

ENGINEERING  
LIBRARY

On Sale  
December,

# AUDIO

60¢

the authoritative magazine about high fidelity

## TAPE RECORDER BUYING DIRECTORY

Compare Features  
And Specifications  
Of Over  
100 Latest Models



Also:  
Equipment Profiles  
●  
Record and  
Music Reviews  
●  
FM Stereo  
Measurements  
●  
Microphones for  
Sound Reinforcement  
●  
Mixer Construction  
Plans... and more

WHY  
LOOK-ALIKE  
RECORDERS  
CAN BE  
\$\$\$ APART!!

LIBRARY  
ENGINEERING FUND  
PASADENA CA 91109  
DEC 67 7C-319

# If you're still listening to 1963 stereo, update with Scott (THERE'S A SOUND REASON)

How long have you had your present amplifier or tuner . . . five years? Maybe eight or ten? A lot has happened since you bought it . . . new developments like Field Effect Transistors, Integrated Circuitry, direct coupled all-silicon output. And the performance you *are* getting just isn't the performance you *could* be getting. Don't miss out . . . check out these two new Scott advanced components:

**Scott 260B 120-Watt Stereo Amplifier** — This solid-state power-house includes a tone-control by-pass switch for laboratory-flat response, plus dual microphone inputs and headphone jack conveniently mounted on the front panel. Professional control complement includes dual speaker selector switches, rumble and noise filter controls, loudness compensation, and tape monitoring facilities. This is truly the audiophile's dream amplifier!

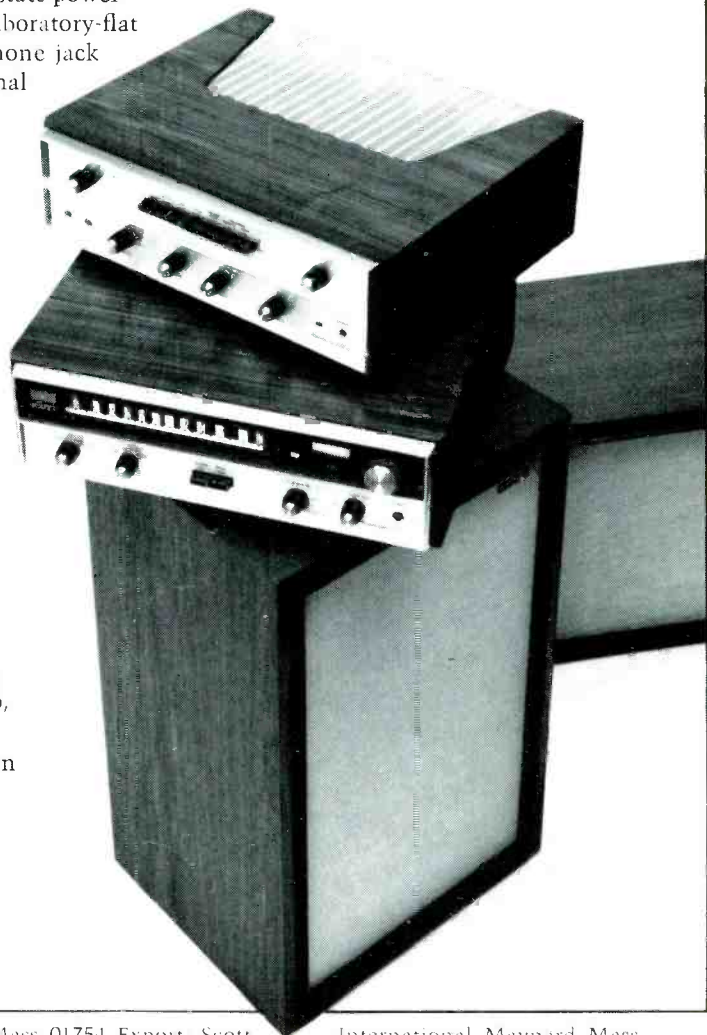
**260B Specifications:** Music power rating at 0.8% harmonic distortion, 120 W @ 4 ohms, 100 W @ 8 ohms; Frequency response, 15-30 kHz  $\pm$  1 dB; Power bandwidth, 20-20 kHz; Hum and noise, -55 dB; Price \$294.95.

**Scott 312D FM Stereo Broadcast Monitor Tuner** — 3-Field Effect Transistor front end and Integrated Circuit IF bring the 312D's performance close to the theoretical limits of sensitivity, selectivity, and interference rejection. 3-way meter provides for signal strength, center tuning, and multipath correction. Levels of both phone and amplifier outputs may be independently varied by special front panel controls.

**312D Specifications:** Usable sensitivity, 1.7  $\mu$ V; Capture ratio, 1.9 dB; Cross modulation rejection, 90 dB; Stereo separation, 40 dB; Selectivity, 46 dB; Signal/noise ratio, 65 dB; Price \$319.95.

Write for complete information and specifications on Scott stereo components.

Scott where innovation is a tradition



© 1967, H.H. Scott, Inc.

H.H. Scott, Inc., Dept. 35-12, 111 Powdermill Road, Maynard, Mass. 01754, Export: Scott

International, Maynard, Mass.

Check No. 100 on Reader Service Card

[www.americanradiohistory.com](http://www.americanradiohistory.com)



# AUDIO

ARTHUR P. SALSBERG, *Editor*

EDWARD TATNALL CANBY  
*Associate Editor*

PETER RENICH  
*Art Director*

## Contributing Editors

HERMAN BURSTEIN      JOSEPH GIOVANELLI  
LEONARD FELDMAN      ALEXANDER ROSNER  
BERTRAM STANLEIGH

C. G. MCPROUD, *Publisher*  
SANFORD L. CAHN  
*Marketing Director*  
LEE IRGANG  
*Circulation Development*  
R. KENNETH BAXTER  
*Production Manager*  
MARY CLAFFEY  
*Subscription Manager*

Successor to **RADIO**, Est. 1917

## AUDIO ARTICLES

- |  |    |                               |
|--|----|-------------------------------|
| Build a Mixer-Meter Amplifier                    | 23 | Hal Magargle                  |
| Why Look-Alike Recorders Can Be \$\$\$ Apart     | 26 | Herman Burstein               |
| Installation Profile—Tape Recorder's Home System | 32 |                               |
| The New NAB Tape Standards, Part 6               | 48 | Herman Burstein               |
| ABZ's of FM—FM Stereo Measurements               | 52 | Leonard Feldman               |
| Microphones for Sound Reinforcement Systems      | 64 | Arthur C. Davis and Don Davis |
| King of Instruments                              | 70 | Edward Tatnall Canby          |

## TAPE RECORDER BUYING DIRECTORY

- |                      |    |
|----------------------|----|
| Audio Tape Recorders | 34 |
| Video Tape Recorders | 46 |

## AUDIO REVIEWS

- |                              |    |                      |
|------------------------------|----|----------------------|
| Classical Records            | 71 | Edward Tatnall Canby |
| Jazz and Sounds of the South | 76 | Bertram Stanleigh    |
| Light Listening              | 78 | Chester Santon       |

## AUDIO PROFILES

- |                                  |    |        |
|----------------------------------|----|--------|
| Dynaco Solid-State Stereo Preamp | 60 | PAT-4  |
| AKG Two-Way Dynamic Microphone   | 63 | D-202E |

## AUDIO IN GENERAL

- |                     |    |                      |
|---------------------|----|----------------------|
| Audioclinic         | 2  | Joseph Giovanelli    |
| What's New in Audio | 6  |                      |
| Audio News          | 8  |                      |
| Tape Guide          | 10 | Herman Burstein      |
| Audio, ETC          | 14 | Edward Tatnall Canby |
| Letters             | 18 |                      |
| Editor's Review     | 20 |                      |
| Sound and Sight     | 44 |                      |
| Classified          | 88 |                      |
| Advertising Index   | 90 |                      |

Number 51 in a series of discussions  
by Electro-Voice engineers



## ENTER THE LASER

THOMAS LININGER  
Microphone  
Project Engineer

A singular light seems on the threshold of a major contribution to audio transducer design. This light is the laser, and its unique properties are opening up new techniques for the development of many audio products.

A laser beam is a very special kind of light. It can be described as a monochromatic coherent light source. This means it is a single frequency (wave length) with all parts of the beam in strict phase relationship, compared to the broad bandwidth and random phase relationship of ordinary light.

By a special technique developed at the Cooley Electronic Laboratory of the University of Michigan, laser beams can be used to "see" vibration. Movement as small as a fraction of the wave length of the light being used can be revealed. This technique is known as holographic interferometry. E-V engineers recognized the potential importance of this research as applied to audio products, and the company supported further study. Thus E-V is now able to analyze the motion of such things as microphone or speaker diaphragms without interfering with their operation.

Using the laser, the engineer can see whether the diaphragm is operating as a piston, or whether it is simultaneously vibrating in more than one mode. He can locate the nodal points of the diaphragm at any specific frequency, and observe as they shift with changing frequency.

The precision afforded by the laser permits the measurement of the amplitude of vibration at any point on the diaphragm, in comparison with other parts of the moving surface. In this respect it is a vast improvement over prior art.

While it would be impossible to explain the operation of the laser in this brief discussion, basically a hologram of the face of the diaphragm is made, using a CO<sub>2</sub> continuous gas laser with the unit at rest. A second hologram is made through the first, with the diaphragm driven at the desired frequency. Finally, a photograph is taken of the interference patterns displayed as a result of slight image displacement between the two holograms.

The laser and the hologram hold out great promise as unique new tools for basic investigation into all kinds of audio transducers. Study of the first photographs reveals aspects of diaphragm behavior impossible to reveal by any other method. Further discussions in this column will detail some of the findings of these new techniques.

For technical data on any E-V product, write:  
ELECTRO-VOICE, INC., Dept. 1273A  
602 Cecil St., Buchanan, Michigan 49107

**Electro-Voice**  
SETTING NEW STANDARDS IN SOUND

Check No. 101 on Reader Service Card



AUDIO (title registered U. S. Pat. Off.) is published monthly by North American Publishing Co., I. J. Borowsky, President; Frank Nemeyer, C. G. McProud, and Arthur Sitner, Vice Presidents. Subscription rates—U. S. Possessions, Canada, and Mexico, \$5.00 for one year; \$9.00 for two years; all other countries, \$6.00 per year. Printed in U.S.A. at Philadelphia, Pa. All rights reserved. Entire contents copyrighted 1967 by North American Publishing Co. Second class postage paid at Philadelphia, Pa., and additional mailing offices.

REGIONAL SALES OFFICES: Sanford L. Cahn, 663 Fifth Ave., New York, N. Y. 10022; (212) 753-8824. Louis Weber, 2927 W. Touhy Ave., Chicago, Ill. 60645; (312) 743-1206. Jay Martin, 9350 Wilshire Blvd., Beverly Hills, Calif.; (213) 273-1495.

REPRESENTATIVE: Warren Birkenhead, Inc., No. 25, 2-chome, Shiba Hamamatsu-cho, Minato-ku, Tokyo, Japan.

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

# Coming in January

## STEREO DISCS: 10 YEARS OLD—

Stereo Playback: Charles Doty, Sr. discusses the impact that the stereophonic disc, which just celebrated a Tenth Anniversary, has had on achieving ultimate quality in high fidelity sound.

Stereo Disc Recording: Al Grundy examines stereo discs from the cutter end, explaining how disc cutters operate.

**Further Adventures of an Audio Purist**—Prodded by talks with other "audio purists," and listening to many of their stereo systems, John Linsley writes about his quest for perfect sound reproduction. AUDIO readers might recall his previous article in AUDIO, April, 1964, "A Purist Tackles Room Acoustics."

**How Negative Feedback Influences Amplifier Performance**—Norman Crowhurst recaps traditional methods of analyzing negative feedback in preparation for later articles on fallacies of the approach.

**Microphones for Sound Reinforcement Systems, Part II**—In the second part of a three-part series, authors Arthur Davis and Don Davis discuss microphone sensitivity, do-it-yourself measurement, and directional effects of various microphone types.

**Plus:** Equipment reviews, record reviews, Audioclinic, Tape Guide, ABZs of FM, and more.

**ABOUT THE COVER:** This month's installation photo features an amateur tape recordist's home installation, which includes a mixer built from plans published in an earlier issue of AUDIO Magazine. See page 32.

## AUDIOCLINIC

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

### JOSEPH GIOVANELLI

#### Distorted Highs in Stereo

*Q. a. Massed highs — particularly strings—are "dirty" and distorted on my equipment.*

*b. On the Mode switch, changing from STEREO to BLEND makes the highs so sharp as to be unbearable.*

*c. Also, if the volume control is turned down (extreme counterclockwise), and I switch from STEREO to BLEND, sound clearly comes through the speakers in the BLEND position.*

*The major problem is, of course, the distorted highs.*

*My stereo music system consists of a preamplifier, amplifier, speaker turntable, arm and cartridge.*

*I have attempted a solution (unsuccessful):*

*1. I took the woofers and tweeters to the manufacturer for checking. All proved O.K.*

*2. I carefully checked the mounting of the arm and increased stylus pressure to two grams.—Franklyn A. Graff, Westport, Connecticut.*

A. First of all, is distortion of the high frequencies present on all program sources or present only in the phonograph position. I ask this because some stereophonic discs are poorly recorded and contain a great deal of this high-frequency distortion.

Still assuming that the trouble is in the phonograph position alone, I would guess that perhaps the stylus and/or the cartridge is defective. If this is not the case, recheck the mounting of the arm. Possibly the arm is still improperly mounted, giving rise to more tracking force than should be present.

If none of these conclusions is borne out, look for trouble in the preamplifier, especially in the first stages of the unit. It may be that the cartridge is overdriving these early stages. Check all tubes or transistors. If you still do not have success, check voltages and

resistances as listed in the instruction manual which accompanies your pre-amplifier.

Assuming that the condition you described is present on all program sources, you must make a general check of the preamplifier and amplifier. Tubes, resistances and voltages should be checked. Check the wiring of the blend switch. If the trouble still escapes you, try someone else's amplifier, feeding it into your speakers. Listen to the way the speakers sound. Then feed another preamplifier into your amplifier and speakers. By this method you can determine the proper place to start, and then carry on a really extensive investigation.

You mentioned that the tweeters are considered working properly by their manufacturers but, perhaps the cross-over network feeding them is defective.

Very often it happens that when the volume control is turned down to its minimum setting, there is leakage into the speakers. However, the BLEND control should introduce a negligible change in the sound of the program. If this change you describe occurs only on the phonograph position, you should check the connections to your cartridge. You may have one channel connected in reverse, causing your equipment to reproduce the vertical (or difference) component of records when the BLEND switch is moved to the blend position.

I have often found that though a cartridge is advertised as tracking at less than one gram, it is frequently necessary to increase tracking to, say, two grams, to obtain good performance.

#### A-B amplifier comparison switch

*Q. I would like to connect two power amplifiers to one control center in such a way as to be able to switch instantly from one amplifier to the other for A-B comparisons. Any help you can give me in this matter will be greatly appreciated. — Floyd Tatro, Williamstown, Mass.*

A. The circuit shown in Fig. 1 should answer your problem. At first glance what I have drawn is elaborate. You probably wonder why I have shown a circuit which switches both the ground circuits for the speakers and for the loads. If we were to consider only tube-type gear, we would not need to switch ground sides. However, with transistor gear, I have seen instances where the common side of the circuit was electrical at some potential other than chassis ground. I want to avoid all possibility of damaging equipment.

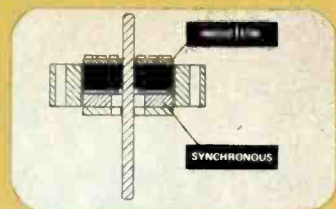
One way I accomplished this was to use a load resistor which will be con-



a quick summary  
of the four new

# Garrard®

**SYNCHRO-LAB™ models  
and their differences**



**New Garrard Synchro-Lab Motor™ Cannot Vary in Speed . . . Locks In to Cycles of Electric Current!**

A revolutionary advancement with the best features of both induction and synchronous types. Induction feature provides high starting torque, instant acceleration; synchronous action insures perfect record speed, regardless of variations in voltage, temperature, stylus pressure or turntable load—plus freedom from rumble. Now, enjoy a quality of performance never achieved before in automatic turntable motors!

**SL 95**

Superb leader of the line. In addition to the Synchro-Lab synchronous motor, it features the most advanced ultra-low mass tone arm system yet produced for an automatic turntable, with gyroscopically gimballed pivots for absolute minimal friction, Afrormosia wood inset for most effective low resonance damping. New safety suspension system for automatic play drops records perfectly every time; platform disappears when not in use. Adjustable counterweight, built-in stylus pressure gauge and patented anti-skating control, simplified cueing-and-pause system, and many other advanced features—the ultimate in automatic transcription turntables.

- New Garrard Synchro-Lab Motor guarantees perfectly constant record speed
- New adjustable sliding counterweight
- New gyroscopically gimballed needle pivots
- Anti-skating control with patented sliding weight design
- New advanced ultra low mass tonearm
- New cartridge clip . . . ends need for plug-in shell
- New versatile automatic control lever functions
- New manual-cueing-pause control
- New auto-rise safety record platform for automatic play
- New combined speed and-record size selector
- New full 12" aluminum turntable
- Anti-static mat with safety grooves
- Two interchangeable spindles

**29.50**

**SL 75**

Companion to the SL 95. Has the same Synchro-Lab Motor, turntable, foolproof Auto-Rise two-point suspension system for automatic play, and beautifully simple controls, but a unique tone arm system all its own, with twin braced, extruded aluminum construction for light weight precision tracking. Fully adjustable counterweight, patented anti-skating device and optical type stylus pressure adjustment assembly. The aristocrat of its field.

- New Garrard Synchro-Lab Motor for perfectly constant record speed
- New full 12" aluminum turntable
- Anti-static mat with safety grooves
- New auto-rise safety record platform for automatic play
- New adjustable counterweight
- Anti-skating control with patented sliding weight design
- New stylus pressure adjustment assembly
- New combined speed and record size selector
- New low mass tonearm
- New cartridge clip . . . ends need for plug-in shell
- New versatile automatic control lever functions
- New combined manual-cueing-pause control
- Two interchangeable spindles

**\$109.50**

**SL 65**

A high performance unit, with Synchro-Lab synchronous motor and completely adjustable, dynamically balanced tone arm, fully capable of the finest sound reproduction; will track flawlessly at as low as 1/2 gram. Has built-in stylus pressure gauge, anti-skating and cueing features, with popular over-arm record changing system. Outstanding value in its price range.

- New Garrard Synchro-Lab Motor
- Heavy, cast, balanced, oversized turntable
- Two spindles
- Automatic anti-skating control
- Built-in stylus force adjustment and pressure gauge
- Manual cueing and pause control
- Tubular, dynamically balanced counterweight-adjusted tonearm
- Lightweight, cutaway shell
- Ultra-compact
- Super-sensitive trip

**9.50**

**SL 55**

Lowest priced model in the Synchro-Lab Series™. Synchronous motor makes it incomparable in its field. Has light weight tubular arm, manual cueing and pause lever, low mass shell, and stylus pressure adjustment. The ideal automatic turntable for medium cost music systems.

- New Garrard Synchro-Lab Motor
- Oversized turntable
- Two spindles
- Lightweight tubular tonearm
- Built-in stylus pressure adjustment
- New manual cueing and pause control
- Super-sensitive trip
- Ultra-compact
- Newly designed lightweight plug-in shell

**\$59.50**



See the new Garrard Synchro-Lab Series and three other fine models now at your dealer's. He will also be glad to give you a 20-page Comparator Guide showing all models in full color, with complete specifications. Or, use the coupon and we'll send you a copy by mail. Complimentary, of course.

**Garrard®** Dept. AX-1, Westbury, N.Y. 11590

Please send Comparator Guide.

Name.....  
Address.....  
City..... State..... Zip.....

Check No. 3 on Reader Service Card

# NOW FREE!

## STEREO INFORMATION

### FM Station Directory

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

### Test Reports

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

### Big 36-Page Catalog

You get a 36 page catalog. It tells you about tuners, power amplifiers, preamplifiers, pre-amp/power amplifier combination and tuner preamps.

## ALL FREE

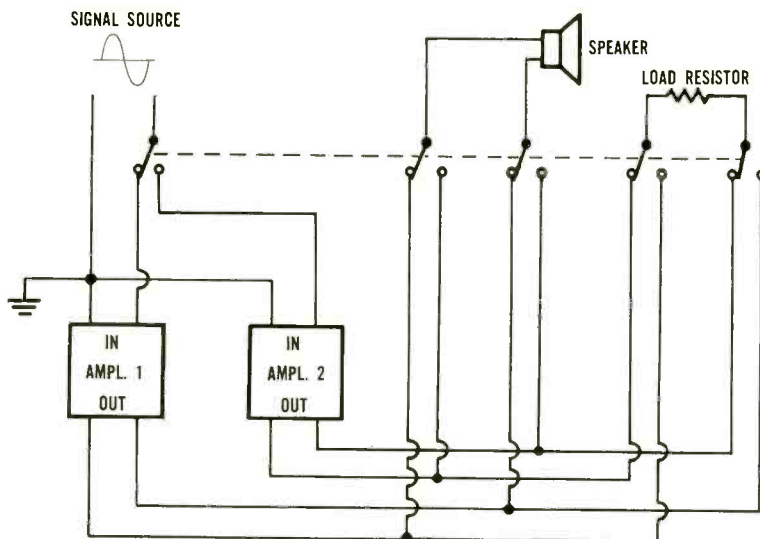
# McIntosh

PLEASE SEND ME YOUR CATALOG  
McIntosh Laboratory, Inc.

Chambers St. Binghamton, N. Y. 13903

NAME \_\_\_\_\_  
STREET \_\_\_\_\_  
CITY \_\_\_\_\_  
STATE \_\_\_\_\_ ZIP \_\_\_\_\_

Check No. 4 on Reader Service Card



NOTE: SWITCH SHOWN CHECKING AMPLIFIER #1

Fig. 1—A-B comparison switch. See text for explanation of ground switching.

ected to the amplifier not fed to the speaker. It is protected against problems which sometimes can occur as a result of a non-loaded output circuit. The value of the load resistor should equal the impedance of the amplifier's output circuit and should be of sufficiently high wattage to handle the amplifier's full power output.

Because there are circumstances where there is danger of circuit damage because of inadvertent connection of two common leads, use a break-before-make switch. A switch of this type is so constructed that its wiper leaves one contact completely before making to the next one. You can see that this will insure that nothing will ever be connected to each other, even on an instantaneous basis during the switching process.

Those of you who plan to use this circuit only with tube-type amplifiers can omit the two ground-switching decks, and bond the two amplifier grounds together.

I have shown only one channel. If this circuit is to be wired for switching a stereophonic set of speakers between two stereophonic amplifiers, you will require a total of 10 switch sections. There are parts available from switch manufacturers which enable you to build up any kind of switching arrangement you might need. Keep this in mind if it happens you cannot locate a preassembled switch.

### Thermal Runaway

*Q. In transistor circuits we hear the term "thermal runaway." What is it?*  
—Arthur Darrow, Troy, New York

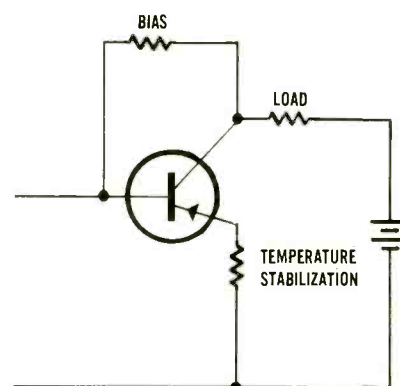
A. When a semiconductor device is conducting fairly heavily, some heat is built up within it. This heat causes more collector current to flow, creating more heat.

This added heat allows the device to conduct still more heavily. You can easily see we have a cycle of events which will ultimately result in the destruction of the device.

Fortunately for us, the situation is avoided with the use of an emitter resistor. This resistor is in the same relative position as the cathode resistor in a vacuum tube. As the semiconductor device draws more and more current, more and more voltage is lost across the emitter resistor, limiting the maximum value of current flowing in the device, resulting in its running at a low enough temperature to prevent its destruction.

Fig. 2 shows a simple transistor circuit with emitter stabilization.

Fig. 2—Emitter resistor minimizes possibility of thermal runaway.





# Integrated Systems\*

BY PIONEER



The Integrated Systems concept is the latest and most advanced development towards the faithful reproduction of sound. It is the result of the creative engineering and advanced technology of Pioneer Electronics Corp., one of the world's largest manufacturers of audio components.

The heart of Pioneer's Integrated Systems concept is the new IS-80, a component in which two power amplifiers combined with an electronic crossover are totally integrated with three speakers in each channel of a stereo system. The electronics are specifically designed to the speakers' requirements—wide frequency range, linearity, and extremely low distortion over a wide dynamic range.

*The integration of these elements produces, for the first time, distortion-free sound and an unbelievable clarity.*

**But the Integrated Systems concept extends even beyond this superior approach to sound reproduction.**

The IS-80 Integrated System may be coupled with Pioneer's SC-100 preamplifier, a distinguished instrument for the control and preamplification of any program source of music.

Or the IS-80 may be coupled with the new IS-31, a complete combination AM-FM stereophonic tuner, turntable, and preamplifier housed in a handsome cabinet. Its striking design makes it adaptable to any room and eliminates any problems of installation.

The technology and design of these concepts are pioneering the future of new areas of high fidelity. As Webster defines it . . . **to pioneer is to open or prepare the way for others to follow.**

Advance your present system or establish your musical reproduction foundation with tomorrow's equipment today! Be sure to hear Pioneer's Integrated Systems at a Pioneer franchised dealer in your area. Pioneer Integrated Systems are available in combinations from \$1,125 up.

*Write for more data and an invitation to one of our demonstrations of this unique concept. We are scheduling nationwide demonstrations now, to be made in conjunction with franchised dealers and factory personnel. Mail the coupon below.*

**PIONEER ELECTRONICS U.S.A. CORPORATION**  
140 Smith St., Farmingdale, Long Island, N. Y. 11735 • (516) 694-7720



Manufacturers of Quality Audio Components • Receivers •  
Turntables • Speaker Systems • Loudspeakers • Headsets

PIONEER ELECTRONICS U.S.A. CORP.  
140 Smith St., Farmingdale, Long Island, New York, 11735

Dear Sirs:

- I am interested in hearing a demonstration of the Integrated Systems and would appreciate receiving an invitation when demonstrations will be in my area.
- Please send me literature.

Name \_\_\_\_\_

Address \_\_\_\_\_

City/State \_\_\_\_\_

Zip Code \_\_\_\_\_

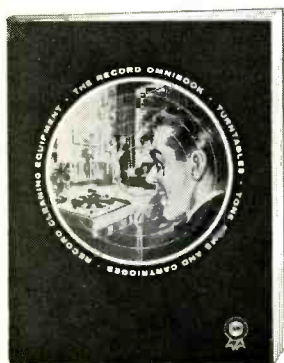
My Hi-Fi dealer is \_\_\_\_\_

\*A mark of Pioneer Electronics U.S.A. Corp.—Registration Applied For.

# If you want the answers to questions like:

How are wow and flutter measured . . . what is compliance . . . how should I keep my records clean . . . why is a tone arm manufactured three years ago obsolete today . . . why don't broadcast stations ever use 'automatic turntables' . . . how do I talk intelligently to hi-fi salesmen?

**A.** Send for Elpa's FREE informative "Record Omnibook"



# If you know the answers... you're probably an Elpa customer already!

Elpa markets through its selected franchised dealers a line of turntables and record playback equipment of the highest quality. And Elpa stands between consumer and manufacturer as a guarantee of the highest quality control. Some of our endorsed products are:

**THORENS** The unchallenged world leader in superb transcription turntables and tone arms.

**Ortofon** The ultimate in fine cartridges, matching tone arms for getting the most out of any recording.  
**CECIL E. WATTS, INC.** — Producer of the finest products for record care and cleaning.

LOOK FOR THE ELPA ENDORSEMENT ON EVERY COMPONENT YOU SELECT; IT WILL CONFIRM YOUR JUDGMENT OF SUPERIOR QUALITY.



Elpa Marketing Industries, Inc.  
 New Hyde Park, New York 11040

Dear Sirs:

Please send me the "Record Omnibook" and put me on your mailing list for future mailings.

Name \_\_\_\_\_

Address \_\_\_\_\_

City/State \_\_\_\_\_ Zip Code \_\_\_\_\_

Check No. 6 on Reader Service Card

## WHAT'S NEW IN AUDIO

### Magnetic recording tape

Tape recordists have never had as wide a selection of magnetic tape as they enjoy today. New formulas, new conveniences. For example, The Magnetic Media Corp., the company that opened some eyes a while back with its 1/4-mil polyester recording tape, now makes available a two-hour recording tape cassette. Called "Quadraplay," it is compatible with tape machines that accommodate the Philips type cassette. Check 34

The 3M Company offers some new convenience features with its newly-designed boxes for Scotch brand sound recording tape. The tape containers



have large areas of write-on space on the front, back and three edges. Also, a tape selection and recording time chart is printed on the back. Check 36

Ampex is now marketing a new, low-noise mastering audio tape for professional and consumer use. The Ampex 404 Series features a new oxide binder formula to enhance high-frequency response and extend undistorted dynamic range. The new series is available in a variety of reel sizes, in 1/4-in., 1/2-in. and 1-in. widths on both polyester- and acetate-base materials. Check 38

### University Sound introduces stereo-FM receiver

With so many electronic manufacturers now producing loudspeakers, it seems only fair for a loudspeaker manufacturer to produce electronic

equipment. And that's just what University Sound is doing. They have introduced a new solid-state FM Stereo receiver. (The company has been involved with electronics for some time now, but this is its first electronic unit designed for the home entertainment market.)

The Studio Pro 120, at \$379.50, includes integrated circuits, a MOSFET front end, and all-silicon construction. Total IHF power output is 120 watts at 4 ohms load; with total harmonic



distortion (THD) at 0.8%. RMS power output is 30 watts per channel at 0.3% THD. Frequency response is 10 Hz to 100 kHz +0, -3 dB. Power bandwidth (IHF) is 10 Hz to 40 kHz. Intermodulation distortion is under 0.5% at any combination of frequencies up to rated output.

The tuner section features a capture ratio of less than 1 dB and alternate channel selectivity of greater than 55 dB; sensitivity: 2.3 microvolts (IHF); frequency response: 20 Hz to 20 kHz ±1/2 dB; image rejection: greater than 90 dB; separation: 40 dB at 1 kHz; distortion: under 0.5% at 100% modulation (±75 kHz deviation).

Dimensions are 4 1/2-in. H x 16 3/8-in. W x 12-in. D. Weight is 17 lbs.

Check 40

### Professional tape winder

The "Pro-Winder," a high-speed professional magnetic tape winder made by Pro-Wind, a Div. of Del-Aid Industries, Pacoima, Calif., features direct-drive capstan, four motors (two



synchronous, two shaded pole), push-button timer with automatic reset and readout, solenoid-operated pinch roller and brake. It has a tape feed capacity of 3-in. to 10 1/2-in. reels, including NAB and bulk tape hubs. Tape speed is 56 1/4-in. per second. Repeat accuracy is ±6 inches of tape. \$295.95. Check 42



# we've "humanized" headphones

Now, for the first time—AKG has developed stereo headphones which recreate the *you-are-there* realism of an original performance.

