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SPECIAL HI-FI SHOW ISSUE

AUDIO

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

JOSEPH GIOVANELLI

FM antenna problems

Here are two unsolicited letters from two readers of this column who took the trouble to write, describing aspects of FM reception which they have experienced.

"I read with interest your reply to Mr. Marvin L. French of San Diego, California, regarding the questions he asked concerning 'Antennas and Auto Ignition Interference' in the December, 1966 issue of AUDIO.

"In my opinion, your reply was well written and 'touches all the bases.' However, there are a few technical points that should be clarified. Mr. French stated that he is currently using RG8/U cable and suggested that he conside RG9/U. Both of these coaxial cables have an impedance of 50 Ohms. The commercially-available baluns for TV-FM antenna systems are the 300/75 type. Therefore, RG11/U (Belden 8238), RG59/U (Belden 8241 or the foam-insulated versions) should be utilized to obtain the best impedance match. RG11/U and RG59/U are 75-Ohm cables.

"You state in paragraph six of your reply that a good, shielded twin-lead should have no more loss than a coaxial line. The fact is, Belden 8290 shielded Permohm is the best shielded, twin-lead available. The losses of an antenna system employing 8290 will be lower than an identical system including coax and the necessary transformers.

"For example:

Nominal Attenuation dB/100 Ft. @ 100 MHz	Belden 8290 Shielded Permohm	RG11/U Belden 8238	RG11/U Foam-Type Belden 8213	RG59/U Belden 8241	RG59/U Foam-Type Belden 8212
	2.3	3.6*	3.2*	5.4*	4.5*

* These values include 1.7 dB attenuation for a pair of 300/75-Ohm baluns (the best commercial baluns we have found to date).

"These losses will be even higher if poorer quality matching transformers are employed. I would also like to mention that our comparative tests show that Belden 8290 more effectively minimized lead-in pickup of auto ignition noise than coaxial cable. This is true because, unlike coaxial cable, the shield in 8290 provides 100 per cent coverage and the shield is not involved in carrying the desired signal from the antenna to the receiver.

"In paragraph five you state the vinyl jacket between the shield and the center conductor. . . . The results you describe are accurate. Coaxial cable losses do increase when the plasticizers in the vinyl jacket over the shield migrate into and contaminate the polyethylene core.

"My remarks are honestly intended to be constructive. I feel that since TV viewers and FM audiophiles are spending increasing amounts for receivers and antenna systems, they also need accurate information in order to obtain the reception they expect and often demand. The lead-in between the antenna and receiver is a vital link. It can make or break an antenna system."—*Paul B. Miller, Engineering Department, Belden Manufacturing Co.*

* * *

"The fellow with 'static' in his FM Tuner in AUDIO, 12/66 interested me; sounds like he has high leakage in the a.c. line bypass condenser in the tuner. He should ground his mast well. Could be high leakage from the TV set to the mast and back to his tuner, too—some of these a.c.-d.c. TV sets run well over 100 mA of leakage current. One bum connection in the return path will give him beaucoup staticy sounds in his tuner. (Most antennas, FM or TV, have an electrical path to ground through them.) You have the situation backwards on coax cables: the *jacket's* plasticizer migrates to the core dielectric, degrading the cable. I have a hunk of GI surplus R6/U that I keep around to prove to people that surplus cable isn't worth hauling home; with a Bird wattmeter at each end, 50 Watts at 100 MHz going, no reflected power, line terminated in a 50 Ohm load, *there is one watt of energy at the far end.* Forty-nine watts dissipated in the cable, made in 1943. The loss at 4 MHz is about 10-15 per cent. The thing to remember is to always look up the specs for the cable—if it doesn't say "non-contaminating jacket," don't buy it. I have found that most brands of foam-dielectric cable, equivalent of RG8/U and RG11/U, have non-contaminating jackets and low loss. Standard coax cables have a life of about five years, if used at 100 MHz and above. If you have a hunk of RG8/U that is older than that, replace it. It is a better attenuator than a transmission line.

"Coaxial cables are easily matched to 300 Ohm antennas and receivers with a half-wave balun; see any radio handbook for a 4:1 balun. Of course, RG11/U (70 Ohm) cable should be used. A balun only costs a couple of feet of cable and a little soldering, much cheaper than manufactured baluns with bifilar-wound coils. They are not fussy — if cut for around 96 MHz, loss throughout the FM band is quite low. Don't forget to multiply the halfwave physical length by the velocity of propagation figure of the cable, usually 0.66. (If a halfwave is, say, five feet, the balun length would be five times 0.66 or 3.3 feet.)

"God forbid that anyone should use RG9/U cable. Costs too much! Foam dielectric cables have lower losses and are cheaper! Of course, if cost is no object, you can get a Teflon dielectric

(Continued on page 115)

October, 1967 Vol. 51, No. 10

AUDIO

Successor to RADIO, Est. 1917

AUDIO ARTICLES

AUDIO REVIEWS

AUDIO PROFILES

AUDIO IN GENERAL

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Focus on Home Hi-Fi Installations — Blending component high-fidelity equipment into a living room gracefully can challenge the imagination of any hi-fier. Here's how others solved their decor/sound problems. Perhaps your solution can be found among them.

The Skating-Force Phenomenon, Part II—Jim Kogen concludes his discussion of skating force and how it can affect cartridge performance.

Jazz, Blues, and the Mothers — Bertram Stanleigh focuses in on hippy musicians, in addition to reviewing other music in the Jazz-Blues idiom.

FM Tuner Measurements—Leonard Feldman examines secondary specifications of FM tuners and receivers, the ones that so many hi-fi enthusiasts find confusing: capture ratio, selectivity, and spurious responses, among them.

EQUIPMENT PROFILES:

Kenwood TK-55 FM stereo receiver

Elac STS-322 stereo phono cartridge

Plus: Audioclinic, Tape Guide, Audio ETC, and more.

ABOUT THE COVER: The N. Y. High Fidelity Music Show always creates a great deal of excitement for anyone interested in fine-quality music-reproducing equipment. The Show has it, all right! Here's where manufacturers display their latest models, demonstrate them for you, answer many questions. And in this issue, **Audio** gives you a taste of what will be featured at the Show, starting on page 14 with Audio ETC, and picking up again on page 23 with names of exhibitors, new products to be displayed, equipment trends, and other significant information.

Letters from Readers

Wireless pioneer seeks tales

■ I'm the fellow who founded your magazine in 1917. While I am still able to draw a bit of breath, I am pounding away at this 1915 vintage typewriter, working on a book entitled, "Tales of the Wireless Pioneers." It goes back to 1902, when my first friends, a few still living, first got into wireless. I followed in 1907.

I need much help to complete this book . . . it will probably cost more than I'll get out of it, but unless one of the still-living old coots of the wireless age does a book of this kind now, it will never be written. I'm getting help from a few in their 80s.

H. W. DICKOW
San Francisco, Calif.

Mr. Dickow seeks short tales of experiences, successes, failures from "pioneers" for use in his forthcoming book. He's interested in stories from those who contributed to wireless from 1900 to 1912. He may be contacted at 225 Buckingham Way. Apt. 503. San Francisco, Calif. 94132—Ed.

Melodeon, where are you?

I have trouble locating the Melodeon label mentioned in your jazz record reviews. Can you recommend a dealer who carries it?

ROBERT V. ROICKLE
Hempstead, N. Y.

Sorry, don't know of any local source. Perhaps the producer, Spottswood Music Co., Inc., 3323 14th St., N.E., Washington, D. C. 20017 can direct you to a dealer in your area—Ed.

The FETS-for-audio story

Could you tell me where I can get FETs. I wrote Dickson Electronics and they never replied. I would like to make a stereo unit like Mr. Rhinefelder described in his article in Audio's November 1966 issue.

L. ROMER
Bolton Landing, N. Y.

Dickson Electronics is not presently supplying FETs for audio use, advises author William A. Rheinfelder. However, notes Rheinfelder, now associated with Anaconda Astrodata Co., Anaheim, California, the selection may be done by you, preferably, with an agreement where you can return units which do not bias-up correctly.

Your own testing is performed quite simply. First, select a device of the proper breakdown voltage. For low noise first stages, a supply and breakdown voltage of 30 volts is sufficient, for large signal output stages a breakdown of 120 or more is desirable. As a general, best circuit, use 120 volt supply with a drain resistor of 100k Ohm and a following a.c. impedance of at least 220k Ohm. Optimum drain voltage is then approximately 55 volts. Adjust gate bias (or bypassed source resistor) for maximum gain at 1 kHz. Bias voltage must be from −.5 to −5.0 Volts for a usable N-channel device (using junction FETs). Best devices bias-up between −1 and −3 Volts gate to source. Return all other transistors to supplier for credit.

With the good devices, construct circuit as with vacuum tubes (see Radiotron Handbook*), but keep in mind that source resistors generally run higher than cathode resistors because of the lower current drain of FET. Also, there is little advantage in going to a higher supply voltage than 120 Volts. For lowest noise a supply voltage of 30 Volts seems best. Also, for lowest noise use the smallest d.c. gate resistance possible. A tape head for example, should be connected directly to the gate and ground without coupling capacitor and 2 Megohm resistor. There is no danger of magnetization of the head, because gate currents are at least 1000 times lower than with vacuum tubes, not to even mention transistors.*

Suitable FETs can be probably obtained from most manufacturers. Some of the best devices are presently often treated as rejects based on such parameters as pinch-off voltage, or drain current at zero bias, both of which have no bearing on audio amplifier design.

Code of devices in the articles was as follows:

1st letter: *D = Dickson.*

2nd letter: *N = N channel.*

3rd letter: *N = low noise (selected A), A—general purpose (breakdown 60-110 Volts), L—large signal amplifier (breakdown 110 Volts up).*

Numbers: *gate-bias in volts ±20%.*

Last letter: *gain at 1 kHz. A = 40-45 dB; B = 35-40 dB; C = 45 dB up.*

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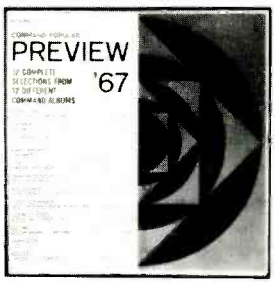

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POPULAR PREVIEW '67 VOLUME 2

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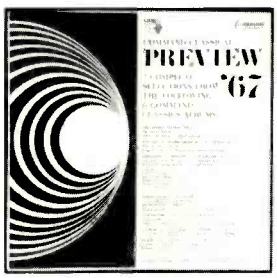

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CLASSICAL PREVIEW '67 VOLUME 2

SELECTIONS: George Gershwin: PORGY AND BESS (excerpt) • Ravel: VALSES NOBLES ET SENTIMENTALES (excerpt) • Johann Strauss: TRITSCH-TRATSCH POLKA • Aaron Copland: BILLY THE KID (excerpt) • George Gershwin: AN AMERICAN IN PARIS (excerpt) • Mozart: FANTASY IN F MINOR, K. 608 (excerpt) • Aaron Copland: APPALACHIAN SPRING (excerpt) • Mendelssohn: SONATA NO. 1 IN F MINOR, OPUS 65, 4th movement, Allegro assai vivace.

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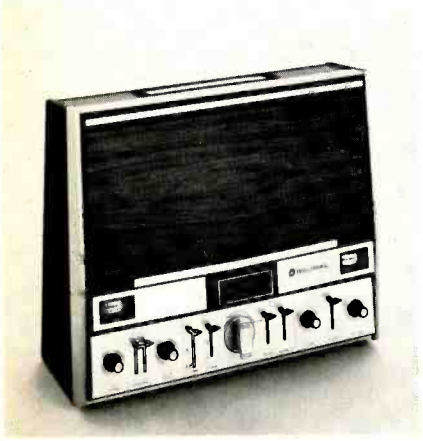
What's New in Audio

Bell and Howell enters tape recorder field

Bell and Howell, the photo corporation, jumps into the electronic home entertainment field with a series of reel-to-reel stereo tape recorders. The 4-track/4-speed recorders are said to be the first fully-automatic tape loading machines, with magnetic tape riding on a cushion of air onto the takeup reel. Other features include: automatic tape reversing for playback in both directions, power-assisted master control knobs for all tape transport functions, mixing provisions for either or both channels, audible search control to locate specific recorded passage on the tape during fast rewind, automatic head demagnetization. Three recorders were announced: Model 2297 (shown



here with its wood-grained reel cover door closed), the top model at $449.95; Model 2295, a lower-powered unit, $399.95; Model 2291, which appears to be a tape deck, $349.95. Check 27

Allied Radio adds new brand-name line

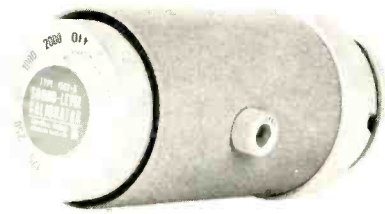
In addition to its Knight and Knight-Kit product groups, Allied Radio now has a new line of hi-fi components under the *Allied* name. The new Allied Model 365 pictured here is a 65-Watt stereo FM/AM receiver that sells for $229.95 with metal case (an optional oiled-walnut wood case is available for $19.95).

The solid-state unit (65 semiconductors) has 2 microvolts IHF sensitivity, 45 dB selectivity, 35 dB separation at 1000 Hz, 2.5 dB capture ratio, 65 dB signal-to-noise ratio; AM sensitivity is 8 microvolts. The amplifier section boasts 25 Watts rms per channel at 8 Ohms; power bandwidth, 15 Hz to 30 kHz; frequency response, 20 Hz to 50 kHz ±1 dB; harmonic distortion,

0.25% at 1 Watt, under 1% at rated output; IM distortion, 1%. Among its many features are: automatic stereo-mono switching, clutch-type controls, afc on-off, high-frequency filter, front-panel stereo phone jack, front panel main-remote speaker control switch. Check 28

General Radio sound-level calibrator

The new GR Model 1562-A Sound-Level Calibrator is a compact, self-contained unit for making field calibrations



on microphones as well as other sound-measuring instruments. It generates five USASI-preferred frequencies, 125 Hz, 250 Hz, 500 Hz, 1000 Hz, and 2000 Hz, all at ±3%, at a sound-pressure level of 114 dB. Level accuracy with the Western Electric 640AA or equivalent microphone is ±0.3 dB at 500 Hz and ±0.5 dB at other frequencies. Price with carrying case and microphone adapters is $195. Check 29

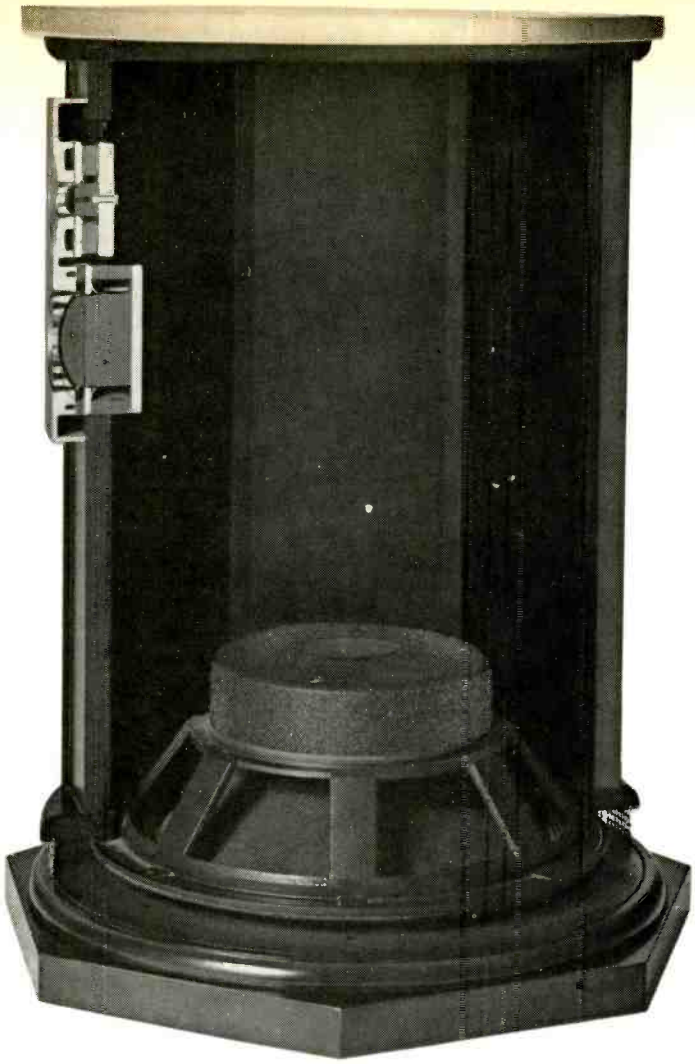
Amplified headphones

Telex introduces amplified headphones, an innovation that promises to be useful in a variety of private-listening situations. The solid-state, battery-powered amplifiers, built into the headphones, include a volume control,

low-level and high-level inputs. Response is said to be 16 Hz to 15 kHz. When the amplifiers are switched off, the Amplitwin operates as a standard headphone with any stereo equipment featuring a headphone jack. $79.50 with connecting cords and a padded storage/carrying case. Check 30

E-V's "hand and stand" mike

The new Electro-Voice Model 631 omnidirectional, dynamic microphone evolved from design concepts developed for the E-V professional 635A mike. But it lists for only $60. The rugged mike features the company's "Uniseal"



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

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

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switch, a magnetically-operated reed-relay switch which is sealed from dirt and corrosion. Located underneath the snap-on switch actuator, a magnet closes or opens the switch contacts when the switch on the case is moved forward or back. If the actuator is removed, the contacts remain in a fail-safe "on" position.

A four-stage filter inside the 631 traps dirt and magnetic particles before they can get to the element. The filter also gives blast and "pop" protection. Mechanical-nesting construction, where internal parts nest inside each other, makes for a solid assembly that minimizes shock. To decrease mechanical noise, the complete assembly is cushioned in viscous vinyl.

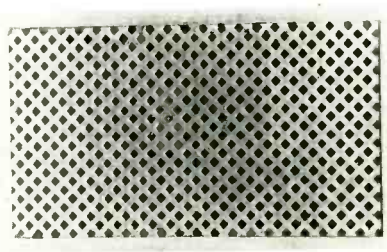
Frequency response is 100 Hz to 13 kHz, shaped for presence and control of feedback and rumble. The mike's output is −55 dB.

The 631 can be installed for stand use with the 310 stand clamp provided. It is available in satin chrome or matte-satin nickel finish for $60 list. Custom carrying cases, complete with standard phone plug, are available at slight extra cost. Check 31

Controlled-Impedance Speaker System

The low source impedance of transistor amplifiers results in a high damping factor, and when used with 16-ohm speaker systems the output is reduced, even though distortion is lowered. A good speaker system for flat frequency response should have a constant impedance over the entire audio spectrum.

Tang SP5AX speaker systems are



designed with controlled impedance specifically for transistorized amplifiers, and have a frequency response from 40 to 18,000 Hz ±3 dB. They have a rear exit to augment low-frequency response, and an acoustical chamber and diffracting grille in front of the special high efficiency 5-in. speaker. Enclosed in a solid walnut cabinet 10 × 7 × 6 in., they are priced at $39.95 with a bare diffracting grille, and at $44.95 with fluffy white or oatmeal grille cloth. Check 32

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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.

Sound-on-sound

Q. I would like to know the variables affecting sound-on-sound performance. Does a better tape recorder affect the number of dubbings one can make? What are the significant criteria to take into consideration as to the sound-on-sound capability of a tape recorder? Is the signal-to-noise ratio all-important? What about frequency response? How many dubbings may I expect to produce with a tape machine before the first track deteriorates noticeably? Could I ever hope to attain 10 dubbings?

A. Each dubbing you make results in about 3 dB loss in signal-to-noise ratio. Therefore an excellent S/N ratio is a vital consideration for the machine you choose. In examining S/N specifications, be sure that these apply to the entire tape machine and not merely to the tape amplifier. Generally, machine quality will vary with price. My guess is that, using a good machine, you can make about two or three dubbings before there is an appreciable increase in noise. Of course this depends in part upon your recording level; if you are willing to sacrifice some increase in distortion for a higher recording level, you will have correspondingly less noise.

Frequency response is important. An aberration in response at the low, middle, or high end might be scarcely noticeable on a single recording, but can become quite pronounced on repeated dubbings. Similarly, good motion (low wow and flutter) is important. Repeated recording may pronouncedly bring out wow and flutter that are initially not apparent. All in all, sound-on-sound requires high quality in every aspect of performance.

Useful Information

Major Emory R. Howell, 3917 N. 31st Street, Waco, Texas writes: "I have information which may be of interest to some of your readers. In 1962-64 the Sebusa Sangyo Company of Japan made and sold to the U.S. and armed forces a sizeable number of professional tape recorders, marketed under the names of Freeman, Frontier, Camena Voice, Stereocraft(?), Neat, and Vansonic. In July 1964 this company closed its tape recorder department and stopped making spare parts. However, its tape machines were excellent and rather expensive ($700 to $1000), and I am sure those who own them would like to keep them operating. I had purchased one of these machines myself, and when the company stopped making them I purchased the remaining machines and spare parts. I can make these spare parts available to other owners. I can also do service work on the machines in question. This is a hobby rather than a business, and the price of parts and/or labor will be low."

8-track standards

Q. I would appreciate information concerning 8-track standards.

A. 8-track standards appear in "Standards for Magnetic Tape Recorders," Bulletin No. E 5, Record Industry Association of America, Inc., 1 E. 57th Street, New York City 22, N. Y. These standards deal with mono and stereo recording, reel-to-reel and cartridge operation, recording sequence, phasing, track width, track disposition, and color coding of leaders.

Reversing features

Q. I would like to purchase a high-quality tape machine that has the "reversing" feature (a) in playback, (b) in recording, and (c) if possible, both. Are there such machines on the market? Am I putting too much emphasis on operating convenience in looking for a reversing machine?

A. While the earliest two-way machines perhaps tended to operate with somewhat more wow and flutter in one direction than in the other, engineers have pretty well worked their way around this problem, so that today you can obtain high-quality, reliable reversing machines. Without question, there are occasions when it is delightful to have instant reversal in recording (for example when the tape is about to run out in the middle of an aria as you are recording live opera). At the same time, automatic reversal should be an optional feature, so that you don't accidentally erase previously recorded material.

Preamp for extra gain

Q. Like many audio buffs, I find it occasionally necessary to combine long cable runs with the high-impedance microphone input of a tape recorder. Therefore I use a low-impedance microphone and impedance-stepup transformer. However, I obtain barely enough signal level to drive my tape recorder. Therefore I am looking for a relatively simple transistorized preamp with good fidelity and having only 10 to 20 dB gain. It might be possible to design such a circuit to use the transistor itself as a matching device, and to permit expansion—via a separate gain control and isolating resistor—to a full-fledged mixer.

A. I suggest that you look up the article "Transistorized Stereo Microphone Mixer," by Peter Stark in the October 1963 issue of AUDIO for answers to your questions concerning a transistorized preamp and a mixer. It seems that you could copy one or two stages of his circuitry to obtain the gain you desire. If there is excessive gain, this could be corrected by taking the signal off a voltage-dividing pot, or perhaps by increasing feedback between collector and base.

8-track recording

Q. I have purchased an automobile stereo tape player. My problem now is to convert my many phono records to four-track tape cartridge. The auto stereo unit has a movable playback head, and the four tracks are all recorded in the same direction. I have heard that it is possible to record one's own cartridge tapes, and I know that blank tape cartridges are available, but how do I record? Will I have to adapt my auto unit by installing a record head and pre-amp, or can a home tape recorder be adapted for the purpose?

A. While the playback head can also be used for recording, in addition you need recording circuitry, including a bias oscillator; and you need switching circuitry for alternating between recording and playback. Unless you are very skilled and experienced, it would be most difficult to make the necessary modifications to your auto tape player. Similar comments apply to modifying a home reel-to-reel tape machine so that it can record tape cartridges. However, the near future may bring us home machines that can operate not only with reels but also with cartridges,

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

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

Its new small-particle oxide meets or surpasses the most demanding low-noise specifications. Holds inherent tape noise ("hiss") far below the level of your most delicate musical passage. Yet from this same quiet tape comes *greater high frequency response* and *broader undistorted dynamic range* —qualities previously sacrificed in low-noise tapes. So the silence has more silence. The flute sounds sweeter. *And* the cymbals crash louder, without distortion — on Ampex 404 Series low-noise tape.

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

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☐ Send me literature on the full line of Ampex professional tapes, including new 404 Series low-noise tape, for

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- ☐ Master
- ☐ Duplicating
- ☐ Other: _____

NAME _____

ORGANIZATION _____

ADDRESS _____

CITY/STATE/ZIP _____

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

AMPEX

so that you can record your own cartridges for use in an automobile or elsewhere. One Roberts model already does this.

Overseas purchases

Q. I am stationed overseas and am in a position to purchase fine-quality tape recorders for around $250. If you know of any manufacturer whose merchandise you would recommend, I would appreciate this information.

A. The policy of AUDIO magazine prohibits me from commenting on specific brands of audio equipment. If you plan to use your tape machine when you return to the United States, you had best stay away from any make that is not popularly sold in this country. Otherwise you face the problem of getting this machine serviced and of obtaining replacement parts.

High-output tape

Q. Would you advise me as to the appropriateness of using high-output tape for sound-on-sound recording.

A. The essential purpose of high output tape is to provide a higher signal-to-noise ratio, which increases in importance when one is faced with the rise in noise inherent in sound-on-sound recording. However, such tape also increases the risk of audible print-through. If you are careful about recording level, you may well find that high-output tape satisfies your needs. You might also want to try the new low-noise tape; at the same time this requires changes in bias and equalization in order to maintain flat frequency response.

5 ips vs. 7½ ips

Q. At the present time is there any advantage of 15 ips over 7.5 ips?

A. 15 ips is superior to 7.5 ips in terms of signal-to-noise ratio, distortion, and frequency response. However, in a high-quality home recorder the difference tends to be more measurable than audible. One tends to get better motion (less wow and flutter) at higher speed. But again the difference is approaching inaudibility. In professional use, when tapes have to go through several stages of duplication (perhaps three or four), miniscule differences on a single taping add up to appreciable differences on repeated duplication. In home use, we generally deal with a single generation of tape, and 7.5 ips is adequate. In fact, today we find that in a *top-notch* machine very little is wanting at 3.75 ips.

Tape it with a Sony Solid-State Stereo 560

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

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

SONY® SUPERSCOPE® The Tapeway to Stereo®

8142 VINELAND AVENUE • SUN VALLEY, CALIFORNIA • 91352

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

AUDIO ETC.

EDWARD TATNALL CANBY

AT THE HI-FI SHOW

This year I have a new idea. This column itself is going to be at the big, fall Hi-Fi Show! It never has before, in quite this way.

In earlier years, back to the very first "Audio Fair," I used to report the event, rigorously, taking voluminous notes and snagging armsful of slick-paper handouts for future reference. When my arms were so loaded I could scarcely walk, I'd go to my secret cache and store the literature in heaps. (It was under the table in AUDIO's showroom, beneath the drapes—all sorts of extra space down there near the floor.) At the end of the day I'd bring up large suitcases and, loaded to the gunwhales, I'd ferry them downstairs, into the subway (reserving a private car), and so home for study.

By the end of several days, my apartment would be afloat in slick paper and my voluminous notes on assorted scraps of this and that (you know how it is at shows: you write down names and addresses on the edges of anything in hand, using somebody's back for a desk and a broken pencil with no point). The notes would have to be pasted up on proper paper sheets, then bound together with a staple gun, before I could even begin work.

Each evening I'd go through them and try to decipher. Most of the remarks were gibberish by that time. Couldn't even remember writing them. The addresses were unreadable, the phone numbers lacked digits and the crucial *names*—my all-important contacts with the latest and best in hi-fi—were all in Greek and Esperanto. I would come upon something like this: Bill Scrpwmmcks, sales rp for Amzlrrft (txsp rscahrder) PHONE HIM! PL 9 8ZZP.

With that kind of info I was supposed to write up the Big Show! It was sort of hopeless. Especially since I could never make it sooner than December. Who wants to read about last autumn at Christmas time?

Seeing and believing

So—here I am, on time at last. Right at the Show itself. Terrific show, isn't it? My aim is to talk to you right *now*, when the Show is really hot off the old griddle and still cooking. I'm starting so early I just can't miss, this time. Better early than late, I always say. (Come to think of it, as I write these words the Show isn't even on the griddle yet. No more than a gleam in a lot of people's eyes. No matter. My eyes are gleaming too, in greedy anticipation. And at long last I've actually made the Show deadline. About time!)

In a change from years past, the N. Y. Hi-Fi Show will be held at the Statler Hilton Hotel.

Why hi-fi shows? Well, that is a point worth considering, now that I'm here.

Of course there are excellent reasons, both for the potential sellers and the prospective buyers. First of all, these shows bring together a grand display of the newest, the latest and, most important, the currently-available hi-fi equipment, for all of us to see and compare, cheek by jowl, room next to room, display by display. And in addition we can find out what is cooking for the near future (and what the competition is doing about it). It's an eye-filling sight and much more useful, say, than a hi-fi catalogue, no matter how complete; because the whole thing is visible in 3-D, live, right there before your eyes.

You can see just about everything now at these shows, and it is worth it even if you are stone deaf. One good 3-D look at a sexy new amplifier in the flesh is worth two dozen gimmicky photo shots complete with Model. (I mean the female of the species, not the Model No.)

Where else can you find such a broad perspective of actual equipment? Nowhere. Not until somebody takes up my old suggestion of a *permanent* Hi-Fi Show, staffed and operated by one of our trade organizations (not by the sellers themselves), at which orders for equipment would be taken on the spot and channeled through the buyer's home-town dealer or nearest equivalent. The prototype for this (long since described in this column) in still running in Copenhagen, Denmark, the *Permanente*. Some day we're going to wake up and try the same thing for our hi-fi. Meanwhile, the temporary but mammoth Hi-Fi Shows (no orders, please) fill the bill uniquely. There isn't anywhere else to see everything. No sales outlet can give you such service, direct from the manufacturer in person—he's usually right there and you can talk to him. Nobody has that much room, either. And nobody can be that much up to date, what with roomsful of prototypes not yet in production (and even more that are supposed to be in production but didn't quite make it). Something to see!

Hearing

If seeing is believing, is hearing too? A well-known children's book is called "A Hole Is to Dig." Is a Hi-Fi Show to Hear?

Uh-uh. Better break that one into two parts, for safety. First, are you likely to find any real aural pleasure at the Big Show, via your undefended ears? Second, is the sound at the Show likely to be informative—will you learn anything you didn't know before?

Add a third part. Will the Show's sound mislead you? Answer that first. Not if you use your innate intelligence and common sense.

I can detect a few derisive snorts, somewhere off there in the background. But even so, I am going to say yes, if a qualified yes, on both the first counts. You *can* find pleasure via your ears at the Show. Enough to counteract the noisy clatter that assails you a lot of the time. (That's the price for Hi-Fi Proximity, the entire Industry all huddled in there together.) And you *are* likely to learn, to pick up useful information from the actual sounds at the Show.

Of all people, I hate loud noise the most. I admit that, after each fall Big

(Continued on page 18)

When Stanton engineers get together, they draw the line.

The frequency response curve of the new Stanton 681 Calibration Standard is virtually a straight line from 10-20,000 Hz.

That's a guarantee.

In addition, channel separation must be 35 dB or greater at 1,000 Hz. Output must be 0.8 mv/cm/sec minimum.

If a 681 doesn't match these specifications when first tested, it's meticulously adjusted until it does.

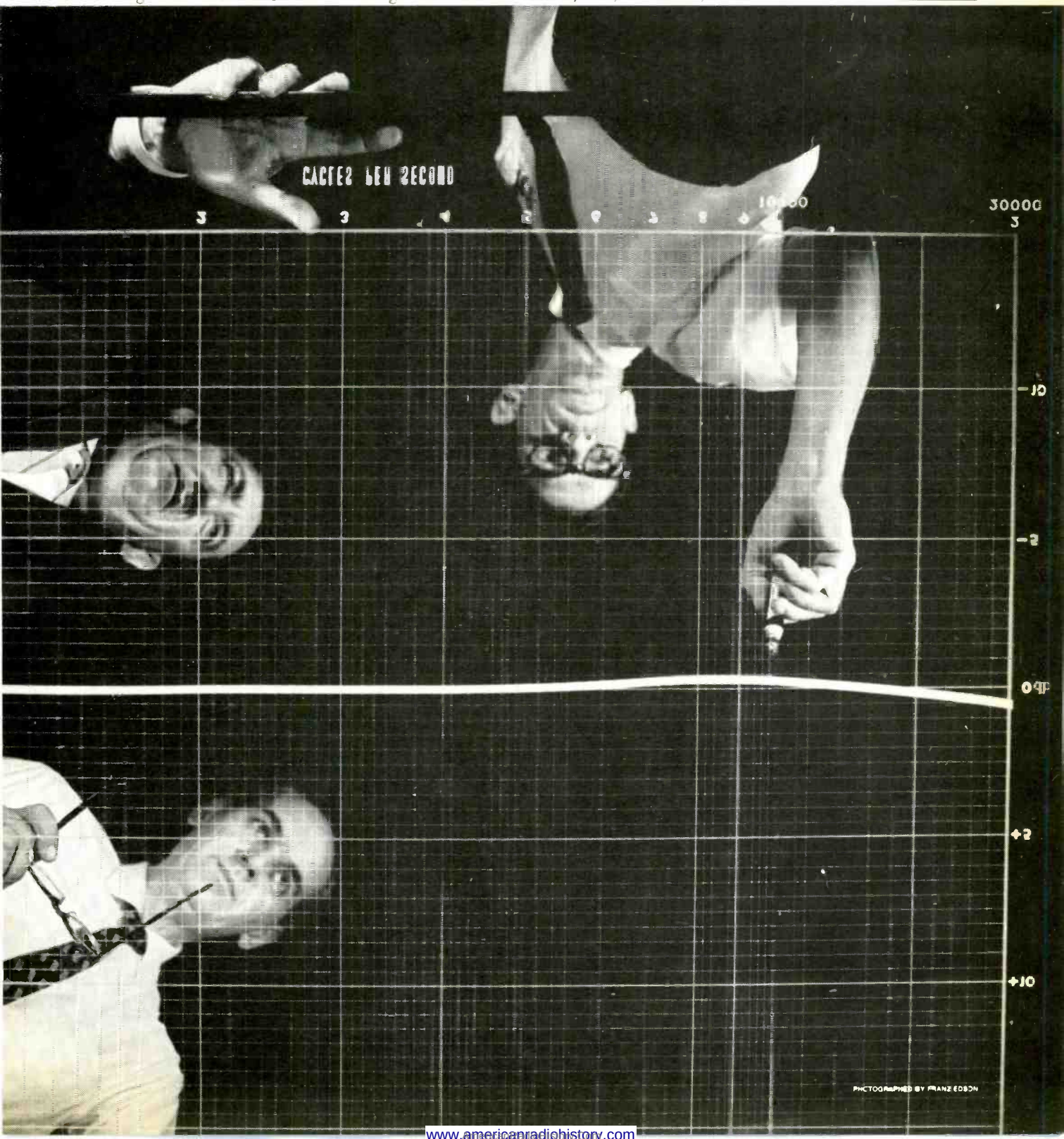
Each 681 includes hand-entered specifications that verify that your 681 matches the original laboratory standard in every respect.

Nothing less would meet the needs of the professional studio engineers who use Stanton cartridges as their reference to approve test pressings. They must hear exactly what has been cut into the grooves. No more. No less.

But you don't have to be a professional to hear the difference a Stanton 681 Calibration Standard will make, especially with the "Longhair" brush which provides the clean grooves so essential for clear reproduction. The improvement in performance is immediately audible, even to the unpracticed ear.

The 681 is completely new, from its slim-line configuration to the incredibly low-mass moving system. The 681A with conical stylus is $55.00, the 681EE with elliptical stylus, $60.00.

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



Dual.

The most advanced thinking in automatic turntables today.

Tomorrow too. Even the most sensitive of today's cartridges, with their ability to track at 1 gram, pose no challenge to the Dual tonearm. Nor is any cartridge now on the drawing boards likely to.

