks (total of five holes). Second, a heat sink and an additional set of four load resistors must be installed. Third, a wafer will be added to the LOAD SELECTOR SWITCH. Fourth, the electrical portions of the equipment will be revised as shown in Fig. 2. (Note that the schematic of the IM-22 in Fig. 2 shows only those portions which are necessary to the modifications.)

Front panel modifications

Unsolder all wires attached to the LOAD SELECTOR SWITCH. Leave attached to the switch the four precision resistors mounted directly on the switch wafer. Remove the switch from the panel and set aside. Unbolt the heat sink from the chassis and set aside. Now, drill a hole for the toggle switch (in Fig. 2, the toggle switch is called the INPUT SELECTOR SWITCH). The hole for the switch should be midway between the FUNCTION and RANGE switches, and approximately level with the pilot lamp.

Now locate the "In" binding posts at the left lower portion of the panel. This set of binding posts is redesignated "Input #1." The four holes necessary to accommodate "Input #2" and "Monitor" will be located in line vertically above Input #1. As in the case of Input #1, the pairs of binding posts of Input #2 and Mon-

itor should be spaced $\frac{3}{4}$ " center to center. Input #2 and Monitor center lines are respectively 4" and $6\frac{1}{4}$ " above Input #1 centerline. Install the two sets of jacks, insulating them from the chassis and fitting each with a solder lug. Install an additional solder lug on the black binding post of Input #1 for future use.

Heat sink and load resistors

All eight 24-Watt load resistors will now be mounted on a single heat sink. Included are the four original and four new resistors. The original resistors should be removed from the original heat sink and all wires disconnected from them. The new sink is cut $5\frac{1}{2}$ -in. high and 6-in. wide from $\frac{3}{16}$ -in. aluminum. Lighter material may be used, but is not recommended.

Bolt the heat sink to the flange at the left side of the chassis, using four evenly-spaced 8-32 bolts. The exact location of these bolts is not critical, but be sure to select positions which do not interfere with other parts of the instrument. Mount the sink with the $5\frac{1}{2}$ -in. dimension vertical, the rear flush with the rear of the chassis, and the top $\frac{3}{8}$ -in. below the top of the front panel. This placement insures that the sink does not interfere mechanically with other parts. The location of the eight 24-W resistors can best be decided after the sink has been bolted into position (temporarily). Mount the resistors in two horizontal rows near the top of the sink. Keep the resistors as far apart from each other as

PARTS LIST

1	4-ohm, 24-W non-inductive load resistor	Heath 3X-1
1	8-ohm, 24-W non-inductive load resistor	Heath 3X-2
1	16-ohm, 24-W non-inductive load resistor	Heath 3X-3
1	638-ohm, 24-W non-inductive load resistor	Heath 3X-4
2	binding-post cap, black	Heath 100-M16B
2	binding-post cap, red	Heath 100-M16R
4	#6 shoulder fiber washer	Heath 253-2
4	#6 flat fiber washer	Heath 253-1
4	#6 solder lugs	Heath 259-1
4	binding-post base	Heath 427-2
4	#6 nuts	—
1	switch index assembly	Centralab PA-300
1	switch wafer section, 11-position, shorting	Centralab PA-30
1	toggle switch, SPDT	—
1	heat sink (see text)	—
4	$\frac{8}{32}$ binder head bolts (length depends on heat-sink thickness)	—
4	$\frac{8}{32}$ nuts	—
4	#8 lock washers	—
4	$\frac{10}{32}$ flat head bolts (length depends on heat-sink thickness)	—
4	$\frac{10}{32}$ nuts	—
4	#10 lock washers	—
4	#10 steel washers	Heath 253-19



Our new low-noise tape...is all surprises!

From surprisingly soft to surprisingly loud—new Ampex 404 Series low-noise tape can capture more audio reality than low-noise tapes of the past.

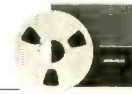
Its new small-particle oxide meets or surpasses the most demanding low-noise specifications. Holds inherent tape noise ("hiss") far below the level of your most delicate musical passage. Yet from this same quiet tape comes *greater high frequency response* and *broader undistorted dynamic range*—qualities previously sacrificed in

low-noise tapes. So the silence has more silence. The flute sounds sweeter. *And* the cymbals crash louder, without distortion — on Ampex 404 Series low-noise tape.

Buy the full range of Ampex professional tapes for extra quality: New Ampex 404 Series low-noise tapes for mastering and duplicating. 600 Series for general purpose professional recording. 681 Series lubricated tapes for endless loop cartridges. 291 Series tapes for a/v. Plus others. Send the coupon for up-to-date information.

To: Ampex Corporation, Room 7-14A,
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- Send me literature on the full line of Ampex professional tapes, including new 404 Series low-noise tape, for
- Professional
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NAME _____

ORGANIZATION _____

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Career opportunities? Write Box D, Redwood City, Calif. 94064





Fig. 3—Modified audio analyzer compared to original, “mono” audio analyzer. Note additional outputs and switches.

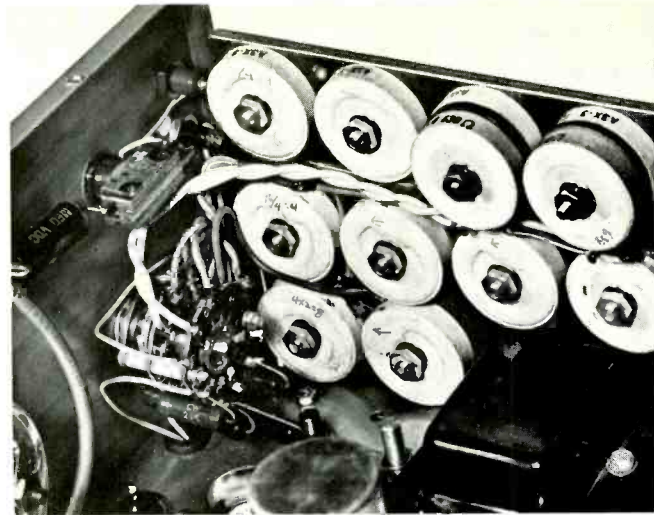


Fig. 4—Interior view of analyzer illustrates modified load selector switch. Additional load resistors are seen.

possible, consistent with space available. After locations have been selected, remove the sink and drill eight mounting holes the same diameter as the holes in the original sink. Mount the resistors on the sink in the same manner as was used with the original heat sink.

To improve the transfer of heat from the sink to the ambient air, it is highly desirable, though not absolutely essential, to cut a rectangular section from that portion of the cabinet which is immediately adjacent to the heat sink. This opening should be slightly smaller in its dimensions than those of the heat sink to protect inner portions of the instrument from outside objects. Mount the heat sink on the chassis but do not wire any connections at this time.

Modification of the Load Selector Switch

Examine this switch, which was previously removed from the front panel. Note that it consists of a single wafer with two separate sections, one section on the front of the wafer and the other on the rear. The front section is the one which connects to the four 24-W original load resistors, while the rear section is associated with the four precision resistors. The switch will be modified by adding the eleven-position wafer (see parts list).

Unfortunately, two problems arise. First, the indexing mechanism

of the original switch is too short to accommodate an added wafer, hence a new and longer mechanism must be procured (see parts list). Second, the wafer of the original switch is riveted to the indexing mechanism, rather than being bolted. Since the original wafer will continue in use as part of the new switch, the rivet head must be filed off to permit removal of the wafer. This operation is the most delicate of the entire modification program. The wafer is a special design; if it is broken, a whole new switch must be ordered. We have never broken a wafer in the several instruments we have modified, so the job *can* be done.

After the wafer has been removed, assemble the new eleven-position wafer at the front of the indexing mechanism and the old wafer about 1/2-in. behind it. Align the switch blade of the new wafer with the switch blade of the front section of the old wafer. Be sure that when the switch is in the fully counterclockwise position (see Fig. 1) the blade of the front section of the original wafer is in contact with the 4-Ohm lug. Re-install the LOAD SELECTOR SWITCH and replace the knob.

Wiring

Use the added solder lug of the grounded jack of Input #1 as the common ground for all added wiring. The only point that might present a problem is that outlined on

page 18 of the Assembly Manual, 6th step from the bottom, which instructs that a bare wire is to be connected from the red jack of Input #1 to lug 8 of the Function Switch. This wire is omitted, but lug 8 continues to be attached to lug 11. Substitute for the omitted wire a wire that connects the rotor of the INPUT SELECTOR SWITCH to lug 8 of the FUNCTION SWITCH.

Uses of the IM-22, as modified

Now the audio analyzer has two inputs instead of one. When mono equipment is tested, either input may be used, with the INPUT SELECTOR SWITCH placed in the appropriate position. When stereo equipment is tested, attach one channel to Input #1 and the other channel to Input #2. An oscilloscope should always be attached to the MONITOR jacks to detect false interpretation of meter readings. Note that when the INPUT SELECTOR SWITCH is in the “down” position, the meter and oscilloscope indications apply solely to Input #1. Similarly, with the handle in the “up” position, the meter and oscilloscope indications pertain to Input #2.

It is easy to feed identical signals to both channels of the equipment under test, then compare the outputs of the channels for balance, distortion, frequency response, etc., simply by flicking the INPUT SE-

(Continued on page 74)

Audiomation® has just made your stereo set obsolete.

Our condolences.

Only Seeburg has Audiomation—great new pet of the stereo set.

But don't despair.

Now you can have it, too. In component form. The heart of Audiomation—replacing your old-fashioned changer-turntable setup—is in the Seeburg Stereo Home Music Center Component. It includes the exclusive elements that make Audiomation work: Our computer-like Memory Bank, and our exclusive Vertical-Play mechanism-magazine. Both the Memory Bank and the Pickering cartridge in the mechanism are covered by a 5-year warranty.

You place up to 50 LP albums in the magazine. Dial any one (or more) you want to hear, and the mechanism plays them for you. One or 100 album sides—up to 40 hours of continuous music—and with optional equipment by remote control from any room in the house. You never have to touch a record again, or get up from your chair! Audiomation heightens your listening pleasure by relieving you of all your record-handling chores. And it plays and stores your records vertically—for best reproduction, least wear.

Audiomation is the most revolutionary development in stereo since stereo. Ask for a demonstration. At better hi-fi dealers now.

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ABZ's of FM

LEONARD FELDMAN

Secondary FM specifications

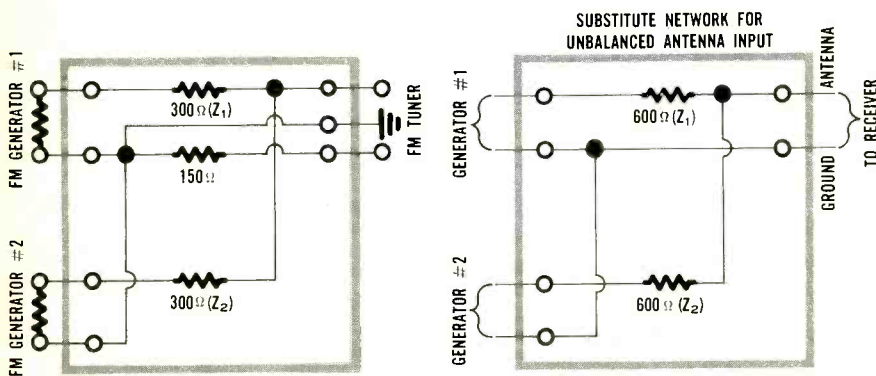


Fig. 1—Test set-up for performing capture ratio and selectivity tests. Impedances 1 and 2 (Z_1 and Z_2) are the internal (source) impedances of the respective generators.

LAST MONTH PRIMARY FM SPECIFICATIONS were examined. According to the Institute of High Fidelity's standard (IHFM-T-100), these are the absolute minimum specs required to describe an FM tuner's performance. The serious-minded FM devotee will, of course, want to know much more about the FM performance of his tuner or receiver. Thus, the so-called "Secondary" specifications listed last month should be of equal interest. These include the following: (1) Capture Ratio, (2) Selectivity, (3) Spurious Responses, (4) IM Distortion, (5) Audio Hum, (6) AM Suppression.

Capture ratio

The capture ratio test is designed to show the effect of an interfering signal that has the same frequency as the desired signal. You may recall that the least usable sensitivity was defined as the number of microvolts input to a receiver or tuner required to produce an output (under

conditions of 100% modulation) 30 dB greater than any residual noise or distortion. This figure of 30 dB is a significant one. It will be used again in the capture-ratio test, for it is considered to be the least difference between "wanted" and "unwanted" components of a signal which make that signal minimally acceptable. In the case of the "capture ratio" test, however, we are interested in knowing how much more powerful our *desired* signal must be, compared to the interfering signal at the same frequency, to produce 30 dB of attenuation of the interfering signal.

The test set-up is shown in Fig. 1. Note that *two* accurately calibrated FM signal generators are required, but that only one need be capable of being modulated in an FM manner. Thus, a laboratory having an FM generator and an accurate AM generator (whose frequencies extend to 100 MHz and above) calibrated in microvolts output could perform the test as well.

To maintain a proper 300-ohm matching impedance between the two generators and a balanced 300-ohm input of a typical receiver, the resistive network shown in the diagram is required. Due to the attenuation introduced by this network, however, all microvolt readings as shown on the generators should be divided by two, since only one-half the number of microvolts is actually reaching the receiver under test.

To obtain rated capture ratio, a 1000-microvolt, 100% - modulated (400-Hz) signal is applied to the receiver from the generator capable of being frequency modulated. The audio output voltage from the detector is noted. Next, the second generator is brought into play, and its microvolts are increased until the audio output voltage from the receiver is reduced by just 1 dB.

As an example, suppose it takes 1200 microvolts to accomplish this. Record this number. Then increase the microvolts output from the second, unmodulated generator until the audio output falls another 29 dB, or a total of 30 dB. Record this number of microvolts, which we'll assume is 2400 microvolts. The capture ratio is the ratio of these two readings, in decibels, divided by two. Thus, in our illustration, $2400/1200 = 2/1 = 6$ dB; 6 dB/ $2 = 3$ dB. The rated capture ratio would be stated as 3 dB and gives the ratio of desired to undesired signal necessary to suppress the undesired signal by 30 dB.

The test is usually repeated at test frequencies of 90, 98 and 106 MHz, and the worst figure (highest number of decibels) is the published rated capture ratio.

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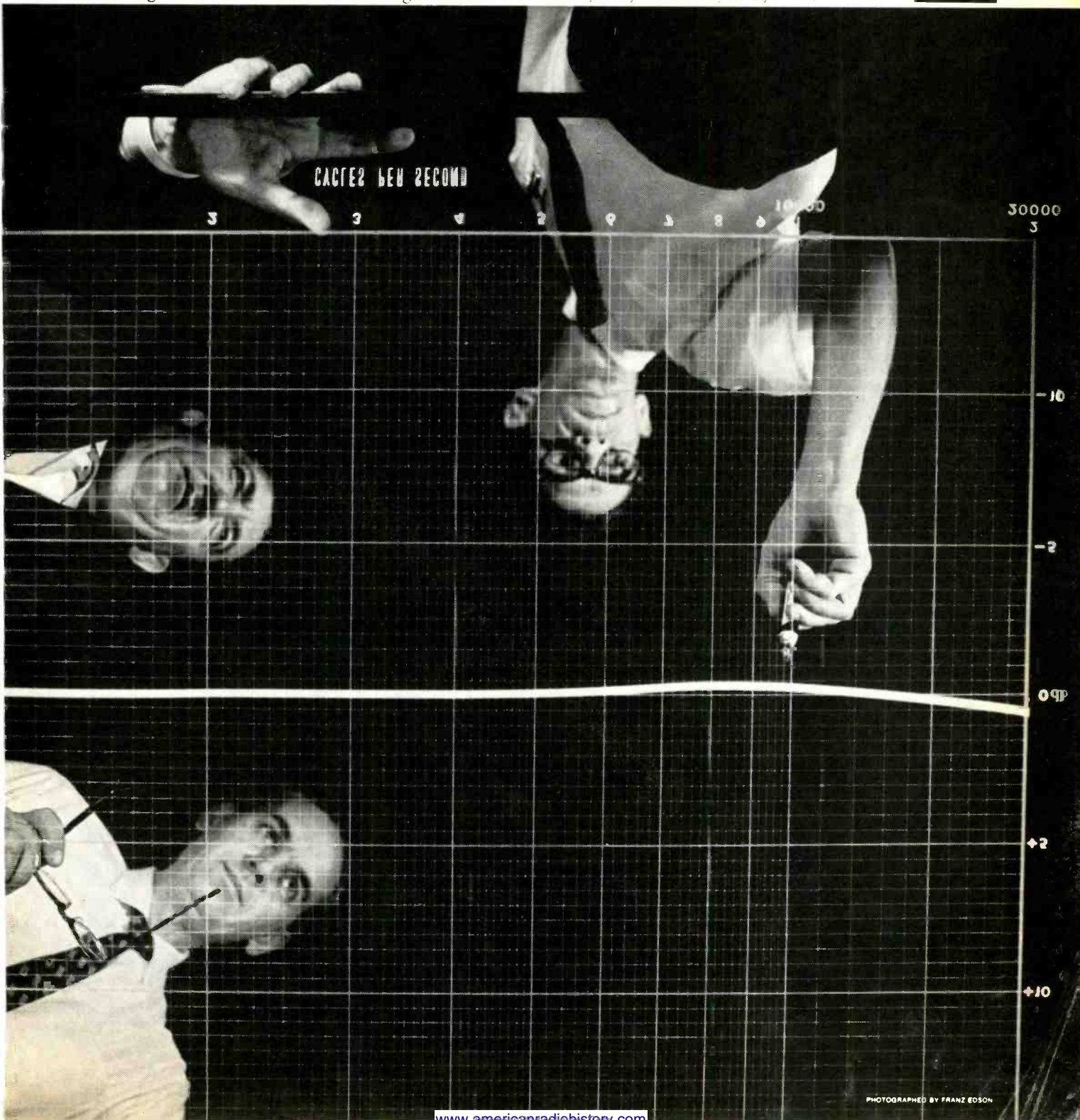
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PHOTOGRAPHED BY FRANZ EDSON

In the event that the receiver under test has a 300-ohm unbalanced (or grounded) input, the resistive network required between the two generators and the receiver under test is also shown in Fig. 1. Generator readings are still divided by two in this case.

Selectivity

The tests categorized under this heading concern determining the ability of a receiver to reject an unwanted signal from an adjacent station while accepting the desired station.

While the tests may be conducted using frequencies 200 kHz apart (one channel), a more realistic approach is to separate the desired and undesired frequencies by 400 kHz (two channels). This is so because the FCC does not assign station frequencies 200 kHz apart to any two stations in a given geographical location.

The test set-up for determining rated selectivity is exactly the same as that used for capture ratio tests, but the procedure is different. First, the "interfering" FM generator is now the one which can be frequency modulated, and it is tuned away from the "desired" signal generator and the receiver setting by 400 kHz. The unmodulated generator is cranked up to a microvolt value of 100 microvolts. The "de-tuned" (by 400 kHz) generator is modulated 100%, and its output is increased until an output from the receiver is obtained which is 30 dB below the output that would be obtained were it tuned to the frequency of the receiver.

As an example, suppose "normal" full audio output from the detector is 1 volt, under conditions of 100% modulation. The detuned generator's output would be increased until an output of .03 volts (30 dB below 1 volt) is noted at the detector output of the receiver under test. Suppose, further, that the detuned generator's output had to be advanced to 10,000 microvolts before this minute interfering signal was noted. The ratio of the two generator outputs, expressed in decibels, would be: $10,000/100 = 40$ dB. The "rated" selectivity would therefore be published by the manufacturer of the receiver as "40 dB."