Impossible you say?

Many thought so, but we investigated and carefully measured the characteristics of human hearing when coupled to headphones. We discovered significant differences between listening to loudspeakers in rooms, and the sound from headphones close to your ears.

AKG K-20 and K-60 headphones are **humanized** with the first scientifically designed driver units specially suited for headphone listening.\* They look like headphones, but sound entirely different—accurate bass, superb transient response, transparent highs and intimate sound. Hear them at your AKG Headphone dealer.

**It's an original listening experience  
you'll take home!**

*\*Send for a copy of this original research report.*



**MICROPHONES • HEADPHONES**

DISTRIBUTED BY  
NORTH AMERICAN PHILIPS COMPANY, INC.  
100 EAST 42nd STREET, NEW YORK, NEW YORK 10017



# AUDIO NEWS

## AES convention awards

The following awards were presented at the 33rd Audio Engineering Society Convention: The John H. Potts



Recipients of AES awards (clockwise): Floyd Harvey, William B. Snow, Robert Morris.

Memorial Award to William B. Snow, Head, Electro-Acoustic Laboratory, Bisset-Berman Co., in recognition of his pioneering work, particularly in the field of stereophonic sound transmission and recording; The Emile Berliner Award to Robert Morris, retired staff engineer, American Broadcasting Co., in recognition of his pioneering work in the field of disc recording, particularly in "orthacoustic" preemphasis volume indicators; The Audio Engineering Society Award to Floyd Harvey for contributions beyond the call of duty during and after his official terms of office.

## "Golden Lyre" award

The Institute of High Fidelity's annual "Golden Lyre" award for outstanding contribution to the high fidelity industry was presented to the Philadelphia Daily News.

## Nagra recorder developer

Stefan Kudelski, was awarded the Samuel L. Warner Memorial Gold Medal Award by the Society of Motion Picture and Television Engineers (SMPTE) for "... engineering and development of a portable synchronous

1/4-in. tape recording system of unique design resulting in exceptional speed stability under widely varying conditions." The Switzerland resident developed the first Nagra tape recorder in 1950.

## Acoustic Research announces overseas XA turntable model

Called the XA Universal, the two-speed manual turntable, identical in performance and appearance to the standard version, is designed for use on either 110V or 220V power lines. Pulleys for both 50 Hz and 60 Hz are supplied. Price is \$87 compared to the standard XA's \$78.

## Industry changes

Dr. Bradley Dewey, Jr., to president of Reeves Soundcraft Div. of Reeves Industries from president of the Cryovac Div. of W. R. Grace □ Howard Durbin to vice president of marketing, Electro-Voice, from general product manager □ Dubbing Electronics, tape duplicator of compact cassettes, has been acquired by Consolidated Electronics Industries (NYSE).

*"Now, satisfy the EYE!"*



12" ACOUSTIC SUSPENSION SYSTEM Price: \$189.00 Net  
 12" Woofer has Impedance: 8 Ohms  
 30 oz. magnet Power Handling: 60 Watts peak  
 Midrange horn, 60 Watts peak  
 Compression Presense and Brilliance controls  
 tweeter L. C. Response:  
 Crossover network 35/20,000 HZ.

## AS-8 Credenza

Only after sound perfection was reached from this 3-way Hi-Fi Speaker System was UTAH ready to incorporate it into fine furniture cabinetry. After all, UTAH'S primary business is engineering and developing the epitome of sound perfection. Well, Sir, the "brass" (they're the sound engineering experts) said that the sound is there. We believe that you, the expert at choosing fine furniture will agree the eye appeal is there.

This provincial model is one of a family of three. There's an Early American version as well as a Contemporary style.

See your dealer, or write UTAH for complete information.



HUNTINGTON, INDIANA





# A FLEXIBLE PREAMPLIFIER

At one time, the function of a preamplifier was simply to increase the level of a signal. Then, as the art of sound reproduction has become more sophisticated, additional functions have been added.



First came tone controls, then equalization, filtering, tape monitoring, blending, and so on.

What was once a simple amplifying circuit and a volume control is now a control center, handling a variety of sources with input signals ranging from a few millivolts to several volts (a range of 1000 to 1), and which must impress special response characteristics on some of these signals. Requirements for distortion now are far more stringent than in the past. Distortion levels which were once significant laboratory achievements are now common in commercial equipment.

The resultant increase in complexity of the preamplifier has caused some confusion. The knobs and switches which the audio hobbyist considers mandatory for proper reproduction bewilder and dismay family and friends.

The Dynaco PAT-4 is a preamplifier which simplifies operation so that the basic functions are readily utilized by the uninitiated. The illuminated power switch tells you the system is on—and transistors eliminate any waiting. The two large knobs are the primary controls—one selects all sources (including the tape recorder) and the other adjusts the volume. [A third similar knob on the companion stereo Dynatuner completes the radio controls.] The smaller knobs and remaining switches contribute the complete versatility and unlimited flexibility so much appreciated by the enthusiast.

A separate front panel input lets you plug in a tape recorder, or an electronic musical instrument. Its special design even makes it possible to mix a guitar, for example, with a microphone, records, or radio. There's a 600 ohm output on the front panel, too, which enables easy connection of a recorder, and has sufficient power to drive medium impedance headphones without the need for a power amplifier.

You may save a power amplifier in another way, too. If you need a remote speaker system, or a center or third stereo channel, the PAT-4's exclusive "blended-mono" mode is all set to provide this from your regular stereo amplifier, where

other preamps having center channel outputs require an additional power amplifier.

A sharp 3-position high frequency filter cuts the scratch with minimal effect on the music, and there's a low frequency filter, too. The "Special" low level input can provide for a second phonograph input, or for a special equalization position when you want to listen to older discs. Dynaco's patented "X" type tone controls provide smooth continuous tonal adjustments with the precise "center-off" assurance of step-type controls, without the complication of separate switches.

The overall quality of parts, ease of construction for the kit builder, accessibility for service, and audio performance are in the Dynaco tradition of acceptability to the perfectionist. On every performance count, the PAT-4 is exceptional. Noise and distortion are almost non-existent. Equalization is precise. Frequency response is superb, resulting in outstanding square wave and transient characteristics. There is not a trace of so-called "transistor sound". And finally, there is the undeniable virtue of complete independence from the power amplifier, so that you can choose the power, price, and tube or transistor design as your requirements dictate.

The PAT-4 is of the quality standard set by the world-famous PAS-3X. That preamplifier has been widely accepted and acclaimed for many years as the finest quality and reasonably priced. How does the PAT-4 compare with the PAS-3X?



Well, the quality of both is fully comparable. It is doubtful that it would be possible to hear any difference between them on careful listening tests. The PAT-4 does have some extra features which justify its slightly higher cost for many users.

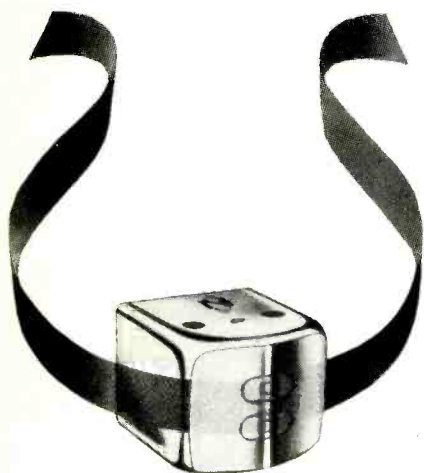
The PAT-4 is very much in demand, and it will be many months before it is in ready supply. If you are willing to forego its extreme flexibility, the PAS-3X will match its quality, with the added virtues of economy and availability. If you want the ultimate in flexibility along with quality, please wait for the PAT-4. It is worth waiting for.

PAT-4—Kit \$89.95: Assembled \$129.95

**DYNACO INC.**

3912 POWELTON AVENUE, PHILADELPHIA, PENNA. 19104  
IN EUROPE WRITE: DYNACO A/S HUMLUM, STRUER, DENMARK

every tape recorder  
owner  
**OUGHT TO  
HAVE  
HIS HEAD  
EXAMINED!**



If you've been using your tape recorder regularly for a year or more—the tape head is probably worn out. As the oxide coating on the tape comes in abrasive contact with the head, it gradually grinds away the metal. Output becomes erratic and high frequency performance suffers. Crisp sounds become mushy. Vivid tones get blurry. Without even realizing it, you *lose* the fidelity and realism your tapes and equipment are capable of giving you.

Every tape recorder should regularly have the Look-Touch-Listen test that immediately tells you if it's head replacement time. Ask Nortronics—world's leading tape head manufacturer—for Bulletin 7260 that explains this simple do-it-yourself test. If you do need a new head, ask your dealer for a Nortronics replacement!



**Nortronics**  
COMPANY, INC.

8193 Tenth Avenue North  
Minneapolis, Minnesota 55427

Check No. 10 on Reader Service Card

## 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.

On availability of a device for exclusive receiving of TV audio mentioned in June 1967 *Tape Guide*, here are some reader comments:

Reader Henry J. Rutowski, Detroit, Mich.: "Conrac, Jerrold, and probably others make very good quality tuners with video and audio outputs, but these cost several hundred dollars. Ampex uses a tuner section in its 6000 series home video recorders, and it may be possible that these tuners can be obtained separately. Concord makes a TV receiver-video monitor with audio and video outputs for use with its video tape recorders. These receivers are widely distributed and sell for \$160. Similar receivers are available from other distributors of Sony, Dage, and probably other video tape recorders. In Canada, Electro-Home makes TV receivers with audio and video outputs."

Reader Jeffrey A. Weiss, Brooklyn, N. Y., writes: "I take my sound for recording from the center tap on my TV set's volume control. This required cutting out the tone control circuit. . . . If the TV is an inexpensive set or misaligned, you may get intercarrier buzz. Lafayette Radio lists in its catalog a hi-fi adaptor for receiving and playing TV sound through a sound system, requiring only a screwdriver for installation. The device is listed as Laf. #24H 2400, and costs \$32.95."

### Triple trouble

*Q. I am very much concerned about the following problem. I have several different tape recorders and expect to acquire more. My goal is to make recordings now which can be played back satisfactorily on any tape recorder I may acquire in the future. But I have found this difficult because of the difference in equalization of different recorders. I have spent much time testing the recording and playback characteristics of machines when tapes are played on machines other than those*

*on which they were made. The results are very discouraging and completely baffling. Perhaps you can throw light on these strange results:*

*I copied an excellent recording simultaneously with three machines (which we may designate as A, B, and C). Each of these can produce a tape recording which is indistinguishable from the original source when played back on the machine which recorded the tape. When the tapes were played on other machines, however, strange results occurred. (1) A recording made on machine A and played back on B had a slight loss of highs. This appears to indicate that A has less treble boost in recording and more treble boost in playback than B. (2) A recording made on B and played back on A sounded bassy and had a substantial loss of highs. This indicates the opposite of the above conclusions with respect to A and B. (3) Machine C produced a recording which sounded exactly like the original source when played back on A. But when the recording made on A was played back on C, there was a loss of highs and an emphasis of bass. This seems impossible. If C can produce a recording which sounds just like the original source when played on either itself or machine A, how can A produce a tape which sounds exactly like the original when played back on itself but sounds different when played back on C? (4) I then tried playing back all three tapes on a fourth machine of very high quality. Now each tape sounded exactly like the original source. This seems to prove that all three recordings are the same. Then why do I get the differences previously described?*

*The above results were obtained at 7.5 ips. I obtained similarly contradictory results at 3.75 ips. These results defy all rules of logic. A possible explanation is incorrect azimuth alignment of machines A, B, and C. I therefore checked azimuth of each machine with an azimuth tape. All were found correctly aligned. I carefully cleaned the heads and repeated my experiments, only to obtain the same baffling results. Can you suggest an explanation for these mysterious results? I should mention that I used the same brand of tape for all machines.*

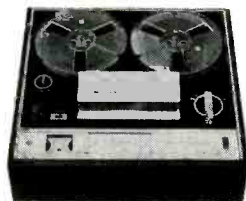
A. One answer is that you and I are the victims of a fiendishly clever plot to drive us out of our minds. I cannot account for your contradictory results. I have not personally nor second-hand run into a similar situation before. To get to the bottom of the matter would require having your three tape machines on my work bench and measuring their performance by instrument. I can only suggest the various factors which can produce deviations from flat





## Tape it with a Sony Solid-State Stereo 560

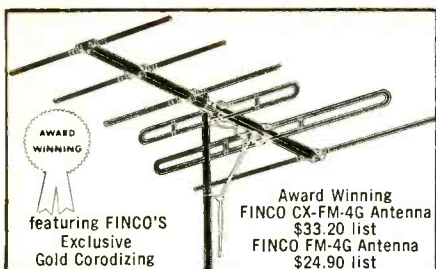
There's a world of beautiful music waiting for you and it's yours for the taping. Let Sony-superb 4-track stereo capture every note faithfully while you relax in your easy chair. Simply connect your stereo tuner to the Sony Solid-State 560, "Stereo Compact Portable," and tape your favorites off the air. 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 ■ Scrape 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!



AWARD WINNING

featuring FINCO'S Exclusive Gold Corodizing

Award Winning  
FINCO CX-FM-4G Antenna \$33.20 list  
FINCO FM-4G Antenna \$24.90 list

# Who put the HIGH in HI-FI? **FINCO** that's who!

Get FM at its very best with a FINCO FM antenna!

- You can hear the difference!
- You get exacting separation!
- You get crisp, clear undistorted sound!

FINCO offers the most complete line of 300 OHM — 75 OHM FM Antennas! See Your Dealer for the one best suited for Your Exact needs!

Award Winning  
FINCO FM-5 \$36.35 list  
FINCO CX-FM-5 \$44.65 list



Model FMT-A All Directional FM Turnstile Antenna Kit. Mounts to present mast. \$12.95 list



Model FMSL-12 \$49.95 list  
Model CX-FMSL-12 \$58.25 list



FM STEREO KIT Model 7512-AB Update your Antenna to shielded co-ax system. \$8.95 list

Model 65-7 FM AMPLIFIER Indoor mounted—20 db gain \$24.95



**THE FINNEY COMPANY**

34 West Interstate • Dept. AM  
Bedford, Ohio 44146

Check No. 12 on Reader Service Card

response when playing on one machine a tape recorded on another: departure from NAB playback equalization (including the characteristics of the playback head); departure from the NAB recorded induction curve (recording equalization which in conjunction with playback equalization produces flat record-playback response); departure from correct azimuth; tape-to-head separation (dirty heads, inadequate tape tension, faulty pressure-pad system); variation from correct speed; faulty tape-guide system; improper setting of tone controls (if any). Also, a minor deviation from correct response in one machine may be virtually unnoticeable, but may become apparent when accompanied by a similar minor deviation in a second machine.

## Color me lemon

*Q. My tape recorder hasn't seemed right since it was brand new. Recorded tapes sound fine, but most of the tapes I record have a sputtery kind of sound; that is, the sound seems to cut out intermittently. This is worse at 3.75 ips than at 7.5 ips, and much worse at the beginning and end of a tape reel than in the middle. It is also worse on old tape than on new tape.*

*I made a loop of about two feet of tape that didn't sound good, and I found that the sound always cut out at the same places on the tape. After cleaning and demagnetizing the heads, I recorded music in this manner while monitoring at the same time (my machine has separate record and playback heads). I found that increasing the pressure pad force helped little, if any. Reducing force below normal also had little effect until the pad was almost off the tape. I removed the loop of tape and put the reels back on, and recorded a selection and monitored with the playback head. Then I removed the connections from the record and playback heads and connected the playback leads to the record head; and I listened via the record head. The same trouble occurred. Yet it seemed odd that the sound was otherwise the same as when using the playback head.*

*I had heard the record head has a wider gap and therefore produces a loss of highs if used for playback. My machine has been in the local authorized repair shop, but they found nothing wrong. It was also returned to the manufacturer along with a sample of tape I had recorded, but when the machine was returned I noted no improvement. Any suggestions you may have will be appreciated.*

**A.** A first thought is that your bias supply behaves erratically, but this

would not explain the fact that cut-out always occurs at the same places on a loop tape. Still, I would have the bias oscillator circuit checked. Another possibility is mispositioning of a tape guide, so that the tape does not move past the record and playback heads in identical fashion. Still another possibility is that the record and playback heads are not properly aligned with respect to each other. One more thought is that you are recording at an excessively high level, thereby overloading the tape amplifier and causing the amplifier to block periodically.

In some tape machines with separate record and playback heads, the same type of head is used for both functions. This may be the case in your machine, which would explain why you get good playback from the record head. While a playback head can be used for recording, a record head cannot satisfactorily be used for playback if this record head is specifically designed for its intended purpose and therefore has a relatively wide gap.

## Tape drive fundamentals

*Q. I have always missed in the general literature a complete discussion and description of the various tape drives offered by the industry. There are spring-wound motors, d.c. motors with or without governors, shaded-pole motors, hysteresis-synchronous motors with inner rotor and with outer rotor, and surely many other types which I have never heard of. These designations are little more than names to me, and I would like to know more about their technical features and constructional details than is generally given out by manufacturers of tape machines. Do you know of any publication which does discuss this topic in a thorough manner?*

**A.** A general discussion of various types of motors appears in most books on electricity. An example, aimed at the beginner, is *Basic Electricity* by Van Valkenburg, Nooger & Neville, Inc. (John F. Rider Publisher, Inc., 116 W. 14th St., New York, N. Y.), pages 5-1 to 5-112. I cannot think of any periodical having articles devoted to motors for tape machines. I agree there is room for such an article, but this is outside my sphere of competence (THE TAPE GUIDE tries to deal mainly with the electronic and magnetic aspects of tape recording). A discussion somewhat of the sort you are seeking appears in the book *Magnetic Recording Techniques* by W. Earl Stewart (McGraw-Hill Book Company, New York, N. Y.), Chapter 4, "Magnetic Recording Mechanisms," pages 105-135.



# This is the long-playing cartridge

*1,000-play tests prove it keeps your records new...Indefinitely.*

How long can you play a long-playing record before distortion creeps into the playback?

Until now, *eight or nine* playings were enough to make record wear *audible*. The difference between a brand-new record and one played only eight or nine times could easily be *heard*...and high-frequency loss could actually be measured after a playback or two!

That's why we designed the 999VE cartridge to a completely new standard—the long-playing standard. We designed it to be the *one* cartridge that *wouldn't* strip away highs, or create distortion, or wear out records.

Here's what our engineers report about 1,000-play tests of the 999VE.

**Test 1:** For *audible* wear, distortion, or frequency loss with standard vocal/orchestral stereo recording.

*Total Plays:* 1,000

*Audible difference between new and tested record:* None

**Test 2:** For *measurable* distortion, frequency loss, or dynamic loss with low-frequency (300 Hz) test record.

*Total Plays:* 1,000

*Measurable Change:* None

**Test 3:** For *measurable* distortion, frequency loss, or dynamic loss with high-

frequency (2k—20kHz) test record.

*Total Plays:* 1,000

*Measurable dynamic frequency loss:* at 2kHz, None; at 20kHz, —3 dB.

*Measurable distortion:*

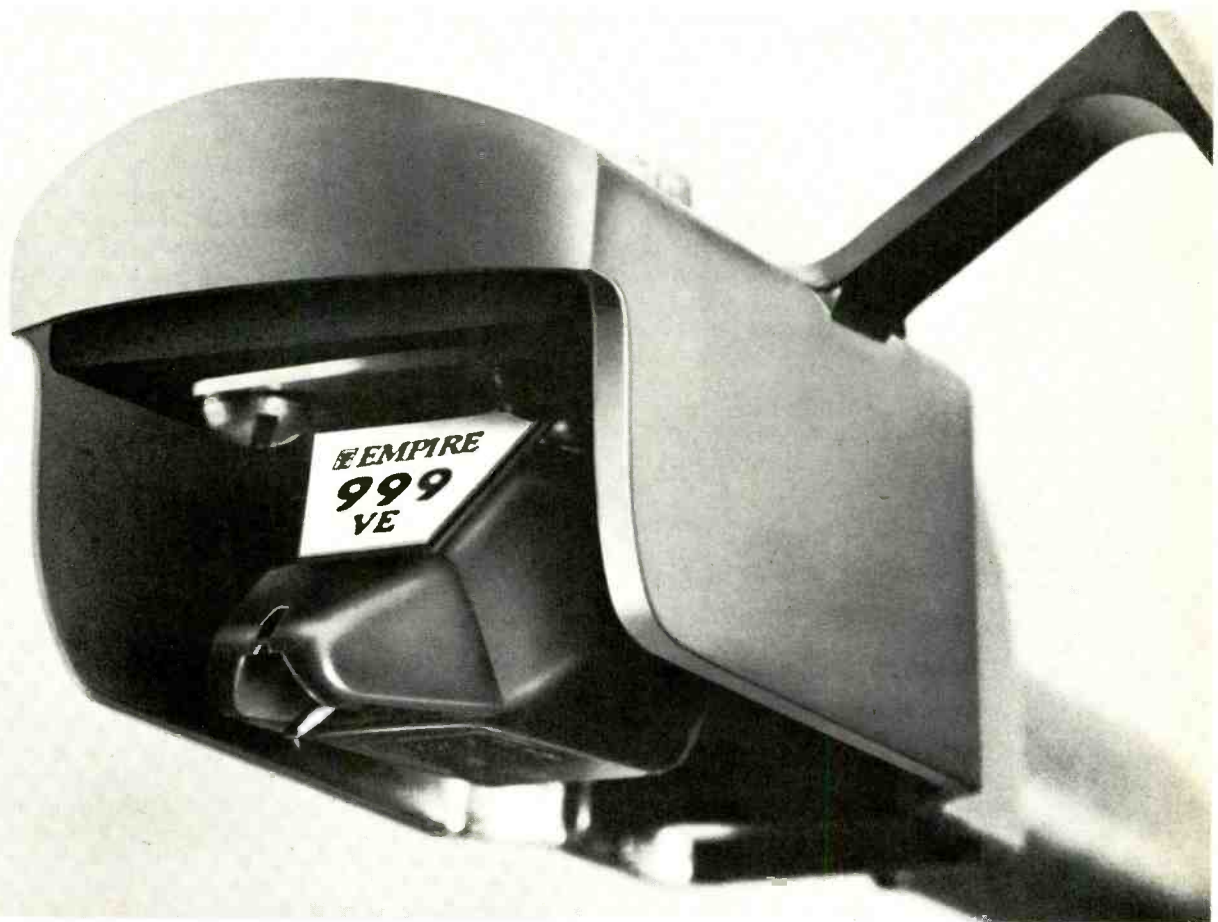
+ .02% at 3.54 cm/sec; + .05% at 5.5 cm/sec; + .1% at 9.0 and 14.0 cm/sec.

In 1,000 test plays—far more than a lifetime of wear for your records—no change in fidelity you will ever hear. How long will *your* records keep sounding brand-new with the 999VE?

The best we can say is: *indefinitely.*

 **EMPIRE**

*Empire Scientific Corp., Garden City, N.Y.*



# THE EMPIRE 999VE

*A long-playing investment at \$74.95*

# AUDIO, ETC.

EDWARD TATNALL CANBY

## Cartridge and cassette

IN THESE LAST MONTHS, the burgeoning flood of new type machines, of new tape systems, has simply spilled all over the place until we scarcely know whether we're coming or going. There are spankingly beautiful new machines for every conceivable purpose where a tape can be run over a tape-head.

Well, it has finally dawned upon me that this cartridge/cassette business isn't really so complicated, down underneath. I do begin to see the sense of it all, and so will you, even if at the moment you are utterly up in the air.

## Functions

Not that anybody could mistake a tape cartridge for a cassette, or vice versa. They don't look at all alike. They don't even work alike. They don't go at the same speed, nor do they have the same size of tape.

What is confusing, especially right now, is the matter of their function. Not only what do they do, but what they do *well*, and even *best*. (And, shall I whisper it, what they won't do. That counts too.) Which of the numerous arrangements is good for what—cartridge or cassette, 2-track, 4-track, 8-track, mono or stereo? How much do they really overlap in usefulness and purpose, and how do they compare with all the older existing systems—still very much alive?

Well, right here is where we are now being treated to a fabulous masquerade party, everything trying to look like everything else, both in terms of publicity and in the actual equipment. It's all very well intended and clearly designed to give you and me, as con-

sumers, the absolute maximum of choice and opportunity in the new cartridge tape field. But it's a masquerade, nevertheless, in the best G & S fashion. A sort of grand costume ball for all the tape system, dressed up in the fanciest outfits and the slickest of disguises.

As you know, there are numerous systems of cartridge tape already well established on the market, and more are on the way. Alas, they are all utterly non-compatible. There ain't no such thing as an all-cartridge-and-cassette tape player (though there are 4-track/8-track cartridge player combinations). So you must make your agonizing choice. Either system A or system B, or C, D, E. All the way. Unless you go out and buy them all.

## You name it

You'd never know it, looking around at all the inspiring offerings now being thrust temptingly in your (consumer) direction. Such a glorious excitement! Such a gorgeous galaxy of good-looking models, such enthusiasms of promotion! The little problem of total incompatibility—and extensive overlap—is simply drowned in the general euphoria. To use an underpowered word, the present situation is totally fluid. It's enough to bewilder the toughest of audio pros, not to mention people like me. Every cartridge system, you'd think right now, is absolutely ideal for every conceivable purpose.

Only when the dust begins to settle, when the feathers cease to fly and excitement boils down, will the public realize that there has indeed been a small revolution in sound. For this time something *really* has happened to

tape. After so many semi-false starts, at last it is going places. That—without the slightest doubt—is why everybody is in such a dither.

Up to this point, the general public has been able to keep up pretty well with happenings in tape. Everybody knows by now that tape cartridges are for automobile players. What else? Haven't they been selling right and left, like warm cakes and, lately, like hot cakes? And most people are aware that cassettes are meant for the new miniature tape recorders. They, too, have been selling like crazy. So it has been simple enough. Even the great 4-track vs. 8-track battle in the auto trade is elemental and almost anybody can see what's going on. Especially if he has one of the systems in his car.

## Living room

I guess it was somehow prophetic that the very first piece of cartridge equipment that came my way—thanks to the usual foresight of one of the Big Companies—was just such a typically improbable example of off-the-beam cartridge application. It was an elegant piece of living room furniture, crafted in rare woods and all that sort of thing, burnished gold, too, styled to match the fanciest interior décor. (It looked sort of silly in my messy living room.) And it was ready to plug straight into my huge, permanent, immovable home system, all thousand-odd pounds of it, including speakers.

Inside that lovely cabinetry there was, of all things, an "automobile" cartridge player.

My first thought was that the Company should have sent along an automobile, too, just to be logical. Or at least one of those dummy steering wheels and mock-up auto dashboards they have in the show rooms to demonstrate auto radios and cartridge players. But no. This was obviously intended for *home* hi-fi, and that was that.

Well, let's admit there are peripheral reasons for such a device. It could be useful, say, as an extra player in your living room, so that you could tote your auto cartridges with you and plug them right back in, thereby missing no more than a few moments of continuous background music. Some people like it that way. Reasonable enough.

Unfortunately, though, a lot of people might get a different idea: that this particular cartridge system has been designed to *replace* a "real" home music system, based on disc records and, maybe, reel-to-reel tapes. It can't. It really can't. It wasn't ever so intended, even if it does appear in this





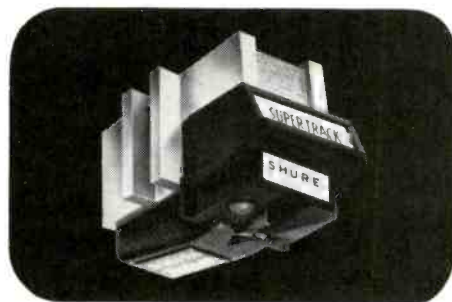
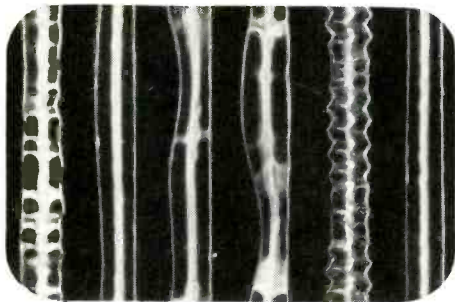
ANY GOOD CARTRIDGE WILL TRACK THESE PASSAGES

BUT ONLY  
A HIGH  
TRACKABILITY  
CARTRIDGE  
CAN COPE  
WITH THIS  
GROOVE!

## CLOSE THE TRACKABILITY GAP (AND YOU'LL HEAR THE DIFFERENCE)

The photomicrograph above portrays an errant, hard-to-track castanet sound in an otherwise conservatively modulated recording. The somewhat more heavily modulated grooves shown below are an exhilarating combination of flutes and maracas with a low frequency rhythm complement from a recording cut at sufficiently high velocity to deliver precise and definitive intonation, full dynamic range, and optimum signal-to-noise ratio. Neither situation is a rarity, far from it. They are the very essence of today's highest fidelity recordings. But when played with an ordinary "good" quality cartridge, the stylus invariably loses contact with these demanding grooves—the casta-

nets sound raspy, while the flute and maracas sound fuzzy, leaden, and "torn apart." Increasing tracking weight to force the stylus to stay in the groove will literally shave off the groove walls. Only the High Trackability V-15 Type II Super-Track® cartridge will consistently and effectively track all the grooves in today's recordings at record-saving less-than-one-gram force . . . even with cymbals, orchestral bells, and other difficult to track instruments. It will preserve the fidelity and reduce distortion from all your records, old and new. Not so surprisingly, every independent expert and authority who tested the Super Track agrees.



# SHURE V-15 TYPE II

**SUPER TRACKABILITY PHONO CARTRIDGE**

At \$67.50, your best investment in upgrading your entire music system.

Send for a list of Difficult-to-Track records, and detailed Trackability story: Shure Brothers, Inc., 222 Hartrey Ave., Evanston, Illinois 60204

© 1967 Shure Brothers Inc.

fancy housing. To be sure, the sound of the thing was better than I would have thought—it did rather surprisingly well. But other things count, too (I'll get to that in a later installment).

The argument runs similarly for many other new items now entered in the big tape race. For instance, if you want, you can now acquire an 8-track recorder. No—it won't rewind. It can't. It'll probably lose you in a maze of different recorded tracks because you can't do very much about locating a particular spot in a hurry. (You can select tracks with some recorders, however.) You just play and play, until you get there. However, for *special purposes*—let's keep all this in perspective—it is surely a good bet. You might want to make up your own endless-loop four-program car entertainments, to enhance those long solo hours of driving.

Then there are those splendid little compact cassette recorders, following after the pioneer Norelco Carry-Corder that launched the cassette on its way to local fame. Terrrific! Mono, and now stereo too, from batteries or a.c., as you wish. Versatile, capable, easy to use and to carry, a remarkable advance in amateur recorder convenience. But should you, maybe, set up one of these babies as a living-room tape machine? Could be done, all right. Power it with house current (Most of them work that way too), plug into the big hi-fi system (they have the re-

quired outputs). And you're in business.