If a cartridge ever appears that can track as low as ½ gram, the Dual tonearm will still be comfortably ahead of it. As will the entire Dual turntable.

Every aspect of the Dual is designed and engineered to perform smoothly and quietly at tracking forces well under ½ gram. This includes tonearm, motor, platter, cueing, automatic cycling and switching.

For example, it takes only ¼ gram of force to slide the operating switch to "stop" when a record is in play. So there's no annoying stylus bounce. It takes even less force to activate the automatic shutoff when the stylus reaches the runout groove.

Tonearm adjustments are equally precise. The direct-dial tracking force adjustment is accurate to within 0.1 gram. And the Tracking-Balance control (anti-skating) is not only calibrated to tracking force, but to different stylus radii as well.

When precision like this is combined with rugged reliability proven over the years, it's no wonder that most leading audio editors and record reviewers use a Dual in their own stereo systems.

Among the many exclusive Dual features these professionals appreciate are the variable speed control and the single-play spindle that rotates with the platter, exactly as on manual-only turntables.

These and other advanced Dual features are described on the opposite page. But as with all audio equipment, nothing can take the place of an actual demonstration. And as you will then learn, nothing can take the place of a Dual.

Elastically damped counterbalance with vernier adjustment for precise zero balance. Other Dual refinements include nylon braking on shaft to prevent slippage, and damping between counter-balance and shaft to reduce tonearm resonance to below 8 Hz.

Rotating single play spindle. Integral with platter and rotates with it, a professional feature that eliminates potential record slip or bind.

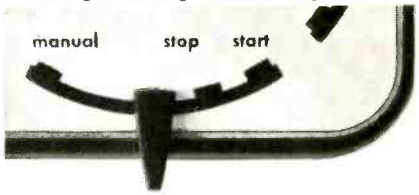
ıl's Tracking-Balance Control (anti-skating) alizes tracking force on each wall of the eo groove, eliminating distortion and ven wear on stylus and record that result ı skating. The direct-dial anti-skating trol is applied in a continuously variable ge and is numerically calibrated to the track-force dial. You don't undercompensate or over-ıpensate. This precision is in keeping with the emely low bearing friction (under 40 milligrams) ual tonearms, which can thus skate freely even n tracking as low as ½ gram.

Constant-speed Continuous-Pole motor rotates platter (not just itself) at exact speeds, and maintains speed accuracy within 0.1% even when voltage varies ± 10%. Quieter and more powerful than synchronous types. Continuous-Pole motor brings 7½ lb. platter to full speed within ¼ turn.

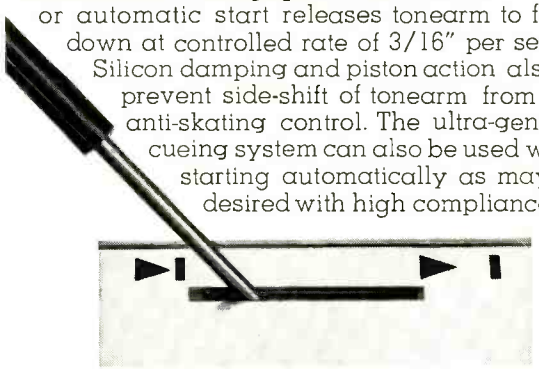
Direct-dial stylus force adjustment, applied directly at pivot to preserve perfect dynamic balance of tonearm. Numerical dial is continuously variable no click stops) and accurate to within 0.1 gram.

Elevator-Action changer spindle holds up to ten records, lifts entire stack off bottom record so that no weight rests on it before it's released to descend. And there's no pusher action against center hole. Records can be removed from platter or spindle without need to remove spindle itself.

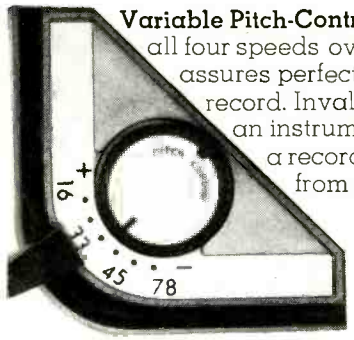
Feathertouch master slide switch controls all start and stop operations in both automatic and manual modes. Smooth sliding action prevents stylus bounce even when tracking at ½ gram.



Feathertouch cueing system for manual or automatic start releases tonearm to float down at controlled rate of 3/16" per second. Silicon damping and piston action also prevent side-shift of tonearm from anti-skating control. The ultra-gentle cueing system can also be used when starting automatically as may be desired with high compliance styli.



Variable Pitch-Control lets you vary all four speeds over a 6% range, and assures perfect pitch with any speed record. Invaluable when playing an instrument accompanied by a recording or when taping from off-speed records.



Which three Duals won't you buy? There are four Dual automatic turntables: the 1010S at $69.50, the 1015 at $89.50, the 1009SK at $109.50 and the 1019 at $129.50. Each is in every respect a Dual, with Dual precision engineering throughout. The essential difference is in features and refinements that nobody else has anyway. It may take you a little time to select the one Dual with the features you'd want for your system. But by making it a little more difficult for you to choose one, we've at least made it possible for everyone to own one. A Dual. **United Audio** Products, Inc. 535 Madison Ave., New York, N.Y. 10022

Dual

AUDIO ETC.

(Continued from page 14)

Show in New York, my ears suffer so monumentally that they have to be coddled for days afterwards, receiving no sound above a whisper. But it is worth it. I go away sonically much better informed than I came. And thus I go back for more each year.

However, if you are like me, you'll find that this takes a certain amount of intelligence and discrimination in the listening. Everybody who patronizes these affairs must turn on his brain, set up his mental filtering circuits and *interpret* sound, as well as selectively ignore it much of the time. This applies just as much to the Exhibitors themselves (who do more wandering in the corridors than all the customers put together), as it does to you and me who are merely Visitors.

I take it for granted that you have the right kind of sonic-fog-penetrating brain for anything the Show can throw at you. And I thank the good Lord that, in recent years, many Exhibitors have been exhibiting the same kind of intelligence in setting up their fine displays for your ears. Great. Many now put on their audible productions with real finesse and know-how—to show off their wares for what they really are worth. Good idea. I really used to be distressed at the way some Exhibitors systematically went about running down their own products—perfectly good amplifiers, speakers, phono players, producing noises so hideous you'd think the manufacturers were trying suicide the easiest way. Nowadays—and at this very Show—the trend is thankfully the other way.

Random noise

The real trouble with past Hi-Fi Shows has been the terrible amount of negativism they have stirred up, unintentionally. Throngs of people came in, would start walking eagerly down the nearest corridor and in moments would turn pale. Such *noise!* How else can you describe fifteen or twenty simultaneous audio signals at once! A Happening? Not by a long shot—you have to be choosy when you stage a real Happening. After all, it doesn't just happen, whatever they say; it is carefully planned. Our noises were both random and totally uncontrolled, and louder than any sound a listener could hope to avoid anywhere else.

Noise in the corridors is one thing. Noise — plain noise — in the exhibit rooms is something else again. Some Exhibitors still think that the way to get ahead twice as fast is to have at least two signals in stereo going on at once. Better still, five or six, all no more than a few feet apart. I run straight out of such exhibits a lot faster than I walk into them, and so will you.

Other Exhibitors (against whom you must use your powers of discrimination) are convinced that the old fashioned way to win is to get there fustest with the mostest. Get where? Next door, where the Enemy lives.

Maybe the highs won't penetrate through the wall but there's always the low end, which will travel anywhere, given enough elementary wallop. You can add a deadly bass rhythm to that chamber concert in the next exhibit if you really want to, and even throw it clean off its base (bass) by sheer power output. That is, if you think it will do you any good. Some Exhibitors evidently do.

The preparation

Then there's the Preparation, before the Show even begins. It affects everybody concerned, transmitting and receiving alike. Take the sonic material, for instance. Time was when the Exhibitor set up his equipment and then, at the last instant, when (sigh!) the stuff finally worked on all nineteen channels — he borrowed a couple of beat-up discs from a friend. (Somehow, they always used to forget to bring records.) Or else an Assistant was dispatched downstairs in a blinding rush to find the nearest record shop (a mile away) and BUY SOME SOUND—QUICK! I've seen it happen.

Now, the Exhibitor does one of three things, two of them wrong. (1) He waits for one of those obliging record makers to come around with free Hi-Fi discs. Puts them straight on the machine, quick-like, and hopes for the mostest. (2) Chooses the loudest, corniest recorded sound he himself can locate, in order to drown out the louder, cornier sound next door. (3) Taking the discriminating way—the hard way—he chooses the sound that will *enhance his own presentation,* and no other sound. If his neighbors rudely drown it out, then he winces and keeps right on going. In the end, he will win the respect of most of the passersby. His is an oasis of restfulness and taste, surrounded by barbaric thumps. *He* isn't making the thumps.

There's more to the Preparation than just the equipment and the sound. Of course, all Exhibitors know that acoustics count. (I wish more of the visitors knew it.) In fact, it eventually dawns on an old-time Showman that, in fact, *the exhibit's acoustic set-up has more effect on the nature of his sound than his equipment itself!* When the stunning implications of that fact get through, your Exhibitor vows that next year he's going to fix things right. And he usually does. Or else. First, you do your best with what you have, adding or subtracting sound proofing, moving speakers and furniture around, etc. But what is most important, in a practical way, is to channel your traffic.

Make 'em listen where they ought to listen! Funnel the kibitzers off to one side and out of the way. Put your chairs and couches (Oh, my aching legs) where people will fall into them with a sigh of relief, right smack in the best possible listening location. (If they want to look at the stuff, it's right there along the side walls.) An awful lot of Exhibitors are catching onto this, lately. A lot haven't, yet. They will.

Most of all, you (the Exhibitor) will keep in mind that just because your exhibit room is jammed full of people, you aren't necessarily making potential sales. A lot of people could be there just to see what's making that horrible noise. Curiosity. You are already on their mental list of Things to Avoid. And right across the hall, maybe, there are five or six people in that big room over there, drinking in the lovely, home-style music and vowing they will Go No Further—This Is It.

The omnipotent visitor

Well, so much for Exhibitors, who as I say, are also the most active snoopers-around whenever they get the chance, which is often. As for you genuine from-the-outside Visitors, it's obvious that you must use that fine intelligence and sense of common discrimination that the Lord has given you. Please, first of all, don't be negative, even if your ears ache. Don't quit, don't get bewildered. Just keep it cool, husband your energy and your ear-awareness and, above all, discount.

Discount the noise in the corridors. Corridors are a necessary form of bodily transportation channel, not for listening. Damp down your ears, then, in the corridors!

Do not fall for every loud thump you hear—but don't quite ignore it either. Inside the exhibit room there might be good sound. Some sound ought to be loud. Some equipment really can put it out, and should. Legit.

Don't ignore the quiet rooms, either. Some are just dull, or dead. Nothing happening. Others, I say again, are oases of sonic delight, where you may recoup your forces, learn something

(Continued on page 109)

WE DON'T GUARANTEE THAT THE DYNATUNER WILL OUTPERFORM ALL OTHERS . . .

KIT 99.95
ASSEMBLED 154.95

But we can be confident that you can spend far, far more for an FM Stereo tuner and not receive more stations than you can get with a Dynatuner. Its low distortion and superior quieting will give complete listening satisfaction in comparison with the most expensive competitive units.

Perhaps our specifications are somewhat confusing. How can our modest 4 μv IHF sensitivity compare with advertised claims which superficially appear to offer far greater sensitivity? Well, the answer is rather complex because effective sensitivity is not fully described by one measurement. It is the actual in-the-home performance which counts, though, and Mr. Baker's letter is just one of many examples of the Dynatuner's outstanding capability.

Because specifications measured under laboratory conditions do not relate directly to the reception problems encountered in the home, only an on-the-scene comparison can establish relative performance. Since this is not always possible, follow the lead of tens of thousands of satisfied users, and

TRY A DYNATUNER

More Dynatuners are in happy owners' homes than any other brand. It's just as easy to use as it looks. Tuning indication is precise, it automatically switches to stereo operation when you tune to a stereo broadcast, and drift is a thing of the past. Dynaco concentrates on performance.

. . . Shouldn't you?

Dynaco Inc. Humboldt, Iowa
3912 Powelton Avenue
Philadelphia, Pa.

Gentlemen:

In January of 1966 I purchased an FM-3 Dynatuner from Holland Standards, Inc., Cedar Rapids, Iowa, who assembled it from a kit. While I have used it mostly for fine music listening (my principal station is over 60 miles away and broadcasts in multiplex stereo with an ERP of only 16,000 watts), I do some FM DXing for fun. The tuner is fed by a JFD 10 element log periodic FM antenna with a rotor on a tower approximately 40 feet above ground level. I do not live in a good reception area, altitude wise, for there are low hills (about 100 feet) less than a mile away in all four directions.

As of this date I have received 93 FM stations (list attached) plus 3 TV stations on Channel 6 received at about 87.7 Mc dial calibration. My most distant reception was a fully-separated multiplex signal from WFSU-FM in Tallahassee, Florida - a distance of over 1000 miles - in August of 1966. All stations listed have been verified by station ID's.

I believe that this number of stations received is unusual, particularly when you consider that there are only two FM stations within a 50 mile radius of my home.

I am very pleased with the performance of my Dynatuner.

Yours very truly,

Robert H. Baker

A list of the stations Mr. Baker received is obtainable from Dynaco on request, along with two similar tabulations from other users: 125 stations received on a mono Dynatuner in northern New Jersey, and more than 60 stations received in Baltimore, Maryland on a simple indoor folded dipole antenna. All were logged on Dynatuners which were built and aligned from kits. Not all stations were received regularly, of course, nor all at the same time. Antenna position and design as well as atmospheric conditions affect reception, and it is not unlikely that another top-flight tuner might possibly match this performance. If you are spending more than $300, you might well expect such results, but under $100 it is unique.

Complete specifications and a comprehensive report on the Dynatuner is available on request, providing detailed test reports on several different samples for objective evaluation.

dynaco INC. 3912 Powelton Avenue Philadelphia, Pa. 19104

IN EUROPE WRITE: Dynaco A/S Christian X's Vej 42 Aarhus C, Denmark

EDITOR'S REVIEW

Hi-Fi Components—First With the Most!

Performance advances in home entertainment sound-reproducing equipment invariably start with component high-fidelity equipment. One of the reasons is a dollars and cents one. If it costs too much, it won't go into low-quality merchandise, the backbone of the mass-market home entertainment equipment manufacturing giants.

Consider field-effect transistors, as an example. Its initial use was for military purposes (great for surveillance communications equipment!), where high cost due to low yield is easily absorbed because exceptional performance, not price, comes first. The next sales target for transistor manufacturers was component hi-fi electronic manufacturers. Combined with production for military applications, device cost was reduced to a reasonable figure, though still too high to be utilized in radios where 98c makes the difference in a retail sale. So component hi-fi gear comes up a winner.

The irony of this is that some of these giant home-entertainment equipment manufacturers, with autonomous component parts groups, number hi-fi equipment manufacturers among their best customers, supplying them with the latest, sophisticated devices while their very own home entertainment product divisions won't even consider using them to improve fidelity.

So if you ever wondered why component high fidelity systems sound so much better than "packaged" products, one reason is: component hi-fi manufacturers have the world's best transistor design innovators, on the "opposing team," working for *them.*

Long-Life Batteries

With so many tape recorders and radios that operate on battery, it's nice to hear that a battery has been developed by Mallory Battery Company that, according to the manufacturer, exhibits a storage life of 20 years or more. Called the "reserve" battery, it is a 1½-Volt alkaline battery in the popular "D" size. The new cell is not activated until a terminal cap is turned, which releases a liquid electrolyte.

Initially, the battery will be used for emergency purposes, but will eventually be made in other sizes for use in portable equipment, says Mallory.

Tape Cassette Optimism

Norelco's Wybo Semmilink notes that industry expects better than 25 per cent of 5,500,000 tape equipment sales this year will be cassette machines. Donald Hall of Ampex Stereo Tapes observes that a recent survey by Ampex indicates that 2,100,000 cassette players may be sold in 1967. Whichever way you cut it, that's a big slice of the tape market; especially when you consider that cassette players were introduced only three years ago, well after the automobile industry opted for 8-track continuous-loop tape cartridges, which followed by many years the introduction of 4-track continuous-loop cartridge equipment.

Among the reasons given for the cassette concept's rising star is its ability to record as well as play back recorded material, adoption of the system by about 70 marketers of tape equipment, and the large present and potential library of recorded music (Ampex Stereo Tapes released 100 recorded cassettes on four labels in June, as an example, with more than 1600 titles from 48 different companies to choose from).

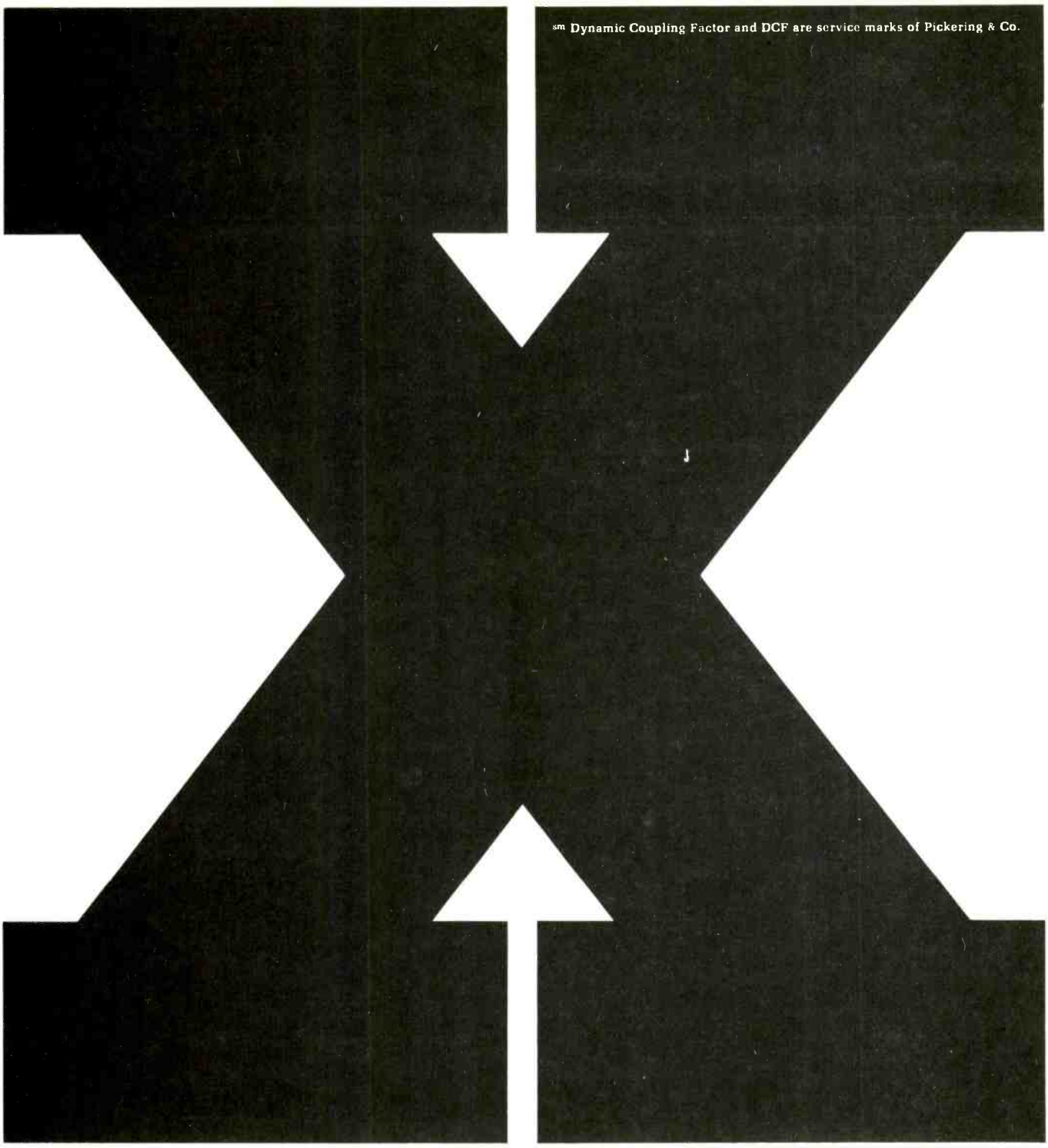
Cassettes will live and grow side by side with reel-to-reel tapes, Don Hall feels, observing that the reel-to-reel market always will be equated to high fidelity. ". . . True lovers of opera, for example, will always buy an opera on reel-to-reel tape."

Seems that we're destined to become two and three tape-recorder families, with joint ownership of reel-to-reel and cartridge or cassette tape equipment. And what's wrong with that?

Go Stereo, Young Man, Says Columbia

Rumor has it that record sales are being lost due to the mono-record price increase instituted recently by some record companies. Mono record buyers who would not plunk down the extra money were expected to buy stereo versions of their mono favorites. But many would rather fight than switch. To counter this, Columbia Records supplied record retailers around the country with brochures which point out that stereo records can be played on today's mono phonographs with excellent results (shades of E.M.I.). The benefits of stereo, however, were delineated quite strongly, with Columbia concluding: ". . . it is nevertheless clearly to the advantage of consumers who own monaural players to buy, give and build collections of current records in the stereo versions, anticipating their future ownership of a stereo phonograph." Step one in *Operation Mono Phase Out?*

A. P. S.



The X factor in the new Pickering XV-15.

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

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

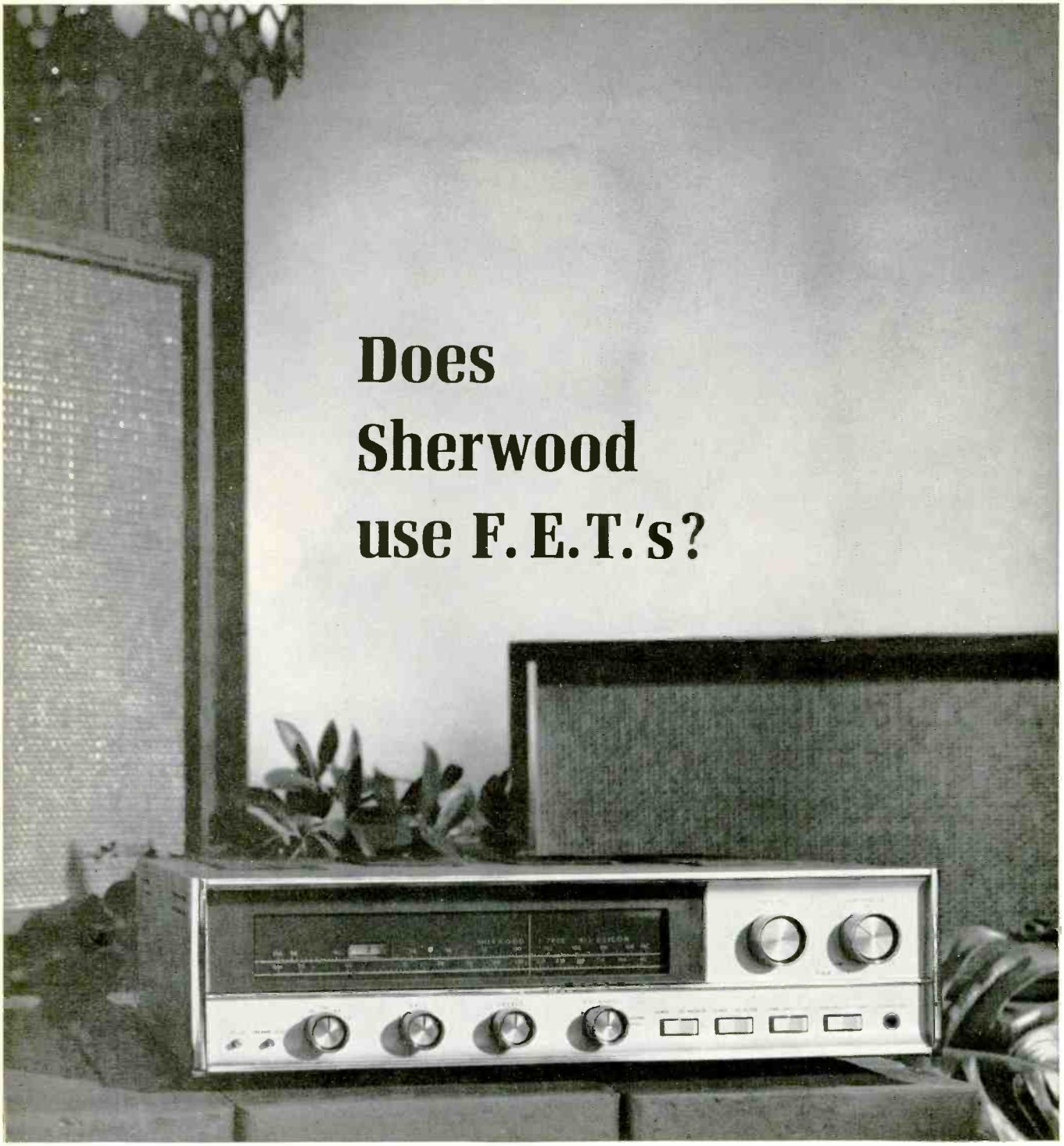
For an ordinary record changer, the DCF is 100. For a transcription quality tonearm the DCF is 400. Like other complex engineering problems, such as the egg, the end result can be presented quite simply. So can the superior performance of the XV-15 series. Its linear response assures 100% music power at all frequencies.

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

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

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

COMPARE THESE NEW SHERWOOD S-7800-FET FEATURES AND SPECS! *ALL-SILICON* RELIABILITY. INSTAMATIC OUTPUT OVERLOAD PROTECTION CIRCUITRY. NOISE-THRESHOLD-GATED AUTOMATIC FM STEREO/MONO SWITCHING. FM STEREO LIGHT. ZERO-CENTER TUNING METER. FRONT-PANEL FM INTERCHANNEL HUSH ADJUSTMENT. MONO/STEREO SWITCH AND STEREO HEADPHONE JACK. ROCKER-ACTION SWITCHES FOR TAPE MONITOR, NOISE FILTER, MAIN AND REMOTE SPEAKERS DISCONNECT. MUSIC POWER 140 WATTS (4 OHMS) @ 0.6% HARM DISTORTION. IM DISTORTION 0.1% @ 10 WATTS OR LESS. POWER BANDWIDTH 12-35,000 CPS. PHONO SENS. 1.8 MV. HUM AND NOISE (PHONO) —70 DB. FM SENS. (IHF) 1.8 μV FOR 30 DB QUIETING. FM SIGNAL-TO-NOISE 70 DB. FM CAPTURE RATIO 2.4 DB. FM CROSS-MODULATION REJECTION —95DB. DRIFT = .01%. AM SENS. 2.0 μV. AM BANDWIDTH 7.5 KC. 45 SILICON TRANSISTORS PLUS 16 SILICON DIODES AND RECTIFIERS. SIZE: 16½ X 14 IN. DP.



Does Sherwood use F.E.T.'s?

Did you think because Sherwood makes such beautiful receivers we would neglect Field-Effect-Transistor circuitry? The new Sherwood *ALL-SILICON* Model S-7800-FET FM/AM 140-Watt Receiver shown above has been specially designed for urban strong-signal locations.* This *ALL-SILICON* receiver offers unexcelled FM reception in areas where powerful local stations can interfere with the reception of distant and weaker stations. The Model S-7800-FET also features two separate front-panel rocker switches for multiple speaker installations throughout your home. Write for a complimentary copy of the new Multiple-Speaker Installation manual.

*Specially-selected Field-Effect Transistors in RF and Mixer stages of S-7800-FET improve cross-modulation rejection almost 10 times (20 db

S-7800-FET 140-watt FM-AM *ALL-SILICON* Receiver
$409.50 for custom mounting
$418.50 in walnut leatherette case
$437.50 in hand-rubbed walnut cabinet

Sherwood

Sherwood Electronic Laboratories, Inc., 4300 North California Avenue, Chicago, Illinois 60618. Write Dept. 10A

AUDIO'S GUIDE TO THE

1967 N.Y. High Fidelity Music Show

Here's a preview of the component hi-fi show that is the doorway to 1968 models. On these pages you will find: • Show Timetable • Exhibitors' Room Numbers • Preview of Hi-Fi Equipment • Calendar of Events

Statler Hilton Hotel (33rd St. and Seventh Ave.)

September 21 (Thursday) ..... 3:30 p.m. to 10:00 p.m.
September 22 (Friday) ..... 3:30 p.m. to 10:00 p.m.
September 23 (Saturday) ..... Noon to 10:00 p.m.
September 24 (Sunday) ..... Noon to 6:00 p.m.

Exhibitors	*Room Numbers*
Acoustech, Inc.	312A, 314A
Acoustic Research, Inc.	287, 289, 293
Altec Lansing	340, 344
Audio Dynamics Corp.	214A, 216A
Audio Magazine	229
Aztec Sound Corp.	271
Benjamin Elec. Sound Corp.	280, 284
Bogen Communications Div.	310A
The R. T. Bozak Mfg. Co.	210A, 212A
British Industries Corp.	231, 232, 236, 348
BSR (USA) Ltd. McDonald Div.	200, 201
David Clark Co., Inc.	306
C/M Laboratories	306
Compass Communications Corp.	219A
Concertone, Inc.	206
Crown Int'l	303A
Dynaco, Inc.	217A
Electronic Instruments Co., Inc.	328
Electro-Voice, Inc.	309A, 313A
Elpa Marketing Industries	240, 244
Empire Scientific Corp.	235, 239
Fisher Radio Corp.	343, 339, 345
Grado Laboratories, Inc.	203
Grundig, Triumph, Adler	202
Harman-Kardon, Inc.	331, 335
Hartley Products Corp.	245
Jensen Mfg. Div.	359, 360
Kenwood	243

Exhibitors	*Room Numbers*
KLH Res. & Development Corp.	203A, 206A, 209A
Koss/Rek-O-Kut	227, 228
James B. Lansing Sound, Inc.	264, 266
Marantz Company, Inc.	317A
Martel Elec. Sales	319A
Neshaminy Electronic Corp.	332
North American Philips Co.	350, 351, 354
Pickering & Company, Inc.	321, 322
Pioneer Elec. USA Corp.	274, 276
Rectilinear Research Corp.	275
Rockford Special Furniture	226
Sansui Electronics Corp.	258
H. H. Scott, Inc.	257, 259, 263
Seeburg Corp.	281
Sharpe Instruments, Inc.	230
Sherwood Elec. Labs.	336
Shure Brothers, Inc.	302A
Sony Corp. of America	320A
Stanton Magnetics, Inc.	213A
Stereo Station WDHA-FM	363, 386, 387, 389
Superex Electronics	323
Superscope, Inc.	364, 365, 366
Tandberg of America	391, 395
Tannoy (America) Ltd.	327
Teac Corp. of America	383
United Audio Products, Inc.	200A, 202A
University Sound	250, 253
Utah Electronics	248
UTC-Sound Div., TRW, Inc.	316A

The 1967 New York High Fidelity Music Show

A Statement by Walter O. Stanton, President, Institute of High Fidelity

IN THE 20 YEARS of its existence, the component high fidelity industry has never really plateaued technologically. One major advance has led to another and the outlook for the next two decades calls for more of the same.

While Edison's development of the cylinder recording device set the stage for the genesis of our industry, it really didn't get underway until the late 1940s. And since then the component industry's accomplishments in technical breakthroughs, marketing techniques and business growth would amaze even Edison. The equipment on display at the New York Component High Fidelity Show opening September 21 at the Statler Hilton Hotel represents an attempt to capture the chronology of our industry's advances, as well as to hint at what's to come in the future.

What does lie ahead? The outlook is as fascinating as a Jules Verne novel. Research and development activity in the component high fidelity industry has produced such outstanding developments as stereo, which provided two sound sources on a simple medium—tape or disc; and the adoption of solid-state technologies to eliminate bulky tubes and heat-producing components, thus making possible size reductions in our equipment, adding longer life and cost savings to consumers.

The components of twenty years hence most likely will be highlighted by development of micro-circuits—tiny, integrated transistors that can reduce tuners, amplifiers or multiplex units to the size of a pack of cigarettes and still maintain quality and distortion-free reproduction never dreamed of before. These little circuits will permit new freedom of design as well as flexibility in manufacturing.

In 1987, we may see speakers which roll up like window shades when not in use or even an entire living-room wall wired for sound.

If you build a house in 1987, you will be as likely to install a complete electronic home entertainment center as you would a built-in kitchen. Component high fidelity dealers even now are providing consulting services for those who prefer custom-built systems. Manufacturers are also leaning toward the custom-built look as they recognize the needs of the decorator. Most of the high fidelity equipment in the market today is available in rich woodgrain housings using hand-rubbed walnuts, mahogany and teak. The flexibility that components provide allow the decor-conscious homemaker to display high fidelity equipment attractively on open shelves, or to hide it in end tables, coffee tables, or even in the arm of an old easy chair.

As a service to decorators, designers and home makers, the Institute of High Fidelity currently is displaying several decoration ideas for the use of component high fidelity equipment in the home at the New York and Chicago National Design Centers. In these displays, several of the country's leading interior decorators have lent their touch to the creation of complete home entertainment centers in many completely different decor themes.

High fidelity enthusiasts will also be able to see the latest advance in equipment and design at the New York High Fidelity Show, where more than sixty manufacturers will demonstrate their latest equipment. The Institute of High Fidelity, whose primary aim is to promote public appreciation of high fidelity, will again sponsor a semi-technical seminar to answer questions from hi-fi buffs and novices. Experts will be on hand to discuss topics from how to install a stereo system to the care of the equipment.

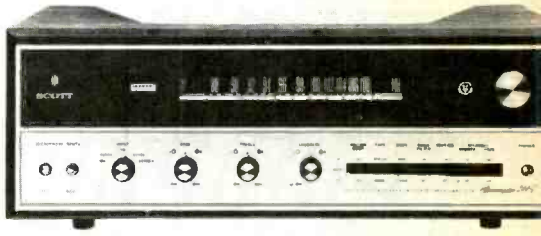
Another seminar, co-sponsored by the Association of Interior Decorators and the National Academy of Interior Design, will discuss the art of decorating with components. A third, sponsored by the National Academy of Recording Arts and Sciences, will cover the theories and basis of the three major musical idioms: classical, popular and jazz.

The Institute is concerned most with introducing into today's homes—and tomorrow's—the finest in component high fidelity, so that, whenever he wishes, the listener may fill his ever-increasing leisure hours with music at its best.

Sherwood S-7800 140-Watt IHF (at 4 Ohms) AM-FM stereo receiver with FETs and ICs.

Kenwood Supreme I three-channel stereo control amplifier.

Acoustic Research integrated stereo control amplifier; sixty Watts rms/channel (4 Ohms).



H. H. Scott Model 344C 90-Watt FM stereo receiver with FET front-end and ICs.

Marantz Model Eighteen 40-Watt rms/channel FM stereo receiver. FETs, ICs, and built-in scope.

KLH Model Twenty Seven 75-Watt IHF (at 8 Ohms) AM-FM stereo receiver.

THE '68s ARE COMING!

Here's a peek behind the curtain at the upcoming N. Y. Hi-Fi Show

ARTHUR P. SALSBERG

THE ANNUAL NEW YORK HIGH FIDELITY Music Show is an exciting event for all participants, exhibitors and consumers. Exhibitors introduce their newest models, hoping to capture the imagination of consumers. And hi-fi enthusiasts get an opportunity to sniff out the latest advances in stereo hi-fi gear, comparing model against model, brand name against brand name.

Pictured here are some of the "hot ones" being introduced at the Show —the new models that are the manufacturers' choices as leading contenders for the hearts (and pocketbooks) of quality-seeking hi-fiers and music lovers.

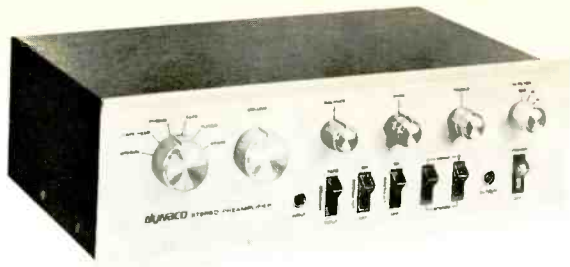
Receivers, tuners, et al

What's new among electronic componentry? Field-effect transistors (FETs), integrated circuits (ICs), AM tuners, pushbutton controls. You'll see more of these features and functions in new models than ever before.