To translate this back to more meaningful terms, this means that a station 400 kHz removed from our desired station, would have to be received by our antenna with a signal strength 100 times more powerful than the desired station to cause an interference signal 30 dB lower than the listened-to signal. Such situations arise frequently, of course, as there are very distant and local stations in any given area. The higher the selectivity (in decibels) the greater the difference in signal strength required before a strong station will interfere with our sometimes-desired weaker station.

Since "decibel" notations are logarithmic, an increase in selectivity of just another 10 dB (in the example cited) to, say, 50 dB selectivity, would mean that the interfering station would have to be received at a signal strength of 100,000 microvolts (much less likely) to cause perceptible interference with our puny 100 microvolt "desired" signal!

Spurious responses

Virtually all FM tuners or receivers are of the superheterodyne type. That is, they involve the use of a local oscillator which "beats" with the incoming signal to produce a lower, intermediate frequency (i.f.), generally 10.7 MHz. While many spurious responses (output from the receiver even though it is tuned to some frequency other than the generator frequency) are possible, two particularly significant spurious responses are usually measured first. These are "Image Response" and "IF Response."

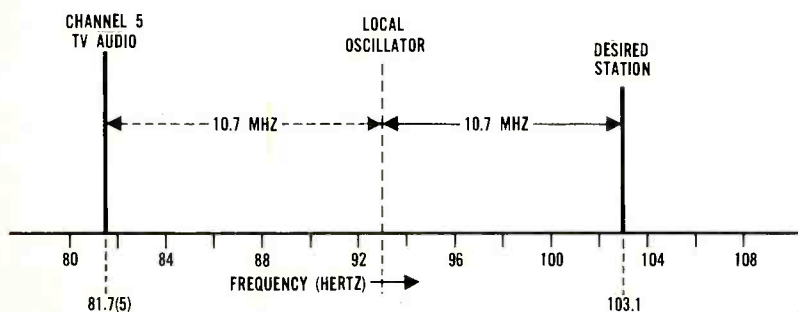
Image response may best be understood by examining Fig. 2. In this illustration, the desired station, located at 103.1 MHz, is selected by means of the tuning knob on the receiver. Assume, for the moment, that the local oscillator of this receiver is set 10.7 MHz below the tuned frequency, at 92.4 MHz. Incoming frequencies will, of course, beat with the local oscillator whether they are above it in frequency (like our desired station at 103.1) or below it! Now, it so happens that exactly 10.7 MHz *below* our local oscillator is 81.7 MHz. This is outside the FM band, but right smack in the middle of the sound channel of TV Channel 5.

All right, you say, design the local oscillator so that it is 10.7 MHz *above* the desired frequency. Most receivers do just that, but that throws the image frequency at a point anywhere from 109.4 MHz to 129.4 MHz, right in the range of aircraft navigation frequencies.

The other predominant spurious response is at the intermediate frequency itself (usually 10.7 MHz). There is much broadcasting taking place at a primary frequency of around 10 MHz. As a result, these direct signals may well by-pass the r.f. and converter sections of a receiver and be amplified directly by the 10.7-MHz stages. Finally, a given receiver may be responsive to all sorts of harmonics, sub-harmonics, and other frequencies mathematically related to the one being tuned in.

In evaluating a receiver in terms

Fig. 2—An image frequency below the local oscillator can beat with the local oscillator to produce a 10.7 MHz i.f. output. R.f. tuned stages prevent this output from being as great as the desired 10.7 MHz beat signal caused by desired station 103.1 MHz.



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of spurious responses, each of the possible interfering frequencies is selected on a signal generator and the sensitivity is measured as in the "least usable sensitivity" test described last month, with one exception: with no modulation applied, the tuner output is adjusted to the same output obtained in the usable sensitivity test with modulation removed. The ratio of generator output for the spurious response and the generator output required for the usual 30-dB usable sensitivity is calculated and expressed in decibels.

Distortion

Harmonic distortion measurements taken with a single modulating frequency (just as in audio circuit evaluation) are of limited usefulness at frequencies above about 1000 Hz. The reason for this is best understood by examining Fig. 3, the de-emphasis characteristic (or frequency response) of FM receivers and tuners.

If we were to attempt to measure the harmonic distortion of a 2000-Hz modulating signal, any 4-kHz and 8-kHz harmonics present in the output would be further attenuated by 4 dB and 9 dB respectively because of the normally decreasing

response of the tuner, giving rise to totally erroneous readings. Of course, under actual broadcast conditions, these higher frequencies are pre-emphasized, so that the overall response of the system (from transmitter to loudspeaker) is flat.

Accordingly, the rated harmonic distortion of an FM tuner or receiver is determined by modulating the signal generator at 400 Hz only, at 75 kHz deviation (100%). The generator is adjusted to provide a 1000-microvolt r.f. input signal to the set under test, so that noise is no longer a significant factor in the measurement.

Intermodulation distortion testing is best for describing deficiencies of the set at higher modulating frequencies. Unlike the equivalent test applied to audio equipment, the two input modulating frequencies required are only 400 Hz apart—15,000 Hz and 14,600 Hz. Furthermore, both modulating signals are equal in amplitude, and together modulate the signal generator to 100% deviation. The generator output is set to 1000 microvolts once more and the resultant 400 Hz produced by the non-linearity of the circuits is measured at the output of the receiver's detector. This measurement is expressed as a percentage of

the 400-Hz output that would be obtained if the generator were modulated with 400 Hz at full deviation.

Audio hum

As would be expected, this measurement is similar to its counterpart in audio work. The total output of the tuner is measured with the tuner tuned to a 1000-microvolt signal at 98 MHz (the generator is not modulated). The results are expressed as the number of decibels below 100% modulation, at the same signal strength. Needless to say, the r.f. generator should itself be free of any hum modulation of its r.f. oscillator, or this will show up as hum in the output of the receiver.

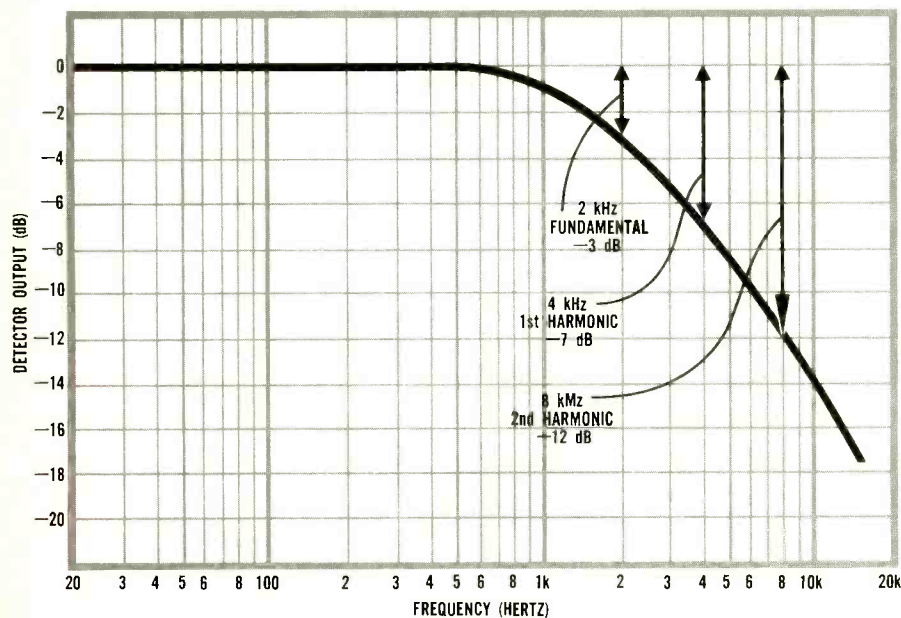
AM suppression

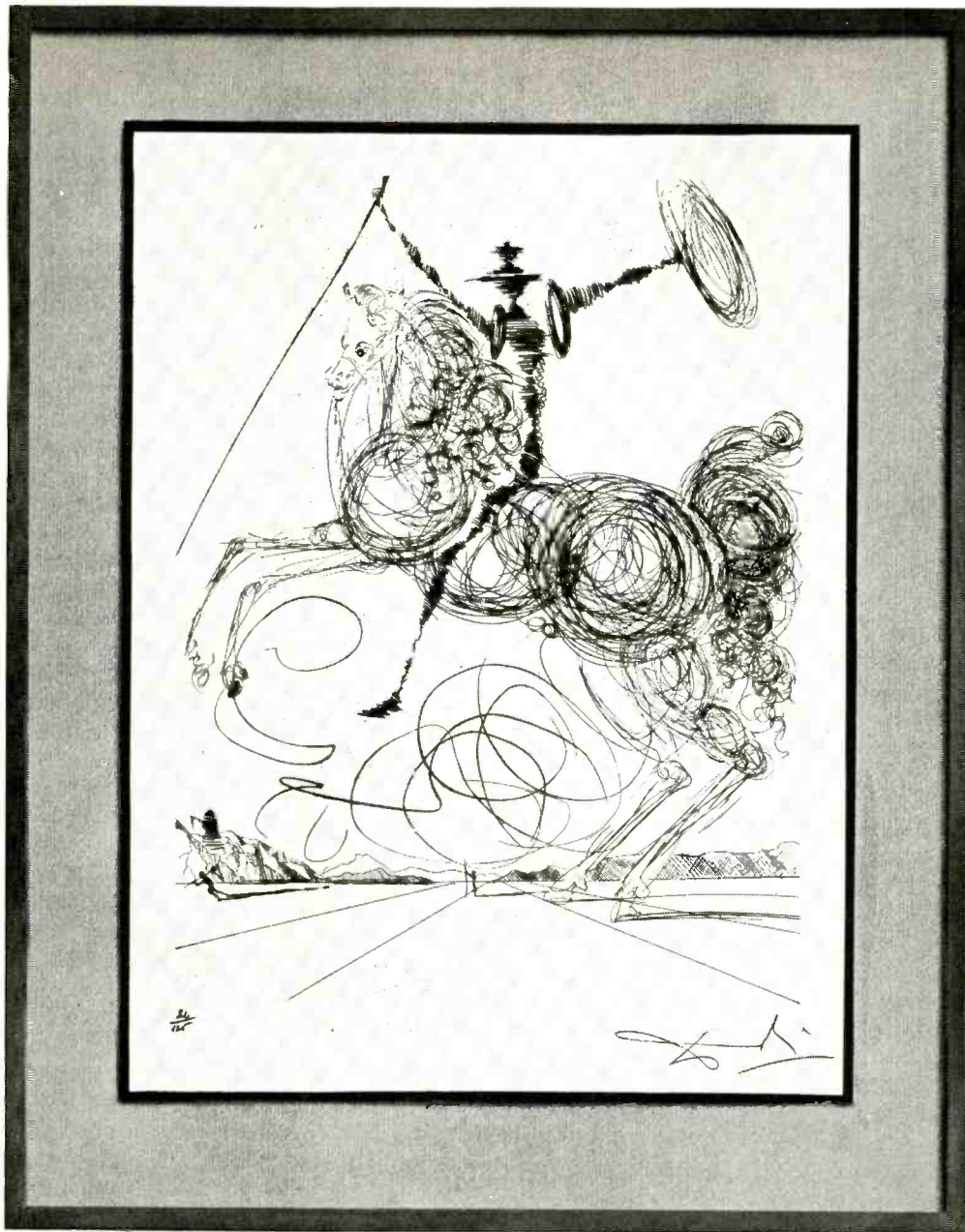
Obviously, the better an FM system is able to reject AM, the more noise-free it will be, insofar as man-made and natural static are concerned. To measure rated amplitude suppression, an AM generator capable of reproducing frequencies at 98 MHz is required. A signal 10 dB higher than the "least usable sensitivity" signal is applied to the set under test, with 100% frequency modulation at 400 Hz. The output voltage is recorded. Next, a 400-Hz null filter is inserted between the output of the tuner and the meter, and the generator is amplitude modulated to 30% (amplitude modulation) at 1000 Hz. The undesired output obtained is expressed in decibels below the FM output obtained above.

Future standards

As you can see, tests of monophonic FM tuners and receivers have been well defined and, in general, carefully observed and standardized by the reputable manufacturers of FM tuners and receivers. Naturally, in the course of an actual primary design, there are many more tests and evaluations that are made at an engineering level. Still, the specifications described thus far are nearly ten years old, and were promulgated long before Stereo FM came upon the scene.

Fig. 3—Due to the de-emphasis characteristic of an FM tuner, harmonic distortion products change in relative proportions, leading to meaningless total harmonic distortion (THD) figures for frequencies above 1 kHz.





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The Skating-Force Phenomenon

JAMES H. KOGEN*

PART 2. The author sums up the effects of skating force on the overall performance of the phonograph system.

Our conclusion, after reviewing the results of all of these measurements, is that the frictional force is essentially constant as a function of groove radius, but that it does change as a function of a number of other factors. These factors could, in turn, change with record radius although not necessarily in a consistent fashion. Such factors might include material hardness, surface roughness—possibly as a function of additives, groove shape, warpage, and dishing of the record. Whatever the cause, significant differences in measurements were noted from record to record and at various radii on the records.

In passing, we should mention that little difference was noted between measurements on circular versus spiral grooves, or between the spirals from the inside out versus the outside in. From a theoretical standpoint, the inward movement of the tone arm as the record is played, should introduce a constant frictional drag related to the viscous damping in the tone arm bearing system. The low velocity of the arm as it moves toward the center of the record, coupled with low viscous damping in the arm, should result in negligible drag in a good system.

A brief comment should also be made on measurements on wet surfaces. These measurements were made pretty much from the standpoint of curiosity, but did show

some interesting results. Frictional force was reduced substantially when the surface was wet. Measurements seemed to be much more uniform under this condition.

Overhang. The installation of the arm is very critical in determining the amount of skating force one would obtain for a given tracking force. All of the above curves, Figs. 6-9, are based on an optimum overhang for the 12-in. Shure SME 3009 arm of 0.6-in.

Fig. 10 gives the variation in skating force as a function of overhang for a given tracking force. This curve shows that if the arm is installed with an improper overhang, the calibrations on the arm for skating-force compensation will be incorrect. For any separate tone arm, great care should be taken in the initial installation. Even with record changers, one must be careful in installing the cartridge to make certain that the overhang is accurate.

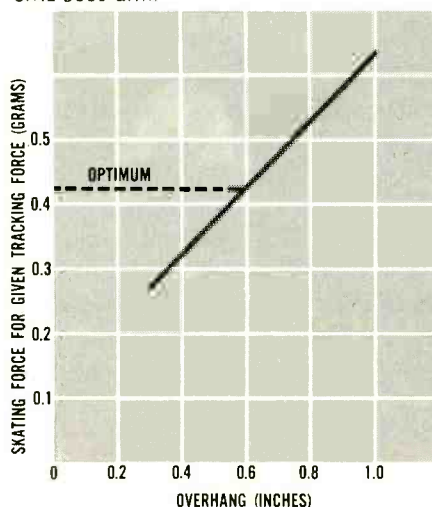
Effect of Dirt. It was noted throughout this study that the measurements were very seriously af-

ected by any accumulation of dirt on the stylus tip and on the record. All of the above measurements refer to a situation in which both the record and tip were kept clean. This requires washing or use of an effective record cleaning device such as the *Manual Parastat*. In spite of the great care which was observed, some of the variability in the results was probably caused by small accumulations of dirt on the record surface. To eliminate this variation, future measurements might be made using records cleaned after the fashion described by Percy Wilson.⁸

Skating-Force Affects Trackability. In addition to making actual measurements of skating force, it is of considerable value from a functional standpoint to determine how skating force is related to the ability of the needle to track the record modulation. Fig. 11 is an example of trackability for a medium-quality cartridge, at minimum rated tracking force, with and without compensation. The upper curve shows the trackability (maximum modulation velocity the cartridge can track as a function of frequency) with proper skating-force compensation. The bottom curve shows a repetition of the test, but without skating-force compensation. In this test, the bias compensation improved trackability in the order of 20 to 25% in the frequency range shown.

It has been suggested that one method of overcoming the skating force is simply to increase the tracking force. In order to check this, the same test was run without skating-force compensation, but with an in-

Fig. 10—Change in skating-force compensation as a function of overhang of the SME 3009 arm.



⁸ "Record Contamination: Causes & Cure," P. Wilson, *Journal of the Audio Engineering Society*, April, 1965, Pp. 166-180.

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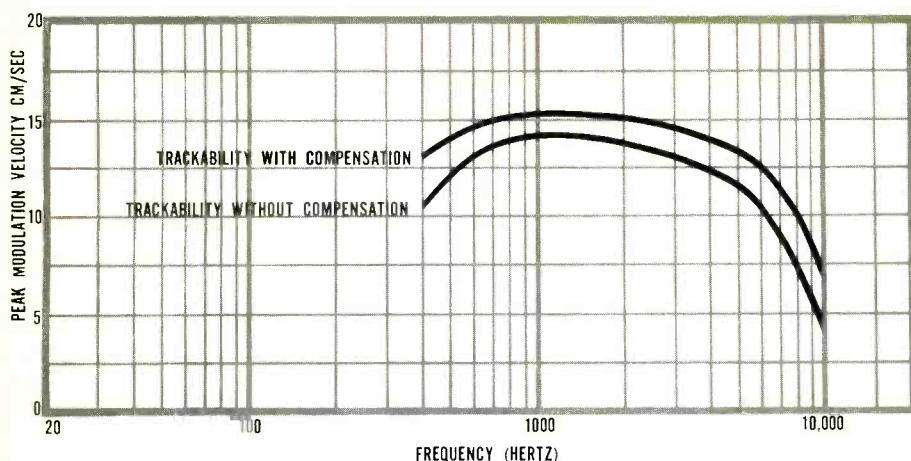


Fig. 11—Trackability with and without skating-force compensation.

creased tracking force to achieve the same trackability as shown in the upper curve. It was found that the tracking force had to be increased from 1 gram to at least 1½ grams to provide equivalent trackability over the complete frequency spectrum.

Life Tests

Another factor under consideration is that of the effect of tip wear with and without skating force compensation. To evaluate wear, life tests without skating-force compensation were run on 14 cartridges for several hundred hours each. Such a test must be run with a reasonable number of units because of probable variations in the diamond tips and the records being used for the test. Fig. 12 is a photograph of an unsymmetrically worn tip after the life test without skating force compensation.

Results of these life tests showed that 9 of the 14 tips wore appreciably faster on the side towards the inner groove where the force would be larger because of the addition of skating force. On four of the units the wear was equal and on one unit the side towards the outer groove wore first. While this is not conclusive evidence, statistically speaking, the indication is that the skating force has an effect on tip wear.

A second test was performed with anti-skating compensation. Of six units, all showed equal wear on both sides of the tip.

These life tests indicate that from the standpoint of wear, compensation by means of a horizontal bias force is preferable to increasing the tracking force. The horizontal bias



Fig. 12—Spherical tip after life test without skating-force compensation.

compensation equalizes the tip wear and optimizes tracking conditions, whereas increased tracking force increases the wear in order to obtain equivalent trackability.

Conclusion

The objective of these studies has been to make measurements which will aid in providing a better understanding of the skating-force phenomena. Although a considerable effort has been expended in developing the data shown here, it is our feeling that a great deal more work will be needed to develop a complete

understanding of the physical situation.

One variable which must be studied in greater detail is the variation among vinyl and acetate record materials. Within the realm of a given record material, there are several variables, including: additives, the molding temperature and cycle, impurities, and the age of the record. It would be very valuable if one or more parameters of the material could be determined which might be standardized in measurements of the type described here. We have noted several anomalies in the measured data which apparently relate to the record material. This point is important because a repetition of the tests reported here, with some change in the record material, could produce somewhat different results.

