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AUDIO

STEREO EQUIPMENT & RECORD REVIEWS

FEBRUARY 1969 60¢

HOW TAPE BIAS CONTROLS FIDELITY

SPECIAL REPORT: ELECTRONIC VIDEO RECORDING CARTRIDGE

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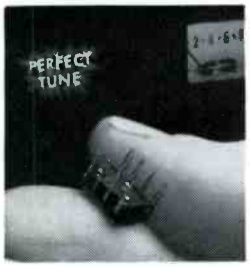

A light that snaps on automatically when you're perfectly tuned:
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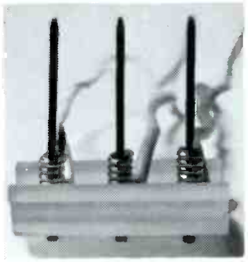

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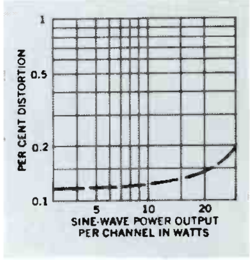

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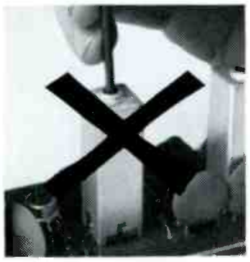

A quartz crystal lattice filter IF section:
Regardless of age or operating temperature, your 342C IF amplifier will never need realignment.

New IC Multiplex section gives better performance and reliability in FM stereo:
No larger than a cigarette filter, Scott's exclusive Integrated Circuit contains 40 transistors and 27 resistors.

Printed circuit modules snap into main chassis:
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PLUS THESE FAMOUS SCOTT FEATURES:
■ Silver-plated Field Effect Transistor front end ■ Integrated Circuit IF strip ■ Integrated Circuit preamplifier ■ Field Effect Transistor tone control ■ All-silicon output circuitry.

CHECK THIS UNBELIEVABLE PRICE:
342C 100-Watt FM Stereo Receiver . . . . only $259.95!

342C Specifications:
Power: IHF ±1 dB @ 4 Ohms, 100 Watts; IHF ±1 dB @ 8 Ohms, 80 Watts; Cont. Output, single channel, 8 Ohms, 30 Watts; IHF Sensitivity, 1.9 μV; Frequency response ±1 dB, 20-20,000 Hz; Cross modulation rejection, 80 dB; Selectivity, 40 dB; Capture ratio, 2.5 dB. Prices and specifications subject to change without notice. Walnut-finish case optional.

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Successor to RADIO, Est. 1917

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Number 65 in a series of discussions by Electro-Voice engineers

ON FLATTENING FEED BACK

WILLIAM RAVENTOS
Field Engineer

Much has recently been written about the sonic problems of typical auditoriums and the affect of poor room acoustics on sound system design. In an effort to better understand the extent of this problem, a series of laboratory tests of room response was conducted in a variety of community and university auditoriums.

Using a "pink noise" generator and a 1/10-octave band pass filter, plus calibrated transducers, each auditorium was curved from 20 to 20,000 Hz (obtaining usable information from 60 to 18,000 Hz). Composite or average curves were computed from 30 separate locations in each room. These curves were remarkably similar and distinguished by a lack of sharp peaks and dips. In short, the rooms studied were relatively flat, with no pronounced deviations in response.

Techniques for narrow-band filtering to compensate for both room and sound system response variations have gained prominence lately, and for good reason. In many installations such methods provide markedly higher gain before feedback, permitting installation of a successful system in environments that would otherwise be notably deficient.

But such elaborations are expensive and complex, demanding considerable experience and knowledge to install correctly. Our studies have convinced us that the use of truly flat transducers can achieve virtually equal results in the majority of auditoriums at greatly reduced cost while retaining simplicity and reliability.

Unfortunately, many highly-regarded sound reinforcement transducers are far from flat, and may themselves introduce serious flaws in system response. Faulty placement of speakers can also create response problems and hinder good coverage. The addition of narrow-band filtering to such a system may achieve the desired final result, but at the expense of greatly increased cost compared to flat, unfiltered, peak-free components.

In any event, if flat response is the desired goal, it seems logical to begin with flat transducers, adding filtering only as needed to complement the characteristics of the room. Experimental results so far confirm the value of this approach in terms of both audible performance and ultimate cost.

For reprints of other discussions in this series, or technical data on any E-V product, write: ELECTRO-VOICE, INC., Dept. 293A 602 Cecil St., Buchanan, Michigan 49107

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Coming in March 1969

Five-Channel Stereo at Home — The author, Ernst Baenninger, contends that a five-channel stereo system obtained from an ordinary two-channel source will improve the stereo effect and greatly extend the stereo listening area.

Layman's Guide to Amplifier Specifications — Continuing this Audio series, which previously examined tape recorder specifications and FM tuner specifications, here's a close look at specifications of audio amplifiers, whether separate or as part of an FM stereo receiver.

Tuning Aids in FM Receivers —Leonard Feldman discusses the various visual tuning aids used in FM receivers in this installment of ABZ's of FM.

. . . and more.

PLUS: Equipment Profiles, Record and Tape Reviews, and other regular departments.

ABOUT THE COVER: A buyer of stereo components should be armed with enough knowledge to make a judicious selection. **The Layman's Guide to FM Specifications** will help him do that by taking some of the mystery out of specifications. As a result, manufacturers' literature and Audio equipment reviews will become more meaningful. See page 21.

Audioclinic

JOSEPH GIOVANELLI

Shorting Unused Inputs

Q. I was most interested to read your article in AUDIO *on "Organizing a Patch Panel."**

I followed your general principles quite well until the end of the article, beginning with your fourth paragraph from the end, where you discuss removing the shorting feature from your preamplifier. May I ask for a more definitive explanation of this paragraph?—Alfred W. Wagner, M.D., Sacramento, California

A. In order to explain the motivation behind the removal of the shorting feature found in most preamplifiers, it might be well to review its operation.

When you switch your preamplifier to, let us say, the "phonograph" position, all other input sources are disconnected from the preamplifier so they cannot be heard at the same time the phonograph is operating. However, because of capacitive leakage in the switches, some signal can find its way into the preamplifier circuit from some of these undesired sources. In other words, if the tuner is operating at the same time the phonograph is being used, some slight sound from the tuner can be heard. This sound can be objectionable.

Therefore, preamplifier designers have taken further steps. In addition to disconnecting the unused input sources, they place shorts to ground on all such sources, except the one actually selected at the front panel by the listener.

There are, however, instances when it might be convenient not to have such a shorting feature present. Suppose you wish to make a tape recording from some program source, such as your tuner. During the course of the recording, you might wish to monitor the signal from your tuner, but, in general, you wish to listen to a phonograph record. If patches are set up in such a way that this monitoring can be accomplished by switching from source to source at the front panel, you will run into trouble. As soon as you switch to the "phono" position, the tuner's output will be shorted, not just in terms of the preamplifier's requirement, but also, in terms of the recorder's needs. The recording would be ruined. Thus, removing the shorting feature will eliminate this source of difficulty.

I just finished saying, however, that, if this feature is removed, there is likely to be a considerable amount of leakage. Leakage will be apparent when the source being listened to is of a high-impedance output. If the source is an emitter- or cathode-follower output, no such leakage will be heard. The built-in phonograph portions of preamplifiers having tubes are not low-impedance circuits. Thus when they are in use, there is no shorting feature present, and some leakage will be apparent.

However, from the standpoint of greater flexibility and convenience, I suggested that it would be well for a serious experimenter to have a separate phonograph equalization circuit, not included in the preamplifier. Such an arrangement could be designed to have a low output impedance, just what the doctor ordered for the elimination of leakage.

It all comes down to the fact that you should not remove the shorting deck in your preamplifier unless only low impedance sources are used. If some sources are of high impedance, you should leave the preamplifier as it was designed.

I suppose that the remaining question is "Why does the low-impedance output act to remove the leakage?"

The answer is that the input circuit is shunted by a low-impedance source. The capacitive reactance of the switch is so high compared to the shunt on the input circuit that no significant leakage voltage can be developed across the low impedance input. We have, in other words, a voltage divider.

You may say that the input is a high-impedance one, perhaps a half megohm. This may be true, except that, seen from the point of view of the leakage source, it is now a low-impedance input since it is shunted by a low-impedance circuit. To make this plainer, what difference does it make if the preamplifier has a half-megohm input if it is loaded by a 100-ohm resistor?

* *Audio Magazine* "Audioclinic" November, 1966 issue.

Excessive Hiss

Q. Why must transistorized preamplifiers sound noisier than tube types? For the past five years I have had a tube-type stereo music system. It was extremely quiet. I could hear no hissing even when only a few feet from my speakers.

I recently changed my amplifier and preamplifier to transistorized units.

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State of the art in automatic turntables. Be critical. Motors: 3 types—2 good—1 better

The Induction Motor . . . most popular, least accurate. Most automatic turntables are built around induction motors. Some are given special names (usually describing their pole structure or starting torque). When well designed and manufactured, they have high starting torque . . . get the platter up to full speed quickly . . . and are relatively free from rumble. But, the rotor of the induction motor "slips" in relation to the magnetic field and varies the motor's speed with changes in power line voltage, turntable load and temperature. Under less than ideal conditions, as in your home, these speed changes can raise or lower not just the tempo, but the pitch of your recorded music.

The Synchronous Motor . . . correct speed, incorrect choice. At first glance, the ideal turntable motor would seem to be the conventional synchronous type. This rotor never "slips" to affect turning accuracy because it is locked in to the precise 60-cycle frequency of the power supply. Turning speed cannot vary when voltage fluctuates . . . when room and/or motor temperatures change . . . or when record loads increase. However, the conventional synchronous motor also has its drawbacks. Starting torque and running power are often too low. And, to increase the torque and power means to increase noise and rumble levels . . . and involves disproportionately high expense.

The Synchro-Lab Motor™ . . . perfect speed, perfect choice. A motor that combines high starting torque *and* synchronous speed accuracy has obviously been needed. The Garrard Laboratories designed the Synchro-Lab Motor to meet these needs, by combining the advantages of both types of motors. This new synchronous motor reaches the correct speed instantly and locks in to the 60-cycle current . . . no matter how the power line voltage varies . . . or the temperature changes . . . or how many records you play at one time. For the many people whose musical senses are easily distressed by variations in pitch, the Synchro-Lab Motor will be a constant assurance of listening pleasure.

There are, of course, other benefits which stem from the Synchro-Lab Motor, notably the elimination of the need for variable controls to obtain proper speed, and of heavy turntables which tend to cause rumble through accelerated wear on the important center bearing over a period of use in your home. The Synchro-Lab Motor powers five Garrards, priced from $57.50 to $129.50 for the SL 95 Automatic Transcription Turntable shown above. These units incorporate other Garrard-engineered innovations such as anti-skating compensation; cueing and pause controls; highly advanced, low-mass tonearm systems. Feature-by-feature descriptions of all models are to be found in a complimentary Comparator Guide. Let us send you one. Write Garrard, Dept. AB1-9, Westbury, N.Y. 11590.

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numerous refinements . . .
place Crown CX822

IN A CLASS BY ITSELF"

— AUDIO MAGAZINE

CROWN CX822 reviewed by Audio

To Crown owners, Audio's evaluation comes as no surprise. They know that every Crown meets or exceeds its specifications. Your own Crown CX822 will deliver the same "phenomenal performance" as the one tested by Audio magazine. You will find, as Audio's engineers, that "the new Crown CX822 is capable of providing the most faithful reproduction of sound through the magnetic recording medium. . . to date." You will also agree with Audio, that "to truly appreciate this machine, you must use it." Your Crown dealer will help you select the Crown model to meet your exact needs.

CX822

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Check No. 4 on Reader Service Card

Both of these are so noisy (hiss) that I can hear them 20 feet away from my speakers. I have had them checked and both meet specifications.—Clyde E. McNeilly, Richland, Wash.

A. I think that some transistor circuits tend to be noisier than tube circuits, but not to the extent you described in your letter. What I think must be happening is that your power amplifier is too sensitive for the preamplifier you are using. This is especially possible when you are using highly efficient speakers.

If the power amplifier has a gain control, turn it down a bit so that the hiss level will become less annoying. You will then need to turn up the gain on your preamplifier somewhat to compensate for the higher signal voltage required to drive your amplifier.

In the event that the hiss level varies with the setting of your preamplifier's volume control, the preceding is not the solution, and you will have to check further. Perhaps you have a cartridge which provides too low an output signal to drive the preamplifier adequately. Perhaps, despite what your service man stated, there is indeed something wrong in the early stages of your preamp.

Balance Controls

Q. I would like your opinion regarding certain features of stereo amplifiers.

Do separate controls offer any advantages over a balance control? Also, what type of control is used for this purpose?

I have always felt that a balance control and a master gain control were more convenient. Of course, some amplifiers have individual gain controls for each channel. The one I am using now has this plus a master gain. I feel that a balance control would be easier to adjust than separate gain controls.

I would assume the correct type of control to use would be a potentiometer having a linear taper and enough resistance so that the middle of it does not load the circuit. However, with a linear taper, the attenuation of each channel occurs rather abruptly instead of gradually as would be desired. This stands to reason because a logarithmic taper is required for a gradual audio attenuation. But if a logarithmic taper is used, the mid-range balance would be crowded at one end of the rotation of the control. This is undesirable. Am I wrong to expect gradual attenuation of each channel? Would you explain please how this is correctly accomplished on amplifiers so equipped? Is it practical to add such a control to an amplifier not having one?—Richard Storey, New Orleans, La.

A. I would say that in general the home user of high fidelity equipment will find it more convenient to have an amplifier equipped with a master gain control and a balance control rather than separate gain control for each channel *and* a master gain control. If the equipment is to operate for purposes other than for stereophonic sound reproduction, however, you would want to have a master gain control and separate input level controls for each channel. This would be the case if you had a cueing arrangement on one channel and the main program on the other. I have built equipment like this for my own recording studio. Most of the time I use the equipment as a straight stereo amplifier. However, sometimes I check one recording while cutting another. I can hear the playback of the just-cut disc on one channel while still listening to the next disc being cut on the other channel. I also use the system as a means of cueing up various sources and still monitoring a main program. Few owners of home music systems will require such an arrangement.

If you want to have a nice balance control, you would want one potentiometer to have a clockwise log taper and the other potentiometer in the balance control to have a counterclockwise log taper. Of course, there are schemes wherein there is only one pot section serving as the balance control. Under these circumstances, a linear taper is the best. You have hit on the reason for that.

There is another consideration which enters into the picture, as I see it. You might want a balance-control circuit designed so that it does not attenuate one channel completely when rotated to an extreme position. Perhaps it might be well to have a balance control which attenuated a channel no more than six dB. This would make for a smoother control action, giving you the gradual approach in which you are interested. Some manufacturers do take this approach, while others believe that there are advantages in allowing a channel to be completely cancelled at the extremes of rotation of the balance control.

The scheme wherein the attenuation of either is not complete at the extremes of pot rotation will allow the designer to use a linear pot and have none of the problems associated with rapid changes in channel balance with small rotations of the control.

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Ask Stereo Review.

Their latest cartridge report rated it #1 in lightweight tracking ability.

And charted its frequency response as virtually flat.

With a picture-perfect square wave.

Ask England's HiFi Sound.

They call it "a remarkable cartridge . . . a real hi-fi masterpiece."

And find it "unlikely to wear out discs any more rapidly than a feather held against the spinning groove."

Ask High Fidelity.

They know the 999VE needs "only 0.8-gram stylus force to track the demanding bands 6 & 7 of CBS test record STR-120, and the glide tone bands of STR-100."

And gives a frequency response flat within "+2.5, —2.0 dB from 20 to 20k Hz" on both channels.

Ask England's Records and Recording.

They say it's "a design that encourages a hi-fi purist to clap his hands with joy"

Ask Popular Science.

Their ultimate stereo 'dream' system, created by Electronics Editor Ronald M. Benrey, features a 999VE.

Why? Because "its performance is impeccable."

Ask any stereo expert.

Then ask yourself what you've been waiting for.

THE 999VE • $74.95

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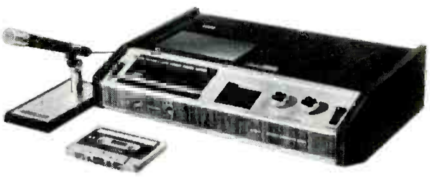
What's New In Audio

Stereo Cassette Tape Deck

Harman-Kardon's new Model CAD4 "Professional Stereo Cassette Tape Deck" incorporates a narrow-gap tape head, permitting high-frequency response beyond 12 kHz, according to the manufacturer. Among the recorder's features are: two large, illuminated VU meters located on a sloping front panel; a recording overload indicator light

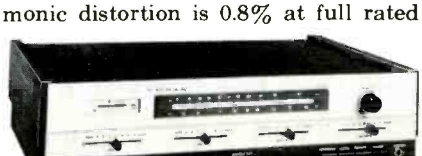


that is triggered at +2 VU; automatic shutoff at the end of the tape; push-button operation; tape footage counter; and stereo microphone inputs. With an enclosure made of heavy-gauge steel, and walnut end caps, the unit weighs ten pounds. Priced at $159.50.

Check No. 6 on Reader Service Card

New FM-Stereo AM Receiver

Bogen Communications Division of Lear Siegler, Inc. announces Model DB250, an AM/FM solid-state stereo receiver which features resonant ceramic filters. The all-silicon unit has an FM selectivity of 60 dB and a rated output of 75 watts (IHF). Mounted on the brushed gold and walnut panel are pushbutton controls (for function, speaker selection, loudness compensation, mode, and power) and slide controls (for bass, treble, balance, and volume). IC's FET's, modular construction, and automatic gain control as well as a stereo minder light, loudness contour switch, FM and AM antennas, and tape output facilities are other characteristics of the unit. Harmonic distortion is 0.8% at full rated



output; frequency response is 20 to 20,000 Hz; and balanced-bridge FM detector reduces FM distortion to 0.3%, reports the manufacturer. The unit, which sells for $279.95, is self-enclosed (16½ in. W. x 4½ in. H. x 12½ in. D.) with solid-walnut end pieces.

Check No. 8 on Reader Service Card

DeLuxe Home Reverb Amplifier

The Lafayette solid-state R-777 home reverb amplifier (Stock No. 21.8100WX), is designed to operate with a stereo receiver or amplifier that has a 3-way speaker selector switch—main, remote, and main and remote simultaneously. The input comes from the remote output terminals, and the unit features a "Percentage of Reverberation" control to allow for the best reverb mix to match the acoustics of your room. It also includes a tone control, volume control, and an on/off switch with pilot light.

Specifications: Power output, 10 W rms; Output impedance, eight ohms; four transistors, four diodes. Walnut wood enclosure with brushed aluminum front panel. Third speaker not included. Licensed by Hammond Organ. Size: 19 x 8½ x 4⅜. Weight, 8½ lbs. Price, $59.95.

Check No. 16 on Reader Service Card

Electronic Organ Kit

The Schober Organ Corp. introduces a new solid-state kit, the *Studio Organ*. The kit, which is said to require an average construction time of fifty hours (excluding wood finishing), includes mechanical parts, electronics, amplifier, speaker, console, and bench. The wood section, made of walnut veneer, is unfinished but sanded and ready to be finished. Only screws, glue (included in kit), and ordinary hand tools are required. The electronic assembly re-

quires a soldering iron and solder to be used. Keyboard and key switches are fully built and adjusted.

Features of the instrument include a spring-type reverberator, variable vibrato, a 25-watt rms amplifier, 12" bass and 6" x 9" treble speakers with LC crossover network. The organ has a 36-note upper keyboard, 29-note lower keyboard, 13 pedals (the lowest one produces a 32.7 Hz bass pitch). Completed, the instrument weighs about 100 lbs. and measures 38" W x 23" D x 34" H. Priced at $599.50.

Check No. 18 on Reader Service Card

Guitar Broadcaster

The solid-state electronic guitar broadcaster from Saxton Products, Inc., can broadcast guitar sound through any FM radio. It plugs into the output jack of an electric guitar or other electrical instrument. This device is said to be able to broadcast to any FM tuner or radio up to fifty feet away from the source. The sound can be received and amplified by tuning the FM radio in the range from 88 to 94 MHz. Its frequency response is from 20 to 15,000 Hz, and it has an input power of 6 mW. The battery-operated unit is 3¼ in. long and has a diameter of about ⅝ in. A miniature antenna and tuning control are packaged with the broadcaster.

Check No. 21 on Reader Service Card

Literature

"How To Select A Recording Tape," a twenty-four page catalog published by Audio Devices Inc., is designed for the tape recorder owner who wants a non-technical explanation of how tape is manufactured and how it is used to record sound. Tips for the use, care, and selection of professional-quality tape and tape accessories, charts, tables, and other aids simplify the user's problem. A glossary of tape recording terms supplements this edition.

Check No. 24 on Reader Service Card

"Professional Audio Controls," a 12-page booklet put out by Altec Lansing and written by staffers Arthur C. Davis and Donald B. Davis, is aimed at the audio experimenter and audio buff. The differences between home high fidelity components and those used by professional engineers are explained, as well as the merits of fixed gain amplifiers, passive control devices and low-impedance transmission circuits.

Check No. 26 on Reader Service Card

Reproducer test tapes is the subject of Ampex Corporation's Bulletin A223. It includes a specification sheet for standard reproducer alignment test tapes and two related articles reprinted from the *Journal of the AES.*

Check No. 28 on Reader Service Card

What can a sound mixer do for a sound system? What type of input connections are used on a mixer? How is a mixer used for stereo mixing? These and other most-often-asked questions about mixers are discussed in Switchcraft's four-page brochure, Report 307TR.

Check No. 30 on Reader Service Card

"Professional Methods for Record Care and Use," a Cecil E. Watts booklet, offers guidelines for the user to follow in taking care of his records. Advice from professionals include hints on such aspects as the newest methods for cleaning records; proper care of stylus, turntable, and cleaning tools; how to eliminate static problems; and the relationship between light tracking force and record cleanliness. It also tells how to handle records, how to rejuvenate them and how to store them. Cost is 50¢. Elpa Marketing Industries, New Hyde Park, N. Y. 11040.

The "RCA Solid-State Hobby Circuits Manual," HM-90, is a 224-page booklet which contains detailed instructions on functional solid-state circuits for use in the home, automobile, photo lab, ham shack, and by audio buffs and experimenters. Theory and practical applications are included, as well as a guide to 35 different solid-state circuits by area of reader interest. The book is available from RCA/Electronic Components, 415 South Fifth Street, Harrison, N. J. 07029. Price is $1.75.

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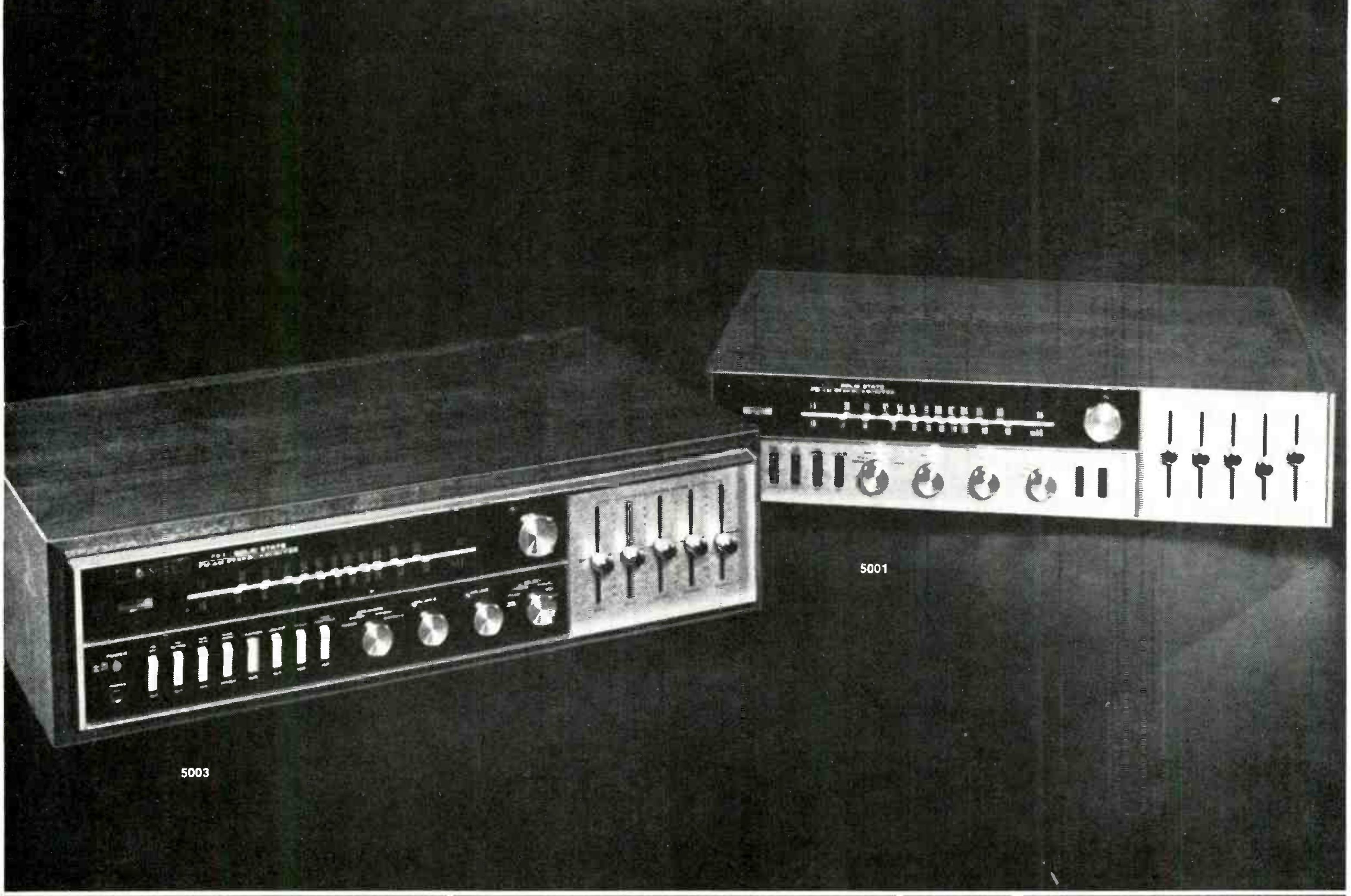

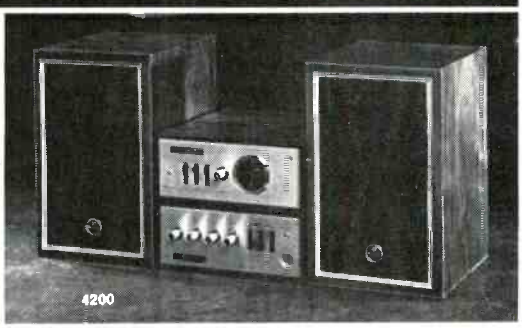

JVC Stereo Components . . . the most formidable line of stereo equipment in the world today. From powerful stereo systems, to all-in-one compacts, to individual components, there is a model designed for everyone from the most ardent stereo enthusiast to the casual listener.

Model 5003 – Powerful 140 Watt Stereo Receiver with Sound Effect Amplifier A deluxe version of the smaller 5001 with a full 140 watts in power output and an exceptionally wide dynamic range. All solid state FET circuitry with five IF stages. Unparalleled AM, FM and FM Multiplex sensitivity and selectivity. Complete with the sensational Sound Effect Amplifier (SEA) for professional studio control of sound effects. Automatic stereo switching, two speaker system selector, and stereo and fine tuning indicators. Full complement of inputs, jacks and terminals with matching controls. Unchallenged anywhere in power and performance. *5⅞″ H, 20¾″ R, 14¼″ D 30.8 lbs. w/cabinet*

Model 5001 – 60 Watt Stereo Receiver with Sound Effect Amplifier This is the most complete and up-to-date medium powered stereo receiver in the world. With built-in Sound Effect Amplifier (SEA), you have complete freedom and control of sound effects in five different frequencies: 60, 250, 1,000, 5,000 and 15,000 Hz. Allows you to match sound perfectly to room acoustics, or speaker and cartridge characteristics. New FET circuitry with four IF stages for new standards in AM, FM and FM Multiplex reception. Automatic stereo switching. Conveniently arranged controls, including the latest graphic type for sound effects. *5⅞″ H, 20¾″ W, 14¼″ D 30.8 lbs. w/cabinet*

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Dept. H

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BEHIND THE SCENES

BERT WHYTE

Electronic Video Recording

AFTER MORE THAN a year rife with rumor and much speculation concerning CBS Electronic Video Recording (EVR), on December 10th in a ballroom of the New York Hilton, CBS gave the first public demonstration of this system. Present were some 250 members of the consumer, financial, electronic, educational and broadcast trade press and a whole bevy of CBS officials including CBS president Frank Stanton and the inventor of EVR, Dr. Peter Goldmark.