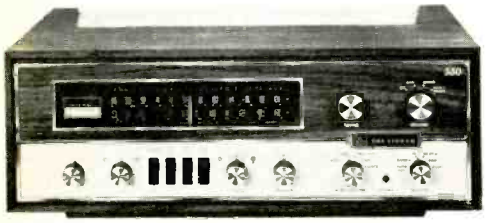
Acoustech, Altec Lansing, Benjamin, Bogen, Fisher, Harman-Kardon, Kenwood, Scott, and Sherwood are among exhibitors who will demonstrate receivers, tuners, and/or modular systems with front-end FET designs. As readers no doubt know, FET devices are capable of providing lower cross-modulation distortion.

Integrated circuits, those monolithic chips that incorporate complete circuits in tiny areas, are now available in models produced by at least three manufacturers at the

Sansui Model 400 60-Watt AM-FM stereo receiver.



Dynaco Model PAT-4 transistorized preamplifier. Kit and wired.



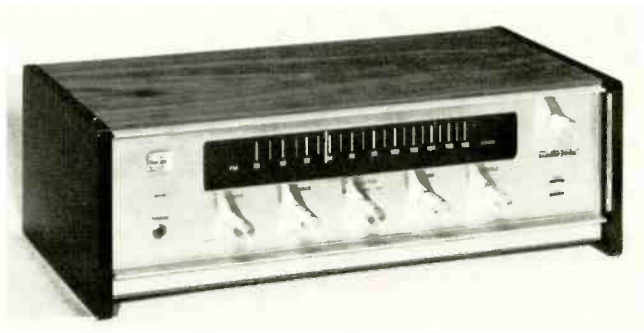
Fisher Model 550-T 90-Watt AM-FM stereo receiver with FETs and ICs.

Pioneer Model SX-300T 40-Watt AM-FM stereo receiver.

Acoustech VIII FM stereo tuner kit with FET r.f. front-end.

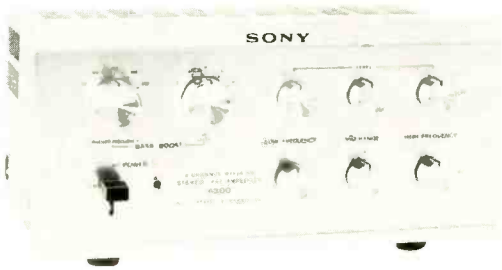
Harman-Kardon Model Five-Twenty 70-Watt FM stereo receiver with MOSFETs and ICs.

Bogen Model RX200 60-Watt AM-FM stereo receiver with FETs. (Available December.)



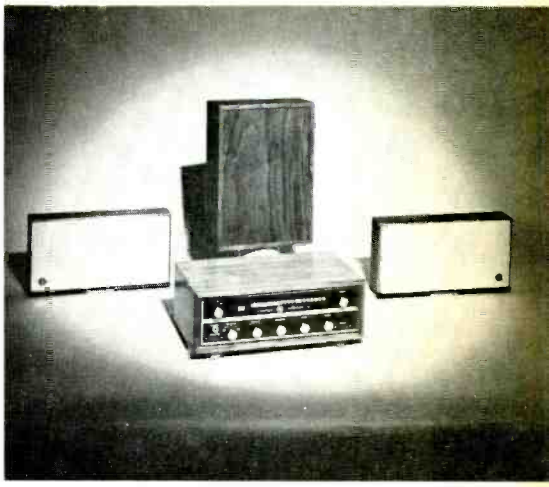
Electro-Voice Model Five • A acoustic-suspension bookshelf speaker system.

Altec Lansing Model 711B 50-Watt FM stereo receiver with FETs and ICs.



Sony Model 4300 3-channel electronic crossover network.

Scott Model 2223 "Berkeley" console.



Compass Triphonic Model 75 FM receiver system with common-base woofer.

Show—H. H. Scott, who was first to introduce them into hi-fi component equipment, Altec Lansing, Fisher Radio, Marantz, and Sherwood Electronic Labs.

The ICs offer four advantages over discrete components: smaller space requirements, lower cost potential, greater reliability, improved performance (better capture ratio is claimed through use of ICs).

Nearly every manufacturer producing receivers and tuners has some models that are AM-FM-FM stereo types, for users who wish to have both broadcast formats.

Pushbuttons, rocker-action and lever switches carry over the airplane control console concept to hi-fi equipment. Why squint at positions on rotary switches, when each function can have its own control?

Over the years, we have seen a number of companies cross into new product categories. Electronic component manufacturers now make speaker systems, record changer manufacturers or distributors now produce modular systems, etc. Two more companies follow suit in the electronic end of equipment: Acoustic Research and KLH. AR, Inc., known for their acoustic suspension speaker systems and manual turntable/tone arm, is unveiling its first integrated stereo preamp-control-power amplifier. The all-silicon, solid-state unit has a power output for each channel of 60-Watts rms into 4-Ohms, 50-Watts rms into 8-Ohms. (Measurements are with both channels driven.) IM distortion at full power is under 0.25%; harmonic distortion at full power, less than 0.5% from 20 Hz to 20 kHz. Among its interesting features are: a built-in null circuit for accurate channel balancing, and individual phono input level control for each channel with concentric friction-clutch shafts. Priced at $225 (optional oiled-walnut wood case, $15).

KLH, who started by producing speakers, followed by electronic component modulars, unveils its first stereo receiver, the only one the company has plans to produce. The Model Twenty-Seven, as it's called, is an FM-FM stereo-AM receiver with better than 75 Watts (IHF) power output into 8-Ohms. IHF sensitivity is 2.5 microvolts with full limiting at well under 10 microvolts. The receiver, with separate vernier tuning, expresses a design philosophy of the company that it is more precise and more trouble-free than is slide-rule tuning. Priced at $299.95.

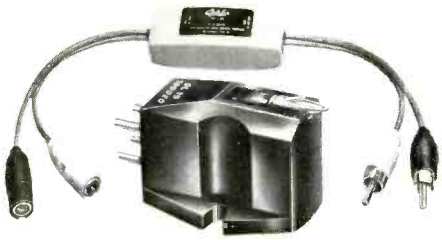
Marantz now has available its new Model Eighteen solid-state stereo receiver. Delivers 40-Watts rms per channel with less than 0.2% distortion across the entire audio spectrum. Features front-end FETs and ICs, and a built-in scope for tuning purposes. $595.

Among the unique products to be demonstrated for the first time at the Show will be Kenwood's new multi-channel stereo amplifier, Supreme 1. The 3-channel amplifier, with 165 Watts, gives a free selection of cross-

Scott Model 2502 FM stereo/AM/Phono compact with Model S-14 speakers.

Benjamin Model 1050 FM stereo/AM/Phono (Miracord) system with EMI speakers.

Thorens Model TD 150-AB manual turntable.



Ortofon Model SL15T moving-coil stereo cartridge.

Pickering Model XV-15 Series stereo cartridge.

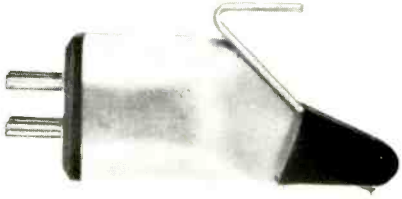
Garrard "Synchro-Lab 95" automatic transcription turntable.

Benjamin Miracord Model 50H automatic turntable.

Shure Model V-15 Type II stereo cartridge.

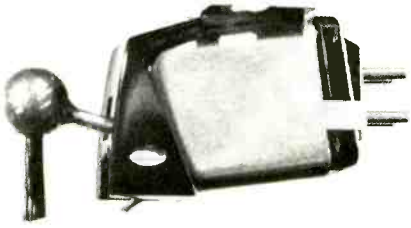
Dual Model 1015 automatic turntable.

Seeburg LP storage/automatic play system.



Empire Model 999VE stereo cartridge.

BSR McDonald Model 600 automatic turntable.

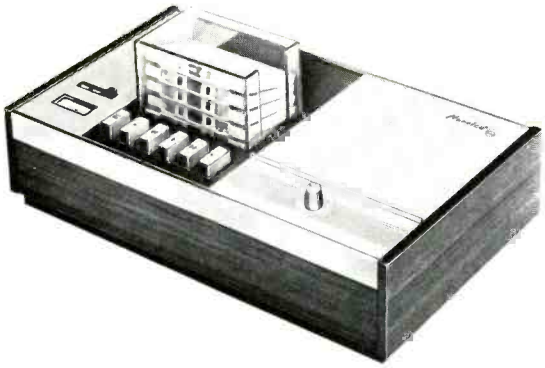


Stanton Model 681 Calibration Standard stereo cartridge.

Kenwood photoelectric stereo cartridge.

Sony/Superscope Model TC-560 D 4-track stereo tape deck.

Crown Model CX Pro-800 recorder with tape-protection memory system.



Norelco Model 2502 automatic stereo tape cassette changer.

Teac Model A-4020 stereo tape recorder.

over frequency and level of each channel. $695. Sansui is introducing a solid-state control amplifier with some interesting control features, including: a presence switch, high filter switch, two center-channel outputs (flat and 200-Hz high-cut output). The 70-Watt (IHF) amplifier is priced at $279.95. Pioneer's new SX-300T FM stereo-AM receiver, with 3 microvolts IHF sensitivity and 40 Watt IHF power output at 4 Ohms, retails for $199.95.

H. H. Scott's entire line of stereo hi-fi component equipment and systems has been redesigned and restyled. Three receivers, Models 260, 348 and 388, incorporate a useful feature: a switch which permits using remote speakers in the mono mode while listening to stereo in the main listening area.

Dynaco's new transistorized stereo preamplifier, Model PAT-4, will be featured at the Show. It's the solid-state counterpart of its PAS-3X vacuum-tubed preamp, though it's even more flexible. Among its control features are three steps of high-frequency filtering and a front-panel high-level input. Total harmonic distortion is less than 0.05%, 20 Hz to 20 kHz at rated output of 2 Volts. Intermodulation distortion is also under 0.05%. Available as a kit for $89.95; assembled, $129.95.

Acoustech will also show a new kit, its VIII-K FM stereo tuner kit, with add-a-kit flexibility. An AM tuner module and a stereo amplifier module ($39) may be added to the $249 kit. The tuner features an FET r.f. front end, 2 microvolts IHF usable sensitivity, and modular circuitry on its plug-in i.f. stages.

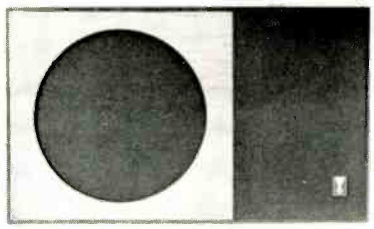
Electro-Voice will present its new value-line electronics, including a 30-Watt stereo FM receiver, 30-Watt stereo amplifier, and a stereo FM tuner. The compact receiver (5-in. high × 15¾-in wide × 8½-in. deep) has 15 Watts IHF music power per channel, 3 microvolts IHF sensitivity. $176.

Modular music systems will be very much in evidence at the show. Benjamin will show Models 1050 ($499.50) and 1030 ($399.50), both stereo FM-AM-Phono systems. The music systems can accommodate an optional Philips cassette-type record/playback module, which fits neatly under the phono cabinet in a convenient slide-drawer enclosure. The 1050 utilizes an FET front-end design. Both models include

Concertone Model 302-D stereo tape recorder.

Tandberg Series 13 2-track record/play cartridge recorder.

University Laredo bookshelf speaker system.



JBL Model 88 bookshelf speaker system.

Empire Model 2000K speaker system

Electro-Voice Model Five • A acoustic-suspension bookshelf speaker system.

Wharfedale Model W70D 4-way Hi and Low boy speaker system.

UTC Maximus 5 three-way speaker system.

EMI speaker systems. Compass Communications will introduce its new Compass Triphonic 75 FM receiver system with three amplifiers, two full-range speakers and a common-bass woofer. H. H. Scott will feature five new compact music systems, ranging in price from $299.95 to $469.95, with optional covers at $22.95. Many feature front-panel jacks for guitar or mike inputs. Among other manufacturers who are expected to show compact music systems are: Bogen, Harman-Kardon, KLH, Sony, and Fisher.

Turntables

Garrard (British Industries Corp.) will introduce a new 1968 line of automatic turntables at the Show. Synchronous motors is the name of the game. Called the "Synchro-Lab Motor," the new motor is designed with two sections: an induction rotor provides high starting torque, a permanent-magnet synchronous section locks into the unvarying 60-Hz frequency of the power line. There are four models in the line, headed by the SL95 Automatic Transcription Turntable, priced at $129.50. A "Power-Matic" base is also being introduced. This turns off the amplifier when the last record has been played.

The Thorens TD-150 4-speed transcription turntable will be seen at the show. It features two low-speed synchronous motors, a spring-loaded tone-arm board and platter, and an interchangeable tone-arm mounting board. $149.50. A new Perpetuum-Ebner automatic turntable, model 2020, will also be introduced at the Show. Among its unusual features is a vertical tracking angle adjustment.

Benjamin Electronic Sound will feature its Elac / Miracord 630 ($119.50) and 620 ($89.50) automatic turntables, both with induction motors, as well as its hysteresis-

(Continued on page 111)

This is a motor -a radically new type of synchronous motor, designed and built by Garrard—and announced today. Its benefits to the user are quite extraordinary because they give him the advantages of both synchronous and induction features: perfectly constant record speed locked into the electric frequency; instant starting power, high torque—and notable freedom from rumble. This is something unique in record playing history.

It is the Synchro-Lab Motor™—Garrard's most important innovation since the announcement of the first automatic turntable.

To learn more about it, please turn the page

The Synchro-Lab Motor shown on the previous page, exhaustively pre-tested and proven, has been incorporated into an unparalleled new series of Garrard Automatic Turntables.

You will be amazed to find that synchronous speed is now available to you in automatic turntables from as low as $59.50 to $129.50. This is a remarkable achievement by the Garrard Laboratories.

We invite you to read about this important new development in the new Garrard Comparator Guide

The Comparator may be removed without harming the magazine.
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The Skating-Force Phenomenon

What it is, how it's measured, and its influence on performance of modern, lightweight phono cartridges

JAMES H. KOGEN*

AS THE ART OF STEREO disc reproduction is refined, we must pay more and more attention to the details of equipment design and use. Years ago, when tracking forces were measured in ounces, there was little need to be concerned with fractions of a gram. Today, with tracking forces in the order of one gram, a fraction of a gram can become an important factor. The same comparison can be made for a number of factors which had little effect in bygone days, but which today loom as important considerations.

One such factor is skating force. This is a force, developed in single-pivot tone-arm systems, which draws the arm toward the center of the record. We will discuss later in the article how this force is developed.

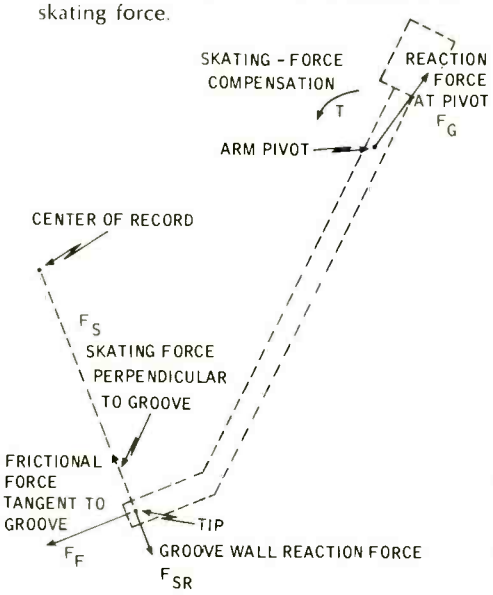
The tracking force of the tone arm is normally assumed to be divided equally between the inner and outer groove walls. This is true under static conditions when there is no relative motion between the record and tip. Under playing conditions, when the record is moving, the existence of uncompensated skating force effectively increases the tracking force on the inner groove wall and decreases the tracking force on the outer groove wall.

Specifications for all phonograph cartridges include a statement of minimum tracking force. This force is chosen as being the minimum needed to keep the stylus tip in contact with the record under maximum conditions of modulation velocity and frequency. This minimum tracking force must be maintained in order to insure proper trackin· (see "Trackability," AUDIO Magazine, November 1966).

As stated here, the existence of skating force will lower the effective tracking force on the outer groove wall. Thus, if the user were to set the tracking force at one gram and if the skating force were, say, 0.2 grams, the effective tracking force on the outer wall of the groove would be 20% less than without skating force. This would result in sub-standard trackability for the right (outer groove) channel. To realize the manufacturer's specification, therefore, one would have to supply some kind of compensation to overcome the skating force.

On the inner groove wall, the addition of skating force increases the effective tracking force. Thus, one would not expect tracking to be a problem. This additional force, however, over and above the intended tracking force, could increase record and tip wear. This, in fact, occurs, as will be shown later.

Fig. 1—Vector diagram shows frictional and skating force.



How skating force is produced

Fig. 1 shows diagrammatically how skating force is developed. Friction between the stylus tip and the record produces a force, F_f, tangent to the record groove at the stylus tip. The reaction force of the arm, Fg, must pass through the arm pivot. The two forces F_f and F_g combine as vectors, leaving an unbalanced force, F_s, which is by definition the skating force. The inner-groove wall opposes this force with a reaction force, F_{sr}, thus making the inner groove force greater than the outer groove force. If the force opposing F_s is provided by other means, the reaction force F_{sr} can be eliminated and the forces on the two groove walls equalized.

Skating force compensators are provided in several available tone arms. These compensators provide a torque by means of a weight or spring. This torque, T in Fig. 1, balances the torque from F_s. It therefore removes the need for the inner groove wall to oppose F_s. When such a system is perfectly balanced, F_{sr} is zero.

The geometrical arrangement of the arm and record will affect the magnitude of skating force. The force is, therefore, dependent on such factors as the distance from the stylus tip to the center of the record, the length of the tone-arm (between tone-arm pivot and stylus tip) and the distance between the tone-arm pivot and the center of the record. The latter two factors will be a constant for a given installation. The first factor, of course, will vary as the record is played.

*Shure Brothers, Inc., Evanston, Illinois

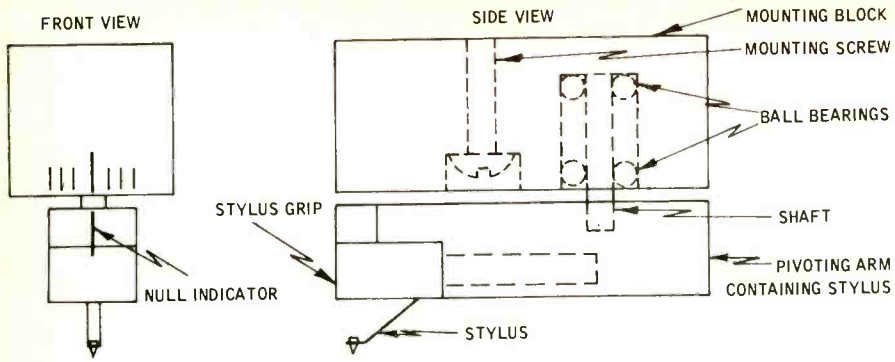


Fig. 2–Diagram of skating-force detector.

Since skating force results from the frictional force tangent to the record groove, it is important to learn more about the factors which affect this frictional force. One such factor is the coefficient of friction between the diamond tip and the vinyl record. This coefficient will be a function of the smoothness of both surfaces as well as the characteristics of the materials themselves (including additives in the vinyl). Surface contaminents on the record will also influence the value of the coefficient.

Another factor influencing this frictional force is the indentation of the tip in the record surface. The subject of record deformation or indentation has been studied intensively by Hunt[1], Barlow[2 3 4], and Walton[5], as well as others.

In our studies, the primary objective has not been to measure indentation, but to determine its effect. Since indentation is directly related to tracking force, tip size, and possible groove velocity, these variables were chosen as factors to measure in relation to frictional and skating force.

There is little data in the literature relating frictional force to modulation velocity. Alexandrovitch[6] has reported an increase in skating force with modulation velocity. Additional work on this variable seems to be in order, particularly to determine whether the change in force with modulation is a first- or second-order effect. Although one would not expect to counterbalance the high frequency variations of skating force under playing conditions, it might be possible to balance out at some average modulation level rather than at a zero level, if this seems to be warranted.

Measuring skating force

In measuring skating force, our approach is to simulate the actual dynamic conditions encountered when a record is being played. This means, essentially, that one should use the stylus of an actual phonograph cartridge. This can be accomplished by using a device as depicted in Fig. 2. A photograph of such a device used in Shure Laboratories is shown in Fig. 3. The device is a null-balance indicator which is mounted in the tone arm in the same fashion as a standard cartridge. When a counteracting force is applied to the arm in a horizontal direction, of sufficient magnitude to balance the skating force, the detector will move to the null position. This system has a reproducibility of about 0.007 grams at the needle tip when used with the Shure SME 3009 tone arm.

Fig. 4 shows the device mounted in a Shure SME arm from which the anti-skating bias adjustment has been removed. The indicator of the measuring device points off-center, indicating an unbalanced skating force. In Fig. 5 the anti-skating bias adjustment is installed and set to exactly counter-balance the skating force. In this case, the indicator points to the null position, showing that the skating force has been counterbalanced.

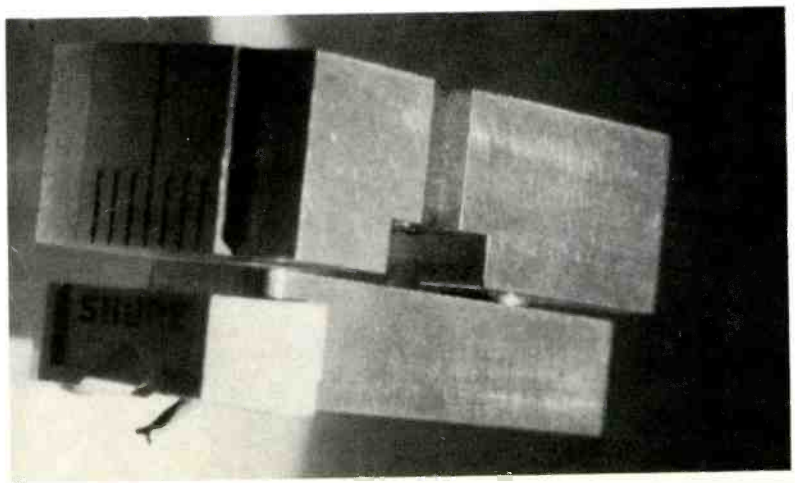
The measurement is made by determining the skating force compensation needed to achieve a balance. Skating force is then calculated from the summation of moments about the tone arm pivot.

Measurement Results

One of the complications in this study has been the large number of variables. We find, for example, that skating force varies somewhat as a function of record radius. This means than an entire set of measurements must be made at several radii. Skating force also varies with mod-

6 "A Stereo Groove Problem," G. Alexandrovitch, *Journal of the Audio Engineering Society*, Vol. 9, No. 1, January 1961, Pp. 166-168.

Fig. 3–Skating-force detector.



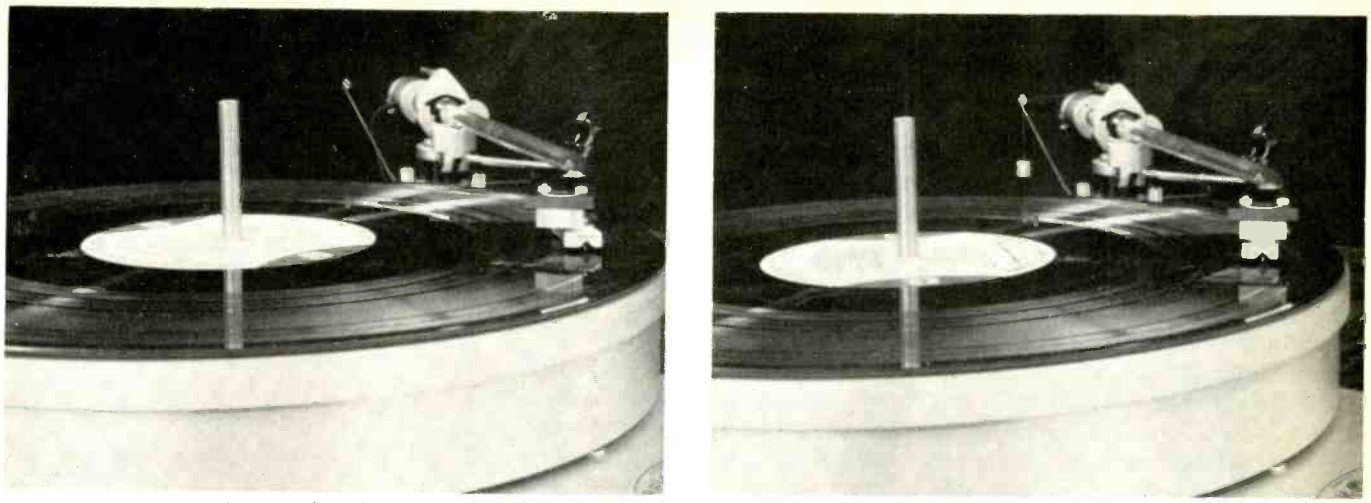
1 "On Stylus Wear & Surface Noise in Phonograph Playback Systems," F. V. Hunt, *Journal of the Audio Engineering Society*, Vol. 3, No. 1, January 1955, Pp. 2-18.

2 "Comments on the paper, 'On Stylus Wear & Surface Noise in Phonograph Playback Systems'," D. A. Barlow, *Journal of the Audio Engineering Society*, Vol. 4, No. 2, July 1956, Pp. 116-119.

3 "The Limiting Tracking Weight of Gramophone Pickups for Negligible Groove Damage," D. A. Barlow, *Journal of the Audio Engineering Society*, Vol. 6, No. 4, October 1958, Pp. 216-219.

4 "Groove Deformation in Gramophone Records," D. A. Barlow, *Wireless World*, Vol 70, No. 4, April 1964, Pp. 160.

5 Gramaphone Record Deformation," J. Walton, *Wireless World*, July 1961, Pp. 353-357.



Figs. 4 and 5—Skating-force detector in Shure SME tone arm illustrates how it operates without bias compensation or anti-skating force (left) and with satisfactory bias compensation (right).

ulation velocity. This means that a complete set of measurements must be made for a series of modulation velocities and that we must measure for the entire series of modulation velocities at each of several record radii.

A number of other variables such as tip radius, record material, groove velocity, and tracking force must be measured with all of the other variables in some kind of logical combination. And, finally, if this weren't enough, sufficient measurements must be made to get some kind of a significant statistical sample, which means that each measurement must be repeated with a quantity of tips and records.

From a practical standpoint, and to provide accurate compensation, it is important to know how skating force varies with tracking force. As a consequence, we have attempted to boil down all of the data into a logical combination related to the tracking force. The ensuing paragraphs will describe how several variables influence this relationship.

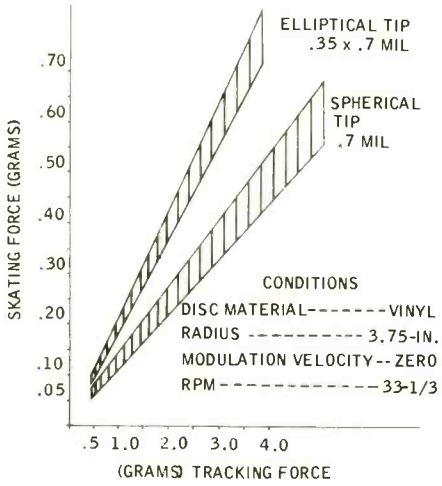
For a starting point, the skating force in a blank groove vinyl record at 3.75 inch radius and 33⅓ rpm is defined as the base skating force. Using this as a base, we can then compare the skating force which would be developed when modulation is added, when the tip is changed, when groove radius and groove velocity vary, and when the record material is changed.

Base Condition. Fig. 6 shows the relationship between skating force and tracking force for the base condition. These measurements were repeated on a large number of vinyl records with unmodulated grooves. Up to about 1½ grams of tracking force, repeatability was quite good. Above 1½ grams there was a significant spread in the measurements, as shown in the illustration. This spread in measurements was noted throughout our study. Factors which may contribute to this are:

1. *The reproductibility of the measuring apparatus.* This we feel is a relatively small contributor, being a constant value of about 0.007 grams of skating force as compared to a maximum variation in the data of about 0.1 gram.

2. *Variations among several pressings of the same record.* This was particularly noticeable in all of our measurements and will be discussed in more detail under "Groove Radius."

Fig. 6—Skating force vs. tracking force.



3. *Possible changes in the stylus tip/record frictional characteristic at higher tracking forces.* The spread in measurements has a definite tendency to increase at higher tracking forces. It is possible that at the higher forces the elastic limit of the vinyl is exceeded to a point where the forces produced by the tip begin to drastically deform and possibly tear up the surface of the groove. If this is the case, one would expect rather unstable conditions which would lead to a variation in measured frictional force.

4. *Surface contamination.* Our records were maintained in a clean condition through continuous and careful use of the *Manual Parastat* record cleaner. It is probable, however, that sufficient contamination remained on the record to cause a variation when making measurements on a series of records.

Elliptical Tip. Fig. 6 also shows relationship of skating force to tracking force for a 0.35 × 0.7 mil elliptical tip. Measurements on this tip also show a spread when performed on several pressings of the test record. The slope of the curve for the elliptical tip is about 0.2 grams of skating force per gram of tracking force. This compares to a somewhat lower slope for the 0.7 mil spherical tip of 0.15 to 0.18 grams of skating force per gram of tracking force.

Modulation Velocity. Figs. 7 and 8 show the effect of modulation velocity for spherical and elliptical tips. Modulation was 80%, 400 Hz; 20%, 4000 Hz. In reviewing these curves one should bear in mind that

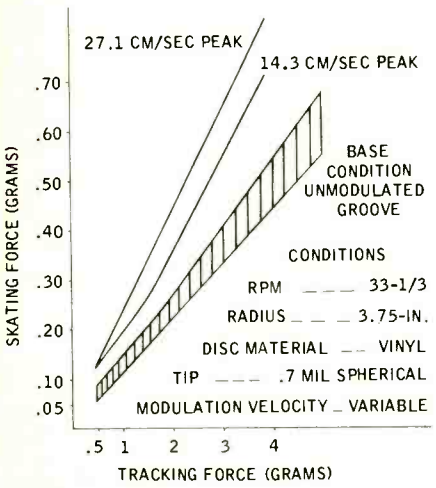
this covers a particular situation with regard to frequency. Therefore, generalizations should be made with great care.

Figs. 7 and 8 indicate the amount of increase one might expect for a rather extreme condition of modulation of 27.1 cm/sec. This would be about the maximum velocity one would find in a good-quality commercial record. This would indicate that for average modulation velocity in the order of 5 cm/sec, the percentage change in skating force is relatively small. Counter-balancing of the skating force in a blank groove should then provide a reasonable condition for calibration.

Record Material. As stated previously, wide variations in skating force were found among records tested. This variation was found on both vinyl pressings and acetate discs cut specially for these tests. Additionally, the frictional force measured on the acetate discs was found to vary as a function of record aging.

In comparing record materials, a number of factors enter into the picture which might alter the measurements. In addition to the material itself, its formulation, its age, and the variables associated with the manufacturing process, one can also conceive of variations caused by the manner in which the groove was cut. The cutting stylus shape, temperature at which the cut was made, velocity of cut, and inherent noise in the cutting system, might all contribute to variations in frictional force.

Fig. 7—Typical effect of skating force vs. tracking force, modulated groove, **spherical** stylus tip.



Considering all of these factors, we would hesitate to state any specific ratio of skating force for acetate versus vinyl records. In general, the skating force of discs we measured was roughly double on the acetate discs as compared to vinyl discs. *This point should be considered by recording engineers in setting skating-force compensation for tone arms which might be used in playing acetate discs.*

Groove Velocity. Measurements were made of skating force versus groove velocity using 0.7 mil and elliptical tips on blank-groove vinyl records. The test was performed using a turntable in which the speed could be varied from 25 to 100 rpm.

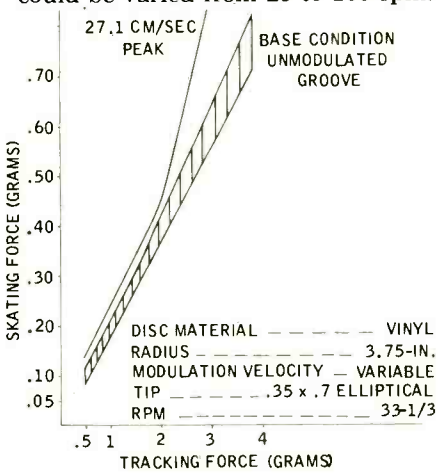


Fig. 8—Typical effect of skating force vs. tracking force, modulated groove, and **elliptical** stylus tip.

This speed change of 4 to 1 is higher than the change encountered as the stylus goes from the outside to the inside of the record (roughly 2.3 to 1.). Within the accuracy of the measuring apparatus, there was not a measurable change in skating force for tracking forces between 1 and 4 grams for either tip.

During this test every effort was made to maintain a stable condition, including the use of a turntable supplied with a vacuum attachment for keeping the record flat. Nevertheless, slight eccentricities in the record grooves caused some difficulty in taking readings at higher velocities. Our conclusion is that although more precise measurements may show some change in skating force with velocity, the change is small enough to be considered insignificant in practical skating force compensation.

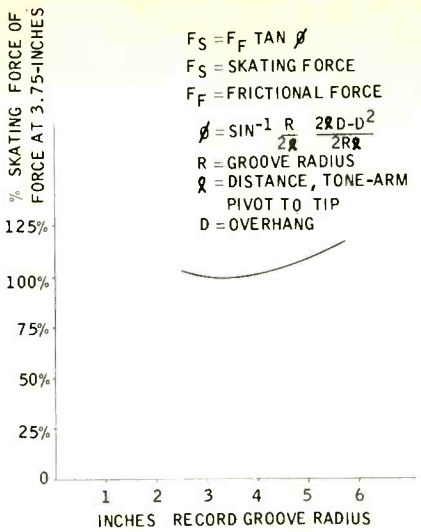


Fig. 9—Skating force vs. record-groove radius.

Groove Radius. As a result of the geometrical arrangement of a single-pivot tone arm system, skating force will change as a function of groove radius.[7] This variation is shown in Fig. 9. This figure is based on the mathematical expression shown in the illustration. It assumes a constant frictional force between tip and record. Measurements on blank grooves followed this curve within a range of ±5%.

A question arises as to whether the frictional force between tip and record is constant as a function of radius. We know that groove velocity varies with radius. As pointed out above, however, frictional force appears to be constant with velocity. Nevertheless, a number of our measurements indicated a change in frictional force with groove radius. A large number of tests were run in order to determine what might cause frictional force to vary with radius. Measurements were made on both acetate and vinyl records. Tests were made on special records cut with circular rather than spiral grooves in order to eliminate the effect of tone-arm movement. Tests were made on records with the spirals cut from the inside out as well as the outside in, records cut at 78 rpm as well as 33 rpm, and records where the frictional force was purposely altered by wetting the surface.

(CONCLUDED NEXT MONTH)

7 "Tracking Angle in Phonograph Pickups," B. B. Bauer, *Electronics*, March, 1945.