In several of the referenced papers (1, 2, 3, 4, & 5), tests were made using spherical tips on flat vinyl surfaces. If the tip is truly spherical there should be a direct relationship to similar measurements in blank grooves. One should not, however, expect such a direct relationship with elliptical tips. Ellipticals are not specified in such a way as to completely define the shape and curvature of the bottom surface. Any attempt to relate measurements of elliptical tips on blank discs to measurement in grooves can, therefore, be very misleading. For accurate adjustment we recommend that the user follow instructions given by the tone arm manufacturer.

These tests indicate that a gross compensation of skating force can be achieved by using a constant bias force directed horizontally. The residual, unbalanced forces which result from changes in modulation velocity, groove radius and groove velocity, will contribute second-order effects which should not have a major influence on factors such as trackability and tip wear. The compensation must be made for a specific tip at a given tracking force and for a particular record material. *Æ*

(The writer wishes to express appreciation to C. R. Anderson, B. Jakobs, and R. Young of Shure Brothers, Inc., for their work in developing the test apparatus, making measurements, and analyzing the test data.)

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The New NAB Magnetic Tape Standards

PART 5

HERMAN BURSTEIN

MAGNETIC TAPE MEASUREMENTS AND SIGNAL-TO-NOISE SPECIFICATIONS

MR. MCKNIGHT OF AMPEX COMMENTS THAT when the NAB Standard Test Tape appears (reel-to-reel samples are presently being evaluated), its "reference level will probably be either the same as the Ampex Operating Level or else 2 dB lower than that level." Therefore the person now using the Ampex test tape for reference obtains S/N measurement that, as events will decide, is the same as or 2 dB higher than the measurement obtained by using an NAB Test Tape.

Assuming the NAB Test Tape is available, the new procedure for measuring S/N raises several questions.

1. Under the old NAB procedure, a signal is recorded on the tape, and tape output is measured in playback; the tape is again put through the recording process but with no signal input, and tape output is measured again. This procedure takes the erase capability of the tape machine into account; un erased signal is measured as noise. Under the new NAB procedure for measuring S/N, erasing capability is not taken into account. Nor does any other section of the new standard refer to erasing capability. (Mr. McKnight observes that "... erasing capability is a function of the recorded wavelength, and also the bias current used in the original recording, the tape type, etc. Therefore a single-frequency measurement of erasure is

of doubtful value. I know of no satisfactory standard procedure for evaluating erasure, though it is possible that one could be written." He notes, too, that professionals ordinarily use a bulk eraser.)

2. In measuring noise of a tape "recorded with bias but with no signal," the NAB standard does not specify what kind of tape should be used. Presumably, one should be using "conventional" 1½-mil tape. But if not, significant differences in measured noise may occur, depending upon the oxide thickness and formulation. The NAB standard partly recognizes this problem by stating: S/N measurements are "figures of merit for comparisons of systems noise." That is, they are intended not to indicate absolute S/N performance but to enable one tape system to be compared with another in the matter of S/N. On the other hand, it is possible that *relative* differences among tape machines may vary according to tape used. For example, measured S/N may be the same for Machines A and B when conventional tape is used, but may be 2 dB better for Machine A, which has quieter electronics, when low-noise tape is used.

3. The NAB standard does not state how much bias should be used in making the S/N measurement. Presumably, one would be using the bias normally provided by the manufacturer or user of the machine.

4. Some machines are underbiased in order to achieve extended treble response at speeds below 15 ips. But underbiasing increases distortion and decreases the recorded level. This is tantamount to reduction of the machine's S/N capability. Yet such a reduction is not reflected in the NAB standard for measuring S/N, inasmuch as the standard does not require the machine to record an audio signal. However, *in another part of the standard*, the machine is required to achieve a certain level of performance with respect to distortion, so that a machine manufacturer cannot cheat excessively by underbiasing.

"The over-all record reproduce system total harmonic distortion . . . shall be less than 3% rms for a 400-Hz sine-wave signal recorded to achieve a reproduce level 6 dB above the NAB Standard Reference Level."

But is this requirement enough? First, the NAB Primary Reference Tape does not reach 3% harmonic distortion until a level 8 dB above the NAB Standard Reference Level, while the machine under test is permitted to (almost) reach 3% distortion at a level about 2 dB lower. Second, the NAB standard does not specify the kind of tape to be used in measuring distortion; high-output tape enables a tape machine to reduce distortion at a given output level. All in all, if a machine is un-

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derbiased to achieve extremely wide treble response, and if "conventional" tape is used to measure S/N, and if the manufacturer therefore cannot meet the distortion standard, he can still claim a high S/N ratio on the basis of the 1965 NAB standard.

5. The NAB standard makes no statement as to the setting of the gain control when recording a tape with bias but no audio signal. But an advanced setting of the recording gain control may affect recorded noise for several reasons: Noise produced by the amplifier stages prior to the gain control may be recorded at a significant level. Noise in these stages may bring out modulation noise (tape irregularities which become manifest as noise in the presence of an audio signal). Bias signal may leak into the record amplifier, be amplified, and reach the record head out of phase with bias fed directly to the head, causing a distorted bias wave-form that results in noise. The highest S/N will ordinarily be obtained with recording gain at minimum. In the absence of an NAB provision as to gain setting, a manufacturer is apparently entitled to measure S/N of his tape machine with gain at zero when recording a tape with bias but no signal. However, does this provide the user with the best information? It might be more instructive if the standard were to specify a recording-

gain-control setting in terms of an input level, say $\frac{1}{2}$ volt, that produces an output level equal to the NAB Standard Reference Level; this $\frac{1}{2}$ -volt signal would be fed into the tape machine's high-level input.

Recognizing that any standard method of measuring S/N will have problems and will not be utterly foolproof against those seeking to elevate the S/N claim for a particular tape machine, nevertheless a procedure along the following lines (similar to the German DIN procedure) has more appeal to me:

The NAB Test Tape might contain a blank section of tape, preferably on a separate reel, to be used for measuring S/N. The procedure would be: Record a 400-Hz tone at 3% harmonic distortion and measure output in playback. Put the recorded tape through the record process again but this time with no input signal and the recording gain control at a designated setting: $\frac{1}{2}$ volt at 400 Hz into the high-level input jack should produce an output equal to that of the Standard Reference Level on the NAB Test Tape. Measure output of the "re-recorded" tape, and obtain the ratio between the first and second measurements. Because all persons making the S/N measurement would be using the same tape, this should go a long way in providing the desired common denominator.

In relation to the above, Mr. Mc-

Knight remarks: "The DIN (German) Standards do exactly as you suggest: their Test Tape contains a 'Reference Medium,' used for testing recorders and as a reference for tape tests. In Germany there are (as I understand it) only two major tape manufacturers, and they supply the 'Test Tapes'; one making the 'professional' ones (high speeds), the other the 'home' ones (low speeds). On the other hand, there are many tape manufacturers in the USA, and no one is willing to have somebody else's tape be the 'Reference Medium.' There is both a real technical problem of quality and control of properties, and the obvious political problems involved with the prestige of being the manufacturer of the 'Reference Medium.' This whole business also reflects the sad lack of blank-tape standards in the USA—there is no published standard in the USA which tells one whether one tape can be interchanged with another in respect to required biasing current, recording sensitivity, noise, wavelength response, etc. Such a standard does exist in Germany."

The NAB Standard Test Tape might also contain a "Playback Reference" tone—400 Hz recorded at 3% harmonic distortion—serving two purposes: (a) It could serve for measuring *playback* S/N, the ratio between measured output of this tone and measured noise when the machine is in the playback mode but with the tape stopped. (b) It could provide a helpful indication of the output that NAB can achieve at 3% harmonic distortion with a "normally biased" tape machine; however, the tone would not actually be used for measuring S/N.

John McKnight has some alternate views on the above: "The idea is good, but I don't agree with the method. If a magnetic tape recording 'Reference Level' were established as suggested above, one could easily measure the 'reproducing head and amplifier electrical noise,' referred to this magnetic flux level. (One may also have magnetic-field induced noise, and mechanical noise: these are somewhat more variable and more difficult to measure, but could

If you ever see a red Cadillac with Pennsylvania license plate, AUD-10, whisking around town, you may be sure that a white-bearded gentleman is behind the wheel—C. G. McProud, **Audio's** publisher.



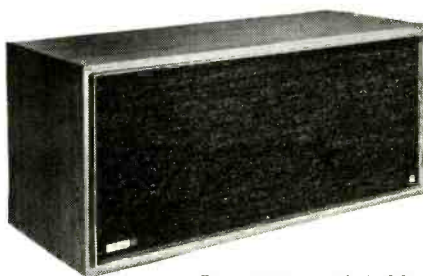
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The Ditton 15 and Ditton 10 — a revelation in 'compacts'!



The Ditton 15 (21 x 9½ x 9¼ in)

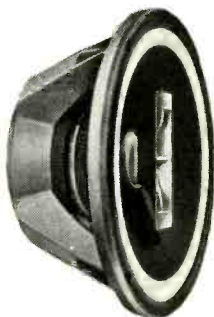
The latest product of Celestion research—a three element, 30 watt peak, full range compact loudspeaker enclosure. This system incorporates a new Celestion design concept—the ABR (auxiliary bass radiator) giving outstanding distortion-free bass down to 30 c/s. In addition there is a long throw 8" loudspeaker plus the HF1300 Mk.2 high frequency unit. Impedance: 4 ohms. Finish: Satin walnut or oiled teak.

The Ditton 10 (12¾ x 6¾ x 8¼ in)

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probably be specified under certain conditions). Also, with such a 'Reference Level,' tape manufacturers and/or recorder/reproducer manufacturers could—if they would—show a specification for the flux level at which a certain amount of distortion is expected. Such data is given in the sales literature for German blank tape."

Signal-to-noise specifications

When measuring noise on an unweighted basis in accordance with the NAB procedure previously described (using the Standard Reference Level on the NAB Test Tape, and using a measuring system with a specified type of meter and response declining in a specified manner above 15,000 Hz), NAB specifies minimum S/N ratios for the following tape speeds and track formats:

Tape Speed	Full-Track	2-Track	4-Track
15 ips	50 dB	45 db	—
7½	50	45	45 dB
3¾	46	46	45

The NAB standard also provides for measuring noise on a weighted basis "to give a more useful indication of the subjective signal-to-noise ratio than the unweighted measurement." The weighting consists of a great deal of bass cut and a moderate amount of treble cut [Fig. 1], which includes a suggested weighting network. This frequency response is intended to be "similar to that of the ear at low volume levels."

The weighting network [such as the one in Fig. 1] is inserted in the system employed to measure noise output level. Because the network produces some attenuation at all frequencies, it is necessary to increase the gain of the playback system to avoid understating noise and therefore overstating S/N. This increase in playback gain is made on the basis of a special 1,000 Hz tone on the NAB Standard Test Tape, recorded at a level producing output equal to the 400 Hz Standard Reference Level. After output of the 1,000 Hz tone is measured without the weighting network, playback gain is adjusted so that this tone produces the same measured output with the weighting network inserted. On a weighted basis, the NAB standard specifies minimum S/N ratios as follows:

Tape Speed	Full-Track	2-Track	4-Track
15 ips	58 dB	53 dB	—
7½	60	55	52 dB
3¾	57	54	52

At 15 ips, full-track, the new NAB standard specifies 50 dB unweighted S/N, based on a 400 Hz reference level 8 dB below 3% harmonic distortion (on the NAB Primary Reference Tape). This translates into 58 dB S/N based on 3% harmonic distortion. In contrast, the 1953 NAB specification was 55 dB S/N, based on a recording level that produces 2% distortion at 400 Hz. Inasmuch as the difference between the recording levels that produce 2% and 3% harmonic distortion is about 3 dB, the 1953 specification also translates

into about 58 dB S/N based on 3% harmonic distortion.

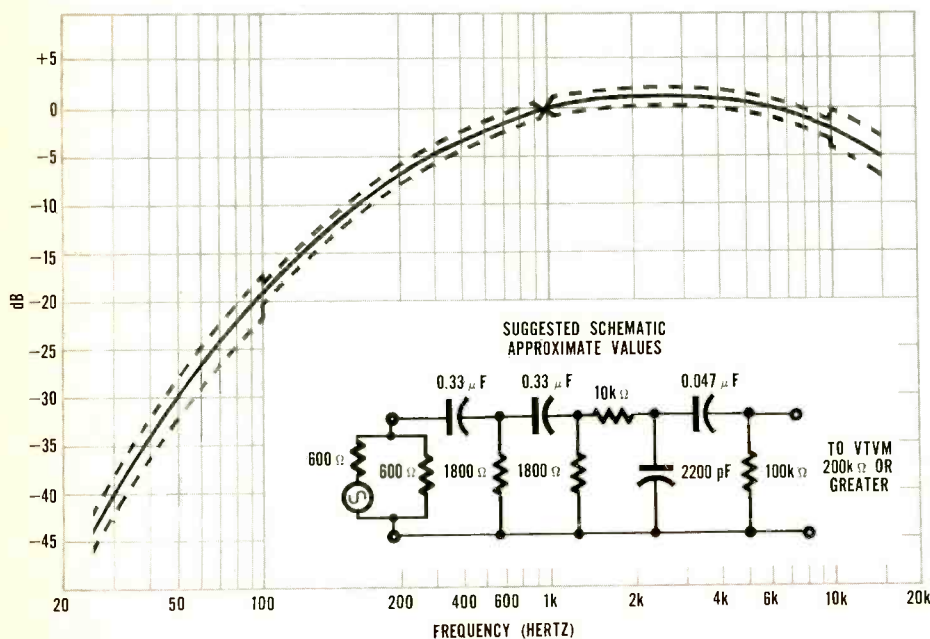
Thus the new standard *seemingly* reflects no advance in the state of the art with respect to S/N. However, we know that frequency response, noise, and distortion are inter-related so that a possible improvement in one or two respects can be foregone in order to achieve an improvement in another respect. With S/N and distortion specifications held at about the 1953 level, the 1965 NAB standard represents an improvement confined out of choice to frequency response. (More specifically, slightly better frequency response is now specified at 7½ ips than formerly at 15 ips. On a record-playback basis, the 1953 standard permitted response to be 5 dB down at 50 and 15,000 Hz at 15 ips; the 1965 standard permits record-playback response to be 5 dB down at 30 and 15,000 Hz at 7½ ips.)

Mr. McKnight of Ampex comments: "The question of S/N versus speed is a good deal more complicated than the NAB standard admits. . . . The NAB figures should never have been called signal-to-noise ratio. They should have been called either 'noise level' or 'reference-signal-to-noise ratio.'"

"The measurements here completely ignore the loss of high-frequency 'power response' at lower speeds. It certainly is *not* true that, because the NAB noise specifications are (nearly) the same at all three speeds, the true dynamic range at the three speeds is equivalent. This reduction of high-frequency dynamic range with reduced speed shows up in the NAB Test Tapes; the frequency run is at Standard Reference Level at 15 ips, but (in order to avoid tape saturation at high frequencies) the frequency run is 10 dB lower at 7½ ips and 15 dB lower at 3¾ ips. The price paid for slower tape speed is bound to be poorer performance. In the U.S.A., equalizations are such as to make the poorer performance show up in the high-frequency power response (not specified) rather than in the noise (specified)."

To Be Concluded

Fig. 1—NAB weighting curve for weighted noise measurements.



From the top



The SX-1000TA \$360 (includes walnut cabinet) "... a top performer, well able to provide the most critical listener with what he wants to hear."* ... "this sort of performance can be attributed to a canny use of advanced solid state circuit techniques."†

Excerpt from AUDIO, and HIGH FIDELITY† June, 1967. Write for complete articles.

...to a little below the top

The SX-300T
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(Walnut cabinet not included)



Whether your budget or taste is geared for the SX-1000TA, or the SX-300T, these two Pioneer AM-FM Multiplex Receivers will give the finest performance per dollar in high fidelity. Each will serve as a brilliant nucleus for a fine music system . . . and each is backed by Pioneer, one of the world's largest manufacturers of fine audio components. Pioneer is *the only high fidelity manufacturer* large enough to produce a complete line from turntables to speakers of its own. See and hear Pioneer at your local hi-fi dealer. If he has not

been franchised as yet, tell him to contact us. You will be doing him a favor as well as yourself.

SPECIFICATIONS:

SX-1000TA Output: 120 watts (IHF) at 4 ohms, 90 watts at 8 ohms; frequency response: 20-60,000 Hz; inputs: 2 magnetic and 1 ceramic phono, tape head, tape monitor, headphones, etc.; separate compensation for 3¼ and 7½ ips tape speeds; sensitivity: 2 uv (IHF); channel separation: better than 38 dB (at 1 kHz).

SX-300T Output: 40 watts (IHF) at 4 ohms; frequency response: 20-20,000 Hz; inputs: magnetic and ceramic phono, tape head and tape monitor; sensitivity: 3 uv (IHF); channel separation: better than 35 dB (at 1 kHz).



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EQUIPMENT PROFILE

KENWOOD TK-55 60-WATT FM STEREO RECEIVER

MANUFACTURER'S SPECIFICATIONS—

Total Music Power (IHF): 60 watts at 4 ohms. Power Bandwidth, 1% THD: 30 Hz to 20 kHz. IM Distortion: 1% at 18 watts (4-ohm load). Frequency Response, 1 watt: 20 Hz to 50 kHz \pm 1 dB. FM Sensitivity (IHF): 2.5 μ V at 98 MHz; 2.8 μ V at 106 MHz. Frequency Response, Mono: 30 Hz to 15 kHz \pm 2 dB. THD, Mono: 0.5% at 400 Hz. Capture Ratio: 2.5 dB. Signal-to-noise ratio: 60 dB. Separation: 38 dB at 400 Hz.

Featuring five FM i.f. stages, this new entry from Kenwood offers many features found in more expensive integrated receivers and several not found even in the high-priced categories.

Most "simplified" front panels have, for example, abandoned the separate left and right tone control approach, the contention being that there is little need to adjust the bass or treble in the left channel to some setting which differs from that in the right channel. Anyone who has had to cope with a heavily-draped or sound-absorptive wall adjacent to one channel will rea-

lize the usefulness, under such special circumstances, for individual tone adjustment. The Model KT-55 offers clutch-type controls so that the bass and treble controls can rotate as a pair if desired, thus maintaining simple, clean lines on the front panel.

Applying this type of dual control to the loudness control does away with the more conventional balance control, since balance is achieved by separate rotation of the dual-clutched loudness control. Presumably, it should not be necessary to "offset" the indicators of the two sections of this control, and this was confirmed at settings of the dual loudness control all the way from maximum setting to 60 dB below full setting. At no setting was the tracking error greater than 3 dB, indicating the use of extremely well-tracking dual potentiometers in this circuit.

Other front-panel controls include a speaker/headphone switch which selects either of two pairs of speakers, both sets of speakers simultaneously, headphones, or turns the power on and off. The main selector switch chooses FM (Stereo FM is heard automatically, when such broadcasts are tuned in), Phono, and Auxiliary. The station

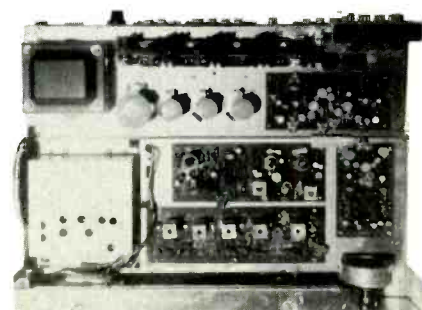


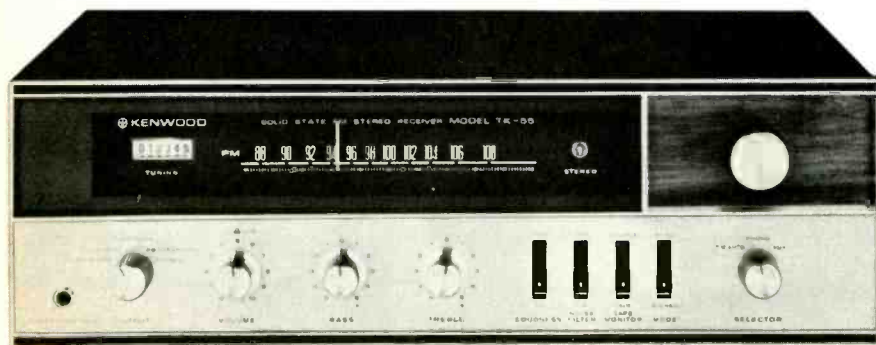
Fig. 2—Modular circuit boards achieve neat construction.

selector, or tuning knob, is coupled to a heavy flywheel whose mechanical coupling to the tuning capacitor, dial pointer, and dial stringing is so smooth that one spin of the knob caused complete transversal of the well-illuminated dial from 88 to 108 MHz.