I'll say this for CBS: they sure know how to put on a show! On the raised platform at the front of the room, two spotlighted EVR players were the center of attention. On each side of the room there were five 21-in. black and white table-model TV sets mounted on posts midway between floor and ceiling, all hooked up to the two EVR players. Lots of pretty gals to hand out press kits . . . a whole gaggle of still and movie photographers . . . all very big time . . . big money, very glamorous. After some largely self-congratulatory introductory remarks and much tossing of verbal bouquets to each other, Dr. Goldmark gave a brief description of EVR and then proceeded to demonstrate the system.

Now friend, when I say that the good Doctor gave a brief description, I mean it was miniscule! At the question and answer period following the demonstration a complaint was voiced from the audience that there was a dearth of technical information, both verbally and in the press kit. Dr. Goldmark concurred, somewhat dourly I thought, "Yes, there is a dearth of information." It seems odd to me that CBS invited members of the technical press to a public demonstration of EVR and then was so niggardly with information as to some of the technologies involved in this system. What we got was the absolute bare bones of the rudiments of EVR. We had to "flesh out" the workings of EVR by buttonholing appropriate CBS people after the show. I can tell you that the "pickin's" were mighty slim.

What is the CBS Electronic Video Recording system? There are three elements: The EVR film, cartridge, and playback machine. The film is 8.75 mm wide, slightly larger than conventional home movie film. There is standard magna-striping on each edge of the film which carries the audio and two rows of visual frames, each frame roughly one quarter the area of the familiar "Super 8" movie frame. There are no sprocket holes. Between each of the two frames in the center line of the film there are tiny square white "windows." From what I can gather these are part of the synchronization device. The film is a special thin-base material, but what the emulsion is remains a mystery. One source said it worked on the Diazo principle. I asked Dr. Goldmark if it were analogous to the dye image of Kodachrome. He said they had worked on something like that but discarded it. A vice president of CBS, with whom I was having lunch, claimed the emulsion was of silver halide, as with regular movie film. As you know, standard film is developed chemically. This is not the case here. Obviously, the film must be processed to a negative and then reversed to a positive image. (I have heard of certain special types of film that are "developed" by the application of heat.)

EVR film, enlarged three times, consists of two side-by-side tracks.

The EVR cartridge is circular, 7 inches in diameter, and has a maximum capacity of 750 feet of film. This is equivalent to 180,000 picture frames or 52 minutes of programming. In actual use, one of the picture tracks runs for 26 minutes and then, in a manner not disclosed, the unit switches to the second picture track and plays for another 26 minutes. In answer to a question from the audience it was stated that with a somewhat thinner film base the total programming could be extended for one hour.

The EVR player is fairly compact, and as you can see from the illustration about the size of an average tape deck. The unit shown is a production prototype made by Motorola, who is at present the exclusive CBS licensee for this product. This version of the EVR player is considered a "ruggedized" unit for industrial and educational use, and will cost about $800. In use, the output of the player is fed into the antenna terminals of a conventional TV set, via a lead and handclips. The film cartridge is placed in the player (which appears to work on the friction drive principle), the TV set tuned to a channel that is not broadcasting, and the starter button pushed. The film automatically threads itself past an electronic sensor that converts the film image to electrical impulses, along with the audio, into the television set where the impulses are reconverted to a black and white TV picture. Since transmission is direct to the TV set, there are none of the interference problems of broadcast transmissions, such as ghost images or ignition noise. There is no projector noise to contend with, as with movie film; there is no heat from projector lamps; and the TV picture is viewable in normal room light. The player has fast-forward and rewind buttons and all controls seem to be solenoid operated. There is also a fingertip adjustment for slow scanning of individual sequences, and the capability for "stop motion" or freezing any frame on the screen without damaging the film, or dimming, flickering, or blurring the image.

The demonstration itself was highly successful. A portion of the "Misssion Impossible" show, which was an EVR film processed from the 35-mm film master, was displayed on the TV screens. You never saw such a sensationally good black and white picture! Of course, the condition of the TV set has a lot to do with the quality of the image, but assuming optimum settings for focus and contrast and brightness

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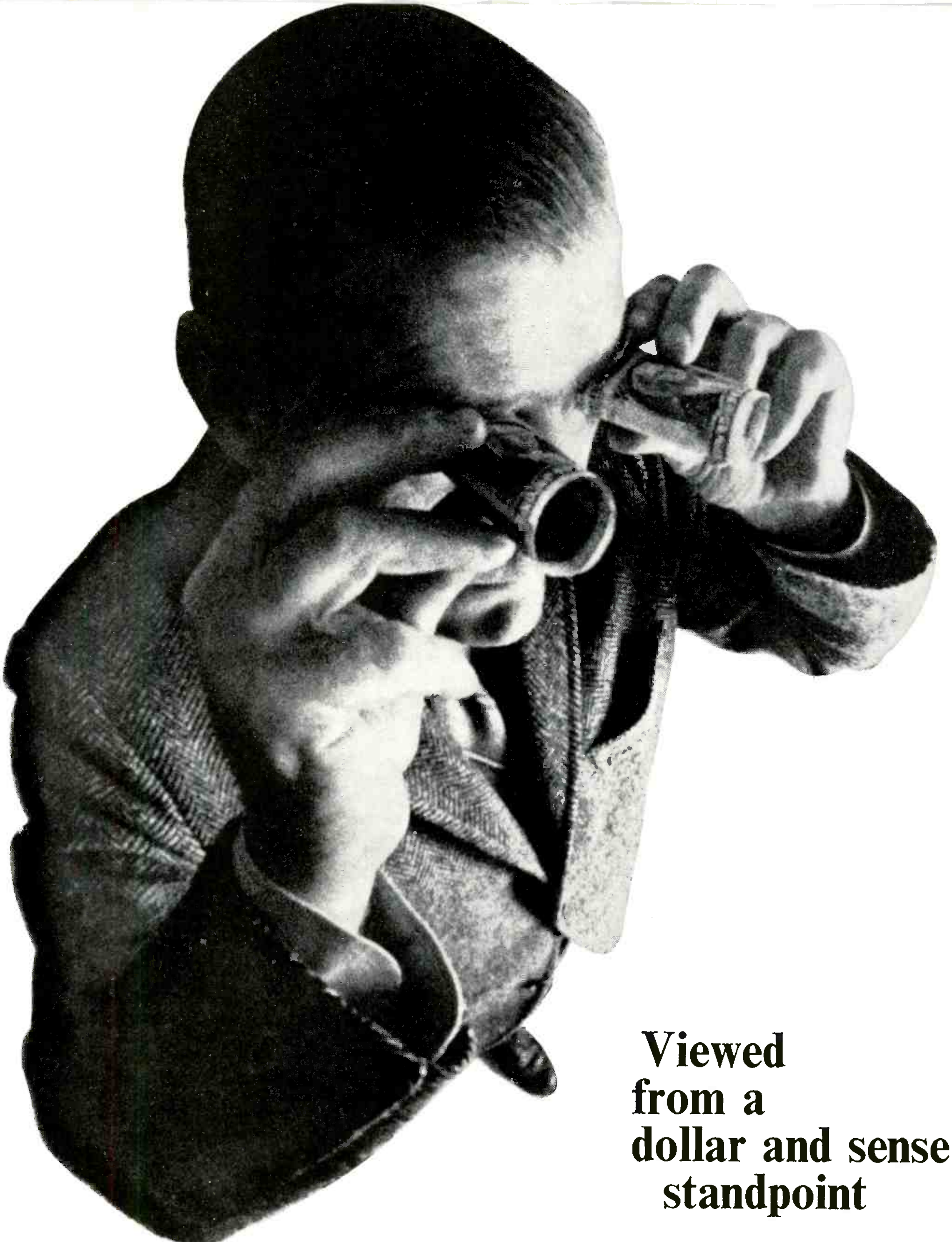

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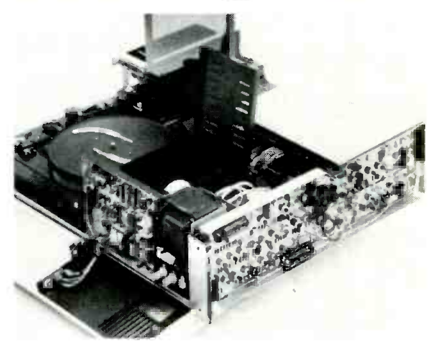
ratios, the image seemed to have an exceptionally broad gray scale with superb definition. A CBS engineer told me that the EVR film has a resolution of over 600 lines, which is better than our 525-line TV standard. The sound was as good as you can get considering the marginal quality of the audio sections in today's TV sets. The fast-forward and rewind functions worked nicely, as did the slow-motion and stop-motion features. The film was switched to the other picture track and we saw a typical educational subject of (I'm not kidding) the "sex life of the grasshopper." At all times the picture was rock-steady, with not a trace of flicker.

Details of the manner of duplication of EVR films were very vague, but in essence a EVR dubbing master can be made from any motion picture, videotape or live TV presentation. The dubbing master and the EVR film stock is run through an "electron beam chamber" (whatever that is) and it is claimed that duplication of an entire cartridge takes only 30 seconds. EVR is obviously an electro-optical process, but that is about all we know. It was stated that technical papers on the EVR system would be forthcoming in the new year.

In addition to the licensing of Motorola as the manufacturer of the EVR player, it was announced that the New York Times Book and Educational Division would create and market educational films produced exclusively for EVR cartridges and intended for elementary and secondary schools. CBS officials emphasized repeatedly that their present market for EVR would be confined to the educational and industrial fields. The target date is that "substantial quantities" of black-and-white EVR players will become available by July of 1970 and a color version of the EVR unit to be in production during the last half of 1971. The color unit will use both picture tracks simultaneously, thus limiting programming to 26 minutes. It was stated that there are over 400,000 black-and-white TV sets in use in American schools, which are in intermittent use because of the lack of educational broadcasting facilities. It is to this market that the CBS people feel that EVR has the greatest immediate potential.

As you can imagine, many of the people attending the demonstration asked such questions as the availability and price of EVR players and cartridges for the consumer market. On these points the CBS people repeatedly hedged. Throughout the CBS press releases the low cost of the EVR film is emphasized, yet they would not give even an approximation of the price, claiming that the cost would be dependent on quantity. Well, shucks fellas, quantity also dictates the cost of tape and movie film duplicates. So what's new?

I feel this question of the duplicating cost and the cost of the EVR cartridge to the consumer is central to the



The seven-inch EVR film cartridge is placed on an EVR player in much the same manner as is an LP disc. It contains up to 52 minutes of visual and audio material. Shown here also is the EVR player with housing removed.

whole question of whether the EVR medium is superior to videotape or "Super 8" movies. There were a lot of grandiose claims made for EVR, but unless the cost is really substantially less than the competing mediums, what advantages EVR has will be negated. After all, there now exists "Super 8" movie film in no-thread cartridge that will give you 30 minutes of gorgeous color with great resolution and sharpness on screens as large as 5 by 7 feet. You can have slow motion and stop motion, too. Cost? Somewhat less than a dollar a minute. The typical reel of videotape costs about $60 for an hour. You can have slow and stop motion.

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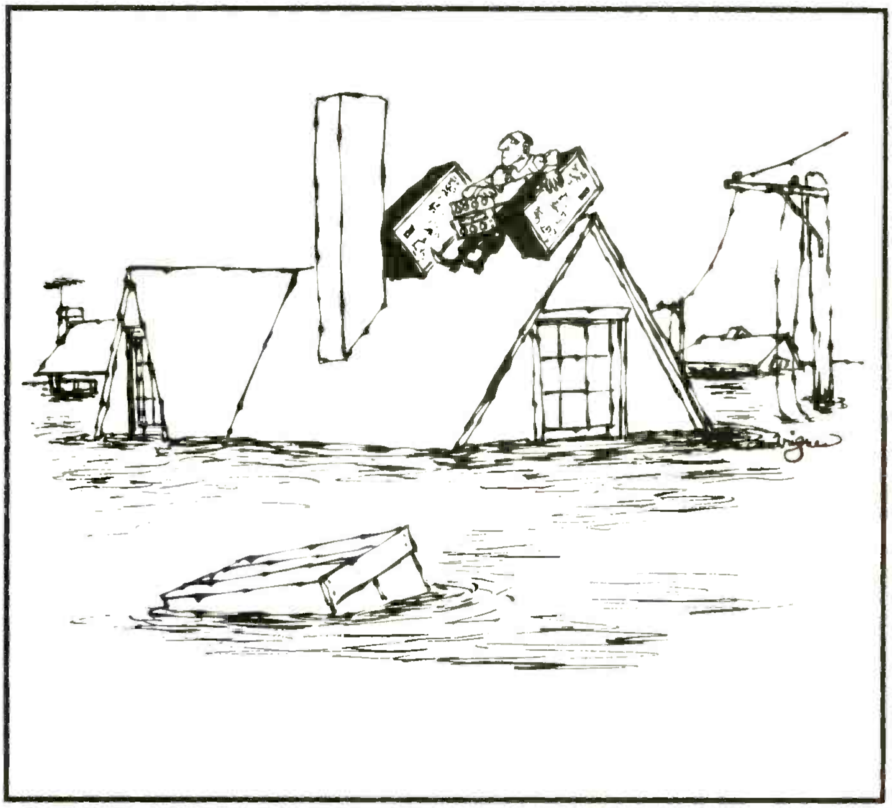
And color. And you can erase the tape and use it over and over if the subject has no permanent value. The CBS press release talks about running off a Jack Nicklaus golf lesson on your EVR player before your Saturday morning round. Great. But what about the advantages of a videotape recorder so you can photograph your swing and immediately play the tape back and observe your form? Sure, videotape machines are quite costly now, but inevitably the technology will be able to come up with relatively inexpensive units. It should be emphasized that EVR is strictly a playback medium. CBS will be the only recording facility and will undertake to produce EVR film cartridges for anyone who supplies them with movie film or videotape.

I mentioned earlier that each 7-inch EVR cartridge had in it's 52 minutes of playing time, 180,000 picture frames. It is said that the entire Encyclopedia Brittanica could be contained on 2 EVR cartridges on the basis of using the frames individually. Dr. Goldmark told me that the EVR film had an information storage potential ten times greater than magnetic tape. The problem which at present would not make EVR of use in the computer field, is information access and retrieval time. After all, how would you find the frame which would be equivalent to page 792, for example, in the Encyclopedia cartridge? Which is not to say that some sort of coding system may not eventually be worked out to make EVR practical for information storage.

In summation, I admit to being very impressed with the high quality of the TV picture produced from the EVR film. It has boundless potential in educational and industrial uses that are too obvious and too numerous to detail here. One can also envision a brisk consumer market for EVR cartridges of plays and operas. Instead of merely buying the sound track recording of "South Pacific" or "Aida" or "Macbeth," you get the visual information as well. All this potential depends on the price of the EVR film cartridge to the consumer. At this point it is sheer conjecture as to what CBS means by its nebulous references to the "inexpensive" . . . "less than" . . . or "modest" cost of the EVR cartridge. About the only assumption I can make is that if the EVR cartridge is roughly the same price as present pre-recorded tapes of equivalent playing time, CBS has a saleable product. Æ



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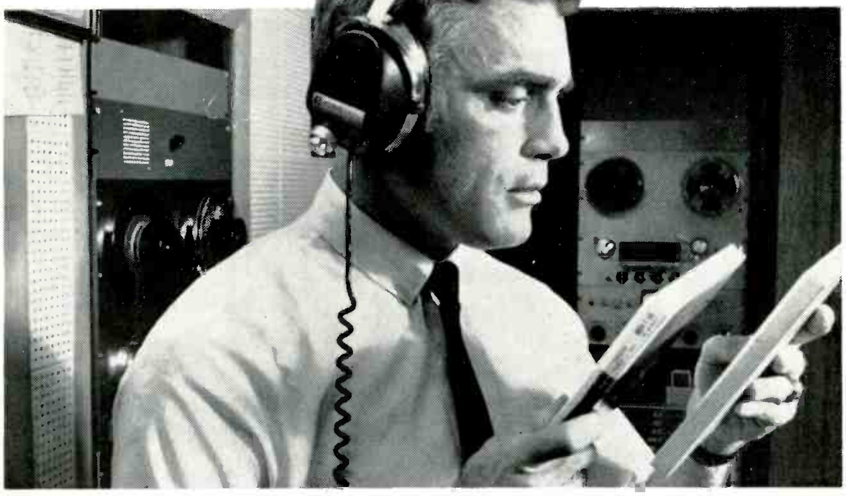

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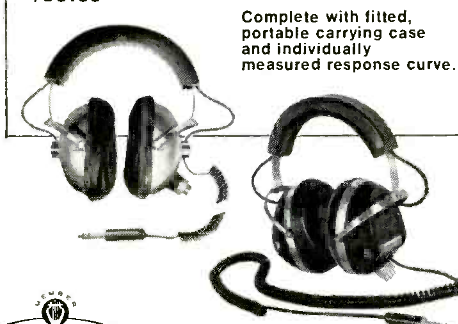

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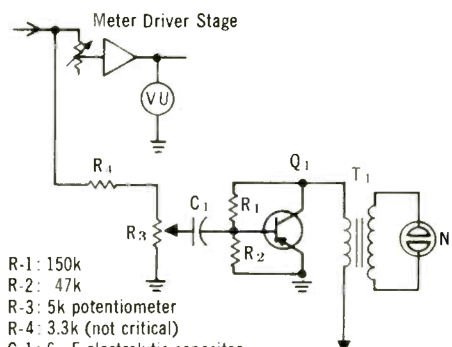
Letters

• I agree wholeheartedly with your reader's comments [*Tape Guide* column, AUDIO, Oct. 1968] on the use of the oscilloscope for tape recording peak indication. (Another very thorough coverage of the subject was published in AUDIO for November 1959). I have to admit that, not until I sat for an extended period of time before a 'scope connected across the meter of my recorder, did I come to realize fully how much a VU meter reading had to be *interpreted* under varying program material conditions (especially in the case of a great many machines which are equipped with an ordinary milliammeter with a VU scale). Although a VU meter fills the specific needs of professional users, it seems that a form of peak indicator is more convenient for home recording: ultimately, it is the instantaneous peak which is of interest.

The oscilloscope, as pointed out, is ideal in this application, but a rather cumbersome adjunct in most livingrooms or for on-location recordings. The "magic eye" is probably the best compromise: witness the Tandberg "eyes" with their optimized slow-release feature. But the best ever encountered was used on an early Revox model (before the G-36 was introduced here: it employed *big* electron ray tubes (EM-70's, I think).



R-1: 150k
R-2: 47k
R-3: 5k potentiometer
R-4: 3.3k (not critical)
C-1: 6 μF electrolytic capacitor
Q-1: ST-303, OC-71, 2N-280, etc.
T-1: UTC SO-1
NE: Dialco 38-1537
(with 7538-XP50 connector & 7538-XP51 clip)

In the case of my 1959 (mostly) transistorized recorder, the installation of a *built-in* magic eye was out of the question: a) no panel space, and b) high tension not present in the recording amplifier. So an ultra-simple neon indicator was devised, which along with the normal VU meters, has proven to be completely satisfactory under most conditions. (See schematic and parts list.)

The bulb should be mounted over the VU meter, just over the "0" VU mark. This location, together with the long cylindrical shape of the Dialco unit, cuts down eye-strain. In my machine this circuit hangs across the meter; preferably, it should be connected ahead of it and its associated

(Continued on page 66)

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Tape Guide

HERMAN BURSTEIN

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

Potpourri

Q. I notice that the output of my tape recorder decreases a bit and the neon-light indicators (one for normal and the other for distorted recording) do not light up normally; the normal lamp lights only partially even when the distorted lamp flashes. I shunted a .047 μF capacitor across C_{30} in the enclosed schematic (which shows one end of C_{30} connected to the high side of the output transformer primary, and the other end connected in series with resistors to a neon lamp and to ground). I turned the volume to maximum. When I did this, there was a loud crackle in the speaker, I saw some bright flashes, and smelled burned parts. The crackling sound persisted even after I pulled the power cord from the house outlet. After everything had cooled off, I tested the recorder for volume, and this time found out that the volume had been adversely affected. I had to use the mike input for recording from a phonograph where before I could use the phono input. The volume and tone controls have become so noisy that even if cleaned with control cleaner the noise returns after a day's use of the recorder.

To give you an idea of the volume output of my machine, when the 1000-Hz 0-VU reference tone in an alignment tape is played at full volume, output at the external speaker jack measures 4.7 volts. Believing that the volume and tone controls were most affected when I shunted C_{30}, I have plotted the resistances of both the volume and tone controls at different points of rotation.

I wish to make the following inquiries:

1. My recorder is supposed to deliver at full volume about 5 watts output. But I measure only 4.7 volts a.c. at the speaker when playing a tape recorded at 0 VU. How would you assess the amplification performance of my recorder?

2. In the graph I made showing the output volume of my recorder, the curve appears steep only in the last third of rotation. Is this normal for a tape recorder? What is the taper usually employed in volume controls of tape machines?

3. What other components in the circuit, besides the volume and tone controls, might have been adversely affected by my shunting capacitor C_{30}?

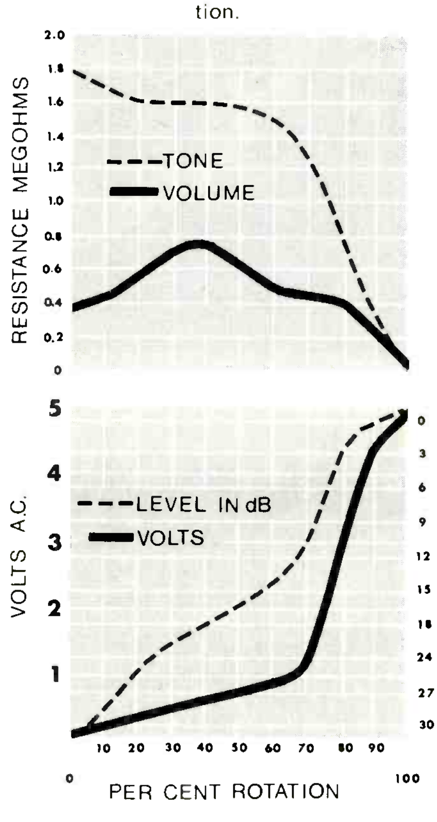
4. What is a flutter filter? Is it available commercially as an accessory? My machine's capstan is operated by a rubber-tired idler wheel between the motor pulley and the rim of the flywheel. Is a flutter filter suitable for use with such a capstan drive?

5. Could you recommend a microphone which will clearly record the beating of the human heart without excessive noise? Where may such a microphone be obtained? I have tried quite a number of microphones, including expensive ones, with the result that noise drowned out whatever useful sound might have been recorded.—Domingo Riego, Jr., Manila, Philippines

A. If your machine has a 4-ohm speaker, as is typical, then for 5 watts output the corresponding voltage by Ohm's Law would be $E = \sqrt{WR} = \sqrt{5 \times 4} = 4.47$. Since you are getting 4.7 volts, it appears that amplification is consistent with your machine's rating.

Fig. 1 – Output in both volts and sound-power level measured at speaker terminals relative to per cent rotation of volume control.

Fig. 2 – Tone- and volume-control resistances measured at various points of rotation.



In your machine the volume control is shunted by a 560 k resistor, and it has a tap leading to a 100 k resistor in series with the tone control of 2 meg. Therefore the resistance of the volume control (presumably you measured it between arm and high side) changes in a complex manner. To measure the resistance taper of the control alone, disconnect it from the rest of the circuit. Typically as you go from maximum to minimum resistance the changes are greatest at the start and smallest at the end for a volume control; this is not necessarily true for a tone control. For a volume control the basic principle is that an equal number of degrees of rotation should produce about an equal percentage change in resistance. Thus if the first 25 deg. of rotation reduces resistance from 2 meg to 1 meg (by half), the next 25 deg. should reduce resistance to about ½ meg (again by half).

Capacitor C_{30} that you shunted goes to B-plus through the primary of the speaker output transformer. If your shunting capacitor was shorted, you may have shorted out B-plus, which could account for sparks flying and things burning. You may have damaged current-limiting resistors and possibly filter capacitors.

A flutter filter is a wheel which rotates as the tape moves against it. Momentum of the wheel tends to smooth out brief fluctuations (flutter) in tape motion. I don't know of such a device being available as an accessory, although I suppose a mechanically knowledgeable person could install one. I don't see that the type of capstan drive would relate to use of a flutter filter.

Special microphones are made for recording the heart, and you should direct your query directly to microphone manufacturers.

Converting Tape Player for Recording

Q. I have a cartridge tape player and would like to use it for recording as well—by connecting a recording amplifier to the playback head through a suitable switch. The question is: If I try this, would it damage the present playback head?—Frank Newhall, Oakland, Calif.

A. Ordinarily a playback head can also be used for recording, provided that it is not of unusually high impedance. And you are unlikely to damage the head in your attempt to use it for recording. Æ

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How to recognize a stacked deck.

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EDITOR'S REVIEW

"Lifeability"

We received an interesting letter concerning equipment testing from a reader, Don Valentine, of Whittier, Calif. Here are some excerpts:

"*...is the instrument under scrutiny a dependable workhorse? I think you should be honest when a particular item is plagued with certain difficulties..."tics," if you please.... I once bought a *** tape recorder on the advice of several lab reports. And it did perform well... but tape squeal began within weeks.... *** receivers always rate high, but those switches and pots get noisy within months!*

"*...dependability and long life are the truly golden virtues. Therefore, some clue to this seems important to include in a lab report....*"

Reader Valentine is rightly concerned about dependability and long life. Unhappily, such problems are not predictable through our examinations, which do not include life, shock, or environmental tests on a wide sampling basis. We do point out good construction and high quality of parts when present, as well as good (and poor) circuit-design features. When it comes to "lifeability," however, it is still a *caveat emptor* world. Warranty terms are longer and more liberal than ever before, though, so the buyer does have protection in the event a model should display a defect after a period of time.

We'll have more to say on this in the near future.

The "Phonon" Amplifier

An interesting device, called a "phonon" amplifier, has been around in the labs for some time now. The device uses acoustic waves to amplify radio signals—thus the name, "phonon," which is the basic unit of acoustic energy.

A *new* phonon amplifier, developed recently at the General Telephone & Electronics research laboratories in Bayside, N. Y., is said to overcome a noise problem displayed by earlier phonon amplifiers. The lab model consists of a ceramic plate, a thin slice of silicon, and electrical connections. Its dimensions are: ceramic, 1" long x ½" wide x 12 thousandths of an inch thick, while the silicon measures ½" x ½" x 2 thousandths of an inch thick. A commercially produced version of the laboratory model would be expected to be one-tenth as large.

The ceramic plate displays a piezoelectric property. Radio-frequency signals introduced into one end of the ceramic plate are converted into acoustic waves that travel through the material. They are amplified as the waves go through the slice of silicon, with amplified radio signals extracted from the other end of the ceramic plate. Thus, electrical impulses are transformed to physical waves and, after amplification, converted into electrical waves again.

Auto Stereo Headphones

Spartan Products, Madison Heights, Mich., has a novel idea to induce people to use head restraints in automobiles: built-in stereo headphones. With the head restraints compulsory on new cars, the safety device/stereo headphone, which is said to protect against severe whiplash, is reported to be priced at under $60 for a pair.

Electronic Music

Electronic music equipment and techniques have spawned courses in the new art form. For example, The Mills College Tape Music Center, Oakland, California 94613, maintains modern facilities for the composition and production of electronic music. Studio facilities are available to qualified Bay Area composers on a rental basis. And informal sessions (at no charge) are held to familiarize people with basic techniques of electronic music. February 24 and May 9 are scheduled dates on the program. On the East Coast, a complete workshop in electronic music is given by Group 212, P.O. Box 96, Woodstock, N. Y. 12498. The course includes active composition, interpretation, and performance of new music that involves magnetic tape, "live" electronics, and multi-media, among others. The workshop runs 12 weeks, with tuition and housing costing $500.

A.P.S.

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100% MUSIC POWER

PHOTOGRAPH BY FRANZ EDSON

Words are inherently limited in stimulating the emotions aroused by music. This is especially so in describing how high fidelity components perform.