Very fine, but again, only for special purposes. If you want to play recordings you've made on the outside, for instance, and right on the machine that made them. Excellent idea. But these tiny portables really weren't meant for regular hi-fi living room use. They are built around the portable idea. In the home they admittedly offer space-saving advantages, especially when integrated with other equipment to form one unit. But I would advise strongly against throwing out your reel-to-reel household monster. A high-quality one will still do a better job.

Then consider the question of home listening to records. It would be nice, wouldn't it, to eliminate all those tiresome LP discs and just drop little cassettes into a baby player. You can do it in theory, at least. The music on any existing LP can be accommodated on a single small cassette, the same two "sides" (or directions of play), and leaving room for more, too. All the room in the world. But in practice we have a bit of catching up to do. Schwann says there are roughly 35,000 LPs now available in his catalogue. There won't be 35,000 recorded cassettes available for awhile. If ever. Nor is it worth your time at this stage, to copy all your LPs onto blank cassettes, unless for a *very* special reason. (Easier to go out and buy a new copy of the same old LP, I'd say.)

So, do buy cassettes, by all means. But don't fall overboard from sheer excitement. And hang onto those LPs a few more months.

\* \* \*

Well, I've worked back to where I started. Definitely, cartridge tape is going places fast. But definitely, it isn't for *every* purpose, everywhere, as you might think.

The thing to do is to put all those seductive extras, those off-the-beam inspirations, straight out of your mind until you have figured out for yourself what the *central* and best area of usefulness is for each different type of cartridge tape. Add up these factors first, and see how they fit your own special interests and necessities. (If you specialize in home tape editing, for instance, you'd better forget about cartridges real quick. You aren't supposed to know how to edit.)

## One-roll

Well, to end this I must veer towards a more personal approach—for it must be obvious that I'm going to have my own special preferences. Reason it this way.

It must be clear to most readers who have looked into cartridge/cassette tape that there are two basic types now in the ascendant, quite unlike each other in fundamental ways, thereby determining great differences between various systems in terms of practical use. One arrangement I like to call, for simplicity, the *one-roll* system. The other is the *two-roll* approach.

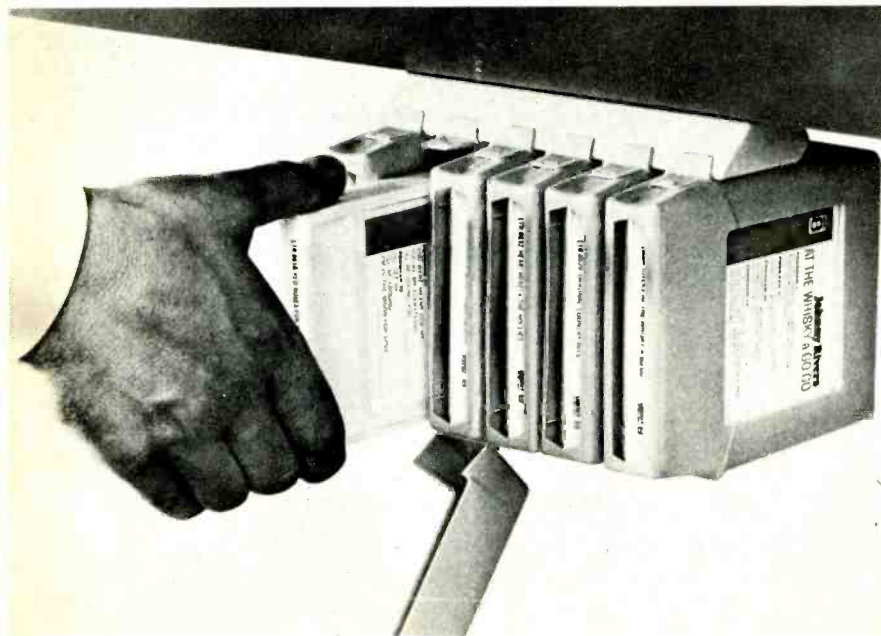
Right away I discovered that this purely physical difference was absolutely central to *my* feelings about cartridge tape.

You see, I have spent most of my life in a personal battle against background music. I am its ever-persistent enemy, and never more so than right now, when I find the stuff so hard to avoid.

I am trained to *listen*, remember. To pay direct attention, to be specifically interested in what is being "said" in musical terms. I *listen* to background music. Can't help it. Drives me nuts. I not only dislike the greasy stuff (pardon my feelings) but I hate the very *idea* of a non-selective sort of music that just oozes, like water leaking from a faucet. Funny—I hate background music even when it is purely classical—that's even worse. (But the Beatles, of course, always rate as foreground.) I hate supermarket music, bank music, elevator, train, bus, plane music. I grit my teeth at it. Also automobile music.

(Continued on page 85)

Fig. 1—With tape cartridges becoming increasingly prominent in automobiles, it's natural for handling and storage devices to spring up. The "Trak Pak" by Liberty Stereo-Tape, shown here, is one such system for 4-track and 8-track stereo tape cartridges. The "Trak" is a slotted holder for the "Pak," holding up to six "paks." One "Trak" plus six "Paks" retails for \$3.98.





# VIKING MEANS EXTRA VALUE IN HI-FI STEREO TAPE RECORDERS

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

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

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

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

VIKING 423



**VIKING**  
tape recorders  
A DIVISION OF THE  
TELEX CORPORATION  
9600 ALDRICH AVENUE SOUTH  
MINNEAPOLIS MINNESOTA 55420

# Letters from Readers

## Making PC boards

• Has a manufacturer made available the printed circuit boards for the Tape Playback Amplifier article which appeared in your October, 1964, issue?

D. A. JEWELL  
Boron, Calif.

*No, but making them should not be difficult. Order from your supplier 1 pkg. (5 pcs.) 7" x 10" Kepro sensitized laminate, No. S1-7105, \$11.45; 1 pt. developing solution, D-1 PT, 1.15; 2 pts. etching solution, E-1 PT, \$.85 ea. Have a local photographer or offset printer make you a negative from the drawing in the article. Making a tight contact between the negative and the copper sensitized side of the laminate and expose to #2 photoflood for time specified in the Kepro instructions (6 to 8 min. at 18 in.), develop, 1 minute, and then etch, which takes about 20 minutes. After thorough washing, you may then drill the laminate for the leads, and you are ready for assembly.—Ed.*

## Addresses unknown

• In your March 1966 issue, you wrote about "Noel Boggs: Western Swing" on Repeat label under Jazz and All That. Could you furnish the name of the distributor on the West Coast?

JOHN VON GLASSNER  
Baltimore, Md.

• I'm having a hard time locating records in your Jazz column, such as: Melodeon, Impulse, Asch, Pinnacle, GHB, and Atlantic.

ROLAND A. SMITH  
Marietta, Ga.

*Perhaps the record manufacturers, whose addresses are listed below, can tell you where their records are available.—Ed.*

Repeat Records  
Div. of Barcus-Berry, Inc.  
5782 E. Second St.  
Long Beach, Calif. 90803

Melodeon  
Spottswood Music Co., Inc.  
3323 14th Street, N.E.  
Washington, D. C. 20017

Impulse  
ABC Records  
1330 Ave. of the Americas  
New York, N. Y. 10019

Pinnacle Records  
5358 South Wells Street  
Chicago, Ill. 60609

GHB  
Jazzology Records  
P. O. Box 748  
Columbia, S. C. 29201

Asch  
Folkways Records  
165 West 46th Street  
New York, N. Y. 10036

Atlantic Records  
1841 Broadway  
New York, N. Y. 10023

## CU's views

• Your editorial in the September issue, "Consumer Reports Strikes Again," contains errors of fact and conveys serious misunderstandings about our mode of operation and about the specific report discussed, the July 1967 one on stereo receivers. There are also errors of interpretation of the IHF standard of measurement for audio amplifiers.

First, as to our choice of models to be tested: A test of a modern stereo receiver at the level of thoroughness we believe desirable is, as the editors of Audio are well aware, a very long, difficult, and expensive process. Our primary responsibility to our readership, largely *not* audio hobbyists, is to keep it reasonably well abreast of the market as they are likely to find it. This means we must restrict ourselves to a reasonable number of brands which are widely advertised and sold. The brands and models selected for inclusion in the stereo receiver report were based on careful market surveys, including statistics from industry and trade sources such as the EIA and IHFM [sic]. We think our choices in this case were eminently reasonable in the light of our objectives, but would welcome any specific criticisms in this area.

We included two additional models that were somewhat different from the rest, the McIntosh, which was outside the price range, and the Dynaco, a series of components and not a receiver. The differences are clearly flagged both in the report and the Ratings, along with our reasons for including the two models. To quote from the published report:

"The transistor receivers in the Rat-

ings range in list price from \$220 to \$400, the most popular price bracket. We also tested for comparison a more expensive, and highly reputed, receiver that uses vacuum tubes in its amplifier, the McIntosh MAC 1500, which lists for \$400. And in another comparison, the receivers were checked against a separate component system that many readers have inquired about. It was made up of a Dyna FM-3/A stereo tuner, a PAS-3X stereo preamplifier and a Stereo 120 power amplifier. . . .

The price average for the remaining receivers is \$313.67, and the maximum deviation from the mean is about 30%. This includes two mail-order models which are at the lowest price level and which, in effect, represent discounted prices. So in fact our price swing was characteristic of products that are roughly comparable, and was not by any stretch of the imagination like the 3-to-1 swing between a Chrysler New Yorker and a Volkswagen, as your editorial says it was.

In the fourth paragraph your writer quotes our statement that we gave heavy weight to frequency response in our tests, and then says: "Yet they kept their test signal low enough to produce only 1/8 watt amplifier output 'to avoid any disturbing effects from distortion.'" Just what the objection is here is not clear. If the writer implies that we ignored distortion in rating the receivers, he has failed to read, or has dropped from consideration, a later paragraph on the same page of our report which went into our tests for distortion in some detail. (But we find an allusion to this part of our report in the last paragraph of the editorial!). At any rate, the meaning of the quoted section of our report should be, we believe, quite simple and clear to the technically-alert reader: Since we measured frequency response from 5 to 100,000 Hz because of the great significance of the extra-audio sections of the spectrum, and these are particularly susceptible to alteration by output distortion, we used a low output level to keep amplifier distortion from *confusing the measurement*. Our precaution was one any knowledgeable audio technician would take. To reiterate, we tested for distortion and frequency response separately, to permit accurate measurement of each criterion. Both criteria were used in evaluating the tested receivers.

Finally, taking a sentence from the first paragraph of Section 4.3 of the IHF standard and following it with a sentence from the second paragraph of Section 4.3 has produced a result

(Continued on page 69)



# Liberator.

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



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

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

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

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

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

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

Two damped 3 1/2-inch cone tweeters provide smooth highs to the limits of audibility. A 3-position brilliance switch lets you tailor the response to the acoustics of your listening room. The crossover network is an inductance/capacitance type with 12-db-per-octave slope. Tweeter and woofer have been electrically and acoustically matched to provide smooth integrated performance over the entire sound spectrum.

All this adds up to an efficient system that offers presence unmatched by any speaker in its price class. Sound is free, natural; does not have the constricted effect that some low-efficiency speakers exhibit in the mid-range. The handsome oil finish walnut cabinet 24 1/2" h x 13 1/2" w x 12 1/4" d, has braced 3/4-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.

**EMI**  
the natural sound

[www.americanradiohistory.com](http://www.americanradiohistory.com)

## EDITOR'S REVIEW

### The Tape Scene

With still-heard mutterings about the questionable need for record discs with two different speeds, 33 $\frac{1}{3}$  rpm and 45 rpm, not to mention 16-rpm discs available here and there for "talking books," imagine how long the controversy will last if all the present tape cartridge systems are accepted by Mr. and Mrs. Consumer.

Right now we have three continuous-loop tape cartridge systems (2-track "PlayTape," 4-track "Fidelipac," 8-track "Lear Jet") and a reel-to-reel cassette (2- or 4-track "Philips"). There's a 16-track system in the wind, too (Bulova), as well as a variety of other entries that do not seem destined for mass acceptance, such as RCA and 3M reel-to-reel cartridges.

The differences between systems are clearly outlined. Continuous-loop tape cartridges operate at 3 $\frac{3}{4}$  inches per second; cassette types operate at 1 $\frac{7}{8}$  inches per second. All things equal, therefore, the higher-speed cartridges offer the potential for better sound quality. In addition, a continuous-loop tape system offers a decided advantage for use in automobiles, where its endless loop provides uninterrupted sound. In contrast, a reel-to-reel cassette must be turned over when playback of one side's recorded tape has been completed.

On the other side of the coin, the cassette concept permits recording of blank tape (in cassettes) as well as playback of recorded material, whereas continuous-loop units cannot record (there is talk of an 8-track unit with recording capability in the offing, however). Further, tape in cassettes can be rewound and operated fast-forward, while continuous-loop cartridges drone on and on with, in some cases, only the possibility of switching from one set of tracks to another.

Some record manufacturers have expressed fear that Playtape, the 2-track cartridge, will gain ground at the expense of 45-rpm records. Its low cost (machine, \$16.95 and up; recorded cartridges, \$1.00 and up), small size (4-in. x 2-in. x  $\frac{1}{2}$ -in.), and concentration on rock-and-roll "singles" and children's songs and fairy tales, make it a formidable prospective competitor. Philco's "Hip Pocket" paper-thin rec-

ords (noted here in November) and General Electric's rumored development of a paper-thin record may meet PlayTape head on, or vice versa.

There are more continuous-loop tape machines than cassette machines in consumer hands thus far. Continuous-loop tape-cartridge player sales were bolstered by almost 170,000 units factory-installed in 1967 model automobiles. But many industry pundits expect cassette machines to pass continuous-loop machines in sales eventually. With 4-track and 8-track continuous-loop tape machines far ahead in autos, and cassette and PlayTape machines firmly entrenched in the portable field, it would seem that the deciding battle will take place in the home.

You need not weep for open reel-to-reel tape recorders, however. They still represent the only tape machines which allow one to splice tape. And the better ones can beat the pants off cartridge or cassette equipment in terms of fidelity.

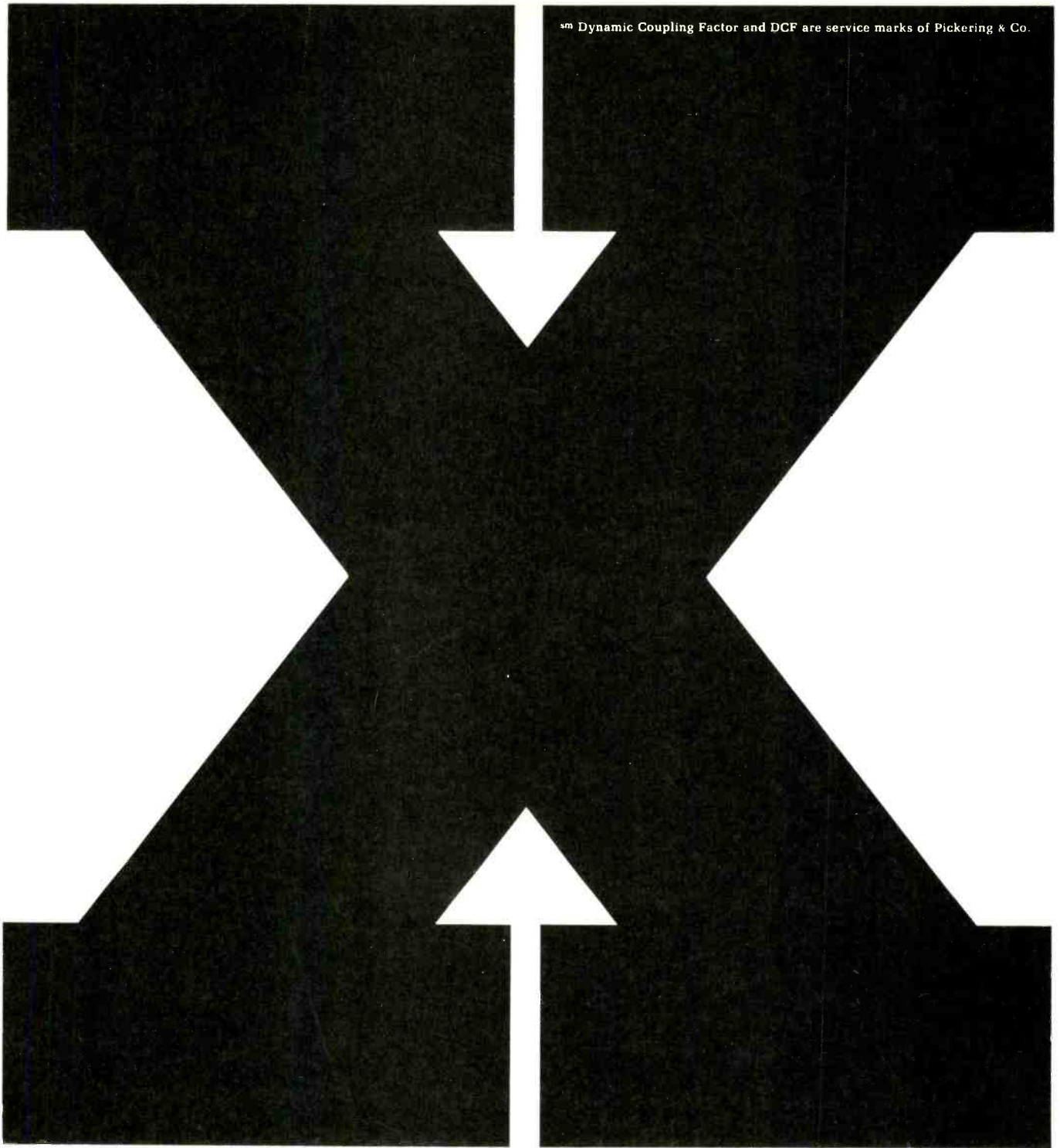
When you observe that sales of tape recorders and reproducers in the U. S. are expected to exceed 5.5 million units in 1967, it is clear that the technique of magnetic recording discovered in the 1890s by Danish scientist Valdemar Poulsen has become a commercial success. And if you're a trend watcher, it is interesting to note that some 43 per cent of these units were reported to be either continuous-loop or cassette machines.

### Signs of the Times

With the New York and Los Angeles High Fidelity Shows, sponsored by the IHF, behind us, Hi-Fi 1968 style is easier to behold. Some interesting innovations were introduced at the Shows, some of which are sure to be adopted by other manufacturers. For example, two manufacturers displayed FM stereo tuners with a group of pushbuttons that may be preset by diode tuning for favorite station selections. Big speaker systems were very much in evidence, though small and intermediate-size systems could be seen in full strength. More compact music systems and a wider choice of consoles with high fidelity components could be observed, too. Cartridge and cassette tape machines have made their mark on hi-fi equipment, with some manufacturers even integrating the new tape machines into their equipment. And there's always a tinge of excitement at the Shows when startling new concepts are demonstrated. These included a record changer with an adjustable vertical tracking angle adjustment, a power amplifier-speaker system combination, 45-rpm record storage/player, a tri-amplifier, telephone-dial LP record selector unit, and a tape recorder with computer logic circuitry for fool-proof operation, among others. You will read about them in the pages of AUDIO as 1968 unfolds.

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).<sup>sm</sup>

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

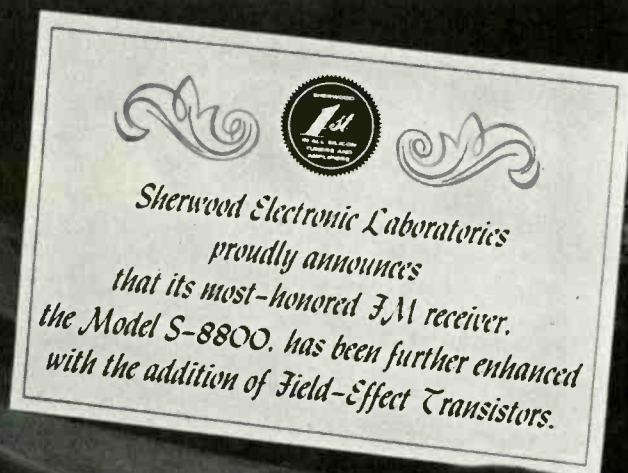
the egg, the end result can be presented quite simply. So can the superior performance of the XV-15 series. Its linear response assures 100% music power at all frequencies.

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 Dustomatic brush.

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

## Our most-honored receiver



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

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

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

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

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

*Sherwood*  
Sherwood Electronic Laboratories, Inc.,  
4300 North California Avenue,  
Chicago, Illinois 60618. Write Dept. 12A



# BUILD A MIXER-METER AMPLIFIER

HAL MAGARGLE

Mixing requirements for recording a puppet show generates construction project

WHEN THE FAMILY DECIDED to produce a puppet play, a suggestion was made to record the sound. A puppet purist would be aghast at this because spontaneity plays such an important part in the presentation. Inasmuch as the entire family could not be present for each show, however, we felt it had to be done this way.

After the stage and other hardware were completed we prepared the necessary recording equipment. The script was evaluated and the music was selected. Because it was felt that sound effects would have to be mixed with the music and voices, some sort of a mixer would be needed. I decided to build one to meet my special requirements. Construction plans for the mixer and associated amplifier, as well as a diagram of the recording session, are discussed here.

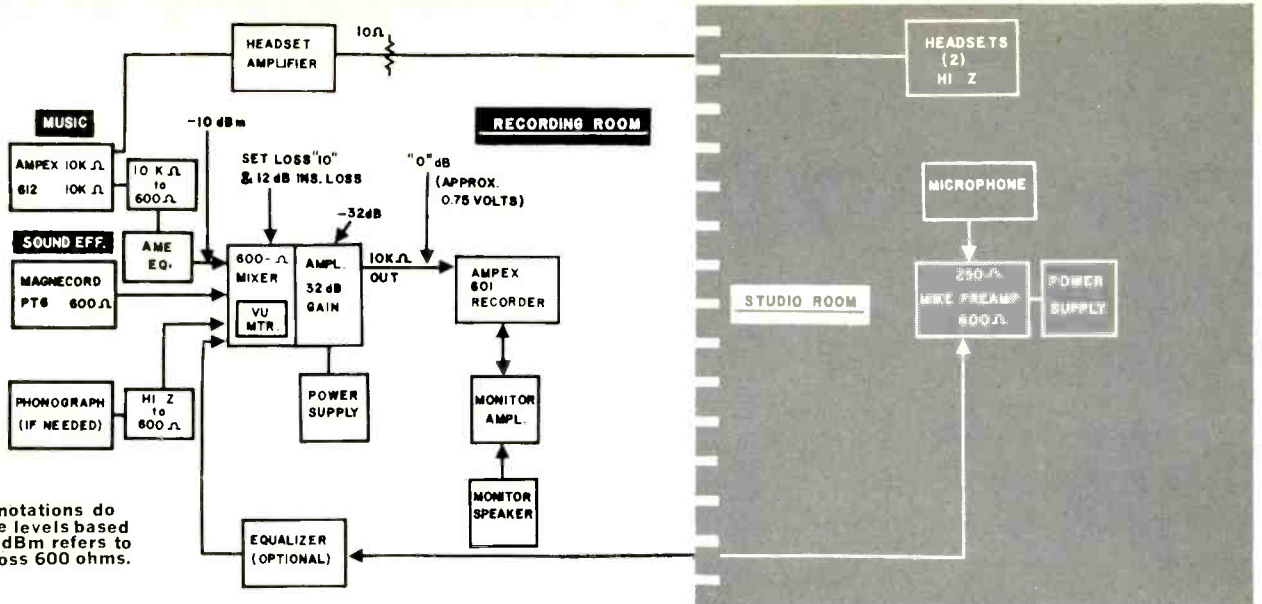
Our recording method was to assemble the music and sound effects on individual reels, editing and fading in and out where necessary and possible. Adding of the voice was the only remaining consideration. With the lyrics in hand, many rehearsals were made so the performer and his coach could become familiar with the music. This gave the mixer operator an opportunity to determine the proper balance between voice and music. Not having a sound studio at home the living room was used as the recording room, and a long line was run to a bedroom, which served as the "studio." With the addition of a "sound blanket" in



Fig. 1—"Monitor room" shows equipment used for recording session. Home-brew mixer is in foreground.



Fig. 2—Performer and coach during a "take." Puppets are shown in inset.



Note: dB notations do not denote levels based on power. dBm refers to 1 mW across 600 ohms.

Fig. 3—Block diagram shows equipment used for recording session.

this room, acoustics were fairly good. No intercom was necessary because of the normal "leak" of modern bedroom doors. The actual recording took less time than anticipated, even though stopped occasionally for some airplane and truck noises. The background noise level was very low and not noticed at all in the final performed version.

Tape was a necessity in the case of our youngest performer, our pre-school-age son. He couldn't read, so each line had to be read to him. After many tries he would repeat the line with exactly the same inflection as the coach's, and it was taped. Editing all these bits and pieces together made a pleasing bit of dialog.

After assembling all the takes in sequence, we had numerous rehearsals with the puppets in an effort to

determine timing. Some of the actual mechanics of puppet manipulation dictated how tight the editing could be. After all the problems were ironed out, the edited tape was transferred to low-print, polyester-base tape for the play copy. This copy would, of course, hold up better under the many future playings ahead, whereas the edited master, with its myriad of splices, might present trouble.

The photographs show the actual recording session, including the temporary set up at the hi-fi end of the living room, as well as one of the scenes from the play.

### Construction

The 4-position mixer here uses 600-ohm attenuators simply because they were available from

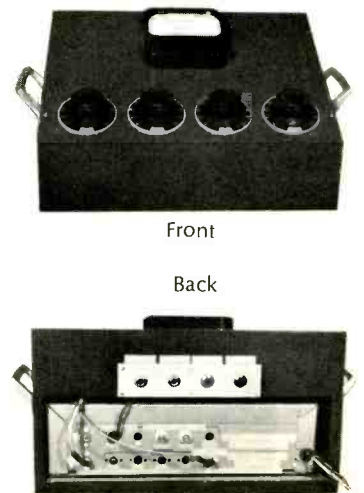
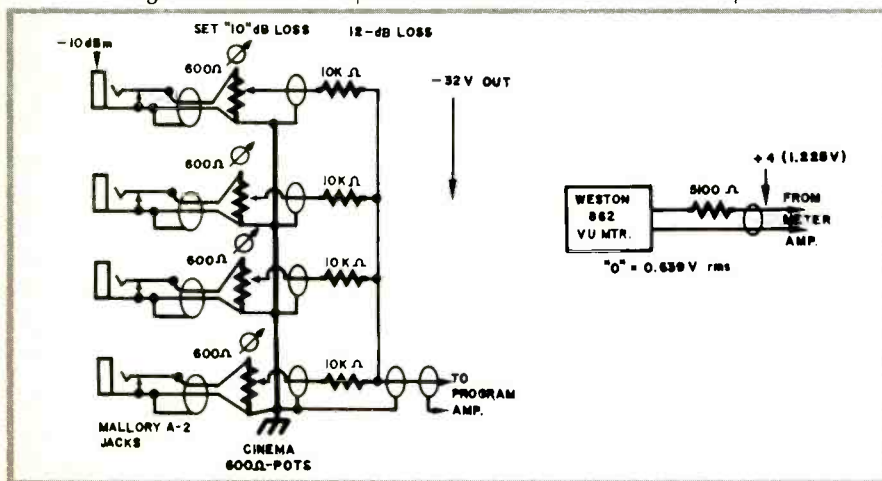
the junk box. This necessitated installation of an impedance-matching transformer at the output of one tape machine that normally has a 10k-ohm cathode follower output. The mixer could use 10k-ohm attenuators or higher with isolating series resistors changed accordingly.

The mixer also uses a standard VU meter that was readily available, but any volume indicator would suffice. The recording-machine indicator could also be used, thereby eliminating an extra VU meter on the mixer. The author uses the AME curve for recording music, so the 600-ohm termination was needed to match the equalizer at the output of the tape player.

At least one tape machine had to

Fig. 5—Front view and back view of mixer.

Fig. 4—Schematic of 4-position mixer which has 600-ohm inputs.





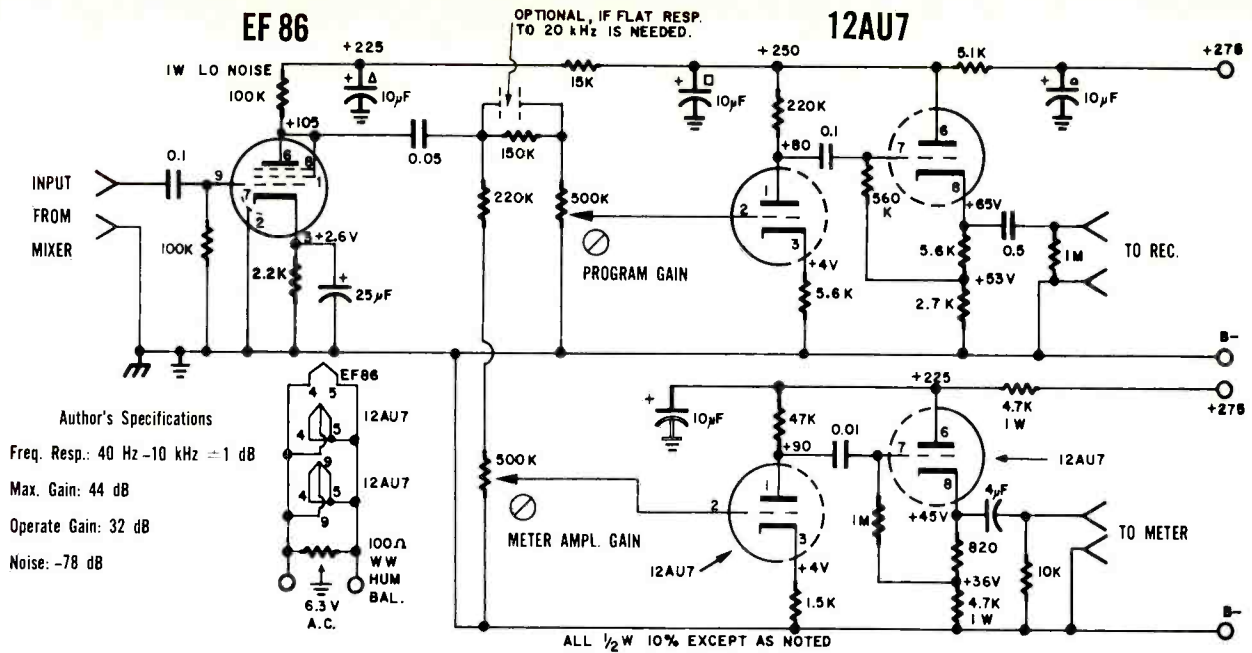


Fig. 6—Schematic of amplifier built for this project. With a special Weston 862 VU meter, the author used a 5.1K ohm resistor to obtain proper ballistics rather than the more conventional 3.6K ohm resistor. Pots are set for 0.75 V amplifier output to recorder.