Secondary front-panel controls include four rocker switches which introduce loudness compensation, a high-frequency noise filter, tape monitoring facilities and mono/stereo mode selection.

The presence of FM stereo is indicated by a light located behind the tuning dial. The FM tuning meter is also located behind the dial glass. Though always a welcome aid in achieving accurate tuning, it is somewhat ineffective since it is a peak-reading meter, dependent upon the development of maximum agc voltage, derived from the output of the 4th i.f. stage. In theory, maximum indication by this circuit should correspond to exact center of channel tuning, providing the ratio-detector stage is perfectly aligned with respect to the rest of the i.f. circuits. Too, this form of meter indication is difficult to define as compared with the more usual zero-center meter movements, which we find easier to use

Fig. 1—Kenwood Model TK-55 FM stereo receiver features 60 watts total music power at 4 ohms.





The story behind Garrard's new Synchro-Lab Motor™

—a true synchronous motor that also incorporates the desirable features of the induction type. Designed to make possible new and higher standards of performance in stereo reproduction.

The advantages of the synchronous motor for record-playing equipment have long been known.

The synchronous motor does not slow down or speed up, even in the slightest, with changes in voltage, load or temperature. Its speed is governed solely by the frequency of the alternating current, which is unvarying at 60 Hz. Applied to a record-playing unit, its perfectly constant speed prevents distortion of time and pitch resulting from variations in rate of revolution. A typical example of the constancy of synchronous motors is the accuracy of the familiar electric clock. Its hands are moved at an absolutely constant, reliable rate of speed by a small synchronous motor.



The electric clock has a synchronous motor

But the motor of an electric clock has relatively little weight to move. When the synchronous motor has, in the past, been applied to automatic record playing equipment, certain problems have been encountered. The starting speed and torque of the ordinary synchronous motor are typically low. Increasing the power and torque also tends to increase the rumble and noise levels. These factors are satisfactorily corrected in manual turntables of the type used in record cutting or broadcasting . . . where the advantages of perfectly constant synchronous speed are so important that cost is a minor consideration, and where a record changing mechanism is not applicable. These professional units have synchronous motors.



The induction motor, on the other hand, has certain advantages of its own. It gets up to full speed quickly. It has high driving torque. When built to quality standards, it is relatively free from rumble.

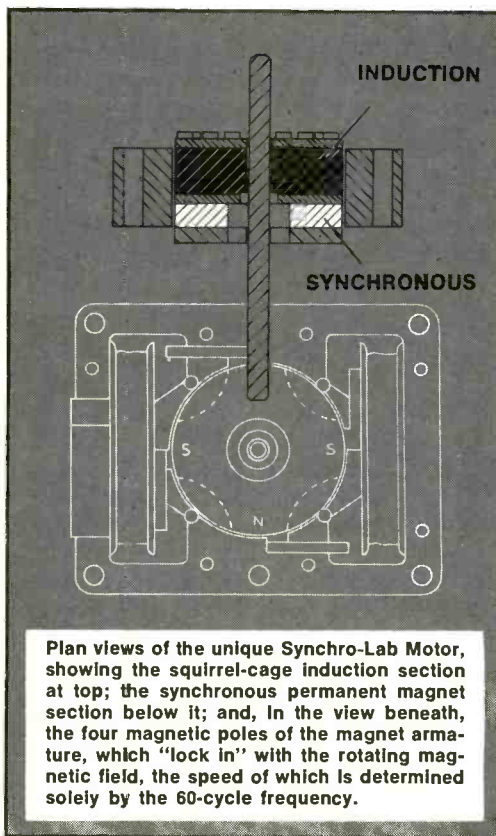
With this background, the Garrard organization undertook a project of great potential significance: to design a synchronous motor that would have the best features of both synchronous and induction types. Such a motor would turn records at perfectly constant synchronous speed, yet it would also have high torque and instant acceleration, plus an intrinsic freedom from rumble that would make expensive correction unnecessary.

That is the engineering triumph that more than a half century of Garrard experience and expertise have achieved, in the revolutionary new SYNCHRO-LAB MOTOR—a true synchronous motor with the most desirable features of the induction type built in. Study the diagram. Note that the motor has two sections. On starting, the squirrel-cage section at top acts as an induction rotor, providing strong driving torque and instant acceleration. Immediately, the synchronous section beneath takes over; its four permanent magnetic poles lock into the rotating magnetic field, the speed of which is determined solely by the rigidly-controlled frequency. The entire motor is now synchronous and cannot fluctuate in speed.

So efficient is the SYNCHRO-LAB MOTOR that it will not vary in speed even when the line voltage is radically altered. It is a common experience to see a television picture, for example, shrink and flutter when a powerful appliance, such as a refrigerator, starts up on the same line; or for other appliances to lose efficiency when the line is heavily loaded.



The Synchro-Lab Motor is independent of voltage variations



Plan views of the unique Synchro-Lab Motor, showing the squirrel-cage induction section at top; the synchronous permanent magnet section below it; and, in the view beneath, the four magnetic poles of the magnet armature, which "lock in" with the rotating magnetic field, the speed of which is determined solely by the 60-cycle frequency.

But the voltage fed to the Garrard SYNCHRO-LAB MOTOR can vary from the normal 117v to as low as 25v or as high as 250v without the slightest change in turning speed!

This means that the user of a Garrard SYNCHRO-LAB Automatic Turntable may have several heavy appliances in use at the same time—as many, in fact, as the line will withstand—without affecting the turning speed of his records. It also means that variations in voltage in the local power supply (as when power drain is heavy at peak periods) will be similarly without effect on record speed.

Record load is another problem which may slow the speed of turntables driven by induction motors, but which has no effect whatever on the speed constancy of the Garrard SYNCHRO-LAB MOTOR.

Stylus pressure and temperature ("running hot" or "running cold") are other factors encountered with induction motors. Neither of these will alter the even speed of the SYNCHRO-LAB MOTOR.

The "locking in" of a Garrard SYNCHRO-LAB MOTOR to the 60 cycle frequency of the electric current can be visually verified. The spindle of the motor is attached to a disk, across the center of which is painted a bar of white. Under a fluorescent lamp (whose intermittent light provides a stroboscopic effect), the motor is started. It quickly accelerates, and the white bar becomes an amber-colored, irregularly spinning cross. At once, however—and the effect is dramatic—the cross straightens into four distinct vanes and holds absolutely steady! This is the instant at which the motor has attained synchronous speed and locks into the frequency. Thereafter, for as long as the motor is left running, the cross (produced by the rotating white bar being always precisely in the same position at the same instant the light flashes on) will remain perfectly steady.



At rest



At synchronous speed

With this exciting motor development, Garrard has established new high standards in the one aspect of record playing equipment where relatively little advance has been made during the high fidelity era.

The Garrard SYNCHRO-LAB MOTOR, exhaustively pre-tested and proven, has been incorporated in a complete range of four superb new automatic turntables, Garrard's all-new SYNCHRO-LAB SERIES™. Two special Garrard factors now prove to be of significant benefit: (1) that Garrard builds its own motors and (2) Garrard's sales in over 80 countries of the world make it possible to amortize the very considerable tooling costs of a radically new motor over volume production. Thus, the matchless benefits of synchronous speed plus high torque can be made available in a complete range of four new Garrard Automatic Turntables—the SYNCHRO-LAB SERIES, priced from \$59.50 to \$129.50, less base and cartridge.

A 20-page Comparator Guide, just published, shows all the new Garrard models in full color, with features and specifications. For a complimentary copy, write: Garrard, Dept. AS-1, Westbury, N.Y. 11590.

SL95— \$129.50	SL75— \$109.50
SL65— \$79.50	SL55— \$59.50

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World's Finest
SYNCHRO-LAB SERIES

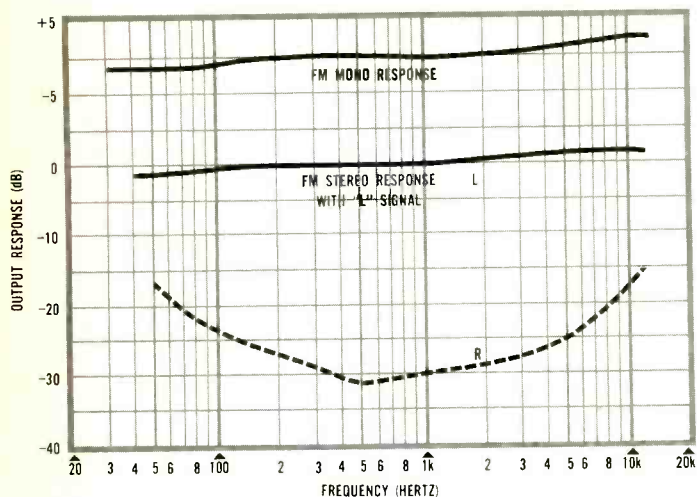


Fig. 3—Kenwood TK-55 FM mono and stereo response, showing at least 20 dB separation between left and right broadcast channels from 50 Hz to 10 kHz.

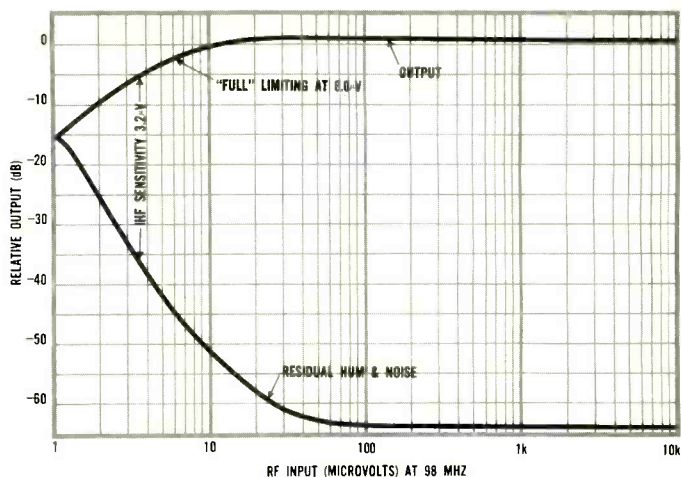


Fig. 4—FM characteristic (mono) of TK-55 indicates that measured IHF sensitivity comes very close to published specification of 2.8 microvolts.

and more sensitive to slight degrees of manual mis-tuning.

Structurally, the Kenwood TK-55 is a model of precision engineering, good layout, and excellence of assembly. The modular circuit boards, mounted on a rugged chassis, are illustrated in Fig. 2, as are the more than adequate output transistor heat sinks and the well-shielded r.f. front-end section. Speaker terminals are sufficiently far apart to prevent inadvertent shorting of speaker leads. But should this unlikely accident occur, the output circuit is protected by a disabling electronic circuit (no clicking relays) which protects the output transistors. Output, under these

conditions, goes on and off approximately once per second, alerting the user to a short or other output overload condition.

Performance

The TK-55 receiver tested here exceeded its own claims in at least as many instances as it fell short of its published ratings. Though the measured IHF sensitivity of 3.2 μV (see Fig. 4) was a bit short of the published figure (2.8 μV), it was certainly close enough, and good enough to be rated among the more sensitive receivers.

As for the lower measured figure of

FM stereo separation, 30 dB (compared to 38 dB specified) is, after all, all that is required even of a stereo broadcasting station, let alone a receiver. Of more importance is the fact that at least 20 dB of separation is achieved at all frequencies from 50 Hz to 10,000 Hz, as shown in Fig. 3.

Other FM and amplifier performance curves are shown in Figs. 4, 5, 6, 7 and 8. Total music power of 60 Watts IHF at 4 Ohms was confirmed. Power bandwidth surpassed the unit's specified range for 1% total harmonic distortion, being 25 Hz to 27 kHz instead of 30 Hz to 20 kHz. IM distortion of 0.5% at 18 Watts (4-Ohm load)

Fig. 5—Power bandwidth and frequency response characteristics.

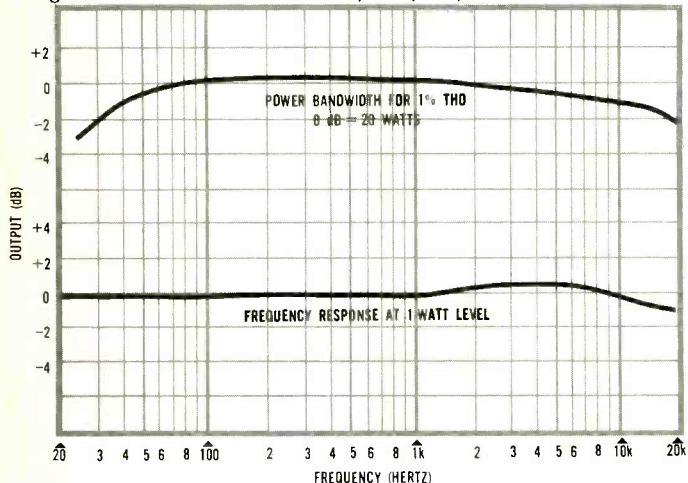
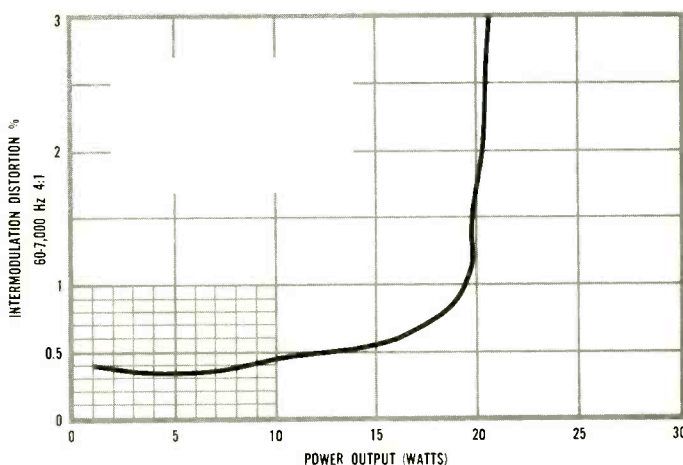


Fig. 6—Intermodulation distortion percentage vs. power output.





Some people will never be "in." Their fancies run high and they are fanatically loyal to logic, imported beer and aged cheese. The out-crowder is long-haired, bald, herring-bone suited, and clad in dungarees with turtleneck sweater.

The conversation is endless. Probing the profound, he will discourse on drugs, Stendahl, the Kennedys, DeGaulle, Art, Love and Be-Ins.

His taste in music can run the gamut of Beatle fad, Bach fugue and Ravi Shankar.

The one thing that is most common is a demand for great performance.

His ear is attuned to the subtleties of delicate instrumentation.

When the conversation becomes subdued and the mood softens to a "listen" the cartridge used is the ADC 10E-MkII.

Top-rated, this mini cartridge is almost human in its instinct. It

brings out the brilliance, from the lowest bass to the highest treble.

Its channel separation, supreme, as it feels and caresses every groove, bringing out each little nuance of the recording.

Using a unique "induced magnet" principle, it reduces the mass of the moving system to a minimal value and significantly increases stylus compliance. This allows the stylus to accurately follow the intricate modulation of the record groove.

There is less distortion and minimum record wear.

The miniscule, geometrically designed, elliptical diamond (lateral radius of .7 mil and contact radius of .3 mil) contributes to a more superior tracking ability.

These elements, carefully opinionated features, result in a genuine effortless reproduction that carries the listener to the edge of his seat.

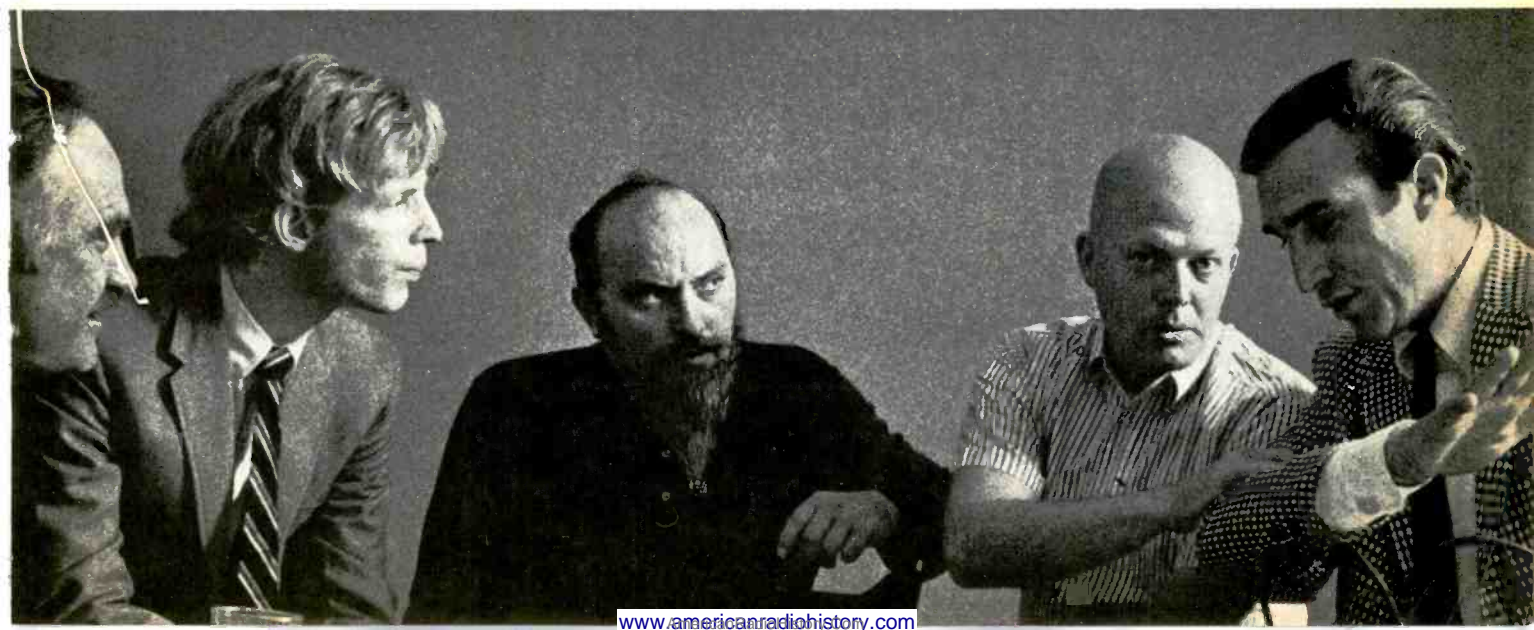
HiFi Stereo Review in an independent survey made these claims, "... its ability to trace highly modulated grooves at only 1 gram, is a feat achieved by few cartridges in our experience." And, "... it would track the HF/SR test record at 0.5 gram, lower than any other cartridge tested."

The cost is high. Just a breath under sixty dollars. But understandably so. Our appeal is to a small "out" crowd.



AUDIO DYNAMICS CORPORATION
New Milford, Connecticut 06776

The "Out-Crowd Pleaser."