With cartridges, for example, we speak of flat frequency response, high compliance, low mass, stereo separation. Words like these enlighten the technically minded. But they do little or nothing for those who seek only the sheer pleasure of listening.

We kept both aspects in mind when developing the XV-15 series of cartridges. We made the technical measurements. And we listened.

We listened especially for the ability of these cartridges to reproduce the entire range of every instrument. With no loss of power. That's what it takes for a cartridge to recreate the most subtle nuances that distinguish one musical instrument from another. An oboe from an English horn. A trumpet from a cornet.

We call this achievement "100% music power."

When you play your records with an XV-15, you won't be concerned with even that simple phrase.

Instead, you'll just feel and enjoy the renewed experience of what high fidelity is really all about.

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THE NEW PICKERING XV-15/750E.
PREMIER MODEL OF THE XV-15 SERIES. TRACKS AT ½ TO 1 GRAM. DYNAMIC COUPLING FACTOR OF 750 FOR USE IN FINEST TONEARMS. $60.00. OTHER XV-15 CARTRIDGES FROM $29.95. PICKERING & CO., PLAINVIEW, L.I., N.Y.

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First of a new breed —from Sherwood

This is what high performance is all about. A bold and beautiful new FM Stereo Receiver bred to leave the others behind. 160 crisp, clean watts—power in reserve. Up-front, ultra-now circuitry featuring Field-Effect Transistors and microcircuitry. Front-panel, push-button command of main, remote, or mono extension speakers and loudness contour. Sherwood high-fidelity—where the action is—long on reliability with a three-year warranty.

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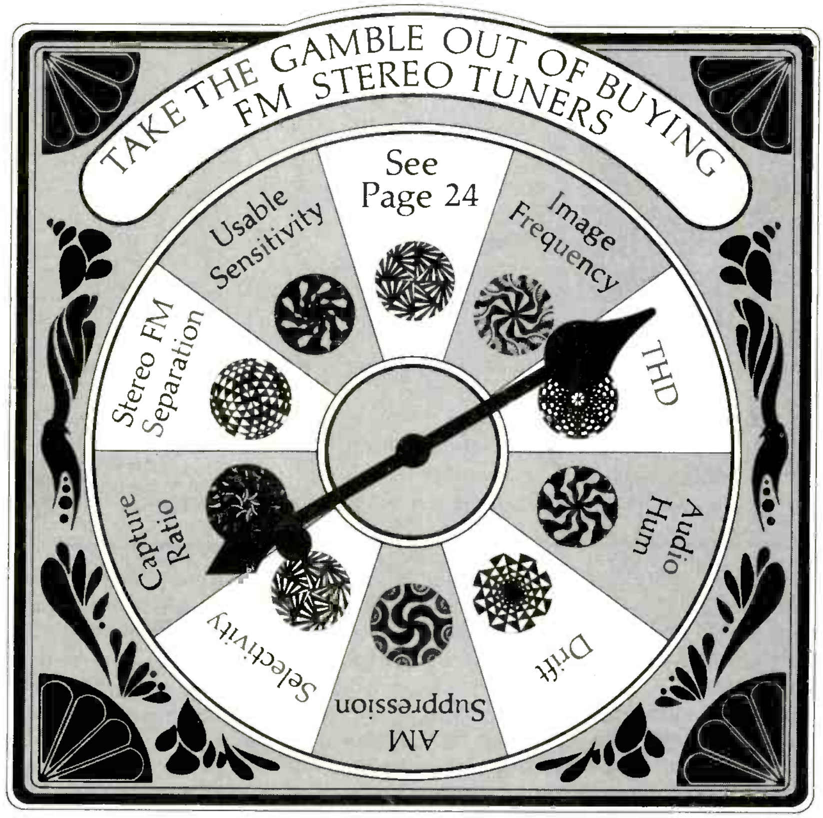

Layman's Guide to

FM Tuner Specifications

Understanding 14 specifications simplifies purchasing of an FM stereo tuner or receiver

WHILE THE IHF (Institute of High Fidelity) goes about its important business of setting up new standards of measurement for tuners (the existing standards date back to 1958, before solid-state tuners and even before stereo FM) many a reader of AUDIO and many a shopper for componentry are still trying to understand the *old* standards for tuners. amplifiers, and receivers. While the standards are extremely meaningful to engineering personnel engaged in the design of new high fidelity stereo components, they tend to leave the layman somewhat baffled when they are published, sans explanation, in advertising brochures.

As for AUDIO itself, ever since we started reviewing new equipment in accordance with the IHF standards we've had two kinds of reactions—kudos from those who feel that the reviews have become more meaningful, and a few "brickbats" from those who can't fathom the dB's, PB's, THD's, IM's and S/N's. For the latter group (and their numbers must be legion . . .), we present the guide to tuner specs. A similar guide to amplifier specs will follow next month.

The IHF lists five tuner specs that must be stated as an absolute minimum, with six more if complete specifications are to be published. This, remember, without regard to stereo FM, which adds at least three more, for a total of *fourteen*.

IHF Sensitivity (Least Usable Sensitivity). FM's main claim to superiority (besides better frequency response) is its noise-free performance. Still, as any FM listener can testify, if he's too far from the broadcast station, there will be noise aplenty—such that the signal becomes *un*usable. What, then, constitutes a *usable* signal? The IHF decided that a signal which is strong enough to cause the residual noise to recede into the background until its measured amplitude is only 3 per cent of the desired sound is usable—providing one other criterion is met. Many tuner circuits are *great* at pushing down the background noise, even at very low input signals to the antenna (from the desired station), but the program you hear at such low signal-strength levels is full of distortion. In other words, when a musical tone is transmitted, its overtones or harmonics (not present in the original program) come barrelling through as well. So, IHF decided that the least usable sensitivity should be that amount of signal (stated in microvolts) applied to the antenna terminals which causes the *sum* of noise *and* distortion to be no greater than 3 per cent, compared to the *loudest* musical program that can be transmitted. Now, three per cent of something is the same as "30 dB lower than" something (see Table I), so the charts we use to

TABLE I

Relationships of two voltages

Relative Level in dB	=	As a percentage of a fixed level
0		100%
−3		71%
−6		50%
−10		33%
−20		10%
−30		3%
−40		1%
−50		0.3%
−60		0.1%
−70		0.03%
−80		0.01%

plot IHF sensitivity denote the point along the "microvolts input" scale at which this difference between "program" and "noise + distortion" is 30 dB, as represented in Fig. 1.

Signal-to-Noise Ratio (S/N). While a program having background noise only

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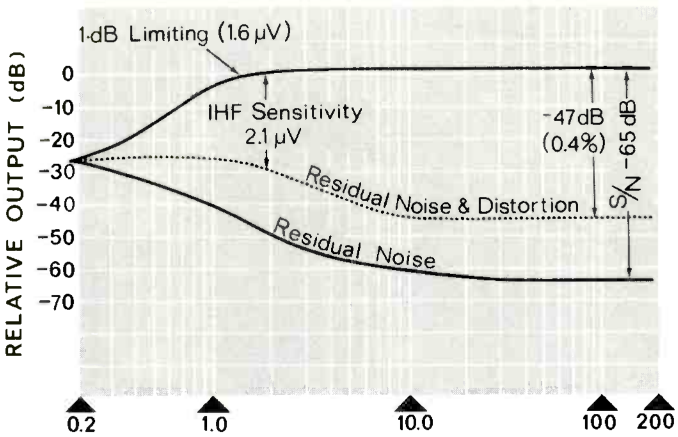

Fig. 1—FM characteristics such as IHF sensitivity, THD, and S/N can all be determined from this one graphical presentation.

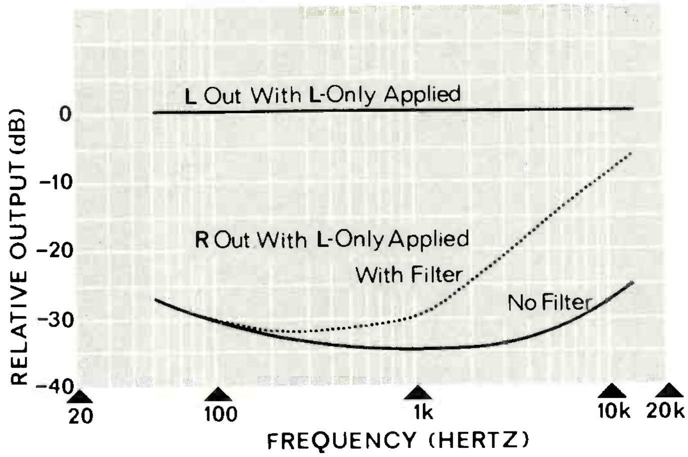

Fig. 2—Typical stereo FM separation curve. Note that the best separation occurs at mid-frequencies.

"30 dB down" may be *usable*, it is not by any means a really "quiet" signal. As the signal strength increases (stations closer in, or more powerful), the background noise recedes further into the background until it finally reaches the *ultimate* quieting of which the tuner is capable. The little remaining noise may be of the wide-band, "rushing" kind, or it may be residual hum, or it may be a combination of both. In any case, as you can see in Fig. 1, in a typical receiver it will be about 60 to 65 dB *below* the loudest part of the program information. If, as in our example, it is 60 dB "down," that means that it now constitutes only one-tenth of one per cent of the program level itself (0.1%). Inexpensive tuners may get down to little more than 45 or 50 dB below program, while superior tuners have been known to get down to 70 dB below program level. Obviously, the higher the dB in this spec, the better this characteristic.

Total Harmonic Distortion (THD). As mentioned before, distortion in a tuner tends to become less and less as signal strength is increased—up to a point. After that, no further improvement occurs. While distortion is most often quoted as a *percentage*, we have already seen that when something is a percentage of something else, it can also be said to be "so many dB" *below* that "something else," so for convenience we plot the ultimate THD on the same graph (Fig. 1), using a dotted line to follow the asymptotic improvement of distortion with increased signal strength. Just for the record, a *good* tuner is one that gets down to 1 per cent (−40 dB) or better. The best we ever saw was better than 0.1 per cent, but such a figure is quite rare.

Drift. No one likes to hop up every ten minutes to re-tune a favorite program, and that's what drift is all about. It is less of a problem with solid-state tuners (tube heat used to be the greatest cause of drift). A complete specification will nevertheless quote amount of drift, unless it's completely negligible. The *rated* drift is usually stated in kHz and is taken after a period of two hours of operation of the tuner.

Frequency Response. The first thing you're taught when you begin to delve into the world of "hi-fi" is that everything has got to be "flat from 20 Hz to 20,000 Hz," because that's the span of "human hearing"—from the lowest note to the highest. What a disappointment, then, to find tuner specifications quoting response from "50 Hz to 15,000 Hz"! And how about the ambiguity of those manufacturers who *do* insist that their tuner's frequency response *is* flat from 20 Hz to 20,000 Hz. Ready for a shock? They're both right! The *tuner* may be flat in response from 20 Hz to 20,000 Hz, but the broadcast station is only *allowed* to broadcast frequencies from 50 to 15,000 Hz. Don't despair, though, and don't throw FM out of the high fidelity classification. Not many people over thirty can hear much above 15,000 Hz anyway, and not much music is written below 50 Hz, believe it or not. The important thing, then, is not the end-points of the frequency response, but *how flat* it is within the usable range of frequencies stated. Maintaining flat frequency response in a tuner is not at all difficult (not nearly as difficult as it is in an amplifier or preamplifier), so any tuner that departs from flat by more than a dB or two should be ashamed of itself in the first place.

Capture Ratio. Suppose you're listening to your favorite *local* station, and it's a relatively low-powered transmitter, but it's close enough to you to produce an input signal of, say, 10 microvolts. With a good tuner, it will be more than just barely listenable—it will be quite good. Now, suppose a big powerhouse of a station is located high on a hill a couple of hundred miles away and, because of its high power, it's producing a signal of five microvolts at the same frequency at your antenna input terminals. Which one will you hear? Well, if your capture ratio is good enough, your local station will still blot out the undesired, distant station broadcasting at the same frequency. The tests prescribed to determine this ability are a bit too involved for this discussion, but the capture ratio gives the ratio of desired-to-undesired signal required to suppress the *undesired* signal by 30 dB. The *lower* the capture ratio (expressed in dB), the better the characteristic.

Selectivity. Ever hear two stations at once on your FM set? Poor selectivity, that's why! The FCC usually spaces stations 400 kHz apart in a given area (and 800 kHz apart in a given city) to prevent just this sort of thing. With today's ultra-sensitive tuners, however, it's not unusual to pick up stations from so far away that their frequency differs from local stations by only 200 kHz. The latter situation is used to define "adjacent-channel" selectivity (stations just one "channel" apart) while the former is used to define "alternate-channel selectivity." In either case, the selectivity is quoted in dB once more and the greater the number, the better the ability of the particular tuner to pick up a desired station

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to the exclusion of nearby (in frequency) stations on the dial. Figures of 60, 70 and even 80 dB are not uncommon with today's modern circuitry.

Spurious Responses. There is an almost limitless mathematical series of situations that can arise to produce unwanted response from a tuner that is tuned to a certain frequency in the presence of mathematically related other frequencies. We've had any number of experiences with tuners tuned to a certain frequency when suddenly we are treated to the private conversation between a commercial airline pilot and the local control tower. Now, the pilot and control tower frequencies aren't even in the FM band, but well above it in frequency. Still, the mathematical relationships are such that our tuner's local oscillator (used in *any* superheterodyne circuit, either FM or AM) beats with the incoming frequency to produce a third frequency which does manage to get through the rest of the set and out to the detector. Spurious response may be quoted as a single figure of "so many dB down" (the higher the number the better) or some of the more popular forms of "spurious response," such as "image response" and "intermediate-frequency response" may be given individual rejection figures (in dB).

IM Distortion. Similar in some respects to, and yet different from amplifier Intermodulation Distortion, IM Distortion in an FM tuner arises from certain non-linearities existing within the circuitry of the tuner. Intermodulation implies a mixing of two program frequencies to produce an *unwanted* "beat" frequency not present in the original program. For example, in the IM tests prescribed by IHF, two tones —15,000 Hz and 14,600 Hz—are applied as FM modulation to the tuner. If the tuner were absolutely free of IM distortion, the two tones would be present in the output, and nothing more. Actually, *some* 400-Hz output will usually be present (the difference between the two desired tones), and it is this 400-Hz content which is expressed as so many dB below (or as a percentage of) normal, intended 400-Hz modulation. Obviously, the lower the percentage or the greater the number of dB, the better the tuner in this respect.

Audio Hum. Not unlike its companion specification applied to audio amplifiers, audio hum is a specific form of unwanted noise and as such, is often quoted separately. It may be caused by power-supply inadequacies or by a variety of other causes. While the ear is somewhat less sensitive to low-frequency (60 Hz) hum than it is to wide-band random noise, a good tuner should have a respectably low hum figure, better than 60 dB below maximum output of program at least.

AM Suppression. We've often been asked why AM suppression is important in an *FM set*. After all, the stations are broadcasting only FM in the region from 88 MHz to 108 MHz, so why worry about the set's ability to reject AM? The fact is that even FM transmissions contain some unwanted AM—either in the nature of imperfect modulation by the station or in the form of man-made or natural AM noise such as ignition sparks from automotive vehicles, lightning storms, and the like. It is the ability of an FM set to reject such AM interferences that was cited as one of the primary advantages of FM when it was struggling for its initial acceptance—and that ability has been borne out over the years. Again, AM suppression is expressed in dB and the higher the figure, the better the rejection. Typical AM rejection figures range from a low of about 40 dB to highs of well over 60 dB.

Stereo FM Separation. While the IHF has yet to come up with a set of standards for stereo FM tuners, the most obvious one that will have to appear is separation—for that is the chief characteristic of stereo FM transmission. In other words, how much "left-channel information" gets into the "right-channel output jack" and vice versa. To date, most manufacturers have chosen to present this figure at one frequency only, usually 1000 Hz. As might be expected, that's the frequency at which most stereo FM sets do their best when it comes to separation. AUDIO magazine has found, however, that to separate the top units from their lesser competitors, it is necessary to show separation at *all* important frequencies, and so we resort to a plotted graph, such as that shown in Fig. 2, to tell the story. Broadcasters are required to maintain at least 30 dB of separation between channels at the transmitting end at all frequencies from 50 to 15,000 Hz, but we have yet to find a tuner or receiver that can do as well. On the other hand, we have run into tuners that do much better than that (often exceeding 40 dB around the mid-frequency region) at *some* frequencies. It is felt that the really low frequencies and the upper highs do not contribute as much to the overall stereo sensation, and so a curve such as that shown in Fig. 2 is not to be construed as representing a poor stereo FM tuner. On the other hand, many sets tested at AUDIO's labs have maintained at least 20 dB across the board. No doubt some more definitive standards will be set by IHF in their forthcoming re-do of tuner specifications and standards.

Stereo FM THD. Because of the complexity of the added stereo decoding circuitry, a great many sets are not able to do as well in distortion when stereo FM is being received as they are in the mono mode. Accordingly, we have started to quote THD for both mono and stereo operation. We wish all manufacturers would do the same, for in the light of stereo FM's ever increasing popularity, to omit this important spec leaves a sizable gap in the overall picture.

Stereo FM Least Usable Sensitivity. It has become accepted knowledge that stereo FM reception requires greater signal strength than its monophonic predecessor for equally noise-free reception. Accordingly, we hope that in future manufacturers will quote a least-usable-stereo-sensitivity figure in microvolts based on the same premises used for the mono spec. The problem is that no general agreement has been reached as to what constitutes "full program," below which the old 30-dB figure shall be measured. Is it full modulation of the left-channel only, full modulation of right only, or some combination of left-and-right modulation totaling 100 per cent? As of this writing, we are in the same quandary too, and so our evaluation of stereo FM sensitivity remains subjective—taking the form of a statement of how many stereo FM stations we were able to receive satisfactorily in our particular location. Admittedly, this doesn't mean much to the reader who glances at our reviews periodically, but over a period of time it does serve as some sort of relative comparison between the products we see passing through our labs.

Now you should feel that you are prepared to tackle any tuner spec sheet placed before you by an eager audio dealer's salesman. Next month, we will go on to amplifiers. Happily, the amplifier IHF standards were revised in 1966, and so they take full account of stereo amplifiers, solid-state circuitry, and other modern features generally found in these products. We'll tackle the mono specs first, but where a specific additional requirement arises in stereo, we'll mention it within the context of each specification discussed. Æ

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How Tape Recorder Bias Controls Fidelity

ANDREW H. PERSOON*

How to adjust bias for best performance from your tape recorder.

MAGNETIC RECORDING TAPE provides a superior method for the permanent recording of information, but it is limited by the natural phenomena of magnetic properties. Fortunately, the shortcomings created by these magnetic phenomena can be compensated for by electronic measures. This article will make no attempt to explore the mathematical or theoretical realms of magnetic recording but will present a simplified explanation of high-frequency bias, its requirements and limitations, and methods of adjustments.

Every magnetic medium exhibits a non-linear characteristic because the magnetization, resulting from an exposure to a magnetic field (such as that produced by the recording head), is not directly proportional to the strength of the field. This non-linear characteristic, if not corrected, would result in severe distortion of the audible recorded information. The use of a high-frequency bias current; applied through the recording head, is the standard method of compensating for the non-linearities in the transfer of electro-magnetic signals onto magnetic recording tape.

The high-frequency bias signal is usually generated by an oscillator circuit in the recorder electronic system and is added to the signals generated by the microphone or supplied by the recorder input circuits. The bias is a high frequency, usually 30 to 100 kHz, which is above the range of hearing. Therefore, during playback of only the bias signal, one could not hear or identify any tones which would indicate its presence. By adding the bias signal to the audio signal, a resultant signal is produced (Fig. 1). In most recorders, the two signals are simply combined without any form of modulation. The resulting signal is what the record head inductively converts from electrical signals into magnetic fields which influence the magnetic tape.

As previously stated, every magnetic medium exhibits a non-linear characteristic. This non-linearity is best illustrated by the Transfer Characteristic Curve which is mathematically derived from a family of hysteresis loops (Fig. 2). The hysteresis loops and transfer curve indicate the degree of tape magnetization which results from an exposure to a magnetic field such as that produced by the recording head. The transfer curve also indicates that the non-linearities exist only at the extremely low signal level (center portion of the curve) and at the very high signal levels (saturation areas) which are at the extreme ends of the curve. The remainder of the curve is relatively straight and allows linear and proportional transfer of magnetic signals.

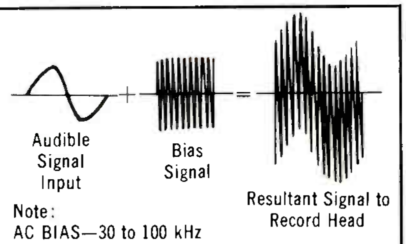
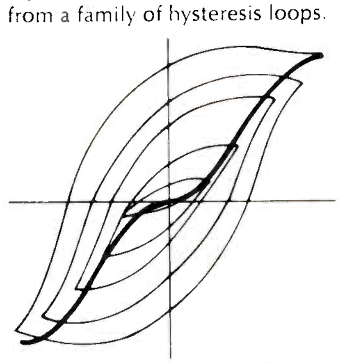


Fig. 1. Production of resultant signal.

Fig. 2. Transfer curve derived from a family of hysteresis loops.



The transfer curve shown in Fig. 3 illustrates the resulting tape magnetization from a magnetic signal generated by the recording head. The curve is typical of those for recording tape and no attempt is made to show non-linearities and signal losses created by either the record head or recorder electronic systems.

As the magnetizing force increases (greater record-head output in terms of magnetic-flux-field intensity) the resulting tape magnetization also starts to increase. Notice that the vertical segments of the transfer curve are relatively straight. It is within these straight segments of the curve that undistorted recording take place. The straight segments indicate that a linear and proportional relationship exists between a given input and the resulting output. This relationship may change for different types of tape because of differences in the magnetic properties exhibited by various oxide coatings.

The straight portions of the curve continue until saturation in either the positive or negative direction occurs. At the saturation points, no effective additional tape magnetization will occur even if the magnetizing force continues to increase. Recording into the saturation levels may produce distortion and tape noise, and may reduce frequency response.

To visualize the recording process, the transfer curve illustrates the resultant signal waveform (sum of bias and input signals), and its transfer

* *Technical Director, Magnetic Products Division, 3M Company*

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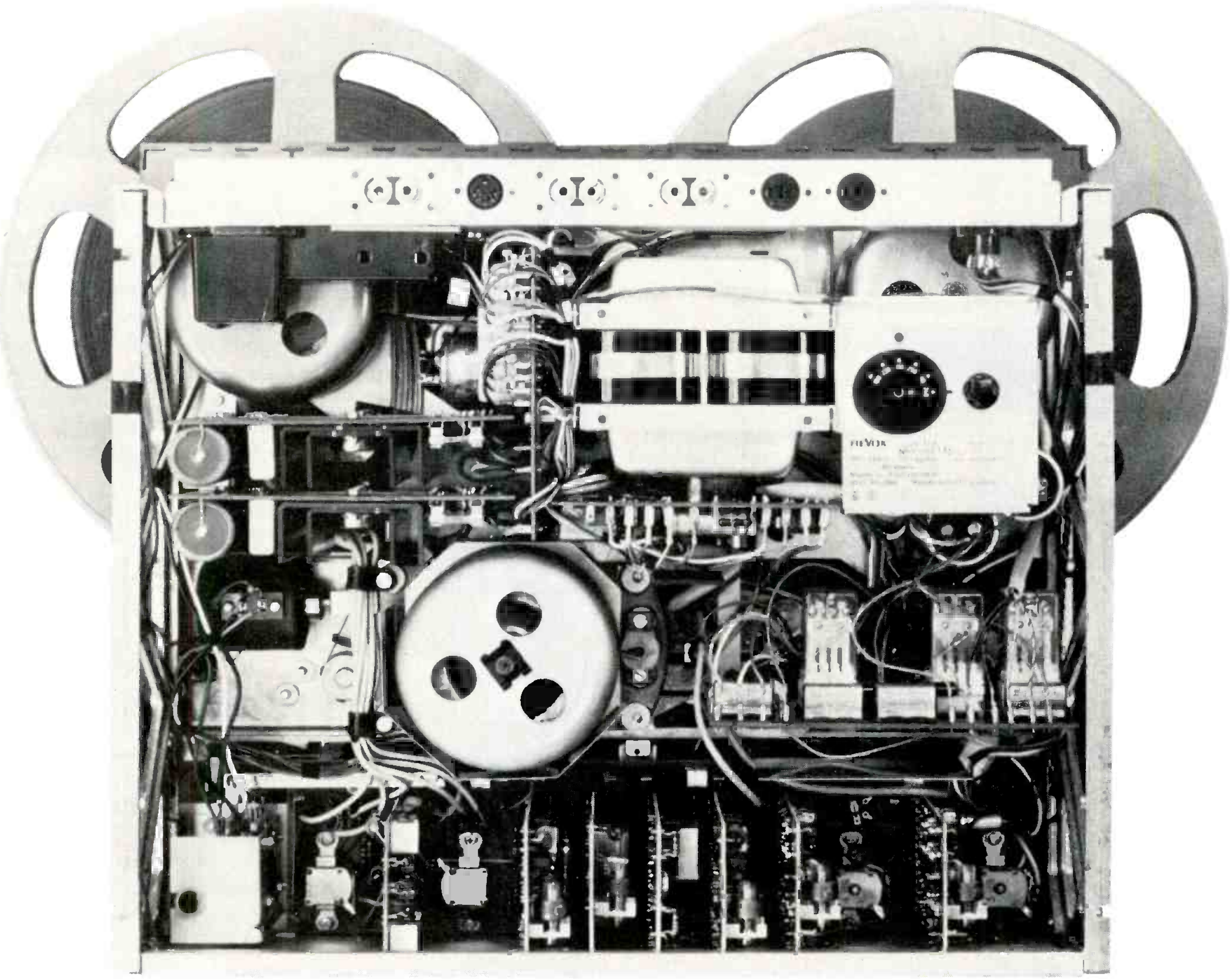

the inside story of Willi Studer

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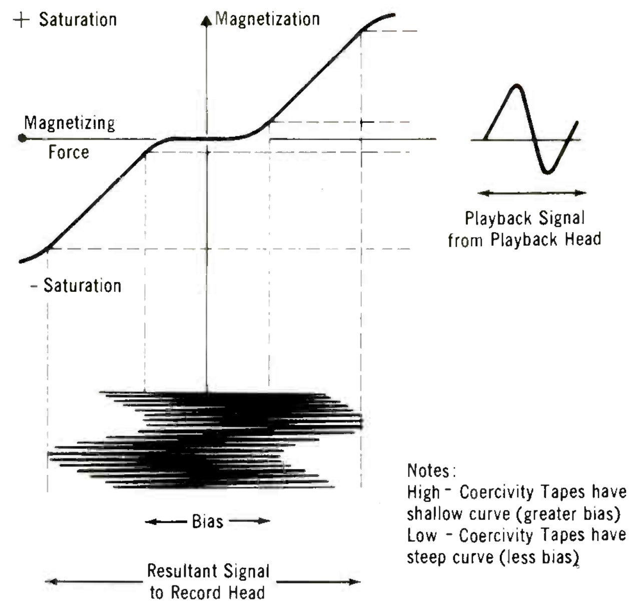

Fig. 3. Recording tape transfer curve.

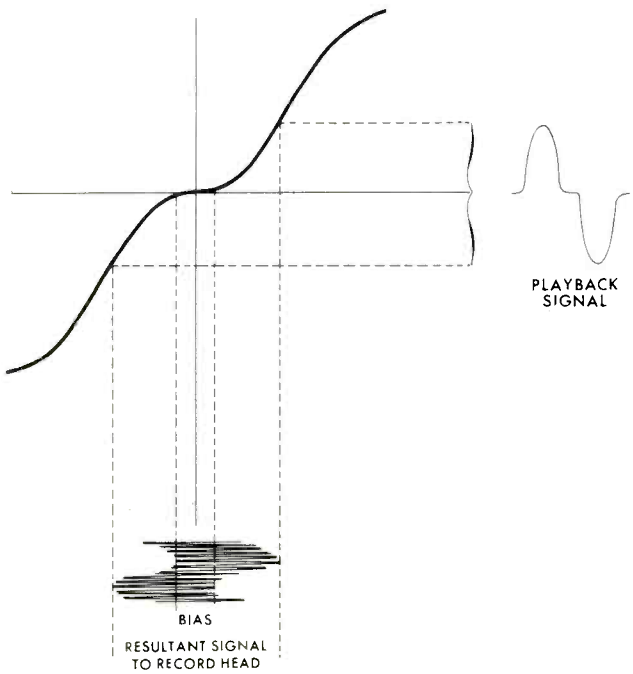

Fig. 4. Under-bias condition.