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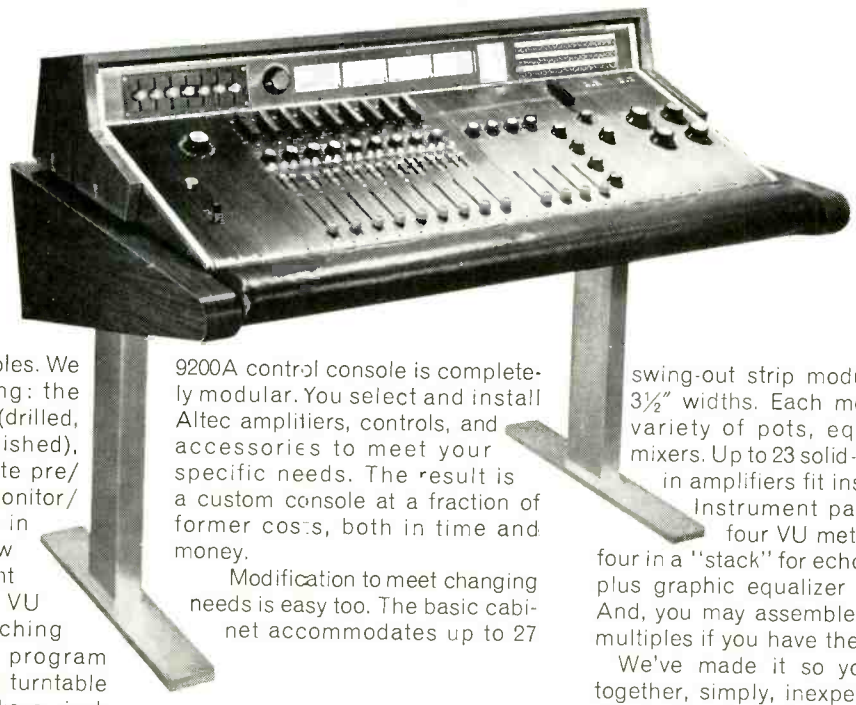

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FM tuner specifications and testing

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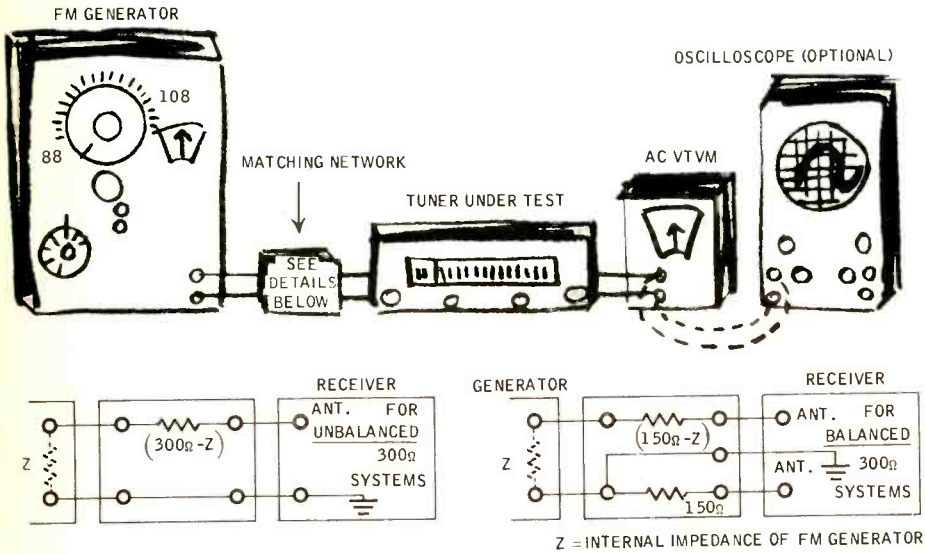

Fig. 1—Test set-up for measuring "quieting sensitivity." The matching network (or dummy antenna) will depend on the type of antenna terminals of the tuner being tested. Note that in both arrangements, the generator's microvolt reading should be divided in two since only ½ the total microvolt input reaches the receiver.

THIS MONTH, WE SHALL DEPART from our planned discussion of noise in FM in order to fill a great gap in the reading matter normally available to the audio enthusiast who needs to evaluate (and perhaps even measure) FM and FM Stereo performance in absolute terms. While this discussion may constitute "jumping the gun" a bit for the neophyte interested in more general subject matter, we hope that it (and possibly the next one or two articles in the series which will also be devoted to FM specifications and measurements) will be immediately useful to the more advanced reader, and certainly of interest to everyone interterested in FM.

It is just about nine years since the Institute of High Fidelity (IHF) issued standards for measuring and specifying the performance of FM and FM/AM tuners. Prior to that updating, nearly everyone involved in FM relied upon a 1947 Standard, issued by the IRE (now IEEE) entitled, *Methods of Test, Frequency Modulation Broadcast Receivers,"* and its subsequent supplements. At the present time, the IHF is again actively preparing a further updating of its test specifications. These newer standards, when issued, will be very welcome, particularly in the light of newer, solid-state circuitry (which was not available in consumer products in 1958) and FM Stereo (which did not become a factor in home FM receivers until late in 1961). For the present, therefore, we shall consider only those tests and specifications which appear in the 1958 IHF standard (#IHFM-T-100) and which relate strictly to monophonic FM performance. Later, we shall present our own, interim tests and specifications relating to FM Stereo which will prove useful until such time as the new IHF standards are ready.

The specifications set forth in the 1958 Standards are divided into two categories. They include the following:

Primary Specifications

1. IHF Sensitivity
2. Signal-to-noise ratio
3. Harmonic Distortion
4. Drift
5. Frequency Response

Secondary Specifications

6. Capture ratio
7. Selectivity
8. Spurious Responses
9. I.M. Distortion
10. Audio Hum
11. AM Suppression

Manufacturers who subscribe to the IHF standards of measurement are required to list all specifications in the Primary Category as minimum published specifications, and all the specifications of the Primary and Secondary Categories for "complete" specifications. If the foregoing 11 specifications fully define the performance of any FM (mono) tuner, an understanding of how these specifications are measured should be most helpful in your quest for a knowledge of what a good FM tuner is expected to do and how it is expected to do it. We shall start, therefore, by an analysis of each of the Primary Category Specifications.

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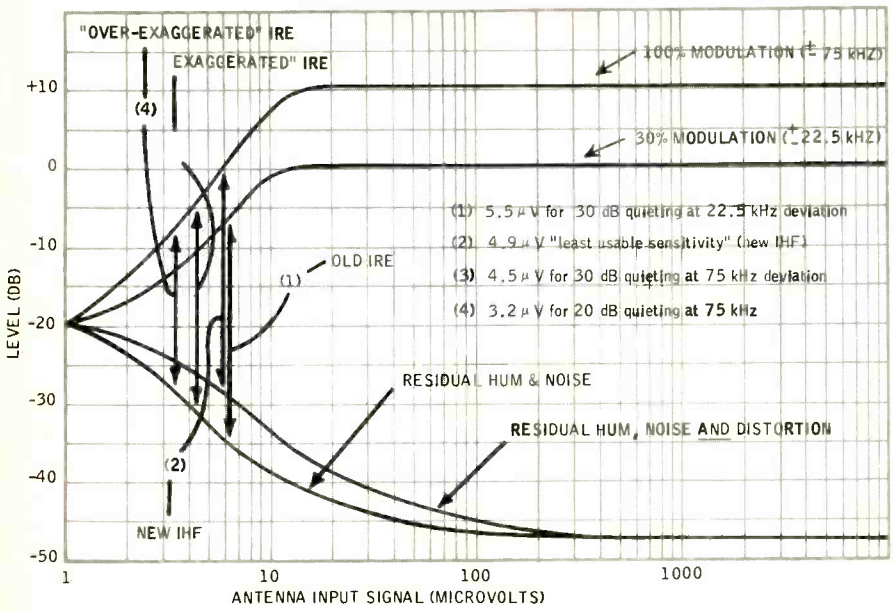


Fig. 2–Example of an FM tuner's signal-to-noise relationships.

IHF Sensitivity

Prior to 1958, this specification was often called "Quieting Sensitivity." The set-up for making this measurement is shown in Fig. 1. An FM signal generator is connected to the antenna input terminals of the tuner under test. The FM generator is modulated by a 400 Hz tone to the extent of 30% of maximum deviation (22.5 kHz). An a.c. VTVM is connected at the audio output terminals of the tuner.

The number of r.f. microvolts applied to the tuner's antenna terminals is varied until a difference of 30 dB is noted on the meter between the modulated and unmodulated conditions. In the unmodulated condition, the meter is reading residual noise, of course, and the sole purpose of the old IRE specification was to denote how many microvolts it would take to produce an audio output (at 22.5 kHz modulation) which was 30 dB greater than the residual noise. Ultimately, this was modified in promotion material to "soup up" specs. It was the "22.5 kHz" deviation part of the specification that was assaulted. The reasoning was that the noise reference should be taken as "so many dB lower than the *loudest* audio possible," which would mean below a 75 kHz modulation.

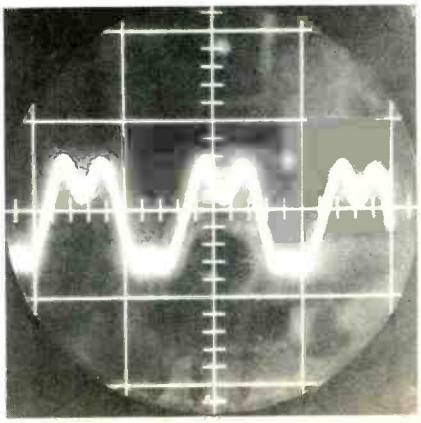
Referring to Fig. 2 you can easily see that this added 10 dB to the signal-to-noise figure — not by any improvement in circuitry, but simply because 75 kHz of modulation results in 10 dB more audio output than does 22.5 kHz. If the noise doesn't change (and it doesn't) this means a 40 dB signal-to-noise quieting ratio. But IRE specified that a 30 dB signal-to-noise ratio was to be standard, so, with this amount of modulation during testing, it was possible to reduce the number of microvolts applied to the antenna terminals. Thus, what looked like a "6.5 microvolt" sensitivity when measured according to correct IRE practice, suddenly comes up as a 4.5 microvolt tuner under the conditions of 100% modulation, conceived as described.

The charade went still further. *They* decided that a 20 dB signal-to-noise ratio was quite acceptable. If that measure of quieting is referred to 100% modulation (compounding the felony), we come up with a 3.2 microvolt tuner! Even worse, the resulting output might well be loaded with distortion and be quite unlistenable from that standpoint, but that factor did not figure into any of the earlier specification methods.

It is a general truth (though not a universal one) with most FM circuits that as the signal strength is decreased below a certain level, the bandwidth of the tuner tends to become narrower and narrower, until, finally, it is not able to linearly pass the full ±75 kHz which stations are authorized to employ for full modulation. The oscilloscope trace photo of Fig. 3 shows what happens to a sine wave when passed through the r.f, i.f. and detector circuits of an FM tuner which has an inadequate bandwidth at low signal levels. True, the signal may well be 30 or even 40 dB louder than the residual noise, in this case, but who would want to listen to such a distorted representation of a pure sine wave tone?

Happily, the IHF Standard of 1958 did away with both the variations in the method of reporting quieting sensitivity and ignoring the distortion factor. The IHF test set-up is similar to the one shown in Fig. 1, except that now a distortion analyzer meter is required instead of a simple a.c. VTVM. The modulating tone is again 400 Hz, but this time it is set to deliberately modulate the FM Generator 100% (75 kHz). Thus, the bandwidth capability of a tuner is tested at low signal strengths. This time, the modulation is left on all the time. But it is tuned out by null filters in the audio distortion analyzer. Consequently, any harmonics of 400 Hz *plus* noise are read. The number of microvolts applied to the antenna terminals are adjusted until the difference between full audio output and distortion-plus-noise (as read on the distortion analyzer) is 30 dB. The resulting microvolt figure necessary to accomplish this is often referred to as the "least usable sensitivity" of the tuner, a much more meaningful figure than its predecessor.

Fig. 3–Distortion in recovered signal is caused by insufficient bandwidth. Although signal-to-noise ratio is adequate here, the signal would be "unlistenable."



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Signal-to-noise ratio

Since 30 dB of signal-to-noise and distortion is considered to be the "least usable" sensitivity, it is important to be able to determine what the ultimate signal-to-noise and distortion capability of a given FM tuner is. That is, under conditions of strong input signal (1000 microvolts fed to the antenna terminals), what will the residual hum and noise component be. Note, that for this measurement, distortion is deemed to be insignificant. At 1000 microvolt input, any tuner incapable of passing a fully modulated (±75 kHz) signal is hardly worth categorizing as a piece of high-fidelity equipment in the first place.

Accordingly, the method first described in the old IRE specification (See Fig. 1) is used, and the rating is determined by comparing the VTVM reading with no modulation applied to the reading for 100% modulation. The higher the signal-to-noise ratio obtained, the better the receiver or tuner. Readings of 60, 70 or even 80 dB are not uncommon among the better tuners.

You will note in Fig. 2, based upon our "fictitious" (and not too good, by today's standards) tuner, that the maximum signal-to-noise obtainable is only about 58 dB (read the difference between the fully modulated output, +10 dB, and the residual noise at 1000 microvolts of input, −48dB). Then again, this imaginary tuner exhibits a "least usable" sensitivity of only 4.9 microvolts compared with actual quality tuners, both tube and solid-state, that approach an amazing 1.5 microvolts or so!

Harmonic distortion

While the meaning of harmonic distortion remains the same whether it relates to a tuner or to an audio amplifier, the underlying cause of such distortion in a tuner's output is altogether different from that associated with audio equipment. This may be appreciated by the following examples.

The 'scope photo of Fig. 4 shows the overall response of a tuner, from antenna input to demodulator output. Usually referred to as an "S" curve, this pattern is achieved by

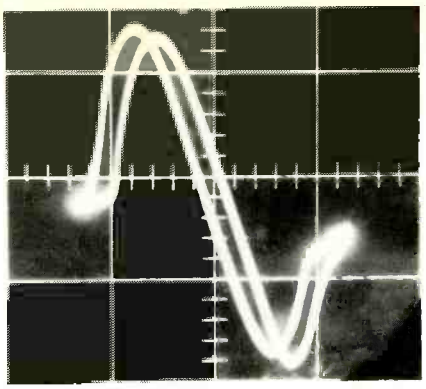


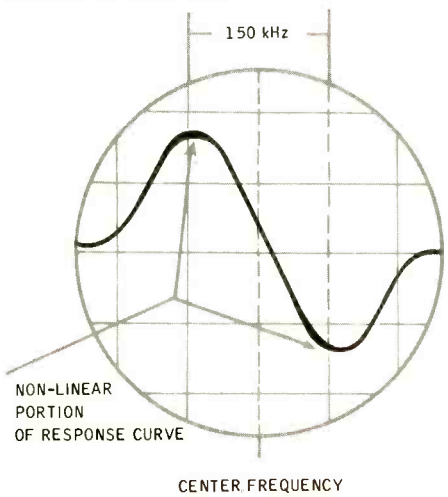
Fig. 4—A typical "S" curve seen at the discriminator or ratio detector output of a well-aligned, quality FM tuner. The linear portion of the response characteristic extends nearly ± 400 kHz about the center frequency.

modulating an FM generator several hundreds of kHz's. The output of the tuner connects to the vertical input of an oscilloscope, while the modulating voltage used to deviate the generator is simultaneously applied to the external horizontal input of the oscilloscope. Thus, as the r.f. frequency is made to sweep above and below the tuned frequency of the tuner under investigation, the scope traces out the instantaneous output voltage above and below the zero axis.

In the actual photo of Fig. 4, the modulation was nearly plus and minus 1 MHz. Therefore, the excursion from one crest of the "S" curve to the other can be estimated at about 800 kHz—a very wide-band response, indeed! You can further estimate the small, but extremely linear portion of the curve that would be necessary to respond to a mere 75 kHz of deviation. This tuner, having such extremely linear response about its center frequency, will have only a minute amount of harmonic distortion in the output.

If, as in the sketch of Fig. 5, the distance from crest to crest of the "S" curve were only about 150 kHz, then extremities of the normal ± 75 kHz encountered in normal broadcasting would involve highly nonlinear portions of the response curve, resulting in a high order of harmonic distortion percentages. The rated harmonic distortion of a tuner, according to IHF standards, is measured with a 1000 microvolt antenna input signal under conditions of 100% modulation, using a 400 Hz modulating tone. It is measured with the conventional audio harmonic distortion analyzer.

Fig. 5—If a tuner's bandpass was as narrow as the "S" curve shown below, a high degree of harmonic distortion would result whenever modulation approached 100% (75 kHz on either side of center).



Drift

There are three causes of frequency drift in an FM tuner. What was formerly the most serious cause — the heating up of frequency-sensitive components in the local oscillator circuit — has largely been eliminated since the introduction of solid-state tuners. Another cause of drift is often due to a change in power supply voltage.

The use of regulated power supplies in modern circuits employing zener diode regulating devices and the like has largely reduced this form of drift as well. Finally, if the receiver is equipped with automatic gain control, the control circuit may, indirectly, cause a frequency shift with changes of signal strength. The three forms of drift must therefore be measured separately, to avoid confusion.

"Warm-up" drift, to the degree that it still exists, is measured for a two hour period, from a "cold" start. The first reading is taken after one minute of operation. The variation in frequency for this test is seen with a beat signal obtained between the FM signal generator and another oscillator of constant frequency. The frequency of the primary signal generator is first adjusted so that the

(Continued on page 114)

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CLASSICAL RECORD REVIEW

EDWARD TATNALL CANBY

POP, MEET CLASSIC

WHAT IS "CLASSICAL" MUSIC? These days it is often very hard to say. The same goes for "popular." The lines are crossing everywhere. And if there is confusion for the record dealers and the catalogue makers, the benefit in the long run is immeasurably great for all of us who listen to any kind of music.

I suspect that 75 years from now the musicologists will begin to tell us that the greatest influence in the entire world of our mid-century music has been the Beatles. Quite seriously. For they are taking an enormous popular audience with with them, step by step, into musical areas never before imagined in "pops." No matter that their arrangements aren't yet quite up to Bartok or Stravinsky, nor that their imitators are usually even further behind. The point is that things are moving now, fluid, on the go, anything can happen. That's what is so interesting.

And "classical" music, smoked out of its high-brow restrictiveness by all the new excitement, is moving too, and nowhere more vitally than on records and tape. Concerts may be better, but they can't keep abreast in this day of mass, multi media. For better or worse, the recorded medium counts strongly.

Take two recent LP records as rather neat aspects of two utterly different aspects of this ferment, this crossing-of-the-lines. One is classical music in disguise. The other is classical music of the West reaching out towards the Far East (and, incidentally, meeting the Beatles' best friend out there).

The first is called simply, *I Like Debussy*. (Capitol SP 8658, stereo $4.79). It's mood music, "piano pictures" played by Samson François. And yet this very popular-looking disc is one of the finest classical recitals of Debussy piano music I ever hope to hear, short of the great Gieseking (long since dead and gone). It is also a most impressive piano recording. Fantastic sound, fantastic performance, top-rank content. I'd nominate it for best classical record of the year, except that it's supposed to be mood music. Crazy.

Capitol has an odd way of dolling up perfectly worthy classical discs in this background-music sort of décor, as if wishful thinking could change "good" music into "popular." That title! And that bleached blonde with the hair, looking startled on the cover. And the program notes on the backside! They begin, "How do I like him? ? Let me count the ways, baby." And they go on to describe Debussy as, "he's one of those lean, Kennedy hair-cut types that dug the action—nineteenth century style . . ." They call the composer, Claude, pops-fashion, and go in for such un-

classical observations as "Oh joy! Oh rapture!" Phew. You'd never guess.

Samson François is a tremendous powerhouse of a French pianist whose long (pre-Beatle) hair kept getting in his eyes at his sensational debut tour here a good many years ago. Now he has matured into a formidable artist, with immense strength and flashing dramatic appeal. And behind all the big noise, a great deal of subtlety in phrasing and tone color—and no Debussy is listenable without subtlety. His carefully-controlled and colored soft passages are perhaps even more dramatic than the loud ones. To be sure, Debussy under the François hands sounds occasionally like big Rachmaninoff; it is anything but traditional. But it flows, it goes, it is full of passion and color and impeccable detail work. Not a thing is missed. François is a born "natural" for Debussy, rare indeed these days.

As for that piano, it is perfectly enormous with a huge bass, an utterly natural concert stage presence and, in the loud passages, clean and crisp to an astonishing degree. Congrats to the French engineers who did the job in France. They're good.

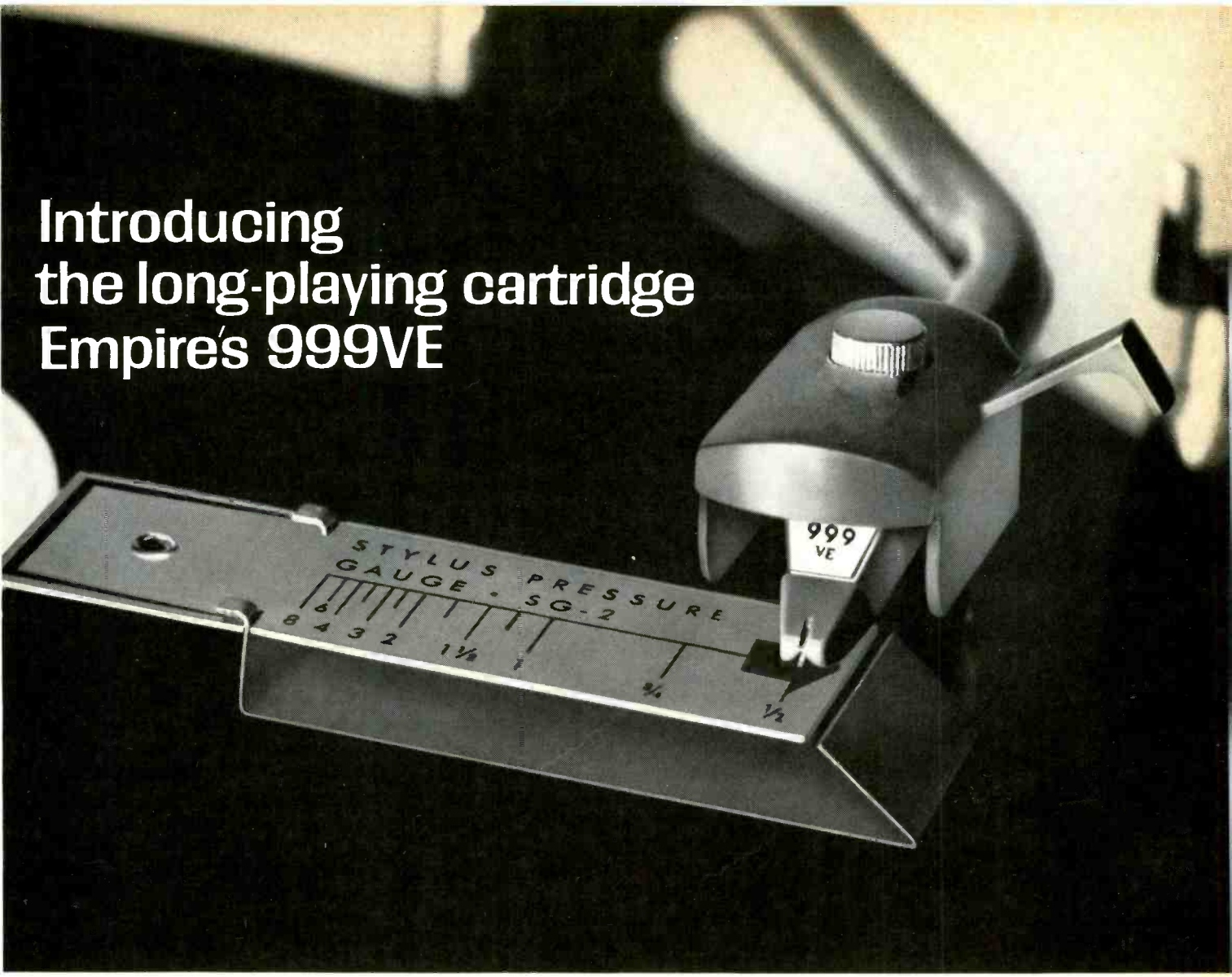
Performance: A *Sound:* A

The other record *(West Meets East*, Angel 36418, stereo $5.79) is indubitably classical, on E.M.I.'s fanciest label—but, just oppositely, it features the Eastern musician with the greatest current "pops" following of all right now, the man who is George (Harrison) Beatle's teacher. Also an old Eastern pro on the virtuoso violin, Yehudi Menuhin.

A most amazing record, this. Yes, Yehudi Menuhin and his violin, his pianist sister, Hephzibah, and three Indian musicians, the famed Ravi Shankar with his sitar, plus cohorts Alla Rakha (tabla) and Prodyot Sen (tanpura). They play together, too, all but Hephzibah, who joins her brother on side 2 in the Enesco Sonata No. 3 ("In the Popular Rumanian Style").

The entire first side is given over to genuine Indian music, and in two of the three pieces, both by Shankar, the Menuhin violin is included along with the Indian instruments. ". . . And never the twain shall meet," huh? Old Rudyard Kipling was wrong, so dreadfully wrong! Now, East is West and West is East.

Most of us are very much aware of the new East-West interpenetration in many forms of art, thought and religion. In music, the cross-breeding is better known in Western



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popular, rock, and hip youth circles, where many a combo (sparked by the Beatles' George) has taken on the sitar along with the electric guitar. There's even an electric sitar now, or so I hear. But the feeling that genuine Eastern music is important for us now, as it never has been before, is affecting all sorts of large-minded Western musicians. Ours, we at last admit, is not the only music.

As an enthusiastic musical thinker (if somewhat of a Romantic), Menuhin has long been fascinated by Indian music. He has already sponsored a previous Angel record of complete Ragas, with his own spoken commentary. Now, one step further, he actually plays. Shankar has integrated him into the rigidly stylized semi-improvisation of the Eastern-type art.

It works. You'll be amazed. (A photo even shows Menuhin sitting cross-legged on his haunches with the proper costume on.) West, to be sure, still sounds West. It's the familiar Menuhin violin, still played in characteristic Western Romantic fashion, legitimately out of Menuhin's earlier basic training. But the notes, the rhythm—even the Menuhin improvisation—fit into the strict Indian scheme. These are true Eastern pieces, literally, not by mere suggestion.

The colorful Enesco sonata on Side 2 might seem to be merely a filler; it isn't. This unusual work, Western in harmonic and thematic structure as well as in movements and tempi, reflects minutely the elaborate and very oriental music of the Rumanian gypsy. After the Shankar, its impact is quite startling. Astonishing similarities. My respect for Enesco (who wrote plenty of potboilers) has gone up sharply. Not surprising that this Sonata is seldom heard; it's a tough proposition and the playing here is superbly right for it.

Performance: A *Sound:* B+

Opera, As You Like It

Monteverdi: l'Incoronazione di Poppea. Carole Bogard, Charles Bressler, Louise Baker, Herbert Beattie, John Thomas **et al.,** instr. ensemble, Alan Curtis, dr. **Cambridge CRS B1901 (4) stereo** ($17.37)

This is a magnificent musical achievement, the first really functional, listenable recording of one of the greatest of early operas, long put aside and, later, heard in distorted versions that gave little sense of the original.

It isn't easy to absorb—all eight sides—unless you are ready to spend time with the complete libretto and the informative background articles that come with it. But if you have a taste for Monteverdi, or for earlier opera—jump fast. You'll never do better. This American performance, for once,

(Continued on page 70)

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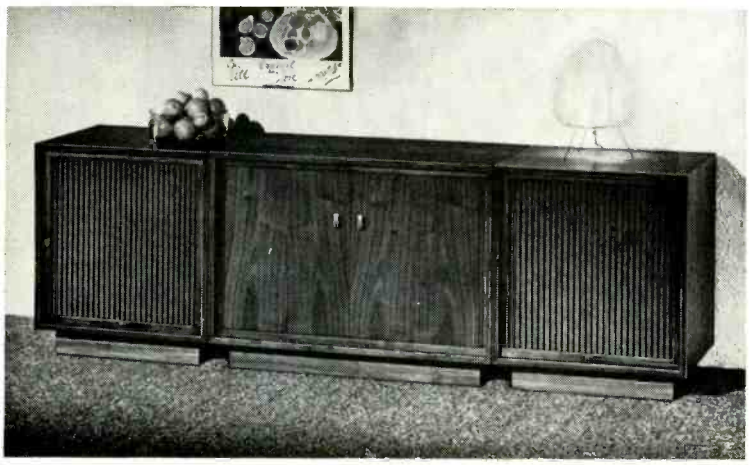

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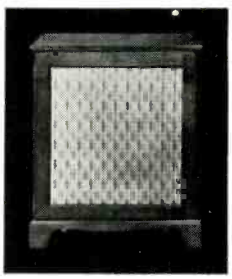

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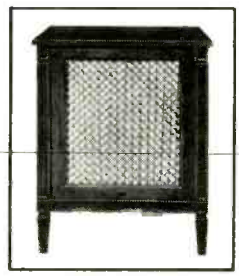

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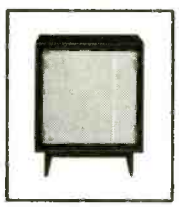

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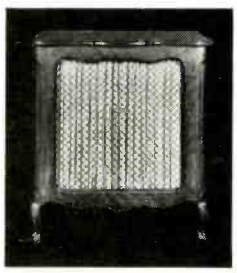

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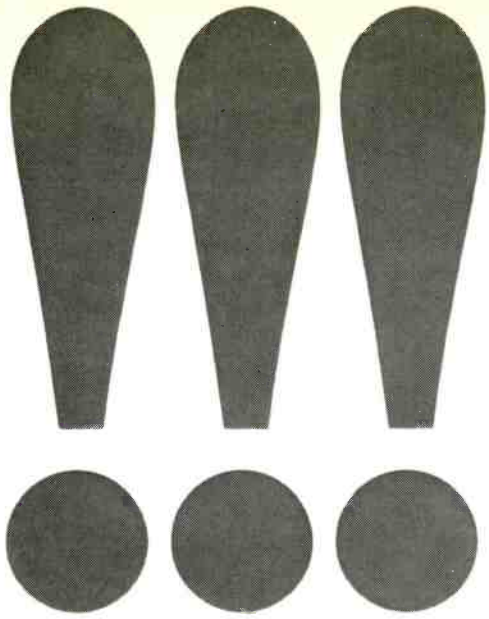

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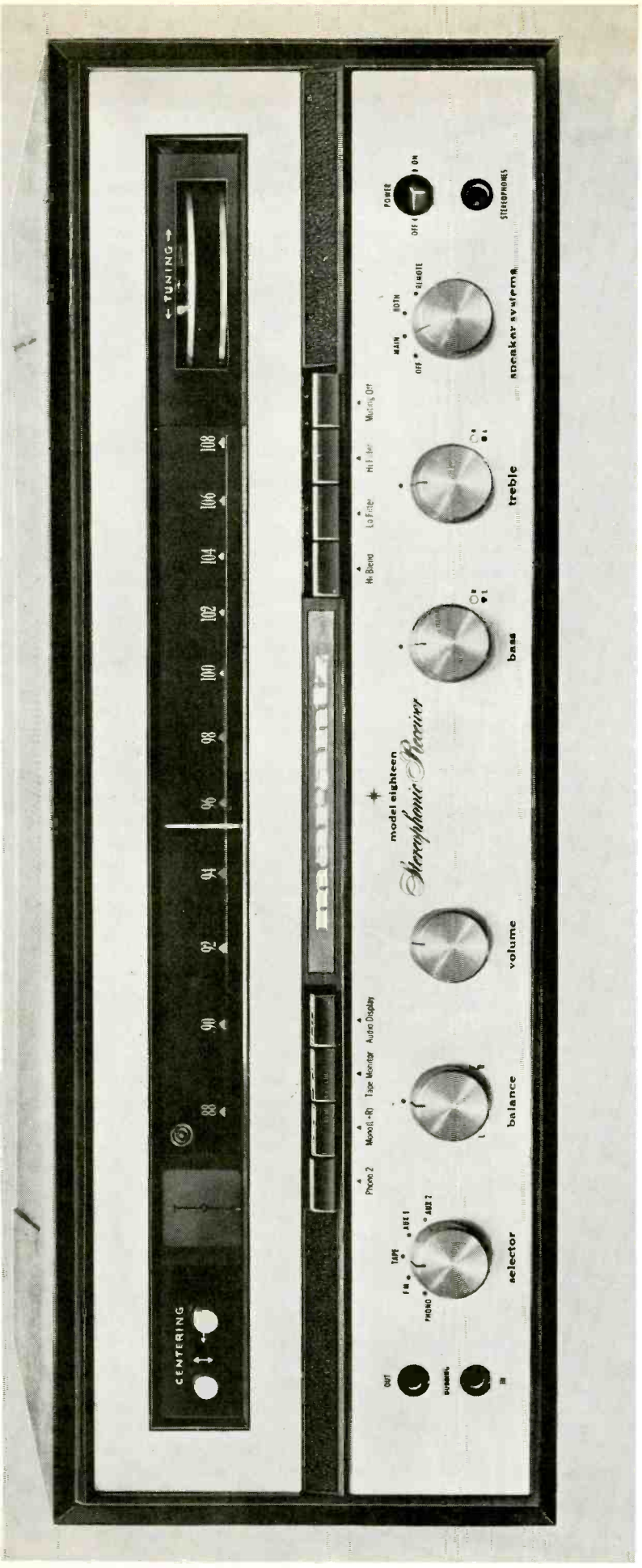

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Multiplex Separation, 20 Hz — 43 DB, 1000 Hz — 45 DB, 10k Hz — 35 DB, 15k Hz — 30 DB.

AMPLIFIER SECTION

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(Continued from page 66)

matches anything that has ever come out of Europe of the sort.

The opera is tough because, even as very late Monteverdi (1642), it belongs in the early phase of opera technique, without the set arias and recitative of later music. It is almost entirely done in the "speaking" sort of musical delivery that later became formalized into recitative; segments are short with frequent stops. In the manner of the period, there are no formal arias as such, though many beautifully tuneful passages will linger in the memory. There is no orchestra, either; the accompaniment is largely *continuo,* via various instruments, plus a few strings, recorder, trumpets, for the many brief instrumental *ritornelli* (repeated segments that return) and interludes.

The opera is thus all voice—and this performance shines because the singers, a big cast and all of them highly musical and utterly dedicated, have at last (under expert direction) given up that misguided and dirge-like "antique" sound, dismally slow, which has so long been affected for Monteverdi. Here, things really move at a normal, active, lively speed whenever there is a reason for it; action is fast, dialogue is quick and dramatic. And the musical power of the opera is astonishingly liberated! About time. Most of us always knew Monteverdi had it in him.

There were enormous problems: no specific instrumentation nor even agreement on the musical text; and there were *castrato* soprano parts for male characters. This highly scholarly reconstruction, involving thousands of corrections, decisions, deductions, seems to be miraculously good. The recording is certainly a great milestone.

E. T. C.

Performance: A *Sound:* B+

Richard Tucker: World's Favorite Tenor Arias
Columbia MS 6957 stereo

Fans of Richard Tucker's, and they are legion, will rush right out to buy this record. And they will not be disappointed. The years have dealt relatively lightly with the Tucker tenor, though dispassionate critics will note a gradual darkening and hardening that has taken place. The old ringing high notes are still there, but there is just a bit of gravel creeping in.

No matter, Tucker is still one of the most reliable voices to trod an opera stake. He has selected fourteen show-stopping arias from the most popular operas. He ranges impressively well from the lilting *Questa O Quella* to the deeply tragic *E Lucevan Le Stelle.*

Columbia has surrounded Tucker with their usual sumptuous recording, albeit with a bit too much reverberation. The unmentioned (or unmentionable) orchestra and conductor in support of the star deserve equal praise for a well-done job. Make no mistake, though, this is Tucker's album through and through. M.R.

Performance: A to B *Sound:* A—

Brahms Across the Board

Brahms: Violin Sonatas 2 & 3. Joseph, Suk, violin/Jan Panenka, piano.
Crossroads 22160088 stereo

These two sonatas by Johannes Brahms are superbly played by the featured violinist, Joseph Suk. Musically, this recording is a thoroughly delightful performance and an outstanding value on this budget Crossroads release. The only notable flaws are in the production. It is hard to say who is responsible since this is one of the many Supraphon productions out of Czechoslovakia now being released here by Epic Records under this economy label. The accent seems to be on the music, which is certainly noteworthy, but nowhere is there any information on the performer, even though they are both outstandingly good. Though both sonatas, the No. 2 in A Major (Op. 100) and the No. 3 in D minor (Op. 108), are even more challenging to the pianist, the stress in both the album billing and the recording balance is on the violin. The piano is both recorded and played as an accompanying instrument, that is to say that the violin is excellently recorded but decidedly forward of the piano and obviously closer to the microphone. The piano is somewhat subdued and sounds as though it was not only off microphone but also as though the top were down. In other words, in the typical fashion of a solo recital featuring Mr. Suk, with Jan Panenka supplying a really fine complementary job at the keyboard. The playing, accepting this premise, leaves nothing to be desired in realizing the values to be found in both scores.