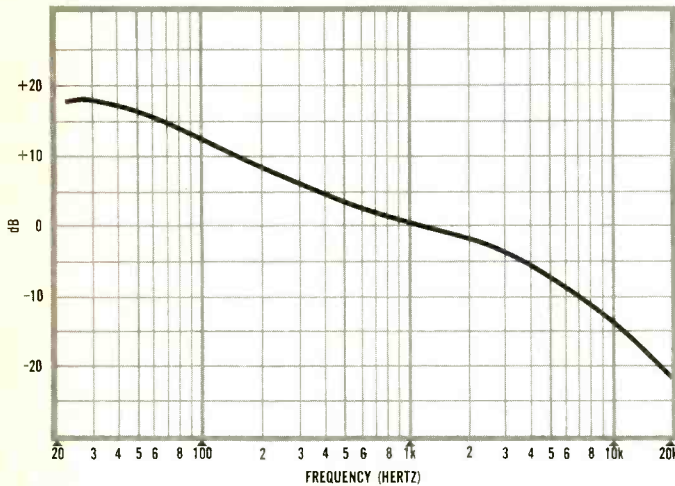


Fig. 7—TK-55 receiver's phono equalization.

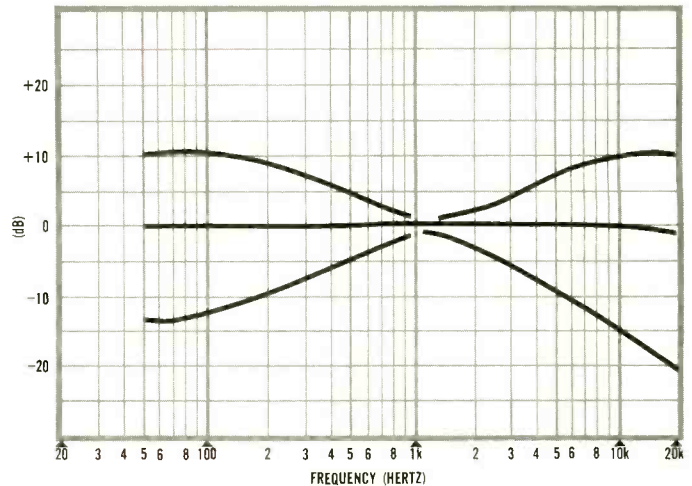


Fig. 8—Tone control range of Kenwood receiver.

bettered claim of 0.7%, as did the tuner section's frequency response of 30 Hz to 15 kHz ± 1.5 dB compared to published figures of 30 Hz to 15 kHz ± 2 dB. On the other hand, the power amplifier's frequency response was a shade off: ± 1 dB from 25 Hz to 30 kHz rather than ± 1 dB from 20 Hz to 50 kHz, as specified. Signal-to-noise ratio was 65 dB; capture ratio, 3.0 dB, compared with listings of 60 dB and 2.5 dB, respectively.

Stereo separation is graphically illustrated under actual operating conditions by the photos of Figs. 9 and 10. Fig. 9 shows the simultaneous output (in a dual-trace photo) of left and right channels when a 400 Hz signal is applied as a "left only" composite r.f. signal at an input level of 100 microvolts. Note that the upper trace ("right channel output") is virtually a straight

line, indicating extremely high order of separation. In Fig. 10, the left-only signal frequency has been increased to 10 kHz and, in this instance, some evidence of 10 kHz cross-talk is demonstrated by the upper (right output) trace. This confirms the measured separation of about 20 dB at this frequency.

As noted in the instruction manual, there are times when an FM stereo signal is too noisy (or susceptible to multipath) to be listenable. In such instances, the user is told to switch the mono/stereo mode switch to "mono." Examination of the circuitry involved here discloses that this switch merely parallels the two channels. While it is true that this will "cancel" associated FM stereo noise to some extent, it will not completely eliminate the disturbance. Noise is primarily high fre-

quency in nature. If there are any phase differences between two stereo channels (as there will invariably be when tone controls are present), complete cancellation of out-of-phase noise cannot occur. A better approach would have been to both parallel the two channels and in some way disable the stereo decoder circuits completely when the mono mode is selected.

Extended listening to the Kenwood TK-55 receiver yielded pleasing sound in both FM and phono service. Power output was more than sufficient for low-efficiency speaker systems in an average size room, though not for a 20 x 30 listening room. There were no apparent peaks or harshness in the response, but the receiver did not display truly crisp sound when reproducing bursts of loud music. Square-wave and tone-burst tests show this to be due to a transient response that is not quite as impeccable as some higher-priced units have exhibited.

Unquestionably, the solid-state receiver offers good value in its price category (\$199.95), a consideration that cannot be lightly ignored. Its transistor-protection circuit is foolproof, capable of saving expensive output transistors in the event of a short circuit. The sensitive FM section operates admirably. And the silky feel of the slide-rule tuning facility should make lovers of high-quality equipment purr with delight. Except for the amplifier's recovery time, as noted earlier, it emulates its more expensive brothers in performance, operating flexibility, and appearance.

Check 110

(Profiles continued on page 56)

Fig. 9—Simultaneous output of left and right channels with 400 Hz signal indicates high order of separation.

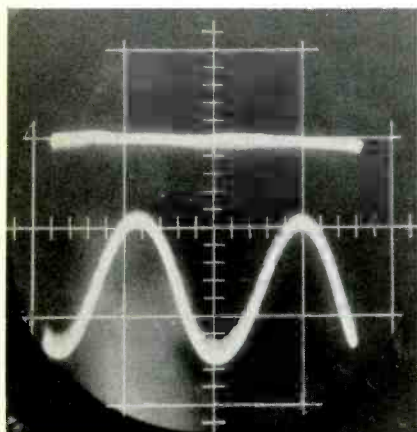
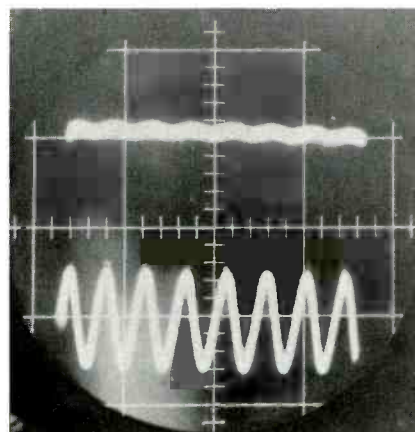


Fig. 10—With the left-only signal frequency raised to 10 kHz, some cross-talk is evident in the right channel (upper trace).



One-finger exercise for the music lover



Audio magazine captured the true spirit of the Elac/Miracord 50H in its September 1967 review: "...an outstanding performer... its automatic features make it a pleasure to use." What was *Audio* talking about?

The 50H has four pushbuttons: a "stop" reject button and three operating ones, each programmed for another record size. The gentlest touch is all that's needed to put the 50H into automatic play: single records, once over or continuously, or stacks of up to 10 in automatic sequence. Or you can ignore the buttons, and play single records manually by simply placing the arm on the record. That's how easy it is

to operate the 50H and enjoy the many performance qualities it has to offer.

Other features of the 50H include: Papst hysteresis motor; leadscrew adjustment of stylus overhang; cueing facilities; anti-skate compensation and direct-dialing stylus force adjustment to as low as $\frac{1}{2}$ gram.

At \$149.50 less cartridge and base, the Miracord 50H is probably the most expensive in the field. It is also the finest. See it at your high fidelity dealer or write for descriptive literature: Benjamin Electronic Sound Corp., Farmingdale, New York 11735

Miracord
the light touch

EQUIPMENT PROFILE

(Continued from page 54)

KNIGHT-KIT KG-2100 D.C. to 5-MHZ TRIGGERED- SWEEP OSCILLOSCOPE KIT

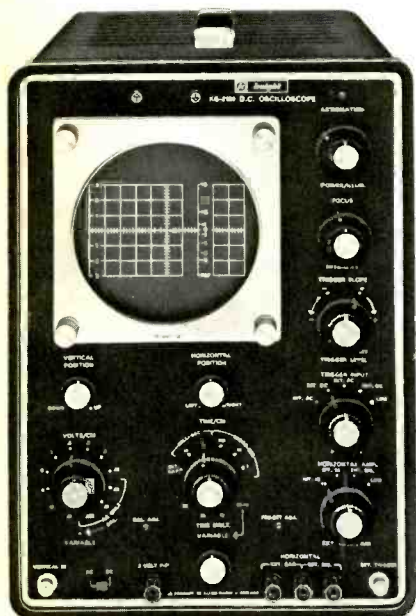
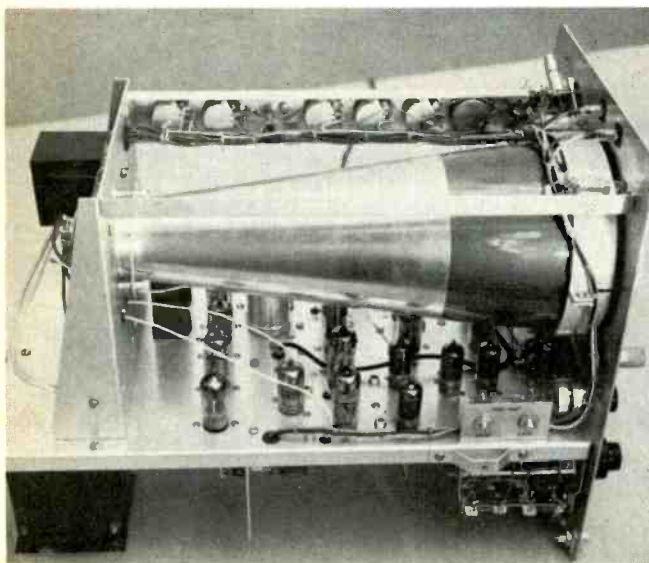


Fig. 12—Top view of the Knight-Kit KG-2100 reveals great numbers of calibration and setup potentiometers (on top bar and at lower right).



MANUFACTURER'S SPECIFICATIONS—Vertical Bandwidth (d.c.): D.c. to 5 MHz, -3 dB; (a.c.) 5 Hz to 1.5 MHz, -3 dB, in 0.005, 0.01 and 0.02 V/cm ranges. Vertical Sensitivity: D.c.-coupled, 0.05 V p-p/cm; a.c.-coupled, 0.005 V p-p/cm. Rise Time: 85 nanoseconds. Horizontal Bandwidth: D.c. to 800 kHz, ± 3 dB. Triggered Sweep Speed: 200 nanoseconds to 0.1 second. Triggered, continuous time-base control. Regulated high- and low-voltage power supplies.

Until recently, it was only possible to get service-type oscilloscopes in kit form. Some of them are certainly sophisticated: wide-band, high-sensitivity, and all that. But there were no calibrated trigger-sweep scopes in kit form. And those that are factory wired start, for the most part, at about \$800. Therefore, Knight-Kit's new Model KG-2100 triggered-sweep scope kit is most welcome.

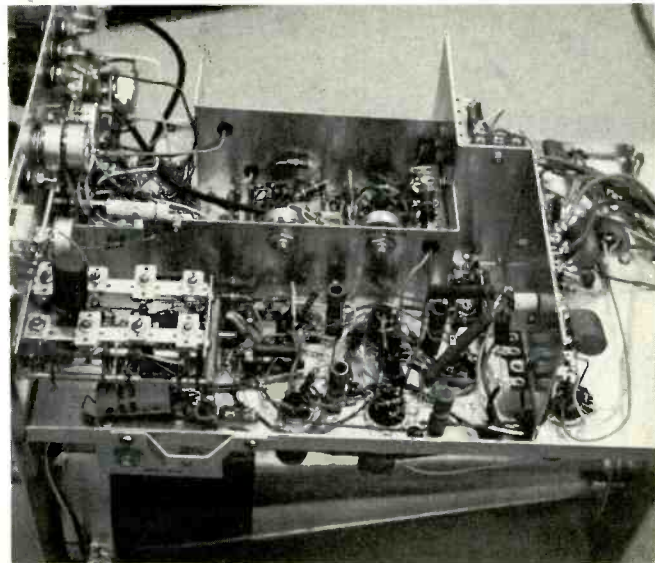
For readers who are unfamiliar with triggered-sweep functions, triggered sweep comes close to providing automatic synchronization. A 'scope pat-

tern will remain in sync even though the horizontal-sweep frequency is changed. In addition, triggered sweep enables the user to "magnify" a portion of a 'scope trace with ease because a great amount of horizontal expansion is possible.

The KG-2100 is a true lab-type oscilloscope of high versatility and excellent performance characteristics. It's available in kit form at a moderate price, \$245. (An assembled low-capacitance probe, at \$22, is a worthwhile addition if you don't have one.) This includes all parts—and there are plenty—pre-cut and tinned wires, assembly instruction manual, operator's handbook, and even solder. The only thing required, aside from a solder iron and a few simple handtools, is to assemble the whole shebang.

And this is not as simple as you might imagine. It is not that assembly instructions are unclear—they're particularly lucid, with easy-to-follow, step-by-step illustrations guiding you all the way. It's just that this is a much more complex undertaking than, say, a hi-fi amplifier kit would be. If you are an experienced kit builder, for ex-

Fig. 13—Bottom view of the new triggered-sweep scope kit shows the power supply (right) and input attenuator trim capacitors (left-foreground).



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Remember, the new C-61 provides low noise, low distortion, overload protection, unequalled mechanical and application adaptability.



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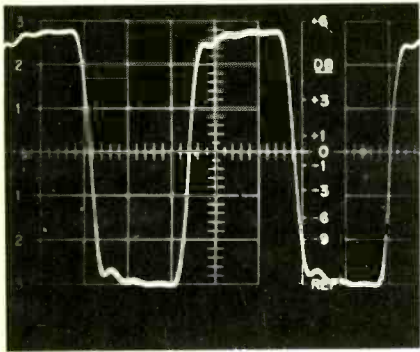


Fig. 14—The 1 MHz square wave above shows slight ringing.

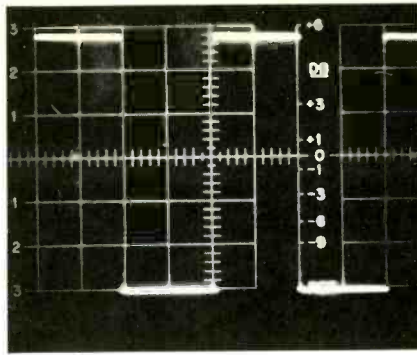


Fig. 15—The 25 kHz square wave is near perfect.

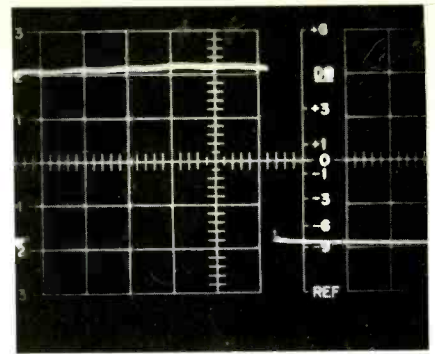


Fig. 16—Here's a 6 μ sec pulse at 600 Hz repetition rate.

ample, expect to spend at least 25 hours to assemble the kit. Then add a few hours for calibrations. All told, figure about 30 hours from unpacking to operating oscilloscope. (All construction involves point-to-point wiring.)

Saying that this is not a beginner's kit is hardly a condemnation. If you faithfully follow the instructions and excellent diagrams, you will end up with a properly-functioning instrument. But experience makes things a lot easier, cutting project-completion time to, say, 30 hours.

And experienced kit builders will recognize some shortcuts. To illustrate, the instructions have you placing the CRT holding bracket in place earlier than is desirable. Delaying this installation until resistor, R110, along its side, is soldered, makes the job easier.

Component quality that goes into the unit is good. They include 21 vacuum tubes and a voltage regulator, plus a 5-in. flat-face cathode ray tube, and seven diodes. The tubes throw off a lot of heat, as you might imagine, so Allied wisely has a rear-mounted Rotron high-velocity fan sucking the heat outwards. This is an effective heat-removing measure, though it still doesn't give owners license to locate the scope in an area with restricted ventilation. Attractive, colored control knobs are well placed. The controls include focus, astigmatism, intensity, horizontal position, vertical position, trigger input, trigger slope, horizontal amplifier, external gain, sweep time/centimeters and multiplier.

There were no hitches to speak of while assembling the kit. Upon completion, however, gain on the vertical input was found to be inadequate. After some searching about, the fault turned out to be a defective variable gain control (which is coaxial with the Volts/cm switch). A call to Allied brought a quick replacement.

Calibration and performance

Calibration of the finished unit requires an accurate d.c. voltmeter to set the -150 volts of reference voltage for the rest of the instrument. The power supply is highly regulated and will be as accurate to its operating parameters as the accuracy of your d.c. meter allows you to set the -150 V control. A fast-rise-time 100-kHz square-wave generator is desirable to frequency-compensate the front-end vertical attenuators. It is worth noting that adjustment may be made to either maximize flat-topping of the square wave or high frequency response. If you don't have a good generator, however, you can follow the instructions for peaking without one. Our measurements revealed that this method would get you close to the high-frequency spec of 3 dB down at 5 MHz, and the square-wave display would be highly acceptable. But even better performance is possible with a good generator.

We set for the best possible square-wave picture. The result, measured against 1 kHz, showed the display to be down 1 dB at 1.75 MHz, 2 dB at 3.5 MHz, 3 dB at 4 MHz, and 3.5 dB at 5 MHz. (We measured the unit as down 19 dB at 10 MHz—well beyond the manufacturer's specs.) As previously said, it is easily possible to trim the unit so that it is well within the 3 dB down spec at 5 MHz; it all depends on whether you place a premium on square-wave appearance or high-end accuracy.

The front panel has a jack that supplied a 0.1 volt peak-to-peak signal. It is an indication of the power-supply's accuracy that, with the instrument operating on 115 V, we measured 0.101501 V using an instrument that has infinite impedance at its null point and 0.01 accuracy. This is as accurate as you could want it, and Allied is to be commended for a circuit that comes

out with this order of accuracy.

The best proof of this scope's capabilities can be seen in the scope tracing photographs here. The 1-MHz square wave shows slight ringing, but very acceptable performance. The 25 kHz wave is near perfect, though some slight lack of horizontal linearity can be observed. The third tracing is of a 6- μ s-pulse at a 600-Hz repetition rate. This reveals how clean the display is—and it is impressively good. Using the pulse to check rise time, it came up as a 40-60 nanosecond figure. Allied only claims 85 nanoseconds, so we find the unit to be better than claimed.

The KG-2100 covers a wide sweep time. It offers calibrated sweeps of 0.05 sec/cm to 200 nsec/cm in 16 ranges. There is also a $\times 2$ and $\times 5$ sweep expander and a 10:1 vernier control. The horizontal amplifier can also be $\times 5$ multiplied. Voltage sensitivity is direct-coupled and goes down to 0.05 Volts-per-centimeter. With a.c. signals, additional steps go down to 0.005 Volts-per-centimeter.

If you have never used a triggered scope before, you will realize what you've been missing once you operate this unit. One feature we liked very much is illustrated by the two small arrows visible above the CRT's face. If the vertical position control is set so that the trace is not visible, you can see by these lights whether it is above or below the graticule. The front bezel has studs that will fit standard camera and light-shielding scope accessories. This is as it should be, for this is a truly professional instrument.

We readily concede that not everyone needs a triggered scope with the capabilities of the KG-2100. But if you can get one as inexpensively as this one, it may well be worth it, just to have that extra "horsepower" when you need it.