### PARTS LIST

#### MIXER

- 1 Weston Model 862 VU Meter (see text)
- 4 Mallory A-2, closed-circuit jacks
- 4 Cinema Engineering 600-ohm pots, audio taper (see text)
- 4 10K-ohm, 1-watt carbon resistors, 10%
- 1 5.1K-ohm, 1-watt carbon resistor, 10%

#### AMPLIFIER UNIT

- 1 10 μF-10 μF-10 μF-10 μF/450 V electrolytic capacitor

- 1 4 μF/350 V electrolytic capacitor
- 1 25 μF/25 V electrolytic capacitor
- 2 0.1 μF capacitor, 400 V
- 1 0.05 μF capacitor, 400 V
- 1 0.5 μF capacitor, 400 V
- 1 0.01 μF capacitor, 600 V
- 2 500K-ohm screwdriver adj. Pots., IRC R2-13-133
- 1 100-ohm hum adj. Pot., Centralab WN-101
- 1 100K-ohm, 1-watt low-noise resistor, IRC DCF-100K
- 2 4.7K ohm, 1-watt carbon resistors, 10%

All below 1/2-watt, insulated carbon resistors, 10%

- 1 820 ohm
- 1 1.5K
- 1 2.2K
- 1 5.1K
- 2 5.6K
- 1 10K
- 1 15K
- 1 27K
- 1 100K
- 1 150K
- 2 220K
- 1 560K
- 2 1 Meg

feed earphones to allow performers to hear the music while they were singing the lyrics. This was simple with the binaural output of my tape machine: One output to the mixer, one to the earphone circuit. A single-track machine would be fine, too; merely bridge the earphone amplifier across the output. Some crosstalk might be present in the earphones, though, depending on the amount of isolation in the mixer.

The block schematic illustrates the electrical hook-up used for the first show plus the one now in production. The microphone is placed in the aforementioned bedroom with its own preamplifier near it. With the low-impedance mike being used, we could have run the mike line from the bedroom to the living room.

However, I chose to amplify the signal first and then send it at a higher level through the house. The output of this amplifier feeds the mixer, along with outputs of the other tape machines. For monitoring, the recorder's output was fed to a power amplifier and speaker. The block diagram shows the lash-up for the entire session, as well as the method used in feeding headsets.

I used wood to build the mixer cabinet, spray-painting it to provide a nice finish. The top plate was fabricated from 1/16" aluminum. A pre-built metal cabinet could have been purchased just as well, of course. The electronics of the mixer are nestled in the bottom of the box, utilizing a surplus metal preamp cover and chassis.

Inasmuch as a VU meter adds a

slight amount of distortion when bridged across a minimum-level line, a cathode-follower output was used for the actual signal, and a separate amplifier for the meter alone. The mixer would never be more than 6 feet away from the recorder, however, so a 10k-ohm cathode follower was considered satisfactory.

The schematics illustrate mixer and meter-amplifier circuitry. Good construction techniques were followed with no real problems because of the relatively low voltage levels used. An external power supply was used because we had one on hand that was too large to fit in the box. Specifications for the electronics section are shown. (A schematic for a separate mike preamplifier is not shown because it isn't relevant to this article.)

# Why Look-A-Like Recorders Can Be \$\$\$ Apart

HERMAN BURSTEIN

Tape recorder buying checkpoints are examined by the author to determine what accounts for price differences

IT IS PUZZLING TO MANY an audio buff that we can go into hi-fi dealer's store and find tape machines with great similarity in all respects but price, which can differ by a factor of 2:1 or more. If two machines are about the same size, look alike, and perform basically the same functions, what can account for such a vast price difference? In general terms the answer lies in the following:

1. Variety of features, conveniences, and functions.
2. How well a machine performs.
3. Reliability — how long a machine continues to perform well.

Before getting down to specifics, it should be stated that we are not arguing a case for either expensive or inexpensive tape machines. We are just trying to explain the differences between them. At the same time we hope to provide worthwhile clues to finding that particular machine most commensurate with your needs and budget.

## Features

Instead of attempting a complete list of features offered by one tape machine or another, we will just provide enough examples to make clear the point that price must go up with both the number and nature of features offered.

Most home machines are put through their paces of "start," "stop," "normal forward," "fast forward," and "fast reverse" (and perhaps "pause") by levers, knobs, or pushbuttons. For greater ease and speed of operation, some machines

supply the force to actuate the mechanism: pushbuttons responding to a light touch control solenoids that perform the actual work. Convenient but costly.

There is a major trend to the automatic reversing machine, which eliminates the need to stop the transport at the end of a reel, lift the reels off the machine, reverse it, and restart the transport. Instead, using one of a variety of sensing techniques (metallic foil, period of silence, etc.), the machine stops automatically at the end of the tape and almost immediately proceeds to operate in the reverse direction. Such a machine must cost appreciably more than its non-reversing counterpart in order to incorporate a sensing direction, and facilities to reverse motor direction and switch from one set of tracks in the forward direction to another set in the reverse direction.

Because it has separate amplifiers for its two channels, a stereo machine has the essential *capability* for sound on sound: to record on one channel while playing the other. But the normal mode of operation is to record on *both* channels or play on *both* channels. To simultaneously record on one and play on the other calls for special switching, including temporary insertion of a dummy load on the bias oscillator to prevent significant changes in bias and erase current for the channel which is recording. Otherwise, such changes might appreciably affect distortion and treble response, and they might injure the erase head (owing to excess oscillator current). Further,

there must be provision for mixing the newly-recorded input signal and the previously recorded signal.

Number of speeds adds to cost. This is not merely a matter of slight extra mechanical complexity in the transport. With each change in speed there are accompanying changes in recording and playback equalization; also, depending on how hard the manufacturer strives for good performance, there may be changes in bias current, recording level, and recording level indication. Moreover, as machines introduce ever-lower speeds, playback heads with ever-narrower gaps are needed to maintain good treble response. A high order of technology, skill, and precision go into such heads.

A highly desirable feature is the ability to monitor the tape; that is, play the tape as it is being recorded to compare the incoming and recorded signals. This requires separate record and playback heads, separate record and playback amplifiers for each channel, and a switch to alternate the machine's output between the incoming and playback signals—all at no small added cost.

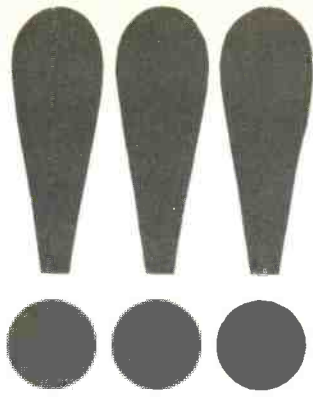
Many more features that add to cost might be named, such as remote control, voice-actuated operation, synchronization with slides, mixing facilities with separate gain controls for each input signal, pause button (to stop the transport without disengaging the record or playback electronics), etc. But by now the point should be clear.

## Performance quality

The basic criteria of high fidelity performance are low noise, low distortion, and faithful frequency response (wide and smooth). These electro-acoustic criteria apply with full force to the tape recorder. In addition, there is a fourth, mechanical criterion: good tape motion, which essentially denotes speed that is accurate and constant. Two machines identical in functions and features may differ appreciably in the extent to which they measure up to these criteria, and therefore will tend to differ in cost.

*Noise.* Of the four criteria, tape recorder noise seems to get least attention although it is just as impor-





# a Marantz receiver

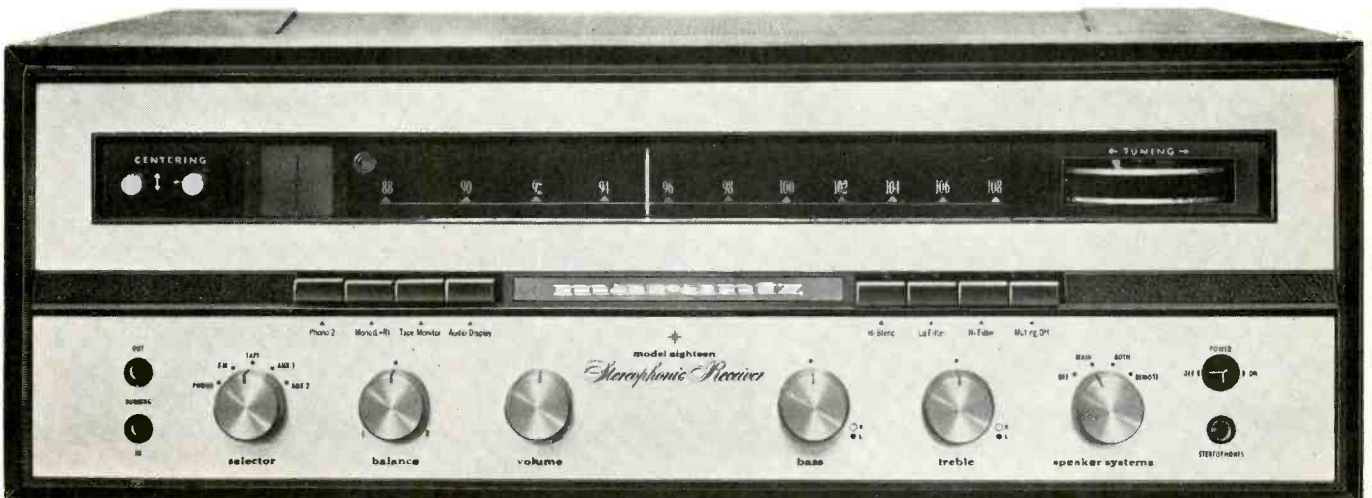
Now everyone may enjoy the eloquent sound of Marantz components, combined in a single completely solid-state system — the Marantz Model 18 Stereo Receiver. Here is the incomparable quality of Marantz stereo components — tuner, preamplifier and power amplifiers — combined on a single chassis. Designed to the unequivocal standards which have made Marantz a legend in stereo high fidelity, the Model 18 achieves the level of performance of the most expensive components in a moderately priced compact receiver. Here is the total performance you would expect from Marantz. Finer sound than you have heard from most quality component systems and it is priced at less than half the cost of the fine Marantz components which inspired its design — only \$695.00

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

**Specifications:** **Tuner Section:** Signal-to-Noise Ratio — 70 DB; Harmonic Distortion at 400 Hz, 100% modulation — 0.15%; Frequency Response, 75 microsecond de-emphasis — ±0.5 DB; Multiplex Separation, 20 Hz — 43 DB, 1000 Hz — 45 DB, 10k Hz — 35 DB, 15k Hz — 30 DB. **Amplifier Section:** Power, 40 rms watts per channel at 4 and 8 ohms, 20 Hz to 20k Hz; Distortion, 0.2% THD; Frequency Response, 15 Hz to 30k Hz, ±0.5 DB. **Dimensions:** 18¼" wide x 16" deep x 6" high.

**marantz**®

37-04 57TH STREET, WOODSIDE, NEW YORK, 11377



MARANTZ MODEL EIGHTEEN STEREOPHONIC RECEIVER

tant as the others. Attention inclines to be diverted to frequency response and tape motion, which are no longer a problem in home machines; at least not at speeds of  $7\frac{1}{2}$  and  $3\frac{3}{4}$  ips. But noise remains very much a problem, and a significant element of tape machine cost is the effort to keep noise at a level low enough to be considered "high fidelity." Pre-amplifiers, power amplifiers, and tuners attain signal-to-noise ratios of 55 dB and substantially more. But for a tape recorder to do so (with reference to 400 Hz recorded at a level producing 3% harmonic distortion on the tape) is still a relative rarity, achieved through extra-careful design and layout and through components of extra-high quality.

An important component of noise is produced in recording as the result of distortion in the bias waveform. To reduce waveform distortion to a minimum, the tape machine manufacturer must be willing to go to extra expense in such matters as oscillator circuitry, quality of the oscillator transformer (a toroidal unit is considered best by some), and quality (stability, precision, and overload characteristics) of the capacitors and resistors used.

Counted in with noise are crosstalk between stereo channels and inadequate signal separation between adjacent tape tracks. To hold crosstalk to a minimum requires that a

stereo head be suitably constructed to provide good isolation between its two sections, and that the tape amplifiers for the two channels be properly laid out to prevent the signal in one amplifier from leaking to the other. Good adjacent track separation requires that the tape heads be precisely constructed and positioned.

Before leaving the subject of noise, it is important to note indications that the Dolby Noise Reduction System (discussed in the March and April 1967 issues of *AUDIO*) may be making its way into home tape machines. Briefly, the system divides the audio range into several bands, emphasizes low-level signals in each band prior to recording, and de-emphasizes these low-level signals and, simultaneously, noise in playback. Unless the original Dolby system is greatly simplified, incorporating it into a tape machine would appear to add an item of considerable cost.

*Frequency Response.* Where frequency response is concerned, the chief problem seems to be that of preserving treble frequencies to the upper limit of the audible range for adults—about 15,000 Hz. As stated before, this depends in good part upon making the gap of the *playback* head (not the record head) sufficiently narrow; the lower the speed, the narrower must be the gap to avoid an abrupt treble drop. It is costly to construct a head with a gap that is very narrow and at the

same time very straight (for well-defined response) and deep (to withstand wear).

As tape speed is reduced, there are intensified treble losses in recording owing to magnetic phenomena. In part these losses can be overcome by reduced bias. But a reduction in bias means an increase in distortion unless recording level is lowered. A satisfactory lowering of recording level can take place only if noise is kept low. And keeping noise low, as we have already seen, is expensive. In sum, good treble performance at low speeds is not achieved through design and components of the garden variety.

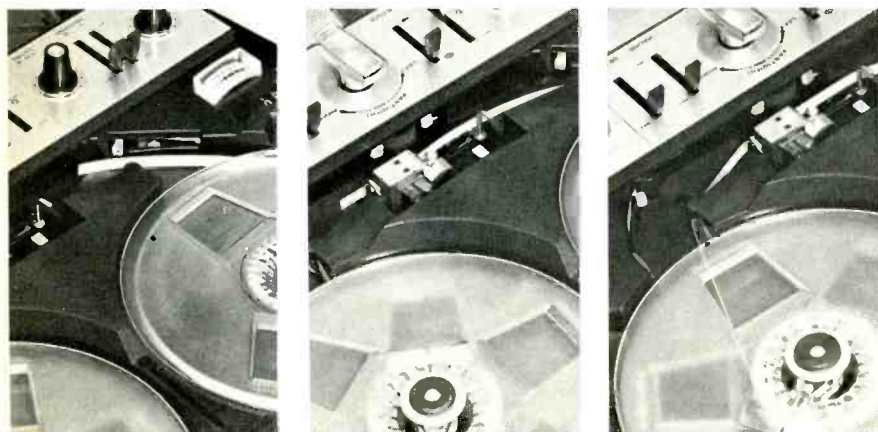
In reproducing bass, the playback head tends to exhibit "bumps" and a hump in response owing to the tendency of the head as a whole, and not merely its gap, to respond to long magnetic wavelengths (low frequencies) on the tape. These irregularities can be minimized through optimum angle of approach of the tape to the head, through optimum "wrap" of the tape about the head, and through suitable adjustment of playback equalization circuitry.

For the rest, flat response depends upon expertly designed record and playback equalization, and upon the use of precision components that fulfill this design. It is not sufficient that record-playing response be flat. In addition, playback response must be flat with respect to a standard test tape—in other words, playback response must conform to a specified industry characteristic to assure flat response when playing tapes recorded on other machines (commercial tapes or otherwise).

To the extent that he seeks to satisfy the various requirements for wide, smooth frequency response, the tape machine manufacturer faces ascending costs.

*Distortion.* Not only should the record and playback amplifiers of a tape recorder have inherently low distortion but they should be able to accommodate a wide range of input signal levels without overloading; that is, there should be sufficient "headroom" for large incoming signals even though these are eventually reduced to appropriate size before reaching the record head.

Fig. 1—Automation has come to reel-to-reel tape recorders, including automatic threading. Ampex, Bell & Howell, and Sony Superscope are among manufacturers offering this luxury. Below, is a Bell and Howell Autoload® recorder which, on pressing a lever, activates a blower that lifts tape from the supply reel, carries it under the tape lifter, up toward the takeup reel, and drawn around the reel hub, whereupon the blower shuts off automatically. (Stop-action, strobe-light photography was used here.)





## 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.

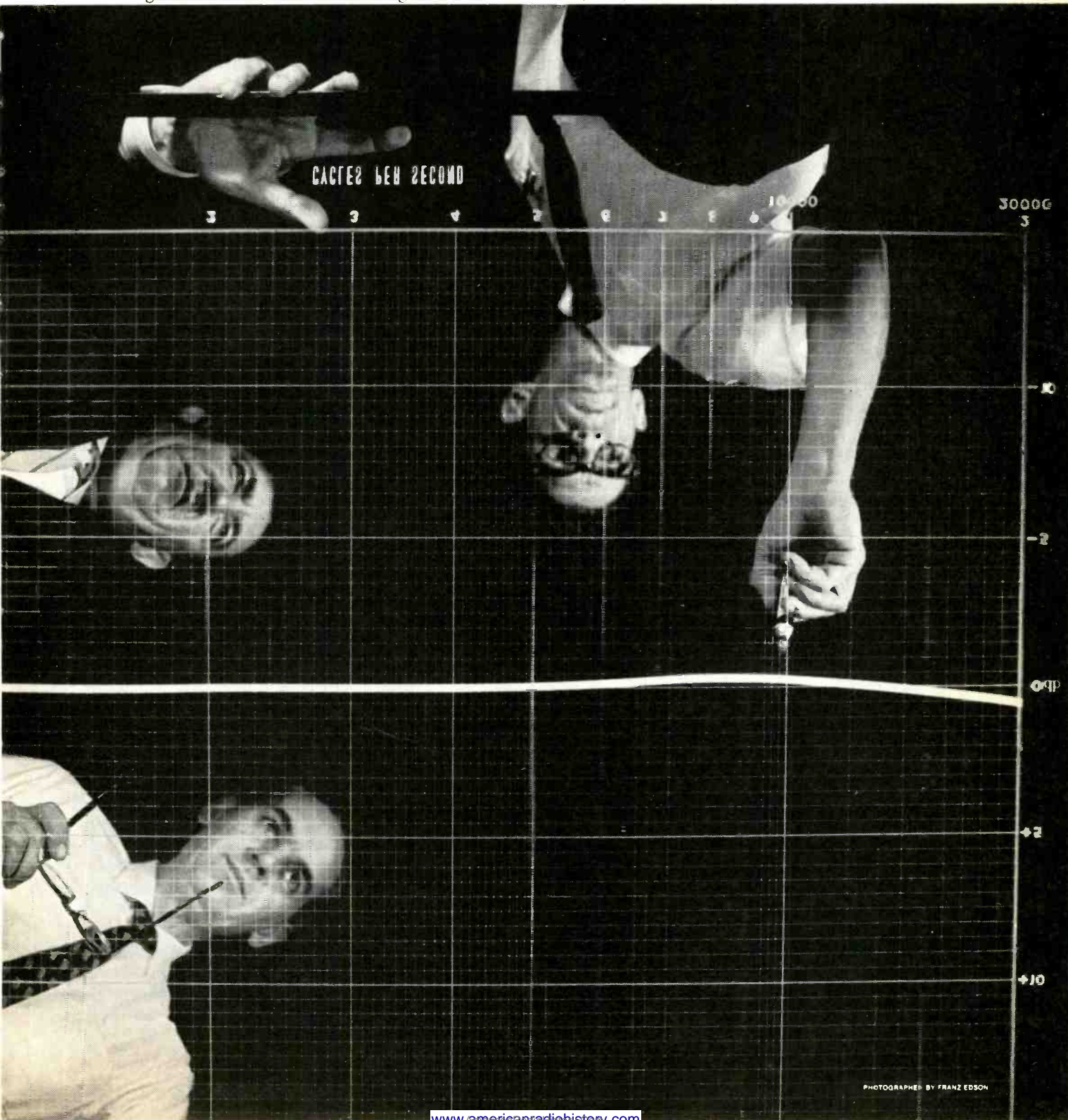
Nothing less would meet the needs of the professional studio engineers who use Stanton cartridges as their ref-

erence 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.



PHOTOGRAPHED BY FRANZ EDSON

Distortion further depends on the quality of the tape heads, particularly the recording head, which if improperly constructed may overload before the tape does at low frequencies.

Thirdly, distortion depends on the steadiness of tape motion. Flutter (rapid variations in tape speed occurring from about 20 to several thousand times per second) modulates the audio signal, resulting in spurious frequencies: distortion. The audible effect is grainy, gritty, or even coarse sound in place of "silky smoothness." If poor design of the tape path, rough heads, or excessive pressure-pad force causes the tape to rub across the head in the manner of a bow against a violin string, the audio signal is correspondingly modulated and distorted.

Finally, and perhaps most important, distortion depends on the recording level. If the tape machine designer has gone to the effort and expense of reducing noise about as far as the state of the art permits, he can afford to let the user record at a moderate level—most of the time causing less than 1% harmonic distortion and seldom or never causing more than 3% distortion. But if corners have been cut to save money and the machine is therefore relatively noisy, the designer may have the user record at appreciably higher levels—often causing more than 3% distortion—to achieve a non-objectionable signal to noise ratio. How does the designer get the user to record at one level or another? Simply by the way he calibrates the recording level indicator. For example, if he intends the user to operate at a high recording level to cover up noise, the indicator is adjusted to say "halt" (the magic eye will close or the VU meter will swing to 0 VU) only at a high recording level.

Parenthetically, this brings us to the much disputed question of VU meters versus magic eyes in home tape recorders. I have long argued that for home use the "magic eye," though less expensive, is at least as good as and probably preferable to the VU meter if you needn't conform to professional specifications. The "magic eye" gives a more definite indication of excessive recording

level. As it is an electronic device, it responds quickly to sound peaks. VU-type meters have gained popularity for two reasons: they look "professional," and of course, they are easier to integrate into transistor circuits than are "magic eyes," which are really tubes.

It is ironical to contemplate that a cheap, non-standard "VU meter" is probably more costly than a magic eye. If it is *truly* a VU meter, meeting A.S.A. specifications as to frequency response, rapidity of response, and ability to withstand overloads, the cost becomes much higher, even though the home user gains little, if anything.

*Separate Record and Playback Heads.* Earlier we pointed out that separate record and playback heads (and with these, separate record and playback amplifiers) are a desirable though costly feature that permits monitoring the signal on the tape as it is being recorded. Probably a more basic reason for separate heads is that they permit the best overall performance in terms of frequency response, distortion, and noise. Although a single head for use in both recording and playback can give good performance, it is nevertheless a product of compromise. Separate heads permit each to be designed for the specific, intended purpose. For recording, a head should have a relatively wide gap and low impedance. For playback, it should have a much narrower gap and high impedance (to maximize signal output and therefore the signal-to-noise ratio at a stated distortion level).

*Motion.* We have already mentioned the need for minimum wow and flutter to obtain maximum transparency and clarity in recording. This requires a well-balanced motor of high quality, careful design of the tape path, accurate machining of rotating parts, and mechanical devices to filter out deviations from constant speed (such as a heavy flywheel). Good motion further denotes accurate speed, constant speed from beginning to end of a reel, and facile transition from one operating mode to another (for example, from "normal forward" to "fast reverse") without spilling or breaking tape. Good motion increases cost.

## Reliability

Though a tape machine initially meets all its specifications, it still must stand the test of time. Reasonably long, uninterrupted periods of correct operation are obviously important. This too can be built into a machine, but again as additional cost.

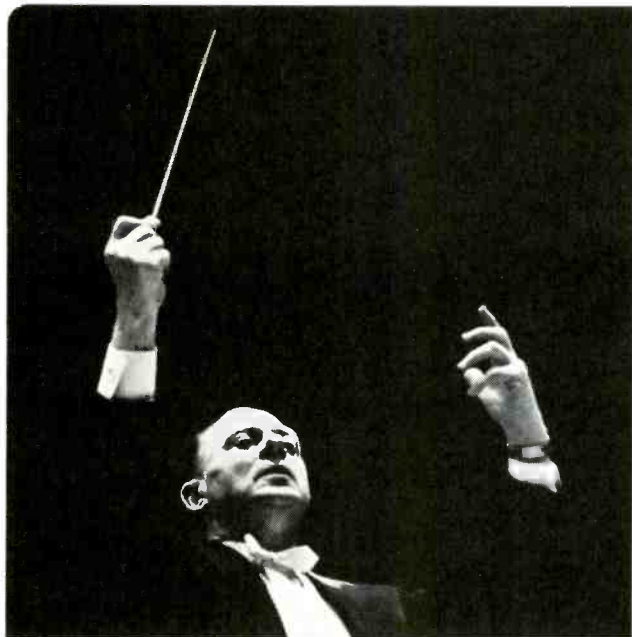
To give a simplified idea of how this works, assume that a tape machine consists of 200 parts, that malfunction of any part will disable the machine, and that each part has 0.001 chance of going bad within a year. Then, based on probability theory, the machine has about 18% chance of breaking down within a year. The manufacturer may feel this is good enough in view of the low price he is charging for his machine. Another manufacturer, however, may seek to offer much greater reliability, though at a higher price, by using more expensive parts (such as resistors of higher wattage rating and capacitors of higher voltage rating) having only 0.001 chance of failure within a year.

Reliability is not only a matter of good parts, but also of good design and proper assembly. The extra engineering hours that a manufacturer may devote to designing, testing, and redesigning a machine to make it failure-resistant must be reflected in higher cost. To prolong head life, for example, he may abandon pressure pads and switch to a more expensive system of tape guides and tape tension to maintain intimate tape-to-head contact (essential for good treble response). When a machine must be extra rugged to withstand all day, day-in, day-out use, he may go to three motors instead of one. To make sure that his product meets specifications and *keeps meeting them*, he may institute an extra-tight system of quality control over incoming parts and outgoing final product. A conscientious job of testing a complex tape recorder and putting it through its many paces takes time and money.

So when you wonder why tape recorder "A" cost more than tape recorder "B," though they appear to be identical, consider the foregoing factors. Æ



# Build a world of your own on "Scotch" Brand Dynarange® Tape.



Great moments in music . . . happy times at home and away—capture whatever sound you want to save on "Scotch" Brand "Dynarange" Recording Tape. "Dynarange" delivers true, clear, faithful reproduction across the entire sound range. Makes all music come clearer . . . cuts background noise . . . gives you fidelity you didn't know your recorder had.

And "Dynarange" saves you money, too! Delivers the same full fidelity at a slow 3¾



speed that you ordinarily expect only at 7½ ips. The result: You record twice the music per foot . . . use half as much tape . . . save 25% or more in tape costs! Lifetime silicone lubrication protects against head wear, assures smooth tape travel and extends tape life. Isn't it time you built your own private world of sound on "Scotch" Brand "Dynarange" Recording Tape?

**Magnetic Products Division** **3M** COMPANY

"SCOTCH", "DYNARANGE" AND THE PLAID DESIGN ARE REGISTERED TRADEMARKS OF 3M CO

# INSTALLATION PROFILE

AUDIO invites you to send in photos and details on your hi-fi system. Payment will be made for all published material.



Figs. 1 and 2—A variety of tape recorders and recording equipment, including a mixer (bottom-center) is shown here lined up on shelves. Below is an overall view of the component installation, a wall-to-wall fabrication. Speaker systems are located at each side of the open cabinet (see page 82).



THE PRESENT HI-FI RIG of computer technician John A. Simpson, Atlanta, Ga., is the result of eight years of purchases, trades, and construction.

An avid tape recording enthusiast who finds time now and then to do freelance recording for transfer to

disc and tape, he owns three tape machines: Viking MLD 95 ESM, Ampex 350-2, and Sony 250-A. The Viking and Ampex models are two-track, 15 ips, 10½-in. reel models, both of which he uses for master copies. The little Sony is employed to make duplication copies at lower

speeds. To maintain a good signal-to-noise ratio when erasing recorded material, he uses a bulk eraser rather than magnetic erase heads of his recorders.

As Mr. Simpson does a lot of "live" recording, it is not surprising to learn that he owns an assortment of microphones, including: two each of Synchron A-7, RCA 44-BX, University 402, Beyer M60, Shure 330, Shure 556, Altec 682-A.

The center console is a home-built mixer for tape recordists, built from construction plans detailed in an early issue of *AUDIO* ("A High-Quality Stereophonic Mixer," Robert Gerbracht, *Audio*, March, 1962), plus additions such as added inputs, monitor amplifier, and other desirable features. Our amateur recordist put low-level preamplifiers on all eight mixing inputs (200-ohm balanced). In addition to these inputs, there are eight high-level, low-impedance inputs. Of the four low-impedance outputs, two are muted.

A built-in 1.5 W monitor amplifier for each channel feeds headphones. Speaker muting relays are also built into the unit. The mixing circuit itself is a common-plate type.

The unit utilizes metal-film resistors, extra-heavy-duty power supply with regulation circuitry, and other premium components, thereby contributing to dependable operation. As tangible proof of the soundness of this philosophy, the mixer has not exhibited any trouble during its four years of heavy use, except for some noisy vacuum tubes. (The mixer uses 31 tubes, excluding voltage-regulating tubes in the power supply.)

Other hi-fi equipment includes the following components: Dynakit Stereo 70 power amplifier, Dynakit PAS-3X preamplifier, Altec Lan-

(Continued on page 82)



**Several interesting facts about the design of the new Dual 1015:  
after you read them, you may wonder why other automatic turntables aren't made this way.**

You've probably noticed that many of the new automatic turntables, in several price ranges, offer features like anti-skating devices, levers for raising and lowering the tonearm (cueing devices), interesting motors of one kind or another, plus some pretty fancy designs for overall appearance.

Well, the new Dual 1015 has these things too. Even the fancy design for overall appearance.

But our features are different. Different because we don't offer them just to offer them. They are there to perform a real function. With precision and accuracy.

Take our anti-skating control.

It's there because, quite simply, our low-mass tonearm skates. No, that isn't something to be ashamed of. In fact, it indicates bearing friction so low (less than 40 milligrams, always) that there's no internal resistance to skating. Even at 1/2-gram. (You'll note that other arms offering anti-skating devices don't mention bearing friction. It's understandable. If bearing friction is high, skating never occurs in the first place.)

And that's not all.

Our anti-skating control is continuously variable and dead-accurate. It doesn't under-compensate or over-compensate. This means the stylus will track with equal force on both walls of the stereo groove. Also, our anti-skating control applies force internally, at the pivot, keeping the force constant throughout the record. You can't do this by applying

a dead weight to the outside of the arm.

Okay, now for our cueing control.

The purpose of cueing is to lower a stylus to a predetermined spot on a record. Accurately and gently. If it does neither, or just one of these things, it's not cueing. It's simply doing what you could do by hand (that includes damaging a high-compliance stylus).

Dual's cue-control is accurate and gentle. Rate of descent is .5cm/second and is controlled by silicon damping and piston action (which also prevent side-thrust from anti-skating). And the cue-control works on automatic as well as manual start.

Here are a few more things that should interest you:

Our hi-torque motor is a constant speed motor. It's quieter and more powerful than a synchronous motor, and turns the record accurately. Not just itself. (It maintains record speed within 0.1% even if voltage varies  $\pm 10\%$ .) Our counterbalance has practically no overhang (for compactness), and locks in position to prevent accidental shifting.