The ensemble and the musicianship are first rate. The lyric beauty and warmth of the A Major Sonata are something that both parts share equally in abundance. Joseph Suk loses no opportunities to sing on his instrument and the wonderful aspect of it is that

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he plays with the accent on the score, so that the spotlight is on Brahms. Every step of the way, the pianist, Panenka, is right there doing everything in a perfectly controlled fashion, which is saying a lot considering the complexities Brahms wrote into the part.

The composer found himself the head of faction, which not only championed Brahms' music, but violently opposed the Wagnerite school. Brahms, himself, admired Wagner's "Meistersinger" and reflects his partiality by suggesting the "Prize Song" in the opening theme of the Second Sonata. This sonata glows with melody and general good spirits. This is the Brahms of the Second Symphony. Thoroughly enjoyable music!

The Third Sonata is a more dramatic and challenging work for both instruments and again these performers conform ideally to the demands of the score. The playing is tighter and more crisp but no less deeply probing.

With this kind of musicianship, it is tempting to be able to learn more of the performers. The name, Joseph Suk, does ring a bell since there was a Czech composer-violinist with the same name, who achieved great fame and success before his death in 1935 and whose compositions still are performed by violinists.

The present Suk, related or no, can only add lustre to the name with continued performances like this one.

O.E.K.

Performance: A *Sound:* B

Brahms: The Four Symphonies. Cleveland Orch., Szell.
Columbia DL 358 (3) stereo, $17.37

The conductor who plays Brahms today really has problems. It always happens when music which has been "standard" begins to go out of style, thanks to the advance of Father Time and the inevitably changing tastes which move along with him. The basic question is—shall we try to "modernize" Brahms for a new and much more nerve-wracking age or shall we do our best to restore the quality of the original as of its own time, out-of-style or no? Eventually, the two approaches merge. But for Brahms, not yet. He hasn't been dead long enough. Merely 70 years this last April 3.

Szell, for all his mid-European origin, is of the modernizing school. Maybe it's because he conducts an American orchestra in mid-continent, far from the lingering traditions of Europe itself. Maybe it's just temperment. Whatever the reasons, these Brahms symphonies are taut, fast, intense and driven. They very much lack the broad spaciousness of, say, Angel's marvelous set under the last of the old-time conductors, Klemperer, recording with English musicians.

On the other hand, the Szell option is a reasonable one and many listeners will find his up-tight Brahms just what they are looking for. It is obviously worked out with care, though perhaps without enough leisurely rehearsal to make for the perfection of ensemble which comes out in the Angel version. Rehearsals cost more in the U.S. So do recording sessions.

Odd what strange things the mikes can do today! In numerous passages of the Szell recordings you will hear someone distinctly *breathing*, long breaths about two feet in front of you. Just before a big, loud chord, usually. Must be The Maestro himself. Real hi-fi breaths, too. Good test for flat system-response. E.T.C.

Performance: B *Sound:* B

Brahms: Liebeslieder Waltzes (Complete, Opp 52 & 65). Vronsky & Babin, duo-pianists. Elsie Morison, soprano; Marjorie Thomas, contralto; Richard Lewis, tenor; Donald Bell, baritone.
Seraphim, 60033 stereo

This is a re-release of an earlier Angel recording that was beautifully performed and excellently recorded. Brahms wrote these waltzes, frankly, to please the Viennese public which was then very waltz conscious. In a sense, these are his little tribute to the city of Vienna (in the form of settings for poems by Friedrich Daumer, which were devoted to all aspects of romance).

Brahms gained most of his early experience writing for piano and voice, and the Liebeslieder Waltzes allowed him to roam an area where he was completely at home. The vocal writing is unusually fine and happily the voices here are all clear and distinct. Diction is superb and the texts, thoughtfully supplied, are easy to follow. Vronsky and Babin collaborate at the pianos to wrap the waltzes up into one ingratiating package. Now on this low-cost Seraphim label for those who want to enjoy listening to a different Brahms. This is light and easy to take. O.E.K.

Performance: A *Sound:* A

The Art of Heinrich Schutz. The Telemann Society Chorus and Recorder Ensemble, Theodora Schulze
Counterpoint/Esoteric 625/5625, $4.98/$5.98

I suppose one shouldn't rise up and say again what one has said before; but here's a new record from the Telemann Society and it asks for a new evaluation.

There are good individual performers here, out of the New York region, many of them well-known for local appearances. But as gathered into this particular ensemble, they collectively produce music that for my ear is just dreadful. It marches thumpingly along like a circus bandwagon with square wheels; there is a dismal lack of musical phrasing and shaping and a strident predominance of harshness that makes one wonder what Herr Schütz has to do with it all. Not too much.

Oof—this must be something the Directors of the group call "Pararhythmic Integration," a discovery of theirs which they say is a "giant step forward" in performing such music. I say it is a giant step in the direction of non-music.

Go ahead, try it. I might be wrong!

E.T.C.

Performance: B *Sound:* B

Palestrina: Missa Brevis. Marenzio: Madrigali. Le Quatuor Double, Courville.
Pirouette (Janus) JAS 19004 stereo

Sorry—all I can say here is *dreadful.* Some people may like it just the same.

This is one of those French singing groups who perform the older church music via big, ecstatic, wobbly operatic solo voices in a style that belongs somewhere in Gounod's *Faust* or Puccini's *La Bohême.* Also the madrigals, which manage to sound even more hideous than the church music.

The style is dismally wrong in both cases. But what really matters is that there is no ensemble; you can't tell the pitch of half the notes and you can only infer the sense of the chords, which are uniformly unstable and out of tune.

Even the jacket notes are right in step. "It would be no exaggeration to say that all music of the XVIth century is dominated by the genius of Giovanni Perluigi, known as Palestrina . . ." That point of view, with all due respect to a splendid composer, dates straight back to the times when nobody knew *any* actual XVIth century music to speak of—including Palestrina himself. Some traditions die hard.

E.T.C.

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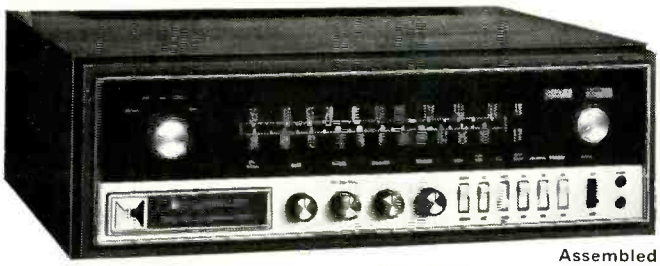

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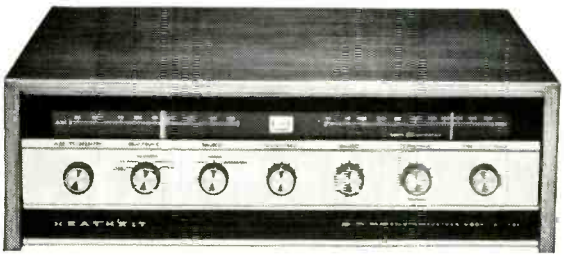

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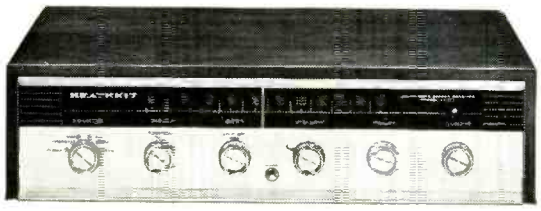

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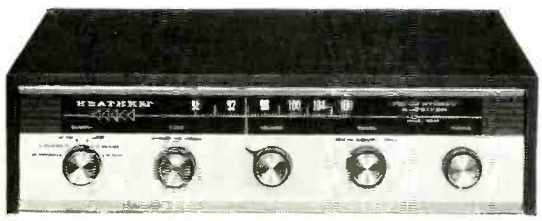
Features 31 transistor, 10 diode circuit; 20 watts RMS, 30 watts IHF music power @ ±1 db from 15 to 50,000 Hz; preassembled & aligned wideband FM/FM stereo tuner; front panel headphone jack; compact 3⅞" H. x 15¼" W. x 12" D. size; stereo indicator light; filtered outputs; fast circuit board assembly. 18 lbs. Optional Heath factory assembled cabinets (walnut $9.95, beige metal $3.95).



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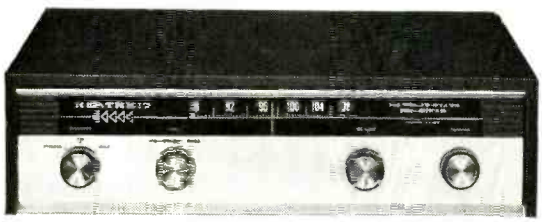

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The Broadway Stage

Hallelujah, Baby! (Original Broadway Cast)
Columbia (Stereo) KOS 3090 ($6.79)

In a Broadway season that has seen few major productions, musical or dramatic, "Hallelujah, Baby" stands out as perhaps a greater show than theatre history will finally decree. There have been other musicals voicing social protest in their plots but few of them have had as appealing a protagonist as "Hallelujah, Baby" has in Leslie Uggams.

In her Broadway debut, Miss Uggams plays the role of Georgina, a Negro maid whose rise to fame as a singer provides the plot for the musical. In the theatre, the show is a series of vignettes spanning a period of sixty years during which time none of the characters get older. This is a rare device on stage but less so on records where the passage of time seldom seems to have any effect on the voices of the performers. This plot seems far less episodic on discs since most original cast recordings, at best, offer only fragmentary glimpses of a show's score.

Jule Styne wrote this one with the help of a book by Arthur Laurents and lyrics by Betty Comden and Adolph Green. Styne has managed quite well in his department, considering the uninspired material he's been furnished by his co-workers. There is little opportunity for suspense in a plot that recounts the familiar struggle of the Negro in American society for the past sixty years. The Styne score has one song that has all the earmarks of a solid hit. At the start of the show, Leslie Uggams sings a tune called *My Own Morning*. In its haunting tune and bittersweet lyrics can be found a summation of the mood of the show. *I Wanted to Change Him* and the ballad, *Being Good*, have good chance of survival beyond the run of the show. As miked by Columbia in this album, I prefer the Uggams voice in the softer numbers. There are traces of a strident element in her voice during the fast and loud tunes that chronicle her career in show business. The peak in the voice is most noticeable in dance numbers such as *Feet Do Yo' Stuff* and the title song, *Hallelujah, Baby*. The ensemble numbers, *The Slice, Smile, Smile* and *Witches' Brew* are very helpful in lending variety to a score that would have sounded quite average without them.

Robert Hooks and Allen Case are strong in their supporting roles but if the show is anybody's baby it is definitely Miss Uggams'. The stereo effect is normal for a show album of today's vintage, with orchestral sound that puts a very bright edge on the brass instruments. C. S.

Performance: B *Sound:* B+

Down Tijuana Way

Peter Nero Salutes Tijuana Brass
RCA Victor LSP 3720 (Stereo) ($4.79)

The full title of this release is "Peter Nero Plays a Salute to Herb Albert and the Tijuana Brass." Whatever impact the album makes will stem from Nero's keyboard work and not his saluting skill. During a moment that some may consider a bit rash, Peter Nero decided to stand in for Herbert Alpert in twelve tunes made famous by the Tijuana Brass. Why Nero attempted such a feat in the first place is not for me to answer. To a potential customer's question about what actually happens on this disc, it can be said that quite a bit happens, most of it in the nature of a stunt.

No one expects to hear a piano, even one played in the brilliant style of Peter Nero, in any sort of tonal imitation of a trumpet's sound. At best, Nero probably intended this release to be a compliment in general terms to the high-riding Alpert crew. Aiding and abetting his piano in the recording studio is a band of musicians armed with instruments meant to deliver an approximation of the Tijuana sound. No matter what the tempo of an individual piece, Nero's keyboard imitation of Alpert's familiar trumpet style seldom rises above the status of a good-natured gag. It's harmless fun that can't do any damage to the reputation of either Nero or Alpert. Considering the huge volume of music that's been recorded by Alpert's band, it couldn't have been easy to pick a dozen tunes that most closely typify the Tijuana style. The inevitable *Taste of Honey* is included, along with *Spanish Flea, Mexican Shuffle, Lonely Bull* and the other top ranking hits of one of the industry's most lucrative repertories.

This experiment comes off best when the trumpets behind Nero and the flamboyant drummer to the right of the piano take the spotlight. The album is on weakest ground when the strings at stage left are asked to carry a melody instead of acting as mere accent for the rest of the band. C. S.

Performance: B *Sound:* B+

In Concert: Miriam Makeba, with guitar, accordion, bass and percussion accompaniment.
Reprise RS 6253 stereo ($4.98)

Miriam Makeba's latest album is a great disappointment, at least to this listener, who recalls her superb folk collections of several years back. The South African singer, here recorded during a performance at New York's Philharmonic Hall, seems intent on turning every number into a melodramatic tour-de-force. She relies on arty, cute introductions; there is a constant striving for vocal effects, and a frequent use of slow, moody, drawn-out tempos, à la Nina Simone. Just compare the fussy, tricked-up version of *The Click Song* on this album with the genuinely humorous one on Miss Makeba's first American recording, and the point will need no further belaboring.

Other items on the disc include a couple of modestly-appealing Brazilian songs, a maudlin thing called *Mommy*, and a long, rather over-dramatized setting of *A Piece of Ground*, the powerful South African protest song (from the revue *Wait a Minim*). Evidentally, the engineers had trouble with the Philharmonic Hall accoustics, for the sound is rather dry, that is, with a non-resonant overall timbre. R. S.

Performance: C *Sound:* C

(Continued on page 104)

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BERTRAM STANLEIGH

JIMMY RUSHING AND DICKIE WELLS REUNITE

Jimmy Rushing

IN THE 1920's, A ten-piece band in Kansas City was building a tradition for bright, open, vigorous, happy music making. There was a special lift and swagger to the playing of the Bennie Moten band, and a number of the veterans of that unforgotten group still retain some of the qualities of its style. Moten died in 1935, but his piano player, a New Yorker named Count Basie, took over the leadership of the group, enlarged it, and in 1936 brought the band to New York.

With them came Jimmy Rushing, a Kansas City blues shouter who had worked with the Moten band. Two years later Dickie Wells, one of the outstanding jazz trombonists, began his collaboration with Basie and Rushing. Wells remained with the band until 1948. Rushing departed two years later. Before they left they made a number of great jazz blues recordings, and the separation of this fine combination has been the cause of numerous critical lamentations.

When ABC's new blues label, *BluesWay*, decided to record Rushing, it had the inspired idea of reuniting him with Dickie Wells. The results of that reunion are sheer magic. Clearly, both men are inspired to deliver the very best performances of which they are capable, and they have been fortunate in the selection of Oliver Nelson as bandleader-arranger for their session. Nelson has provided backgrounds that are models of open, transparent support that never overpower the soloists.

Basie is represented, too, in this splendid collection. Five of the nine blues recorded were written by Basie and Rushing: *You Can't Run Around*, *Blues in the Dark*, *Baby Don't Tell on Me*, *I Left My Baby*, and *Evil Blues*. Rushing's own *Undecided Blues* is in the same classic blues manner, as is *Everyday I Have the Blues*, a number associated with Joe Williams, who sang with the Basie band after Rushing's departure.

An effort to update the collection by the inclusion of two bits of contemporanea, *Berkeley Campus* and Shirley Scott's *Keep the Faith, Baby*, provides a couple more smoothly-delivered numbers, but does little to alter the fact that this set is basically a first rate piece of 1940 music making. Only the splendid sound engineering of Bob Arnold has the flavor of 1967.

Nelson's orchestra is fortunate in containing a number of regulars who have participated in many of his studio dates and who have a particular affinity for the music at hand. Outstanding among them is Clark Terry, a veteran of both the Ellington and Basie bands, whose trumpet solos add a bright filip, and Shirley Scott, whose subdued harmonies are always in the right tradition. She alternates with Hank Jones, who provides an airy filigree of commentary. And Grady Tate contributes his reliably bright and stylish drumming.

Rushing's voice is not a large one, and it is not his manner to strain for effects. His expressiveness is achieved through subtle tonal variations and flexible rhythmic shifts. His work reflects the melancholy of the blues, but these are jazz blues, and the emphasis is on their swinging line, rather than on any soul-wrenching anguish. He delivers each line with an unhurred pacing that is propulsive even though there is total absence of any driven quality or sense of hurry. And each vocal line is underscored by the trombone riffs of Dickie Wells. Wells retains the wonderful control and color that were a part of his great performances in the 40s, but there is little left of the swinging forward quality that characterized his earlier work.

Happily, that element is nowhere lacking in the balance of the accompaniment, and the Rushing voice is just as clear, bright, and ably controlled as on his old Basie recordings. This is in every respect a piece of magnificent music making with a team of well-matched collaborators and clean, balanced recording.

Jimmy Rushing; Everyday I Have the Blues
BluesWay Mono BL-6005 ($4.79)

Performance: A *Sound:* A

(Turn page for more reviews)

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The Zodiac Cosmic Sounds
Elektra Stereo EKS-74009 ($5.79)

Psychedelic-rock mood music by Mort Garson, coupled with a spoken text by Jacques Wilson. Twelve outer-space-tinted pieces, played on assorted electronic instruments, are named after the signs of the zodiac and designed for playing in the dark. Just the right accompaniment for a hippy happening.

Performance: ? *Sound:* A

Ella Fitzgerald, Duke Ellington at the Cote D'Azur
Verve Stereo V6-4072-2

A two-disc live recording of the Ella and Duke performances at the Juan-Les-Pins Jazz Festival of 1966, it offers Ella accompanied by the Duke and his band and by the Jimmy Jones trio as well as several orchestral offerings by the Duke. Highlights include a performance of *Mack the Knife* that surpasses Ella's famous Berlin recording of 1960, a largely improvised *Jazz Samba,* and a bouncing, swinging *It Don't Mean a Thing (If It Ain't Got That Swing)*. The supreme instrumental delights are an unrehearsed Lawrence Brown performance of *Rose of the Rio Grande* and a Ben Webster solo on *All Too Soon*. Sound is typical for live festival performances. But the special plus feature of this set is its price. The two-platter set is being sold for the price of a single disc. This is the kind of great music making that one is prepared to pay premium prices for, and at this bargain rate, it should move briskly.

Performance: A *Sound:* C

Count Basie: Hollywood Basie's Way
Command Stereo RS 912 SD

The reference to the film capital in the title of this disc is, happily, related to the origins of the musical material, not the recording. Each of the dozen numbers is taken from a film, but the treatment is in the great Basie manner with all of the arrangements stemming from the fertile imagination of Chico O'Farrill. It is the recording that is most important here. This is probably the finest band sound ever to find its way onto microgrooves. All of the strong, clean, stabbing impact of a Basie brass chorus is present with the full bloom of its overtones. So, too, are crisply transient percussion, wide dynamic range, and some genuine room sound. The recording, made last December in New York, was engineered by Bob Fine. It has a rich, broadly-spread stereo effect and a quality of three dimensionality that is generally lacking from recorded performance of large bands.

Performance: B *Sound:* A

Gabor Szabo: Jazz Raga
Impulse Stereo AS9128

Guitarist Gabor Szabo offers a special program of Indian-influenced cavortings that probably owes much to the recent prominence of Ali Akbar Khan and Ravi Shankar in this country. Performing on both guitar and sitar, Gabor has been fortunate to collaborate with Jack Gregg, a bassist of exceptional sensitivity who anticipates Szabo's ideas and supplies meaningful commentary of his own, and "Pretty" Purdie, a rock-and-roll drummer who provides drive and color. This is the first disc these men have made together, but they work with the well-oiled precision of old companions. Each nuance of Szabo's playing is shared with the others. On side B, Bob Bushnell, on guitar, ads some additional flesh to the sound. Much of the merit of this fascinating release would have been lost without the great engineering of Rudy Van Gelder, whose miking picked up all of the subtle shadings of Gabor's sitar and the linear wandering of Gregg's bass.

Performance: A *Sound:* A

Vince Guaraldi & Bola Sete: Live at El Matador
Fantasy FAC 8371
(4-track stereo tape)

This is a somewhat more vigorous, nervous performance than the other Guaraldi-Sete recordings. In part, this stems from the very sensitive brush and cymbal work of the unnamed drummer. It also seems to be due to a more dominant role for the Guaraldi piano. It is at the center of all activity from start to finish. Bola Sete fans may be disappointed to hear the guitarist blend into the rhythm background for so much of this brilliantly recorded session, but he achieves proper prominence in the Jobim-Bonfa suite from *Black Orpheus* which occupies the major portion of side 2. The musical delights of this new taping were obviously not lost on the patrons of San Francisco's El Matador, for they remain quiet and attentive throughout the reel.

Performance: B+ *Sound:* A

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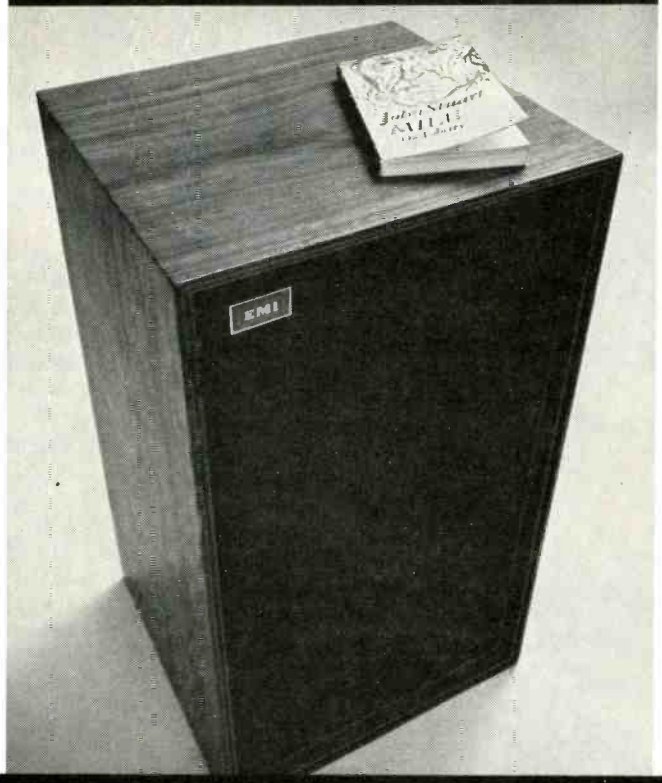

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If you're acquainted with our model 529 (the well-regarded "dangerous" loudspeaker) you'll be pleased to know that the EMI 629 has an 8-ohm nominal impedance instead of the 529's 4 ohms. This makes it especially desirable for use with modern, solid-state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

In addition, we fitted the 629 woofer with a larger voice coil, increased the gap, and doubled the size of the magnet – greatly increasing power-handling capacity. But we retained the unique elliptical woofer construction, with its rigid aluminum center cone and molded PVC (polyvinyl chloride) edge suspension, which contribute so much to the low frequency performance of EMI speakers.

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

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

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EQUIPMENT PROFILE

Fig. 1—Sherwood S-7600-FET AM-FM stereo receiver features FET r.f. amplifier and mixer stages for FM, 80-Watts music power output at 4 Ohms.

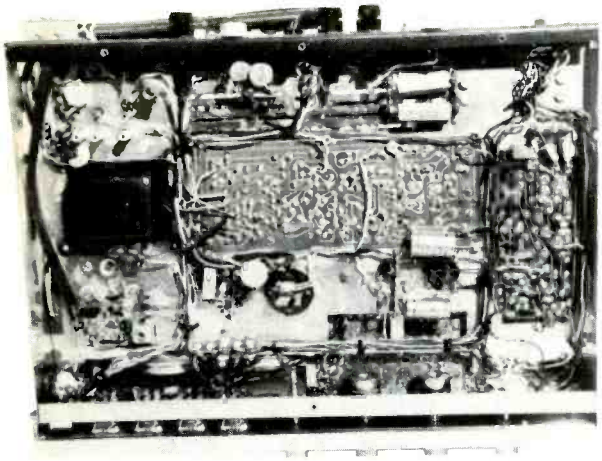


Fig. 2—Printed-circuit modules make it possible to achieve a neat, chassis underside.

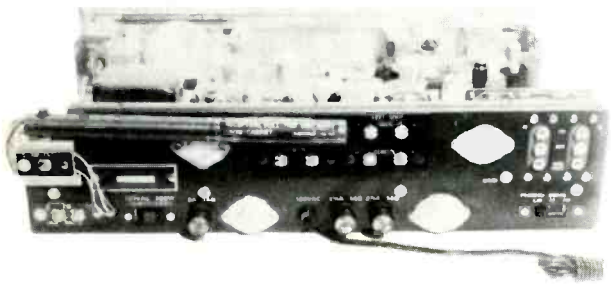


Fig. 3—Rear panel of receiver shows AM ferrite antenna rod (left), output transistors, and 3-position cartridge-sensitivity switch.

Sherwood S-7600-FET/ 80-Watt AM-FM Stereo Receiver

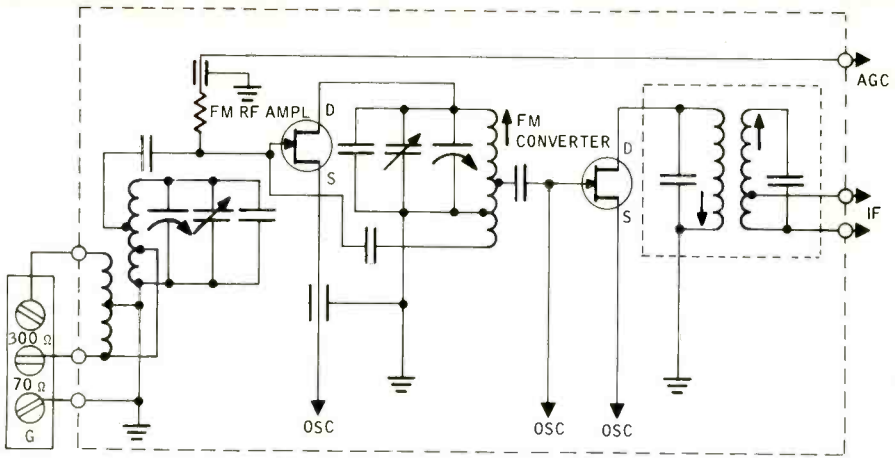
MANUFACTURER'S SPECIFICATIONS—Music Power Output: 80 Watts at 4-Ohms; 50 Watts at 8-Ohms. Frequency response: (FM mono): 20 to 20 kHz ±½ dB, (FM stereo): 20 to 15 kHz ±½ dB, (AM): —6 dB at 4.0 kHz, (Amplifier): 20 to 20 kHz ±½ dB. FM sensitivity (IHF): 1.8 μV. FM Capture Ratio: 2.6 dB. FM Distortion: 0.15% harmonic at 100% mod. FM Cross-modulation Rejection: —95 dB. FM Stability (±0.01%). Typical Selectivity: (FM): 250 kHz at —6 dB, 820 kHz at —60 dB; (AM): 7.5 kHz at —6 dB. Inverse Feedback: 35 dB. Max. Hum and Noise: 90 dB (weighted) below rated output w/vol. control min. Dimensions: 15½ in. x 12 in. x 4½ in. high. Weight: 26 lbs. with case.

The three-lettered suffix, FET, appended to the model number of this new receiver entry represents a major difference between the FM performance of this new unit and its otherwise excellent predecessors.

FETs (field-effect transistors) have been touted by many manufacturers as the device(s) that pushed performance of FM receivers and tuners to new heights. Operating on a principle quite different from bipolar transistors, the n-p-n and p-n-p transistors used so widely, FETs are indeed capable of advancing front-end performance of FM equipment. This, in turn, can enhance the performance of an entire receiver or tuner.

The FETs (junction type, in this case), exhibit much lower cross-modulation distortion capabilities than bipolar transistors do, countering one of the few remaining advantages that vacuum tubes hold over transistors. Cross-modulation rejection of local,

Fig. 4—Partial schematic of tuner illustrates FET circuitry, resulting in cross-modulation rejection of 95 dB.



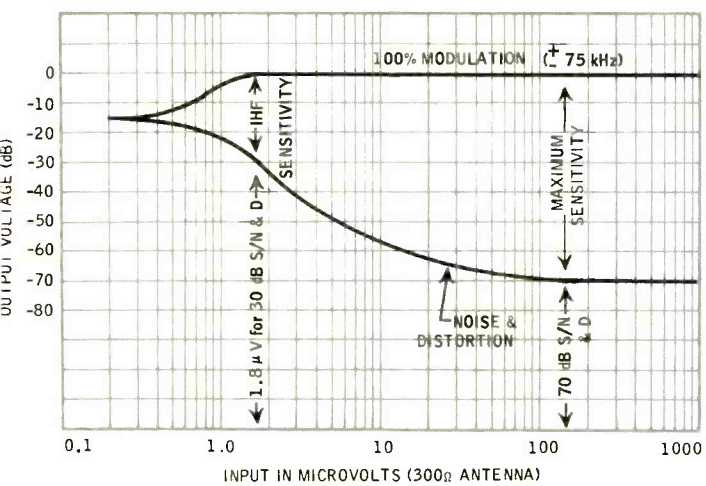


Fig. 5—Limiting and quieting characteristics of S-7600-FET.

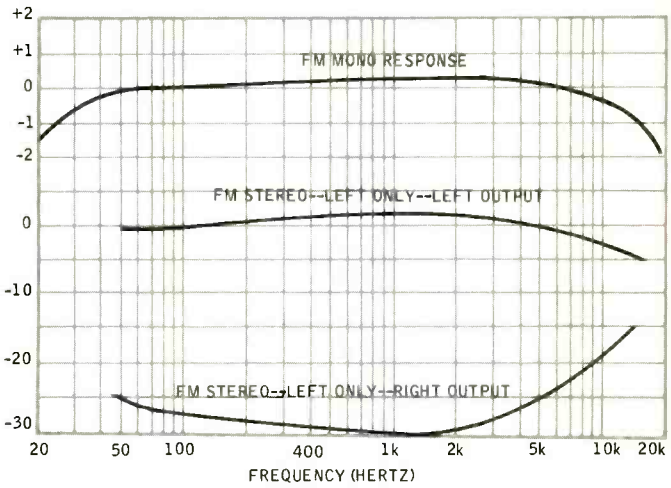


Fig. 6—FM stereo and mono frequency response curves.

powerful stations which might otherwise interfere with more distant, weaker station reception has been reduced in the S-7600-FET to —95 dB, a figure better than that achieved by "tube-type" front ends. This accomplishment, combined with an IHF usable sensitivity of 1.8 microvolts (see Fig. 5), is due largely to a newly-designed FM tuner section which features FETs in both the r.f. and mixer stages (the oscillator uses a bipolar device). A partial schematic can be seen in Fig. 4.

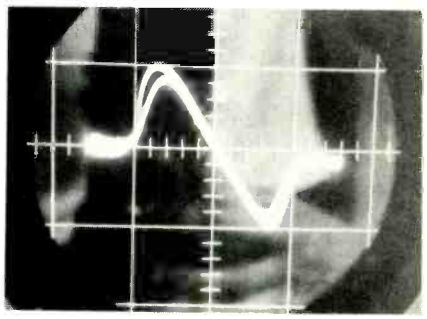
Features

Notwithstanding a total of 38 silicon transistors, 5 silicon rectifiers, 15 silicon diodes and a voltage-regulating Zener diode, the S-7600-FET FM/FM stereo/AM receiver is marvelously compact. Its smart, low-silhouette format (dimensions are 15½ in. wide x 12 in. deep x 4½ in. high) is complemented by an intelligently laid-out front panel. A very smooth-acting, flywheel tuning control and a loudness control (bass compensation only) which is defeatable share an upper-right location on the front panel. To the left of them is one of the widest slide-rule tuning scales we've seen, measuring almost 7½ in. from 88 mHz to 108 MHz (Sherwood's dial uses pre-Hertz Mc and Kc frequency abbreviations). This makes station selection easier than a narrower slide-rule scale would, of course. The well-illuminated tuning dial area includes a center-of-channel FM tuning meter and a small, red indicator light which, when lighted, denotes reception of FM stereo.

In a neat, horizontal lineup along the bottom half of the front panel are a string of secondary controls and switches. These include separate bass and treble tone controls (ganged for dual-channel operation), a ganged balance control (which features a mono-stereo push-pull arrangement), and a function selector (PHONO-FM-AM). These four controls, with smaller knobs than the primary tuning and loudness control knobs, are matched by four rocker-action "on-off" switches: tape monitor, loudness, main speakers, and remote speakers. A stereo headphone jack ends the front-panel lineup.

With the balance control pushed in, the Sherwood unit automatically switches from mono to stereo and back, duplicating what the broadcast station is transmitting. Pulling the balance

Fig. 7—Linear "S" curve obtained at discriminator output is about 500 kHz wide.



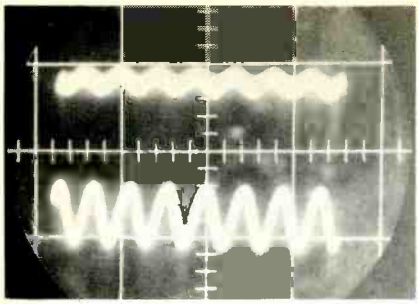


Fig. 8—Left and right FM-stereo outputs with 10 kHz stereo left-only signal applied to antenna terminals.

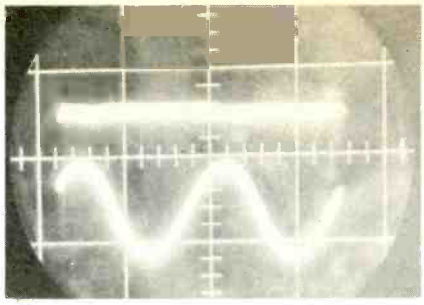


Fig. 9—Lower trace is "left" output with a left-only signal applied. Upper trace is "right" output with same input.

control out, defeats automatic operation and provides mono-only operation.

You may have noted the absence of "tape" on the function selector switch. The tape monitor rocker-action switch (cryptically abbreviated TP MONTR/NORM-AUXILIARY) takes care of this. When it's depressed in the tape monitor-auxiliary position, the circuit is ready for either the usual tape out-and-in monitor arrangement *or* an auxiliary high-level input. Thus, it does double duty. This simplifies operation, but you cannot do any dubbing from one tape recorder to another and hope to monitor the results with the receiver. You'd require separate tape monitor and auxiliary inputs for this.

The rear panel of the S-7600-FET (Fig. 3) features phono and auxiliary inputs, speaker outputs (including a pair for remote speakers, switched "on" and "off" at the front panel), FM antenna terminal strip, ferrite antenna rod that can be swiveled for optimum AM reception, line fuse, and convenience outlet (switched). In addition, some further refinements are offered to warm the hearts of hi-fi enthusiasts.

For example, there is a three-position phono sensitivity switch with positions that correspond to cartridge outputs of 1.5 mV, 6 mV, and 12 mV. This overcomes one of the problems that plagued many preamps in the early days of transistorized equipment (as well as some present-day units)—overloading. Earlier vintage Sherwood receivers had a continuously-variable control located on the front panel for the same purpose. The rear-panel switch approach seems more practical. It's the kind of adjustment that needs to be set only once for a given cartridge and therefore doesn't merit front-panel status. And a switch makes it easy to repeat the setting should other cartridges, with different sensitivities, be used.

Accidental shorting between speaker leads is minimized by the use of widely-spaced speaker terminal screws. In addition to this precaution, each speaker circuit is fused with a 2½ Ampere fuse, accessible at the rear panel.

The rear input panel serves a second function by acting as a heat sink for four power-output transistors, which are mounted externally.

Performance

Examining the circuitry, we find a total of three wide-band i.f. stages, followed by two cascaded stages of limiting and a full-fledged discriminator demodulator. All of these stages, along with the AM-i.f. components and an age-amplifying stage, are mounted on one printed-circuit module.