Check 111

(Profiles continued on page 76)

!!! a Marantz receiver

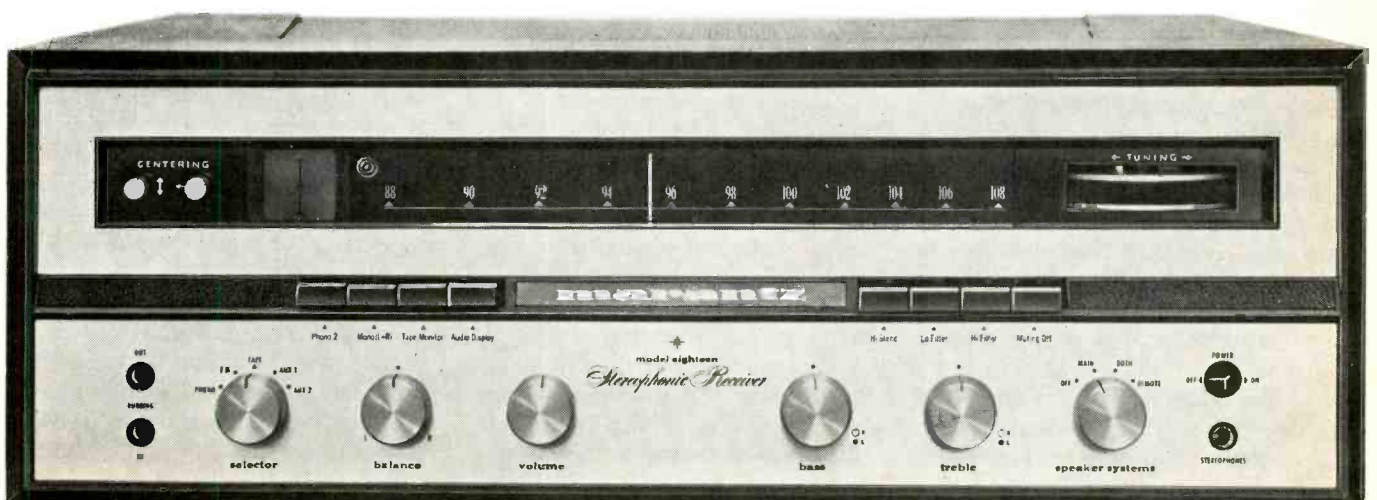
Now everyone may enjoy the eloquent sound of Marantz components, combined in a single completely solid-state system — the Marantz Model 18 Stereo Receiver. Here is the incomparable quality of Marantz stereo components — tuner, preamplifier and power amplifiers — combined on a single chassis. Designed to the unequivocal standards which have made Marantz a legend in stereo high fidelity, the Model 18 achieves the level of performance of the most expensive components in a moderately priced compact receiver. Here is the total performance you would expect from Marantz. Finer sound than you have heard from most quality component systems and it is priced at less than half the cost of the fine Marantz components which inspired its design — only \$595.00.

Features: Out of intensive research comes the Marantz "passive RF section" a revolutionary new development which advances the state of art and eliminates the overloading problems commonly encountered in strong signal areas . . . Four I.F. stages assure maximum phase linearity and maximum separation . . . an integral Oscilloscope, a Marantz hallmark, provides absolute tuning accuracy and permits elimination of multipath . . . Gyrotouch tuning provides a new experience in quick, silky-smooth station selection and precise tuning. **Amplifiers:** Solid-state throughout with a massive power output of 40 watts continuous rms per channel, from 20 Hz to 20k Hz, nearly three times the output of many receivers rated at 60 "music power" watts . . . Direct coupled design for instantaneous recovery from overload . . . Automatic protector circuits for amplifier and speaker systems eliminate program interruptions . . . Total distortion from antenna input to speaker output is less than 0.2 per cent at rated output . . . and substantially less at listening level. Flawless performance was the design objective. Flawless performance has been achieved.

Specifications: **Tuner Section:** Signal-to-Noise Ratio — 70 DB; Harmonic Distortion at 400 Hz, 100% modulation — 0.15%; Frequency Response, 75 microsecond de-emphasis — ± 0.5 DB; Multiplex Separation, 20 Hz — 43 DB, 1000 Hz — 45 DB, 10k Hz — 35 DB, 15k Hz — 30 DB. **Amplifier Section:** Power, 40 rms watts per channel at 4 and 8 ohms, 20 Hz to 20k Hz; Distortion, 0.2% THD; Frequency Response, 15 Hz to 30k Hz, ± 0.5 DB. **Dimensions:** 18 $\frac{1}{4}$ " wide x 16" deep x 6" high.

marantz

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MARANTZ MODEL EIGHTEEN STEREOPHONIC RECEIVER

ELECTRONIC ORGAN "DEMO" RECORDS

EDWARD TATNALL CANBY

THE VARIETY OF NEW ELECTRONIC instruments appearing these days is amazing. Many of them are appearing on "demonstration" records, as a means of enlightenment and a sales tool, and as we listen to these an old truth comes out: In the long run, it isn't really the instrument that counts, but the product—the music or organized sound which it produces.

Thus, oddly, the cart is put before the horse in these records. They are pre-aimed at the desired market; and the market is as wildly various as it always is. Three recent discs of this sort are nice illustrations.

The most impressive, if perhaps the most specialized at the moment, is the 10-inch mono LP "*Moog 900 Series Electronic Music Systems*," put out by the R. A. Moog Company of Trumansburg, New York, 14886. Dr. Moog is clearly an imaginative avante garde engineer; his specialty is equipment ingeniously designed for the creation of electronic music, with the electronic composer's specific needs in mind. The unusual feature of the equipment illustrated on this disc is voltage control, by means of which a variety of generators are easily and rapidly handled to produce not only the fundamental wave shapes—square waves, saw-tooth, etc.—and the usual pitches, in steps and siren-style, plus dynamics, but also a quite fascinating range of rapidly-changing wave forms, one type of action modulated by another. Most unusual are the "weeyouuu" or "wow" color-change sounds and the modulation of rapid tonal changes onto a steady-pitched note.

In addition to brief narration, the Moog record presents a large amount of illustrative material—

and, happy to say, it is not only absorbing for its own sound but is done up in a delightfully humorous fashion. One episode imitates a kind of Western Horse Opera, with thunder, horses, guns, whining children (?). Another episode shows off some rather nice synthesized pops music. All the sounds, of course, are purely synthetic, generated directly by the Moog equipment.

Dr. Moog must be an active engineer-artist. He also produces a slick-paper, technical magazine, *Electronic Music Review*, along with Reynold Weidenaar (quarterly, with membership in the Independent Electronic Music Center; \$6), a quite fascinating review of the newest means of electronic music procedure.

Though this music is primarily a new art form, it obviously finds many mundane uses in films, advertising, assorted new-style "happenings" and the like—enough to keep Dr. Moog profitably in business.

A remarkably different disc is that from Electro-Voice, "*The Electro-Voice Series D Organ Speaks With Authority*," a full-sized stereo LP disc featuring Jon Spong, organist, with Ken Nordine, narrator. The first side is an illustrated exposition of the organ's capabilities, the second a brief musical program of complete short organ works.

The disc is just as clearly aimed away from the electronic technician as the Moog disc is aimed towards the technical-minded electronic composer. The audience is obvious enough from the first moment—church committees and the church organist. In spite of a certain amount of mildly humorous material, there is an air of sanctity and decorum on this record which immediately sets the proper tone for churchliness—

this is a sales effort in that direction, definitely.

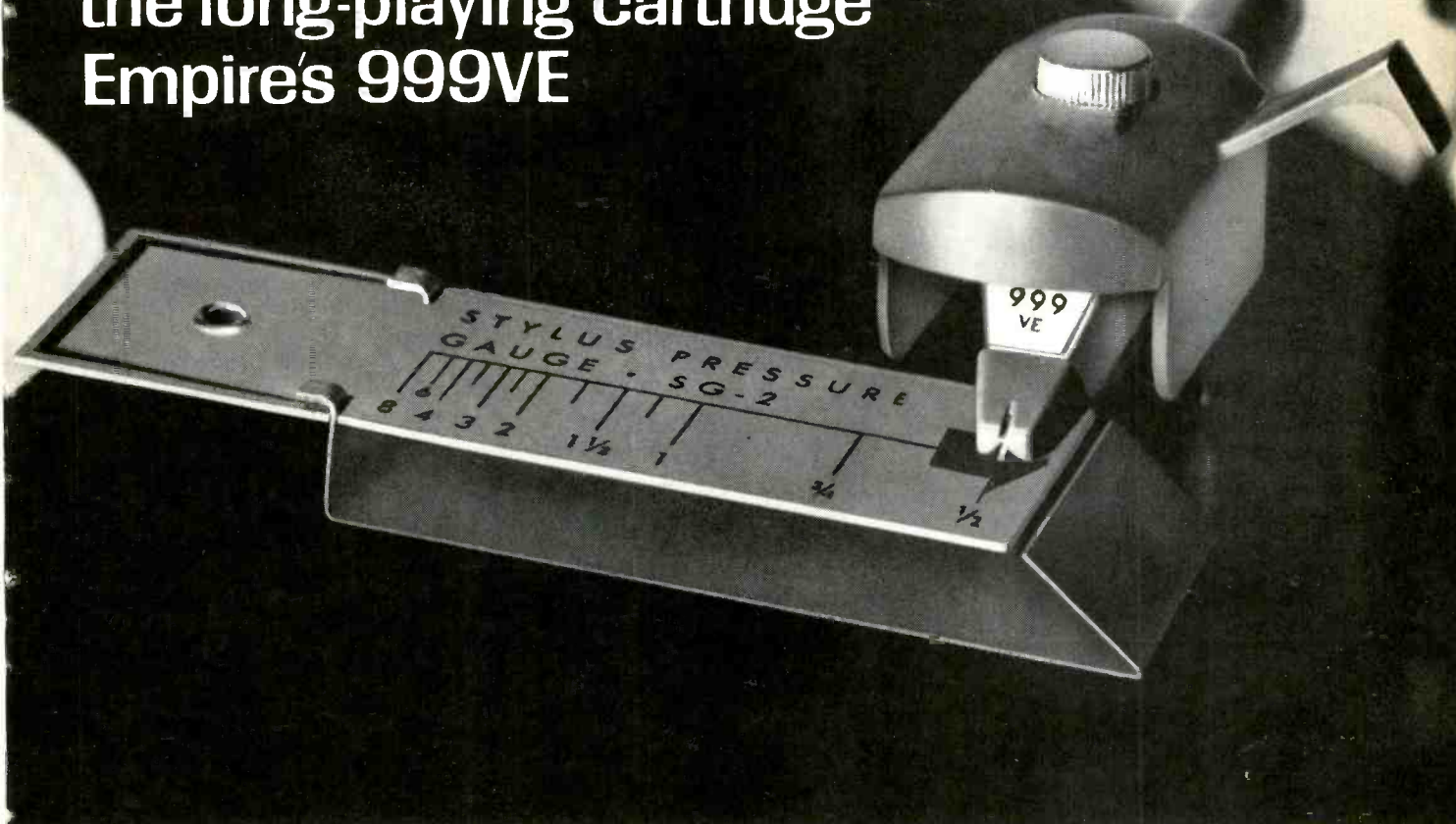
The result is that we find out a lot about what stops the organ offers, how well it can play conventional hymns, voluntaries, preludes, and so on, and we hear, in all truth, that the device is indeed a perfect, if utterly conventional, American-style church organ—which happens to operate electronically. The music is so very much of this genre that we do not even know whether the Electro-Voice, for instance, can put on a program of real Baroque organ music with the brilliance of tone desirable in that sort of organ sound. There is none on this disc—but neither is there in the average small church organ.

The Series D organ is a fascinating instrument because it is not electronic in the generative sense; its tones are reproductions of actual organ sound, pipe by pipe, the distinctive sound of each pipe reduced to a kind of endless-loop recording that is "scanned mechanically, discharged electrostatically" — whatever that means. In theory, any organ sound at all—or other sounds ad lib—could be actuated by the keys and stops. Those chosen are obviously for the special purpose the designers had in mind.

Questions unanswered in the lay reviewer's technical brain are (a) how is the endless loop of sound joined, spliced, without an audible "bump"? Possible, but tricky. (b) How is the *ictus*, the attack sound, accomplished? It can hardly be the original, in an endless-loop device. As all who study musical acoustics know, the initial attack is vital to the sound of all instruments. My ears tell me that it is artificial here, and not particularly effective — it sounds electronic to me. (It's as good as most small pipe organs, in any case.)

Mr. Spong's musical program is not of a very high artistic order but he is an excellent and lively musician; I enjoyed his playing. He ought to help Electro-Voice no end. Æ

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Heliodor HS 25047 stereo (\$2.49)

This is a whiz-bang of a good record, on M-G-M's low-priced Heliodor label. Don't be scared of it, University or no University! It's a terrific sound-experience, as well as intellectually instructive and all that. I can't be sure, but it even seems to be deliberately humorous in many a spot. Anyway, I found it funny and I liked it. All this in spite of an awesome quantity of taped trickery and "live" performery and a most impressive array of learned connections and accomplishments in music on the part of the various composers. One even started as a chemist.

Electronic music today is far from that early postwar (and pre-tape) *musique concrète*—music made from concrete, i.e., actual physical sounds—that first introduced this new art. There is a much greater variety of sound now, the natural sounds supplemented by all sorts of ingenious synthetic sounds, often computer calculated; they are now clean, wide-range, solidly pitched (no more unsteady wavering) and the old annoyance of the over-used pulsing tape-feedback echo is gone. In a word, the art is getting on its feet technically. Musically too.

This record offers six wildly contrasted works, both short and long, featuring again one of the earliest ideas to be tried in this area, taped and live sounds combined in performance. On records, the live sound, from voices and instruments, can scarcely be told from the pre-taped, so well are they integrated in tonal qualities and clarity. The human voice, both live and variously tape-doctored, is much in evi-

dence. Maybe I'm old fashioned but I say that this adds a lot of human interest. We *are* human, after all.

"Machine Music" by Hiller opens the record with live piano and percussion against enormous groaning and twittering tape sounds, at length. "Lemon Drops" and "For Harry" (Harry Partch) are cool, clear little works by Kenneth Gaburo for tape alone, the first entirely derived from synthetic sounds. It quite fascinatingly suggests cool, late-late jazz at a quiet night club, without actually being it. The "Harry" piece (evoking Partch's futuristic musical instruments?) is all glassy and wiry. Then comes a big "Canto" (Hamm), to a Canto by Ezra Pound, a much more pretentious affair featuring two girls, live, one speaking, the other singing, plus assorted chamber instruments; I never did get to figure out which sounds were taped.

Side 2 starts with a grisly piece called "Futility" (Brün), dentist-drill and splitting-headache noises and much down-sagging pitch; in breaks between sound segments, a lady recites.

Finally, there is "Underworld" (Martirano) almost 18 minutes long, a piece with Everything, both live and taped, and especially the demoniac sounds of men, yukking, howling, groaning, acting demented. These human sounds are most skillfully mixed in with the live instrumental and assorted taped material—my immediate thought was, who done it? Did the learned and accomplished composer and maybe some of his more fun-inclined university students get together one Saturday night to record all this yukking? *Somebody* did. It must have been a gas, for all concerned.

E. T.C.

Performance: B

Sound: B

Julian Bream—Lute Music from the Royal Courts of Europe.

RCA Victor LSC 2924 stereo \$5.79

RCA is not noted for its penetration into "old music," but in the lute department this label is right up on top. Julian Bream is Mr. Lute himself.

The appeal of the lute nowadays is not only because of our increasing general interest in older music. This aristocratic music-maker is the instrument that initiated the present-day "classical guitar" school which, in spite of rock and folk, continues to interest many thousands of guitar pickers and listeners. (I personally know a "rock" electric guitarist who is mad for lute and "eats up" every lute record that appears.)

The special thing about the lute is that it can play such a variety and complexity of music, and particularly music in complex counterpoint; not just one melody but several going on at one time. As can be heard on this record, that was its specialty in the great days of the 16th century, though its ability to play everything from dirges to dances and its easy elaboration of melodies were also big factors. Low bass notes, a wide range of pitch, are also plus features.

In Bream the old lute has finally found a player whose performance, we can guess, matches up to the virtuosity of the great lutenists back in the 16th century. Most modern lute players pluck away at their instruments with a frown and a certain clumsy intensity, as though the music were just too hard for them (it probably is) and the instrument too crude (it isn't). Tone quality is haphazard and often includes nasty unintended buzzes and slaps of the strings. Not from Bream! His playing flows effortlessly, his rhythms are faultless, his phrasing lively and musical. He has reserves of extra acceleration, so to speak, that, when he lets go, are really breathtaking. He is total master of lute tone color and can vary different parts of the music from soft and gentle to hard and wiry, and often both at once. A liberated lute, definitely.

Several of the great lute composers appear here—Dowland, for example—plus others who are unfamiliar mainly because they haven't had a Julian Bream to play their music. The program ranges over the 16th century, from the less familiar early and middle portion (now actively in revival) through the familiar Elizabethan period and on into Jacobean—i.e. as of



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5. Winners to be selected by random drawing. All decisions of the judges will be final.
6. Contest void in states where prohibited by law.
7. Entries must be postmarked or deposited at dealer's before midnight, November 30, 1967.
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King James I, who succeeded Elizabeth.

A curious faint wavering whine is a defect on side 2. Seems to have been in the tape rather than a fault in the groove cutting. E.T.C.

Performance: A Sound: B

1.5 Quartets

Tchaikowsky: Sextet ("Souvenir de Florence"). Guarneri Quartet and Boris Kroyt, Mischa Schneider.

RCA Victor LSC 2916 stereo \$5.79

There's a quartet and a half here, in several senses. The Guarneri group is aided by one half of the most celebrated Quartet of all, the famed Budapest. That group belongs to Columbia, but half of it is fine for RCA under the players' relatively anonymous private names. The music is half again as wide and half again as long, too, as most quartets. A lengthy two sides.

There isn't much Tchaikowsky chamber music; his taste was for bigger, more brilliant and complex forms and his extraordinary skill at instrumentation for large orchestra was cramped by chamber limitations. Thus this Sextet, written with enormous technical skill, nevertheless keeps reminding us that it is a sort of scaled-down orchestral work, the six string players making up in sheer quantity of effect for the lack of orchestral variety. The instruments are positively loaded down with every trick in the bag. The music is thick not only in its six-part texture but in the multiplicity of colors and rhythms.

As a result, the sound is brilliant but often labored; the performers do prodigies, but much of the time they seem winded and the music often has a scratchy, over-wrought quality.

On the other hand, the material itself, oddly, is less intellectual, more "popular" than the normal chamber music work. It is full of Russian folk tunes and dances, more so than any other piece of Tchaikowsky I can think of. (Florence has nothing at all to do with it, despite the title.) That makes it interesting, scratchiness or no. If you can just forget the medium and the hard-working musicians, you'll find this a fine work.

The performance, with the youthful competence of the Guarneri intensified by the experienced drive of the two older Budapest musicians, is vigorous and meaningful. E.T.C.

Performance: B+ Sound: B

Opera by Errors

Opera By The Dozen. Vienna State Opera Orchestra, Sv Shaffer, Conducting.

Westminster WMS 1024 Stereo \$9.57

The title of this album should have been appropriately named "Errors By The Dozen." The basic idea for a multi-record set embodying various popular selections from the operas, is a good one. The operatic repertoire contains some of the most beautiful and familiar melodies written. If restricted only to performances in original form, a great many people would be deprived of the opportunity to know and enjoy them; the cost of collecting complete operas on records can be prohibitive.

Extracting and arranging select excerpts from any opera is not a simple task. The parts usually sung must be allocated to their orchestral counterparts. Tempi must be carefully re-evaluated to maintain momentum normally supplied by the vocal and stage action.

To begin with, the tempi in this performance are at complete variance with those heard at a live performance of an opera. The playing is extremely slow and ponderous, particularly in the *Boheme*, *Butterfly*, and *Tosca* excerpts. The orchestral arrangements show little imagination or craftsmanship. For example, the abrupt resolution to E flat major at the close of "E lucevan le stelle" from *Tosca*, is insensitive and unmusical. The score calls for a resolution to D minor at the end of the aria.

The most successful sections are those from *Lakme*, *Carmen*, and *Faust*. Here, at least, the orchestra exhibits some life.