By the way, about that fancy design for overall appearance:

We know that a lot of you wouldn't even consider a top, precision product if it didn't look good.

With all that precision, and a price of only \$89.50, the Dual 1015 gets better looking all the time.

United Audio Products, Inc., 535 Madison Ave., New York, N.Y. 10022.

**Dual 1015**



# TAPE RECORDER DIRECTORY

Product specifications and photographs presented here represent an expanded, updated version of the tape recorder product preview which appeared in the August 1967 issue of AUDIO Magazine. The same tabular format is used to simplify comparison of specifications. All specifications have been supplied by respective manufacturers. For more information, a circled number under a manufacturer's name directs you to the page on which his advertisement appears. Further information may be obtained by writing directly to the manufacturer. (A directory of manufacturers' names and addresses is included on page 90.)



Allied TD-1030



Concertone 302



Bell & Howell 2297



BSR TD1020



Ampex 800 Series

MANUFACTURER (Circled number indicates ad page)	Model	Speeds	No. of Heads	Tracks	No. of Motors	Drive Motor Type	Reel Motors - Type	Drive to Capstan	Rev. & F. Drive	Max. Reel Size, in.	Wow and Flutter at 7 1/2 %	Wow and Flutter at 3 1/2 %	Timing Accuracy, %	Rewind 1200 ft., sec.	Built-in Power Amps ?	Mic Input Sens., mV.	Mic Input Imp., ohms	High Level Imp., ohms	Mixing Facility	Vol. Indicator Type	Line Feed Output ?	Dimensions, in. W x D x H	Weight, lbs.	Price	SPECIAL FEATURES
ALLIED RADIO	TD 1030	1 7/8 3 3/4 7 1/2	2	4	1	4-p	-	Belt	Belt	7	0.15	0.25	99.7	90	No	2	10k	600	No	2 VU Meter	Yes	15 1/2 13 7	24	129.95	Headphone output w/vol. control.
	TR 1040	1 7/8 3 3/4 7 1/2	2	4	1	4-p	-	Belt	Belt	7	0.15	0.25	99.7	90	Yes	2	10k	600	No	2 VU Meter	Yes	15 1/2 17 7	36	169.95	Speakers Detach.
AMPEX	800	1 7/8 3 3/4 7 1/2	2	4	1	Induc.	-	Belt	Belt	7	0.15	0.2	99	160	861 Yes	3	280k	220k	No	Dual VU Meter	Yes	19 13 1/2 7 1/2	33	289.95	Deck only for \$199.50
	1100	1 7/8 3 3/4 7 1/2	3	4	1	Hys. Sync.	-	Belt	Belt	7	0.15	0.2	99	160	1161 Yes	3	280k	220k	No	Dual VU Meter	Yes	19 13 1/2 7 1/2	33	389.95	Auto. Reverse, also avail. in deck only. Spkrs. detach.
	2100	1 7/8 3 3/4 7 1/2	4	4	1	Hys. Sync.	-	Belt	Belt	7	0.08	0.15	99	130	2160 Yes	2	110k	200k min.	Yes	Dual VU Meter	Yes	18 1/2 13 3/4 7 3/8	33	599.95	Auto. Reverse, Reverse Record.
	AG-500	3 3/4 7 1/2 15	3	4	3	Hys. Sync.	-	Belt	Belt	7	0.18	0.25	99.75 at 15 7 1/2 %	-	Yes	-	-	bal/Unbal. Brdg.	No	Dual VU	-	20 14 9	42	1202.	Professional Recorder.
BELL & HOWELL	2291	1 1/16 1 7/8 3 3/4 7 1/2	-	4	1	4-p	-	Idler Belt	Idler Belt	7	.09	0.15	99.75	120	No	1.5	150k	480k	Yes	2 Meters	Yes	-	22	349.95	Auto. loading; auto. revers., s/s; plays-records in both directions. PB tone contr.
	2295	1 1/16 1 7/8 3 3/4 7 1/2	-	4	1	4-p	-	Idler Belt	Idler Belt	7	.09	0.15	99.75	120	Yes	1.5	150k	480k	Yes	2 Meters	Yes	15 3/4 13 1/4 8 1/2	25	399.95	Same as above, but incs. stereo pwr. ampl.; 8.4 w./chan., 50-15,000 Hz.
	2297	1 1/16 1 7/8 3 3/4 7 1/2	-	4	1	4-p	-	Idler Belt	Idler Belt	7	.09	0.15	99.75	120	Yes	1.5	150k	480k	Yes	2 Meters	Yes	-	25	449.95	Same as above, except pwr. ampl. is 15 w/chan. 50-20,000 Hz.
BSR (41)	TD 1020	1 7/8 3 3/4 7 1/2	2	4	1	Induc.	-	Drive Wheel	Direct	7	0.15	0.25	99.8	180	No	0.6	High	High	No	VU Meter	Yes Lo Z	14 3/4 12 3/4 6	18	129.95	S/S, illum. VU meter, Pause pos. walnut base.
CONCERTONE	302-D	1 7/8 3 3/4 7 1/2	2	4	1	Sync.	-	-	-	7	0.15	0.25	-	120	No	-	-	-	No	Dual VU	Yes	14 1/2 13 4 1/2	16	200.00	
	700	1 1/16 1 7/8 3 3/4 7 1/2	2	2	1	4-p	-	Belt	Idler	7	0.25	0.25	-	-	Yes	-	-	-	No	VU Meter	Yes	10 3/8 11 1/4 5 1/16	12	189.95	Mono. only.
	727	Same	3	4	1	4-p	-	Belt	Idler	5	0.25	0.25	-	-	Yes	-	-	-	No	2 VU Meter	Yes	12 1/2 18 1/2 5 1/2	16	199.95	
	770	Same	3	4	1	4-p	-	Belt	Idler	7	0.25	0.25	-	-	Yes	-	-	-	-	2 VU	Yes	12 1/2 18 1/2 5 1/2	16	239.95	a.c. or battery



# PRICE?

High price does not guarantee high quality. The Studio Pro 120 at \$379.50\*\* is equal or superior to many receivers costing up to \$600.

Here's why.

By designing around the most advanced electronic devices commensurate with the state of the art such as, MOSFET front end, integrated circuits, all silicon transistors, encapsulated circuit breakers, 98 semi conductors, etc., we have built in all the quality that is possible for anyone to achieve. By developing new production line techniques with computer controlled material flow, we have been able to establish the exciting price and quality of the Studio Pro 120.

Each Studio Pro 120 has its individual quality control program supervised by the most demanding engineers in the business. Each will live up to the claims we make. We had the specifications certified by two of the nation's leading independent testing firms so you can believe them implicitly.\*

Stop by your University dealer today and hear this great new pacesetter in the receiver world. Write desk M73.

\*\*Manufacturer's suggested resale price.

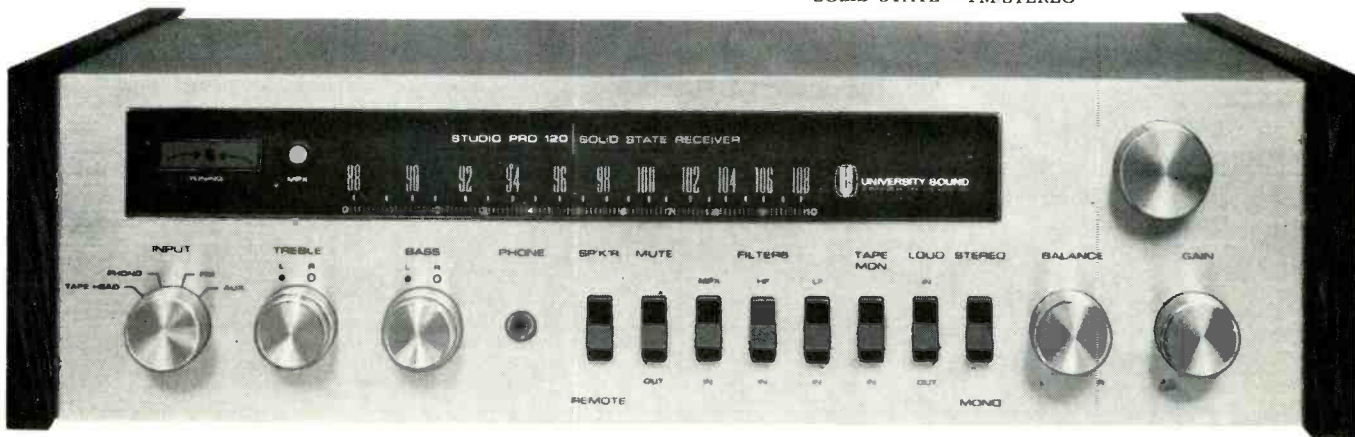


## UNIVERSITY SOUND

A DIVISION OF LTV LING ALTEC, INC.  
9500 W. Reno Oklahoma City, Oklahoma

### UNIVERSITY STUDIO PRO 120 - THE *Certified* RECEIVER

SOLID STATE • FM STEREO



\*AMPLIFIER SECTION: IHF Power Output: 120 watts total, IHF Standard at 0.8% THD, 4 ohms (60 watts per channel). RMS Power Output: 8 ohms: 30 watts per channel at 0.3% THD. Frequency Response: +0, -3 dB from 10 Hz to 100 kHz. Power Bandwidth: 10 Hz to 40 kHz, IHF Standard. Intermodulation Distortion: Less than 0.5% at any combination of frequencies up to rated output. Tone Control Range: ± 18 dB at 20 Hz and 20 kHz. Damping Factor: 50 to 1. Noise Level: (Below rated output) Tape monitor: -83 dB — Auxiliary: -80 dB — Phono: -60 dB — Tape Head: -63 dB. Input Sensitivity: (For rated output) Tape Monitor: 0.4 Volts — Auxiliary: 0.4 Volts — Tape Head: 1 mV at 500 Hz — Phono: 4 mV at 1 kHz. Input Impedance: Phono and Tape Head: 47,000 ohms — Tape Monitor: 250,000 ohms — Auxiliary: 10,000 ohms. Load Impedance: 4 to 16 ohms. FM TUNER SECTION: Sensitivity: 1.6 μV for 20 dB of quieting, 2.3 μV for 30 dB of quieting, IHF. Frequency Response: ± 1/2 dB from 20 to 20,000 Hz. Capture Ratio: Less than 1 dB. Image Rejection: Greater than 90 dB. IF Rejection: Greater than 90 dB. Separation: 40 dB at 1 kHz. Selectivity, Alternate Channel: 55 dB. Drift: .01%. Distortion: Less than 0.5% at 100% modulation ± 75 kHz deviation. Multiplex Switching: Fully automatic logic circuit. GENERAL: Dimensions: 4 1/2" H x 16 3/8" W x 12" D (including knobs). Weight: 17 lbs. Amplifier Protection: Three 1-ampere circuit breakers. Complement: 31 Silicon & MOSFET transistors, 21 Diodes, 2 Integrated circuits (each containing 10 transistors, 7 diodes, 11 resistors).

University is the proprietary trade name of University Sound © 1967

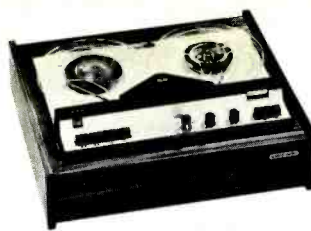
# TAPE RECORDERS



Concord 776-D



Crown SX 824



Dual TG 27



Dynaco 2000

MANUFACTURER (Circled number indicates ad page)	Model	Speeds		No. of Heads		No. of Motors	Drive Motor Type	Reel Motors - Type	Drive to Capstan	Rev. & F. Drive	Max. Reel Size, in.	Wow and Flutter at 7 1/2 %	Wow and Flutter at 3 3/4 %	Timing Accuracy, %	Rewind 1200 ft., sec.	Built-in Power Amps ?	Mic Input Sigs., mV.	Mic Input Imp., ohms	High Level Imp., ohms	Mixing Facility ?	Vol. Indicator Type	Line Feed Output ?	Dimensions, In. W x D x H	Weight, lbs.	Price	SPECIAL FEATURES
		1 1/2	3 3/4	2	4																					
CONCORD	501-D Deck	1 1/2 3 3/4 7 1/2	2	4	-	-	-	Belt	Direct	7	<0.17	<0.22	-	-	No	-	Lo	-	Yes	Dual VU Meter	Yes	12 1/2 14 5/8 4 3/4	19 1/2	Under 150.00	Auto shut-off.	
	776-D Deck	3 3/4 7 1/2	3	4	-	-	-	Belt	Auto	7	<0.15	<0.18	-	-	No	-	Lo	-	Yes	Dual VU Meter	Yes	20 13 1/2 7	29 1/2	Under 250.00	Auto reverse. Auto shut-off.	
	727	3 3/4 7 1/2	2	4	-	-	-	Belt	Direct	7	<0.15	<0.18	-	-	Yes	-	Lo	-	Yes	Dual VU Meter	Yes	13 13 20	40	Under 300.00	Auto shut-off.	
	776	3 3/4 7 1/2	3	4	-	-	-	Belt	Auto	7	<0.15	<0.18	-	-	Yes	-	Lo	-	Yes	Dual VU Meter	Yes	13 13 20	40	Under 350.00	Auto reverse. Auto shut-off.	
CROWN	SX 724	7 1/2 3 3/4	3	4	3	Hys. Sync.	Torq.	Belt	Direct	10 1/2	0.09	0.18	99.8	45	No	0.4	100k	100k	Yes	Dual VU Meter	600	19 9 15 3/4	45	995.00	Dual mic or line mixing, 2-tr. play opt., 5" meters, sil. s/s, SA30-30 ampl. opt.	
	SX 824	7 1/2 3 3/4	3	4	3	Hys. Sync.	Torq.	Belt	Direct	10 1/2	0.09	0.18	99.8	45	No	0.4	100k	100k	Yes	Dual VU Meter	600	19 9 15 3/4	48	1495.	Pro-800 transp. w/ logic-computer oper. electr. as above; full remote opt.	
	(37) CX 724	7 1/2 3 3/4 1 1/8	3	4	3	Hys. Sync.	Torq.	Belt	Direct	10 1/2	0.09	0.18	99.8	45	No	0.25	100k	100k	Yes	Dual VU Meter	5000	19 9 17 1/2	50	1385.	250 Ohm Lo-Z mics opt. plug-in modules, mixing, tone controls, echo prov. remote str-stop and 600 Ohm output opt.	
	CI 844	15 7 1/2 3 3/4	3	4	3	Hys. Sync.	Torq.	Belt	Direct	10 1/2	0.09	0.18	99.8	45	No	0.08	250	100k	No	4 VU Meters	600 bal.	19 9 24 1/2	70	3700.	Studio mastering, transp. opt.; cal. steppe input, output atten. c. electronics, pro-800, transport.	
	CX 822	15 7 1/2 3 3/4	3	2	3	Hys. Sync.	Torq.	Belt	Direct	10 1/2	0.09	0.18	99.8	45	No	0.08	250	100k	Yes	2 VU Meter	600 bal.	19 9 17 1/2	54	2070.00	Dual Lo-Z mic inputs, balanced 600 Ohm line-out. New Pro-800 deck, cue, and edit switch.	
DUAL	(33) TG 27	3 3/4 7 1/2	2	4	1	Induc.	-	Belt	Belt	7	<0.1	<0.1	>99	120	No	0.3	200	110k	Yes	VU Meter	Yes	14 1/2 11 2 1/8	-	199.50	S-W-S; S-O-S, hyperbolic heads, tape-controlled braking, all-silicon.	
DYNACO	(9) 2000	1 1/4 3 3/4 7 1/2	3	4	1	Hys. Sync.	-	Idler	Idler	7	.075	0.11	99.8	100	Yes	.05	200	-	Yes	Dual Meter	Yes	18 14 1/2 9	38	498.00	Slide-type mixing controls/plug-in circuits, interchangeable mixing inputs.	
HEATH	AD-16	3 3/4 7 1/2	3	4	3	Hys. Sync.	Cap. Ind.	Belt	Direct	8 1/4	0.18	0.25	99	80	No	.28	50k	50k	Yes	2 VU Meters	Yes	17 1/8 13 3/4 8 1/4	35	399.50	All s/s; kit version of Magnecord 1020; pb/solenoid oper. digital cntr.	
KNIGHT-KIT	KG 415	3 3/4 7 1/2	3	4	2	4-p	Cap.	Belt	F.Fwd Direct Rev. Pulys.	7	<0.2	<0.3	98	90	No	1.5	3000	5000	Yes	2 VU Meters	-	14 9 5/8 14 1/2	30	269.95	Stereo Headphone amp module; Viking transp. factory-assembled. Electronics, Kit.	
LAFAYETTE	RK-960	1 1/4 3 3/4 7 1/2	4	4	2	Hys. Sync.	-	Belt	-	7	-	0.25	99	-	Yes	-	10k	500k	-	2 VU Meters	-	22 15 1/2 8 1/4	44	299.95	3 Auto. oper. modes. L Reverse.	
	(81) RK-880	1 1/4 3 3/4 7 1/2	3	4	1	Hys. Sync.	-	Belt	-	7	0.15	0.25	98.8	-	No	0.4	10k	500k	-	2 VU Meters	-	11 3/4 7 11 3/4	22	249.95	Dual Ind. bias adj. tap eq. adjust; headphone jack, S-O-S.	
	RK-860	1 1/4 3 3/4 7 1/2	2	4	1	4-pole	-	Belt	-	7	0.15	0.03	99	-	Yes	1.6	-	-	-	2 VU Meters	-	15 1/4 7 1/4 14	25	219.95	S-o-S; S-W-S; two 5 x 7 spkrs. direct phono. pickup.	
	RK-840	1 1/4 3 3/4 7 1/2	2	4	1	4-pole	-	Belt	-	7	0.2	0.3	98.6	-	Yes	0.2	10k	500k	-	2 VU Meters	-	15 1/4 7 1/4 14	24	169.95	Two 5-in. spkrs. S-W-S Direct Mag-Phono Pick up; S/S.	





*Crown Leadership presents the*



**MODEL CX 822**

For the studio where flexibility means creative productions.



**MODEL CI 844**

Four channel recorder for perfect mastering.

# NEW

## Computer Logic Control Pro 800 Transport

In the league of nimble-fingered tape-handlers there exists a recurrent problem. It has been demonstrated time and again that anyone can ruin a valuable tape by absentmindedly outsmarting the interlock system of an otherwise safe tape recorder.

In answer to this problem and similar problems arising in automated and remote control applications, the *CROWN Pro 800* was designed. This recorder has a computer logic system using IC's which prohibit all such destructive operations.

The CROWN computer stores the last command given it in its memory (forgetting all previous commands) and by a continuous knowledge of the operating state of the machine (motion and direction), it takes all the necessary measures and executes the command. This is all done *without* time-wasting delay mechanisms.

Computer logic control brings to you rapid error-free tape handling. It is actually impossible to accidentally break a tape. Call your CROWN dealer NOW!

### MOST PERFECT REPRODUCTION

- 👑 Performance as yet unequalled
- 👑 Four years proven Solid State circuitry
- 👑 Extremely low noise electronics

### FINEST TAPE HANDLING

- 👑 Computer smooth operation
- 👑 True straight line threading
- 👑 Patented Electro-Magnetic brakes never need adjusting

**THE HALLMARK OF CROWN — QUALITY CRAFTSMANSHIP THROUGHOUT**

**MADE  
ONLY  
IN  
AMERICA**

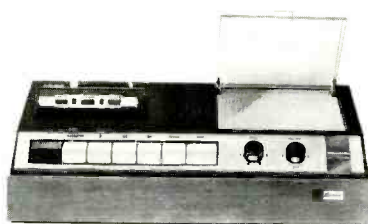


**BOX 1000, ELKHART, INDIANA 46514 • PHONE (219) 523-4919**

# TAPE RECORDERS



Magnecord 1020



Norelco 350



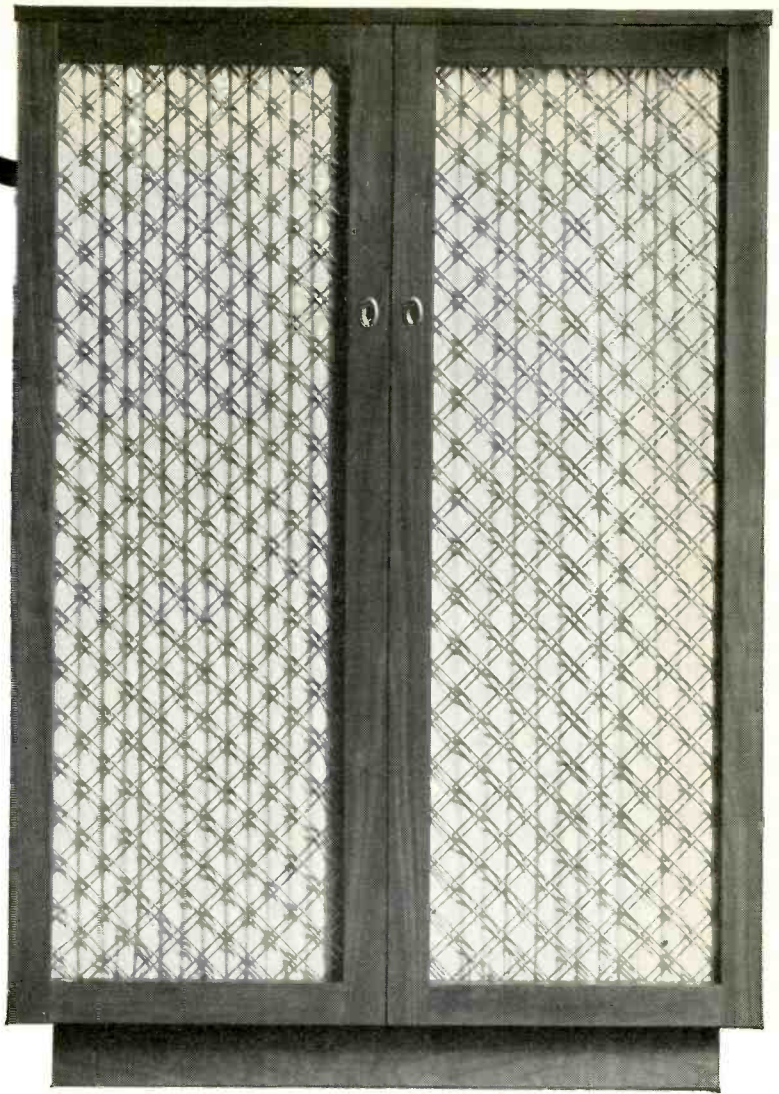
Roberts 770X

MANUFACTURER (Circled number indicates ad page)	Model	Speeds	No. of Heads	Tracks	No. of Motors	Drive Motor Type	Reel Motors - Type	Drive to Capstan	Rev. & F. Forward Drive	Max. Reel Size, in.	Wow and Flutter at 1 1/2%	Wow and Flutter at 3 1/4%	Timing Accuracy, %	Rewind 1200 ft., sec.	Built-in Power Amps?	Mic Input Sens., mV.	Mic Input Imp., ohms	High Level Imp., ohms	Mixing Facility?	Vol. Indicator Type	Line Feed Output?	Dimmers, in. W x D x H	Weight, lbs.	Price	SPECIAL FEATURES
81 MAGNECORD	1020	3 3/4 7 1/2	3	4	3	hys. sync.	Split Ph.	Belt	Direct	8 1/4	0.17	0.22	99	80	No	0.27	50k	HiZ	Yes	2 VU Meters	Emit. foll.	17 1/16 13 3/16 6 5/8	35	570.00	
	1024	3 3/4 7 1/2	3	4	3	hys. sync.	Split Phs.	Belt	Direct	8 1/4	0.17	0.22	99.8	80	No	0.32	50k	HiZ	Yes	2 VU Meters	Emit. foll.	19 12 15 1/4	48	648.00	
	1021	3 3/4 7 1/2	3	1	3	hys. sync.	split phs.	Belt	Direct	8 1/4	0.17	0.22	99.8	80	Yes	.038	150	HiZ	Yes	One VU Meter	600 bal.	19 15 3/4 12	48	708.00	Mono
	1028	7 1/2 15	3	2	3	hys. sync.	split phs.	Direct	Direct	10 1/2	0.1	-	99.8	50	No	-	50k	160k	No	2 VU Meters	Cath. foll.	17 1/16 11 1/16 14 1/2	47	1095.	
	1022	7 1/2 15	4	2	3	hys. sync.	Split Ph.	Belt	Direct	8 1/4	0.17 Sum Total	0.17 Sum Total	99.8	80	No	.038	LoZ	HiZ	No	VU Meters	600Ω plus 4dbm	19 15 1/2 12	48	788.00	
	1048	3 3/4 7 1/2	3	2	3	hys. sync.	Split Ph.	Direct	Direct	10 1/2	.15	.25	99.8	45	No	.24	HiZ	HiZ	No	VU Meters	Unbal. Cath. foll.	17 1/16 11 1/16 14 1/2	47	1095.	Balanced input and output available with accessory transformers.
73 NORELCO	150	1 7/8	2	2	1	D.C. Tran. Reg.	-	Belt	Belt	cass-ette	1 7/8	0.1	-	-	Yes	0.2	2k	1.5 MΩ	No	Meter	.5V 20k Ω	4 1/2 2 1/4 7 1/8	3	69.50	Mono Cassette port. "carry corder" incl. spkr., dyn. mic, case.
	350	1 7/8	2	2	1	A.C. Ind.	-	Belt	Belt	cass-ette	1 7/8	0.1	-	-	Yes	0.25	4.5K	1M	No	Meter	1V 18k	14 1/2 3 1/2 8 1/2	8 1/2	127.50	Auto/man. record. mic, spkr., A.C. oper.
	420	7 1/2 3 3/4 1 7/8	2	4	1	A.C. Ind.	-	Belt	Belt	7	.07	.1	2-	150	Yes	.25	2k	500k	Yes	Magic Eye	1V 50k	17 1/2 8 1/2 13 1/2	22	199.50	Mic, Duoplay, multi-play, 4 Tk mono.
	450	1 7/8	2	4	1	A.C. Ind.	-	Belt	Belt	cass-ette	1 7/8	.1	-	-	Yes	.25	1k	1	No	Meter	1V 1M	12 5/8 3 1/2 8 1/4	16 1/2	199.50	2 Satellite spks., mic. A.C. Home Stereo version.
	2500	1 7/8	1	4	1	A.C. Ind.	-	Belt	Belt	cass-ette	.1	.1 RMS	-	-	-	-	-	-	-	-	600 mV 20k	8 1/4 2 1/4 4 1/2	2 1/2	-	Cassette stereo. Playback deck.
ROBERTS	1719	3 3/4 7 1/2	2	4	1	4-p	-	Belt	Idler	7	0.25	0.30-0.33	-	150	Yes	0.5	50k	1 Meg.	No	Dual VU	1 V, 500Ω	15 1/2 x 9 x 14 5/8	25	199.95	15 ips opt. no pressure pads, auto tape lift
	1720	3 3/4 7 1/2	2	4	1	4-p	-	Belt	Idler	7	0.25	0.30-0.33	97	150	Yes	0.5	50k	1 Meg.	No	Dual VU	1 V, 500Ω	15 1/2 9 14 5/8	26	219.95	15 ips optional.
	1721	3 3/4 7 1/2	2	4	1	4-p	-	Belt	Idler	7	0.25	0.30-0.33	97	150	Yes	0.5	50k	1 Meg.	No	Dual VU	1 V, 500Ω	15 1/2 6 1/2 14 5/8	23	179.95	
	770X	1 7/8 3 3/4 7 1/2 15	3	4	-	Hys. sync.	-	Belt	Idler	7	0.15	0.2	98	75	Yes	1.5	500k	1 Meg.	No	2 VU Meters	Yes Lo Z	20 14 9	48	399.95	Cross-field head.