In addition to the usual audio-and-power-supply voltage take-offs from this module, there is also a take-off point associated with the first i.f. stage and the age amplifier. This provides a noise-actuated signal for the FM stereo module that determines the signal level where the S-7600-FET's automatic stereo provision shall be effective.

When a noisy FM stereo program is received, in all likelihood from a very distant station, there's an automatic switchover to mono operation. This excellent feature can well save the day when you're taping a stereo program and excessive noise occurs (the multiplex channel is more subject to noise than the main channel is, as FM set owners who use indoor antennas have no doubt discovered). This does present a mild drawback: what if a listener *wanted* to hear an FM program in stereo, however noisy it was? He couldn't do this without an adjustable stereo noise-threshold control. But, then again, who truly wants to listen to "noisy" FM stereo?

Only one station known to be broadcasting in stereo failed to trigger the threshold circuit and, therefore, came through monophonically. But this station was 60 miles away and of relatively low power. All other eight stereo broadcasts in the area were reproduced, in stereo, with clarity. Interchannel quieting was very effective, as channels popped in from utter silence as the tuning knob was twirled.

FM specifications were impressive. Usable sensitivity (IHF) measurements confirmed the manufacturer's claim of 1.8 μV, as mentioned earlier (Fig. 5). Capture ratio was 2.6 dB. FM

Fig. 10—IM distortion vs. power output curve illustrates that IM distortion is under 1% up to 20 Watts rms at 8 Ohms load. Single-channel measurements were made with both channels operating.

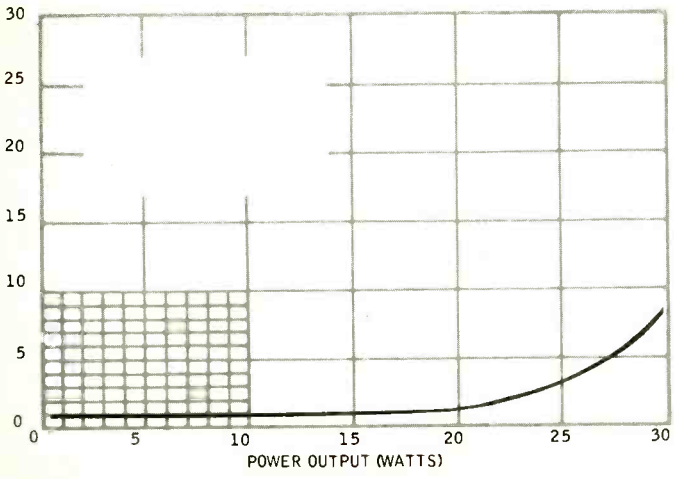
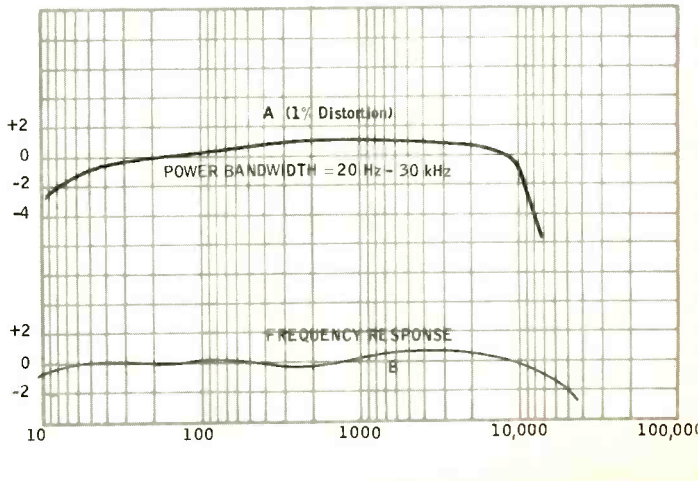


Fig. 11—Power response of S-7600-FET is shown by curve A. Zero dB = 20 Watts per channel into an 8-Ohm load, with both channels driven. Curve B shows frequency response of the amplifier at 1 Watt.



We got rid of rumble

what's left is virtually unmeasurable)

ur engineers wanted to design a turntable that was so free rumble, that it was unmeasurable and certainly inaudible. hey started by directing their attention to the motor, where ost of the rumble-producing vibration is born. While the otion of the motor cannot be eliminated, it can be reduced reducing its speed and so reducing vibration at its very urce. The motor employed in the Sony TTS-3000 is designed provide optimum torque at 300 rpm, *about 1/6 the speed of nventional turntable motors.* This accounts for a sharp duction in rumble-producing vibrations.

Whatever little vibration that still might be left was olated and contained by the use of a belt-drive coupling tween the motor and turntable to absorb all residual echanical vibrations. The problem of rumble caused by e motion of the turntable itself was dealt with by maintaing extremely close tolerances in the main bearing.

Sony designers then tackled the problem of precise eed regulation. Their approach: a precision servo-conolled motor, first ever used in a turntable. It is designed operate at low voltages which are provided by a solid-state amplifier, an integral part of the turntable system. To assure precise speed accuracy, the motor shaft is coupled to an alternator or frequency generator. The output of this generator is fed to the control circuit of the servo amplifier. This control circuit is highly frequency sensitive. The slightest change in frequency output from the generator or even the slightest change in turntable speed, results in an instantaneous compensating change in the operating voltage provided by the amplifier to the motor. Model TTS-3000, $149.50.

This servo-controlled turntable is designed for use with today's finest tonearms and cartridges. The Sony VC-8E, the first moving coil cartridge with high enough output to eliminate the need for transformer coupling, makes an ideal mate. $65. Add the Sony PUA-237, 12" professional arm (or the PUA-286, 16" transcription arm) a remarkably sensitive and stable arm, and you've got the finest playback system available today. PUA-237, $85; PUA-286, $99.50. See these new components at your Sony high-fidelity dealer, or write for complete catalog: Sony Corporation of America, Dept. H. 47-47 Van Dam St., Long Island City, N.Y. 11101.

SONY

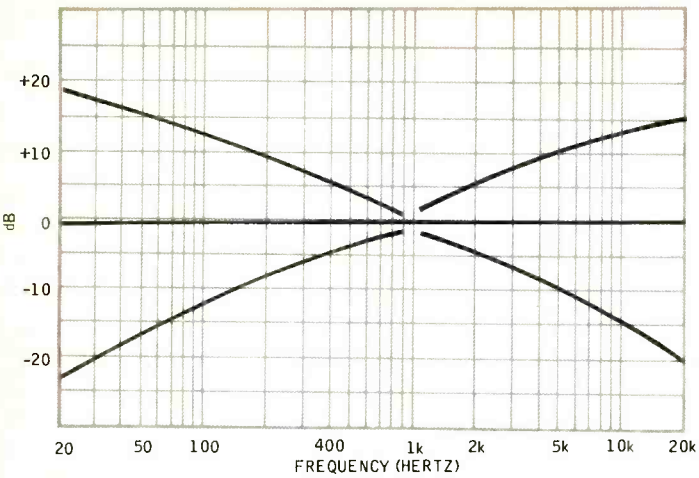


Fig. 12—Tone control range.

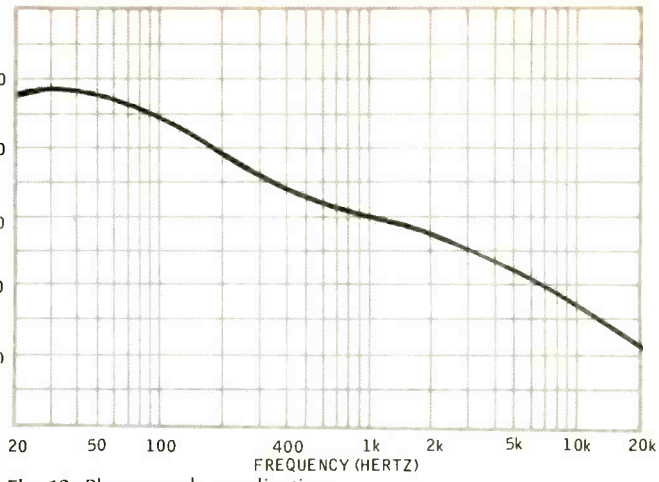


Fig. 13—Phonograph equalization.

distortion measurements, made at 25 microvolts input and 100% modulation, measured 0.17% for harmonic distortion and a mere 0.25% for intermodulation distortion.

These excellent figures are not altogether surprising when one examines the recovered "S" curve at the output of the i.f. discriminator (see Fig. 7). The linear portion of this curve, with nary a "kink" in it, is fully 500 kHz wide (about 200 kHz is *theoretically* all that is required), and the peak-to-peak width is about 800 kHz. That's wideband if we ever saw it!

FM stereo separation measurements at mid and high frequencies indicated that separation was very respectable: 31 dB at 1000 Hz. This is illustrated by the double trace of Fig. 8, in which the lower trace is the signal channel and the upper trace is the no-signal channel. Fig. 9 is a double-trace photo of the stereo outputs when a left-only signal of 10 kHz is applied. Separation measures slightly better than 20 dB at this high-frequency point.

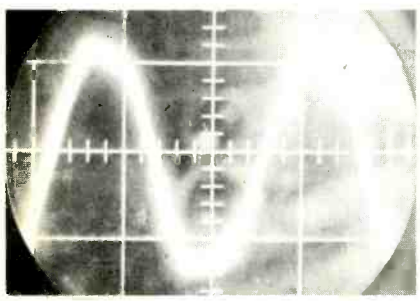
The S-7600-FET's superb FM tuner section is backed up by a fine audio amplifier. Intermodulation distortion is well under 1% at all power-output levels up to 20 Watts rms (8-Ohm load), as shown in Fig. 10. Harmonic distortion was measured at 1000 Hz as 0.5% at 20 Watts rms (8-Ohm load), and 1% at 30 Watts into a 4-Ohm load. Both measurements are for a single channel, with both channels operating. Crossover distortion obviously does not present a problem since distortion is lowered as power output is reduced. Sherwood, in addition to quoting rms power capabilities consistent with our measurements, rates the entire receiver at 50-Watts music power into an 8-Ohm load, and 80-Watts music power into a 4-Ohm load.

The manner in which a power amplifier goes into clipping, or high levels of distortion, tells much about the basic quality of the amplifier. Accordingly, the amplifier was pushed into clipping at low (50 Hz), medium (1000 Hz) and high (10,000 Hz) frequencies. The results are shown in Fig. 14A, B, and C. Note that at each of the frequencies mentioned, clipping occurs uniformly and sharply at both extremes of the waveform, indicating a well-balanced and properly-biased design of the output stages. Fig. 15 illustrates square-wave response of the amplifier at frequencies of 100 Hz and 5000 Hz, further confirming the excellent power handling and recovery characteristics of the amplifier section. Damping factor is 30:1 at 8 Ohms with 35 dB inverse feedback applied, according to the manufacturer.

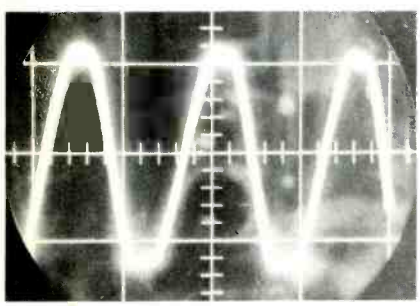
(Continued on page 89)

Fig. 14—Overload characteristics of the S-7600-FET power amplifier are excellent, as shown.

(A) 50 Hz



(B) 1000 Hz



(C) 10,000 Hz

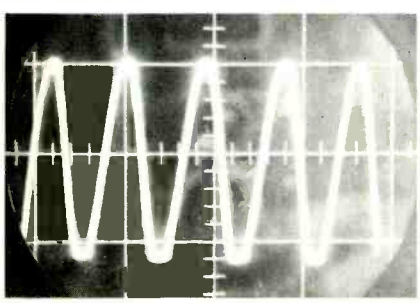
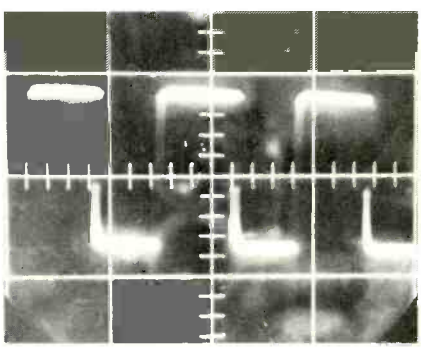
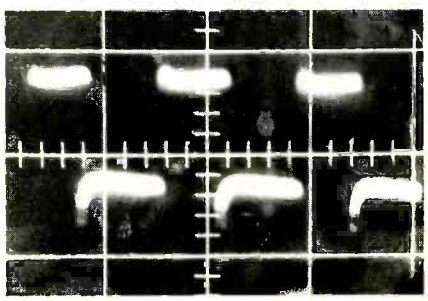


Fig. 15—Square-wave response at low and high frequencies.

(A) 100 Hz



(B) 5000 Hz



Announcing the **Wharfedale** *Achromatic Systems* *new "D" Series...*

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The scene is Carnegie Hall, New York, Oct. 9, 1955. The event will mark a milestone in audio history. Onstage, a number of internationally known performing artists, plus a group of Wharfedale speaker systems, and G. A. Briggs, England's pioneering authority on sound reproduction. It is one of the fascinating series of concert demonstrations given by Mr. Briggs in leading concert halls of Europe and America . . . to test concepts, to demonstrate techniques, to compare live music with Wharfedale performance before critical audiences and to develop what is today the warmly admired Wharfedale Achromatic sound.

This is, in fact, a special kind of sound engineering, and something more: a sensitive appreciation of musical values, and of the emotional response of the listener, leading to the truest kind of sound reproduction, free of spurious resonances and artificial tonal coloration. It is the kind of engineering and patient research into the reactions of listeners with the keenest musical sense, that has today resulted in the magnificent new Wharfedale "D" Series speaker systems pictured in this folder.

See for yourself how well the new Wharfedale Achromatic Systems have carried forward their great tradition to achieve superiority . . . in technical characteristics, in use of the exclusive Wharfedale sand-filled constructional principle, and in the beautiful new styling . . . for they are truly elegant furniture, gracing any room. Then, experience for yourself the warm musicality and exceptional smoothness of the new "D" Series Wharfedale speaker systems. You'll want to have the Wharfedale Achromatic sound in your own music system without delay. And you can! For a preview of the "D" Series, in decorator-designed room settings, please turn the page.

Wharfedale

proudly presents the "D" Series –
six magnificent new
Achromatic Speaker Systems

ACHROMATIC **W20D** TWO-WAY SYSTEM

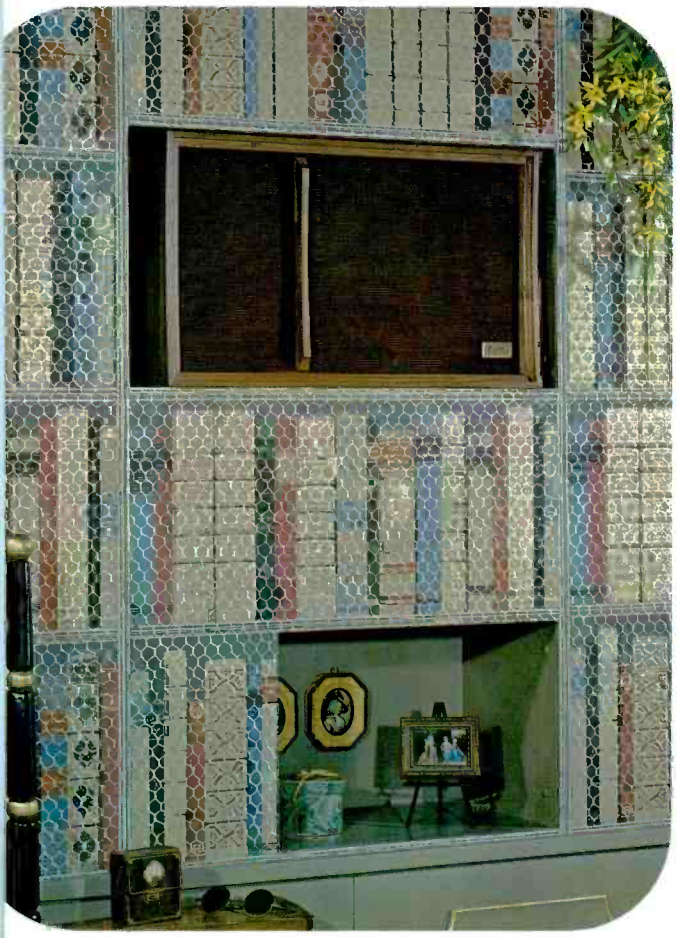
ACHROMATIC **W30D** TWO-WAY SYSTEM

BOOKSHELF MODELS

ACHROMATIC **W40D** THREE-WAY SYSTEM

FLOOR-STANDING MODELS

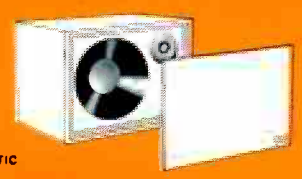
ACHROMATIC **W70D** DELUXE FOUR-WAY SYSTEM



ACHROMATIC **W60D** THREE-WAY SYSTEM

ACHROMATIC **W90D** DELUXE SIX-SPEAKER, FOUR-WAY SYSTEM

COMPACT MODELS



ACHROMATIC

W20D

TWO-WAY MINORETTE SPEAKER SYSTEM WITH ACOUSTIC SUSPENSION

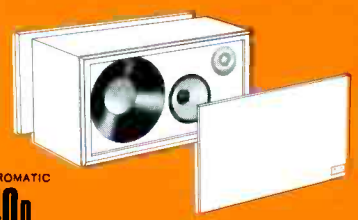
Enthusiastically acclaimed in magazine test reports, the W20D uses a high excursion, low resonance, full 8" woofer with exclusive high compliance Flexiprene cone suspension. A new advance-design mylar-domed pressure tweeter provides excellent omni-directional dispersion characteristics. Speakers have heavy magnet assemblies for controlled transient response. The LCR 2-section crossover network and voice coil values were designed for optimum performance with vacuum tube or transistor equipment. A continuously variable acoustic compensation control is included.

The cabinet (acoustic suspension principle) has a removal front grille to make changing the cloth simple. Small overall dimensions allow either stand-up or horizontal positioning.

Listen to the W20D with your eyes closed, and forget that it's so small and costs so little.

OTHER SPECIFICATIONS: Frequency response, 45 to 18,000 Hz. Input power (IHF, per channel): min., 10 W; max., 35 W. System impedance, 4 to 8 ohms. Crossover point, 1600 Hz (electrical). Dimensions, 9¾" x 14" x 8½" deep. Scuff resistant oiled walnut vinyl finish. Price, $49.95.

BOOKSHELF MODELS



ACHROMATIC

W40D

THREE-WAY BOOKSHELF SPEAKER SYSTEM WITH ACOUSTIC SUSPENSION

The new W40D is a full 3-way multiple speaker assembly, yielding the carefully tailored ultra linear response that can best be accomplished with individual speakers, each specially designed for and operated over a restricted frequency range. A heavy duty 10" high compliance, low resonance woofer is mated with an acoustically isolated 5" midrange speaker and an advance-design omni-directional 3" pressure dome tweeter. Separate mid and treble range continuously variable acoustic compensation controls are provided.

Employing the acoustic suspension principle, the handsomely appointed cabinet is completely airtight.

The front grille assembly is removable, to facilitate decor changes, and the nameplate is rotatable so that the speaker may be used either vertically or horizontally.

OTHER SPECIFICATIONS: Frequency response, 35 to 20,000 Hz. Input power (IHF, per channel): min., 10 W; max., 35 W. System impedance, 4 to 8 ohms. LCR 3-section crossover network. Crossover points: midrange, 1250 Hz (elec.); treble, 3500 Hz (elec.). 12½" x 23½" x 10⅛" deep. Genuine oiled walnut, $94.00; polished walnut (special order), $98.70; utility (sanded birch, flat molding), $86.00.

FLOOR-STANDING MODELS

ACHROMATIC

W70D

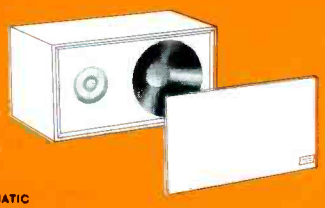
VERSATILE HI AND LOW BOY DELUXE FOUR-WAY SPEAKER SYSTEM EXCLUSIVE SAND-FILLED ENCLOSURE

The new W70D incorporates the finest component for multiple speaker systems. The 12½" woofe employs a massive (9½ lb.) magnet assembly on heavy cast aluminum chassis. The 2" pole piece an magnet keeper plates, of finest Sheffield steel, insur maximum gap flux density with minimum heat los as well as exceptional power and transient handlin

A special, heavy duty 8" speaker serves as a "pas sive" radiator for the upper bass range and as a energized driver for the lower midrange. An acoust cally isolated 5" unit handles the upper midrang while Wharfedale's advance-design mylar pressure dome 3" tweeter contributes pure, wide-angle treble Individual, continuously variable controls adjust th mid and treble ranges.

The enclosure employs Wharfedale's exclusive sand filled construction. Superbly styled, the W70D used as a "high boy" or, on its side, as a "low boy.

OTHER SPECIFICATIONS: Frequency response, 25 to 20,000 Hz. Inpu power (IHF, per channel): min., 8 W; max., 40 W. System impe ance, 4 to 8 ohms. LCR 4-section crossover network. Crossov points: low midrange, 175 Hz (mechanical); upper midrange, 12 Hz (electrical); treble, 3500 Hz (elec.). Finished model, 24" x 22¾ x 13⅜" deep (includes table tops); utility model (no table tops 24" x 20⅞" x 12⅜" deep. In genuine oiled walnut, $188.00; polishe walnut, $203.00; utility (sanded birch, flat molding), $175.00.



ACHROMATIC

W30D

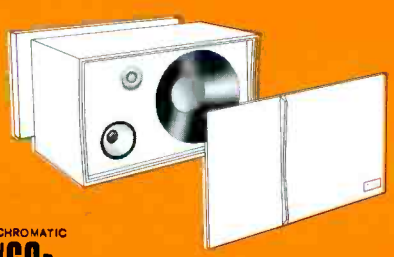
TWO-WAY COMPACT SPEAKER SYSTEM WITH ACOUSTIC SUSPENSION

The new Model W30D, suitable for any amplifier with an output of 4 to 8 ohms, embodies an enlightened technical approach to the problems met by modern speaker systems. Heavy woofer magnet assembly provides proper damping, eliminates hangover, insures excellent transient response . . . all desirable when a bass speaker employs a high compliance, low resonance suspension, such as Wharfedale's exclusive new Flexiprene cone surround.

The acoustically isolated mylar-domed omni-directional tweeter performs effortlessly and smoothly throughout its range, and insures full range response throughout the listening area. The acoustic suspension cabinet uses heavy, airtight construction, with removable grille to facilitate changes in cloth.

Despite its modest size and price, the W30D may be used as a high performance main system, or as a gratifying "second" system.

OTHER SPECIFICATIONS: Frequency response, 40 to 18,500 Hz. Input power (IHF, per channel): min., 10 W; max., 35 W. System impedance, 4 to 8 ohms. Acoustic control, treble, continuously variable. LCR 2-section crossover network. Crossover point 2000 Hz (electrical). 10" x 19" x 9¼" deep. Scuff resistant, oiled walnut vinyl finish. Price, $59.95.



ACHROMATIC

W60D

BOOKSHELF AND FLOOR-STANDING THREE-WAY SPEAKER SYSTEM EXCLUSIVE SAND-FILLED ENCLOSURE

For the critical connoisseur, this latest version of the very popular W60 enjoys important new benefits. The 12½" woofer now has a massive 9½ lb. magnet assembly. Its one-piece cone uses an exceptionally compliant, long throw suspension. Result: Remarkably undistorted, efficient and extended bass response. A newly developed 5" acoustically-isolated midrange speaker, with generous 1¾ lb. magnet assembly and climatically impervious cloth suspension, delivers well-controlled, wonderfully smooth reproduction; and Wharfedale's omni-directional mylar-domed pressure 3" tweeter, with extra heavy magnet, assures comparable output level. Individual, continuously variable mid and treble range controls are provided.

The heavy, sturdily built enclosure is truly fine furniture. Sound coloration is virtually eliminated by use of Wharfedale's exclusive sand-filled construction.

The W60D may be used as a bookshelf or floor-standing system, positioned horizontally or vertically. A floor base (B67) is also available.

OTHER SPECIFICATIONS: Frequency response, 30 to 20,000 Hz. Input power (IHF, per channel): min., 8 W; max., 40 W. System impedance, 4 to 8 ohms. LCR 3-section crossover network. Crossover points: midrange, 1000 Hz (elec.); treble, 3500 Hz. (elec.). 14¼" x 24" x 13" deep. In genuine oiled walnut, $135.25; polished walnut (special order), $146.75; utility (sanded birch, flat molding), $123.00.

ACHROMATIC

W90D

DELUXE SIX-SPEAKER, FOUR-WAY CONSOLETTE SPEAKER SYSTEM EXCLUSIVE SAND-FILLED ENCLOSURE

The truly remarkable sound of the W90D is du both to the particularly high quality of its cor ponents and to a design that puts them to best us Bass range is divided between two 12½" woofer each with massive 9½ lb, magnet assembly. On with a flat 75 sq. in. polystyrene radiator, provid free piston action for deep bass; the other, wi conically shaped diaphragm for upper bass ar lower mid ranges. Both speakers operate in a acoustic suspension type enclosure, with surprising uniform output and extended bass range.

A pair of special 5" heavy duty mid-range speake and a pair of Wharfedale's omni-directional, myla dome pressure 3" tweeters handle the balance of t spectrum. The wide angle dispersion resulting fro this array of speakers insures correct musical timb and definition anywhere in the listening area.

The exquisite styling and fine furniture quality the W90D sand-filled cabinet will enhance a room. Front grille assemblies are removable. A optional set of legs (B67) is available.

OTHER SPECIFICATIONS: Frequency response, 20 Hz to inaudibili Input power (IHF, per channel): min., 10 W; max., 50 W. Syst impedance, 4 to 8 ohms. Acoustic controls, treble and midran continuously variable. LCR 4-section crossover network. Crosso points: upper bass, 75 Hz (mech.); midrange, 1000 Hz (elec.); treb 4000 Hz (elec.). Finished model, 23¾" x 30" x 13½" (includ table top); utility model (no table top), 23¼" x 27¾" x 12⅝". genuine oiled walnut, $294.00; polished walnut (spec. orde $315.00; utility (sanded birch, flat molding), $279.00.

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Room interiors designed by Miriam B. Friedlander (NSID).

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Prices shown are manufacturer's suggested list.

EQUIPMENT PROFILE

(Continued from page 84)

Conclusion

A moderate number of hours spent listening to the receiver was all that was necessary to confirm our measurements. No fewer than 34 FM stations were logged, using a simple dipole outdoor antenna. AM stations were reproduced clearly, too, without chirps and birdies marring reception. (Surprising, too, as we could not locate a whistle filter in the circuit.) A check of phono performance with familiar records proved that the S-7600-FET was also a fine performer here. And driving a pair of low-efficiency bookshelf speakers attested to the receiver's adequate power output.

Here, indeed, is a fine, medium-price receiver. It's not Sherwood's most powerful unit, of course. However, it will handle all but the really inefficient speaker systems in small to medium-sized rooms, at normal listening levels, with ease. Naturally, it's the FM tuner section that's the principal attraction. High sensitivity and very low distortion are hallmarks of the receiver. For urban dwellers, who live amidst very strong local FM broadcasts intermingled with distant FM broadcasts, the field-effect transistor design will be a blessing. The AM section is a fair performer, though it plays second fiddle to the FM section.

The solid-state AM-FM stereo receiver is a handsome unit, too. Its gold and black escutcheon sets off well against a walnut leatherette-covered cabinet ($348.50). The unit is also available with an oiled-walnut cabinet ($367.50), and with no cabinet for custom mounting ($339.50). Check 23

ELECTRO-VOICE MICROPHONES MODELS 667A, 635A AND 636

There are so many models of Electro-Voice microphones that it is most convenient to group a few of them together to cover a wider range of types in one issue. For example, in three different groupings (including the American line), fourteen E-V microphones appeared in the August listing of products, and these included only one of those covered in this profile—the 635A.

Model 667A

The most sophisticated microphone of the three covered in this profile is the Model 667A, which is a derivation of the 668, originally designed for use in professional applications where a light-weight, noise-free, cardioid dynamic is required for boom and fish-pole use, and where a variety of frequency-responses could be obtained without the use of external equalizers. The 668 was the same in appearance, essentially, as the 667A, and provided three variations in low-frequency response, three variations in high-frequency response, and two filters—an 80-Hz high pass, and an 8000-Hz low-pass—thus making it possible to choose between 36 separate responses. It has the same mounting, the same wind-screening, and the same general appearance as the 667A, which has similar frequency-correcting networks with the exception of the low- and high-pass filters. The microphone utilizes the "Continuously Variable-D®" principle to produce the cardioid effect which gives extremely uniform rejection of unwanted background noise. This principle employs a matched pair of slotted tubes which are coupled to the back of the diaphragm, and which phase out unwanted sound from all portions of the audible spectrum to ensure a maximum front-to-back ratio.

Fig. 16 shows the appearance of the "programming panel" of the Model 667A, which is immediately accessible upon removal of a cap from the back of the microphone. Changes in low- and high-frequency response are made by relocating pins which terminate two leads coming from the inside of the unit. Three additional pins provide the connections to ground, common, and the desired output impedance—50, 150, or 250 ohms.

Fig. 16—The terminal panel on the 667A serves as a programming panel to adjust frequency response and select output impedance. Ten pin jacks accept pins on connecting cable for impedance changes and on flexible leads for response variations.

Thus the simpler 667A is more than adequate for professional applications where it is common to provide both low and high-pass filters in the mixing panel, yet where variations in both low- and high-frequency responses are desirable to correct for voice qualities, constricted shooting areas, and either particularly reflective or absorptive sets.

Fig. 17—The disassembled 667A consists of the microphone body at bottom, the two die-cast supports with their wind-screen end bells, the cylindrical Acoustifoam® wind screen for the center section, and the bail with its molded rubber suspension cords.

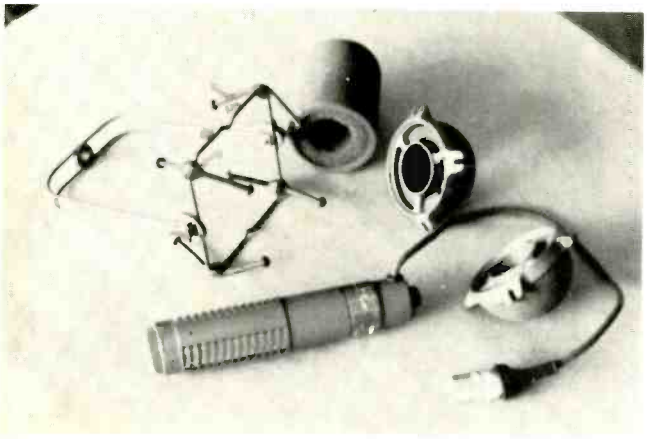
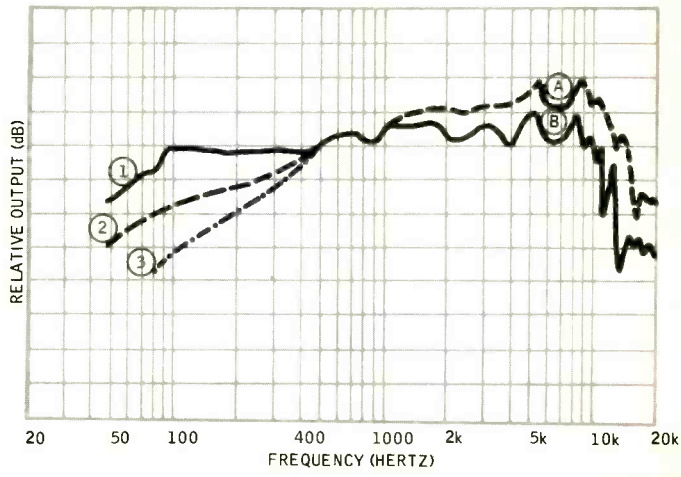


Fig. 18—Frequency-response measurements on the 667A produced the curves shown. 1, 2, and 3 indicate the variations available in low-frequency response, while A and B indicate variations in high frequency sensitivity.



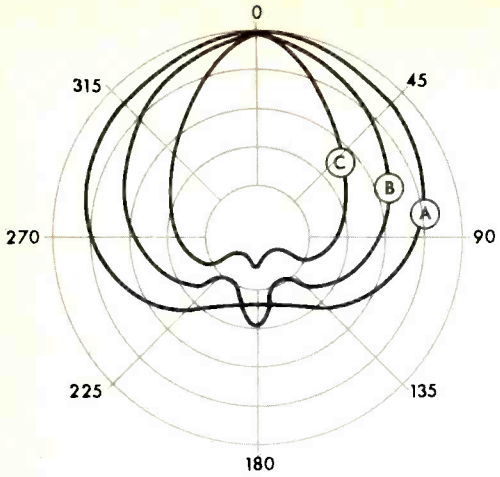


Fig. 19—Polar response curves taken at three different frequencies—A, 300 Hz; B, 5000 Hz and C, 10,000 Hz. Note that cardioid effect reduces responses at 180 deg. by a minimum of 17 dB.

Fig. 20—The 667A mounted on an improvised "fishpole" as it would likely be used in motion picture recording. The bail may be attached to a floor stand, however, when usual studio mounting is required.

The mounting of the 667A consists of a bail which is designed to be mounted on the boom or fishpole for motion picture work, or on a stand for usual studio applications. This bail has a square wire frame attached to it to provide a variable tilt angle, and the microphone proper is held in two die-cast rings which have the Acoustifoam™ end bells permanently mounted to them. The central cylindrical portion of the foam slips over the microphone body, and is held in place by the rings, which are, in turn, attached to the wire frame by ingeniously designed rubber suspension cords. The entire microphone carrier can be disassembled in less than a minute if any replacements have to be made. And to change response characteristics takes less than half that time. The suspension is extremely effective in eliminating boom noises, and the windscreening throughout the frequency range eliminates any problems from that source.

Fig. 17 shows the disassembled 667A, and *Fig.* 20 shows how the microphone is used with an improvised "fishpole."

The response of the microphone with the various settings of the variable controls is shown in *Fig.* 18 and *Fig.* 19 shows the polar response. With a sensitivity of −51 dB referred to 1 mW/10 dynes/cm², the 667A would be rated a fairly high level microphone. This sensitivity corresponds to an EIA sensitivity of −145 on the 150-Ohm tap with the response selectors in the A and 1 positions.

The uniformity of response in the polar diagram indicates that the 667A is free from some of the problems that plague many cardioid microphones, and further shows that accuracy of direction should not be exceptionally critical in usual dialogue sequences.

The 667A measures 9⅝ in. long overall, and is 6½-in. wide over the bail. It is equipped with a 24-in. cable terminated with a Cannon UA-3-11 plug which mates with the corresponding female on a 20-ft. 3-conductor shielded cable, also furnished. The weight, less the cable, is only 1 lb. 8 oz. The user net price is $207.00.

Check 24

Model 635A

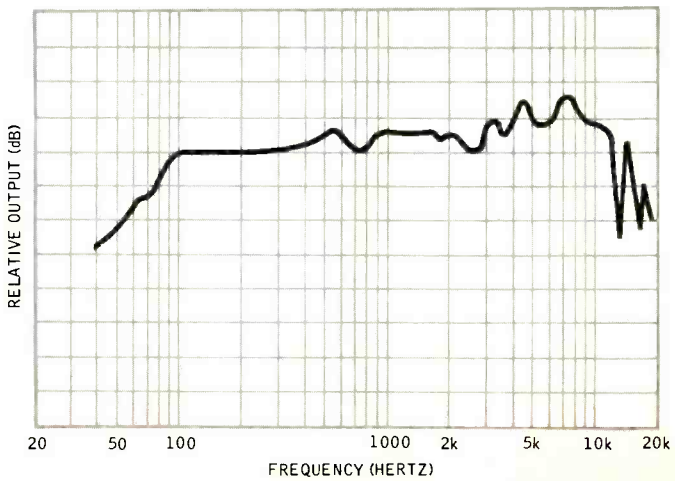
This microphone deserves to be put in the intermediate class—its performance is certainly in the professional group, while its price is certainly in the general-purpose class. An omnidirectional device, it has a wider frequency response than the 667A, but was designed as a general purpose microphone which is as likely to be used "hand-held" as on a stand. The low end is reinforced by a cavity behind the diaphragm, and because it was designed for use as a hand-held model, it is equipped with a four-stage pop and dust filter which eliminates the usual "p" pops, collects magnetic particles which would otherwise collect on the diaphragm and change frequency response, as well as eliminating the need for an external windscreen. Internal isolation between the magnetic structure and the case reduces the effect of handling and inserting in the stand mount, so common in modern television and night-club use. Frequency response is essentially uniform from 60 to 15,000 Hz. Output impedance is 150 Ohms, which is common with professional uses, yet is suitable for use with consumer-type transistorized tape recorders, which are usually designed with an input impedance of around 1000 Ohms.