The second record totals only thirty-five minutes playing time for both sides. This is rather skimpy by today's recording standards. There would have been adequate time to include excerpts from *Aida*. Criticism can also be made for the failure to insert separation bands between the selections.

Technically, the recording is good. There was some high frequency distortion in the *Madame Butterfly* excerpts that was not apparent in the balance of the recording. Until something better comes along, this set will have to do.

It might not be a bad idea for Columbia to reissue the excellent "Opera for Orchestra" series that Andre Kostelanetz did, or the marvelous excerpts of *Carmen* by Sir Thomas Beecham.

L.R.

Performance: C Sound: B+

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JAZZ, BLUES, AND THE MOTHERS

BERTRAM STANLEIGH

NO OTHER GROUP OF HIPPIE musicians displays the same amount of freedom, variety, invention, and lunatic good spirits as the West Coast group that calls itself *The Mothers of Invention*. Utilizing a variety of electronic sounds and an agglomeration of strange forms of percussin, they produce musical backgrounds for a vocal message that ranges from the eloquently poetic, to earthy good humor, to embarrassingly unfunny bathroom jokes, to simple high-spirited inanity.

Everything is approached in a rough, vigorous style that matches well with the long-haired, unwashed look of this undisciplined appearing crew. But thoughtful listening reveals that there is a substantial amount of careful work and genuine sensitivity behind this coarse facade. Music that sounds like little more than a rude joke on first hearing, reveals unexpected inner subtlety and charm after a number of repetitions.

Leader of the group, and composer of all its music, is a leonine-appearing fellow with a disheveled coiffure of shoulder-length ringlets, an ample moustache, and a small goatee. He is Frank Zappa, and on his new recording, his creative talents extend to the notes and artwork for the record jacket. Although his music stems from rhythm & blues and rock & roll, Zappa has tried to get away from the short composition of conventional length. He has combined a num-

ber of pieces of varying duration into record-side length works with a single programmatic theme and a close musical relationship.

Much of his dramatic effect is based on slow unison chanting of a type that derives directly from the theatre of Brecht and Weill, and he relies heavily on musical quotations for other effects. But the level of creativity in his work is high enough so that these devices are successfully incorporated into Zappa's own design. It is a far different result from the kind of vulgar shenanigans in which the late Spike Jones imposed his own musical nonsense upon the design of someone else's music.

Nonetheless, there is much of the same feeling of irreverent, zany fun-making about the Mothers that there was about the Jones band, and if you don't want to search for the superior craftsmanship and creativity of this new group, you can still enjoy this music on its surface level for its wacky sounds and earthy lyrics.

Side 1—#1 in a series of *Underground Oratorios*—is called *Absolutely Free*. It goes on for nearly twenty minutes of wailing, chanting, shouting, and groaning analogies about plastic people, prunes, beans, cabbages, and pumpkins. But for all its strangeness, it contains moments of truly haunting beauty as well as a robust spirit with which it is easy to identify.



Side 2—#2 in a series of *Underground Oratorios*—is called the *MOI American Pageant*. It deals with drinking, middle-class status symbols, the high-school dance, sex, and the country club dance. It adds up to a pretty cogent picture of the hippy's view of American society, and if it's a distorted view, it's still a pithy and clever commentary that makes some pretty telling digs.

Since its earlier two-record set for Verve, the *Mothers of Invention* have had one replacement and added a couple of extra performers to their ranks. Judging from the album notes, which are a bit difficult to decipher without an analytical guide, there are presently 7½ in the group. At times they manage to sound like a hundred.

The recording is vastly more successful than their previous set. A product of the same engineer and studio, it has probably benefited greatly from the experience gained at the earlier sessions. This is difficult sound to focus properly. Levels vary widely, and many of the effects rely on either close or distant miking. It all comes across crisply, with excellent perspective, and a reasonable helping of directional gimmickry.

The Mothers of Invention: *Absolutely Free*
Verve Stereo V6-5013X (\$5.98)

Performance: A Recording: B+

Letters from Readers

(from page 16)

Tuner, for example, is not a "monitor" as stated in the special features column, but a tuner designed for ultimate-quality FM stereo broadcast monitoring. (The price will be \$985 instead of the \$1200 listed.) The source for the Telefunken 086 Professional Monitor Loudspeaker System, Gotham Audio, was omitted. In addition, the number "4" under impedance should be deleted, leaving 4k ohms. Also, as a result of severe abbreviations in the microphone section, special features read as though what it said in each section applies only to the particular microphone in the main heading. Under specs, the following microphones are "equal": U-87 and U-67, KM-86 and KM-66, KM-84 and U-64, KM-83 and U-63. Beyer model DT-48s and DT-48SN headphones are marketed by Gotham Audio. All other Beyer headphone types, as well as Beyer microphones, are marketed by Elpa Marketing Industries.

HUGH S. ALLEN, JR.
Gotham Audio Corp.
New York, N. Y.

A temperature bug

■ The *Solid-State Wien-Bridge Auto Oscillator* (AUDIO, July 1965) is unstable with changes in ambient temperature. It either stops oscillating or the output waveform becomes distorted. Besides, some readers have had trouble obtaining the Veco 32A50 thermistor.

Here is how to improve performance of the oscillator by using an incandescent lamp as the amplitude control element. Substitute R25 with a 125 volt/3 watt lamp and the thermistor, T, with a 1500-ohm pot. Adjust the pot to obtain the lowest distortion and best stability. In my unit, this happened at around 0.5 volt rms output. The modified oscillator will operate satisfactorily with supply voltages from 24 volts down to 16 volts. In the original article, polarities of electrolytic capacitors are shown reversed.

CARLOS SOLIS
Fayetteville, Ark.

Spatial shift

■ I can foresee a problem which might occur in using Mr. Denny's limiter for stereo recording. [September, AUDIO].

It appears from his circuit that the two channels of the limiter are totally independent. This will work fine if the program material on one channel is totally independent of the program material on the other, as on some of the early "ping-pong" stereo discs. With normal recording techniques, however, some sources are picked up by both mikes. If limiting occurs on one channel, but not on the other (or to a lesser extent on the other), those sounds which are picked up by both mikes will appear to "shift" spatially toward the channel with the least limiting. To prevent this aural "jumping around" of musicians located between the mikes, most commercial stereo limiters determine the amount of limiting to be done from the sum of the two channels. Both channels are then limited equally, based on this sum signal. Thus, if a peak occurs in one channel, the other channel is also limited (even if it doesn't need it to avoid distortion) to preserve proper balance between the channels. In Mr. Denny's circuit, this could be accomplished by driving the filaments of both Raysistors from one amplifier, whose input is the sum of the two channels.

PETER WOLFE
South Boston, Mass.

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Jazz, Blues (Continued)

John Coltrane: Kulu Se MaMa
Impulse Stereo AS-9106 (\$5.98)

Side one of this recent experiment by the late John Coltrane is devoted to a composition by Juno Lewis, a drummer born in New Orleans in 1931 and now living in Los Angeles. The work consists of a ritual chant in an Afro-Creole dialect called Entobes, and an accompaniment that includes Lewis' performance on a percussion group that is made up of Juolulu, water drums, the Doom Dahka, bells, and a conch shell. The chanting is also done by Lewis, and a translation of his text is included on the album liner. The balance of the group on this 18-minute number consists of Coltrane, tenor, McCoy Tyner, piano, Jimmy Garrison, bass and bass clarinet, Pharoah Sanders, tenor, Elvin Jones, drums, and Frank Butler, drums.

This intensely emotional composition rises to several surging climaxes of very high volume level before ending in a soft, placid whisper. Lewis' interest is in the establishment of an international Afro-American Art Center, and proceeds from this album will contribute toward that dream. Side two of this set is made up of two Coltrane compositions, *Vigil* and *Welcome*. Tyner, Garrison, and Jones supply an accompaniment to a vigorous nine-and-a-half minute solo on the first of these two pieces. The second features fussy piano flourishes by Tyner and a rather syrupy theme player by Coltrane that is a bit too reminiscent of *Happy Birthday*.

Performance: B *Sound:* B

Rieber Hovde and Associates
Repeat Stereo 150/12 (\$4.79)

A lively, swinging organist whose improvisatory ideas have color and variety without wandering far afield from the melodic line, Hovde displays superior rhythmic poise and an unerring sense of taste in his selection of instrumental voices. His "associates" are two of the finest rhythm makers in the business, Shelly Manne, drums, and Leroy Vinnegar, bass. They play an agreeably mixed bag of music that includes *What Now My Love*, *On a Clear Day*, *Samba de Orpheus*, *Like Danny*, and five bouncy originals by Hovde.

There is an easy, informal, and relaxed feeling about these performances that would make this a worthwhile set under any circumstances. Both Manne

and Vinnegar are at the top of their form, and they can be heard with a clarity of detail quite different from that of any of their other recordings. That clarity is the result of the Barcus-Berry recording technique, a process that employs transducers affixed to the instruments instead of microphones. An article on this recording method appeared in *AUDIO* in May, 1965. That report, by Robert Hazelleaf, included several photographs of instruments that had been specially designed for direct wiring into the recording console. Whether Manne and Vinnegar are performing on these special instruments or on conventional ones is not made clear in the notes.

Hovde is heard on a Hammond "H" series instrument that I assume was fed into a single channel of the console from the output of the organ's amplifier and then split equally between the two channels of the stereo recording. The organ sound is smack in the center, and seems to be identical on both tracks. Bass is isolated on the left channel, and drums emerge solely from the right, except for a few very low-level upper-frequency impact sounds that probably represent crosstalk in my stereo cartridge. As in the earlier *Repeat* records I have reviewed, distortion is at the lowest level I have ever encountered on a disc recording. The bass is firm and detailed down to its lowest fundamentals. It goes down an octave to an octave-and-a-half below what we can generally hear on major labels.

The drum sounds are a bit unusual. Actual impact sounds are a trifle lighter than in conventional recordings, resonances are a shade more pronounced and their decay period is slightly more extended. This is most apparent in the cymbal work, but it is characteristic of all of the drum sounds. The same clarity of detail is heard in the drumming as in the other instruments. Whether the variation in timbre is acceptable to all listeners is a matter of question. I don't mind it, and it certainly makes possible some substantial improvements in getting sound into the grooves of a disc.

The technique has another merit pointed out by Shelly Manne in a quotation on the liner, "Now the rhythm section can group together in any comfortable placement and groove together, as they are recorded separately. We could even record together in our living room as the major acoustic problems have been eliminated."

Performance: A *Sound:* A+

Johnny Hodges: Blue Notes
Verve Stereo V6-8680 (\$5.98)

Hodges solos with a large band arranged and conducted by Jimmy Jones. Included in the group are such able sidemen as Snooky Young, Ernie Royal, Jerome Richardson, Jimmy Hamilton, Hank Jones, Don Ashworth, Kenny Burrell, and Joe Venuto, but aside from some harmonica solos by Buddy Lucas on *Rent City*, most of the attention is focused squarely on Hodges.

The nine selections offer a broad variety of mood and pacing, and the clean, spare arrangements by Jimmy Jones keep everything crisp and open sounding. Four Hodges originals include the title tune, *Broad-Walk, L.B. Blues* and *Say It Again*. The balance of the platter consists of *I Can't Believe That You're in Love With Me*, *Sometimes I'm Happy*, *The Midnight Sun Never Sets*, *Sneakin' Up on You*, and the aforementioned *Rent City*. Sound is bright and Hodges has never sounded more comfortable and relaxed away from the Ellington band.

Performance: A *Sound:* A

Lightnin' Hopkins: Something Blue
Verve Folkways Stereo V6-8684 (\$5.98)

Lightnin' Sam Hopkins from Houston, Texas is a blues singer of major stature and a guitarist of some ability. Born in 1912, he has been making records since the 1940s. His live appearances have been limited due to his reluctance to remain away from Houston, but his strong, nasal voice has been widely heard and admired on his many discs. In a previous review of Hopkins' recent recording on Arhoolie, I mentioned a rhythmic excitement not often present in the work of this singer. That excitement is not only still present on this new release from Verve Folkways, it has been further intensified, and there is a subtlety and refinement to his guitar playing that I don't recall in any of his past work. Some of the credit for the increased vigor in this new disc is undoubtedly due to the driving accompaniments of Jimmy Bond, bass, Earl Palmer, drums, John Ewing, trombone, and an anonymous mouth-harp but there has been a definite change of style. He sings *Shaggy Dad*, *I'll Be Gone*, *Shining Moon*, *Shake It Baby*, *Goin' Back Home*, *Good Times*, *What'd I Say*, *Don't Wake Me*, and *Talk of the Town*.

Performance: A *Sound:* B

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Sonic splendor

Ringling Bros. Circus Spectacular
London SP 44095 (Stereo) \$5.79

In case you haven't been to the circus in some time, I'm sure you've forgotten how many feasts for the ear a typical Ringling Bros. performance can provide. London Records has decided to remind us in this bristling-with-sound documentary.

Some of the sounds heard here are somewhat larger than life because London's recording crew was permitted to eavesdrop on the acts at a short distance never possible to the regular spectator. The technical wizardry expended on this album permits the stereo listener to drink in the whole panorama of an actual Ringling circus performance. The ringmaster's voice booms throughout the building as Merle Evans leads the band. Then, out of the general hubbub, very sensitive and highly-directional mikes pick out the sounds of the specific act that happens to be in the spotlight at the moment.

This album is easily the sonic highlight of the month. The crisp, wide-range sound of the band is only part of the story as the arena stereo mikes present a series of candid closeups in sound that is frequently startling in its realism. There are many exciting animal acts (elephants, dogs, seals, monkeys, and ponies) producing their characteristic sounds, but for sonic thrills you can't beat the closeup of the tiger act. The crack of the trainer's whip as recorded by London will offer the transducers of your playback system a steeper wavefront than any they've encountered in recent months. The roar of the tigers as they react to the cool voice of the trainer is one of the top moments of drama caught in the album. The best stereo effect is the

launching of Carlo, The Human Cannonball, in the left speaker and the thud of his landing in the net placed opposite your right speaker. Not to be dismissed as stereo spectaculars are the fireworks heard on all sides at the close of the program, an effect that is actually capped by the fluttering roar of 300 white doves of peace released into the air as the band plays the United Nations March by John Ringling North.

The average record is going to sound pretty tame after a sampling of this delight for audiophiles of all ages.
C.S.

Performance: A Sound: A

Off-Broadway winner

You're a Good Man, Charlie Brown
M-G-M (Mono) 1 E-9 OC \$5.79

One of the surprises of the past New York season occurred off-Broadway with the production of this captivating show based on the comic strip, "Peanuts." It's never an easy job to transfer to a stage characters that play their parts in the mind of a cartoonist and those of his readers. It may be added, in passing, that it's even more difficult to describe an original cast recording of a show that is based more on philosophical attitude than action in the stage sense.

A simple block buster of a character such as Superman can easily be projected on to a large stage as a recent season has demonstrated. The low-key philosophy of the Peanuts characters is something else again. A tiny stage off Broadway is the only logical outlet for their musings set to music. This average day in the life of Charlie Brown forms an unusual musical. A

piano and percussion are used mainly to underline the thoughts of Charlie, Linus, Lucy, Snoopy and the other Charles Schulz characters. Some of the titles, *My Blanket and Me*, sung by Linus, *Queen Lucy*, *The Red Baron* and *T.E.A.M.*, will immediately strike a chord with Peanuts readers. The dog, Snoopy, finds an important place in the cast in the person of Bill Hinnant. His by-now legendary battle with the Red Baron in the skies of World War I and a hilarious song and dance upon getting a delayed supper are the highlights of the show. The daily struggle with life in the "Peanuts" strip, usually lost, is neatly set forth in songs such as *Book Report*, *Summertime*, and *Little Known Facts*.

The finale of the show can't possibly lose with any audience as the entire company proceeds to recount what Happiness is, based upon the sayings found in the best-selling book. The music and lyrics of Clark Gesner hit just the right mood. Percussionist Lou Nazarro rates a special nod for the fantastic variety of musical effects he creates. The sound is crisp and natural in a closeup recording that captures the atmosphere of a small off-Broadway theatre.
C.S.

Performance: A+ Sound: A

Blockbuster

Offenbach-Rosenthal: *Gaite Parisienne*
J. Strauss II-Dorati: *Graduation Ball*. Philharmonia Orchestra. Charles Mackerras, cond.

Capitol SP 8654 Stereo (\$4.79)

Capitol has itself a blockbuster here. At least that is their intent. These are, from a musical point of view, two excellent readings of these peas-in-a-pod. Both the Offenbach and Strauss II are not original compositions. Both are assemblages made afterward by scorers (admittedly talented ones). Both are commissions for the ballet stage of works that were not necessarily created for this medium.

That doesn't stop either one from being a heck of a good show and a lot of listening fun. Capitol has attempted to take full advantage of this fact by spreading them over a super-wide stereo stage and boosting the top end (just a little). The net result is all the ingredients for an excellent show-off record.
M. R.

Performance: A Sound: B

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Three Singers

Margaret Whiting: *Wheel of Hurt*
London PS 497

It's awfully easy to lose track of good singers if, for some odd reason, they disappear from the spotlight for several years running. At one time, Margaret Whiting's name was virtually a household word wherever good singing was appreciated. Her version of *Moonlight in Vermont* would have made any vocalist popular. In later years, I recall an outstanding album she made for the Verve label called "The Jerome Kern Song Book," a model of its kind. Miss Whiting's has always been a totally unforced style of singing that only a small handful of vocalists possess. No musical assignment appeared to give her any difficulty, an understandable trait since her father was Richard Whiting, one of the country's top song writers. Then in recent years Miss Whiting's albums grew fewer and fewer in number until the beginning of 1967 found her with only two LP recordings in the catalog. A release dating from 1959 on the Dot label and a 1965 recording for a just-about-unknown outfit called Hamilton.

Along with this album's title tune is to be found such solid fare as *Winchester Cathedral*, *Somewhere There's Love*, *Where Do I Stand* and Jule Styne's *Time After Time*. Rounding out the roster of Miss Whiting's debut appearance before London's microphones are *World Inside Your Arms*, *But Why, Nothing Lasts Forever* and *Show Me A Man*.

It's a genuine pleasure to find Margaret Whiting busy again on records and for no less an organization than London. The change in her fortune is explained by the success of her hit single recording of *The Wheel of Hurt*. Whenever possible these days, every label lucky enough to snag a hit in the single record market incorporates that selection in a followup LP album. Old-timers may find it a bit disconcerting to hear the familiar Whiting voice on a program of songs tinged with a modified rocking beat but there's no mistaking the talent or the personality. C.S.

Performance: A

Sound: A

John Gary: *Spanish Moonlight*
RCA Victor LSP 3785

It's hard to say whether tenor John Gary owes more to records or televi-

sion for the very real success he has enjoyed in recent years. There is no denying the fact that his television series gained him the mass audience required to put a performer over the top into the big money. Yet I prefer to think that, of the two media, Gary's long string of record albums on the Victor label has done a more accurate job of reproducing the phenomenal range of his lightly soaring voice. The first Gary disc demonstrated to listeners that this was a voice able to handle itself with total ease in the very few upper reaches of the staff where few tenors, with the possible exception of Victor colleague Sergio Franchi, are willing to travel in a popular tune.

For his twelfth album, John Gary has tried something a bit different. *Spanish Moonlight* offers lyrics in Spanish as well as in English, following six weeks of diligent study of a tongue strange to the singer. Two selections alone, *Paloma* and *Granada*, are worth the extra effort that sets this entire album apart from today's vocal discs. The Marty Gold arrangements play no small part in the recording's cumulative impact. c.s.

Performance: A+ *Sound:* A

In My Life: Judy Collins
Elektra EKS-7320 stereo

This Judy Collins, she weaves a spell quite like no one else. There is a cohesive *whole* to this album of songs that is hard to pin down. Yet I find myself captivated by this first encounter with the rising star.