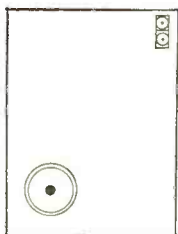
# Cross Over to ALL THE MUSIC

The unique Bozak "building block" principle is a speaker system growth that helps you cross over, in easy stages, to truly full sound. Grow to the Concert Grand — the optimum in home music enjoyment. You can begin with as few as three speakers — a bass and a tweeter pair. Then, when you decide, add another bass and another tweeter pair. It's just like adding violins to your orchestra! Step three — add a midrange and a crossover network. Improve upon it, when you want to, by completing the array with two more bass speakers, two more tweeter pairs, and a second midrange — fourteen speakers in all. This is sound quality you have to hear to believe! Listen to it at your nearest Bozak dealer's — or to other Bozak models. If you don't know your dealer's name, ask us. Then, go hear "ALL the music at its big sound best,"

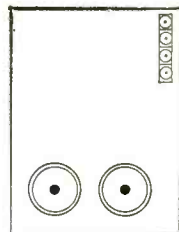


P.O. BOX 1166 • DARIEN  
CONNECTICUT 06820

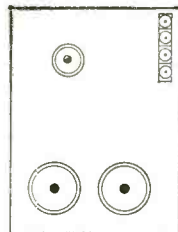
CONCERT GRAND  
CLASSIC ENCLOSURE



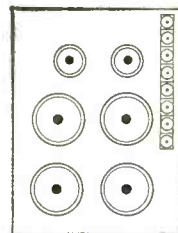
Begin with B-199A  
Bass and  
B-200Y Treble Pair



Add Second B-199A  
and Second B-200Y



Add B-209B Midrange  
and N-10102A  
Crossover



Add Two B-199A's,  
a Second B-209B  
and Two B-200Y's

EXPORT: Elpa Marketing Industries, Inc., New Hyde Park, N.Y. 11040

# TAPE RECORDERS



Revox xx G-36 MkIII



Sony TC-560D



Tandberg 64X

MANUFACTURER	Model	Spreads	No. of Heads	Tracks	No. of Motors	Drive Motor Type	Reel Motors - Type	Drive to Capstan	Rew. & F. Forward Drive	Max. Reel Size, In.	Wow and Flutter at 7 1/2 %	Wow and Flutter at 3 1/4 %	Timing Accuracy %	Rewind 1200 ft., sec.	Built-in Power Amps ?	Mic Input Sens., mV.	Mic Input Imp., ohms	High Level Imp., ohms	Mixing Facility ?	Vol. Indicator Type	Line Feed Output ?	Dimensions, In. W x D x H	Weight, lbs.	Price	SPECIAL FEATURES
REVOX	G-36 Mk III	15 7 1/2	3	2	3	Hys. sync.	direct	Direct	Direct	10 1/2	0.1	-	-	6 W Mono	3	0.5 Me g.	47k Adj.	Yes	2 VU Meters	Cath. Foll.	12 1/4, 15, 9 1/2	45	665.00	Chassis model price. With port. case, \$679. Steel-rack mount avail. for \$10.	
SUPERSCOPE (Sony)	250A	7 1/2 3 3/4	2	4	1	4 p Ind.	-	Idler	Idler	7	<.019	<.025	-	No	-	-	-	No	2 Meters	Em fol	14 1/4, 11 1/2, 6 1/2	15 1/4	149.50	Auto shut-off auto tape lifter, dig. ctr.	
	350	7 1/2 3 3/4	3	4	1	4 p Ind.	-	Idler	Idler	7	<.019	<.025	-	No	-	-	-	No	2 Meters	Em fol	-	-	199.50	As above, plus vert. or hor. oper. pos. With port. case \$219.50.	
	530	7 1/2 3 3/4 1 7/8	-	4	1	4 p Ind.	-	Idler	Idler	7	0.1	0.12 0.16	-	Yes	-	-	-	No	2 Meters	Em fol	-	38	399.50	As above, plus 20 W Amp. Quadriaial spkrs.	
	660	7 1/2 3 3/4	-	4	1	Syn.	-	Idler	Idler	7	<.06	<.01	-	Yes	-	-	-	No	2 Meters	-	17 17 10 1/4	55	575.00	Autoreverse, 50 w/amp/chan.	
	777	7 1/2 3 3/4	3	2 or 4	3	Syn.	-	Idler	Dir.	7	<.06	<.01	-	No	-	-	-	Yes	2 Meters	-	-	-	695.00	2 or 4 track pb relay op. conts., incl. rem cont.	
	800	7 1/2 3 3/4 1 7/8	2	2	1	Servo-Control	-	Direct	Belt	5	0.1	0.15-0.2	-	Yes	0.195	600	100k	No	VU Meter	Yes	12 1/4, 4 1/4, 10 1/4	12	less than 199.50	A.C. or Battery, Digital counter, auto. rec. w/defeat.	
	TC-100	1 7/8	2	2	1	D.C.	-	Belt	Belt	compact cassette	-	0.28	-	Yes	0.0775	25	100k	No	Meter ARC	Yes	5 1/2, 2 3/8, 9 1/8	3 14 Oz.	99.50	Pop-up ejector button, Aux. input, auto. rec. control.	
	560	7 1/2 3 3/4 1 7/8	3	4	1	Servo-Control	-	Belt	Belt	7	0.07	0.1 0.15	-	Yes	0.2	250	100k	No	2 VU Meters	Yes	20 3/8, 11 17 1/2	52-14 Oz.	449.50	Stereo center, A.C./D. D.C., scrape filter, E5 auto. tape reverse. Vert. and horiz. oper. Model 560-D deck, \$349.50	
TANDBERG	64X	3 3/4 7 1/2 1 7/8	4	4	1	Hys. sync.	-	Spd. Tran. Wheel	Belt	7	<.01	<.015	99.8	120	No	1.5	5 Meg.	1 Meg.	Yes	Eye	Yes cath. foll.	15 1/8, 11 13/16, 6 13/16	23	549.00	Freq. resp. ±2 dB: 7 1/2, 30-20k; 3 3/4, 30-15k; 1 7/8, 40-9k.
	12	3 3/4 7 1/2 1 7/8	2	4	1	Asyn-Chronus	-	Spd. Tran. Wheel	Belt	7	<.015	<.02	99.8	120	Yes	0.15	200	1 Meg.	Yes	Eye	Pwr. Ampor Cath. Foll.	15 3/8, 11 13/16, 5 7/8	23	498.00	Sound on Sound Freq. resp. ±2 dB: 7 1/2, 40-16k; 3 3/4, 60-10 1/2, 80-5k.
	11	3 3/4 7 1/2 1 7/8	4	2 & 1	1	9 Volt DC Motor	-	3-sp-Motor	Belt	7	<.02	<.03	99.8	120	Yes	0.15	200	-	Yes	VU Meters	1.5V 600	13 10 4	7	595.00	S/N, >56 db Freq. resp., ±2 dB: 7 1/2, 40-16k; 3 3/4, 60-9 1/2, 80-5k.
	923	3 3/4 7 1/2 1 7/8	2	2	1	Asyn. Chronus	-	Spd. Tran. Wheel	Belt	7	<.015	<.02	99.8	120	1	1.5-7.5	1 Meg.	0.5 Meg.	No	Eye	Pwr. Amp	15 11 1/8, 6 1/4	22	287.00	S/N 56 db, Freq. resp., ±2 dB: 7 1/2, 30-16k; 3 3/4, 40-1 1/2, 55-5k.
TAPESONIC	70-TRSQ	3 3/4 7 1/2 1 5	3	4	3	Hys. sync.	Cap.	Direct	Direct	10 1/2	0.12	0.23	99.8	45	No	-	-	-	Yes	4 1/2 VU Mtr. ea. Chan.	Yes Emit. fol.	19 8 1/2 21	69 w/case	615.00	Port. case for all models, \$34.50 extra
	70-TRSH	3 3/4 7 1/2 1 5	3	2	3	Hys. sync.	Cap.	Direct	Direct	10 1/2	0.12	0.23	99.8	45	No	-	-	-	Yes	4 1/2 VU Mtr. ea. Chan.	Yes Emit. fol.	19 8 1/2 21	69 w/case	615.00	Port. case for all models, \$34.50 extra
	70-TRH	3 3/4 7 1/2 1 5	3	2	3	Hys. sync.	Cap.	Direct	Direct	10 1/2	0.12	0.23	99.8	45	No	-	-	-	Yes	4 1/2 VU Meter	Yes Emit. fol.	19 8 1/2 21	69	480.00	Port. case for all models, \$34.50 extra
	70-TRF	3 3/4 7 1/2 1 5	3	1	3	Hys. sync.	Cap.	Direct	Direct	10 1/2	0.12	0.23	99.8	45	No	-	-	-	Yes	4 1/2 VU Meter	Yes Emit. fol.	19 8 1/2 21	69	542.00	Port. case for all models, \$34.50 extra



## WHAT A GREAT IDEA!

At last BSR has done something to take the confusion out of your shopping for a quality automatic turntable. We've completely pre-assembled the Total Turntable unit for you . . . cartridge and all . . . in these superb new BSR McDonald models.

Each is precision engineered in Great Britain with features you'll find only on the most expensive professional equipment.

An anti-skate control, a resiliently mounted coarse and fine vernier adjustable counterweight, a micrometer stylus pressure adjustment from 0 to 6 grams, a cueing and pause control lever and an automatic locking rest to secure the tone arm in the "off" position. These are just a few of the very many features of BSR McDonald turntables.

Ask your dealer to demonstrate the many features or send for a free detailed brochure and name of your nearest dealer.



PRECISION CRAFTED IN GREAT BRITAIN  
BSR (USA) LTD., BLAUVELT, N.Y. 10913

The BSR McDonald 400 / 808



The BSR McDonald 500A / M44-7



The BSR McDonald 600 / M44-E



# TOTAL TURNTABLES

Complete with cartridge, wood base and dust cover . . . ready to plug into the hi-fi system . . . and play beautifully!

# TAPE RECORDERS



Viking 811



Uher 4400



Teac A-6010

MANUFACTURER	Model	Speeds	No. of Heads	Tracks	No. of Motors	Drive Motor Type	Reel Motor Type	Drive to Capstan	Rev. & F. Drive	Max. Reel Size, in.	Wow and Flutter at 1 1/2 ips	Wow and Flutter at 3 3/4 ips	Timing Accuracy, %	Rewind 1200 ft., sec.	Built-in Power Amps?	Mic Input Sens., mV.	Mic Input Imp., ohms	High Level Imp., ohms	Mixing Facility?	Vol. Indicator Type	Line Feed Output?	Dimensions, in. W x D x H	Weight, lbs.	Price	SPECIAL FEATURES	
TEAC	A-1200	7 1/2 3 3/4	3	4	3	Hys. syn.	2 eddy cur	-	Direct	7	0.12	0.15	99.5	100	No	1.0	10k	100k	Yes	Dual Mtr.	1.0V 10k	17 1/8 16 13/16 11 1/2	46	349.50	2-sp. capstan motor; pushbutton oper; tape/ source mon.	
	A-3010	7 1/2 3 3/4 1 1/2	2	4	3	Hys. syn.	2 eddy cur	-	Direct	7	0.15	0.2	99.0	90	No	0.5	10k	100k	No	2 Mtrs	0.5V 50k	17 15 1/2 7 3/4	36	399.50	Auto reverse; tape-tension cont, auto shut-off; 8-ohm phone mon. ampli, tone cont.	
	A-1500	7 1/2 3 3/4	4	4 or 2 or 1	3	Hys. syn.	2 eddy cur	-	Direct	7	0.12	0.15	99.5	100	No	1.0	10k	100k	Yes	Dual Mtr.	1.0V 10k	16 13/16 15 1/8 11 1/2	42	449.50	Playback auto reverse, 2-sp. capstan mtr. push button oper; remote cont. avail.	
	A-6010	7 1/2 3 3/4	4	4 or 2 or 1	3	Hys. syn.	2 eddy cur	-	Direct	7	.08	0.12	99.5	90	No	0.5	10k	100k	Yes	2 Mtrs	1.0V 10k	20 3/4 17 3/8 6 7/8	46	699.50	As above, plus plug-in head assy; 8-ohm phone mon. ampli; tape-tension cont.	
UHER	4400	7 1/2 3 3/4 1 1/2 15 36	2	4	1	Sync. D.C. Motor	-	Belt to Fly-wheel	Belt	5	.10	.12	99.0	120	Yes	0.1	2000	4700 or 1 Meg.	No	VU Meter	Emit. Fol.	11 9 3 1/2	8	450.00	Professional Quality. Batt. oper.	
	7000 Deck	7 1/2 3 3/4	2	4	1	Sync. Type	-	Idler	Belt	7	.08	.10	99.0	120	No	0.35	2000	4700 or 1 Meg.	No	VU Meter	Emit. Fol.	15 14 7	15	149.50	40-18000 Hz ±2.5 db (7 1/2 ips)	
	9000L	7 1/2 3 3/4	3	4	1	Hyst. Sync.	-	Idler	Belt	7	.06	.08	99.5	120	No	0.15	5000	4700 or 1 Meg.	No	VU Meter	Emit. Fol.	15 14 7	23	400.00	20-20000 Hz ±2 db (7 1/2 ips)	
	1000 report Pilot	7 1/2	4	1	1	Sync. D.C. Motor	-	Belt to Fly-wheel	Belt	5	.10	.12	99.	120	Yes	0.2	8000	4700 or 1 Meg.	No	VU Meter	Emit. Fol.	11 9 3 1/2	7 1/2	695.00	Mono portable for lip sync. recording	
VIKING	423	1 1/8 3 3/4 7 1/2	2	4	3	Ind.	Ind.	Belt	Direct	7	0.2	-	99.5	70	No	550	Med.	120k	No	Dual Meter	Emit. Fol.	12 3/8 8 3/4 15 1/4	29	249.00	Remote Pause opt.	
	433	1 1/8 3 3/4 7 1/2	3	4	3	Ind.	Ind.	Belt	Direct	7	0.2	-	99.5	70	No	550	HiZ	120k	Yes	Dual Meter	Emit. Fol.	12 3/8 8 3/4 15 1/4	31	369.95	Remote Pause opt.	
	88	3 3/4 7 1/2	3	2 & 4	2	Ind.	Ind.	Belt	Direct & Puck	7	0.2	-	99.5	90	No	1	HiZ	100k	No	Dual Meter	HiZ	13 13 6 3/8	22	339.95		
	880	3 3/4 7 1/2	3	2 & 4	2	Ind.	Ind.	Belt	Direct & Puck	7	0.2	-	99.5	90	Yes	1	HiZ	100k	No	Dual Meter	HiZ	19 3/8 9 3/4 21 1/2	44	439.95		
	807	3 3/4 7 1/2	1	2 & 4	2	Ind.	Ind.	Belt	Direct & Puck	7	0.2	-	99.5	90	No	None	None	None	No	None	None	6 1/2 10 13 1/2	15	124.95	Playback only. Half or quarter track.	
	811	3 3/4	1	8	1	Ind.	-	Belt	-	Cartridge	-	0.3	-	-	No	-	-	-	-	-	.75V LoZ	-	-	-	99.95	40-15000 Hz. Auto. track select and indic.
	811W	3 3/4	1	8	1	Ind.	-	Belt	-	Cartridge	-	0.3	-	-	Yes	-	-	-	-	-	.75V LoZ and 10W IHF	-	-	-	149.95	40-15,000 Hz. Two spkrs., Headphone jack, auto. track select. & indic. tone vol. Bal. controls wal. case. Port. model avail.
WOLLENSAK (3M Co.)	5800	1 1/8 3 3/4 7 1/2	2	4	1	-	-	-	-	7	<0.25	<0.3	-	-	Yes	-	-	-	No	VU Meter	-	63 9 11	45	299.95	AM/FM. Tuner. Opt.	
	5750	1 1/8 3 3/4 7 1/2	2	4	1	-	-	-	-	7	<0.25	<0.3	-	-	Yes	-	-	-	No	VU Meter	-	42 10 10	28 3/4	249.95	Wood trim.	
	5740	1 1/8 3 3/4 7 1/2	2	4	1	-	-	-	-	7	<0.25	<0.3	-	-	Yes	-	-	-	No	VU Meter	-	42 10 10	27 3/4	229.95	Vinyl trim.	
	4200	1 1/8 3 3/4 7 1/2	2	2	1	-	-	-	-	-	<0.25	<0.3	-	-	Yes	-	-	-	No	VU Meter	-	4 1/2 2 1/4 7 1/8	4	74.95	Mono. cassette recorder	



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

The Dolby system gives

A 10dB increase in  
usable dynamic range

A 10dB hiss reduction

A 10dB print-through and  
cross-talk reduction

A 10dB hum reduction

**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 system offers an entirely new 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.

## 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.



# TAKE 10 WITH THE DOLBY

## SOUND AND SIGHT

We witnessed a number of refinements and developments this year in video recorders and magnetic tape, many of which have yet to reach commercial fruition.

DuPont, in mid-1967, for example, announced it will manufacture and market magnetic recording tapes. Called "Crolyn," the magnetic tapes incorporate chromium dioxide instead of iron oxide as the magnetic medium. The new tape is said to accept more information per inch, recording and reproducing high-frequency signals with greater fidelity than present gamma iron oxide tapes. The tape,



Fig. 1—Video tape recorded and played back at half speed ( $3\frac{3}{4}$  ips) as it goes over splice between iron oxide tape (top) and "Crolyn" tape (bottom).

which will have a premium price, is designed for use in video, instrumentation, and computer applications.

"Crolyn's" audio potential has not yet been assessed. A possible drawback in the audio area is that greater performance benefits are usually obtained on recording equipment adapted for use with the new tapes, though it can be used interchangeably with iron oxide tape in many applications.

Video tape recorded and played back at half speed ( $3\frac{3}{4}$  ips) as it went over a splice between iron oxide tape (top) and "Crolyn" magnetic tape (bottom) is shown in Fig. 1.

CBS Laboratories recently announced development of an electronic video recording system (called "EVR") which combines optics and physics. Video and audio information is contained in cartridges, each one holding one hour of black and white program material or a half-hour of color program material. An attachment has been developed to play back the EVR material on present TV receivers. Aside from ease of handling (the EVR cartridge features automatic threading, with signals transferred through connecting wires at a TV set's antenna terminals), the new system will cost  $\frac{1}{8}$ th of the cost of broadcast video tape recorders, according to a company spokesman.

Earlier this year, Newell Associates, Sunnysvale, Calif., introduced a new device for tape recording that the company expects will be the basis for a home color TV recorder. The key to recording equipment is a high-speed transport that uses only three basis rotating parts. This is said to enable ultra-thin magnetic tape ( $1\frac{1}{4}$ -mil base) to be safely handled, as well as reducing costs. A principal of the firm said that the first color TV recorders would probably be introduced for around \$1250, with an expected drop to under \$500 in a couple of years. See Fig. 2.

The Sony Corporation of America introduced a miniaturized, portable video tape recorder in mid-year that weighs only 12 pounds including bat-

Fig. 2—Single-drive motor tape transport developed by Newell Associates.

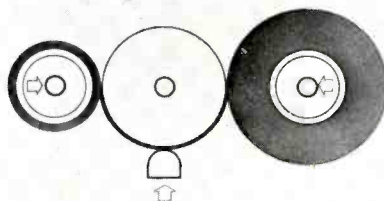
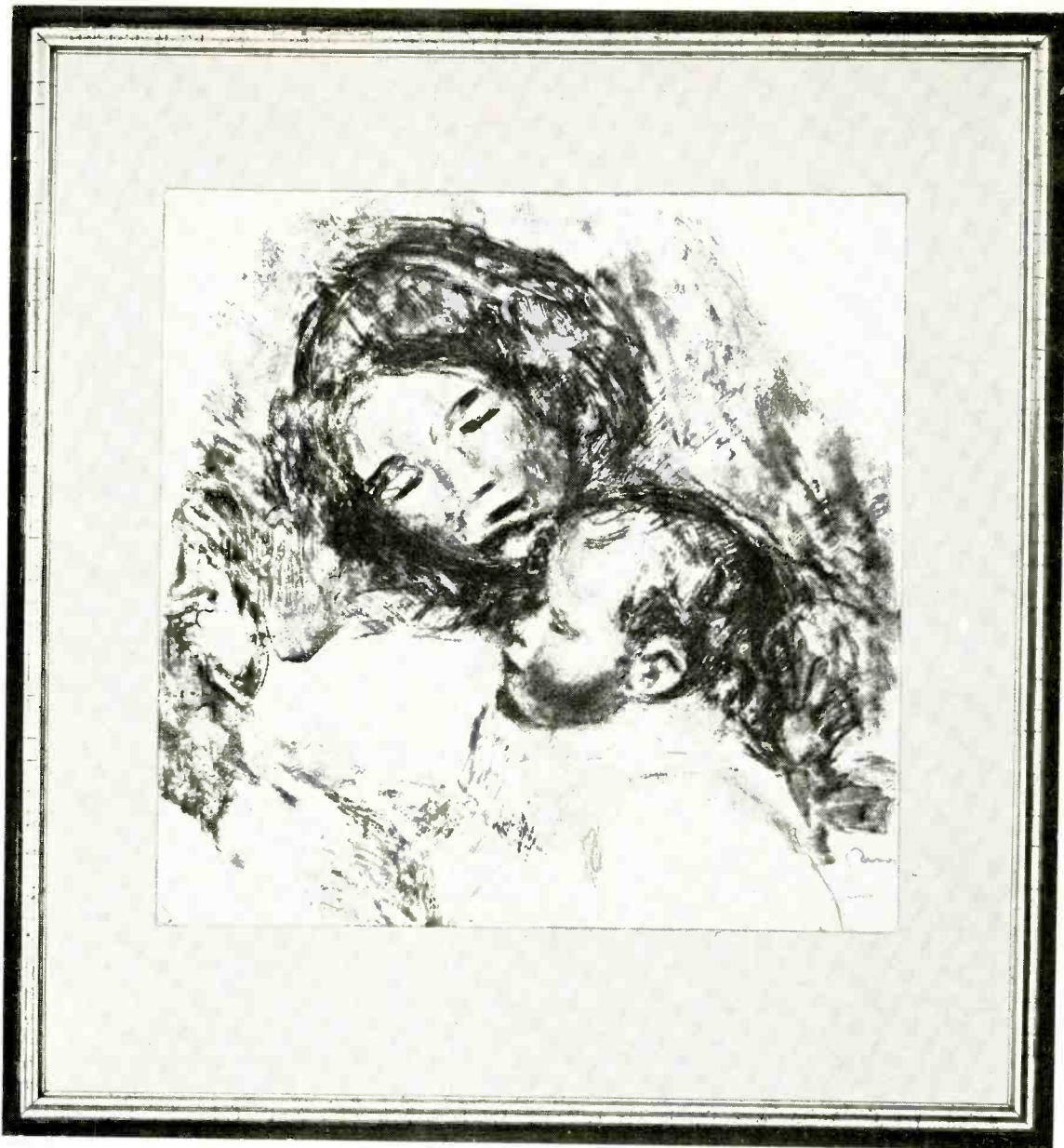


Fig. 3—Sony portable video tape recorder and camera.

tery and video tape. As shown in Fig. 3, the new model DV-2400 VTR can be carried with a shoulder strap. It records black and white pictures, with sound, for playback on Sony's CV-2000 series of VTRs (see specifications on next page). Thus, it uses a 20-minute,  $\frac{1}{2}$ -in. tape at  $7\frac{1}{2}$  ips.

The video camera has a microphone (removable) attached to the top of it. A 1-inch built-in CRT gives the operator accurate zooming control and simplifies focusing. Recording level of both sound and picture is controlled automatically by an AGC circuit in the recorder and an ASC (automatic sensitivity control) in the video camera. Total price of the package, including the VTR unit, video camera, zoom lens, microphone, battery and battery charger is expected to be \$1250. Æ





**Art as a  
component of  
perception.**

Solid objects broken down into component elements of light, shade, and texture, combining to create an undistorted mosaic of reality; fleeting visual impressions captured and recorded with uncompromising lucidity of style.

"Impressionism" was a technique of discovery, an examination and portrayal of the components of perception.

True perception of sound results from the exact portrayal of each element of its composition.

The quality of sound reproduced by high fidelity equipment depends on the sensitivity of the loudspeakers and other component parts. Engineers and craftsmen at James B. Lansing Sound, Inc., have developed the world's finest

loudspeakers and electronic components through uncompromising dedication to the ultimate expression of sound.

**JBL**

Experience total sound . . . from JBL

JBL 3249 Casitas Avenue, Los Angeles, California 90039

Check No. 45 on Reader Service Card

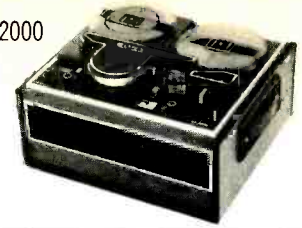
[www.americanradiohistory.com](http://www.americanradiohistory.com)

# VIDEO RECORDERS

Ampex VR-7000



Sony CV-2000



MANUFACTURER	Model	Scan System	Tape Width, in.	Tape Speed, ips	Equiv. Tape Speed, ips.	Video Bandwidth Hz / MHz / ±dB	Lines Resolution	Audio Freq. Resp. Hz	Weight, lbs.	Price	SPECIAL FEATURES
AMPEX	VR-6175	helical	1	9.6	1000	30-2.5 ±3	250	90-9k ±4 db	186*	1795.00	Includes Video recorder in walnut case, and TR-821 large screen TV receiver.
	VR-6000	helical	1	9.6	1000	30-2.5 ±3	250	90-9kc ±4 db	78*	1595.00	All recorders, both color and black and white, guaranteed tape-interchangeable.
	VR-7000	helical	1	9.6	1000	30/3.5 ±3	350	50-12kc ±4 db	100*	3450.00	Maximum recording time, all recorders, one hour.
	VR-7500	helical	1	9.6	1000	Hi-Band 30/4.2 Lo-Band 30/3.5	350	50-12kc	100*	3995.00	Four-minute fast forward. Low-band audio, 250-5000 Hz.
	VR-7500-C	helical	1	9.6	1000	Hi-Band 30/4.2 Lo-Band 30/3.5	350	50-12k	110*	5000.00	Color Recorder. Low-band audio, 250-5000 Hz. * Shipping weights
CONCORD	VTR-600	helical	1/2	12	484	30/2.5	250	80-10,000	52	1150.00	Built-in head cleaning, portability.
3M (31)	VTR-150	helical	1/2	7 1/2	180	50/2	200	50-10k	50	1495.00	Special head design incorporates 3M-improved ferrite for long life.
	VTR-150 MC	-	-	-	-	-	-	-	200	2995.00	Same as above, but is console model, including camera, monitor, etc. mounted in movable console.
PANASONIC	NV-8000	helical	1/2	12	480	30-2	>200	80-10k	54 1/2	1050.00	Home type, 40 min recording time (2400 ft.); rewind and fast forward, 5 1/2 min. S/N, both video and audio, 40 db camera, monitor, other accessories available.
	NV-8100	-	-	-	-	-	-	-	-	1100.00	Same as NV-8000 but in portable case.
	NV-204	helical	1	8.57	630	10-3	350	80-8k ±2db	97	3750.00	Industrial model, color compatible; rewind and fast forward, 2 3/4 min. 67 min. rec. time (2900 ft.) S/N: video - 43 db; audio - 46 db Camera, tripod, remote control, etc. available.
SONY (51)	CV-2000	helical	1/2	7 1/2	450	-	200	80-10k	46	730.00	Light weight portable, one motor.
	CV-2000D	helical	1/2	7 1/2	450	-	200	80-10k	42.5	695.00	Least expensive, walnut base, with same features as CV-2000.
	TCV-2010	helical	1/2	7 1/2	450	-	200	80-10k	66	995.00	Built-in Monitor, portable. Same features as CV-2000
	TCV-2020	helical	1/2	7 1/2	450	-	200	80-10k	70	1150.00	Built-in Monitor, Walnut cabinet, built-in timer to record in your absence. Same features as CV-2000.
	CV-2100	helical	1/2	7 1/2	450	-	7220	80-10k	46	-	Light weight portable, one motor, continuous Recording Audio after Recording Editing.
	CV-2200	helical	1/2	7 1/2	450	-	7220	80-10k	46	-	Same features as CV-2100. Can make own duplication of tapes with two units adaptor.
	TCV-2110	helical	1/2	7 1/2	450	-	7220	80-10k	66	-	Built-in Monitor, portable. Same features as CV-2100.
	DV-2400	helical	1/2	7 1/2	450	-	7220	80-10k	12	-	Shoulder-held "Videocoder"; battery-operated; lightweight; with hand-held camera, VCK-2000. Completely interchangeable with CV-2000 series.



# One-finger exercise for the music lover



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

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

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

Other features of the 50H include: Papst hysteresis motor; leadscrew adjustment of stylus overhang; cueing facilities; anti-skate compensation and direct-dialing stylus force adjustment to as low as ½ gram.

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

**Miracord**  
the light touch

# The New NAB Magnetic Tape Standards

PART 6 (CONCLUSION)

HERMAN BURSTEIN

## Recording level, flutter specifications, and crosstalk are examined in this final installment

### Recorded program level

FOR TAPE MACHINES USING A VU meter as the recording level indicator, it is frequent practice to adjust the meter to produce a meter reading of 0 VU in accordance with the reference level on a test tape, usually the 700 Hz tone at "operating level" on an Ampex test tape. The meter is set so that its pointer swings to 0 VU when a 700 Hz signal is recorded at a level producing the same output in playback as does the Ampex test tone.

With the appearance of the NAB Standard Test Tape (not available at this writing), it would probably be the practice to equate 0 VU on the meter with the Standard Reference Level.

"Recorded program material shall produce the same reference deflection on a Standard Volume Indicator (ASA Standard C16.5-1961) as that produced by a 400 Hz sine wave signal recorded at the NAB Standard Reference Level."

This signifies that the pointer of a VU meter shall swing to 0 VU at the Standard Reference Level.

### Flutter specifications

NAB uses the term flutter to include wow.

"The unweighted flutter content when reproducing an essentially flutter-free recording of 3,000 Hz at any portion of the reel of tape in use shall not exceed the following:"

Tape Speed (ips)	Flutter (rms)
15	0.15%
7½	0.20
3¾	0.25

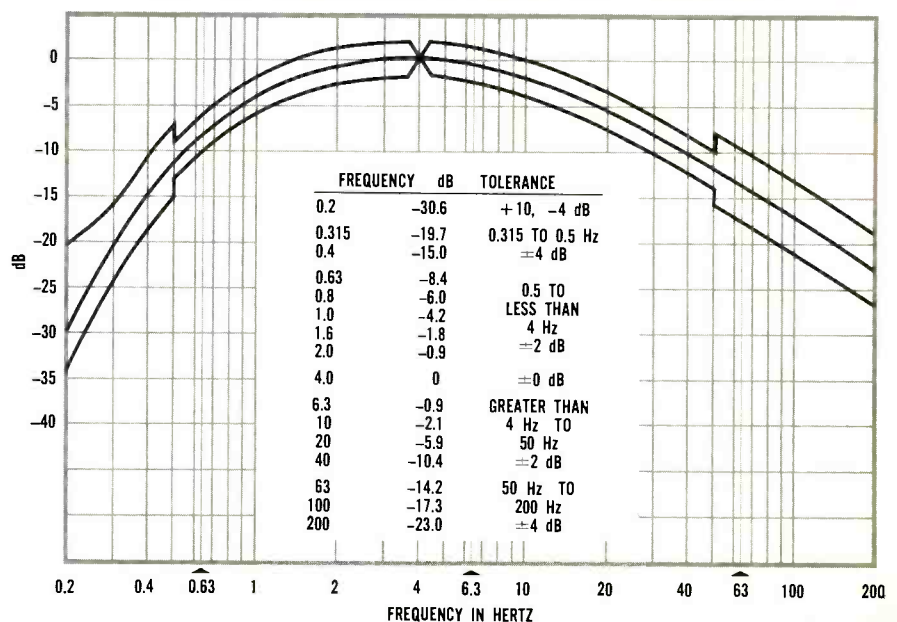
To achieve uniformity among flutter measuring systems and procedures, which is rather a problem, the NAB standard carefully spells out the requirements for measurement.

"Unweighted flutter content shall be measured over the frequency range of 0.5 Hz to 200 Hz. The response of the measuring system shall be 3 dB down at 0.5 Hz and 200 Hz, and falling at a rate of at least 6-dB-per-octave below and above these frequencies, respectively. At low frequencies, where the meter pointer follows the wave form, the maximum deflection shall indicate the rms value. The indicating meter shall have the dynamics of the Standard Volume Indicator (ASA C16.5-1961), a full-wave rectified average mea-

surement law, and shall be calibrated to read the rms value of a sinusoidal frequency variation. . . . The meter shall be read for random periods throughout the length of the tape, noting the average of the peak readings, but excluding random peaks which do not recur more than three times in any 10-second period."

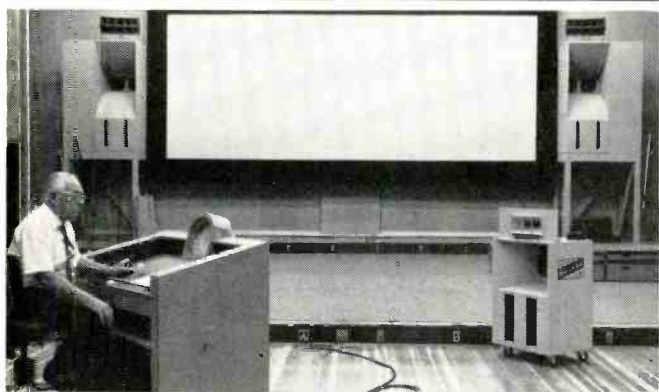
The NAB standard also provides for weighted flutter measurements that correspond to the characteristics of the average ear. The weighting curve is shown in Fig. 1. A specific network is not suggested by NAB but is left to the manufacturer of the measuring system, or else to the user.

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





# Disney's Magic World of Sound... from Altec.



The magic that is Disney is not just a pat formula. It is a form of perfectionism that pervades everything which carries the Disney name. Certainly, there's a Disney look. But just as certainly there's a Disney sound. And that's where we come in.

For example, the new control console at the Disney Studio's orchestra stage is made up of 29 Altec slide-wire attenuators, 7 rotaries, and one 4-gang master. The works are powered by rack-mounted banks of Altec amplifiers. Monitoring in the control room is done in a big way—with three giant Altec A4 "Voice of the Theatre"<sup>®</sup> systems butted together in a single plane of the most powerful, pure sound you can get.