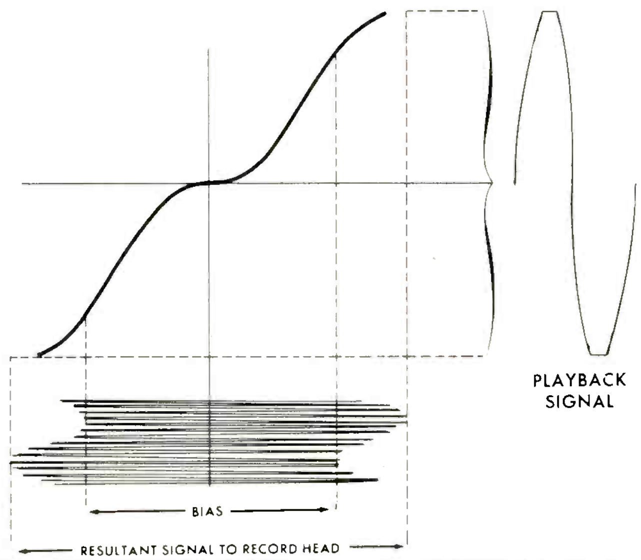

Fig. 5. Over-bias condition.

across the curve to form the recorded signal waveform. (Fig. 3) Observe that the signal with bias essentially bridges the "zero-point" and the low-signal-response portion. The bias position across the curve allows the signal-changing portions of the input waveform to fall onto the linear segments of the curve.

The shift of the input waveform across the transfer curve to form the recorded-signal waveform shows that the non-linear segment is essentially removed by the bias signal, and the recorded signal is relatively distortion free. Also, it can be visualized that either a low- or high-bias condition will drive the signal onto the non-linear segments of the curve and will cause distortion.

With a low-bias condition (Fig. 4), the low-level input signals fall onto the "zero-point" region and either may be severely distorted or not even be reproduced at all. In a high-bias condition (Fig. 3), the high-frequency response will decrease. The high frequencies will distort sooner or go into saturation because of a phenomenon called "self-erasure." Also, the signal-to-noise ratio may be reduced causing undesirable tape noise.

The transfer curve is typical of most magnetic recording tapes but each particular type of tape will exhibit a different slope, and a different "zero-point" region, as well as different saturation peaks. The differences of the curve shapes are created by the individual magnetic properties exhibited by each tape type. As the shape of the curve changes so do the bias requirements.

A low-coercivity tape has very steep linear segments and will require less bias current. On the other hand, a high-coercivity tape has relatively shallow linear segments which require a greater bias current. Because of the differences in tape magnetic properties, the slope of the curve changes and the bias level required to eliminate distortion will change accordingly.

To evaluate the changes of bias requirements involved with different types of tape, the wavelength response of the tape must be considered. Bias current is required to eliminate distortion but is also directly involved with frequency response and output. In terms of

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the birth of the AR-5

This is a photograph taken immediately after our final test of the prototype of the AR-5. The speaker system was measured while buried in a flat, open field, facing upward, its front baffle flush with the ground. This technique provides more accurate information than indoor tests, especially at low frequencies, where the precision of such measurements is adversely affected by the limited size of an anechoic chamber.

Our standard of accuracy when measuring the AR-5 prototype was the sound of live music, that is, absolute accuracy of reproduction. At AR, the best response curve for a speaker system, like that for a microphone or amplifier, is the one which most closely matches the input.

The specifications which AR advertises are obtained from production units, not prototypes. All AR-5 systems must match the performance of the prototype within close tolerances. To see that this is true, every AR-5 is tested numerous times in ways which permit it to be compared to the prototype. Only in this way can we be certain of what we have made, and consumers certain of what they are being offered.

AR speaker systems have uniformly received favorable reviews in publications which carry test reports. But even more accurate and comprehensive tests than most of these magazines perform are made on the AR production line, of every AR speaker system which will go into a listener's home.

The AR-5 is priced from $156 to $175, depending on cabinet finish.

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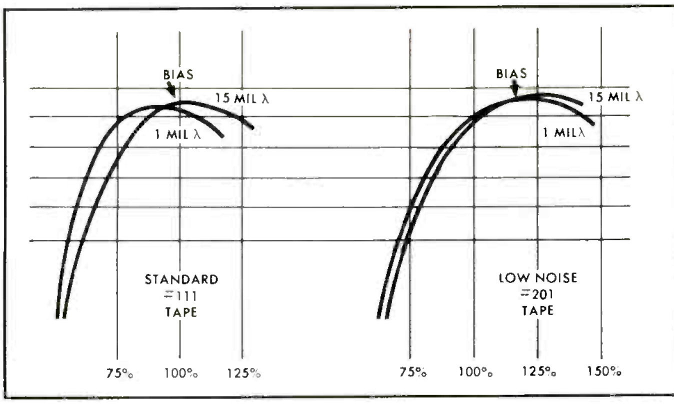

Fig. 6. Bias curve.

response and output, the bias requirement is related to tape construction such as: type and thickness of coating; quality of oxide dispersion forming the coating; and smoothness of the coating surface.

As a general rule, high-frequency response can be improved by using a tape with a high-coercivity oxide, relatively thin coating depth, and a smooth (specially prepared) coating surface. These improvements of high frequencies may have an opposite effect for the low frequencies to the extent that they may not be reproduced with the same efficiency. This situation becomes apparent in the bias curves (Fig. 6).

Because of the slight differences that may occur in the reproduction of the different frequencies, the actual bias setting is of a selective nature. The ideal situation would be one where the bias setting is at the point of peak output for all frequencies. Note that a bias setting is easily accomplished for the low-noise tape as shown in the bias curves (Fig. 6). For this particular tape both the high-frequency (1-mil wavelength) and the low-frequency (15-mil wavelength) output peaks coincide with each other allowing the bias setting to be at the overall output peak.

In the case of the standard tape, the high- and low-frequency (short- and long-wavelength) output peaks do not coincide at maximum output. The bias setting could be at either output peak or at the mid point. In normal recorder adjustment however, the bias setting most often used is at the output peak of the longer wavelengths. This setting is justified because the greatest percentage of recorded information is in the low- or mid-range portion of the frequency spectrum. To compensate for any unbalance in response output, the equalization settings of the recorder are adjusted until the overall output frequency response is flat.

Typical Bias-Adjustment Procedure

The bias settings shown in the illustrations indicate only a relative bias-level comparison between two different types of tape. The percentage-value relationship will generally hold true for most recorders. Specific information on bias adjustment or settings is impossible to enter into here because of the large variety of recorders in use. Most recorders have their own individual requirements and specifications for bias current (or voltage) adjustments. If a bias-level adjustment is attempted, care should be taken to assure correct settings. The recommendations of the recorder manufacturer must be followed precisely.

As mentioned in the preceding paragraphs, the low-midrange-frequency (longer-wavelength) output peak is generally used to obtain the most desirable bias setting. The normal adjustment frequency (for 7½-ips tape speed) is 500 to 1000 Hz. This audio signal is available from an audio, function, or signal generator which most electronic repair facilities have available.

The following adjustment of recorder bias is typical of many machines now in use. For stereo recorders, the adjustment procedure must be followed for both channels. Before attempting any adjustment, be sure that the machine is operating properly, the record and playback heads are clean and in good condition, and thoroughly review the manufacturers service manual. The bias-adjustment range, location, and function of controls, and the operation and scale of the output meters (VU meters) must be understood. Since the bias setting is determined by the type of recording tape, establish the basic type of tape you use most often. Prepare the machine for normal recording at 7½ ips with a low-signal-level input (approximately 20dB below tape saturation).

Set Gain, Record Volume, or Level adjustments low to avoid the possibility of recording in the saturation levels. Adjust the signal generator (1000-Hz, signal source) for a low-voltage output and connect to the recorder input terminals. If the recorder is a three-head type, listen to the recorded signal while recording the 1000 Hz. Slowly increase the bias and observe any increase of output as indicated on the VU meters. An increase of intensity of the playback signal should also be heard. Continue to adjust the bias, starting at low output, until the maximum output signal is observed. Continue to increase bias until the output begins to drop, indicating an overbias condition (Fig. 6), and return the bias setting to the point of maximum output.

If the recorder is a 2-head type, the set-up procedure is similar except that a series of short recordings is made, each with a change in bias, and then played back afterward. A simple method is to voice-identify the recording segment and bias setting and record the 1000-Hz signal for 10 seconds, readjust the bias and record another segment. Repeat this procedure over the entire range of bias control. Then play back all the recorded segments noting which one has the greatest fidelity and intensity, and set the bias accordingly.

The recommended bias setting for most recorders is where maximum output is indicated for the 1000 Hz signal. This setting coincides with the low-frequency (long-wavelength) output peaks as shown in the response-curve illustrations.

After the correct bias adjustment is obtained, a corresponding equalization-control adjustment may be required in some cases to compensate for differences in overall frequency response. Usually a simple listening test of recorded material will determine if the overall response is correct. Æ

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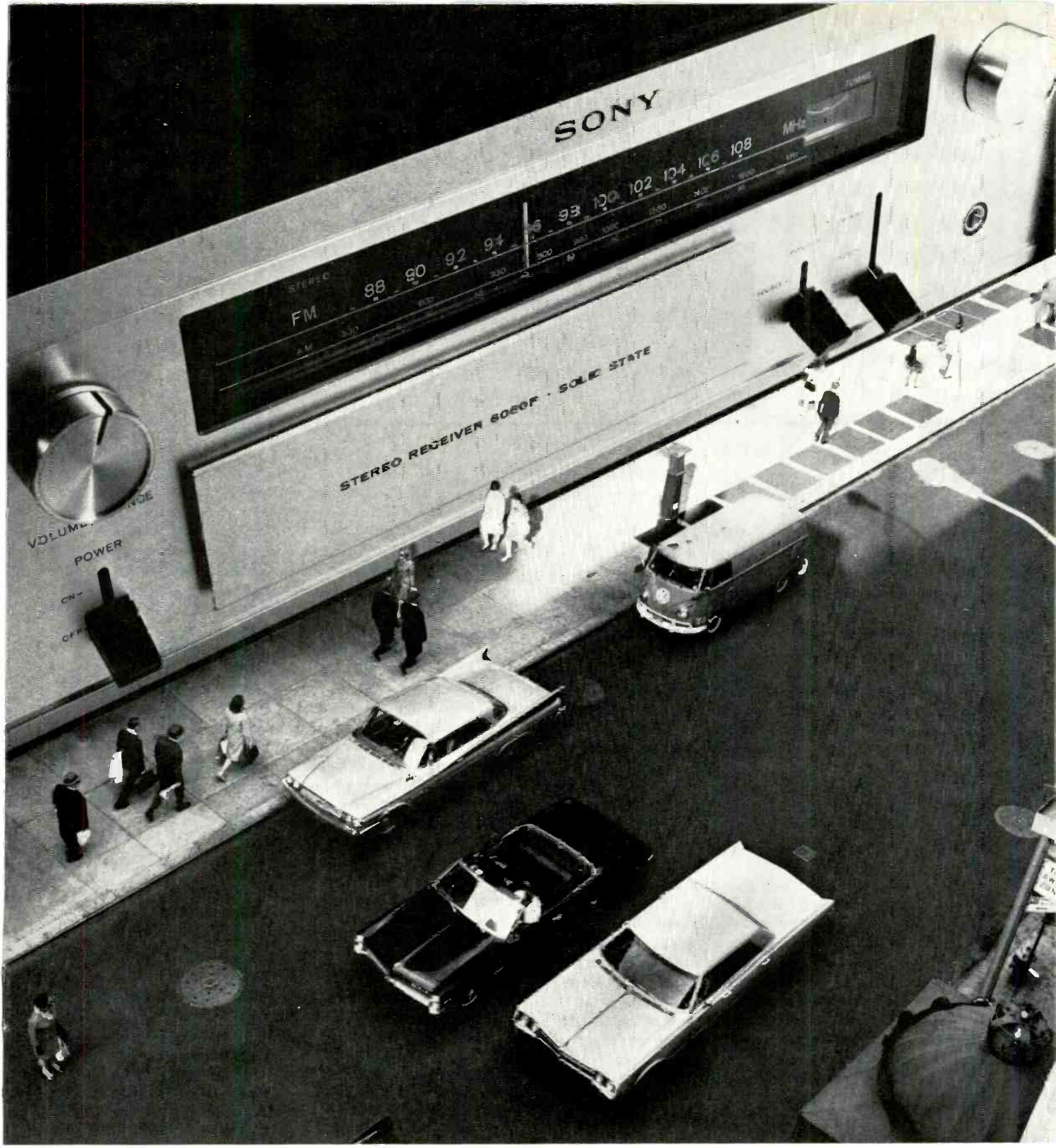

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The Commonality of Speaker Systems & Musical Instruments

ANTONY DOSCHEK

PART 3 (Conclusion): Idiophones

THE IDIOPHONES, or self-sounders, are most likely the very first of man's artifacts designed to create sound. And it is reasonable to assume that the performance of music was *not* their original function. Early in his development, man must have discovered that the striking sounds of wood on wood or bone on bone could be heard at far greater distances than the voice could penetrate; and that the pattern of strikes could be made to represent a meaningful communication. As he experimented further with his new-found breakthrough, man discovered that a hollow log or bone made a louder and more individualistic sound, and that this often was effective in frightening off his enemies. Then he realized that a particular sound could be created by a particular choice of material, its shape and size, and its condition of hollowness. Finally it dawned on him that he could adjust many of these neolithic transducers to produce a series of sonants. All of this showed the same character of attack but differed in depth of tone—the appreciation of musical pitch was born!

Somewhere in this misty recess of man's beginning he may have conceived the idea that if the clacking, thudding, and booming sounds that he was able to make at will could be used to frighten intruders or signal his friends, they may also be used to amuse and entertain him when a lull in the hardships of primitive existence permitted it. Such must have been the birth of music!

The practice of music dates back to long before any written records. The ethnology of all the world's peoples, regardless of their cultural levels, includes much evidence of an avid love for music. People of every language revel in or struggle to compose and perform music. And the end, in any land, is set to the strains of a somber music. It appears that life is a periodicity of material episodes permeated by the abstract—but not immaterial—phenomenon of music.

The idiophonic, self-sounding class of musical instruments establish the pace, the punctuation, and the skeletal frame of musical expression. Idiophones are usually divided into two classes: those of indefinite pitch—such as the drums (except timpani), cymbals, gongs, tambourines, the triangle, and so on—and those of definite pitch. The class of definite-pitch idiophones includes the timpani (kettledrums), bells, chimes, the xylophone and marimba, and several variations of bell-like instruments. All of these are played by some form of striking mechanism and are therefore called percussion instruments; all of them have the common characteristic of displaying a sudden onset of tone (the attack transient). In this respect the piano is also a percussion instrument and, indeed, is often scored as one in symphonic ensembles; but, academically, the piano belongs to the struck-string chordophone family. Generally speaking, the indefinite-pitch instruments outline the rhythm and impart a sense of power and excitement, while those that sound an identifiable pitch add glitter, mystery, and drama to music. Yet strange as it may seem, loudspeaker system designers have had—and still have—their greatest problems with the accurate reproduction of the indefinite pitch sounds.

There are several reasons for this. A brief discussion of the physical situation that results in a sound of indefinite pitch is in order before the analogies are carried on to speaker systems.

Our appreciation of musical pitch involves not only the fundamental frequency of a tone (as represented by a pure sine wave) but also its harmonic structure. As the term implies, the first few harmonics of a tone are harmonious; that is, the second harmonic through the sixth are usually the most prominent and create a "pleasant" sensation. Harmonics that are higher than the seventh are dissonant to the fundamental in progressive degree and create an "unpleasant" sensation: these are also called "partials" or "overtones." In a Fourier analysis of a geometrically regular complex wave—such as the square-, triangular-, sawtooth-, and so on, the amplitudes of the upper-order harmonics gradually diminish with increasing frequency. But musical instruments often produce partials and overtones quite as strong or stronger than the fundamental, and it is by perceiving and integrating their structure automatically that the brain can identify the color (timbre) of a tone and which instrument produced it. For example, we identify the tuba part in a musical composition, when

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listening to a pocket radio, by the high-order structure of its harmonics *only;* because the tiny speaker cannot reproduce the fundamental and lower orders with any degree of audibility. But the identification is nevertheless positive. However, two other factors strongly influence the identification of a tone. These are the attack transient and the tone-decay characteristics.

The remarkable sound-spectrum analyzer which we call the ear is able to discriminate between the rise-time (steepness) of arriving wavefronts which differ by as little as two or three milliseconds (thousandths of a second). Any tone that has a duration of less than about 15 milliseconds impresses the ear as just a click; but the ear is still able to sort out many kinds of clicks. The proof of this lies in the fact that we can distinguish easily between the tones of a xylophone played with boxwood sticks or those which have hard-rubber heads. Furthermore, drummers will argue the relative merits of wood or nylon-tipped sticks as though they produce a night-and-day difference in tone.

The decay characteristic of idiophones, with a few exceptions, is sudden and the tone dies out very quickly. Nevertheless, the exceptions are interesting. The cymbal, for example, has a strike tone and a continuing "ring" of considerable duration (largely dependent upon its size). Its overtone structure is by no means harmonic and, because the output of its fundamental frequency is not prominent, it is classed as an indefinite-pitch instrument. The cymbal shows a strong acoustic output in its very-high-order partials—extending into the ultrasonic region beyond 20,000 Hz—and an irregular acoustic spectrum. Physically, the cymbal can be considered to be a thin, circular, stiff metal plate supported at its center. Its fundamental motion during vibration is known as the "umbrella mode"; during which the periphery moves back and forth through its static position. But almost immediately after being struck, the cymbal develops a large number of subsidiary modes consisting of complex combinations of diametral, radial, and lesser peripheral patterns. This confuses any possible order of harmonicity in its acoustic spectrum. But note that the analogy between the cymbal and the cone of a loudspeaker is disquietingly close: the edge of a speaker cone is as free as the compliance of the surround will permit it to be, and the driving point is at its center instead of the edge.

This latter factor does not alter the *redistribution* of motional energy very much and the formidable problem of the speaker designer is still concerned with holding the spurious flexures indigenous to the cone material to an inaudible minimum. This is one reason why electrostatic speakers generally sound "cleaner" than direct radiators (dynamic cone drivers): the distributed-field nature of the attractive and repulsive forces acting on the sound-producing moving foil is such that the foil material, essentially, is driven from an infinite number of points, thereby inhibiting the development of its own vibrational modes. Nevertheless, eletrostatic-speaker-driving elements consist of moving squares of a foil that is restrained around its edges, and this configuration, also, develops indigenous vibrational modes because its central region is freer to move than its peripheral zones. The musical instrument analogy here is in the behavior of a tambourine (with its jingles removed) or a drum. Both square and circular restrained-edge membranes develop an umbrella mode and a large assortment of diametral, peripheral, and diagonal modes that result in an indefinite pitch. At this point, then, how do we rationalize the fact that trap-drums, side-drums, tenor-drums, and bass-drums produce an indefinite pitch while kettledrums are tuneful?

The explanation is that the indefinite-pitch drums have two heads consisting of stretched membranes spaced by a cylindrical body shell which encloses an air volume. The enclosed volume of air has a fundamental resonant frequency, but cannot radiate enough of it through the small holes in the shell to make this frequency audible. Instead, the air volume simply translates the energy it receives from the batter head to the rear head; which is not under identically the same tension as the batter head and therefore elaborates the already-complex harmonic spectra even further. However, the large areas of bass-drum heads—reportedly up to 10 feet in diameter—vibrating in two fundamental but inharmonic umbrella modes, move an enormous amount of air to produce a deep bass tone of very high acoustic power: viz., the last movement of the Ormandy recording of Berlioz' "Symphony Fantastique." Furthermore, the acoustic systems of two-head drums are greatly under-damped and will tend to "sing" in sympathetic resonance with the orchestra unless restrained by the player or a damping cloth.

On the other hand, the kettledrums have only one membrane which encloses an air volume contained by a rigid, approximately hemisperical shell. The fundamental frequency of this batter head is determined by its size and degree of tension (under the control of the player) and the principal air-volume resonance is designed to be harmonic within the tuning latitude of a particular size drum. Thus the two factors complement each other to amplify the principal drum-head resonance and suppress the higher-order inharmonic resomances, resulting in a well-defined pitch.

Another of the idiophone family, the bell (and its various relatives), is of considerable interest to the

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audiophile. The large churchbell, though not scored in symphonic music very frequently, can be heard in Tschaikovsky's "1812 Overture," the Moussorgsky-Ravel orchestration of the "Pictures at an Exhibition," and the Respighi "Fountains of Rome." Its tone is on the borderline between definite- and indefinite-pitch instruments. Everyone is familiar with the general shape of the bell and that it should be made of cast bronze, preferably; but few people realize its limitations with respect to the fundamental frequency that it can produce in view of its enormous weight and size.

A bell designed to sound a strong middle C (261 Hz) tap-note (ictus) has to weigh about twenty tons! But the sub-harmonic hum-note sounds approximately one major seventh lower than the tap-note; the distribution of the upper partials along with their own sub-harmonics creates an auditory illusion that some listeners judge to be two octaves lower than the tap-note (about 65 Hz). In addition to these peculiarities, some of the prominent frequencies heard in the original strike of the bell die out very quickly and new ones take their place (!), which, if they appear in the most sensitive region of the ear at about 3000 Hz, will make the loudness of the bell seem to increase *after* the original strike is heard. The reason for this strange behavior results from the large amount of energy imparted to the body of the bell by its heavy clapper, and the progressive redistribution of this energy through sections which want to assume and retain their own resonant modes as long as internal friction and competing vibrational forces will permit. Actually, the situation is precisely the same for any of the self-sounder instruments except that the initial exciting energy is not as great and therefore the sound dies out much sooner than that of the bell. Here the analogy to speaker systems is more subtle than in the case of membranes, but it is equally pertinent.

The enclosure of a loudspeaker, unless very rigidly constructed, absorbs a large amount of acoustic energy through mechanical contact with the driver as well as from the motion of the air within it. This causes the sides of the enclosure to flex, during which time some of the absorbed energy is dissipated in the form of heat due to internal friction of the enclosure material. Some is reradiated as sound. The reradiated portion is hardly ever complementary in pitch to the music that the speaker is reproducing and therefore it constitutes an adulteration. If the enclosure material is thin, we will have large excursions of the enclosure sides—leading to audible out-of-phase reradiation of what the driver may be doing at the moment, as well as flexure frequencies spurious to the wanted signal. This is similar to the situation we have in the chordophone family of instruments except that the sides of their resonant chambers are tuned to vibrate at definite desirable frequencies in order to embody a broadband acoustic amplifier as well as a characteristic tone color. Offhand, the cure for enclosure vibrations would seem to be in the use of material as *thick* as possible. But this leads to a fallacy! As the sides of an enclosure are thickened, their normal resonant frequencies increase. This can be seen from the equation for a simple oscillator,

$$f = \frac{1}{2}\pi\sqrt{s/m}$$

where f is the principal mode of vibration, π is 3.14159, s is a stiffness factor of the material, and m is its mass. Though the mass m simply doubles if we double the thickness of the material, its stiffness increases by some exponent greater than 1; and its vibrational frequency soon gets into the region of the ear's greatest sensitivity —thereby adulterating the highly critical upper mid-range of the musical spectrum. The correct answer to the complete elimination of enclosure vibrations is hardly a practical one since it involves using materials of specific design thicknesses, selective bracing, and mastic damping that would make our "bookshelf" speakers prohibitively expensive—and too heavy for bookshelves.

But enclosure vibrations are not of major concern to most music listeners: only to genuine audio buffs who want their symphonic, choral, or piano reproduction to sound "real" in the listening room. Far too many owners of hi-fi and stereo systems use them to generate a sort of auditory perfume through which they can chat comfortably. At the sound-pressure levels needed for this sort of thing, spurious cone or enclosure flexures are no problem since one can barely make out what the kettle-drums are doing. But at the levels required to bring Liszt's or Alkan's piano music alive, or to summon Wagner or Prokofieff into one's home, spurious vibrations begin to do some ugly things to quite a few of "the best" speaker systems. Scale distortion—the failure to reproduce music at the subjective sound level intended by the composer—is seldom mentioned nowadays; yet it was so important to many of us in the early years of hi-fi. But scale distortion plays a most important role in the reproduction of the idiophonic instruments since these suffer more from low-level reproduction in the effect of realism than the sustained-tone aerophones and chordophones. Due to the short tone duration and/or delicate overtone structure of the percussion group, their sound-pressure level of reproduction must be near the original to create the impact or harmonic colorations that the composer intended. How often have we heard the triangle part in Liszt's E-flat piano concerto sound like the neighbor's telephone bell?

In view of the prodigious complexities of sound and musical traceries, it is a wonder that we *can* have what we *do* have in the loudspeaker's ability to recreate the composer's and performer's genius. But to take full advantage of the mystique of music, we must reveal the HORRIBLE TRUTH (mentioned in Part 2 of this series): which is that *no one* speaker system does full justice to *every* kind of music! The delicate shading and transparent scoring of Renaissance music is reproduced almost ideally by the electrostatic systems, while the richer, weightier tonalities of the Romantic period fare well from the bland, grille-clad faces of the direct radiators; and it is hard to deny that the vast sonic panoramas of a Strauss tone-poem or Shostakovitch symphony are displayed most spaciously by the large horn systems.

Therefore, which shall it be?—since to have the best of the best in sound reproduction at home, all we really need is money, space, and an understanding spouse. Æ

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Electronic Organs

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ONE OF THE most universal "extras" on electronic organs is a vibrato or tremolo. Many organs provide more than one rate or level of modulation. The steady unvarying tone is not only less "interesting" for most of the music played: it shows up any defects in tuning, or in the way the player performs, much more than when vibrato or tremolo is added. One might say that vibrato or tremolo can cover a multitude of sins.

Vibrato—Electromechanical

The method of achieving vibrato or tremolo depends on the form of tone generator used. For the Hammond and other organs using electromechanical means, the addition of vibrato is simple—just put a mechanical "wobble" in the drive.

The simplest method of achieving the correct tone intervals is to mount the generators on twelve shafts that rotate at the basic speeds needed for the twelve notes of the musical scale. Successive octaves of the same note merely use numbers of teeth to correspond with each octave. If a tone wheel uses two teeth for a given note on the lowest octave, other wheels will use 4, 8, 16, 32, and 64 of them for subsequent octaves up the scale.

As the master oscillators lock lower octaves of the same note by means of dividers, so all octaves of the same note are locked by tone wheels rotating on the same shaft in the electromechanical tone generator. Then the individual shafts are driven by pulleys and a belt from a constant-speed motor of high stability. Precision control of individual pulley diameters in the manufacture ensures that the twelve notes maintain the correct tone intervals (Fig. 6-1).

To apply vibrato to such an organ is then a matter of inserting an eccentric pulley into the drive chain, with a jockey pulley to take up the variable slack (Fig. 6-2). This method achieves true vibrato, or variation in pitch, rather than variation in intensity.

Electronic Forms

Most of the electronic organs apply vibrato or tremolo to the oscillators in the form of a variable voltage. This is almost invariably derived from a phase-shift oscillator (Fig. 6-3), which may be either tube or transistor type. A phase-shift oscillator, with values chosen so it oscillates reliably, but not too hard, will give a good waveform, at least at some point in the network.

The phase-shift network, which usually consists of three R-C couplings in cascade, tends to emphasize harmonics progressively. The best place to pick off a good waveform that is a reasonably good imitation of a slow-speed sine wave is at the input to the phase-shift network, before the har-

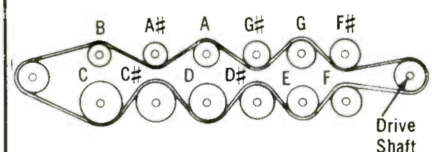


Fig. 6-1—Method of drive for an electromechanical tone generator.