That she has a way with a song, be it folk song, or semi-folk, is on the record for all to hear. It is interesting that Elektra seems as mystified as me, for there are no liner notes, simply the titles of the songs. She ranges from the *Tom Thumb Blues* of Bob Dylan through a marvelous *Pirate Jenny* (*Threepenny Opera*), to four thought-provoking selections from *Marat/Sade*. The final song is the title song, the gentle Beatles number, *In My Life*.

Perhaps the best characterization that can be applied to all eleven numbers contained on this disc is that they are demanding of complete attention. Neither Miss Collins in her interpretations, nor the music itself, allows indifference by the listener. R.L.L.

Performance: A *Sound:* A

Mark Twain a la Holbrook

Hal Holbrook—Highlights from the CBS Network Special: Mark Twain Tonight! Columbia OL 6680/OS 3080, \$5.79

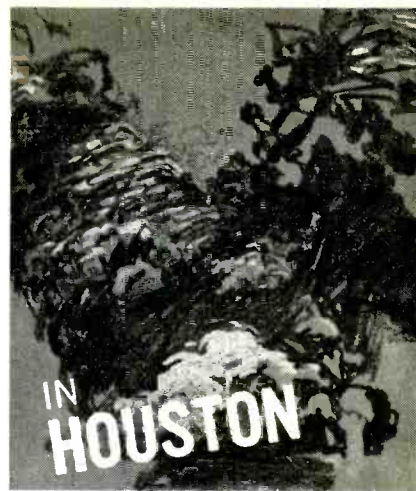
There were two earlier Mark Twain recordings from Hal Holbrook on Columbia which have often had me rolling merrily in the aisles of my living room. Terrific. This one is a sequel, even though technically it was part of a TV show whereas the earlier records were made out of the live theatre performance. They all sound alike, all with the same gravel voice, the same marvelous double-takes and triple-takes, the same big audience of people practically choking themselves with appreciation. It's a great show on records, wherever it originates.

In a way, this one is even better than the earlier pair of discs because it is more pointedly organized, with the purely gag-like material on the first side and a carefully shaped collection of more serious commentary by Mark Twain (though still full of laughs) on the second side.

Interestingly, the timing is absolutely perfect for every laugh, every long, pregnant silence, even though the show was originally meant to be seen as well as heard. Extremely intelligent editing of the TV tape? Could be. Somebody knew what he was doing, all right. (Have you ever listened to a TV gag show minus the picture? Sometimes it makes no sense at all.) One of the funniest sequences of this record, in fact, is the one where Mark Twain imitates an old man telling a long, rambling story about a ram—he keeps getting off the track and, finally, falls sound asleep right in front of you, to the most lovely collection of old-man gargles, grunts and long, long pauses you ever heard. Superb! You're practically looking down his scrawny windpipe, even without a picture.

P.S. I went to the "live" Hal Holbrook Mark Twain Show last year and, after the records, found it strangely disappointing. Not half as good. It was too far away, it wasn't as well timed, nor as well organized. And after awhile got terribly tired looking at that distant white-suited figure, 'way off down on the stage, cupping my ears trying to hear him. It's amazing how often, these days, a phonograph recording or tape does a better job of entertainment than a live show. It's a *great* medium, ours, if you ask me. E.T.C.

Performance: A *Sound:* B+



**SHURE
MICROPHONE
BURNED
IN
CLUB
BLAZE**

This Shure 55SW Unidyne survived a very hot time the night Rosalie's Club burned in Houston. Even though the heat melted the hard plastic section of the switch plate, the microphone was in almost perfect working order. But, since Shure routinely tests microphones at a searing 185° F. for day-long periods, it wasn't particularly surprising that after the fire

**... IT STILL
WORKED**

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SOUND SENSE

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Convert Your Audio Analyzer to Stereo

(Continued from page 30)

LECTOR SWITCH up or down. Note that the loads placed on the equipment under test by the LOAD SELECTOR SWITCH remain attached to the equipment regardless of the position of the INPUT SELECTOR SWITCH. This is an invaluable feature when testing power amplifiers.

In cases where MPX stereo decoders are to be adjusted and separation measured, the output of the "on" channel is measured, then the INPUT SELECTOR SWITCH is switched to the "off" channel. The difference between the two meter readings expressed in dB is the separation. At the same time, the oscilloscope shows the nature of the residuals in the "off" channel.

A word of caution is in order concerning the use of the instrument, either with or without the modifications described in this article. Manufacturers of some stereo power amplifiers ground the 4-Ohm tap of the output transformers (there are still some around, you know) to the chassis, leaving the common taps floating at some potential above ground. This practice has the perfectly valid objective of providing an L plus R signal for a center channel speaker. If you are testing this type equipment, ground the 4-Ohm tap of the transformers to the IM-22 and attach the hot leads to the common taps. Use the 4-Ohm load resistors in the IM-22. The 8- and 16-Ohm outputs on this type of equipment cannot be used for tests with the IM-22.

Violations of this warning will result in shorting a portion of the output transformer secondary, with reduced output and serious distortion. Furthermore, it is not conducive to long life of the output tubes. Also, a few solid-state stereo power amplifiers are designed so that damage will result if the loudspeaker grounds are connected together. In such cases, only one channel at a time may be connected to the IM-22. A separate load resistor will have to be used for the other channel. \AA

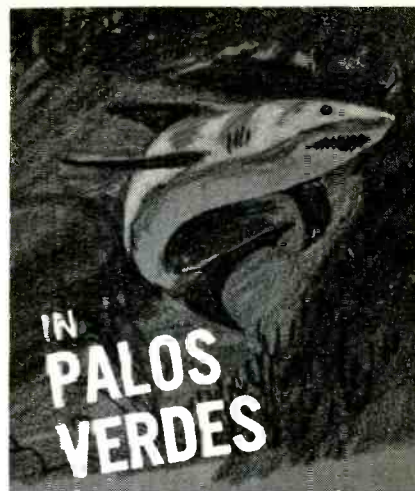
Acknowledgement is made to Mr. R. S. MacCollister's contributions to this modification project.

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Acoustech, Inc.	117H, 118H	KLH Res. & Development	108H, 109H
Acoustic Research, Inc.	101G, 102G	Koss/Rek-O-Kut	120H
Altec Lansing	56E, 57E	KRHM Radio	52D
Audio Dynamics Corp.	81G	James B. Lansing Sound	115H, 116H
AUDIO Magazine	34C	Marantz	112H
Aztec Sound Corp.	136H, 137H	Martel Electronics	79G
BASF/Compton, Inc.	14B	Nikko, Ltd.	133H
Benjamin Electronic Sound Corp.	124H	North American Philips Co.	28C, 32C
Bogen Communications Div.	106H	Pickering & Co., Inc.	72F
The R. T. Bozak Mfg. Co.	87G, 88G	Pioneer Electronics USA Corp.	49D
British Industries Corp.	93G, 94G, 107G	Roberts Electronics	22B
BSR (USA) Limited	132H	Sansui Electronics Corp.	39D
David Clark Co.	51D	H. H. Scott, Inc.	122H, 123H
Compass Communications	125H	Sharpe Instruments, Inc.	33C
Concertone, Inc.	78G	Sherwood Electronic Labs	85G
Dynaco, Inc.	121H	Shure Brothers, Inc.	67F
EICO	50D	Sony Corp. of America	126H, 127H
Electro-Voice, Inc.	114H, 119H	Sony/Superscope	16B, 20B
ELPA Marketing Industries	26C, 27C	Stanton Magnetics, Inc.	60E
Empire Scientific Corp.	75F	Superex Electronics	21B
Fisher Radio Corp.	86G, 96G, 98G	Tandberg of America	76F
Grado Laboratories	68F	Tannoy (America) Ltd.	38D
Grundig, Triumph, Adler	134H	TEAC Corp. of America	15B
Harman-Kardon, Inc.	63E, 64E	United Audio Products, Inc.	130H, 131H
Kenwood	103G	University Sound	128H, 129H
		Utah Electronics	71F



**SHURE
 MICROPHONE
 ATTACKED
 BY
 OCEAN
 TERROR**

This Shure hand-held microphone was suspended over Marineland of the Pacific to pick up the "voice" of a porpoise. An undiscovered pinhole break in an external protective plastic cover subjected the unit to ruinous salt spray for months on end. But since Shure routinely tests microphones with salt spray, it wasn't particularly surprising that after being corroded beyond recognition

**... IT STILL
 WORKED**

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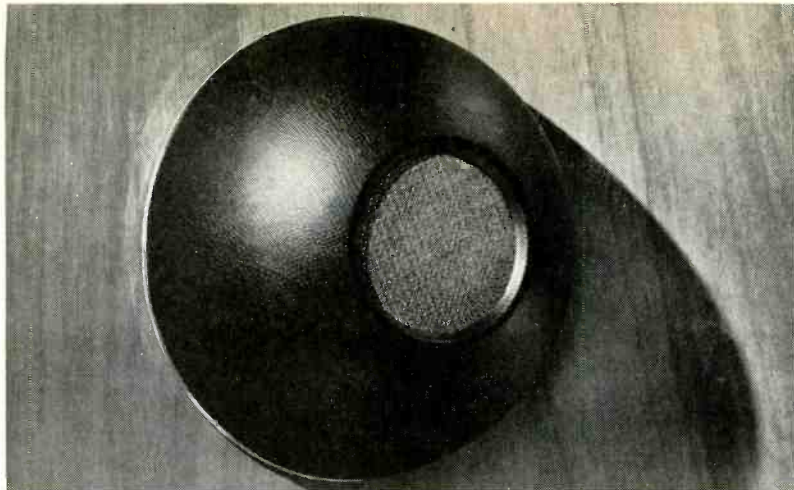
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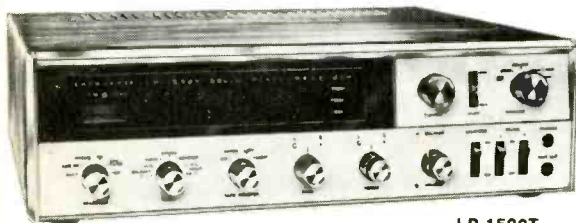


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EQUIPMENT PROFILE

(Continued from page 58)

**ELAC STS 322 "Studio Stereo
 Professional" Cartridge**

MANUFACTURER'S SPECIFICATIONS—
 Frequency response: 20-20,000 Hz \pm 2d B.
 Sensitivity: 10 mV/10 cm/sec at 1 kHz.
 Difference between channels: 1.5 dB.
 Crosstalk: -26 dB at 1 kHz. Intermodulation:
 Less than 2% at 24 cm/sec at 400/
 4000 Hz using 2.5-gram stylus force. Stylus
 force: 1.5-3 grams. Static Compliance:
 12×10^{-6} cm/dyne. Diamond tip radius:
 0.50 mils.

The Elac Model STS322D is a moving-magnet type stereo cartridge, which means that the generated voltage is proportional to the inverse square of the distance between the magnet and the pole pieces. The moving magnet induces this voltage in a stationary coil which has several thousand turns of very-fine-gauge wire to produce a usable output. In this case, the output was measured at 4.7 mV and 4.8 mV, left and right channels, respectively, at 1000 Hz referred to 3.54 cm/sec rms 45-deg. velocity. This is equivalent to about 13 mV/10 cm/sec, provided the 10 cm/sec is a 45-deg. velocity, in which case the cartridge exceeds its specification of 10 mV/10 cm/sec.

The pull-out stylus assembly, which is replaceable by the user, has a stylus which retracts into a semi-tube when excessive pressure is exerted on the stylus. The protection is limited, however, because the stylus shoe bottoms before the stylus disappears entirely and the tube makes contact with the record. The cartridge comes with a supporting clip that mounts onto standard half-inch centers and, therefore, should fit most tone arms.

For our tests the model 322D was installed in a Miracord Model PW50H automatic turntable; tracking force was set to 2.2 grams. Frequency response and separation, as shown in the accompanying graphs, is excellent. Note

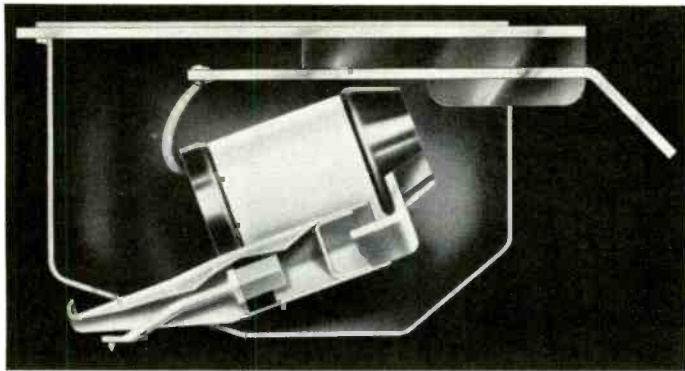


Fig. 17 — Cross-section drawing of the Elac 322 stereo phono cartridge.

the balance between channels throughout the range. The curves also reveal a slight drop on the upper treble, followed by a peak at 16 kHz. The overall response was found to be 20-20,000 Hz ± 4 dB, with crosstalk at 1000 Hz averaging -22 dB for both channels. Above 16 kHz, separation dropped to 7 dB.

The 322D cartridge tracked all discs well. Intermodulation distortion, as derived from the CBS Labs STR111 test record, was average for a moving-magnet design. The unit's response to square waves is shown in Fig. 19. Minor ringing at the start of each cycle, most likely caused by the 16-kHz peak, characterizes the response to a square wave. Vertical tracking angle

was determined to be between 11 and 16 degrees, using the CBS Labs STR160 test record. Hum susceptibility of the cartridge is judged to be low—a 53-dB dynamic range from the cartridge was measured through a wide-band RIAA preamp.

Listening tests revealed a pleasant surprise in the cartridge's crispness and in even response. Recorded male voices sounded natural and percussion instruments retained their sheen. It is a fine-sounding cartridge, worthy of consideration in its price class as a companion to an automatic turntable. Model 322D (with radial diamond stylus), \$26.50; Model 322E (with elliptical diamond stylus), \$32.50. *AE*

Check 112

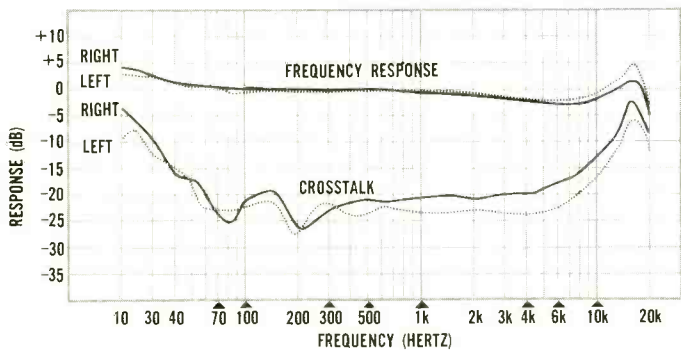


Fig. 18—Frequency response and cross-talk characteristics.

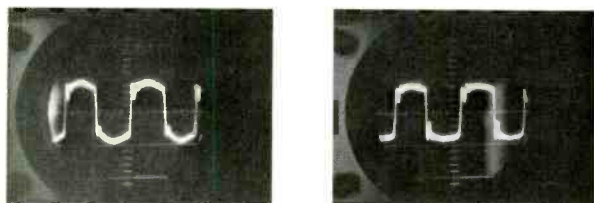
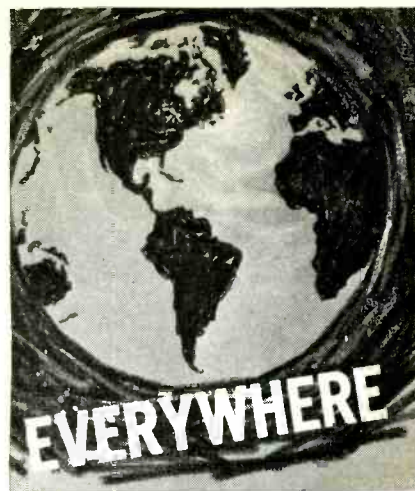


Fig. 19—Response to a 1000 Hz square wave (CBS Labs Test Record STR111): (Left) shows left cut played with left channel; (right) lateral cut with right channel.



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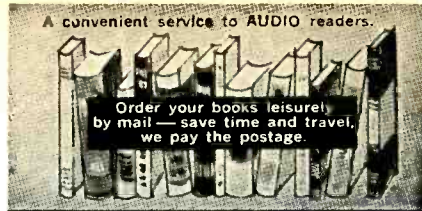
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AUDIO ETC.

(Continued from page 16)

nation of the brand new, the continuing, the redundant and duplicative *mono* disc.

Millennium

Just think. If all mono releases were instantly eliminated, new and old, right now, our record dealers' stocks would virtually be cut in half, with only marginal loss of catalogue! Thousands of miles of shelving, hundreds of tons of vinyl, enormous reams of card files and labels, billions of order sheets, countless square acres of cardboard shipping boxes . . . In fact, I'm inclined to suggest that when the day of the Millennium finally arrives, it would be worthwhile simply to destroy all mono stock in one enormous operation, overnight. Dealers could send it all back to the record companies in trucks, at a scrap trade-in value. Or maybe at manufacturers' prices, in exchange for stereo!

Actually, something of the sort will happen, though not as drastic. The monos will be sold off and junked, just as the 78s were, 'way back, via successive sales, dwindling gradually in volume and lowering gradually in price. Inevitable—once stereo is universal on all *discs*, however they may be played.

I must admit that I gasped when I

heard what some big U. S. companies had done to meet the changing challenge of the mono phase-out. *Raise* the mono prices—in the face of all the new low-price record competition???? Astonishing move! Offhand, you might expect a decrease in mono prices, as per the usual spate of sales on a semi-obsolete type of disc.

But I think I now see the logic. It isn't the old, discontinued monos that are up in price. It is that crucial type, the new or continuing mono release, which is costing you more. Brand new releases, just out. Equally important, older releases that are *kept in the catalogue*.

Remember—that means an immense supply, shipping, and ordering operation, as it always has. We all recall the infamous "cut outs" during the war years, at the time of the early LP era and, once again, when stereo came in.

Once un-catalogued, a record is officially dead (though it can be brought alive again at any time, if opportunity knocks for profit). In the catalogue, it must be maintained in supply, repressed, shipped—in a word, kept "available." A big word, that. And so, we can understand, the "available" mono LPs are now going to cost more because of the dwindling demand and hence higher upkeep costs. Really, quite reasonable.

(I can still buy blank stereo color slide mounts, to do up my own stereo pictures at home, as I like to do. But the price has gone up. And whereas Kodak used to do free stereo mounting, or return the roll unmounted at a lowered price, now there is an "extra" charge for stereo mounting and no reduction at all for returning the film unmounted. But I am thankful I can get my pictures mounted at all. I can't really complain about the price; it is what keeps my operation alive.)

Mono sales

When will the U. S. mono disc really disappear?

What will probably happen is, again, the *gradual* phase-out, with prices adjusted to pay the overhead for mono continuing releases, with a continuing spread of stereo phonographs and—more important—stereo cartridges for all machines of any sort, stereo or mono. Soon (maybe already) the mono sales will begin. That is, sales of un-catalogued items, which will rapidly proliferate. There are millions available already. Bargains. But there's no rush. It will take years to get rid of all that vinyl hanging around. Take your time. Æ

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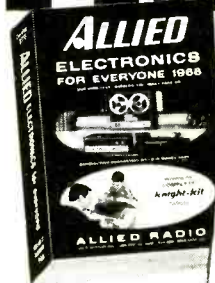
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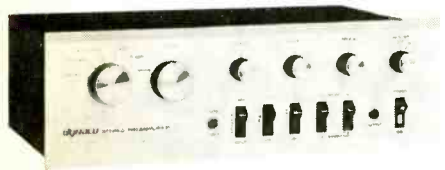
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