The over-all response, shown in *Fig.* 22, indicates that there is a rising high-frequency, which is usually desirable in speech work, although on direct comparison with the 667A in musical recording, the 635A most closely matches the A-2 equalization of the former. The 635A is, however, a rugged instrument, and is, in fact, spot checked for a drop test to ensure that production is following engineering design. The design details were covered fully in an article in the January, 1966, issue.

(Continued on page 105)

Fig. 21—The 635A microphone, a rugged onmidirectional dynamic unit which derives from the time-tested Model 635 which racked up so many years of faithful and reliable service. The improved model is less susceptible to handling noise than its predecessor.

Fig. 22—Frequency response of the 635A microphone. Low-frequency response is held up by the use of a relatively large back cavity, while response above 8000 Hz is aided by a Helmholtz resonator in front of the diaphragm.



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PART 4

The New NAB Magnetic Tape Standards

HERMAN BURSTEIN

FREQUENCY RESPONSE AND SIGNAL-TO-NOISE RATIO MEASUREMENTS

LAST MONTH, WE CONCLUDED PART 3 of this series by examining frequency response specifications of the NAB standards for magnetic tape. Response specs were enumerated. The NAB response curves are repeated here to complement the following summation, which further clarifies recorded response. See Fig. 1.

Thus the distance of Curve A *above* the 0 dB line equals the *decline* of recorded flux at high frequencies. And the distance of Curve A *below* the 0 dB line equals the *boost* in recorded flux at low frequencies. This decline and this boost in recorded flux are implicitly part of the NAB standard.

Measuring Frequency Response

Because practical heads are not ideal heads, the playback characteristic of a tape machine cannot be checked simply and directly by measuring equalization of the playback amplifier. Instead, it is necessary to follow the indirect course of checking frequency response when playing an "NAB Standard Test Tape."

> "The signal frequencies are recorded on these tapes in such a manner that they would supply a constant output level when reproduced on an ideal reproducing system." (The Ideal Reproducing System is one with the NAB playback characteristic, as measured by special methods described in an Annex of the NAB standards.)

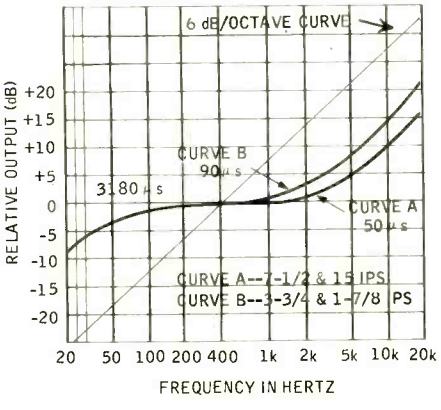
It is impractical to measure recorded flux directly, except by laboratory methods. Therefore the following indirect procedure is provided by NAB.

> (1) Playback response is measured when playing an NAB Standard Test Tape. (2) Record-playback response is measured, using "normal operating bias" and recording frequencies at the same level as on the NAB Test Tape. (3) The difference between measurements 2 and 1 is the "recorded response."

"Recorded response" is therefore the deviation from the recording characteristic implied by Fig 1 — that is, from the complement of Curve A or Curve B, depending on tape speed.

> In the case of playback response, the NAB standard recommends a roll-off at the rate of at least 6dB per octave outside the frequency limits specified for each speed.
>
> The standard further states that when measuring playback response with a half-track or quarter-track head, "a low frequency boost may be expected" inasmuch as the NAB Test Tape is full-track.

Fig. 1—NAB reproducing characteristics for magnetic tape.



Such boost is due to fringing. That is, at long recorded wavelengths (low frequencies) the head tends to respond to more of the tape than is spanned by the gap. The standard does not indicate the magnitude of boost due to fringing inasmuch as this depends upon the individual head. It only says:

> "Refer to the instructions supplied with the test tape for further details."

Inasmuch as the NAB Test Tapes were not yet available when this was written, no further explanation is offered here, except to note that with a playback head of high quality, fringing boost should not exceed 2 or 3 dB around 50 Hz.

It is noteworthy that the NAB standard gives no specifications for record-playback response, except those which may be inferred by combining the separate specifications for playback response and recorded response. Instead, the standard states:

> "The recording equalization of a recorder/reproducer should be adjusted for an over-all response which matches as nearly as possible the response of the reproducer from the NAB Standard Test Tape. This response is standardized, rather than the simple over-all record-reproduce response, in order to assure better interchangeability of recorded tapes."

To illustrate, assume that a tape machine exhibits a 5 dB peak at 10,000 Hz when playing the NAB Test Tape. Record equalization should be such as to produce the same 5 dB peak at 10,000 Hz on a record-playback basis. If record equalization results in the same playback response as does the NAB Test Tape, the machine's recording characteristic necessarily matches the NAB standard.

In other words, it is undesirable that an error in the playback characteristic (for example a treble peak) be compensated by a complementary error in recording (a treble

From the top

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SX-1000TA Output: 120 watts (IHF) at 4 ohms, 90 watts at 8 ohms; frequency response: 20-60,000 Hz; inputs: 2 magnetic and 1 ceramic phono, tape head, tape monitor, headphones, etc.; separate compensation for 3¾ and 7½ ips tape speeds; sensitivity: 2 uv (IHF); channel separation: better than 38 dB (at 1 kHz).

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

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dip). If there are complementary errors, the machine stands doubly isolated from machines that meet the NAB standard: It cannot play their recordings satisfactorily. Its own recordings cannot be played satisfactorily on these other machines.

Measuring signal-to-noise ratio

To measure S/N one must, of course, have a reference level—an audio signal of specific magnitude with which the noise level can be compared. For example, in measuring a power amplifier, the reference level may be the unit's maximum rated power. Or, to apply a common denominator to all amplifiers, it is frequent practice to use 10 Watts output as the reference: The amplifier is driven hard enough to produce 10 Watts, the corresponding output voltage is measured, the drive signal is removed, and the remaining noise voltage is measured. S/N, ordinarily expressed in dB, is the ratio between the measured audio and the noise voltages.

For other components, an appropriate reference level becomes problematical. What should be the reference for measuring a preamplifier's S/N on magnetic phono input? The measurement will depend on the magnitude and frequency of the input signal. Therefore it has become frequent, although not universal, practice to base S/N upon the preamp output when it receives a 5 millivolt, 1,000 Hz input signal (which roughly corresponds to the average output of the average magnetic phono pickup when playing the average high quality phono disc).

An appropriate reference level becomes still more problematical for tape recorders. The 1953 NAB standard said that it should be the output level obtained when playing back a tape containing a 400 Hz tone recorded at a level producing 2% total harmonic distortion, with the "recording system operating under normal operating conditions . . . (and) using tape that is normally available."

But what are "normal operating conditions"? Tape recorder manufacturers vary in their frequency response objectives and accordingly, in the amount of bias current employed. The result is differences in the amount of 400 Hz signal impressed on the tape for given distortion. And what is "tape that is normally available"? For a given frequency response at a given tape speed, the amount of 400 Hz signal recorded at given distortion tends to vary according to kind of tape used —conventional, high-output, low-noise, etc. And it tends to vary according to tape coating thickness. True, with the exception of high-output tape, these differences in recorded level are not very profound. They tend to be on the order of 1, 2, or perhaps 3 dB. But in an art where every improvement of 1 dB is virtually an engineering triumph, there is a need to be quite precise about the reference level.

Therefore the new NAB standard seeks to introduce a reference free from variations in operating conditions and in the tape used. In effect it seeks to postulate as the reference a specific amount of magnetic flux presented to the playback system.

"The NAB Standard Reference Level shall be that 400 Hz level which is equal to the recorded level on the NAB Primary Reference Tape." The Primary Reference Tape, made under laboratory conditions, "is a tape of the normal general-purpose type which has been selected for average characteristics of output, sensitivity and distortion. The 400 Hz recording on it was made at 7½ ips with bias adjusted for maximum output (at 400 Hz), at an output level 8 dB below that which produced 3% third harmonic distortion . . . It is . . . a practical convenient method of specification consistent with the magnetic recording and reproducing process. Since neither the tape nor the measurement conditions can be duplicated exactly in the field, all NAB Standard Test Tapes contain a 400 Hz recording at the NAB Standard Reference Level within ±0.25 dB as a means for making this level available."

In sum, the new NAB reference level for S/N measurement is a 400 Hz tone on an NAB Standard Test Tape. The same reference level is used on the seperate test tapes for 7½, 15, 3¾, and 1⅞ ips.

John G. McKnight, Ampex staff engineer who was on the NAB committee that formulated the new tape standards, comments on reference levels, as follows:

"Since, in magnetic tape recording *applications*, it is common to express levels in decilogs ("decibels"), rather than using the basic units themselves, it would be convenient to have a reference quantity for a magnetic recording decilog system. (This reference quantity would be comparable to 1 mW as a reference quantity for the dBm, or 1 V as the reference quantity for the d1V.) Such a quantity may be arbitrarily chosen; it is convenient that it be the basic SI unit (Wb/m) or a decimal multiple of it; and that it be in the order of magnitude of commonly-used flux values, namely, 150 to 320 nWb/m. Thus, a convenient quantity for a "decilogs, flux" would be 0 d1 = 100 nWb/m.

"In a practical recording and reproducing system, the levels are indicated on some sort of "volume indicator"; for example, a VU meter, a quasi-peak-reading meter, etc. The choice of flux level for the "operating level"—that is, the flux level when the meter points to its "0 d1" mark—it is an operating quantity determined by experience with a recording system. When recordings are to be interchanged, as in broadcasting applications, and with master tapes for phonograph disc manufacturing, it is very desirable that a uniform "operating level" be adhered to. Surpisingly enough, most of the standards—BS, EIA, IEC, CCIR, RIAA and SMPTE—make absolutely no mention of an operating level. Those who do consider an "operating level"—Ampex Corp., DIN, and NAB,—do not employ uniform terminology and practices.

"The Ampex Reproducer Test Tapes contain an "operating level" section in the sense defined above. The NAB "standard reference level" is identical to the NAB "standard recorded level," and is, in fact, also an "operating level" as defined

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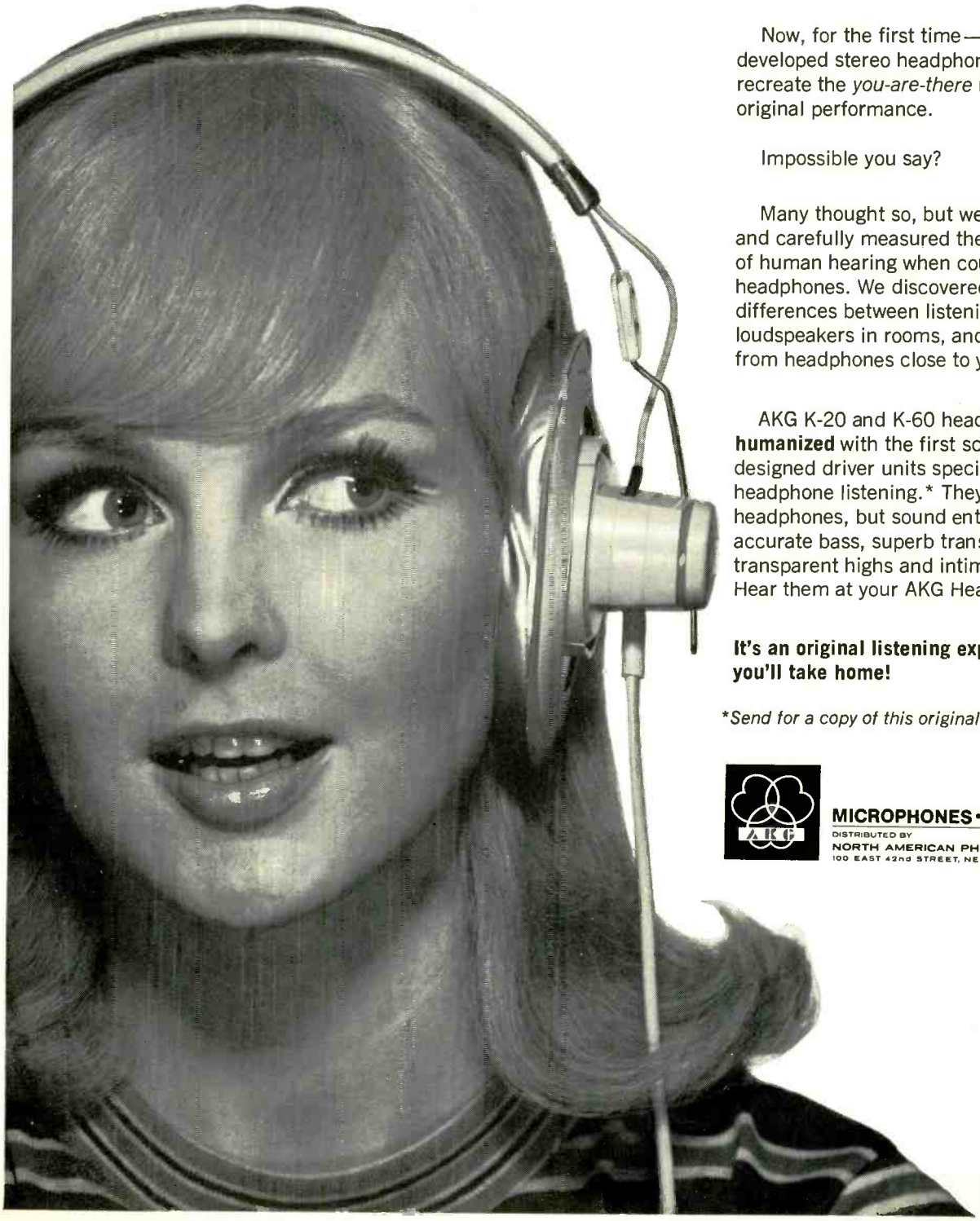

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above. The DIN Standards call out setting the operating level of a recorder by means of a *distortion* measurement; the "Bezugspegel" (reference level) on the DIN Test Tapes is not referred to in the other DIN Standards. On the other hand, the "Bezugspegel" is used as the operating level in German broadcasting practice.

"The SMPTE has standardized a "signal level," which is "for use in controlling magnetic sound recording levels and standardizing methods of signal-to-noise measurements...." Since no description is given of operating practices, this signal level is really an arbitrary reference quantity similar to the "100 nWb/m" mentioned above; it is not an operating level."

"The clear separation of the "reference quantity" and the "operating level" is very desirable: the reference quantity is only a measurement unit, and, once chosen, needs never be changed. On the other hand, the operating level is variable because it is influenced by the tape, the equalization, the volume indicator, and other factors."

As previously remarked, the NAB Test Tapes were not yet available when this was written. Measurement methods, however, are not totally uncertain inasmuch as the new procedure can be related within a small number of dB to present measurement practices.

Assuming an NAB Standard Test Tape is available, the new procedure is as follows. (1) Play the 400 Hz tone on the test tape and measure the output of the playback system. (2) Put another tape through the recording process with bias but no audio signal applied to the tape, and measure the output of the playback system. (3) Calculate the ratio, in dB, of the first to the second measurement; this is the S/N ratio.

The NAB standard further specifies that "the response of the measuring system shall be uniform ±0.3 dB from 30 to 15,000 Hz. Response at 20,000 Hz shall be 3 dB below the 400 Hz value, falling at the rate of at least 12 dB per octave above 20,000 Hz."

The reason for rapid cutoff of high frequency response of the measuring system is to exclude inaudible noise frequencies from measurement, particularly the bias frequency.

"The indicating meter (for measuring output) shall have the dynamics of the Standard Volume Indicator (ASA Standard C16.5-1961). The measuring system shall have a full-wave rectified average measurement law."

How does the foregoing relate to current practices? Some parties, including manufacturers of high quality tape recorders, specify the reference as the output level of a 400 Hz tone recorded at 3% total distortion or third harmonic distortion. (Inasmuch as third harmonic is the principal distortion component for tapes, total harmonic and third harmonic distortion are approximately the same for present purposes.) Others employ the Ampex test tapes containing a 700 Hz tone at "operating level." This signal is recorded at a level producing about 1% harmonic distortion on the tape, and about 6 to 8 dB below the level producing 3% harmonic distortion. We have already noted that the 400 Hz reference signal on the NAB Primary Reference Tape is to be recorded 6-8 dB below the level producing 3% harmonic distortion on the tape (with "normal" bias, and excluding amplifier distortion). Therefore the Ampex "operating level" and the NAB Standard Reference Level are about the same. If a person sets his own reference level by recording a 400 Hz tone at 3% harmonic distortion, his reference is *about* 6-8 dB higher than the Ampex and NAB references; the actual distance depends on how nearly the tape used by the individual resembles the magnetic characteristics of the tape selected by NAB for making its Primary Reference Tape.

As an approximation, we may say that a person employing 3% harmonic distortion as the reference, and using conventional tape (1½-mil thickness and not a special-purpose type such as high-output, low-noise, etc.), should reduce his S/N measurement about 8 dB to conform to the new NAB standard or to a measurement based on the tone at "operating level" on an Ampex test tape.

(Continued next month)

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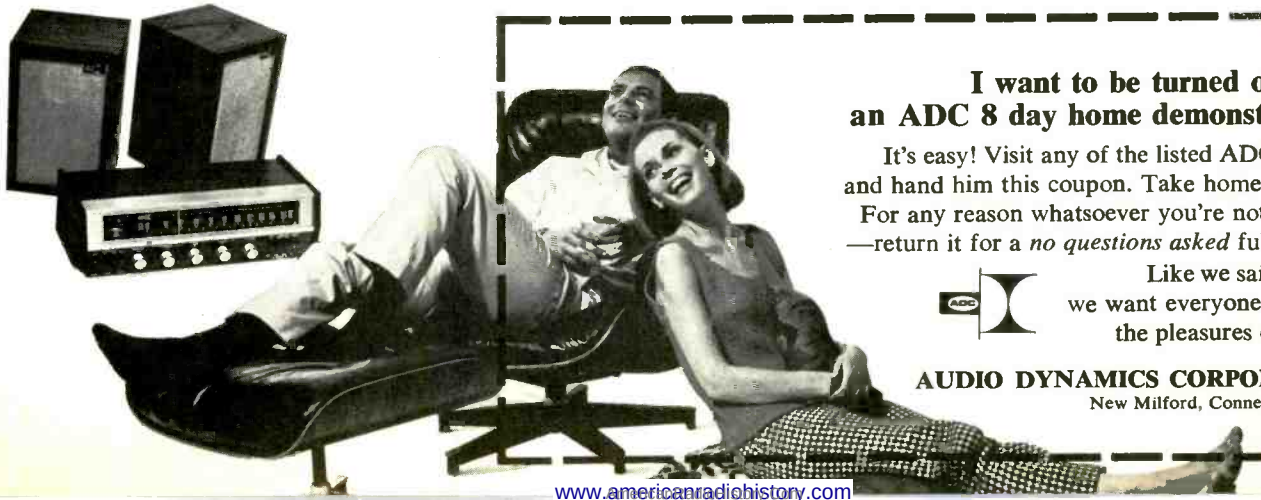

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Exhibit Areas:

Salon de Musique
North and East Galleries
Mezzanine and Library

AES

CONVENTION PAPERS

To be presented at Technical Sessions

AUDIO APPLICATIONS

Monday, October 16—9:30 A.M.

Chairman Frank A. Comerci
CBS Laboratories, Stamford, Connecticut

A Review of Some of the Applications of Acoustic Waves to Oil Field Problems
Gerald J. Crawford, Schlumberger Technology Corporation, Ridgefield, Conn.

Mortar Location with Orthorgonal Gradient Microphones
Edward J. Foster, L. T. Fiore, and B. B. Bauer, CBS Laboratories, Stamford, Connecticut

Acoustical Measurements by Time Delay Spectrometry
Richard C. Heyser, California Tech Jet Propulsion Laboratory, Tujunga, California

R-C Active Filters for Audio Frequency Applications
David Friend, RCA, Princeton, New Jersey

Design of an Inductive Communication System for Shipboard Application
Philip Marino, Michel Copel, US Naval Applied Science Laboratory, Brooklyn, New York

Magnetic Tape Considerations for Continuous Loop Operation
Ralph Cousino, Orrtronics, Inc., Toledo, Ohio

(Continued on page 100)

EXHIBIT HOURS

Monday (October 16) ..... 4:00 p.m-9:00 p.m.
Tuesday (October 17) ..... Noon-9:00 p.m.
Wednesday (October 18) ..... Noon-5:00 p.m.
Thursday (October 19) ..... Noon-7:30 p.m.

Exhibitors	*Booth Numbers*
Altec Lansing	21
Ampex Corp.	44, 45, 46
Audio Designs and Manufacturing, Inc.	16
Audio Instrument, Co., Inc.	12, 13A
Audio Magazine	49
B & K Instruments, Inc.	5
The R. T. Bozak Manufacturing Company	26
Caddco Audio Industries Corp.	7
Capps & Company, Inc.	8
Crown International	19
Dolby Laboratories (England)	42
Electrodyne Corp.	40, 41
Electro-Voice, Inc.	6
Fairchild Recording Equipment Corp.	10, 11
Gauss Electrophysics, Inc.	32
General Radio Co.	29
Gotham Audio Corp.	48
Langevin, a Div. of Scientific Industries, Inc.	17, 18

Exhibitors	*Booth Numbers*
Lang Electronics, Inc.	34
Lipps, Inc.	35
McMartin Industries, Inc.	47
Melcor Electronics Corp.	22, 23
Nagra Magnetic Recorders, Inc.	50
North American Philips Company, Inc.	34
Nortronics Company, Inc.	28
Phase III (R. A. Moog)	13B, 14
Scully Recording Instruments Corp.	24, 25
Sennheiser Electronic Corporation (N. Y.)	1, 2
Sintered Specialties	9
Sound Techniques	20
Spectra Sonics	38, 39
Taber Manufacturing and Engineering Co.	36
3M Company, Revere Mincom Div.	27, 27A
Universal Audio Inc., Div. of Studio Electronics Corp.	33
Vega Electronics Corp.	37
Waveforms, Inc.	31

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TRANSDUCERS

Monday, October 16—1:30 P.M.

Chairman Philip B. Williams
Jensen Mfg. Div. Muter Company
Chicago, Illinois

Dispersion as a Factor in Loudspeaker Performance
Charles L. McShane, Acoustic Research, Inc., Cambridge, Massachusetts

Nonlinear Distortion in Dynamic Direct Radiator Loudspeakers
Harry F. Olson, RCA Laboratories, Princeton, New Jersey

Transient Response of Loudspeaker Crossover Networks
Oliver McDaniel, Pennsylvania State University, State College, Pennsylvania

An Implantable Applanation Transducer
Philip Kantrowitz, Sonotone Corp, Elmsford, New York; Paul Freed, Maimonides Medical Center, Brooklyn, New York: Dr. T. Okura, University of Tokyo, Tokyo, Japan

Application of a Miniature Noise Suppressing Microphone to an Oxygen Mask
George R. Sebesta, Arthur J. Mellen, Alan Hofer and Richard W. Carlisle, Dyna Magnetic Devices, Inc., Hicksville, New York

Basic Circuit Consideration in FET-Equipped Condenser Microphones
Stephen F. Temmer, Gotham Audio Corporation, New York, New York

Some Problems in Head-Worn Aid Response Measurements
Hugh S. Knowles, Knowles Electronics, Inc., Franklin Park, Illinois

The "Humanized" Headphones
Ingf. Amplatz, AKG, Vienna, Austria (To be read by A. Brakhan)

SPEECH AND MUSIC

Monday, October 16—7:30 P.M.

Chairman Robert A. Moog
R. A. Moog Company
Trumansburg, New York

Information Content of a Sound Spectrogram
Tiong Suy Yu, Wayne State University, Detroit, Michigan

Limited-Vocabulary Adaptive Speech-Recognition System
Paul W. Ross, RCA Laboratories, Princeton, New Jersey

Apparatus for Generating Serial Sound Structures
Hugh Le Caine, National Research Council of Canada, Ottawa, Canada

Electronic Music in Communications
Eric Siday, Indentitones Incoporated, New York, New York

Computer Control of Sound Apparatus for Electronic Music
James Gubura and Gustav Ciamago, Dep't. of Computer Science; University of Toronto, Toronto, Ontario, Canada

Creative Aspects of Live-Performance Electronic Music Technology
Gordon Mumma, Cunningham Dance Foundation, New York, N. Y.

Music Signal Processing for Fun and Profit
Robert A. Moog, R. A. Moog Company, Trumansburg, New York

Integrated Circuits in Organs
Harold O. Schwartz, The Wurlitzer Co., N. Tonowanda, N. Y.

AMPLIFIERS

Tuesday, October 17—9:30 A.M.

Chairman A. W. Linder
H. H. Scott, Inc., Maynard, Massachusetts

The Charge Amplifier
David Bell, Electro-Voice, Inc., Buchanan, Michigan

Sources of Noise in Magnetic Tape Reproduction and Their Minimization
Norman P. Doyle, Fairchild Semiconductor Products Inc., Phoenix, Arizona

Design Factors and Considerations in Full Complimentary - Symmetry Audio Power Amplifiers
George C. Haas, Motorola Semiconductor Products, Inc., Phoenix, Arizona

Protection of Amplifiers
Daniel R. von Recklinghausen, H. H. Scott, Inc., Maynard, Massachusetts

Latest Advances in Linear Integrated Circuits for Professional Audio Amplifiers
Basil T. Barber, Sperry Gyroscope Corp., Great Neck, L. I., N. Y.

Power Output and Power Dissipation in Class B Transistor Amplifiers
R. S. Hartz, RCA, Somerville, New Jersey

Automated Production Testing of Audio Amplifiers
Derek Wheeler, McCurdy Radio Industries, Toronto, Ontario, Canada

CONTROL SYSTEMS

Tuesday, October 17—1:30 P.M.

Chairman Philip C. Erhorn
Philip C. Erhorn and Associates, Inc.
Stonybrook, New York

Active Isolation "Transformers" In Studio Console Design
William G. Dilley, Spectra Sonics, Ogden, Utah

A Modular Audio Facilities Mixing System
John P. Jarvis, Langevin, Santa Ana, California

A Versatile Table Top Audio Control Console
Donald N. McLaughlin, Electrodyne, North Hollywood, California

Remote Control of Modular Equipment in Audio Consoles
George Alexandrovich, Fairchild Recording Equipment Corp., Long Island City, N. Y.

A New Custom Modular Console Constructed with Standard Stock Components
Arthur C. Davis, Controls Division, Altec Lansing, Anaheim, California

ABC's New Standard Audio Production Console for Television
James R. Baker, American Broadcasting Company; New York, New York

Rerecording Console for the Preparation of Duplicating Master Tapes
Mitchell G. Heller, Tape Transfer Techniques, Chicago, Illinois. Alfred Antlitz, Radio Station WFMT, Chicago, Illinois

A High Performance Control Console with Flexibility
Allan P. Smith, Naval Training Device Center, Orlando, Florida

A Completely Solid State Audio Follow Video Switching System
Michael H. Stoll, Sarkes Tarzian, Inc., Bloomington, Indiana

SOUND REINFORCEMENT

Tuesday, October 17—7:30 P.M.

Chairman Wayne Rudmose
Tracor, Inc., Austin, Texas

Audio-Visual Engineering—A New Discipline
William Szabo, Will Szabo and Associates Ltd., New Rochelle, eNw York

Church Sound Reinforcement
Daniel W. Martin, D. H. Baldwin Co., Cincinnati, Ohio

A Difficult Church Sound System Design
G. R. Thurmond, Tracor, Inc., Austin, Texas

Characteristics Influencing the Gain of Speech Reinforcement Systems
Daniel Queen, Perma-Power Co., Chicago, Illinois

A 1/3 Octave Band Variable Notch Filter Set for Providing Broadband Equalization of Sound Systems
Don Davis, Altec Lansing, Anaheim, California

Sound At Expo '67
N. E. Rudback, N. J. Pappas and Associatess, Montreal, Canada

Special Reproduce System for Independence Hall at "Knott's Berry Farm"
Akio Hosoda, Ampex Corporation, Redwood City, California

Integration of High Level Sound Systems and Acoustic Environment in the Houston Music Theatre
Charles F. Webber, Audio Acoustic Engineering, Santa Ana, California

A Solid-State School Paging and Music System
Philip C. Erhorn, Philip C. Erhorn and Associates, Inc., Stonybrook, N. Y.

BROADCASTING

Wednesday, October 18—9:30 A. M.

Chairman Harold L. Kassens
FCC Broadcast Bureau, Washington, D. C.

Integrated Circuits in Organs
Harold O. Schwartz, The Wurlitzer Co., N. Tonowanda, N. Y.

The Measurement of Loudness Level
Benjamin B. Bauer, Emil L. Torick and Allen J. Rosenheck, CBS Laboratories, Stamford, Connecticut

Automatic Control of Loudness Level
Emil L. Torick, Richard G. Allen, and Benjamin B. Bauer, CBS Laboratories, Stamford, Connecticut

Control of Broadcast Program Loudness
Arnold Schwartz, American Broadcasting Company, New York, New York

Loudness Control at NBC
J. L. Hathaway, National Broadcasting Company, New York, New York

Educasting
Lewis D. Wetzel, Triangle Publications, Inc., Philadelphia, Pennsylvania

Automatic Self-Monitoring for FM Transmitters
J. L. Smith, Collins Radio Company, Richardson, Texas

Advancements in SCA Receiver Design
Leonard Hedlund, McMartin Industries, Inc., Omaha, Nebraska

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STANDARDS

Wednesday, October 18—1:30 P.M.

Chairman Floyd K. Harvey
Bell Telephone Labs, Inc.
Murray Hills, New Jersey

RIAA Engineering Committee
H. E. Roys, Indianapolis, Indiana

IEEE's Work On Standards in the Field of Audio
Robert H. Rose, Newark College of Engineering, Newark, New Jersey

A Brief Review of EIA Standards in the Audio Field
J. A. Caffiaux, Electronic Industries Association, Washington, D. C.

The Standards Activities of the Institute of High Fidelity
Daniel R. von Recklinghuasen, H. H. Scott, Inc., Maynard, Massachusetts

The Role of the Society of Motion Picture and Television Engineers in Audio Standardization
H. W. Knop, Jr., E. I. du Pont de Nemours and Co., Inc., Rochester, N. Y.

NAB Audio Standards
Warren L. Braun, Consulting Engineer, Harrisonburg, Virginia

Rules and Regulation of the Federal Commission Pertaining to the Audio Fidelity Characteristics of FM Broadcast Transmitting Equipment
John T. Robinson, Federal Communications Commission, Washington, D. C.

USA Standards for Acoustical Measurements
Richard K. Cook, Environmental Science Serv. Admin., Rockville, Maryland

International Standards for Audio
William W. Lang, International Business Machines Corp., Poughkeepsie, N. Y.

John H. Potts Memorial Awards Banquet

Guest Speaker: GENE SHEPHERD

Barbizon-Plaza Hotel, New York City

Cocktails: 6:00 p.m.

Dinner: 7:00 p.m.

DISC RECORDING AND REPRODUCTION

Thursday, October 19—9:30 A.M.

Chairman Welton Jetton
Pepper Sound Studios, Inc.
Memphis, Tennessee

Tracking Ability Specifications for Phonograph Cartridges
J. H. Kogen, Shure Brothers, Inc., Evanston, Illinois

An Audio Noise Reduction System
Ray N. Dolby, Dolby Laboratories, London, England

Factors Affecting the Needle/Groove Relationship in Phonograph Playback Systems
C. R. Bastiaans, Westinghouse Research Labs, Pittsburgh, Pennsylvania

Phonovid, A System for Recording Television Pictures on Phonograph Records
Kenneth E. Farr, Westinghouse Electric Corporation, Pittsburgh, Pennsylvania

The Sony Servomatic Turntable
Sam Mabuchi, Sony Corporation, New York, N. Y.

The General Electric Letterwriter
Jack L. Kelly, General Electric Company, Audio Products Dept., Decatur, Illinois

TAPE RECORDING AND REPRODUCTION

Thursday, October 19—1:30 P.M.

Chairman Arthur E. Gruber, Consultant
East Rockaway, New York

The Grandy TDS-1 Tape Duplicating System
Edward Kissack, (To be read by D. E. Killen) Grand, Inc., West Caldwell, New Jersey

New Electronics for the 3M Master Tape Recorder
Dale Manquin, 3M Revere Mincon Division, Camarillo, California

Design Feature of a Flexible Multi-Track Recorder-Reproducer
John Curtis, Scully Recording Instrument Co., Bridgeport, Connecticut

Pitch and Timing Error in Tape Recording and Reproducing
John McKnight, Ampex Consumer and Education Products Div., Los Gatos, California

Alignment of Stereophonic Tape Machines
H. J. Korkes, CBS Radio Division, New York, New York

Magnetic Head Lapping for Professional Tape Recorders
William Taber, Taber Manufacturing and Engineering Co., Alameda, California

Design Considerations in the Boston University Library Headphone Listening System
William R. Lewis, Audio Lab. Inc., Cambridge, Massachusetts

FILM RECORDING AND REPRODUCTION

Thursday, October 19—7:30 P.M.

Chairman John Arvonio
Photo-Magnetics, Inc., New York, New York

Optical Sound Recording with a Silicon Carbide Electro-Luminescent Diode
Allan S. Miller, Paul L. Vitkus, National Reasearch Corp., Cambridge, Massachusetts

Synchronous Sound for Motion Pictures
Loren L. Ryder, Ryder Sound Services, Inc., Hollywood, California

A Mobile Electro-Acoustic Laboratory
Allan P. Smith, Naval Training Device Center, Orlando, Florida

The Film Projector – Magnetic Reproducer Double Sound System at CBS Television, N.Y.
Arthur C. Helmer, CBS Television Network, New York, New York

Audio Facilities for the Labyrinth Pavilion, Expo '67
Peter Mundie, N. J. Pappas and Associates, Montreal, Canada

The Survey of Current Problebs in TV Transmission of 16 mm Sound-on-Film
James Townsend, Townsend Production Service, New York, New York

Celestion loudspeakers transform "high fidelity" from a hackneyed phrase into living reality

(They're British —  — and you find them in all the best stately homes!)

The name Celestion may be new to you, but in the U.K. it goes back over 40 years. Celestion are both specialists and perfectionists: their speakers are used by the BBC and professional sound engineers, as well as by a vast critical listening public.
They are distributed in the U. S. by International Electronics Corporation, L. I., New York.

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

The Ditton 10 (12¾ x 6¾ x 8¼ in)
This represents the most advanced and sophisticated design yet seen in mini systems. The high frequency unit is developed from the HF1300 already in use by major broadcasting authorities, including the BBC, and the 5" long throw bass unit gives solid lows down to 35 c/s. Power handling capacity : 20 watt peak. Impedance : 3-4 ohms and 15-16 ohms. Finish : Satin walnut or oiled teak.

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LIGHT LISTENING

(Continued from page 74)

George Carlin: Take-offs and Put-ons
RCA Victor LSP 3772

A Detroit nightclub is the recording locale of this comedy album by George Carlin. Many a TV viewer is familiar with Carlin's act yet his name is not too well known in other sections of show businesss. As with so many rising young television comics, a new name such as his is inclined to get lost in the shuffle when he is introduced by the master of ceremonies. Then at the end of his act, audience laughter, especially true in the case of Carlin, drowns out the name when the video host calls him back for a curtain call.