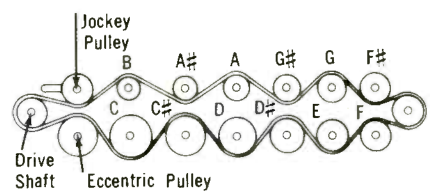
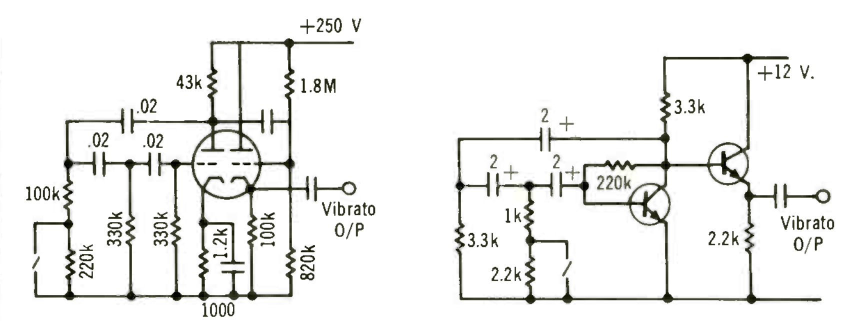


Fig. 6-2—Applying vibrato to the electromechanical tone generator.

Fig. 6-3—Two circuits for oscillators to provide vibrato or tremolo voltages at two speeds. Values are close to those that will give reliable performance, but may need adjustment for best results (or even any results at all, if it doesn't oscillate).



Speed: Open Slow = 10Hz: Closed Fast = 16Hz

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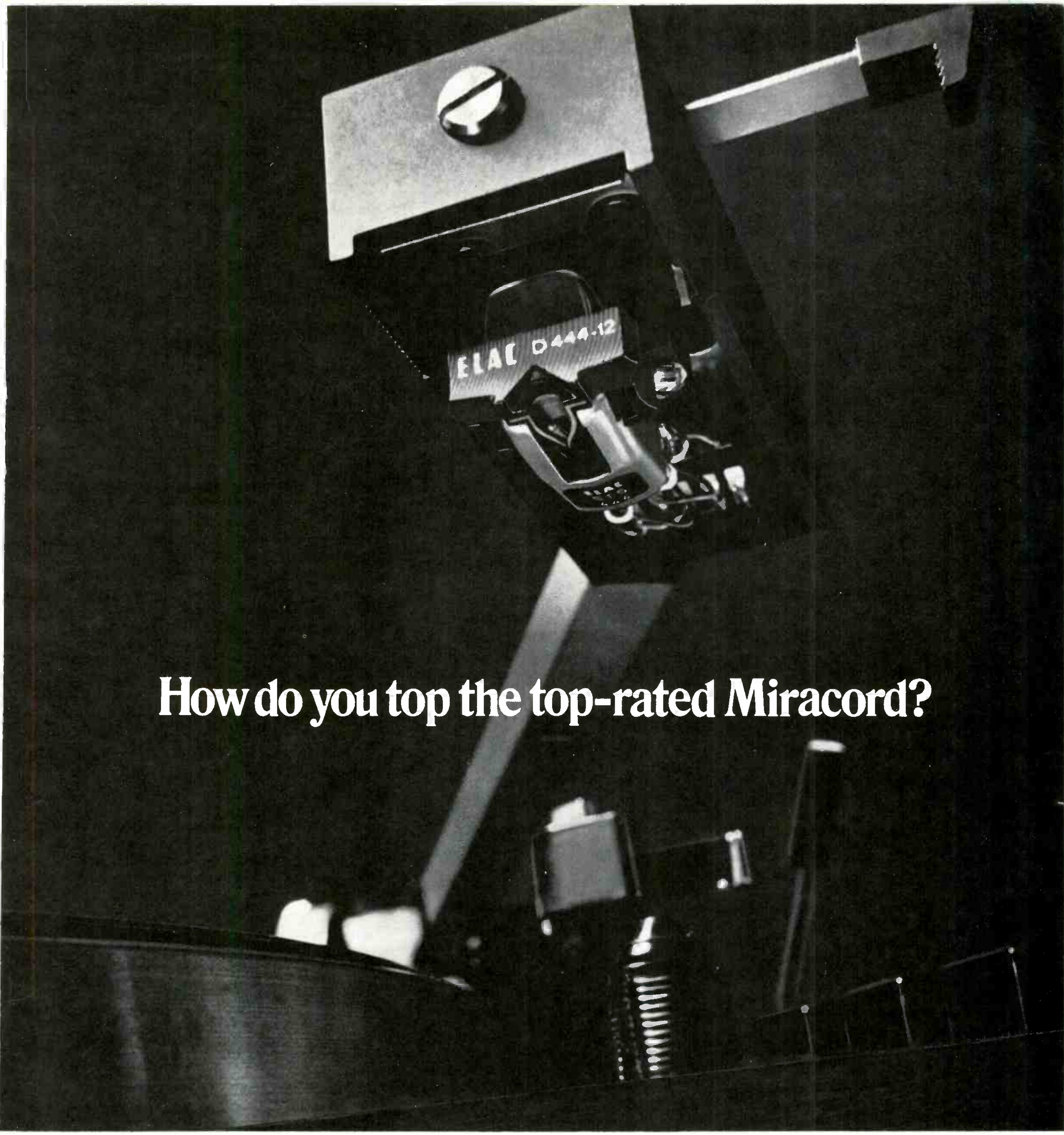

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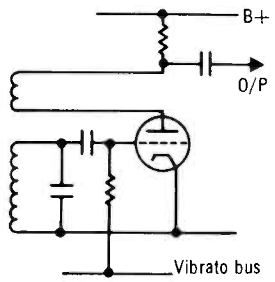


Fig. 6-4—Applying vibrato as variable bias to the earlier-type tube oscillators.

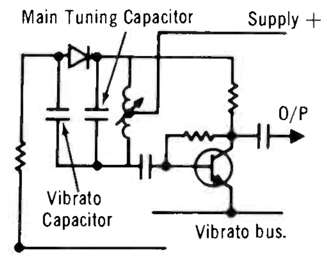


Fig. 6-5—Applying vibrato to a transistor oscillator by means of a diode that varies tuning.

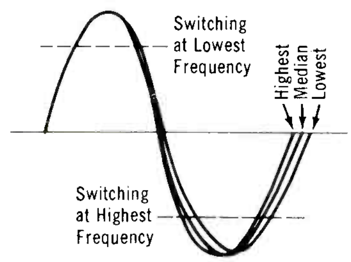


Fig. 6-6—Actually the circuit of Fig. 6-5 changes frequency by bending the waveform in different places. This waveform is that across a fairly high-Q tuned circuit, with diode vibrato. The oscillator's output voltage may not be so nearly sinusoidal.

Fig. 6-7—A vibrato-voltage-controlled variable resistance, for applying to the modulator circuit of a post-oscillator type vibrato.

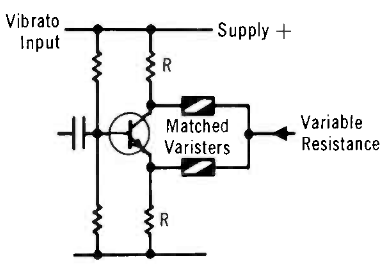
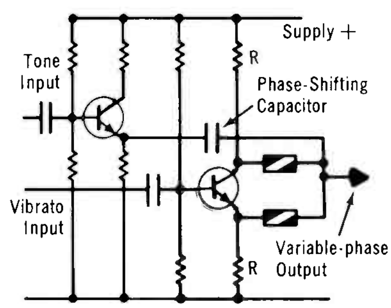


Fig. 6-8—A completed single stage of phase-shift modulation for the post-oscillator type vibrato. More than one stage would be needed to produce recognizable vibrato.



monics are emphasized, and where the amplitude is highest as well.

Then this can be fed through a cathode follower or an emitter follower, to avoid loading the oscillator circuit. Output loading will vary according to how many notes are played at once. Coupling this loading directly to the oscillator would vary the intensity of vibrato, or perhaps stop it altogether at times. The follower avoids this interaction. How this voltage is applied to modulate the tone generators varies from one organ to another.

Tube Types

In the tube types, this could vary the grid bias (Fig. 6-4) which in turn varies the gain, causing the oscillations to build up and die down alternately. While this is basically a variation in amplitude, or intensity, and thus would correspond with tremolo, most oscillator circuits also change frequency or pitch a little, so that the result may be more realistic than either pure amplitude or pure frequency variation.

Transistor Types

For transistor oscillators, and also for some tube types, a more definite effort is made to vary frequency, rather than amplitude. In tube types, that's a matter for choice. In transistor types, varying either frequency or amplitude by changing bias is a little difficult, because gain varies little as bias is changed. Transistors turn on or off suddenly, rather than exhibiting any curvature of the type common in tubes. Varying frequency by changing the tuned-circuit constants proves the easier way with transistors. The almost universal method here is to use voltage to vary the bias of a diode, which progressively connects and disconnects a capacitor in parallel with the main tuned circuit capacitor (Fig. 6-5).

This method actually changes the waveform slightly, but its effect on frequency is most noticeable. Changing the bias on the diode changes the point on the generated waveform at which the extra capacitor is connected and disconnected. Thus one half of the waveform represents a portion of lower frequency than the other half. By changing the point on the waveform at which this change occurs, the resulting frequency varies quite smoothly (Fig. 6-6).

Post-Oscillator Modulation

One more method of achieving vibrato was developed primarily for instruments like the guitar or accordion, in which a true vibrato is difficult or impossible to obtain in the natural instrument. This works on phase shift. The simplest method applies variable resistance as part of the phase-shift element.

If two matched varistors are connected across a push-pull variable voltage derived from the vibrato generator (Fig. 6-7), their junction point will be balanced to the vibrato voltage, but will exhibit a variable resistance to ground. Applying this as a variable resistance element in a simple phase-shift network (R-C) causes a variable delay in signal transfer (Fig. 6-8).

Using a number of such phase-shifting networks in cascade enables enough phase shift to be produced to result in audible vibrato effect. Certain limitations should be noted, since they make the method uneconomical for organ application in most instances.

First, the phase-shift networks only produce their best phase-shifting over a rather limited frequency range. Above that range, where the capacitor reactance is negligible compared to the variable resistance throughout the vibrato cycle, the vibrato effect vanishes. And below that frequency range, the effect is more like pure tremolo, because the capacitor has a reactance that is large and thus produces almost 90 degrees of delay, resulting in variable amplitude.

Extra gain is needed for these lower frequencies, or else several of these modulators are used, each of which covers only a segment of the organ's musical scale. This results in a greater number of matched pairs of varistors being required (and the associated circuit components), so that other methods will usually be less costly. Æ

(Continued Next Month)

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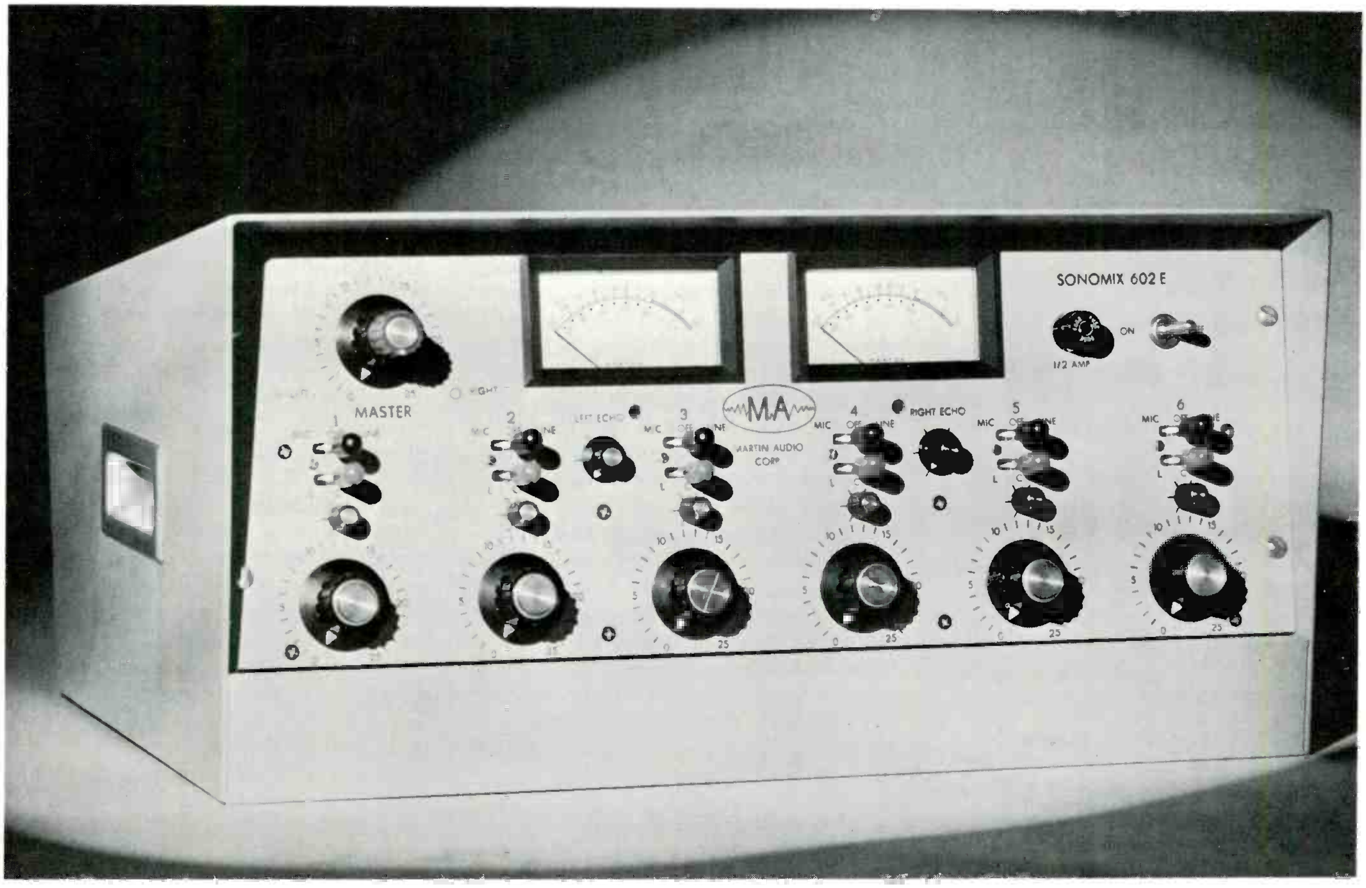
Martin Audio announces the first professional stereo mixer with built in echo mixing facilities



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Equipment Profiles

- Sony Model TC-666D Stereo Tape Deck
- C/M Model 35D Stereo Power Amplifier
- C/M Model CC-2 Stereo Preamplifier
- Koss Model ESP-6 Electrostatic Stereo Headphones

Sony/Superscope Model TC-666D Stereo Tape Deck

MANUFACTURER'S SPECIFICATIONS—

Four-track system, stereo or mono. Reel Size: up to 7 in. Motors: Three. Tape Heads: Four. Frequency Response: 7½ ips, 20-22,000 Hz; 3¾ ips, 20-15,000 Hz. Wow and Flutter: less than .09% at 7½ ips; less than 0.15% at 3¾ ips. Signal-to-Noise Ratio: without SNR, better than 53 dB; with SNR, better than 59 dB; (SNR is "Sony-Matic Noise Reduction System"). THD, less than 1.5% at 0 dB line output. Dimensions: $17\frac{3}{16}$"W x $8\frac{1}{16}$"H x $16\frac{5}{8}$"D. Weight: 48½ lbs. Price: less than $575.00.

The Sony TC-666D stereo tape deck proves that a sophisticated tape deck can be designed with an attractive, uncluttered control panel. This deluxe deck, for use with a high-quality stereo audio system (it does not incorporate power amplifiers or speakers), has a number of truly meaningful features. For example, its "Sony-Matic Noise Reduction System" reduces tape noise during playback of recorded tape by 6 dB through simply sliding a switch to another position; the deck has the ability to reverse automatically at the end of the recording without need for placing a metallic strip on the tape end; the TC-666D can record as well as play back monophonically or stereophonically in both directions. Other fine features include: three motors, four tape heads, dual-level headphone output, a scrape flutter filter. But those are only a few of the excellent features of this machine.

Starting at the top of the panel, the four-digit counter is seen at the center, with the usual two reel spindles to left and right. The head covers are next, centered on the panel from right to left, with the tape tension arms extending from both sides. At the left are two rectangular buttons for speed selection, 7½ and 3¾ ips, the automatic tape reverse switch, and an instant-stop button. To the right of the head covers is the direction selector lever, the horizontally shaped stop button, the two narrow buttons for fast forward to left and right, and between them the play button. Each of these buttons operates a microswitch which in turn actuates the proper relay circuits. All of these controls (with the exception of the instant-stop button) are black, while the top plate is finely satin-finished anodized aluminum. The black lower portion of the top accommodates the SNR switch and the headphone jack at the left, and the power switch and a minute pilot light at the right. A sliding plate (with the model number displayed when it is closed) covers the two miniature microphone-input jacks, the two red record buttons, and the two small aluminum recording-level controls. The dual VU meter is visible at all times, and indicates both when recording and playing back. There is no playback volume control (one would use the control on the stereo hi-fi system for this purpose).

At the rear is a recessed panel which accommodates the AUX input phono receptacles, and another pair for line output. In addition, there are two fuse holders—one for a 2-amp fuse which protects the main power supply, and one for a 1.6-amp fuse which protects the transport mechanism. Power for actuating the many relays is derived from the main power supply and is d.c. In addition, there is a switched a.c. receptacle, and a two-position headphone-level switch.

The unit employs a total of 32 silicon transistors and 19 diodes. There are three motors, and 4 tape heads—2 for erasing, and 2 for combination record/playback. These are mounted from left to right as forward erase, forward record/play, (capstan), reverse record/play, and reverse erase.

Fig. 1—Sony Model TC-666D stereo tape deck (bottom photo reveals hidden controls when control-panel slide is opened).

The capstan motor is a reversible hysteresis-sync type, and the spooling is done by torque motors. These are energized by relays actuated by the control circuits—some by simple pushbuttons and others by the sensing section which reverses the direction of tape travel on the incidence of more than ten seconds of silence on side 1 and side 2 of the tape. Thus a prerecorded tape can be put on the machine and started. When it has finished the music on that side and silence on both sides of the tape continues for ten seconds, the sensor circuitry operates, and the direction of travel is reversed. There is no need to put metallic tapes on the tape at the points where reversal is desired. The TC-666D must be used with an external amplifier if you want to hear your music through loudspeakers. If you want to listen without disturbing others, you can use phones of the usual low-impedance type. The monitor circuit employs separate transistor which drives a transformer to match your phones. At the same time, this transistor also drives the recording-level meter, thus avoiding the effect of the recording equalization. Some machines drive the VU meter direct from the recording amplifier, and with its usual pre-emphasis, the meter indications are not in accordance with the program level content. This is a definite advantage, in our opinion.

Circuit Description

The two channels are identical, with each consisting of six transistors arranged with one pair as the preamplifier, followed by another pair which provides some of the recording equalization. A single transistor feeds the recording head through the constant-current resistor and a bias trap. Additional high-frequency recording boost is provided by a resonant circuit across the emitter-to-ground resistor. It is resonant at 20 kHz for 7½ ips, and at approximately 14 kHz for 3¾. Separate level-set controls provide for each of the directions of tape motion, as do level-set and equalization controls for playback. The recording level controls—one for each channel—employ a circuit which is designed to provide optimum control of the input signal as far back in the amplifier as possible without the possibility of degrading performance of the first two stages due to overload. This is accomplished by increasing the feedback from the collector of the second stage simultaneously with

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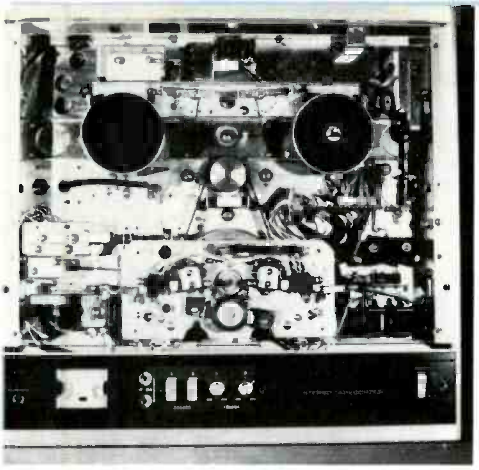

Fig. 2—Top view of Sony TC-666D chassis with cover plate removed.

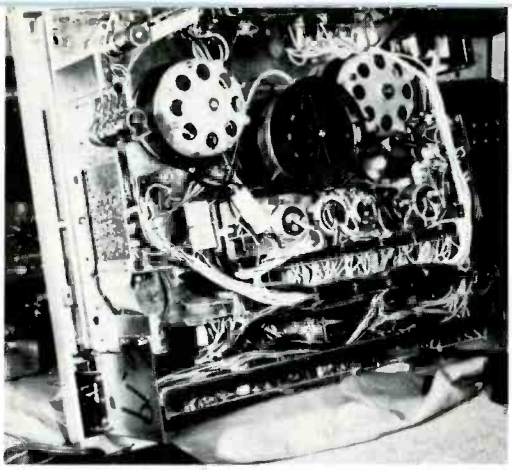

Fig. 3 — Rear view of Sony stereo tape deck shows three motors.

decreasing the signal fed to the base of the third stage. Thus input levels which would normally be distorted in the first two stages are kept under control by the feedback circuitry to provide an especially high S/N in the recording function.

When this is followed by the Signal Noise Reduction System in the playback mode, it results in a S/N which is relatively high, in comparison with most other machines. The SNR operates by reducing the gain of the playback amplifier when its output goes below a pre-determined level—approximately 30 dB below 0 VU as indicated on the meter. When this happens, the overall gain is reduced by about 6 dB, resulting in an unprecedented S/N of 59 dB. In effect, it might be said that the circuit functions as an expander with a very low threshold level — everything above that level is expanded 6 dB, while everything below is reproduced at normal gain.

The SNR is purely a function of the reproduce circuit. Any tape, including commercial pre-recorded tape, can be benefitted by this noise reduction system by simply throwing this switch to the SNR position.

The third and fourth stages of the amplifier are another feedback pair with additional bias-frequency degeneration, and the output of the fourth stage feeds the monitor and VU meter circuits, as well as the recording driver stage, which is equalized for the recording characteristic. Its output feeds the recording head through the constant-current resistor and another bias trap to the head-switching circuits.

Bias is furnished by a push-pull transistor pair at a frequency of approximately 160 kHz—the highest frequency we have yet encountered in a consumer-type tape recorder.

The "silence sensor" circuitry involves a group of three transistors in a cascode connection, followed by a rectifier which triggers a long-time-constant multivibrator after a 10-second period of silence, and it, in turn, actuates a medium-power transistor which operates the reverse relay. The action functions only on the passage of tape in the forward direction. Once the tape has reversed and played through, the machine stops when the tape runs out.

Operation

The TC-666D is remarkably easy to use. For playback, one puts the reels in place, drops the tape into the slot—making sure to feed it around both of the tension arms. Then with the direction selector in the forward position, depress the PLAY button. When the music finishes and is silent for ten seconds, the reversing sensor circuit operates, the direction selector lever moves to the reverse position, and the machine reverses.

To record, move the sliding cover over and depress the red RECORD button corresponding to the channel on which you wish to record (or both for stereo). Adjust the level, and while holding the record buttons down, press the PLAY button. Aux inputs at levels above 61 mV, although usually in the vicinity of 250 mV, can be accepted, while the microphone jacks accept a minimum of just under 0.2 mV, which will accommodate practically any microphone—high or low impedance.

The deck may be used in either a horizontal or vertical position, using reel caps (provided) for the latter.

Performance

One of the criticisms of noise-reduction systems has always been that they caused a change in the frequency response, and to many listeners that was more objectionable than the noise itself. We tried to determine if there was any effect in the TC-666D and we came up with the astounding measurement of identical response at levels of 0, —10, —20, and —30 dB. Response at normal levels is shown in one of the illustrations here for both playback from a standard tape as well as in the record/playback mode for both speeds. The differences in level between channels was less than the width of the line. We measured wow and flutter at .075% at 7½ ips and 0.14% at 3¾. S/N measured 54 dB without SNR, and 59 dB with the SNR circuit in operation. Channel separation measured better than 45 dB, and crosstalk between adjacent channels—which could be a problem on any four-track machine if the tape were recorded in both directions as it normally would be—measured 44 dB.

Less than 0.1 mV fed into the microphone jacks would provide a 0-VU recording level, as would a signal of 29 mV at the AUX inputs. The measured signal at the output jacks was 0.8 V for a signal of 0 level. And in keeping with its superb operating figures, we mustn't forget that the mechanical aspects of the machine are equally top-notch. Tape spooling in the rewind and fast forward positions was smooth, and required 54 seconds in either direction for a 1200-ft. reel.

With its fine measurements and high mechanical quality, one would natur-

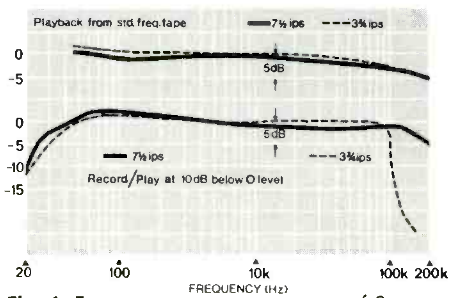

Fig. 4—Frequency response curves of Sony TC-666D tape deck at 7½ ips and 3¾ ips speeds.

ally expect an equally high standard of reproduction, which is just what we heard. The noise reduction system eliminates tape hiss during relatively silent periods on recorded tapes. And we liked the solid action of the solenoid-operated relays when a pushbutton was depressed. Further, the machine's mechanism operated quietly, indicating that it is also well designed from a mechanical viewpoint.

In addition to its unusually handsome appearance, the TC-666D is furnished with a plastic dust shield and the usual accoutrement which accompany any Sony gear: set of patch cords, elaborate instructions, and to our complete satisfaction, a schematic listing all parts values, transistor types, and such desirable information. In short, the recorder is presented in a manner befitting its excellent performance.

The Sony TC-666D stereo tape deck is not inexpensive, but for a unit that is obviously intended for the "fusspot" recordist who wants to have *both* his high quality and automatic conveniences, it appears to be well worth the price (less than $575.00).

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C/M Laboratories Model 35D Stereo Power Amplifier

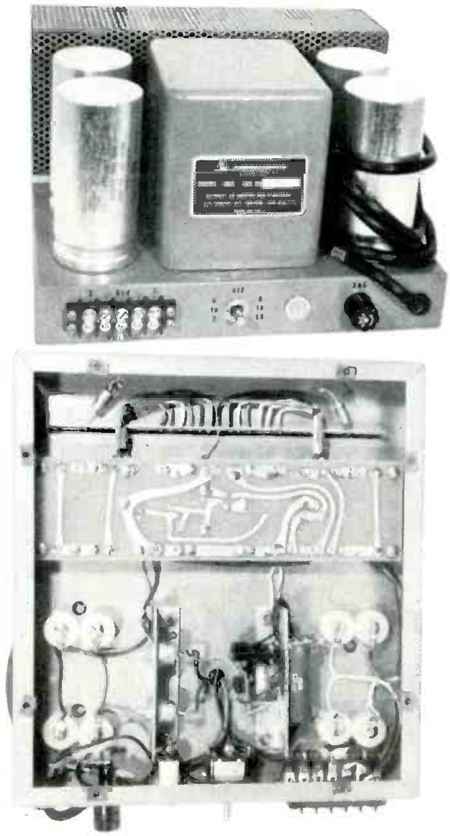
MANUFACTURER'S SPECIFICATIONS:

Continuous output power: 35 W/chan. into either 4, 8, or 16 ohms. Frequency Response: 20-20,000 Hz ±0.5 dB; 1 Hz to 100 kHz ±3 dB. THD: less than 0.5%, 20 to 20,000 Hz into 8 ohms. IM: less than 0.5% at any power level from 0.35 W to rated power. Damping factor: better than 500 with 16-ohm load, entire audio range. Hum and Noise: 70 dB below rated output. Input Sensitivity: 0.65 to 1.3 V, depending on load. Input Impedance: 100 kOhms. Dimensions: 6 1/8"H x 10 1/8"W x 12 1/4"D. Weight: 25 lbs. Price: $285.00.

For those who still prefer a separate power amplifier and control chassis in their stereo installations, the C/M Laboratories Model 35-D Power Amplifier offers much that is new and of superior quality. While most power-amp purchasers are not overly concerned with the outward appearance of such units, even the blue and gray baked enamel treatment of the exterior bespeaks a "cool" design in every sense of the word.