The stage itself uses three more A4's for monitoring, re-recording, and playback. (That's one good way to keep the musicians happy.) Eight caster-mounted A7 "Voice of the Theatre"<sup>®</sup> systems are mobile, may be moved where and as needed.

And that's not all. On the back lot Altec PA equipment provides the paging. Dialog stages at the Studios also use A4's, with Altec's space-saving 844A Monitor Speaker Systems in the compact transfer room. The list could go on, but the point is made.

So who listens when Altec Lansing sounds off at Disney? Everybody, that's who. And if you understand the remarkable expertise of Disney sound engineers, perhaps you should listen too. Let's hear from you.

ALTEC LANSING, A Division of  
LTV Ling Altec, Inc., Anaheim,  
California 92803 Dept. A-12



On a weighted basis, rms flutter is not to exceed 0.05% at 15 ips, 0.07% at 7½ ips, and 0.10% at 3¾ ips.

The 1953 NAB standard merely specified that "the instantaneous peak flutter and wow shall not exceed 0.2% . . . when recording and reproducing on the same equipment." There was no specification of the measuring system and procedure, and no provision for a weighted measurement. On an unweighted basis, at 15 ips, the 1953 and 1965 standards are on a par inasmuch as 0.15% rms is nearly equivalent to 0.2% peak.

### Crosstalk

Crosstalk concerns signal leakage between adjacent tape tracks. To measure crosstalk it is first necessary to adjust recording and playback gain so that equal signals recorded on adjacent tape tracks result in equal output levels. A signal is then recorded on one track, and the output levels of that track and the adjacent track are measured. The crosstalk ratio, for the adjacent track, is the ratio between the two output measurements, expressed in dB.

The NAB standard specifies that the crosstalk ratio for the adjacent track shall be at least 60 dB between 200 and 10,000 Hz. Measurement must be made with a tuned voltmeter to eliminate the effect of noise. In making the test, bias is not to be applied to the adjacent (unrecorded) track. The signals are to be recorded at the same level as the 400 Hz tone in the frequency response portion of the NAB Standard Test Tape. This tone is at Standard Reference Level in the 15 ips Test Tape; at a level 10 dB lower in the 7½ ips Test Tape; and at a level 15 dB lower in the 3¾ and 1¾ ips test tapes.

The above specifications apply to two-track and four-track mono systems and to four-track stereo systems.

Why isn't a crosstalk test specified for two-track stereo? The answer is that such a test is encompassed in the stereo channel separation test described in the next section. In the case of four-track stereo, the adjacent track does not correspond to the "other" channel (in a given direction of tape travel,

either tracks 1 and 3 are recorded, or else 2 and 4). But in the case of two-track stereo, the tracks for the two channels are adjacent. Therefore, in measuring channel separation, one necessarily includes crosstalk between tracks.

### Stereophonic channel separation

Channel separation deals with leakage between channels of a stereo system. Largely or entirely, it involves leakage between the channel amplifiers and between the two sections of a stereo head. To measure channel separation it is first necessary to adjust recording and playback gain so that equal signals simultaneously recorded through both channels and their corresponding tracks will produce equal output levels. A signal is fed into one channel, and the output levels of that channel and of the "other" channel are measured. The channel separation ratio for the "other" channel is the ratio between the two output measurements, expressed in dB.

The NAB standard specifies that the channel separation test be made with bias applied to both tracks. Between 100 and 10,000 Hz, stereo channel separation should measure at least 40 dB.

Although not explicitly stated, the level at which the test should be made is the same as used for crosstalk measurement.

### Special-Purpose, Limited-Performance Systems

In a special, relatively brief section, the NAB standard sets less demanding specifications for "light-weight portable magnetic recorders . . . where adequate voice intelligibility and interchangeability of recorded tapes are of primary importance . . . (but which are) not suitable for maximum fidelity recording of speech or music." No mention is made here of 15 ips. On the other hand, provision is made for 1¾ ips. Inasmuch as we are largely concerned with high-fidelity performance, we shall deal very briefly with this section.

Speed tolerance is  $\pm 2\%$ , compared with  $\pm 0.2\%$  for high-quality sys-

tems. Unweighted flutter content may not exceed 0.5% rms, compared with a maximum of 0.15% to 0.25%, depending on tape speed, for high-quality systems. Playback response specifications are the same for all three limited purpose speeds: response may be +2 dB at any frequency, -2 dB relative to 400 Hz at 200 and 3,000 Hz, and -5 dB at 100 and 5,000 Hz. Recorded response may be +2 dB at all frequencies, -2 dB between 200 and 5,000 Hz, and -5 dB at 100 Hz.

Thus on a record-playback basis, a limited purpose system may be down as much as 10 dB at 100 Hz and 7 dB at 5,000 Hz. While it "is not intended to restrict the frequency range of voice-recording systems which have the inherent capability of wide-range recording, without distortion, it is, however, often considered desirable to limit the extreme low-frequency response for improved speech intelligibility. . . . Attenuation above 5,000 Hz is recommended (in recording) to reduce the chance of high-frequency tape overload at the lower tape speeds."

On an unweighted basis, S/N is specified for all three speeds as 46 dB full-track, 43 dB two-track, and 40 dB four-track; S/N specifications are about 3 to 4 dB higher for a high-quality system.

### Standard test tapes

The NAB standard provides for test tapes at speeds of 15, 7½, 3¾, and 1¾ ips. All are to be full-track recordings and to contain five parts: (1) 60-second azimuth tone of 15,000 Hz at 15 and 7½ ips, 10,000 Hz at 3¾ ips, and 5,000 Hz at 1¾ ips; (2) 20-second 400 Hz tone at the NAB Standard Reference Level; (3) Another 20-second 400 Hz tone at the same level at 15 ips, 10 dB lower at 7½ ips, and 15 dB lower at 3¾ and 1¾ ips; (4) A series of signals for testing frequency response. These signals are at the Standard Reference Level at 15 ips, 10 dB lower at 7½ ips, and 15 dB lower at 3¾ and 1¾ ips. All speeds include the following frequencies: 30, 50, 75, 100, 250, 500, 750, 1,000, 2,500, and 5,000 Hz. In addition there are frequencies of 7,500 and 10,000 Hz at 3¾ ips; and of 7,500, 10,000, 12,000, and 15,000 Hz at 7½ and 15 ips. (5) 60-second 1,000 Hz signal at a level equal to the Standard Reference Level.

Though not examined here, the 1965 NAB standard further contains annexes on methods of tape speed measurement, on the playback characteristics at various speeds, and on a Primary Calibrated Reproducing System for the purpose of calibrating Standard Test Tapes. Æ



Transistors in a turntable? Unusual? Not to Sony engineers. In designing the TTS-3000, they discovered an unusual use. The result: the quietest turntable with the most precise speed regulation of any available today.

The TTS-3000 employs a servo-controlled motor designed to operate at low voltages provided by a solid-state amplifier. To assure precise speed accuracy, the motor is coupled to a small frequency generator. This generator continuously monitors the speed of the turntable. Any deviation from correct speed results in an instantaneous compensating change in the operating voltage supplied by the solid-state amplifier. The motor is not driven directly by the power line voltage or frequency and does not depend on them in any way. The turntable will operate at the correct speed at either a 50 or 60 Hz.

Transistors are not the only thing unusual about the TTS-3000. The motor runs at 300 rpm — about 1/6th the speed of other turntables. This greatly reduces the intensity of vibration. And any vibration that remains is effectively isolated from the turntable platter. In commenting on this unique approach, High Fidelity reported, "CBS Labs tests showed this turntable as having the 'lowest rumble figure yet measured (-77db, CBS-RRL Standard)".

For a superb playback system consider the PS-2000. It consists of the turntable and PUA-237 arm with Sony VC-8E moving coil cartridge mounted on a handsome teak base for \$329.00. The TTS-3000 turntable itself is \$149.50. All prices suggested list.

No longer is there anything unusual about a solid-state turntable — except the performance. See it at your Sony hi-fi dealer. Sony Corporation of America, 47-47 Van Dam St. Long Island City, N.Y. 11101

**SONY**<sup>®</sup>

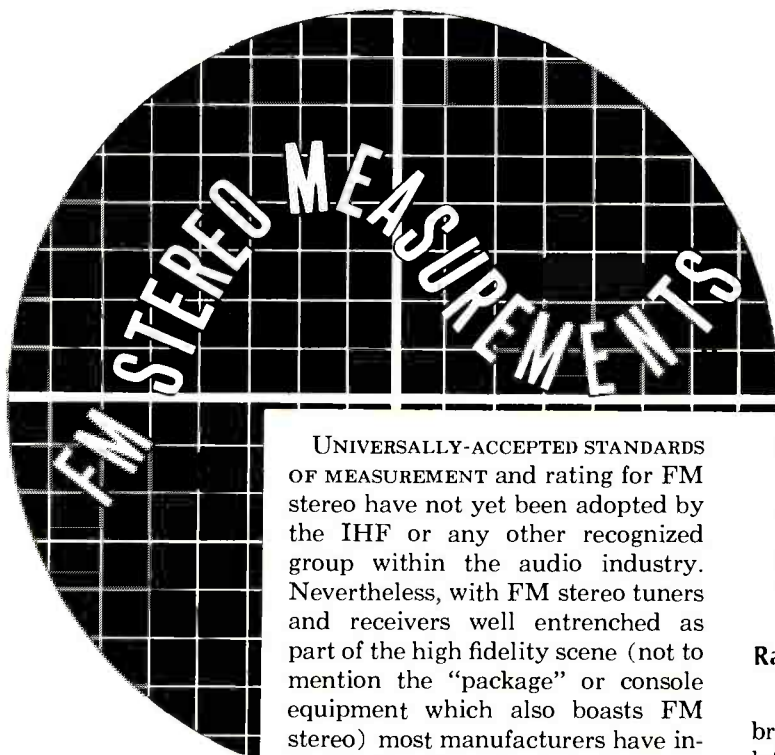


**The solid-state turntable**  
(leave it to Sony to discover another ingenious use for transistors)

[www.americanradiohistory.com](http://www.americanradiohistory.com)

# ABZ's of FM

LEONARD FELDMAN



UNIVERSALLY-ACCEPTED STANDARDS OF MEASUREMENT and rating for FM stereo have not yet been adopted by the IHF or any other recognized group within the audio industry. Nevertheless, with FM stereo tuners and receivers well entrenched as part of the high fidelity scene (not to mention the "package" or console equipment which also boasts FM stereo) most manufacturers have individually selected what they consider to be the defining specifications relating to FM stereo reception, listing listed such "specs" along with the more standard tuner and amplifier criteria.

It is from these "voluntary" listings, as well as from our own experience with the new medium, that we shall list what might be considered the minimum specifications (until a standard comes along) in defining FM stereo performance. Then, we shall examine methods of measurements which are proposed as standard procedure, so that everyone's results will be consistent with everyone else's.

## Primary FM stereo specifications

1. Rated Separation, Left and Right Channels.
  - A. Mid-band
  - B. High Frequency
  - C. Low Frequency
2. Least Usable Stereo Sensitivity
3. Separation Stability

4. FM Stereo Harmonic Distortion
5. Sub-carrier, Sub-harmonic, and Harmonic Rejection
6. SCA Rejection
7. Stereo Indicator Sensitivity

## Rated separation

The FCC requires that a station broadcasting FM stereo transmit left and right channels with separation in excess of 30 dB. This corresponds to about 3% of left channel information getting into the right channel and vice versa. What's more, this capability must extend over the entire audio spectrum, from 50 Hz to 15,000 kHz.

While few receivers on the market can duplicate such separation, it must be said that separation figures of lesser magnitude still yield a highly satisfactory stereo illusion. However, continued degrading of separation ultimately destroys the stereo effect for many people. Just how much separation and over what band of frequencies is necessary is still a subject of debate. To measure separation, however requires a quality FM stereo signal simulator as well as the usual FM r.f. signal generator used with mono FM measurements.

Though many inexpensive "combination" pieces of equipment are available (combining a rudimentary r.f. signal, modulated by a properly-



# Watt for Watt Spec for Spec Dollar for Dollar Sansui offers you more...



This is the new Sansuifidelity 2000. 100 watts (IHF) of music power ... 36 watts/channel RMS ... harmonic distortion of less than 0.8% at *all* rated outputs ... FET Front End ...  $1.8\mu\text{V}$  (IHF) FM Sensitivity ... frequency response from 15-40,000 Hz. If you are an expert in audio equipment you will know what these specifications mean; if you are not, ask any sound engineer; he will tell you. He will also tell you that specifications alone do not make a great receiver. There is the perfection of every component, the most exacting quality control, the integrity and pride of the manufacturer, and that extra care and extra imagination that make a truly great product.

Your Franchised Sansui Sound Specialist invites you to see and listen to the Sansuifidelity 2000. Watch the exclusive Sansui blackout dial light up when you listen to AM or FM broadcasting and change when you switch the selector to phono or tape or auxiliary; notice the ease with which the controls let you choose exactly the blend of music you want to suit you and your personal taste. All this and much more at the unbelievable price of **\$299.95**.

## Sansui

Sansui Electronics Corporation • 34-43 56th Street • Woodside, N.Y. 11377 • Telephone 446-6300  
Sansui Electric Company, Ltd., Tokyo, Japan • Electronic Distributors (Canada), British Columbia

Check No. 53 on Reader Service Card

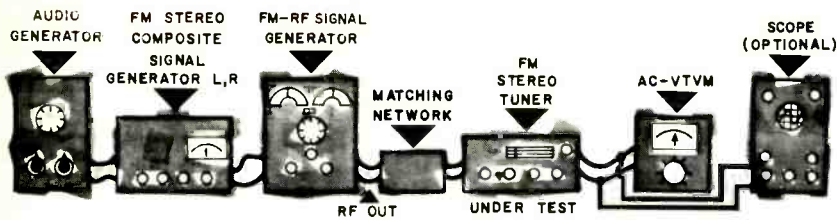


Fig. 1—Test setup for plotting FM stereo separation characteristics.

constituted FM stereo composite signal), the r.f. portion is usually devoid of any means of accurately calibrating microvolt input to the antenna of the equipment under test. Since FM stereo usable sensitivity is our second most important specification, this type of all-in-one equipment would not be usable for this purpose.

The test set-up is illustrated in Fig. 1. Often, the composite FM stereo signal simulator will also contain several audio modulating frequencies for application to either left or right channel. In such cases, the separate audio oscillator can be eliminated.

Normally, a correctly constituted "left-only" signal is applied to the external modulation terminals of the FM generator. Readings are taken from both the left and right outputs of the FM stereo decoder circuitry, at a deviation or modulation of approximately 45 kHz. The frequency of the modulating left-only signal is varied over the usual range (50 Hz to 15,000 Hz) and a double plot such as that shown by the solid lines in Fig. 2 is made of the results. The procedure is repeated, applying a "right-only" signal, and the results are plotted on the same graph (as shown by the dashed lines). The reader can, at a glance, determine separation capability from left to right or right to left at any frequency. Three frequencies are of interest: 1000 Hz (mid-band), 10 kHz (high frequency) and 100 Hz (low frequency). It would be well to use a standard input signal (r.f.) of 1000 microvolts, since separation may often vary with input signal strength. Further, the worst of the two curves, or that exhibiting the least separation (be it left into right or right into left), could be used in formulating a written specification. Thus, the "rated" separation might be stated

as: 30 dB mid-band, 26 dB high-frequency, 24 dB low-frequency.

### Stereo sensitivity

As with mono FM, a program whose highest level is 30 dB above any audible noise and distortion is considered marginally satisfactory. Unfortunately, in the case of stereo, it takes more r.f. microvolts of input signal to produce such a noise-free, distortion-free signal than would be the case in mono reception. It is for this reason that many converts to FM stereo are surprised to find that

a signal strength long deemed adequate in a given location to produce noise-free reception is altogether unsatisfactory for FM stereo. The usual remedy is the installation of an outdoor antenna if none has been used or, in extreme cases, a more sensitive receiver turns out to be the only solution.

Least usable FM stereo sensitivity should, essentially, be measured in the same manner as the equivalent mono FM spec., with one significant exception. The normal "left" or "right" outputs of a decoded stereo signal will contain varying amounts of signal frequencies at 19 kHz, 38 kHz, and harmonics of these frequencies. In the normal FM sensitivity measurement procedure, these might show up as residual distortion if only a distortion analyzer is used. A sharp cut-off filter is therefore recommended (featuring a cut-off frequency at 15 kHz). The filter would be interposed between the output of

Fig. 2—Typical separation curves of FM stereo circuits.

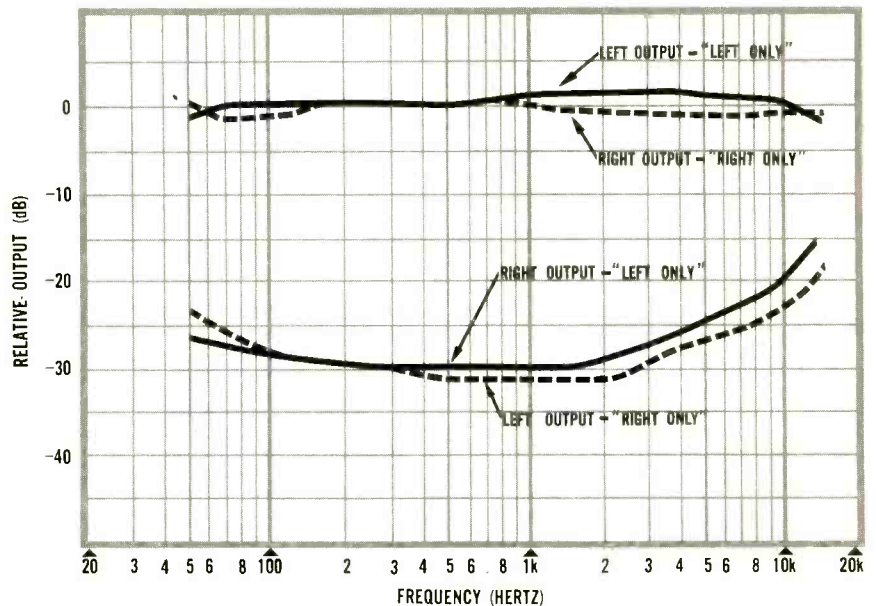
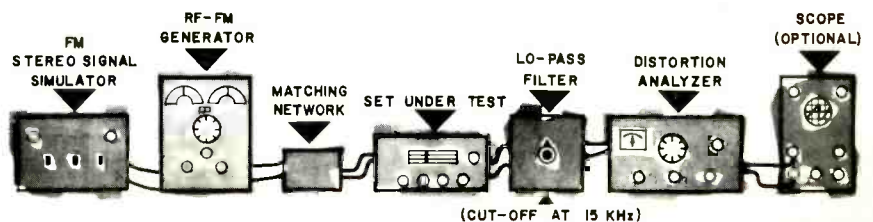
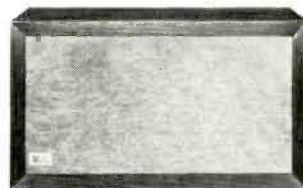


Fig. 3—Test setup to determine "least usable FM stereo sensitivity."







# AR-3a

## ***Acoustic Research announces a new speaker system.***

In 1959, our first advertisement for the AR-3 stated, "it has the most musically natural sound that we were able to create in a speaker, without compromise." This judgment was supported by distinguished writers in both the musical and engineering fields. Hirsch-Houck Laboratories, for example, agreed that "the sounds produced by this speaker are probably more true to the original program than those of any other commercially manufactured speaker system we have heard." For nearly nine years the AR-3 has been the best speaker we could make.

However, technical development at Acoustic Research, as at many companies in the high fidelity industry, is a never-ending search for improvement. After much effort we have found a way to better the performance of the AR-3. The new speaker system, the AR-3a, has even less distortion, more uniform dispersion of sound and still greater power handling capability. The improvement can be heard readily by most listeners; it has been brought about by the use of newly designed mid-range and high-frequency units, and a new crossover network. Only the woofer and the cabinet of the AR-3 are retained in the new system. The AR-3a is priced from \$225 to \$250, depending on cabinet finish, and is covered by AR's standard five-year speaker guarantee.

Detailed information on conversion of an AR-3 to an AR-3a is available from  
**ACOUSTIC RESEARCH, INC., 24 Thorndike St., Cambridge, Mass. 02141**

the set under test and the distortion analyzer.

Since we wish to employ full 75-kHz deviation of the main carrier to correspond to the monophonic test procedure, a "left-right" signal (plus the required 19-kHz pilot signal) should be used to modulate the FM generator, rather than a "left only" "right only" signal, as in previous separation tests. Readings may therefore be taken at either the left- or right-channel outputs of the decoder section. A block diagram of the proposed test set-up is shown in Fig. 3.

### Separation stability

Optimum rated separation is dependent upon many factors, not the least of which is a requirement that the input signal be sufficient to cause "full limiting" of the receiver. At signal inputs of lesser strength, the amplitude of the incoming 19-kHz pilot signal may be insufficient to cause either proper locking of the local 38-kHz oscillator (restored carrier) or, in the absence of such an oscillator (as in the directly-amplified and doubled 19-kHz circuits), improper phase relationships between the stereo audio information and the reconstituted 38-kHz sub-carrier. In such cases, ultimate separation will suffer. The purpose of this test, therefore, is to determine at what signal strength the separation is degraded by 3 dB.

The procedure involves a repetition of the test setup shown in Fig. 1. This time, signal strength is gradually reduced until separation decreases (in either channel) by three dB. Thus, if original rated separation was 30 dB at mid-band, signal strength is reduced until separation at mid-band is only 27 dB. If the number of microvolts being applied exceeds "least usable FM stereo sensitivity," then this number of microvolts determines the separation stability. The rating may be written thus: "Separation Stability: 10 microvolts or more."

If, on the other hand, the decrease in separation does not occur all the way down to "least usable FM stereo sensitivity" microvolts, then this specification becomes academic, and the rating would read: "Separation

Stability: Totally stable at all signal strengths."

### Harmonic distortion

Since additional circuitry is involved in the re-creation of an identifiable "left" and "right" signal at the output of an FM stereo tuner, there are additional sources of harmonic distortion. Certain characteristics of the composite stereo signal itself also render it more susceptible to distortion products. Thus, a new distortion rating is needed for this type of equipment.

To impose really tight demands upon the circuitry, we suggest that the signal applied during the distortion measurement be an "L = -R" signal which shall modulate the FM generator to 90% of full deviation. The remaining 10% modulation shall, of course, be produced by the ever-present 19-kHz signal. Readers may argue that such a signal hardly ever occurs under broadcast conditions, but our counterargument is that it may *possibly* occur, and since it constitutes the most difficult signal to handle (from the point of view of distortion), why not use it—so long as all manufacturers use the very same signal. In any event, the rated distortion shall be the distortion read at either the left or right outputs, with a sharp cut-off (above 15 kHz) filter interposed between the output and the distortion analyzer. Signal strength, for the test, shall be a full 1000 microvolts, so that "noise" is not a contributing factor to the reading.

### Sub-carrier and harmonic rejection

Left- and right-channel information recovery is not unlike simple AM detection. Much has been written about FM stereo demodulation, interpreting it as "matrix" circuitry, "switching" circuitry, envelope detection, and so on. (In later articles, we too shall attempt to describe the demodulating process involved in stripping the FM stereo composite signal of its left and right information.)

The photo of Fig. 4, however, shows a composite signal just before demodulation. If you are at all familiar with AM-modulation wave-

- |   |   |
|---|---|
| <p><b>ALABAMA</b><br/>Birmingham<br/>James W. Clary<br/>Lasseter's<br/>Lixis Stereo Center<br/>Mobile<br/>Electronic World<br/>Montgomery<br/>Bellias Hess<br/>Tuscaloosa<br/>Audio House</p> <p><b>ARIZONA</b><br/>Phoenix<br/>Audio Specialists<br/>CALIFORNIA<br/>All White Front Stores<br/>Artesia<br/>Carsons Electronics<br/>Bakersfield<br/>Bakersfield Audio<br/>Berkeley<br/>Cal Hi Fi<br/>Pacific Electronics<br/>Zackit Corp.<br/>Covina<br/>Hi Fi Covina<br/>Culver City<br/>Hi Fi Matic<br/>Hollywood<br/>Hollywood Electronics<br/>Inglewood<br/>Inglewood Electronics<br/>Laguna Beach<br/>Music Systems<br/>Lakewood<br/>Cal Fi<br/>Los Angeles<br/>Figaris<br/>S &amp; N Camera<br/>Warsco Sales<br/>Mountainview<br/>Cal Hi Fi<br/>Madesto<br/>Pacific Electronics<br/>Oakland<br/>Fidelity Sound<br/>Fisher Electronics<br/>Waynes Sound Accent<br/>Orange<br/>Fidelity Sound<br/>Pasadena<br/>High Fidelity House<br/>Redlands<br/>Sound Room<br/>Sacramento<br/>Cal Hi Fi<br/>Lafayette Radio<br/>Lombard Electronics<br/>San Francisco<br/>Bay Listening Post<br/>Hal Cox<br/>Eber Electronics<br/>House of Sound<br/>McDaniels Hi Fi<br/>San Francisco Radio<br/>Skinner Hirsch and Kaye<br/>Stairway to Sound<br/>San Jose<br/>Electro Sound<br/>Queument Electronics<br/>United Radio &amp; TV<br/>Santa Ana<br/>Hi Fi Associates<br/>Santa Barbara<br/>Skyline Electronics<br/>Santa Monica<br/>Sano &amp; Insane<br/>Santa Rosa<br/>Golden Ear<br/>Torrance<br/>Signal Electronics<br/>Vallejo<br/>Boyd-Wonn<br/>Westwood<br/>Bel Air Camera<br/>Whittier<br/>Hi Fi Haven<br/>Orbow Electronics</p> <p><b>COLORADO</b><br/>Denver<br/>GEM<br/>Howard Sound</p> <p><b>CONNECTICUT</b><br/>Fairfield<br/>Bader TV<br/>Hamden<br/>Lafayette Radio<br/>New Haven<br/>Audio Den<br/>Norwalk<br/>Arrow Electronics<br/>Stamford<br/>Atlantic Electronics<br/>Trumbull<br/>E. J. Korvette<br/>West Hartford<br/>Lafayette Radio<br/>Westport<br/>Beck and Quint</p> <p><b>DISTRICT OF COLUMBIA</b><br/>Custom Hi Fi<br/>Glen's Audio Annex</p> <p><b>FLORIDA</b><br/>Jacksonville<br/>Hi Fi Service Center<br/>Parks Unlimited<br/>Miami<br/>Electronic Equipment<br/>Freedman Sound<br/>Orlando<br/>Electronic Wholesalers<br/>Lafayette Radio<br/>Olson Electronics<br/>Sarasota<br/>Audio Fidelity</p> <p><b>GEORGIA</b><br/>Atlanta<br/>GEX</p> <p><b>HAWAII</b><br/>Honolulu<br/>Audio Center Ltd.<br/>Hawaii Camera</p> <p><b>ILLINOIS</b><br/>Chicago<br/>All E. J. Korvette<br/>Allied Radio<br/>Musicraft</p> <p><b>IOWA</b><br/>Sioux City<br/>Bellias Hess</p> <p><b>INDIANA</b><br/>Fort Wayne<br/>Maxwell Radio<br/>Indianapolis<br/>Van Sickle Radio<br/>South Bend<br/>Al Smith's Record Bar</p> <p><b>KANSAS</b><br/>Overland Park<br/>Village Hi Fi</p> <p><b>LOUISIANA</b><br/>All Sterling Electronics<br/>Lake Charles<br/>Sylvan's Sound Service<br/>Shreveport<br/>Koelamy Sales</p> <p><b>MAINE</b><br/>Augusta<br/>Corner Music &amp; Book</p> | <p><b>MARYLAND</b><br/>Baltimore<br/>All E. J. Korvette<br/>Bethesda<br/>Audio Center<br/>Mt. Rainier<br/>Lafayette Radio<br/>Silver Spring<br/>Custom Hi Fi<br/>Silver Spring Electronic Supply</p> <p><b>MASSACHUSETTS</b><br/>Boston<br/>All Lafayette Radio<br/>Cambridge<br/>Musicrite Man Radio<br/>Wellesley<br/>Music Box<br/>Worcester<br/>Consumer Audionics</p> <p><b>MICHIGAN</b><br/>Ann Arbor<br/>Electronic Discount Ctr.<br/>Detroit<br/>All E. J. Korvette<br/>Ecorse<br/>Double-U-Sound<br/>Warren<br/>Home Electronic Center</p> <p><b>MINNESOTA</b><br/>Minneapolis<br/>Ken-Craft<br/>Sound of Music</p> <p><b>MISSOURI</b><br/>St. Louis<br/>All E. J. Korvette<br/>All GEM<br/>Best Sound<br/>Kansas City<br/>David Beatty<br/>Richmond Heights<br/>West Sound</p> <p><b>NEBRASKA</b><br/>Lincoln<br/>Leuck Radio Supply</p> <p><b>NEW HAMPSHIRE</b><br/>Manchester<br/>Wholesale Electronics</p> <p><b>NEW JERSEY</b><br/>All E. J. Korvette<br/>All Lafayette Radio<br/>Atlantic City<br/>Rainbow Electronics<br/>Elizabeth<br/>American Recording<br/>Franklin Lakes<br/>Franklin Lakes Stereo<br/>Newark<br/>Sound Reproduction<br/>New Brunswick<br/>Hi Haven<br/>Springfield<br/>Disco Electronics<br/>Faded Purchasers<br/>Totowa<br/>Arrow Electronics<br/>Wayne<br/>Stereo Sound</p> <p><b>NEW YORK</b><br/>Albany<br/>GEX<br/>Ithaca<br/>Dryden Radio &amp; TV<br/>New York City<br/>All Arrow<br/>All Sam Goody<br/>All E. J. Korvette<br/>All Lafayette Radio<br/>Airex Radio<br/>Audio Unlimited<br/>Byrco Audio<br/>Defa Electronics<br/>Electronic World<br/>Harvey Radio<br/>Koopers Products<br/>Leonard Radio<br/>Liberty Music<br/>Packard Electronics<br/>Rabsons<br/>Schenectady<br/>Hysat's Stereo<br/>Reales<br/>Syracuse<br/>Gordon Electronics</p> <p><b>NORTH CAROLINA</b><br/>Hendersonville<br/>Joy Record Hi Fi Center</p> <p><b>OHIO</b><br/>Cleveland<br/>Audio Craft<br/>Fox Radio Parts<br/>Columbus<br/>Palmer Electronics<br/>Dayton<br/>Klopf Audio/Video<br/>Mentor<br/>Headlands Consolidated<br/>Parma<br/>Winteradio<br/>Tolado<br/>Jamieson's</p> <p><b>PENNSYLVANIA</b><br/>Erie<br/>House of Records<br/>Fairless Hills<br/>C. A. Rogers Audiobab<br/>Johnston<br/>Hessebein Studios<br/>Philadelphia<br/>All E. J. Korvette<br/>Danby Radio<br/>Sam Goody<br/>Pittsburgh<br/>Lafayette Radio<br/>Opus One</p> <p><b>RHODE ISLAND</b><br/>Cranston<br/>Sound-D-Rama<br/>Pawtucket<br/>Apex</p> <p><b>TEXAS</b><br/>All Sterling Electronics<br/>Corpus Christi<br/>Electronic Equipment &amp; Eng.<br/>Fort Worth<br/>Audio Associates<br/>Houston<br/>Audio Center<br/>Home Entertainment<br/>Sound Equipment</p> <p><b>UTAH</b><br/>Ogden<br/>Hi Fi Shop</p> <p><b>VIRGINIA</b><br/>All E. J. Korvette<br/>All Lafayette Radio<br/>All GEX</p> <p><b>WASHINGTON</b><br/>Seattle<br/>Seattle Radio<br/>Tall's Camera<br/>Spokane<br/>Hunters Hi Fi<br/>WISCONSIN<br/>Menasha<br/>Tip Top Radio<br/>West Allis<br/>Hi Fi Salon</p> |
|---|---|



# THE OTHERS GIVE YOU LITERATURE.

It seems that every time you read an ad someone is asking you to write in for product literature, spec sheets and what have you.