Carlin is most famous for his penetrating study of an all too typical Top-40 Disc Jockey at a mythical radio station called *Wonderful Wind*. No one has come closer than Carlin in capturing all the trappings of today's disc jockey as heard on a radio station bent on promoting its own call letters instead of the program's "entertainment" content. The accuracy of Carlin's aim in this skit is explained in part by the fact that he worked as a disc jockey before becoming a writer for "The Kraft Summer Music Hall." His backstage knowledge of radio and television forms only a part of the ammunition he uses in demolishing both media.

The Carlin wit has a great time with the inane inflections heard on the air once you leave the big cities with their accumulation of reasonably big-time talent. His provincial sportscasters and bumbling weathermen are a harrowing reminder of TV fare seen on a motel receiver on one's last business trip. While most of the album is devoted to the foibles of the communication industry, George Carlin also reveals good potential as an all-around comedian in his sketch called "The Indian Sergeant." There's a lot of imagination at work in Carlin's depiction of "Military Life" in the ranks of the redskin as he campaigned against the white settlers.

C.S.

San Remo '67
M-G-M E-4461

Only persons outside the music industry are apt to confuse the title of this album with a current-year import motor car. San Remo, a lovely spot on the Italian Riveria, has been the scene of an annual song festival for the past seventeen years or so. The event started out as a showcase for Italian composers and singers hoping to gain some sort of fame strictly within the borders of their own country. With the growth in popularity of Italian popular tunes on the international music market, San Remo has gradually become a once-a-year gathering point for record firm executives and music publishers who somehow allow themselves to be persuaded to leave their lands every January for the rigors of a visit to the Riviera.

For the very reason that the festival has become such an international affair, many of the arrangements now sound quite non-Italian in flavor. This year's songs in the competition, as represented on this album by the vocalists who sang them in the contest, have more than an occasional echo of the Twenties style found most prominently in *Winchester Cathedral*. The winning tune, *Non Pensare A Me*, is more in the straight Italian tradition than some of the other finalists, reflecting the fact that juries from fifteen different towns in Italy cast votes for the winner after watching the contest on television. This may not be an earth-shaking release for the general listener but it does offer an unusual insight into musical democracy in action.

C.S.

The Greenbriar Boys – Better Late Than Never!
Vanguard VRS 9233/VSD 79233,
$4.79/$5.79

Dunno if the management will let me toss this review into the non-classical department; I hope so 'cause I like the Greenbriar Boys a lot and I like to share my enjoyment.

These four (short haired, more or less) play a basically traditional non-electrified kind of sound, with a quirky, off-hand humor that's on the edge of satire—very nice and easy. A great relief from too much Social Significance music—though that kind is enjoyable too, when the moment is right.

This, I suppose, is modified bluegrass, which is a modification of old-timey or country music, as played by city folk mostly. All to the good, these successive modifications! For the old-fashioned corn is still there but much better polished and the sound effects, take it from me, are a lot more enterprising and original (which means more interesting) than the stuff from 'way back.

Sort of super-country music. Like, say, Kodachrome II, after plain old Kodachrome; same thing but more sophisticated.

E.T.C.

Performance: A *Sound:* B+

EQUIPMENT PROFILE

(Continued from page 90)

As a general-purpose dynamic microphone, the 635A is likely to continue the saga of the famous 635, of which it derives in a continuing effort to improve the line. Its price is $49.20, which includes an 18-ft. cable and the matching Cannon XLR-3-11 plug, as well as a stand coupler with the usual 5/8-27 thread. Check 25

Model 636

This unit is primarily intended as a public address model, and resembles in general appearance the professional 654A with the exception of its mounting. While the latter has a Cannon XLR-3 connector and if intended for use on a stand requires a mount, the 636 has an integral mounting base

Fig. 23—The Electro-Voice Model 636 microphone primarily intended as a public-address model. Note the switch on the swivel mounting base, which is integral with the microphone.

equipped with a switch and terminating in an Amphenol 91MC4M plug which permits changing between low and high impedance simply by changing the connections inside the female receptacle. The output level is approximately—58 dB, and frequency response is fairly uniform between 80 and 11,000 Hz, with usable sensitivity from 60 to 13,000 Hz. This model is attractive in appearance, partially because of its resemblance to the higher-quality 654 and 655 models, and is thus considered an ideal model for PA use; especially when one considers its price, which is only $43.50. It is also available with a gold finish at $46.50. Check 26

SOUND AND SIGHT

HAROLD D. WEILER

WE CONCLUDE THIS SERIES describing the use of a test pattern (Fig. 1) for the analysis, adjustment and evaluation of the various components employed in video recording and closed-circuit television.

The group of short, individual lines located above the figure 300, in the lower-left quadrant of the large circle in the test pattern (indicated as "A") and those below the number 350, in the upper-right quadrant of the circle (indicated as "B") are called "ringing bars."

Each of the five individual lines which make up the two "ringing bars" is exactly the same width as a single line of the horizontal resolution wedges at the position indicating the same number of lines. For example, the last line in ringing bar "A" is exactly the same width as a single line at the position of the horizontal wedge opposite the number 300. The second line in the ringing bar, indicated as "B," is the same width as a single line at the position of the horizontal wedge opposite the number 400. The five individual lines of ringing bar "A" indicate 50, 125, 175, 250 and 300 lines. The lines on ringing bar "B" indicate from top to bottom, 350, 400, 475, 550 and 600 lines.

These bars are employed to check equipment for the condition known as "ringing" at various frequencies ranging from approximately 600 kHz to 7.5 MHz. (Lines may be converted into frequency and frequency into lines by means of the table provided in AUDIO, April 1967). Ringing is a condition in the image displayed on the screen of a monitor/receiver where fine white and/or black lines follow any sharp black or white transition.

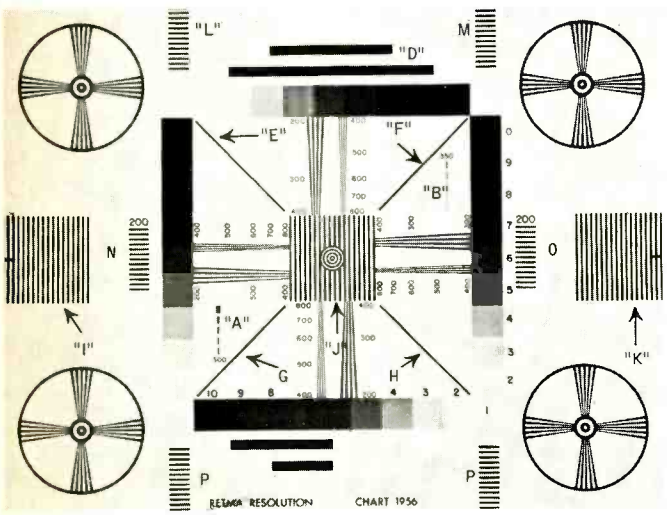

Fig. 1—The RETMA resolution chart.

Should the response of a video amplifier be peaked at some frequency due to excessive high-frequency compensation or some defect which creates a resonant circuit, a ringing or damped oscillation will occur whenever that particular frequency is present. When this condition occurs any portion of the reproduced image containing that particular frequency will repeat itself several times. These multiple images are usually evenly spaced from each other, decreasing in intensity as their distance from the point of transition increases. Ringing can best be described as a series of shadows similar to the ghost images in commercial broadcasting created by multipath distortion.

The horizontal-resolution wedges on the test pattern will also display this effect when ringing is present. The approximate frequency at which ringing occurs will be indicated by the position on the wedges at which the multiple images are most prominent. The horizontal resolution wedges are not generally employed for this purpose since the ringing may occur at some multiple of the wedge lines and therefore be obscured.

An effect similar to ringing, which also creates multiple reflections of the basic wedges of the test pattern, is caused by improper termination on the transmission line. All monitor/receivers, when used singly or as the last one in any transmission line, must have a 75-Ohm termination.

"Streaking" is a term employed to describe the condition displayed on a monitor/receiver when any reproduced object appears to be extended horizontally beyond its normal boundaries. This condition is most apparent at the vertical edges of any object where a large transition from black to white or white to black occurs. The change in luminance is then carried beyond the point of transition. It may be either positive or negative. When the tonal degradation is opposite to the original shade (black following white or white following black), the streaking is called negative. When the shade of the streaking is the same as the original shade (white following white or black following black), the streaking is called positive.

Streaking becomes readily apparent when a test pattern is employed. It is indicated by any extension of the four horizontal black bars shown as "C" and "D" in Fig. 1 (at the top and bottom of the large circle). Any streaking following these bars indicates now-

AN ASTOUNDING NEW AUDIO NOISE REDUCTION SYSTEM WHICH IS MAKING BACKGROUND NOISE YESTERDAY'S PROBLEM.

The Dolby claims—and gives

A 10dB increase in usable dynamic range
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PLUS generally cleaner, more transparent recordings—with unaltered frequency response and signal dynamics.

In only 12 months the Dolby S/N Stretcher system has created such an impact on recording engineers that already over 25 major European and U.S. broadcasting, film, and recording companies are using it for master recording, dubbing, transferring to disc, landline and microwave link transmission, and the production of motion picture and video tape sound tracks.

The basic principle of the system is simple. Low-level signals are amplified in four independent frequency bands during recording and attenuated in a complementary way during playback—recording noises being reduced in the process. High-level signals are unaffected by this procedure (no distortion or overshooting), and the symmetrical design of the circuitry ensures that the signal is restored *exactly* in all details—high-level *and* low-level, amplitudes *and* phases. The result is a noise reduction system with ideal characteristics—perfect signal handling capability which can pass any line-in, line-out A-B test, and a genuine 10dB noise reduction.

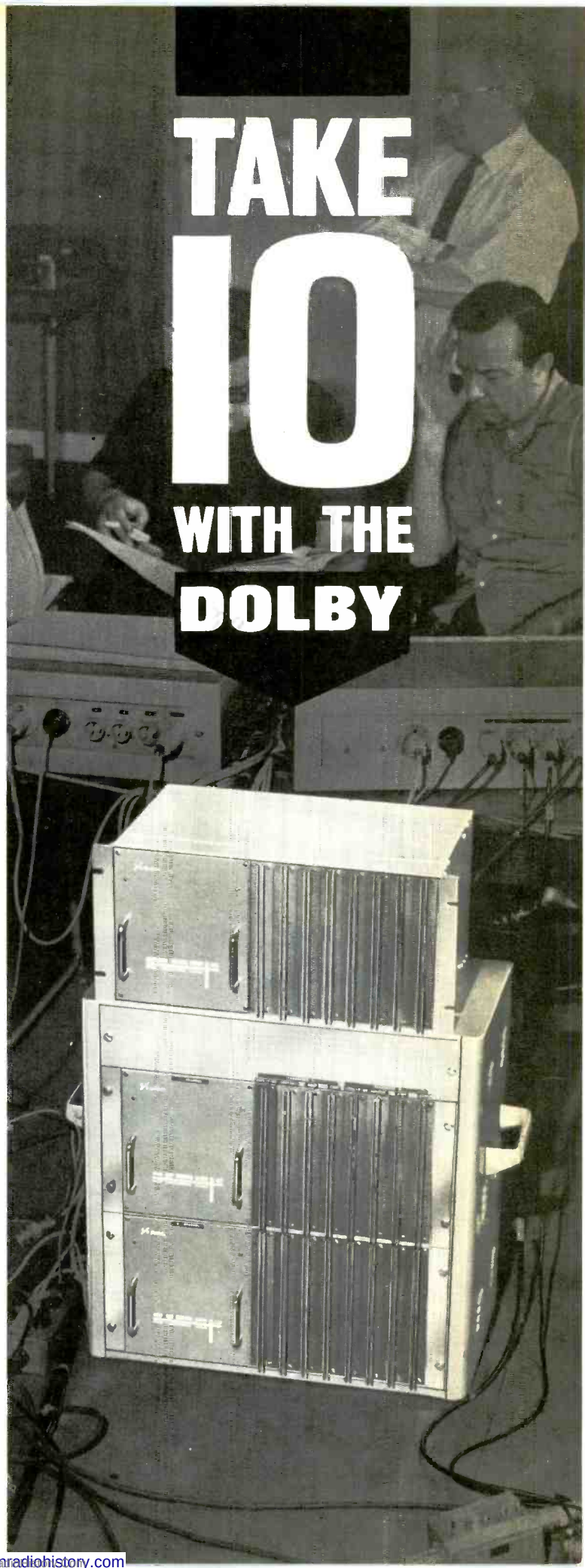
In short, the Dolby offers an entirely new usable area of sound for the recording engineer. Get to know more about it fast by writing directly to Dolby Laboratories or contacting your nearest agent.

VISIT THE DOLBY BOOTH AND DEMONSTRATION ROOM AT THE A.E.S. FALL CONVENTION

DOLBY LABORATORIES

590 Wandsworth Road · London, S.W.8 · England
Telephone: 01-622 0949 · Cables: Dolbylabs London

Europe and the Middle East: Impetus SA, 2 Via Berna, Lugano, Switzerland. **Australia:** General Electronic Services Pty. Ltd., 5 Ridge Street, North Sydney. **Japan:** Sakata Shokai Ltd., No. 10, 2-Chome, Kandakaji-Cho, Chiyoda-Ku, Tokyo.



frequency phase and/or amplitude distortion. The bars represent half cycles of square-wave signals ranging from about 30 kHz for the longest bar to 100 kHz for the shortest. These bars are employed to determine the approximate frequency range within which the distortion is being created. When the distortion is close to 30 kHz the longest bar will display more intense streaking than the others. Should the distortion be close to 100 kHz the shortest bar will display more intense streaking than the other three. When no distortion is present the streaking bars will all be very sharply defined with no leading or trailing edges.

Streaking bars are most commonly employed when adjusting the high-peaking circuits used in video cameras to compensate for high-frequency roll-off of the coupling network between the vidicon tube and the first stage of video amplification.

In order to eliminate "flicker" in video recording and closed circuit television, a technique known as interlaced scanning is employed. The picture is scanned from top to bottom twice and the two sets of scanning lanes are then interlaced. Most cameras employed with lower-priced video recorders and for industrial closed-circuit television employ a technique known as random interlace. Here, the scanning lines of alternate fields do not always fall exactly between each other but tend to fall (in pairs) one on top of the other. Professional cameras on the other hand provide complete (or 2 to 1) interlace, the scanning lines fall exactly between each other at all times, providing improved vertical resolution. (A complete description of interlaced scanning was provided in AUDIO, March 1966.)

The four diagonal black lines, indicated as "E," "F," "G," and "H," located inside the square formed by the grey scales, are employed to check the quality of the interlace. Should these lines appear jagged or serrated, partial pairing of the interlace lines is occuring. This is not a positive test, however, when the even and odd fields overlap exactly. Under these circumstances, the vertical resolution is reduced to the extent that the cause is immediately apparent.

The corner and center vertical resolution wedges may also be employed as a check for the quality of interlace. When the interlace quality is poor, the lines in the wedges weave and intermix and produce a moire effect.

The large center circle, the four corner circles and the three squares of 200 line vertical bars, indicated as, "I," "J," and "K," are employed to determine the horizontal linearity. Ideally the circles should display no distortion; they should be perfectly round. The horizontal length of the square should be equal. Under normal circumstances any deviation from normal can be usually corrected by adjustment of the width and horizontal linearity controls of the camera or monitor.

The six sets of short 200 line horizontal bars, indicated as "L," "M," "N," "O," "P" and "Q," and the large center circle are employed to check vertical linearity. The circles should appear perfectly round and the height of all horizontal bars should be equal. Any deviation from normal can usually be corrected by adjustment of the height and vertical linearity controls in the camera or on the monitor/receiver. Æ

AUDIO ETC.

(Continued from page 18)

positive and enjoy yourself all at the same time. Gems, those exhibits—and often put on by very big companies, too.

I do suggest that every Visitor at the Hi-Fi Show exercise his immemorial right to vote, in person. Not by casting a ballot (though there are lots of desperate little "please send me further information—when & if" ballots and boxes for equipment that Didn't Quite Make the Deadline). Just register a visible and audible reaction. The Big Shots are all over the place, in every exhibit, you know. Watching their audience like hawks.

You can do an awful lot to boost your own ego at the Show. An expressive frown at the right moment, or a look of utter disgust straight at the Chief Exhibitor, as you walk out of his room *very* quickly, will curl his hair for him if he has any. Maybe you think he didn't notice? He did! Inside, he's boiling. Or wilting.

But be kind to intelligent Exhibitors. If you find something you really like, please say so. Or just smile. That does it. Hang around, too. Look as interested as you really are. Be receptive, if the man starts telling you all about it.

Remember, you're perfectly safe. He can't sell you a thing. All he can do is to be persuasive. If he's a good man, you'll learn something. And if he's even better, he'll put on a sonic show just for your benefit—imagine it! The President of the Big Company giving *you* a private and special demonstration. It happens plenty often.

Finally, though I hate to say it, you'll have to keep in mind that the sound you like best isn't always the best sound. Inevitably. I'm not thinking so much of those boorish loud noises that seem to steal all the thunder (and aren't worth it) as, oppositely, the more modest sounds that are really better than they seem, under such difficult conditions. Also the loud sounds which, for one freakish reason or another, sound distorted—and aren't. Acoustics, again. It's a factor we have to live with in such places. I do hate to hear a loud, ugly blast coming out of equipment that I *know* is absolutely first rate! It is often the Exhibitor's fault, to be sure; but often it is not.

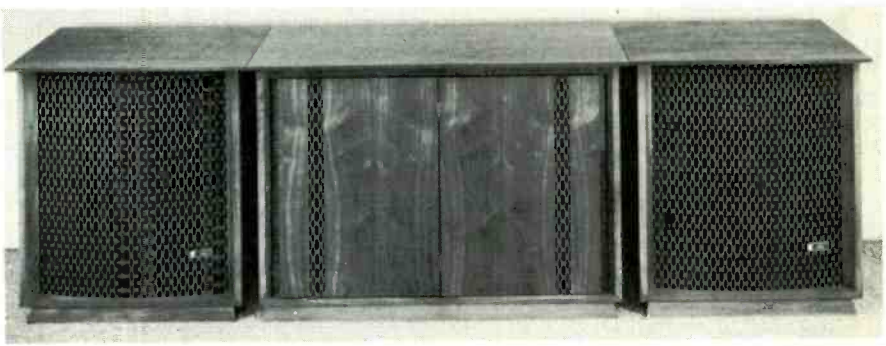
So, Visitors, keep your cool and keep your discrimination going in top gear, and you will both enjoy and learn. If you didn't, there wouldn't have been so many Big Shows in the past. And there wouldn't be this one, this year, either. There IS one. So I must be right. *Æ*

Rockford Model 920 hi-fi equipment cabinet/#980 speaker enclosures.

Jensen Model 1200-XLE 4-way console speaker system.

Bozak Model B-4000 console speaker system.

Hartley-Luth Concertmaster V-a 3-way speaker system.



Altec Lansing Valencia III: Model 833A equipment cabinet and Models 846A speaker systems.

The '68s Are Coming

(Continued from page 30)

synchronous motor-equipped Model 50H ($149.50). United Audio will display its line of Dual automatic turntables, which includes its feature-loaded Model 1015. Priced at $89.50. BSR (USA) will display its line of BSR McDonald automatic turntables, starting at $49.50.

Phono cartridges

We've got an exotic one here—Kenwood will introduce a photo-electric cartridge. The pickup incorporates a lamp, screen, photo-electric diodes, and a preamplifier. Here's how it works: The movement of the stylus on the record causes the screen to vibrate. This movement controls the amount of light passing through the screen onto the diodes. The amount of light on the diodes determines the amount of audio signal going to the preamp. $120.

Stanton has added two new models to its Calibration Standard Series: Models 681 EE (elliptical stylus) and 681 A (7-mil stylus). Both are designed for professional use, says the manufacturer. They are priced at $60 and $55, respectively. Individually calibrated, they each feature a 10-Hz to 20-kHz frequency response that is within ±½ dB from 10 Hz to 10 kHz. And each model is equipped with a replaceable "long-hair" stylus assembly that cleans record grooves while it plays.

Shure will demonstrate its new M75E high-trackability/modestly-priced pickup ($39.50), along with the "Trackability" cartridge, Model V-15 Type II ($67.50). The new Ortofon SL-15T cartridge, which features external transformers to reduce cartridge size and weight, will star at Elpa Marketing's exhibit. It's priced at $75 with transformers. Empire will show off its new Model 999VE Professional, priced at $74.95. Pickering will introduce a new series of Dustamatic cartridges, the XV-15 line, which features five models, each for a different application.

Tape recorders

The proliferation of tape recorders over the past few years has bewildered some prospective purchasers. "Should I buy reel-to-reel?" "Which cartridge system is best?" and so on. Attendees at hi-fi shows can seek out answers to many of their questions, of course. With so many manufacturers being represented, chances are reasonably good that some questions will be resolved.

Here are a few insights to some new, exciting tape recorders to be disclosed at the N. Y. Show: Crown International has a beauty—a computer-controlled Pro 800 recorder, Model CX-824. A small, built-in logic memory system is said to make it impossible for the operator to damage a magnetic tape due to activating the wrong operational button. For example, with the transport fast-reeling, the "Operate" button may be pressed without fear. The transport will automatically go into the operate mode! In addition to providing safety measures, especially useful when handling master tapes, the deck is said to exhibit unusually smooth tape handling. Crown International guarantees a signal-to-noise ratio of 60 dB at 7½ ips. Other speeds are 15 ips and 3¾ ips. Priced in the $1500 vicinity.

Sony-Superscope will be showing off a group of new tape recorders. No doubt that the company's automatic reel-to-reel tape recorder changer ("What's New in Audio," AUDIO, September 1967), first shown at the Consumer Electronics trade show, will be on hand. Sony's new Model 560 "Stereo Compact" tape recorder and model 560-D deck will be shown, too. The four-track, three-speed recorders, priced at $449.50 and $349.50, respectively, incorpo-

(Continued on page 112)

The '68s Are Coming

(Continued from page 111)

rate Sony's E.S.P. system to automatically reverse tape direction in the absence of a recorded signal on any tracks.

Expect to see two new entries in the tape recorder field (new for this country, that is): BSR's TD 1020 4-track/3-speed tape deck at $130, and United Audio's (Dual) 4-track/2-speed tape recorder at $199.50. Both are reel-to-reel types.

Norelco will demonstrate how its stereo cassette changer operates ("What's New in Audio," AUDIO, September 1967), as well as other cassette and reel-to-reel recorders. Tandberg will show its Series 13 endless tape cartridge playback and playback-record machines, plus reel-to-reel models.

Speaker systems

It might appear that the high-fidelity industry is inundated by speakers. AUDIO's Annual Product Preview Issue (August 1967) listed 230 speaker system and speaker mechanism models, as an example. But the wide assortment available to hi-fi enthusiasts is not as foolhardy as it might seem. Speakers, all of which have *some* coloration, are often changed as listening tastes mature; new cabinet styling, which blends into the room decor more easily than earlier models did, is another inducement to change; additional speakers for remote listening areas are also responsible for the great number of speaker models produced. (Recognizing that so many people are adding remote speakers, many manufacturers have incorporated front-panel remote speaker control switches.)

Decor-conscious Empire, who introduced speaker systems which double as marble-topped pedestals a few years back, now introduces its "Kitten" line of speaker systems—

Koss Model K-6 stereo headphones feature 10 to 15 kHz response.

Sharpe Model HA-670/PRO, glamour version of the HA-660/PRO, with individual volume controls.

David Clark Model 1000 has 14 karat gold-plated hardwear.

Superex Model ST-PRO-B woofer-tweeter stereophones.

one of which doubles as a cushioned seat (Model 2000K), another as a marble-topped table (Model 2000M), and a third as a standard-looking compact speaker. Each model incorporates a 10-inch high-compliance woofer and a mid-range/tweeter direct radiator. Overall dimensions are 18½-in. high x 11⅞-in. deep x 11⅞-in. wide. Prices start under $100.

The Wharfedale Div. of British Industries will usher in a new, 1968 line of speaker systems, six in all. They all feature acoustic-suspension systems for low bass speakers. Three are bookshelf types, one can be used for either bookshelf placement or floor placement, two are floor-standing types. The latter three employ sand-filled enclosures. Equally as important as the foregoing, all the enclosures have removable grilles for fabric coordination. Prices range from $49.50 for Model W20D, a two-way bookshelf speaker system, to $315 for a six-speaker, four-way floor-standing system.

JBL will introduce its first 12-inch composite transducer, Model LE12C. It's composed of a 12-in. low-frequency speaker which surrounds a "perfectly-phased" piston-type direct radiator, plus a frequency-dividing network. $108. In addition, a new compact speaker system, the JBL 88, will be shown. Highly styled, it houses a new 12-in. woofer, the same LE20-1 high-frequency transducer used in JBL's Lancer 77 and 99 systems, and a frequency-dividing network. $180.

Among University Sound's 1968 speaker system entries will be the Laredo bookshelf speaker system, which utilizes the company's Mustang line of speaker components: a 12-in. M-122 woofer, 8-in. M-8D mid-range, and Mustang MS "Sphericon" super tweeter. The total system is said to exhibit less than ±4 dB frequency-response deviation over its entire usable range. The bookshelf speaker system, finished on four

(Continued on page 114)

ABZ's of FM

(Continued from page 62)

tuner or receiver is correctly tuned. The beat frequency is measured and recorded, as is the subsequent change in generator frequency with time to achieve the same beat frequency.

For voltage variation's affect on drift, the supply voltage is varied from 105 volts to 125 volts and the amount of frequency shift which occurs for this change of line voltage is stated.

For frequency shift relating to agc control circuits, the signal input is varied from the "least usable sensitivity" all the way up to 100,000 microvolts. Any attendant frequency shift is recorded. The rated frequency drift of the tuner or receiver is the largest of the three drifts measured.

Frequency Response

This test has the same meaning as it does with any piece of audio equipment. It is performed by applying a series of modulating frequencies from 50 Hz to 15 kHz (the limits for FM Broadcasting). Unless you understand pre-emphasis and de-emphasis in FM broadcasting and reception, you will be astounded to find that the response of a perfectly-adjusted tuner will look exactly like the curve shown in Fig. 6. If you don't know about de-emphasis, be patient, for it will be fully explained in a future installment. For the moment, take our word for it, your tuner is not "lo-fi"—the situation is not unlike that associated with record equalization curves, with which you are already familiar.

(Continued next month)

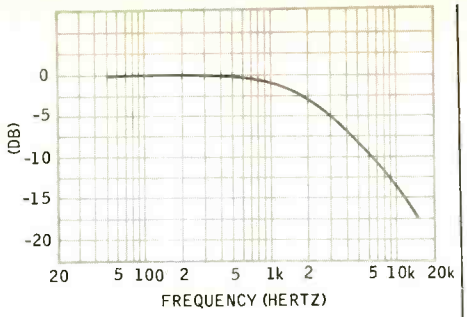


Fig. 6—Correct standard response of properly de-emphasized FM tuner.

The '68s Are Coming

(Continued from page 113)

sides, has a totally-sealed enclosure, with dimensions of 24-in. × 15-in. × 122-in. Also features a continuously-variably brilliance control and a removable front grille. $109.50.

Electro-Voice will feature, among its broad speaker line, the E-V Five-A. An acoustic-suspension bookshelf speaker system, the newly designed system boasts a new 10-in. woofer with a 4-layer voice coil, a 2½-in. cone tweeter with viscous damping in its magnetic gap, electrical crossover, and level control. The system handles 60-Watts peak. Dimensions of the walnut cabinet, finished on all sides, are: 12½-in. high × 21¾-in. wide × 10⅜-in. deep. $88.

Hartley-Luth will demonstrate its first three-way speaker system, the Concertmaster V-a. It includes a 24-in. woofer, 10-in. mid-range, and 7-in. tweeter. All have polymer cones and feature "magnetic" suspension. Oiled-walnut cabinet measures 39-in. high x 29-in. wide x 18-in. deep. Priced at $730.

A variety of miscellaneous hi-fi equipment will flavor the Show, too. For example, the Sony Corporation of America will show its TA-4300 3-channel electronic crossover preamplifier ($199.50), and its home video tape recorders will be operating full blast (or is it full sight). Aztec Sound Corp. is expected to exhibit psychedelic light columns which display color light. And you may expect to see a great number of stereo headphones, the popular hi-fi components that provide us with a new dimension and extension of stereo hi-fi sound.

In all, the 1967 N. Y. High Fidelity Music Show promises to be even more exciting than past shows. Taking place in a different location—the Statler Hilton instead of the N. Y. Trade Show Building—it will even be easier to scout out exhibit rooms, we imagine, since they will be located on two floors rather than four floors. Æ

IHF SHOW SEMINARS PROGRAM

In addition to seminars on hi-fi equipment directed toward the novice as well as the technically-oriented hi-fi enthusiast, the upcoming N. Y. High Fidelity Music Show has added symposiums on musicology and home decoration.

Here is a complete schedule of seminars to be presented at the Show:

THURSDAY, SEPTEMBER 21

6:30-7:30 p.m.—**Novice Symposium: Introduction to Hi-Fi Components**
Leonard Feldman, engineering vice president, Crestmark Electronics

7:30-8:30 p.m.—**Tape and Tape Recorders**
Moderator: **Milt Snitzer,** technical editor, Electronics World
Panelists: **Joe Kempler,** technical services department manager, Audio Devices
Paul Bunker, Magnecord Division product manager, Telex Corp.

8:30-9:30 p.m—**The Classical Recording Scene**
Moderator: **David Hall,** director, Library of performing Arts at Lincoln Center
Panelists: **Martin Bookspan,** former program director, WQXR
Jim Lyons, editor, American Record Guide

FRIDAY, SEPTEMBER 22

6:30-7:30 p.m.—**Novice Symposium: Introduction to Hi-Fi Components**

7:30-8:30 p.m.—**Cartridges, Turntables and Changers**
Moderator: **Bill Stocklin,** editor, Electronics World
Panelists: **Jim Kogen,** chief engineer, R&D Shure Brothers
Bud Childs, president, Elpa Marketing Industries (Thorens)

8:30-9:30 p.m.—**Decor Group**
Albert Herbert, President, Albert Herbert Design

SATURDAY, SEPTEMBER 23

2:00-3:00 p.m.—**The Pop Scene**
Moderator: **George Avakian,** former supervisor, album production, Columbia and Victor Records; current national president, Record Academy (NARAS)
Panelists: **David Kapp,** president, Kapp Records
Bob Crewe, Bob Crewe Productions
Tom Dowd, chief engineer, Atlantic Records

3:00-4:00 p.m.—**Amplifiers and Tuners**
Moderator: **Bill Stocklin,** editor, Electronics World
Panelists: **George Meyer,** product manager, Fisher Radio
Larry Fish, chief engineer, H. H. Scott

4:00-5:00 p.m.—**Decor Group**
Bill Leonard, President, William L. Associates (designers)

6:30-7:30 p.m.—**Novice Symposium: Introduction to Hi-Fi Components**

7:30-8:30 p.m.—**Stereo and the Listener**
Panelists: **Abe Cohen,** manager, acoustics, Instrument Systems Corporation
Vic Brociner, assistant to the president, H. H. Scott

8:30-9:30 p.m.—**The Successful Recordings (Let's Look at The Record)**
Moderator: **Goddard Lieberson,** President, CBS/Columbia Group
Panelists: **Ernie Altschuler,** vice president and artists & repertoire director, RCA Victor
Phil Ramone, vice president, A&R Recording Studios
Guest Artist

SUNDAY, SEPTEMBER 24

2:00-3:00 p.m.—**Decor Group**
Vladimir Kagan, President, Kagan Dryfuss (designers)

3:00-4:00 p.m.—**Novice Symposium: Introduction to Hi-Fi Components**

4:00-5:00 p.m.—**The Jazz Recording Scene**
Moderator: **Father Norman J. O'Connor,** author, radio/tv personality ("Dial M for Music"); president, N. Y. Chapter, Record Academy (NARAS)
Panelists: **John Hammond,** director of talent acquisition, Columbia Records
Bob Thiele, artists/repertoire director, ABC Paramount and Impulse Records.
Billy Taylor, jazz pianist; disc jockey (WLIB); head of Jazz Interaction

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November 3 (Friday) . . . . . 4:00 p.m. to 10:30 p.m.
November 4 (Saturday) . . . . . Noon to 10:30 p.m.
November 5 (Sunday) . . . . . Noon to 6:00 p.m.

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Check No. 127 on Reader Service Card

AUDIOCLINIC

(Continued from page 2)

version of RG17 for about a buck and a half a foot.

"Boosters in general are individual cases; you can multiply nothing by 30 dB gain and still have nothing, if there is no signal there in the first place. I have found that a booster usually will not improve the performance of a *good* receiver (like the REL 722A's that I use), but will help out an older one with a not-so-hot front end. The older receiver would probably be better off with a new-type RF stage, a couple of 6CW4's or a couple of FET's. Almost any pentode RF stage will be helped out by a booster, especially one at the antenna—but most triode cascodes just get a poorer noise figure from using a booster.

"I should qualify my rather positive statements by the fact that I have some 16 years of running FM stations with off-the-air rebroadcasts, now stereo and SCA and still by direct off-the-air air pickup of a station some 85 miles away. Believe me, we have tried everything to get the noise down! Some conclusions I have come to are: Use a good receiver—this is the weak link. It must have a low-noise front end. Nothing else will do. Good transmissions are a 'must.' New RG11 in our case.

"Too much antenna height can be misleading—I actually got above the radiation pattern once. Every time the wind moved their tower a couple of degrees, I lost the signal. I also learned that binding post terminals are no good at all—install a coaxial connector on the chassis. Too much noise pickup and mismatch from connecting coax cables to screw terminals.

"I use regular UHF series cable connectors—the VSWR of these connectors at 100 MHz is negligible if they are properly installed. The 'solderless' versions of this series are quite satisfactory if they are well smeared with silicon grease and well taped with at least two layers of No. 33 plastic tape.

"This turned out to be a longish dissertation, when I really intended only a few comments on coaxial lines.

"One more gem of info: This is a good trap for the fellow who lives on top of a TV station or FM station. (See Fig. 1.) Make the trap as high C as possible to keep it sharp, about 100 mmF (or pF if you are one of these Hertz people). Install it at any high impedance point in the RF line, preferably at the RF stage grid if possible. It will work when connected across 300 Ohm antenna terminals. Put the whole works in a Minibox, ground the chassis, and tune it with an insulated alignment tool. You will have to experiment with coil dimensions, of course. I use surplus APC type capacitors for the variables. I tried a parallel-resonant trap connected in series with the coax line to get rid of an FM station a block away from the home of a friend of mine. It helped, but I wound up installing a series trap inside the tuner.

"A coaxial T and a halfwave stub also work very well (shorted stub). An open-ended quarterwave stub does the same thing. (It acts like a series-tuned circuit.)

"As a matter of course, I install T's at the receiver inputs here and use shorted, quarterwave stubs for the frequency I am receiving. It cuts down on noise, images, etc. Very helpful at the input of a solid-state SCA receiver to get rid of undesirable cross-modulation products.

"For shorting stubs, I cut the cable about 10 per cent long, put on a connector and assemble to its T line and receiver. I then start on the open end of the stub with an icepick (ask any museum what these are), progressively shorting the inner conductor to the sheath until the desired signal peaks and interference drops. I solder in a permanent short at this point—and if I had gone by the point (usually) I put a drop of Duco Cement in the holes in the sheath. You will be surprised at the reduction in auto ignition interference you can get with quarter stubs at the receiver and coaxial feeders.

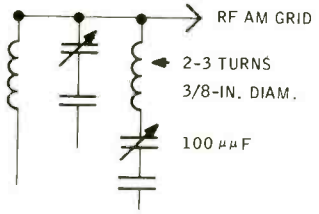

Fig. 1—Filter you can build to prevent strong TV transmissions from affecting FM reception fidelity.

"Again, don't forget the cable Vp; stubs will be about ⅔ of calculated physical length. 300-Ohm ribbon line stubs are usually a waste of time. They pick up more signal than you can trap out with them.

"And in all cases, there is just no substitute for a good receiver alignment job."—*F. C. Hervey, Engineer-in-Charge, WHKW, Chilton, Wis.* Æ

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