Everything about the 35-D connotes ruggedness, as you can see in Fig. 1. The four huge electrolytic capacitors surround a power transformer reminiscent of high-powered, vacuum tube designs—with one great difference—this one runs cool after hours of testing and listening. Two of the electrolytics are used in the power-supply filter circuit and total 4800 μf of capacitance. Talk about stiff power supplies! The two others are each valued at 3400 μf and are used to couple the output signal from the push-pull output pair of transistors in each channel to the loudspeaker. No loss of ultra-low frequencies here—even when looking into a 4-ohm load—the 3-dB attenuation point would not be reached until you get down to a 11.7 Hz!

If you glance back at the published specifications, you'll notice something unusual. While most amplifiers are rated for 8-ohm operation or even 4-ohm operation, the 35-D claims a 35-watt rms rating per channel *regardless* of load (4, 8 or 16 ohms). In order for an amplifier to be able to deliver 35 watts rms into a 16-ohm load, it must be able to do much better at 4 ohms, where maximum power transfer takes place. Such was indeed the case, as we shall see presently.

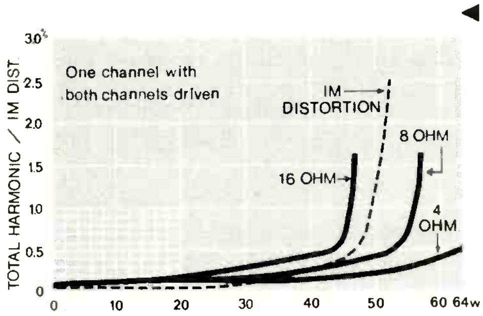


Figs. 1 and 2—External and interior views of C/M Laboratories' Model 35D stereo basic power amplifier.

The power switch had us stumped for a while. Instead of the usual on/of toggle, a three-position switch was used. In its center position, power is off. If the switch is thrown to the left, the amplifier comes on (after a few seconds delay to allow the power-supply voltages to reach perfect stability). Thanks to a delayed-action relay there are no speaker thuds or pops! The nomenclature in this position of the power switch reads "4 to 8." If the switch is thrown to the right, the amplifier pilot light comes on again, indicating that power is on, and with our 8-ohm speakers connected we couldn't tell a bit of difference at any listening level. Why the two positions, then?

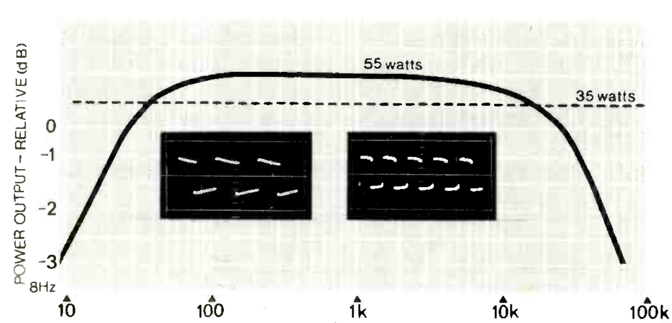
A look at the schematic disclosed the reasoning behind this innovation. For a power amplifier to drive 35 watts rms into a 16-ohm load it requires a voltage swing of almost 24 volts rms and a correspondingly high power-supply voltage. Under such conditions, a current flow of around 1.5 amps would result. If the amplifier were now connected to a 4-ohm load (assuming a constant-voltage source which this amplifier almost is, with all that feedback applied) and the voltage swing approaches 24 volts, *six amperes* of current would flow—far too much for the output transistors used. For 35 watts per channel at 4 ohms, a swing of only about 12 volts is needed—which means the power supply voltage need not be as great as before. That's just what C/M Laboratories does to solve the old "solid-state impedance-matching problem." They actually alter the power supply voltage by selecting alternate taps on the power-transformer primary by means of this unique three-position on/off switch, choosing power-supply voltages so that an 8-ohm load will be driven to at least 35 watts per channel in either the "4 to 8" or the "8 to 16" postion of the switch.

Conservatism in design, as evidenced by the more-than-adequate heat-sinking and professional internal construction (see Figs. 1 and 2) is more than matched by the conservatism of stated specifications. Figure 3 presents THD curves for all three popular speaker impedances—4, 8 and 16 ohms. Note that rated distortion (0.5%) is reached at 45 watts for a 16-ohm load, 55 watts for an 8-ohm load and 64 watts for a 4-ohm load. With an 8-ohm load, THD



◀ Fig. 3 – Total harmonic distortion for various load impedances. IM distortion shown as dotted line.

Fig. 4—Power bandwidth of C/M 35D amplifier, based on 0.5% THD, 8-ohm load, with 35 watts equaling zero dB. Square waves at 50 Hz and 15 kHz are also shown here. ▶



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If you plan to spend less than $74.50 for an automatic turntable, you're reading the wrong magazine.

Most of the people who read this magazine know that you can't get high fidelity sound from a cheap record changer. Or a high degree of enjoyment. Or, for that matter, the peace of mind that comes with knowing that your records are being handled with precision and care.

If you spend less than $74.50 (the price of the Dual 1212) you won't get a changer that will track a high-compliance cartridge at one gram, flawlessly.

Or compensate precisely for tonearm skating at low stylus forces.

Cheaply made record changers tend to be plagued by audible rumble, wow and flutter. Any regular reader of this magazine knows that. (Rumble, wow and flutter of the Dual 1212 easily surpass NAB standards for broadcast turntables.)

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So if you want a high fidelity record changer, and you're willing to spend a few extra dollars to get one, you've just read the right ad.

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at the rated power of 35 watts was only 0.2%.

Figure 3 also shows the equally impressive IM distortion (or lack of it) for the 35-D. Notice that at 35 watts per channel (again, with an 8-ohm load) measured IM was well below rated IM—only 0.12%. Power bandwidth for the amplifier (not stated in the published specs) was measured as from 8 Hz to 65 kHz, based upon 35 watts per channel at 0.5% THD. Results of this measurement are shown in Fig. 4.

Listening tests were conducted in two ways. First, we combined the 35-D with C/M Labs CC-2 preamp control. Speakers were a pair of high-quality, low-efficiency book-shelf types. Program sources included professionally recorded master tapes which we reserve for such occasions. Our recording of Moussorgsky's "Pictures at An Exhibition," for example, has a dynamic range of nearly 60 dB, and contains some of the best percussive work for testing transient response we have ever heard. Happily, the 35-D in combination with the CC-2 stood up very well under the test. The high damping factor and fast recovery time provided transient response as excellent as we have ever heard. And all this at near ear-shattering levels. Lows were noticeably tighter than usual and all program frequencies seemed well balanced, clear and clean at all levels.

As a further test, (and to make sure that the CC-2 wasn't in any way influencing performance of the 35-D) we fed the output of our stereo FM tuner directly into the 35-D, since it was the only piece of equipment we had which produced enough level of itself and had a volume control too. We could detect no difference in performance between this set-up and that involving tuner, control chassis and 35-D. We were limited only by the varying quality of FM broadcasts over the period of time during which these tests were made. To confirm our reaction with respect to frequency response and excellence of transient response, the equipment was returned to the bench for square-wave testing, with the results shown in Fig. 4. Since the square waves at 100 Hz and 10 kHz appeared almost perfectly square, we departed from usual practice and utilized frequencies of 50 and 15,000 Hz. Even these waveforms show less departure from ideal square form than we have encountered with much equipment at the less demanding frequencies of 100 Hz and 10 kHz.

Electronic overload protection and fusing are adequate for this powerful amplifier, and the speaker connection strip is of the barrier-type, discouraging the possibility of inadvertent shorts across the output treminals. In summary, all is well with the 35-D. It is a superb 50 watt-per-channel power amplifier.

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C/M Laboratories Model CC-2 Stereo Preamplifier/ Control Chassis

Fig. 5

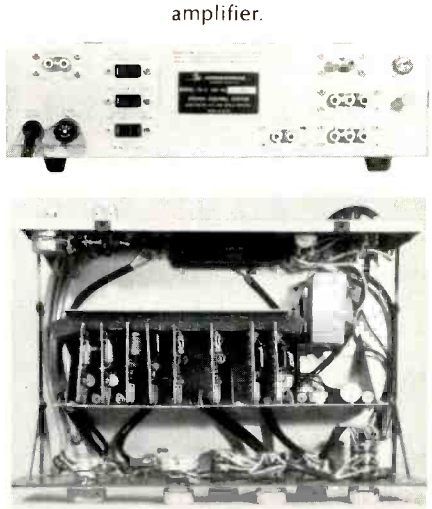
MANUFACTURER'S SPECIFICATIONS:

Rated Output: 2 V (maximum, 10 V). Frequency Response: 1 Hz to 100 kHz, +0, −3 dB. Sensitivity: phono—variable, 2 to 8 mV (clipping at 90 to 250 mV); high level, 0.1 V. Total Hum and Noise: Phono—80 dB below 10 mV input; high level, 80 dB below rated output. THD: less than 0.1% at any input, for rated output. IM: less than 0.1% at any input; less than 0.25% for 10 V output. Input Selector: Low level – phono (RIAA): High level – tape, tuner, aux. Tone-control Range: ±17 dB at 50 Hz; ±13 dB at 10 kHz. Both controls can be defeated from front panel. Subsonic Filter: Flat or −3 dB at 20 Hz. Convenience outlets: two switched, one unswitched. Dimensions: 12½″W x 4″H x 9″D. Weight: 10 lbs. Price: $225.00. (Optional walnut cabinet, $15.00).

The CC-2 stereo preamplifier, shown in Fig. 5, costs $90.00 less than C/M Laboratories' premier preamp, Model CC-1 ($225.00 *vs.* $315.00). According to the manufacturer, it has all the performance features of the CC-1, less a few seldom-used controls and a simplification of functions. Used in conjunction with a high-quality power amplifier, such as C/M Laboratories' Model 35D (see previous review), it does not add any discernible distortion to the final output, which is as it should be.

Employing 22 silicon transistors (20 active in the signal circuits and two in the power supply circuit for regulation), 5 silicon diodes and 1 zener diode, the various circuits are sectionalized on vertically mounted printed-circuit modules, as can be seen in the photo of Fig. 6. The rear panel, which includes the necessary inputs, outputs, a.c. convenience outlets (two switched, one not switched), and an input-level control for phono, is also shown in Fig. 6. A line fuse and ground terminal post complete the rear layout. Front-panel operational controls include the input selector (having positions for AUX, TAPE, TUNER, and PHONO), a mode switch (LEFT, RIGHT, MONO, REVERSE, and STEREO), along with balance, volume, bass, and treble controls. The tone controls may be removed from the circuit by means of two slide switches. Other secondary controls in the form of simple slide switches include a loudness on/off switch, tape-monitor switch, "sub-sonic" (low-frequency) filter on/off and the power on/off switch. A small red "jewel" becomes illuminated when the unit is turned on.

Fig. 6 – Rear-panel and exposed-chassis views of the C/M Model CC-2 stereo preamplifier.



Performance

Electrical measurements disclose a very low level of harmonic distortion and IM distortion, as claimed. In fact, THD reaches 0.1% for 10 volts out as opposed to the 2 volts rated output claimed by the manufacturer. Frequency response is plotted in Fig. 7, with and without the tone controls in the circuit. High-frequency rolloff occurs somewhat sooner with the tone controls active, but an attenuation of 3 dB at 60 kHz is hardly anything to be concerned about. Tone-control action is of the desirable "feedback" type and the total range of control is plotted in Fig. 8. It is more than adequate for any conceivable purpose.

The sub-sonic (low-frequency) filter action is plotted, together with loud-

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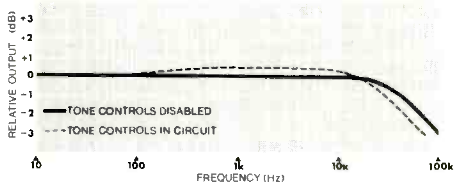
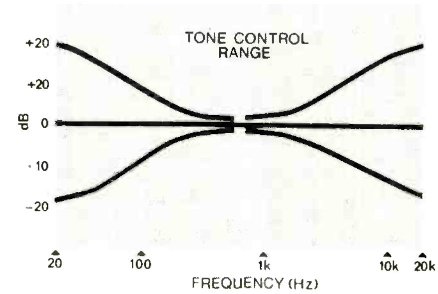


Fig. 7—Frequency response of the CC-2 stereo preamp is plotted here with and without tone controls in the circuit.

Fig. 8—Tone-control action of the CC-2. ▶



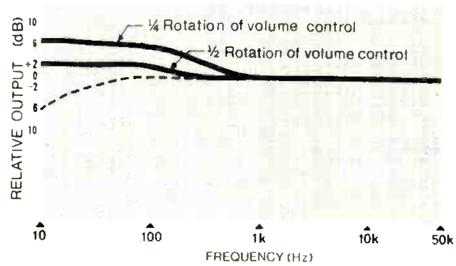


Fig. 9—Filter-action and loudness-compensation curves.

ness-compensation curves, in Fig. 9. With respect to the former, it is simply a 6-dB-per-octave R-C filter. To prevent it from having a deleterious effect upon bass musical content, C/M Labs chose to make the crossover frequency (−3 dB point) at 20 Hz. With such a slight rate of attenuation, however, response at 10 Hz (region of most rumble) is only −9 dB. Thus, it is doubtful if it would materially help a bad rumble situation. The loudness-compensation circuits are moderately effective. As shown in Fig 9, the compensation afforded at 40 dB below maximum setting of volume control (at about ¼ rotation of the control) is about +6 dB at 50 Hz, which does not conform with accepted Fletcher-Munson curves.

Summing up, while the CC-2 preamplifier is good to listen through, it appears to be rather Spartan in design. For example, we miss high-frequency rolloff filters (for scratch and other high-frequency disturbances), provision for tape-head inputs, independent treble and bass controls for each channel, and independent level-set controls for each input. Thus, going the stereo hi-fi path with "separate" components, the CC-2 is certainly adequate. But if one wishes to have more control flexibility, he might be inclined toward a more expensive preamp.

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Koss Model ESP-6 Electrostatic Stereophones

MANUFACTURER'S SPECIFICATIONS:

Source Impedance: 4 to 16 ohms; Sensitivity: 90 dB SPL at 1000 Hz ±2 dB referred to .0002 dynes/cm² with 1 volt at the input; Frequency response range, Typical: 27-19,000 ±5 dB; 35-10,000 Hz ±2½ dB. Individual machine-run curve provided with each pair. Isolation from external noise: 40 dB. Total Harmonic Distortion: Less than 1½% at 110 dB SPL. Size of Cup: 4½″ H, 3¾″ W, 2½″ D. Cord: 4-conductor, 3-ft. coiled length; 10-ft. extended length. Cushions: Fluid filled. Plug: Standard tip, ring, and sleeve phone plug. Weight: 27 oz. Price, $100.00.

Fig. 1—Koss ESP-6 stereo headphones, the first electrostatic units to be marketed here.

The most recent offering from this specialist company in the headphone field is the ESP-6 electrostatic model, which brings the advantages of the electrostatic speaker system to the much more compact "wearable" system. Plugging into the output circuit of a usual stereo amplifier, the new headphones provide their own polarizing voltage which is derived from the signal itself, since there is no power required for the polarizing circuitry—only a relativly high voltage.

Because of the high impedance of the "condenser" element of electrostatic headphones, a step-up transformer is required to raise the impedance far above that of the 4- to 16-ohm source. However, since the step-up transformer thus raises the impedance, it also provides a higher-voltage source which may be rectified in a voltage-tripler circuit to provide 240 V. d.c. which serves as the polarizing potential. This voltage is fed to the diaphragms of the "speaker" mechanism through 22-Meg. resistors. The capacitances of the elements themselves serve as the filtering capacitors to produce a relatively constant d.c. voltage. In addition, from a non-filtered tap in the diodes which are the rectifier elements of the d.c. supply, neon indicator bulbs are connected to show the SPL present in the aural cavity. These lamps flash when the SPL reaches 90 dB, and remain on most of the time when the SPL reaches 105 dB.

The story of the development of the electrostatic phones makes good reading. To ensure minimum distortion, it was found that there must be two fixed plates, with the diaphragm placed between them—as is also true with electrostatic loudspeakers. If only one fixed plate is used, there is considerably greater distortion from the plate, the driving force decreases in a non-linear fashion, while it increases also in a non-

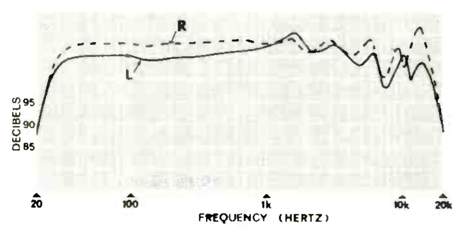

Fig. 2—Frequency response of the Koss ESP-6 headphones.

linear fashion as the diaphragm comes closer to the plate. Because of the need for two fixed plates, with the diaphragm between them, the plates must be perforated so that the radiation can reach the ear. For minimum distortion again, the back wave must be absorbed, which is accomplished by judicious use of polyurethane foam and felt—a process which took a lot of cutting and trying. Similarly, the size and shape of the cavity required a similar amount of cutting and trying to get the optimum performance. A booklet which accompanies the phones tells the story thoroughly, and, as a chronicle of the search for the best possible pair of headphones, it is interesting reading.

(Continued on page 50)

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For our president's birthday, we baked him a cake.

And gave him the first production model of our new Project "M".

Haskel Blair celebrated his birthday just as we turned out the first Project "M". The timing was so perfect, we gave it to him for his birthday.

But why give a speaker system to the president of a firm that makes so many speaker systems?

You see, we all believe the new Project "M" is our finest achievement in compact speaker systems. (And we've been building fine speakers for over 30 years.)

Besides, we certainly put a lot of work into it. When we started on the Project "M", we wanted to develop an entirely new and superior speaker system that would surpass the lows and highs of any high-quality, high-priced compact bookshelf system.

To achieve that we began with some pretty sophisticated design principles and ended up creating a new woofer and a new tweeter and even a new enclosure. But it was worth the effort. The result is the remarkable Project "M".

To give you an idea of how good the Project "M" really is, we took our first two production models and conducted a blindfold listening test with Mr. Haskel Blair matching the Project "M" against the two speaker systems he has in his home. He thought the Project "M" sound was so great, we gave him the two units for his birthday. Oh yes, and he was very surprised and pleased when we told him the project "M" would be selling for $99.50!

How can the Project "M" do it? Well, for one thing, Project "M's" all-new woofer has our secret new surround material which permits the cone to make ½" excursions with a linearity that is accurate to within 0.1%. This means that our woofer has a linearity that is better than the minimum distortion capability of even the best amplifiers.

Together with an equally new tweeter, the system puts out a magnificent sound along the entire audible range, with an exceptionally smooth frequency response from below 30 Hz to beyond 20,000 Hz.

Project "M" is housed in an attractive 23½" x 12¾" x 11⅞" oiled walnut enclosure that is finished on four sides for vertical or horizontal placement.

Compare the sound of our Project "M" with any other compact speaker system, the more expensive the better. Forget the price until you've compared the sound. After that, compare the price. Then you'll know why we gave our president the first Project "M"!

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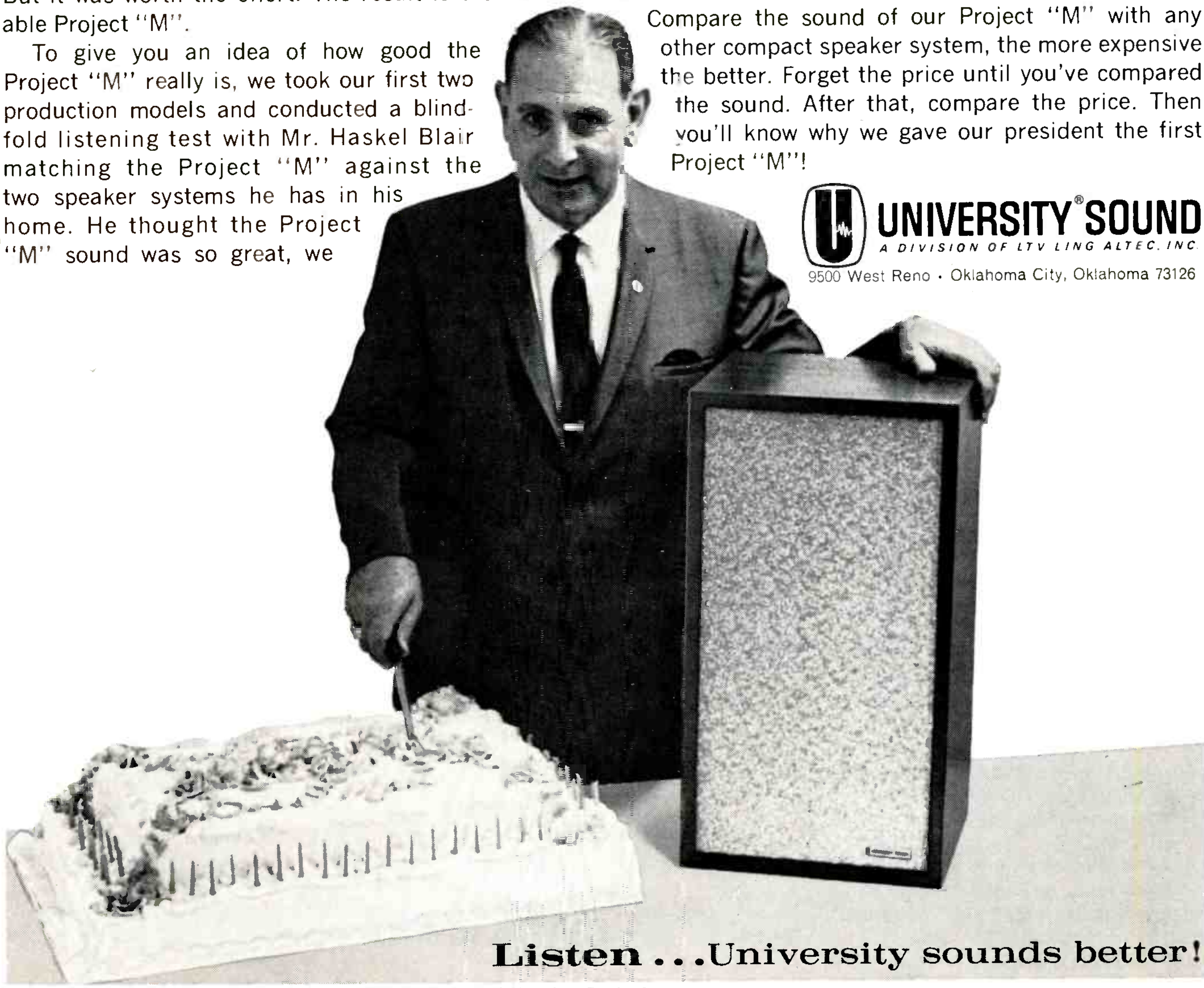

Listen . . . University sounds better!

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Equipment Profiles (continued)

The headset must be plugged into the ouput of the amplifier with a series resistor in each channel, the maximum recommended value for this resistor being 5 ohms, and a minimum of 2 ohms. This latter value of resistor is mounted in the adapter which is included with the phones, and which is provided with two leads per channel, each tipped with spade lugs. These are to be connected to the speaker terminals on the back of the amplifier, rather than simply plugging the three-circuit plug into the headphone jack on the front of the usual amplifier or receiver. Instead, the plug is inserted into the jack of the adapter.

This will be somewhat of a disadvantage to the non-technical user who expects that he should be able to plug the phones into the front-panel jack, as he would any other. However, most amplifiers and receivers have a series resistor in each channel to avoid offering too much signal to the usual dynamic headphone elements. These resistors typically have a value of about 100 ohms, which is far too much for the ESP phones. The technically-minded user would likely remove the amplifier from its case and connect two 2-ohm resistors across the series resistor in the amplifier so he could then use the front-panel jack in the normal manner. Either of the methods of connection is worthwhile, however, since the listening quality is superb.

One caution must be remembered, however—if you are listening to a mono program which is reproduced only on the right channel, no signal is being fed to the polarizing-voltage circuit, and no sound will be heard. To listen to mono programs, therefore, the mode switch should be set to reproduce the program in both channels, rather than to short the tip and ring of the plug. If the phones are to be used solely for mono, both "hot" leads should be connected to the tip of the plug.

The sound quality from the phones is such that upon putting them on, the listener feels as though he is still hearing the speakers through the air seal. The listening is outstanding, and once tried, it is likely that the shopper will be convinced enough to add the ESP-6 Stereophones to his collection of hi-fi gear.

These attractive phones are supplied in a foam-fitted molded carrying case, which is not the least of the desirable qualities of the ESP-6 headset.

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ABZs of FM

LEONARD FELDMAN

Automatic Frequency Control

THE NEED FOR accurate center-of-channel tuning in FM reception (and especially for stereo) has been stressed before in this series. Consider, for a moment, what takes place in a relatively narrow-band i.f. system if the listener is tuned even 50 kHz off of the optimum frequency. Figure 1 shows a discriminator or ratio-detector "S" curve, in which the perfectly linear portion extends about 90 kHz to either side of 10.7 MHz—more than the 75 kHz minimum required, but not very much more. Point "A" on the curve represents center-of-channel tuning, while point "B" represents a point 50 kHz too high, or off-center, to which our unsuspecting listener has tuned. So long as the program being transmitted is relatively low in audio level (quiet music passages, and so on), this amount of detuning will cause no audible defects in the received signal. Suppose, however, that a loud passage of music comes along which causes a full ±75-kHz deviation of the main carrier (and therefore, the same amount of deviation of the 10.7-MHz i.f. signal). Every time the carrier is shifted upward in frequency, the last 35 kHz or so of deviation will encounter a very non-linear portion of the detector "S"-curve, designated by the bracketed length "C" in Fig. 1. Instead of being perfectly sinusoidal, the resultant recovered audio will appear as shown in Fig. 2—severely distorted at one extreme of its excursion. As illustrated in the figure, this amounts to as much as 20 per cent distortion, and would be most unpleasant to the ear.

Assuming that the average listener cannot be taught to tune to exact center-of-channel every time (in the absence of any visual indicator to tell him when the set is properly tuned), there are only two solutions to this problem. The first is to make the i.f. and detector bandwidth so great (say, 300 or 400 kHz for the linear portion of the "S"-curve), that even when a station is carelessly tuned in, there is likely to be at least 75 kHz of linear curve on either side of the tuned point. However, no matter how "wide" the linear portion is, there will still be those listeners who might tune close to *one end* of that linear portion, with the same disastrous results depicted in Fig. 2. The second (and more often practiced) solution is to incorporate a "sensing" circuit which detects errors in tuning and automatically corrects for them. Such a circuit is called Automatic Frequency Control, usually abbreviated AFC.

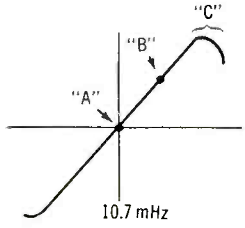

Fig. 1—Linear portion of detector response curve is centered about 10.7 MHz (point "A").

You may recall that in an earlier discussion of FM broadcasting techniques, we discussed the function of a "reactance-tube modulator." This was a tube (or transistor) circuit which was associated with the basic r.f. oscillator in such a way that it appeared as an additional inductance or capacitance in parallel with the frequency-determining elements of the main oscillator. As varying audio was applied to this circuit, its effective contribution of "L" or "C" varied accordingly, causing the master oscillator to shift back and forth in frequency. Had we applied fixed values of d.c. potential to this circuit instead of audio, we could have shifted the oscillator frequency as well, for the audio information applied may be thought of as continuously varying instantaneous d.c. levels.

Now, every FM tuner or receiver contains a local oscillator, and its frequency determines which incoming r.f. frequency will "beat" with it to produce the desired 10.7-MHz signal for application to the i.f. and detection stages that follow. Alter the local-oscillator frequency and you alter the frequency with which it will beat to produce 10.7 MHz.

Both the ratio detector and the Foster-Seeley discriminator are ideally suited for providing a d.c. correcting voltage to apply to a circuit such as reactance tube. The audio take-off point produces 0 volts of d.c. when the incoming frequency is exactly 10.7 MHz, and produces positive or negative voltages when the frequency is above or

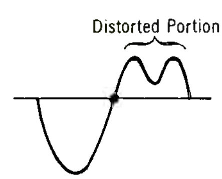

Fig. 2—Distorted audio sine wave caused by detuning a narrow-band i.f. system to point B in Fig. 1.

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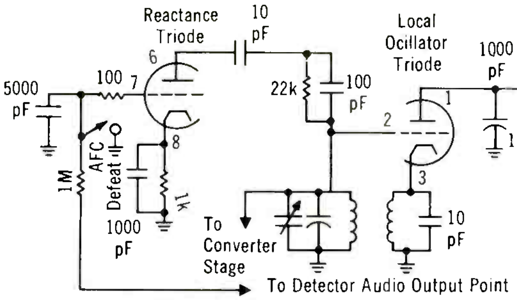
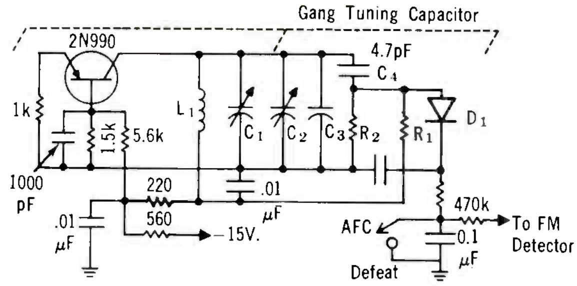


Fig. 3 (left). Early AFC circuit.

Fig. 4 (right). Modern AFC circuit.



below 10.7 MHz. Figure 3 illustrates an early tube-type local-oscillator circuit together with a second triode section used as a reactance tube in parallel with the tuned circuit. The voltage applied to pin 7 of this triode is derived (after suitable by-passing to eliminate audio variations) from the output of the FM detector (not shown).

Polarities of the various voltages have to work in a prescribed manner for AFC correction. For example, suppose that when a station is de-tuned on the high side of correct frequency a positive voltage appears at the detector output. If the reactance tube appears to be inductive, the application of this positive voltage to the grid of the reactance tube must have the effect of *increasing* the effective inductance contributed by this reactance circuit. An increase in total inductance will result in a *decrease* in local oscillator frequency and so the effect is to bring the tuner closer to correct tuning. Of course, this form of AFC can never bring the tuned frequency exactly to center, for it depends upon the presence of some error voltage. If the tuner were perfectly tuned, the d.c. error voltage at the output of the detector would be zero. Properly designed AFC circuits can, however, reduce the tuning error to ⅕ of its original value. Thus, de-tuning of a station by 50 kHz (as in our first example) can be reduced to about 10 kHz, which is quite insignificant.

Many tuners and receivers have two selector-switch positions for FM tuning. In the first position, the AFC circuits are defeated by shorting the d.c. correcting voltage to ground. With no variable d.c. applied to the grid of the reactance tube, this tube then represents a fixed inductance under all conditions and does not act to correct tuning errors. This feature enables the user to tune in the station first as best he can without AFC. Then the selector switch is thrown to the "FM-AFC" position to correct for any remaining error and to "lock the station in." This phrase, "locking the station in," has given rise to a great misconception about AFC.

Many users have been led to believe, (through implied advertising claims), that AFC is also a cure-all for tuner drift problems. Nothing could be further from the truth. If a local oscillator is improperly designed so that it drifts for long periods after turn-on because of temperature changes, change in power-supply voltage (caused by fluctuating power-line-voltage levels), or other causes, AFC can do nothing to prevent such drift problems. In fact, in a certain sense, AFC makes the condition worse. The user may *think* that he is properly tuned to a station because the AFC circuits have reduced the real tuning error from, say, 50 kHz to 10 kHz. As the improperly designed local oscillator begins to drift further, in the same direction as the original error, for example, the AFC circuits cannot keep "pulling" the oscillator back towards center indefinitely. A point is reached where the d.c. correcting voltage, instead of becoming greater and greater, drops to zero once more (as the extreme end of the detector "S" curve response is reached), and the station "pops out of lock" all at once, instead of gradually, as would be the case if no AFC were applied.

The rapidly expanding use of solid-state circuitry in FM design has given rise to a new form of AFC circuit. It was long ago discovered that a simple diode, biased to a state of non-conduction, appears to be capacitive. Further, diodes can be so constructed that their apparent capacitance can be made to vary quite linearly with a change in "reverse bias" voltage. Obviously, such diodes lend themselves readily to AFC circuits, replacing the more complex reactance-tube circuitry. A late model transistorized local-oscillator circuit is shown in Fig. 4. Here, D_1 is a voltage-tuned capacitive diode which forms a frequency-determining element of the oscillator resonant circuit in much the same way as do L_1, C_1, C_2, and C_3. Back bias is applied through a voltage divider consisting of R_1 and R_2. C_4 is in series with the "capacitive-looking" diode to isolate the corrective d.c. from the voltage applied to the collector of the oscillator transistor. In every other respect, the circuit behaves in the same manner as that shown in Fig. 3. Before leaving the subject of voltage-tunable diodes, it may have occurred to you that if a diode can be made to look like a variable capacitor by applying varying values of d.c. to it, then such a diode (or several of them) might well be used to replace the multi-section, bulky variable capacitor used in most FM front ends to tune in stations across the entire 88-108 MHz FM band. The fact is that many such designs are already appearing on the market. The tuning control for such sets need only be a simple potentiometer which picks off a desired voltage to "tune" the diode-capacitance to desired values. Such designs lend themselves particularly well to "push-button-operated" FM sets. In such sets, the push buttons, instead of being coupled to a complex mechanism which rotates the variable capacitor to a preselected setting, need only pick off a preselected voltage to apply to the diodes which replace this variable capacitor.

While this would seem to be an optimum new scheme for tuning FM radios, thus far it has found limited use because of the difficulty in matching perfectly tracking diodes for the three or four tuned circuits usually present in the front-end section of FM sets. Already, this problem is being overcome by rapid, computerized selection of groups of diodes suitable for the purpose.

With today's drift-free, solid-state, wide-band FM designs, many manufacturers take the position that quality FM equipment has really outgrown the need for AFC, contending that even the best AFC designs introduce a bit of distortion of their own. This distortion results from the slow time constant associated with the by-passing elements in the circuit which are used to eliminate all traces of audio voltage from the d.c. applied back to the local oscillator. Do not be surprised, therefore, if you find that the *very best* FM tuner and receiver products have abandoned AFC altogether, in favor of more stable, wide-band designs. Æ

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AUDIO MUSIC REVIEW

Classical Record Reviews

EDWARD TATNALL CANBY

Musical Spectaculars

Tchaikowsky: 1812 Overture. Rachmaninoff: Spring; 3 Russian Folksongs. New Philharmonic Orch., Cathedral and Children's Choir of St. Ambrose, Central Band of the R.A.F., Guns of the King's Troops, Royal Horse, Russian Church Bells, etc., dir. Igor Buketoff.

RCA Victor LSC 3051 ($5.79)

By golly, after umpteen super-stereo (and mono) ultra-versions of this spectacular war-horse, which has been the bellwether (no pun) of hi-fi showstoppers for decades, somebody has thought of something new to add, and it works. Beautifully! This is (gulp), the most musical version of the "1812" I have ever heard, and the novelty addition doesn't impede the musicality a bit. What's new? On top of massed orchestra, bands, artillery and Russian bells, all of which have been tried before, *massed voices*, right in the overture, singing part of the music.

You see, the piece opens with a solemn Russian-type hymn, scored for strings. Re-score it for Russian-type choir (with low, low basses) and it IS a hymn. Gorgeous. Then there is that Russian folksong, used twice. Why not give it to a children's choir? No sooner said, so to speak, than done. Excellent! And as for the grand finale, with the guns banging and the bells ringing, add the sound of a couple of thousand massed voices, Mother Russia incarnate, to cap the climax in the most impressive fashion.

Good taste and highly musical, highly imaginative performing are what really make this version sing out. Compared to this performance, all the others are ham and corned beef. There are real beauties in the work, in spite of its sensational aspects; they come through here. And the hammy parts are at least tastefully projected, not thrown at you like a meat cleaver.

I never did get to hear the seldom-heard Rachmaninoff cantata on the obverse. But with the same round of performers, minus a few artillery pieces, it can't fail to come off.

Performance: A *Sound:* B+

Handel: Music for the Royal Fireworks—in the Original Scoring; Concerto No. 2 in F for Two Wind Choirs and Strings. 64 winds and 9 percussion, Pro Arte Orch., Mackerras.

Vanguard Everyman SRV 289 SD stereo ($2.50)

At last! I've always wanted to hear this "Fireworks Music" as it was originally scored. Modern versions use one or two oboes (whoever has heard more than, say, four oboes at a time?). Handel used masses of them (and the same, reportedly, for many of his oratorio performances). Now, somebody has tried it out, to see what might happen.

Well, it isn't *quite* authentic. Handel used the then-current type of Baroque oboe, of which we have a good many now operating via other record labels. This recording uses the modern type, not nearly as colorful. Nevertheless, the gist of Handel's original is here: 26 oboes, 14 bassoons, four contrabassoons, two serpents, nine trumpets, nine horns, three timpani, six side-drums. And it sounds just fine. Indeed, the massed oboes — as Handel surely knew — sound not unlike a modern string section. Not nearly as zany as you might expect. And none of those misguided attempts here at "authentic" out-of-tune playing, either. Rightly or wrongly, these performers are always in tune and, the essence, always musical. Some of the best names in the business, too, probably draining all the orchestras in England of their oboe players for the duration of the recording.

A lovely and novel concerto on the reverse side, with a standard Handelian attraction: virtually every note will sound familiar, if you know much Handel. One segment is straight out of "Messiah." This was Handel's normal and charming practice when it came to exhibition-type pieces. He transcribed and re-wrote his own music and that of others into new formats and shapes.

Performances: B+ *Sound:* B+

Orchestre de Paris. La Marseillaise and Eight Other Favorite French Showpieces. With vocal soloists, children's chorus, dir. Jean-Pierre Jacquillat.

Angel S-36518 stereo ($5.79)

The new Orchestre de Paris is a sort of "all-American" outfit in French terms, made up of some of the finest individual players in France. Its aims, judging from this record, are more on the level of the Atlantic City Miss America contest. The music is straight out of the showpiece category, from Chabrier's "España" to "Danse Macabre" and "Sorcerer's Apprentice," with a grand finale-in-reverse to head off side 1, the "Marseillaise" arranged by Berlioz, for all available performers and the kitchen sink.

Is it merely the recording that makes me sense a certain crass, corny playing style here, famous performers notwithstanding? Is it cynical boredom *chez* the overworked players, making their daily bread and wishing they weren't? Partly. But part, too, is in the recording/acoustics mix. The whole program is immersed in the most enormous Madison-Square-Garden sort of liveness, some sort of empty concrete coliseum a mile long. And in this preposterously over-sized acoustic surround, the recording is necessarily close and harsh, without subtlety.

You may think it's a grand and glorious effect—as was no doubt intended. I thought it was commercial corn.

Music for the Queen. (British ceremonial marches, fanfares and songs for military band, chorus and organ). Central Band of the Royal Air Force, Finchley, Barnet and District Choral Societies.

Capitol SP 8685 stereo ($4.79)

The World's Greatest Marches. Band of Her Royal Majesty's Marines, Col. F. Vivian Dunn, C.V.O., O.B.E., F.R.A.M., R.M.

Capitol SP 8692 stereo ($4.79)

From EMI via Capitol come these two decidedly British band recordings —British even when the music is by John Philip Sousa. British Sousa, mind you, is utterly unlike American Sousa.

It is the second Band, the Marines, conducted by Col. Dunn and his rows and rows of initials (above), which

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plays the Sousa, in a relaxed, non-Peppy, ultra-mellow fashion that epitomizes British band performance. There are several of the same, plus a brace of similar British and U. S. popular band marches, all immersed in a fine big liveness, yet recorded with sharp hi-fi stereo quality. I can only say, hooray for Col. Dunn, C.V.O., O.B.E., F.R.A.M., R.M.

As for the first recording, it is another sort, featuring one of those immense British concert bands augmented by hordes of inspiredly patriotic-sounding singers, who cover such music of national importance, on an enormous and impressive sonic scale, as "God Save the Queen," "Jerusalem," and the familiar "Pomp and Circumstance" music. The rest isn't so easy: great royal occasions call for leading contemporary composer-elder-statesmen of the Empire to produce appropriate musical flourishes—for royal marriages, coronations, etc. They all do it, and every last one in a style that might best be described as neo-Elgar fruitcake, very ripe. Whether it's Bliss, Walton, Bullock, or Elgar himself, as far back as 1897, this music is all more or less the same to a non-British ear, much too ripe, too thick, too juicy and very indigestible. British citizens may swoon with joy. Not me.

Performance: OK — *Sound:* Huge

Elgar (Cockaigne Overture, Ser. for Strings, Pomp and Circumstance Nos. 1, 4, etc.). Royal Philharmonic Orch., Weldon.
RCA Victrola VICS 1377 stereo ($2.49)

If you want to hear where all the later ceremonial-band music of Britain comes from, just try this survey of Elgar himself. No band music here, but a proper symphony orchestra of impeccable quality. Even so, the fruity Elgar message gets through all too easily, along with the symphonic aura.

Somehow, the Elgar combination of extreme complexity and unregenerate *schmalz* has never set well with Americans. It seems a wrongheaded style to us, for if you're going to be modern and complex, then *be* it. We like our post-Romantic music to smell properly of coming Doom and Transfiguration, like Mahler, Strauss, Schoenberg of the same era. Elgar, however busy his orchestra, is as urbane and offhand as a British music-hall tune, Before the Beatles; a sort of nothing expression that, today, slides in one ear and out the other, leaving no Message at all but, maybe, an ostrich complacency. . . .

If you don't know what the heck I'm talking about, and you *like* Elgar, then this is a highly-attractive disc and ought to be bought *pronto*.

Performance: B+ — *Sound:* B

Classical Soloists

Julian Bream and His Friends. (Boccherini: Quintet in E Minor; Introduction and Fandango. Haydn: Quartet Op. 2, No. 2.) With George Malcolm, hps., the Cremona String Quartet.
RCA Victor LSC 3027 stereo ($5.79)

The somewhat-odd title of this record is just a time saver. Julian Bream's guitar is joined by the Quartet in one piece, by three members of the same in another, and by the harpsichord alone in a third. The music is perfect, with unity and variety in just the right proportions.

Julian Bream, whether on lute or guitar, is one of the most astonishing "classical" soloists in the business; he plays with such fluency and grace that, in the proverbial fashion, you might think either instrument "easy." Where others plod, or flounder, Bream sails. And his musicianship, his sense for harmonies, for rhythms, for phrasing, is superb as well. If he were a pianist he would be a Horowitz.

His "friends" give him excellent backing (a fine Quartet and one of the greatest masters of the harpsichord) in these eighteenth-century works. The Haydn is, for that composer, a very early work, nominally for strings but easily transcribed for other media; the guitar (more likely lute) arrangement seems to be of Haydn's time. Boccherini, an Italian who, like D. Scarlatti, spent most of his life in Spain, writes in a related style, though with some easily recognizable Spanish rhythms.

Performances: A— — *Sound:* B—

Igor-Kipnis—Spanish Music for Harpsichord. (de Nebra, Soler, Scarlatti.)
Epic BC 1374 stereo ($5.79)

A particularly pleasant harpsichord record, beautifully recorded to bring out the gentle, delicate quality of the instrument, with a minimum of harshness, the music covering a half century of connected Spanish eighteeth-century tradition following the brilliant Domenico Scarlatti.

Mr. Kipnis plays with affection and care, using a moderately "old fashioned" approach, expressive rather than brilliant (though his technique is plenty OK), which makes us listen to the music first, rather than merely to the finger technique. There are four of the one-movement Scarlatti sonatas, three works by Antonio Soler and two by a seldom-played composer, in style a sort of an updated Scarlatti of the Mozart period, Manuel Blasco de Nebra. An excellent man.

Performances: A— — *Sound:* A

Schütz: Symphonie Sacrae; 8 Concertos from Book II. Soloists and Instrumentalists, Helmuth Rilling.
Nonesuch H 71196 stereo ($2.50)

In keeping with a time of war, Schütz's music is largely written for small ensembles, with a maximum of flexibility in the use of alternatives. Too often, modern performances take the cue and present us with spare, chaste, small-sounding versions of the music. This quite amazing record does the opposite: every possible *ad lib* is taken advantage of, to bring in a most potent assortment of colorful instrumental sounds along with the solo and ensemble voices, male and female. It's a fabulously effective Schütz and an eye-opener.

There is, first, a heavy reinforcement of the bass continuo, a big, solid double bass (string) and with it a bassoon. These, on proper speakers, add an enormous foundation. Then the obbligato instruments, pairs of violins, or oboes, are given the old acoustic uplift treatment—they sound like an orchestra in themselves, though never unnaturally. Finally, in music where it is allowable, a whole phalanx of other instruments are brought in, for a dazzling variety of Baroque sound. Thus the final work on side 2, *Meine Seele erhebt den Herren* (The Magnificat) is listed as merely for "soprano, 2 instruments and continuo"—but in the various short segments of the piece the "two" keep changing, like a musical relay race: trombones, recorders, trumpets. A brilliant effect and convincing in view of the traditional brilliance of the Magnificat text itself, and the numerous splendid settings of it by other composers.

Male soloists, alone and in ensemble, sing on side 1, women on side 2. All are good, though not outstanding. A considerable amount of vibrato interferes now and then with purity of line; but the singers are earnest and dramatic to a man, and a woman, and the instruments make the harmonic backing entirely clear, carrying the voices along easily enough. I could do with less double bass in the continuo (the running accompaniment), maybe in only

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three or four of the works. Too heavy in sound. (You won't hear it on small phonographs.)

Performances: B+ *Sound:* A−

High-Romantic

Rimsky-Korsakoff: Scheherezade. London Symphony, André Previn.
RCA Victor LSC 3042 stereo ($5.79)

Suddenly, a spate of "Scheherezade" recordings. I am all for one at a time, and this one is plenty good enough to satisfy me. It is done up in a conservative but high-quality fashion, both in the playing and the recording, which is just the ticket for old Rimsky, who is hardly a modern composer at this late date.

Musically, the performance is a good combination of orchestra and conductor. The British orchestras, rather more conservative in their outlook than most, have managed to keep alive the tradition of playing these once-spectacular "war-horses" of the concert repertory, where orchestras elsewhere force them, overwork the effects and, often enough, miss much of the real content. This is the most relaxed, authoritative and fresh-sounding "Scheherezade" I can remember since the heyday of this sort of music in recording, back before World War II. As for the conductor, though hardly a veteran of that area, he has the sort of drive and intensity that can organize the English orchestra's excellent concept of the score into a high-power musical projection.

Stereo sound is conservative. This isn't a "stereo demo" disc, thank Heaven. A bit distant and dull when the strings predominate, in fact. But when you get to brass and percussion, your ears may well perk up. And the big bass drum, a solid thump-thump, will surely jolt your chair a few inches along the living room floor. Dividend at the end includes that eternal "Bumble Bee," played as fast as possible. How else?

Performance: A− *Sound:* B

Sibelius: 4 Legends, Op. 22. Buffalo Philharmonic, Lukas Foss.
Nonesuch H-71203 stereo ($2.50)

An interesting recording, both in its virtues and its faults, if you can call them that.

I seem to have been damning all Sibelius performances with faint praise of late. Not this one. Mr. Foss doesn't come from the Sibelius-loving generation (he is too young) but, instantly, one senses his understanding of the Sibelius language. He can produce the right intensity and moodiness, and in exactly the right places. He gets the point — the many points — straight through, where many another conductor/orchestra combination misses them, straight through. Two of these four-tone paintings are moderately familiar: "The Swan of Tuonela" (that misty elegy for English horn solo) and "Lemminkainen's Homeward Journey." The other two, "L. and the Maidens of Saari" and "L. in Tuonela," have been seldom heard; but it is good to have the whole picture together, and the quadruple totality increases the impact of the separate items.

Recording? Very curious, indeed. Technically it can't be faulted, what with super hi-fi and the Dolby system to catch every mysterious trace of *pianissimo*. Sibelius requires an immense dynamic range. He gets it here. Even if you may have to run over to your volume control now and then to adapt the music to living room exigencies.

But another prime Sibelius requirement is spaciousness, and that we do not have. The Nonesuch sound (the sound of Buffalo . . .) is, for my ears, unpleasantly studio-like. Not enough reverb time (and Dolby merely emphasizes the too-quick silences, after the big orchestral blasts) and too much intimacy. We are too close to the orchestra for a Sibelius-like mystical reserve and passion: that ever-talked-about Northern moodiness of the Finnish forests and lakes and frozen wastes.

Granted that recording technique has its own developing language, and that our tastes in sound also develop and change, as the recording engineers find new ways of doing things. I'm the first to champion that viewpoint, but within limits. Somehow, the essential in "translating" Sibelius to disc is to preserve the vast sense of moody space, that impressionistic distance and reserve which he so wonderfully projected into the concert hall. Any way you can do it is OK with me, but I don't get it here. I hear the instruments first, not the orchestra. I hear the separate choirs, not the whole. I hear the solos, the single players, as though in a chamber music ensemble. Too intimate for this formal-dress stage music.

Performance: A− *Sound:* B−

Piano Music of Mendelssohn. Anton Kuerti.
Monitor MCSC 2128 stereo ($4.79)

Mendelssohn, once a powerful influence in music, has gone dreadfully out of fashion in this century. We tend to hear only the somewhat milksop harmonies and the repetitious conventionalities of melody and development; we usually miss the part that "knocked 'em dead" a century and a half ago, almost: the then-new Romantic excitement of expression, the soulfulness, if you wish.

Here's a pianist who takes Mendelssohn seriously, and a good thing it is. My own feeling is that the known Mendelssohn, the man himself, as we still can find out about him, was a more fastidious pianist than is this somewhat passionate Romanticist. But his impact on hearers of that day must have been something like our pianist is on us—Anton Kuerti really whangs out the music, with immense conviction and no apologies at all. If his pedal blurs rather continuously — much, much better than the harpsichord-like desiccation of some contemporary Mendelssohn-playing and the hard-nosed thundering of even more, as though the trip-hammer technique were the only way to bring the ancient stuff to life.

You'll find some very noisy Preludes and Fugues, à la Bach (that is, as Mendelssohn conceived of Bach) on Side 2—Kuerti does a remarkably good job of projecting their prolixities. The rest is made up of moderate-sized works (none of the minatures, "Songs Without Words," etc.) including a Rondo Capriccioso and a Scherzo, the same, plus the large "Fantasy in F Sharp Minor, Opus 28," in several parts. Nice jacket quotes from the writings of M. himself, a very literate composer.

Performances: B+ *Sound:* B+

Schubert: Unfinished Piano Sonata and Other Posthumous Piano Works. Frederick Marvin, piano.
SFM (Society for Forgotten Music) S2011 stereo ($5.95)

Anything by Schubert, finished or unfinished, familiar or totally unknown, is worth listening to. An advantage of the recorded medium is the ease with which a group of leftover odds and ends like these can be put together for a coherent whole, an LP disc. (In concert, these items have to be attached to a longer program, for a cumbersome whole—and you hear them only once.)

Frederick Marvin, U.S.-born, has

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spent much of his recent life in Europe and brings a European *finesse* to his Schubert playing, which is sincere and musical if not earth shaking. (Who wants earth-shaking Schubert?) The L.A. studio recording, under the supervision of the indefatigible Vernon Duke, who digs up these forgotten items, is a nice full-bottomed sound, faulty only in an occasional small-room "peak" on a few of the piano's notes. The unfinished Schubert Sonata, partly assembled on speculation (three movements that probably go together), is a modest but wholly lovely piece, first-class early Schubert. The other small items are equally pleasant, on a smaller scale.

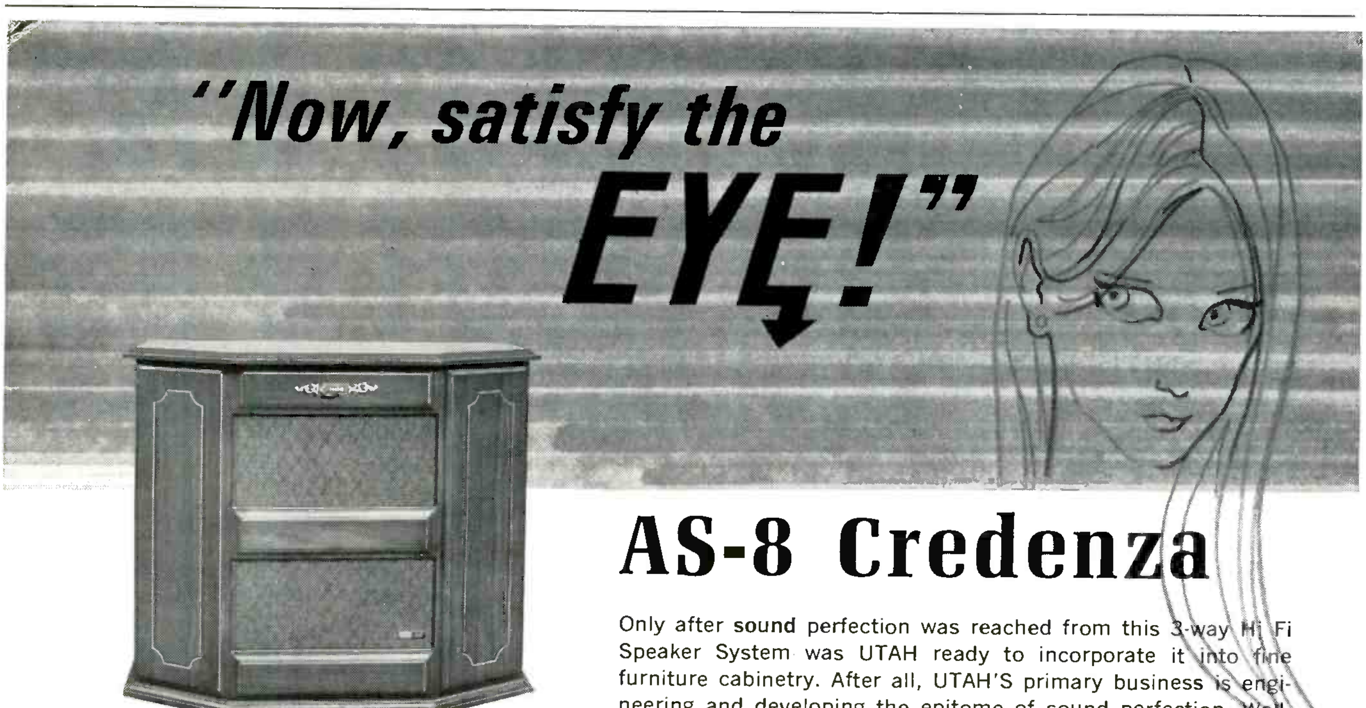
Performance: A— *Sound:* B+

Horowitz on Television (Chopin, Scriabin, Schumann, Scarlatti, Bizet-Horowitz). Columbia MS 7106 stereo ($5.79)

In terms of media propagation, this disc is just a curious incidental, an instant frozen in timelessness—for it was released well ahead of the now-famous TV color spectacular that featured Horowitz playing "live" before a Carnegie Hall audience. Crazy, man! The actual time of recording (as if it mattered) goes 'way back to February of 1968, and the TV show didn't come off in September as scheduled (and as noted in the past tense on this disc!) because of a hideous unintended oversight, the coincidence of Horowitz and the autumn Jewish holidays. Horowitz, on tape, was postponed. The Holidays weren't.

The greatest living stage pianist, Horowitz has never been a media artist. The fabulous finger technique can never be matched in any medium, short of electronic music. But the Horowitz sound is truly not suited to *any* form of recording, whether for sight or sound; nor does Horowitz, quite rightly, enjoy recording his music. The incredible dynamic projection of the essence of bravura performance which is his enormous asset, in the flesh, on the big stage, is, by its very nature, unsuited to that objective "universality" of performance that is best on discs, and even via the visual recording media. Just as the actor's hoarse stage whisper is wrong for the close-up mike, though right for the theatre, so the pianist's whole music must be different, adjusted in impact, for the close-to-microphone and the intimate loudspeaker.

Here we have, in effect, a documentary recording, for better or worse, of a Horowitz "live" concert — even though that concert was specially staged, and, in fact, was more than a single event. This is a fascinating freak, for it uses all the tricks of the modern media to *simulate* an old-fashioned, standard concert! Here, then, we have the roar of audience applause, at the beginning, and the almost animal-like howls of glee from the audience at the end. (The rest of the applause is suppressed). And here we find ourselves fairly shattered by the violent dynamics of the stage projection at close hand, ranging from what seems (on records) an exaggerated *pianissimo* to a horrendously-banging *fortissimo*. (Is such wrenching violence really needed to project the music to us, in the living room?) Here, too, we have the highly-individualistic Horowitz interpretations of a narrow range of once-familiar, concert-stage piano music, still taken for granted in concerts but by no means the "norm" for listeners who buy records today. Definitely, whatever the acclaim, this disc is for Horowitz fans, not for the general record listener. Æ



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Jazz

BERTRAM STANLEIGH

The Roots of America's Music.
Arhoolie Stereo 2001/2002

A 2-record set at the special low price of $4.00, this well-annotated collection offers 31 different performers or groups from nearly as many Arhoolie albums. A side is devoted to country blues, city blues, gospel and jazz, and country, Cajun, and folk music. While the total hardly adds up to a complete survey of the fields, it does offer an interesting and well-balanced program of traditional folksong. And it can serve as a valuable guide to persons who are a bit frightened to order a whole disc by one of these performers without first hearing a sample. Among those included are Fred McDowell, Mance Lipscomb, Big Joe Williams, Bukka White, Juke Boy Bonner, Big Mama Thornton, Lightnin' Hopkins, Clifton Chenier, Joe Turner, Otis Spann, Robert Shaw, Kid Thomas, Nathan Abshire, and James Cotton. Not all of the performances are top notch, and hardly any of the recordings are good enough to be called adequate, but the bargain is fabulous, and the music is always fascinating. Although the album bears the legend "Stereo," most of it sounds like mono without any "enhancement." For persons who have trouble locating Arhoolie locally, the set can be ordered directly from Arhoolie Records, Box 9195, Berkeley, California 94719.

Performance: A to C — *Sound:* C

Sinatra Conducts on Wilder Reissue

In the early Forties, Alexander Lafayette Chew Wilder was a composer who commanded a great deal of attention from the cognoscenti. Popular songs such as "I'll Be Around" and "It's So Peaceful in the Country," a ballet, "Juke Box," and a series of highly original compositions scored for an instrumental octet (consisting of Jimmy Carroll, clarinet; Mitchell Miller, oboe and English horn; Harold Goltzer, bassoon; Reggie Merrill, bass clarinet; Walter Gross, piano; Frank Carroll, bass; and Gerry Gillis, drums) had resulted in some very appreciative comments from sophisticated listeners whose scope was not limited to big band pop music and Dixieland jazz.

However, for the audiences who couldn't listen in comfort unless they found a cozy category into which to place the music they heard, Alec Wilder was a serious disturbance. His sound conservatory background and scoring for classical instruments (the harpsichord was strictly limited to lady-like recitals in 1940) put off jazz buffs, and aficionados of "serious" music found it difficult to give consideration to music with catchy melodies and a bouncy beat. Even among those intellectual types who murmured sagely about the merger of jazz and classical music in Stravinsky's "Ragtime for Eleven Instruments," and Milhaud's "Le Boeuf sur le toit," and "Creation du monde" or the other group who sensed the same kind of merger in Gershwin's "Concerto in F" and "Rhapsody in Blue," there was an uneasiness about the Wilder compositions. There was simply nothing about these works

Johnny Dodds.
RCA Victor Mono LPV-558 ($4.79)

Clarinetist Johnny Dodds was one of that group of pioneers who brought jazz from New Orleans to Chicago, and his influence can be found in the styles of Benny Goodman, Frank Teschemacher, Pee Wee Russell, and the other young white musicians of the Chicago school. In addition to playing in the King Oliver and Louis Armstrong bands, he headed various combos of his own during the late twenties, and he made numerous recordings in groups headed by Armstrong, Jelly Roll Morton, and with his own combo. These *Vintage Series* reissues feature recordings with his own groups plus three of the four sides he cut in 1926 with the Dixieland Jug Blowers. The liner notes point out that Johnny "never played a phony note or made a bad record." Certainly there are no bad ones in the present set, and the sound is the best that can be hoped for.

Performance: A — *Sound:* B+

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that made for easy analysis. They were too facile, too thoroughly integrated, and too direct and uncomplicated. As a result, the critics and theoreticians had little or nothing to say about his music, and it was left to musical performers to spread the word.

The first Wilder octet discs, recorded in 1939 and 1940, did not remain in the active catalog very long, but they were the prized possessions of a wide array of jazz and concert performers. It was from those recordings that Frank Sinatra was first introduced to the music of Wilder, and when he heard some air checks of a couple of Wilder compositions for woodwind octet, string orchestra, and harpsichord, he became so enthusiastic that he began to pressure Columbia Records to bring out a set of these pieces. Columbia was understandably reticent; the previous Wilder discs had not been a commercial success, and the proposed recordings would be costly to produce. But Sinatra's enthusiasm for this music was unquenchable, and he was Columbia's biggest star at that time.

Somehow he got Columbia to wax a set of three 12-inch 78's under his baton. It was the first, and I think the only, time that Sinatra led an orchestra on records. He did not, at that time at least, know how to read a score. But he loved the music deeply, and Sinatra has always commanded the respect and understanding of the musicians with whom he has worked. The results he achieved on that set were memorable, but, alas, hardly more commercial than the first Wilder recordings. Within a couple of years these discs went the way of the earlier octets, and Wilder turned his mind to more serious compositions. The current *Schwann Catalog* includes more than a dozen of those works.

Now the old Columbia 78's are available once more in a new long-playing transfer on Odyssey. And this listener, for one, is overjoyed. I've missed these recordings, and the few Wilder 78's I still own have been played frequently over the years. Now I have fresh copies with better sound than the old pressings. The new versions have been electronically rechanneled for stereo, which, in this case, seems to mean a bit more bass on the right channel than on the left. These pieces could have benefited from true stereo recording, but they were all well-balanced mono recordings, and each voice comes through with clarity.

Maybe it's nostalgia getting in the way of objectivity, but the reservations I once had about certain details of performance or ensemble have all disappeared. I can't recall when I've been so excited about a reissue.

The six Sinatra-led numbers are "Theme and Variations," "Air for Bassoon," "Air for English Horn," "Slow Dance," "Air for Flute," and "Air for Oboe." The octet pieces are: "Seldom the Sun," "Her Old Man Was Suspicious," "His First Long Pants," "It's Silk, Feel It!," "Pieces of Eight," "Such a Tender Night," and "She'll Be Seven in May." In view of the past history of these recordings, it's not safe to wait before acquiring them.

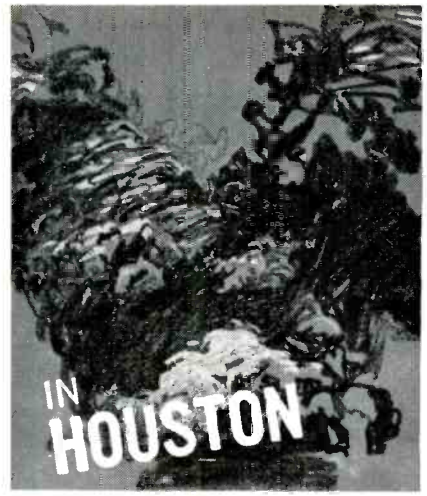
The Music of Alec Wilder Conducted by Frank Sinatra.
Odyssey Stereo 32 16 0262

Performance: A — *Sound:* A

Eddie Harris: Plug Me In.
Atlantic Stereo SD1506 ($5.79)

With an electric tenor sax, and a solid backing from a group that includes Haywood Henry, baritone, Melvin Lastie, trumpet, Jodie Christian, piano, and sometimes includes Joe Newman or James Bossy, trumpet, Tom McIntosh or Garnet Brown, trombone, Mel Jackson or Ron Carter, bass, or Charles Rainey, fendér bass, and Richard Smith or Grady Tate, drums, Eddie Harris demonstrates his complete affinity with this new instrument. His solos are prominently positioned in front of the rest of the group, and would appear to have been conceived with the idea of demonstrating the range of the instrument. However, in strictly musical terms, everything works out nicely with a fresh fund of melodic ideas and a bright, bold beat.

Performance: B+ — *Sound:* A



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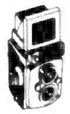


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Light Listening

STUART TRIFF

Broadway

SURVEYING THE BROADWAY musical scoreboard, we note that four song-and-dance shows have come to bat so far this season. The lead-off entry, "Her First Roman," struck out resoundingly, while the other three have managed to attain hit status, without being solid homeruns. "Promises, Promises," the last of the quartet, has not yet been waxed, but should reach us very soon. Waiting in the wings, then, are "Maggie Flynn" and "Zorba," and the original cast albums therefrom.

"Maggie Flynn" (RCA, LSOD-2009, $6.79, stereo) is the story of a spunky young lady who runs an orphanage for the offspring of runaway slaves, in New York City, during the 1863 Draft Riots. Maggie is charmingly played and sung by SHIRLEY JONES—ditto JACK CASSIDY as her ne'er-do-well husband. It's refreshing to have a musical with real singers again, but unfortunately, the songs by Hugo Peretti and Luigi Creatore in collaboration with George David Weiss, are merely pleasant, without any particular originality or inventiveness. Best of the bunch, are "Look Around Little World" and "I Won't Let It Happen Again," An old-fashioned showstopper is "Mr. Clown," to my ears just a big helping of pure (pop) corn. Stereo effects are lively, though the overall sound quality tends to be harsh and edgy.

"Zorba" (Capitol, SO-118, $6.79, stereo), based on the movie, "Zorba the Greek," has a score by the talented team of John Kander and Fred Ebb. The songs are not of the blockbuster variety, but they do create an altogether appropriate atmosphere — at least, most of the time. It's when they become too self-consciously ethnic, or, on the other hand, too Broadwayish, that they miss the boat. Herschel Bernardi, an affecting character actor and more than passable singer, is excellent in the title role, while Maria Karnilova, as Hortense, is simply wonderful. Invariably, her numbers are the production's standouts: be it the funny and delightfully performed "No Boom Boom"; the touching "Only Love"; or the exuberant, yet poignant "Happy Birthday To Me." Contributing enormously to the total effect are Don Walker's superb orchestrations. Excellent reproduction provides exciting theatrical aura.

Instrumental Mood

ANDRE KOSTELANETZ, in "For the Young At Heart" (Columbia, CS-9691), continues his maestro-gone-mod series, with results no better or no worse than his previous efforts. Pedestrian arrangements and heavy-handed conducting all but suffocate such fragile tunes as "Mrs. Robinson," "Lady Madonna," and "Valleri." Kostelanetz should stay in the league more sympathetic to his particular talents.

MANTOVANI, knowing full well on what side *his* pancakes are syruped, is eminently himself in "Mantovani Memories" (London PS-542), presenting a dozen sugar-coated goodies, mostly from the show and movie bag. Enough said, except a word for the suave, sumptuous London sound.

Trumpeter AL HIRT blows some beautiful sounds on "In Love With You" (RCA, LSP-4020)—a bouncy collection of tunes framed in lush choral-instrumental settings by Bill Walker. Sparkling horn work on "This Guy's In Love With You," "Eleanor Rigby," and "Dream a Little Dream."

"In a Sentimental Mood" (RCA, LSP-4013) is the ninth album the guitar-playing Lima brothers from Brazil—better known as LOS INDIOS TABAJARAS—have made for RCA, and every bit as welcome as the previous eight. Their technique is truly remarkable and their style altogether unique. I found myself completely mesmerized with the sensitivity of the playing in "Cry Me a River," "Serenade In Blue," and "Baby, Won't You Please Come Home." Lovely reproduction, with a suitably warm and intimate quality. Put this one down on your "must get" list!

Vocal

RCA has a virtual monopoly on this month's outstanding male vocal releases, leading off with ED AMES, a singer who seems to get better with each succeeding record. "Broadway and Hollywood Hits" (RCA, LSP-4079) gives him the opportunity to really let loose his big baritone on some very solid material, ranging from "I Can't Give You Anything But Love" to "Kiss Her Now," from the Broadway-bound "Dear World." The highlight track is "Who Will Buy?" (from "Oliver"), in which Ames sings the lead line and also does all the street vendors' cries.

Another vocalist of consistent quality and good taste, and blessed with a fine set of pipes, is JOHN GARY. His newest disc, "Holding Your Mind"

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(RCA, LSP-4075), arranged and conducted by Dick Grove, features beautiful stylings of "MacArthur Park," "Little Green Apples," and the unusual "The Zebra."

To paraphrase RCA's recently demised trademark, "His Master's Voice," here is the "voice of the master," PERRY COMO, in "Look To Your Heart" (RCA, LSP-4052). The collection takes its title from the Cahn and Van Heusen song resurrected from the TV musical version of "Our Town," and spotlights Perry with the Ray Charles Singers and Nick Perito's Orchestra in some undeservedly-neglected songs, including two by Johnny Mercer and Gene dePaul: "Love In a Home" (from "Li'l Abner") and "When You're In Love" (from the film "Seven Brides For Seven Brothers"). What a great pleasure to sit back and listen to Mr. C.'s wonderful musicality and stylistic ease—all minus the slightest trace of gimmickry or affectation!

"JOANNA GAULT and Her Symphonopop Scene" (RCA LSP-4081) introduces to records a multi-talented young lady who combines all the facets of music-making into a one-woman show. She writes her own material, arranges and sings it, and directs the accompanying combo. Electronic wizardry allows us to hear the busy Miss Gault singing vocal leads to her own multiple-voiced harmonic parts, backed by unusual instrumentation, consisting of organ, guitar, clavichord, vibes and winds. It all adds up to a potpourri of novelties for novelty's sake, and it inclines to wear fairly thin before too long.

The International Scene brings us chanteuse LINE RENAUD, in her first album sung entirely in English. Nine of the twelve numbers, including the popular "Majorca," were composed by Louis Gasté—Miss Renaud's husband. Ingratiating performances and very pleasant listening.

More Gallic charm is provided in an exciting recital by CHARLES AZNAVOUR, (Reprise, RS-6294), recorded "live" at the Olympia in Paris. Monsieur Aznavour is a magnetic artist and, as always, far and away the best interpreter of his own material.

THE TROUBADOURS OF SPAIN (Decca DL-75031) comprise ten instrumentalists and two female dancers, singing in four languages: Spanish, English, Italian and Yiddish. The group combines trumpets, guitars, drums and voices in a fresh and interesting way, with most of the solo vocals handled by Ricardo Guillot and Gil Sevil. Worthy of special mention is an exciting, pulsating version of "Love Is Blue" and a smashing rendering, in Hebrew, of "Hava Nagillah." Æ

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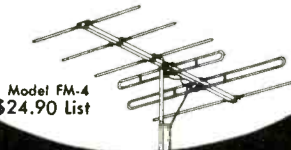

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Recorded Tape Reviews

BERT WHYTE

Previn Conducts Rachmaninoff

Rachmaninoff: Symphony No. 3 / Fantasy for Orchestra Op. 7, Symphony No. 2.
André Previn conducting the London Symphony Orch.
RCA Victor TR3/5030, 3¾ ips ($9.95)

Gaining recognition as a symphony conductor is a difficult task in itself. André Previn has had the added burden of "living down" his past as a purveyor of "pop" music. That he has succeeded in doing this is amply documented by his generally well received recordings and his conductorial appointments to the London and Houston Symphony Orchestras.

This tape packages his earlier recording of the Rachmaninoff "Second" with his recent reading of the "Third Symphony," plus a rarely heard and not very distinguished work, the "Fantasy for Orchestra." Previn gives these richly-scored works performances which are essentially lyrical, yet he imbues them with plenty of vitality and produces climaxes of stunning power. The conducting is altogether quite exemplary, as is the superb playing of the London Symphony.

Quite apart from the fine music-making, this tape affords the unusual opportunity of comparing the sound of the Dolby-processed "Third Symphony" with the conventionally recorded "Second Symphony." The "Third Symphony" (and the "Fantasy") was shipped to RCA in the Dolby "compressed" mode and then "expanded" (restored) through the playback processor of the Dolby A301. The output of the A301 was fed into another tape recorder to produce a dubbing master from which the commercial copy was made. This was equivalent to the slaves being fed by a master tape, with none of the usual intervening sub-masters and multiple tape generations which are so deleterious to the quality of the consumer copy. Because the slaves are conventional recorders with inherent noise problems, we don't get the full benefit of the Dolby system, but procedure described does help to maintain the quality of the original recording and certainly is a step in the right direction. I deliberately played back the "Third Symphony" at a louder-than-usual room filling level. While some hiss was discernible it was considerably less than I have encountered with other tapes played at this level and was far less than the "Second Symphony" at this same acoustic output. In spite of some great fortes, there was but the barest hint of print-through on the "Third Symphony" (probably attributable to the slaves) and crosstalk was virtually non-existent. Print-through and crosstalk were more audible in the "Second Symphony." Besides the improvement in the noise parameters, the overall sound of the Dolby-recorded "Third Symphony" was appreciably cleaner, dynamics wider. For example the tympani near the end of the first movement were clearly delineated and not at all over-resonant. In general the sound of the "Second Symphony" is quite good, but it only takes a few moments of listening to the "Third Symphony" to appreciate its superior quality.

It should be understood that some of the limiting factors of the 3¾-ips format still persist: noise problems, dynamic range, transient response—all would benefit from 7½-ips playback. (As you probably know, RCA no longer issues 7½-ips tapes.) As a suggestion, when there are Dolby originals available, why not dub some on a top-quality slave with low-noise tape at 7½ ips? Even if the quality tape enthusiast has to pay a modest premium, I'm sure there would be enough sales to support such a venture. Unquestionably RCA gained some converts to the lower-priced 3¾-ips tapes, but just as surely they lost many of their 7½-ips tape customers, who now must seek other sources of 7½-ips tapes or go back to disc recordings.

"Pop"

Strings Latino: Edmundo Ros and his Orch.
Ampex/London LPL74107, 7½ ips ($7.95)

This is a typical London Phase Four "pop" recording: much spotlighting of individual instruments, multi-track big, bright sound, recorded up close for maximum definition and presence. However, there is a difference. I am pretty sure this was a Dolby original and since Ampex now has their Dolby equipment, this might account for the fact that played back at a high level there was very little hiss, no crosstalk and just a trace of print-through. Add, too, very clean, solid string bass and

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bass drum, as a true bass is missing from many Phase Four tapes. In fact, the overall sound was quite a bit cleaner than previous Phase Four tapes.

Friend Ros does his usual excellent job with such Latin favorites as "Cumana," "Granada," "Green Eyes," "Malaguena," and other similar repertoire. An outstanding tape of its type.

A Bouquet of Hits: Ferrante and Teicher. Duo-pianists.
Ampex/United Artists UAC6659, 7½ ips ($7.95)

Although Ferrante and Teicher have long since embraced the "pop" medium, I'm convinced that their success in the two-piano sweepstakes is due to their classical backgrounds. These boys are merely brilliant. Their teamwork is no longer just rapport; it has become instinctive. They toss off with insouciant ease a well-balanced program of such songs as "Love Is Blue," "MacArthur Park," "Honey," "Goin' Out of My Head," among others in this vein. The arrangements are good and the orchestra gives them solid backing.

This is a fine multi-track mix, moderately reverbed, recorded with a lot of presence. Excellent balance between pianos and orchestra. Good high end, but slightly bass deficient. The piano sound is interesting in that it is recorded close-up, emphasizing the percussive qualities, yet you don't hear hammer action and there is no transient overload. Most enjoyable.

Slaughter on Tenth Avenue: Hugo Montenegro and his Orch.
Ampex/Mainstream MSC6111, 7½ ips ($7.95)

This tape is a rip-roarin' rouser! Hugo Montenegro fronts a big orchestra that is loaded with talent and works his way through eleven of the most frantic, frenetic arrangements of some "pop" tunes such as the title number and "Limehouse Blues," "Take the A Train," as well as some numbers of classical derivation. The massed-string playing in a take-off of Rachmaninoff's "Rhapsody on a Theme of Paganini" is astonishing for its virtuosity.

The sound is very big and bright, recorded close-up with moderate reverb. Great presence and generally clean, except in some spots where there is just so much going on that the sound becomes diffused. Some may characterize this as vulgar and overblown, but it is difficult to conceal admiration for such tremendous propulsive drive and the sheer vitality and expertise of the musicians. Æ

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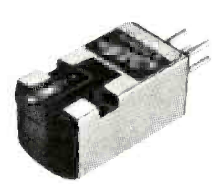

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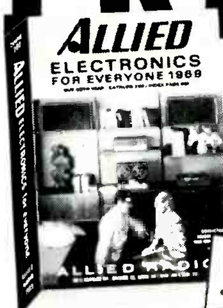

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GARRARD record changers, hi-fi components, cartridges, needles, Scott, Fisher, Dual, AR. Write for Unbelievable Prices. Gregg Electronics, Post Office Box 184, Glen Head, New York 11545.

SOLID-STATE 50-WATT RMS plug-in d.c. through 25 kc operational power amplifier kit, model 440K. Price $30.00 Plus $1.00 postage. Send for free catalog and 50 operational amplifier applications to: Opamp Labs., 172 So. Alta Vista Blvd., Los Angeles, California 90036.

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VIKING Stereo tape deck $125.00; tape albums $3.50 each. Charles Hurt, 602 Tennessee, Charleston, W. Va. 25302; Phone: 304-343-8991.

KLIPSCH, TANNOY, Altec, Rectilinear, AR, Wharfedale, Garrard, Benjamin, Sherwood, Kenwood, Dynaco, Toujay, Audio Originals, Martel, Uher, TEAC. Superior Sound, 1801 Brewerton Road, Mattydale (Syracuse), New York 13211.

DECCA/LONDON ffss Cartridges individually checked – guaranteed. Creighton Audio Labs., Haven Place, Linden, N. J. 07036.

HYPNOTIZE SUCCESSFULLY! "Instantaneous"–"One Word"–"Against Will." Methods Exposed! Complete illustrated course including "Secret Nerve Pressure Technique"–Self-Hypnosis–10 inch Hypnodisk. $2.00. RESULTS ABSOLUTELY GUARANTEED. Fowler, Box 4398, Woodbury, New Jersey 08096.

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PRESTO 3D 500-ohm Cutter, $95. Fairchild 602 Stereo Conax, $485. Westrex Mono Cutter, $950. B. Mefford, 1035 S. Plane, Burlington, Iowa.

ACOUSTIC RESEARCH, Dyna, Koss, Shure discount specialists. Write for free catalog. SCS Corp., 95 Vassar St., Cambridge, Mass. 02139.

TEAC 310 Studio Recorder. New. $995.00. Box 154, Woodacre, Calif. 94973. 415-457-1208.

AUDIO 48-67 $4/year. E. Fewell, 5323 Cicero, Mesa, Ariz.

SCULLY, Ampex, Universal Audio, Fairchild, Revox, AR, Sony mics, Kenwood, Fisher, Scott, Dual. Send for your free list. Professional and audiophile. Georlan Enterprises, 1782 Ura Lane, Denver, Colo. 80234.

CROWN SS824 ¼ T. Stereo professional tape recorder, 15-7.5-3.75 ips, 4 – SS2A mike amps., 2 – SS6 line amps., remote record, case. New heads and factory set-up. Best Offer. James J. Welsh, 215 Garneau Hall, W.M.U., Kalamazoo, Michigan 49001. Phone: 619-383-3587.

EQUIPMENT WANTED

MARANTZ Model 9 amplifiers. G. R. Bowen, 5496 Hugh Howell Rd., Stone Mountain, Ga. 30083.

SONY TC-777-2J tape recorder wanted; like new if possible but will consider any. Also consider TC-777-4J. Jon Black, 40-18 Hampton St., Elmhurst, New York 11373.

McINTOSH MI-3, Victor Vine, Post Office Box 145, Keuka Park, New York 14478.

WANTED: KLH Nine Electrostatic Stereo Speaker System. Fred Steele, 502 Homewood Drive, S.W., Huntsville, Alabama 35801.

CONCERTONE 1401 any cond. Harriston, 1044½ S. Kingsley, Los Angeles 90006.

WANTED: V-Discs. Stephen Bedwell, 5880 Spring Garden Road, Halifax, Nova Scotia, Canada.

FAIRCHILD COMPANDER: A-1 condition. Panel must not be marked. State price wanted. A. P. Sanvido, Jr., 34 Maurice Street, Kitchener, Ont., Canada.

HELP WANTED

EXPERIENCED HI-FI, HAM, CB salesmen wanted. J. S. Draper, Lafayette Radio Electronics, All Cape Shoppers Bazaar, Rt. 132, Hyannis, Mass. 02601.

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SCA Services Co.
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LETTERS

(from page 14)

calibrating control. Space (the whole unit, on a Vector board, mounts on the back of a meter) and other practical considerations (the transformers were on hand) limited me to this simple hookup.

I have long since realized that the frequency response of the whole neon driver stage should be as flat as that of the recording system. Some rare high-intensity peaks below about 100 Hz and above 10 kHz will fail to be indicated; therefore, a larger, better high-ratio transformer is recommended (and possibly, for perfectionists, some feedback, along with the necessary extra gain, collector swing and higher supply voltage). Calibration, and correlation with "0" VU reading, is obviously easy with the aid of an oscilloscope calibrated according to the method described by reader Stark, and reference to the above-mentioned November 1959 article, "Visual Stereo Monitoring."

ANDRE THIVIERGE
Hull (P.Q.), Canada

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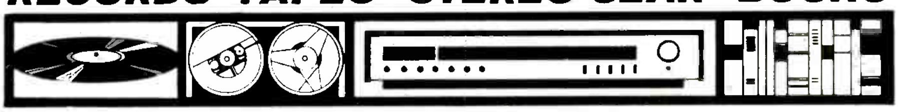

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Advertising Index

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The reconstructed Nationaltheater in Munich, originally built 1811-18, scene of the world premieres of "Tristan" and "Meistersinger."

PHOTOGRAPH BY FRANZ EDSON

The ultimate test of a stereo cartridge isn't the sound of the music.

It's the sound of the hall.

Many of today's smoother, better-tracking cartridges can reproduce instrumental and vocal timbres with considerable naturalism. But something is often missing. That nice, undistorted sound seems to be coming from the speakers, or from nowhere in particular, rather than from the concert hall or opera stage.

It's easy to blame the recording, but often it's the cartridge.

The acoustical characteristics that distinguish one hall from another, or any hall from your listening room, represent the subtlest frequency and phase components of the recorded waveform. They end up as extremely fine undulations of the record groove, even finer than the higher harmonics of most instruments.

When a cartridge reproduces these undulations with the utmost precision, you can hear the specific acoustics of the Nationaltheater in Munich, or of any other hall. If it doesn't, you can't.

The Stanton does.

"The tracking was excellent and distinctly better in this respect than any other cartridge we have tested . . .
The frequency response of the Stanton 681EE was the flattest of the cartridges tested, within ±1 dB over most of the audio range."
Hirsch-Houck Laboratories, HiFi/Stereo Review, July, 1968.

The specifications.* Frequency response, from 10 Hz to 10kHz, ±½ dB. From 10kHz to 20kHz, individually calibrated. Nominal output, 0.7mV/cm/sec. Nominal channel separation, 35dB. Load resistance, 47K ohms. Cable capacitance, 275 pF. DC resistance, 1K ohms. Inductance, 500mH. Stylus tip, .0002" x .0009" elliptical. Tracking force, ¾ to 1½ gm. Cartridge weight, 5.5 gm. Brush weight (self-supporting), 1 gm. *Each Stanton 681 is tested and measured against the laboratory standard for frequency response, channel separation, output, etc. The results are written by hand on the specifications enclosed with every cartridge. The 681EE, with elliptical stylus and the "Longhair" brush that cleans record grooves before they reach the stylus, costs $60. The 681T, identical but with interchangeable elliptical and conical styli both included, costs $75.

For free literature, write to Stanton Magnetics, Inc., Plainview, L.I., N.Y. 11803.

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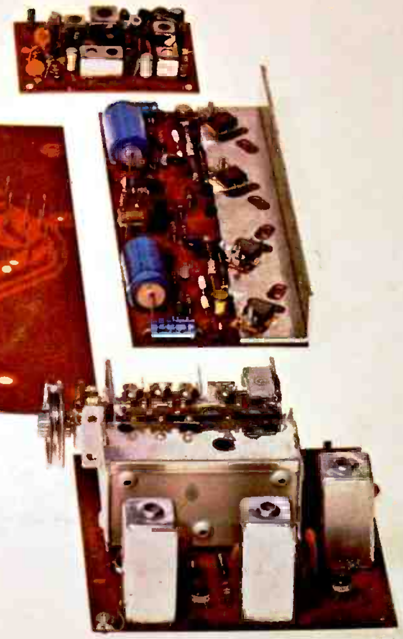
What do you call an etched circuit board that eliminates 49 chances for trouble in every Electro-Voice modular stereo receiver?



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Our big etched circuit board is at the bottom of a significantly better way to make stereo receivers. With one stroke, Electro-Voice has eliminated hand-wiring from almost every signal circuit.

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