Then you spend the next several weeks mulling over thousands of words, frequency responses, plus and minus DB's until you don't know elliptical from horizontal, tuner from amplifier and IPS from CPS.

We, at ADC, understand and have tried to temper the confusion of facts with just one fact. Namely, to appreciate stereo you must hear it under the exacting conditions of your home.

The size of your listening room and its furnishings all play a heavy part in the performance and reproductive quality of any component. That is why we are offering our new top-rated musical 606-90 watt, solid state, FM stereo receiver for a trial home demonstration.

Listen to the true harmonic quality, low distortion and high sensitivity.

Test its large slantback readable FM dial, automatic frequency control, and automatic FM stereo switching.

Notice when we say true bookshelf shallow depth, we mean for any shelf.

But all this is spelled out in our literature, which is enclosed with our products. Then, at least, when you're reading you can hear what we're talking about.



## ADC GIVES AN 8 DAY HOME DEMONSTRATION.

It's easy! Visit any of the listed ADC dealers and hand him this coupon. Take home the 606. For any reason whatsoever you're not satisfied—return it for a *no questions asked* full refund. Incidentally, take home a pair of top-rated ADC 404 speakers as well. After all, you can't hear literature.

**AUDIO DYNAMICS CORPORATION**  
New Milford, Connecticut 06776



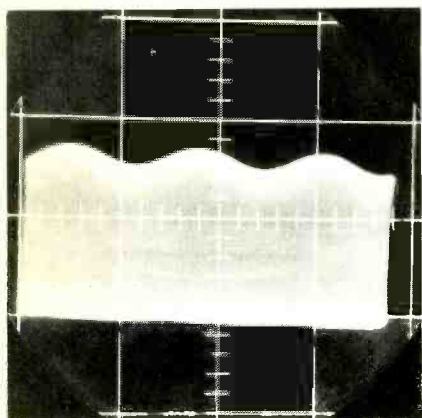


Fig. 4—Composite “left-only” signal prior to demodulation. Audio information consists of upper “envelope” on 38 kHz restored subcarrier.

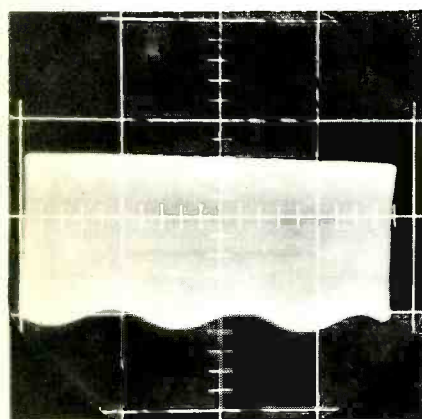


Fig. 5 — Composite “right-only” signal prior to demodulation.

forms, it will seem odd to you that an envelope is “traced out” on one edge of the total waveform. The fact is, that this photo represents a “left only” signal about to be demodulated. Fig. 5, its counterpart, represents—you guessed it—a right-only signal about to undergo demodulation. Just as it is necessary to “filter out” any 455-kHz i.f. signal after the AM information has been detected in an AM radio, so is it necessary to attenuate the sub-carrier frequency involved in the FM stereo composite signal—38 kHz. Not that this frequency could be heard by the listener if it were allowed to go on to the audio amplifier and loudspeakers! It is too high in frequency for that. If present in sufficient amplitude, however, it could conceivably damage tweeters. Too, since it usually contains an abundance of harmonics (76 kHz, and so on), one or more of these frequencies might be close in frequency to that of the

bias oscillator of your favorite tape recorder (on which you plan to record that “perfect” library from your favorite FM stereo station). Resultant recordings might contain an audible beat tone, arising from the heterodyning effect of the two super-audible frequencies.

For these reasons, it is desirable that all super-audible frequencies associated with the recovery of the stereo channels’ information be attenuated in the output as far as possible. We suggest that the rated attenuation be the number of decibels below 100% modulation that are measured in the absence of stereo modulating tones other than the usual 19-kHz pilot signal. In this case, the low-pass filter is removed and the meter is connected directly to the output of the receiver under test. 100% modulation is first applied (in the form of a full-modulation mono signal, plus 19 kHz) and the output noted. With the mono-signal turned off, the output is again noted (19 kHz still being present, of course, to actuate the stereo circuitry).

The rated rejection of sub-carrier and sub-harmonic and harmonic signals is then expressed in decibels representing the ratio of the unwanted signals to the 100% modulation reading at the output.

### SCA rejection

Long before stereo FM was authorized by the FCC, there was a form of “multiplex” transmission approved for use on existing FM stations which enabled the simultaneous transmission of regular public programming along with “private” subscriber programs, such as background music (to restaurants and other public places). This latter form of transmission cannot be received on conventional FM receivers, but goes out over the air as a sort of “piggy-back” arrangement. A carrier having a frequency of 67 kHz is involved, and authority to continue this private service was granted by the FCC even in the case of a station also broadcasting stereo.

As you can appreciate, a receiver equipped for FM stereo reception must have pretty flat response throughout its decoder circuitry all the way to 53 kHz, which is peril-

ously close to the “private” service at 67 kHz. Filters must therefore be incorporated in the receiver circuitry which will eliminate any cross-talk effects from the SCA (Subsidiary Communications Authorization) programming. Such cross-talk, by the way, does not come through as recognizable audio intelligence, but as a series of whistles or “whooshing” sounds which can be annoying to a stereo listener (even at 30 dB below program content). A standard rating of SCA rejection could be obtained by modulating an FM generator with all frequencies from 60 kHz to 75 kHz, with 10% (7.5 kHz) deviation of the main carrier. The highest reading resulting at the output of the stereo decoder circuitry (either left or right channel) may be taken relative to 100% modulation output. In making these measurements, the 19-kHz pilot signal associated with the stereo composite signal must remain “on” to actuate the stereo decoding circuits in the receiver under test.

### Stereo indicator sensitivity

Most modern stereo FM tuners and receivers include some form of visual indicator (such as a lamp) to denote the presence of a stereo signal. These should be rated in terms of minimum number of microvolts required to actuate these devices, if that number exceeds the “least usable FM stereo sensitivity” figure described earlier. The same type of rating could be applied to the so-called “automatic switching” circuits which actuate the stereo decoding circuits in the presence of an adequate stereo signal.

Since stereo requires more signal input strength than mono, these circuits usually do not work in the presence of a weak, noisy signal. Accordingly, the consumer should know how many microvolts of signal strength are required to actuate the stereo circuitry, for if this number is greater than the “least usable FM stereo sensitivity” rating, it will govern the actual stereo performance of the receiver. If, however, the automatic circuits are capable of being defeated by a front panel switch, then this last specification need not be stated. Æ



# The Harman-Kardon Nocturne Five-Twenty. Unquestionably the best stereo receiver we have ever built.



The Five-Twenty isn't the most expensive stereo receiver we make.

But on a performance to power to styling to cost basis, we think it's the best.

Our more expensive receiver has somewhat more power and several additional features. If you need the extra power and the extra features and you don't mind the extra cost, it may be just the receiver for you. (It's called the Nocturne Seven-Twenty.)

If not, consider the Five-Twenty. The Five-Twenty has the power to drive any speaker, regardless of impedance or efficiency; the sound quality to please the most critical ear; the styling to please the most critical eye; all the features that most listeners require; and a surprisingly low price. We believe that the Nocturne Five-Twenty delivers a

degree of excellence never before attainable at such a modest price.

The Five-Twenty is a complete, solid state control center with a powerful 70-watt stereo amplifier and FM/FM stereo tuner that delivers astonishingly clear broadcast reception. The most advanced integrated micro-circuits are employed for absolute reliability and unsurpassed performance. Ultra-wide frequency response, well beyond the range of hearing, guarantees flawless, distortion-free sound quality with extraordinary clarity and spaciousness.

The Five-Twenty can drive low-efficiency speakers to full output, without strain or potential damage to the output devices. In fact, it can handle four low-efficiency speaker systems simultaneously.

Listen to it at your dealer soon. We think you'll be overwhelmed by its sound.

And astonished by its price.

If you're interested in AM, listen to the Nocturne Five-Thirty. It's the Five-Twenty *plus* a radically new kind of AM; the best AM we've ever made. The Five-Thirty employs a MOSFET front-end and separate AM board with its own I.F. strip.

The Nocturne Five-Twenty for FM. The Nocturne Five-Thirty for FM and AM.

Whichever one you choose you'll get nothing but our best. They're at your Harman-Kardon dealer now.

For more information, write Harman-Kardon, Inc., Box H3, Plainview, New York 11803.

**harman kardon**

A subsidiary of Jervis Corporation

# EQUIPMENT PROFILE

## Dynaco PAT-4 Solid-State Stereo Preamplifier

### MANUFACTURER'S SPECIFICATIONS—

Frequency Response: High-level input, 10 Hz to 100 kHz  $\pm 0.5$  dB; low-level, 20 Hz to 20 kHz  $\pm 1$  dB. Distortion (at rated 2V output): THD—under 0.05%, 20 Hz to 20 kHz; IM, under 0.05% with any frequency combination. Hum and Noise: Magnetic Phono—70 dB below 10 mV; High Level—85 dB below 0.5V. Tone Control Range:  $\pm 16$  dB at 50 Hz;  $\pm 12$  dB at 10 kHz. Inputs: low-level and high-level RIAA magnetic phono, and ceramic phono; NAB tape head; tape amplifier; tuner; spare high level; front-panel high level; special (normally microphone). Outputs: tape out ahead of controls; 2 audio outputs (one switched) front-panel output. Controls: switches, selector, volume, balance, 2 bass, 2 treble, high filter at 15 kHz, 10 kHz, 7 kHz; loudness; tape monitor; low filter; paired stereo-mono for A or B channels or A + B channels with blend for 3rd channel. Dimensions: 13 $\frac{1}{2}$ -in. wide  $\times$  4 $\frac{1}{4}$ -in. high  $\times$  9-in. deep. Weight: 10 lbs.

The long-awaited PAT-4 has finally arrived, and it turns out to be all that any avid audio buff could expect in the way of performance. This is the first Dynaco solid-state preamp, and follows

the Stereo 120 as the company's second venture into the world of transistors. The PAT-4 is a unit for which we have received many requests to Profile over the past several months.

Actually, the preamplifier is by way of becoming a near-extinct component, it appears. In the days of tubes, the power amplifier was usually heavy, generated a lot of heat, and was best relegated to the bottom of the cabinet, with only the tuner and preamplifier up in the control area. With the advent of solid-state equipment, the receiver has practically usurped the field.

In the August Product Preview section, for example, only thirteen preamps were listed this year, although there were twenty-two in 1964. Dynaco has kept the preamplifier alive ever since its first one, both in kit form and as a factory-wired product.

This is not to indicate that separate preamplifiers have been rendered obsolete. Decidedly, they have not. With a separate preamplifier, a more selective choice of a high-quality power amplifier can be made. In addition, separate preamplifiers are generally more sophisticated units than are integrated preamplifiers, both in operating flexibility and performance characteristics. Too, some separate preamps,

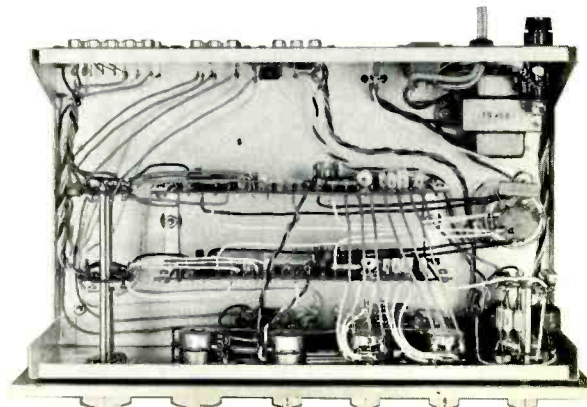
like the Dynaco unit examined here, are small and light weight in comparison to integrated amplifiers or receivers, making it possible to locate it in a convenient area that is normally barred to larger, monolithic units.

The design of the PAT-4 offers a number of interesting features, some of which are hold-overs from earlier Dynaco preamps and some of which are new items. The holdovers include provision for extra inputs which give considerable flexibility for the user who may have special requirements or who may wish a second phono input or a second tape head input, for example.

The panel accommodates, from left to right, the input selector switch, dual volume control, balance control, dual-concentric bass and treble tone controls and a filter switch, all of which are rotary controls. Along the bottom are an input jack, a momentary spring-action tape monitor switch, a loudness switch, low filter switch, two mono/stereo switches, an output jack, and the power switch. All switches are of the popular rocker type, and the input and output jacks are three-circuit units which break the normal connections when a plug is inserted. The tape monitor switch is spring loaded, so it returns to the normal position when not held in the monitor mode. This may be defeated in the construction by substitution of a normal detent-action switch, which can be supplied if the builder does not plan on using the monitor function extensively. Instructions are provided for ordering the switch if required.

The two stereo/mono switches require some explanation. These switches are both normally left in the stereo position, with the bottom of each switch depressed. Three choices of operation are available: with the top of the "A" switch depressed alone, the left-channel input is switched through both outputs; with the top of the "B" switch depressed alone, the right-channel in-

Fig. 1—Front-panel and interior views of the new Dynaco PAT-4 solid-state preamp, available in kit or assembled form.







## TODAY'S TAPES, TOMORROW'S TREASURES

WHY IMMORTALIZE ECHOES, DISTORTION, AND ROOM REVERBERATIONS? Whether you're building an audio chronology of your children, practicing speech, using tapes to develop vocal or instrumental technique, or compiling tapes of live lectures and concerts—your microphone is the vital link between you and distortion-free, professional sounding tapes. It is a fact that microphones supplied with tape recorders (even on relatively expensive models) are significantly below the performance capabilities of the recorder itself. Further, with a

good unidirectional microphone that picks up sound from the front while suppressing sound entering from the back and sides (such as the incomparable Shure Unidyne<sup>®</sup> III shown above) you can control objectionable background noise, room echoes and reverberations, and the "hollow" sound common to most amateur tapes. The Shure Unidyne microphone actually represents the lowest cost investment you can make in upgrading your entire tape system, yet, the difference in sound is astounding!

# SHURE

### MICROPHONES FOR TAPE RECORDING

© 1967 Shure Brothers, Inc.



SEND FOR  
COMPLETE  
MICROPHONE  
CATALOG

listing dozens of tape  
recorder improvement  
microphones, in every  
price range.

SHURE BROTHERS, INC.  
222 Hartrey Ave., Evanston, Illinois 60204, Attn: Dept. 63  
Please send me your catalog of microphones for  
tape recording. (No. AL 314)

NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_ STATE \_\_\_\_\_ ZIP \_\_\_\_\_

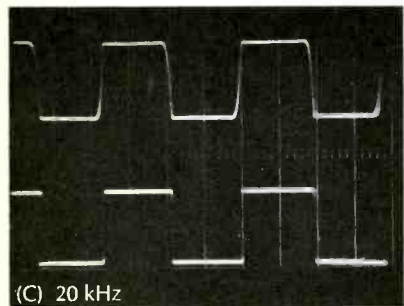
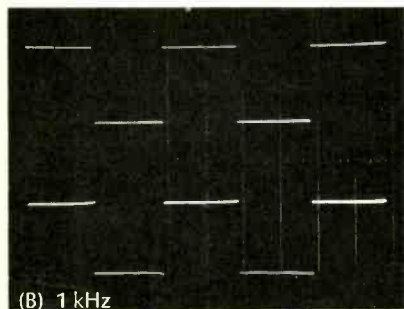
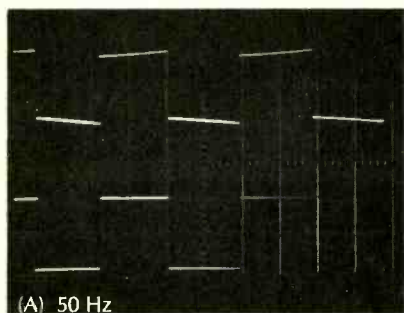


Fig. 2—Oscilloscope traces of PAT-4 square-wave response.

Fig. 3—Tone-burst pattern of PAT-4.

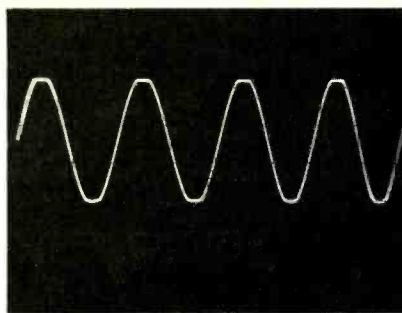
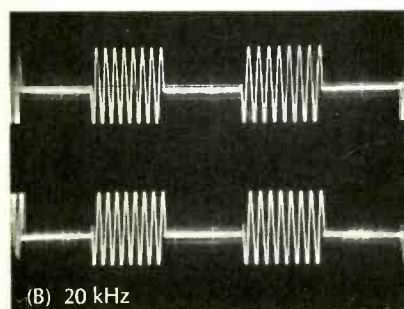
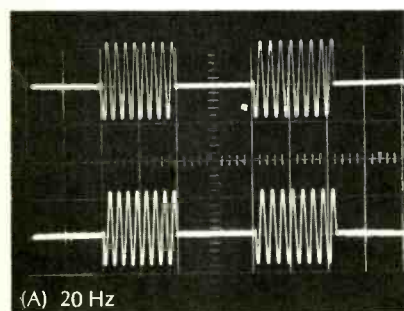


Fig. 4—The new solid-state Dynaco preamp goes into symmetrical clipping here at 11.2 V output with a 1 kHz signal.

puts are switched to both outputs; with the tops of both switches depressed, a partially blended signal is obtained at both outputs. This provides 6 dB of separation, and is desirable for reducing the apparent separation between stereo speakers, as well as providing the proper spatial effect when using headphones, and is the normal position to use when playing mono records with stereo cartridges. Instructions are given for a minor wiring change which will give a fully blended signal.

While this switching system seems complicated, it does permit connecting mono sources to either the "special" (high-gain) or "spare" (low-gain) inputs with full control from the preamp panel.

The input and output jacks are similarly double-purposed. Inserting a plug in the input jack cuts out the selector switch, and feeds the signal from the plug to the input of the second amplifier section, just as with any other high-level input. If the plug is inserted only part way, so as to contact the right-channel jack spring only, a mono signal may be fed into the right channel only, leaving the normal signal feeding the left channel. Thus a guitar amplifier, for example, could be plugged in and reproduced on the right channel, while a record could be playing through the left channel at the same time. This jack also permits the introduction of the signal from a tape recorder without disturbing the rear panel connections.

The output jack provides a normal 600-ohm output in parallel with rear-panel OUTPUT-1 jacks, and mutes OUTPUT-2 jacks on the rear panel. Thus plugging in a pair of 600-ohm (or higher) phones could serve to disconnect the speakers by feeding the power amplifier from OUTPUT-2 jacks. The OUTPUT-1 jacks are not muted, but plugging in a 600-ohm load will lower their level by 6 dB.

All normal connections are made by phono jacks on the rear panel. Eleven jacks are provided for each channel—

five low-level inputs, three high-level inputs, and three outputs. Of the latter, one is to feed a tape recorder, while the other two are to feed a power amplifier as described in the preceding paragraph.

The five low-level inputs are labeled LO PHONO, CER PHONO, HI PHONO, TAPE HEAD, and SPECIAL. The latter is normally wired for use as a microphone input which will accept the output of any high-impedance mike. The three phono inputs feed the same switch position, and are compensated by a couplate wired to the three phono jacks of each channel. The high-level inputs are labeled TUNER, TAPE, and SPARE.

The filter switch has four positions which are marked FLAT, 15, 10, and 7, with the output down approximately 6 dB at 15, 10, and 7 kHz respectively in the numbered positions, and flat to over 100 kHz in the FLAT position.

The tone controls in this unit, as well as in the earlier PAS-3X and PAS-2X, are of a patented Dynaco design which effectively removes them from the circuit when in the center of their rotation. This is accomplished by a double-armed pot on the bass control to provide a short on the unused portion of the rotation for each half, and by an open in the center of the treble control. This has the added advantage of a truly flat position for some 10 to 15 deg. of rotation at the center, so that the setting does not have to be exact to ensure flat response.

The power transformer has a split primary, so the unit can be wired to operate on either 120 or 240 volts, as required by the available supply. The power switch is fitted with a clear plastic rocker, and a small neon bulb is mounted on the switch, along with a current-limiting resistor. This combination serves as the pilot light. Two "hot" power receptacles are provided on the rear panel, as well as two switched ones and the line fuse.

## Circuit

Two pairs of npn silicon transistors are used in each channel—one providing the low-level amplification required for phono, tape-head, and microphone inputs, and the other providing sufficient gain to permit the use of tone control and filter sections. Each pair has both a.c. and d.c. feedback paths, and both sections are of the same configuration, although their values and the transistors themselves are different. The selector switch controls the source and the equalization, and the filter switch, which follows the output of the second pair, uses an inductance in com-



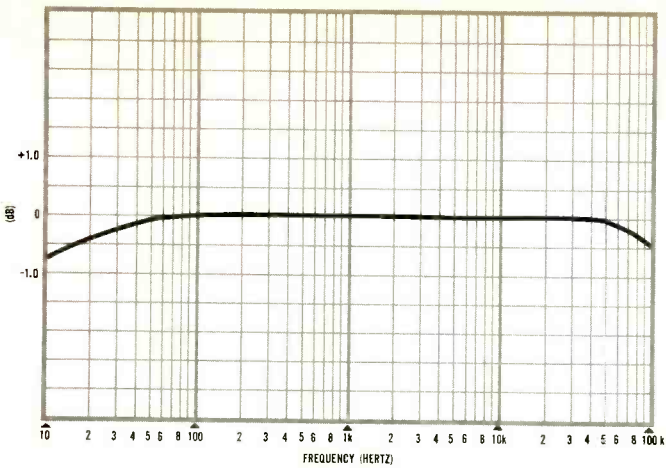


Fig. 5—Frequency response characteristics of PAT-4.

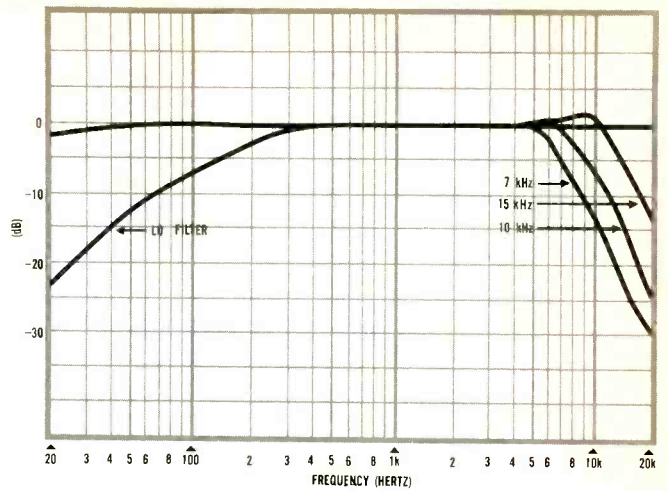


Fig. 6—Action of high- and low-frequency filter switches.

bination with a number of capacitors to achieve the relatively sharp cutoff. The power supply employs full-wave silicon diode rectification with RC filtering, using a total of 2200  $\mu\text{F}$  of capacitors.

### Construction

At first glance it might appear that the instructions for assembly are hardly adequate, since only one pictorial diagram is provided. However, this one diagram, together with two small ones for assembling the filter switch, are all that are necessary. There are 64 separate operations in assembling and wiring the front panel, which is integral with the chassis bottom. The filter switch requires 30 operations, and the separate rear panel requires 32 more. Then the rear panel is wired to the main chassis unit in a flat position before it is finally mounted on the chassis. Then there are 99 more operations

to complete the assembly, which should be done in slightly over nine hours total. We took 9 hours and 20 minutes, but were especially careful to follow the instructions as closely as possible. The printed-circuit boards are completely assembled at the factory, and require only the connections to the remainder of the unit. After completion, the PAT-4 worked perfectly from the first moment it was turned on, indicating that care in assembly is certainly worthwhile.

### Performance

The PAT-4 is one unit which comes up to its specifications without any fudging whatever. Its frequency response is flat within  $\pm 0.5$  dB from 10 Hz to 100 kHz at the high-level inputs, and within  $\pm 1$  dB at the low-level inputs, all of which are equalized except the SPECIAL, which is flat for microphone inputs. Most interesting is the

fact that both channels are so nearly identical, with equalization tracking within  $\pm 1$  dB throughout the range. This also applies to the filters and to the volume control, which exceeded the 1-dB mark only at over 40 dB attenuation (it actually reached 2 dB at that point). Response curves are shown in Figs. 5, 6, 7, and 8. The unit's performance in face of square waves and tone bursts was excellent, as can be seen in scope traces pictured in Figs. 2 and 3. Figure 1 shows front panel and interior views.

Total harmonic distortion at the rated 2-volt output measured less than 0.05% at 20, 100, 1000, 10,000, and 20,000 Hz, and IM distortion measured less than 0.05% with 60 and 7000 Hz mixed 4:1 at 2 volts out. The unit went into a symmetrical flattening of a sine wave at 11.2 volts out, which is more than sufficient to drive any power amplifier to total distortion. See Fig. 4.

(Continued on page 82)

Fig. 7—Loudness contour curves. (Unit has loudness defeat switch.)

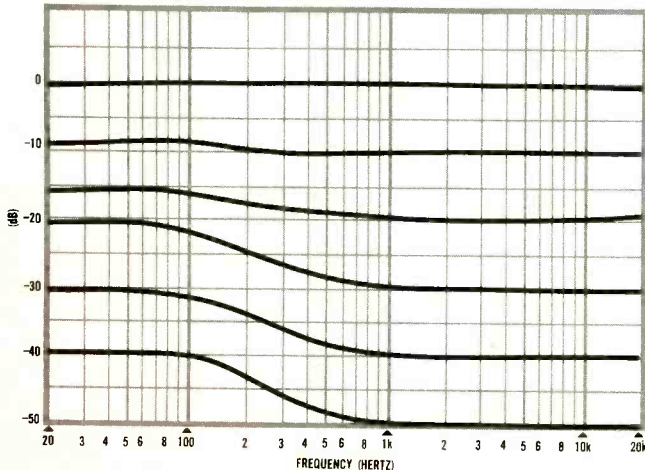
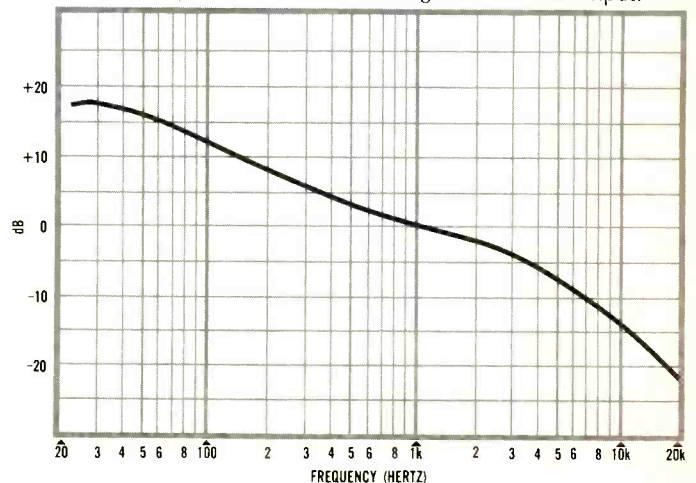


Fig. 8—Equalization curves for magnetic low-level input.



# Microphones for Sound Reinforcement Systems

ARTHUR C. DAVIS & DON DAVIS\*

## Acoustical requirements of large-audience listening areas and the role played by microphones in meeting system criteria are examined

The design, installation and successful adjustment of a high-quality sound reinforcement system is a complex engineering problem. Modern practices have tended toward increased use of precision acoustical measuring equipment at all three stages prior to customer use of the system. A well-engineered sound reinforcement system today will meet all the following criteria:

1. Provide an acoustic gain between 10 and 30 dB. (See Figs. 1 and 2 for an explanation of acoustic gain and its measurement.)
2. Provide even distribution of the reinforced sound throughout the audience area — typically  $\pm 2$  dB from front-to-back or side-to-side for the one-octave band centered on 4000 Hz. (See Fig. 3.) Total variation from the worst to the best seat equals  $\pm 4$  dB.
3. Provide uniform frequency response throughout the audience area—typically  $\pm 3$  dB as measured with  $\frac{1}{3}$ -octave bands of “pink noise” at positions across the main audience area.
4. Provide correct “time” relationship between the loudspeaker and the listener’s ear

as compared to the time interval from the talker to the listener’s ear. (See Fig. 4.)

5. Provide adequate dynamic range at an acoustic distortion sufficiently low to insure minimum listening fatigue. The reinforcement system should be capable of providing 90- to 100-dB sound pressure level (SPL) to any seat in the audience area at an acoustic distortion below 5% total harmonic distortion (THD).

All of this must be accomplished with components that are rugged, reliable, easy to service, and because of their price, they must have a long life expectancy to allow for a low amortization figure.

This article is intended as a detailed discussion of the microphone’s role in such a system and the parameters it must contribute if the system’s criteria are to be met.

It can be realized quickly that carbon, crystal, ceramic, and hot-wire microphones are not the type required. The basic types we can consider are:

1. Moving coil
2. Ribbon
3. Condenser

Further, we can divide the use of these basic mechanisms for transducing acoustic energy into electric energy as follows:

1. Omnidirectional response
2. Bidirectional response
3. Unidirectional response

All three types of microphones in each of the directional response patterns will have to have the following questions answered correctly before being connected into the electronics of your reinforcement system:

1. For a SPL of 94 dB at the microphone’s diaphragm, what is the effective output in dBm? ( $10 \text{ dynes/cm}^2 = 94 \text{ dB SPL}$ .)
2. What is the rated impedance of the microphone’s output?
3. Does it require an external power source?

Mechanically, the following questions must be answered.

1. Is a shock mounting provided?
2. Is a wind “pop” screen provided?
3. Is any special mounting required?

These must be ascertained at the design stage.

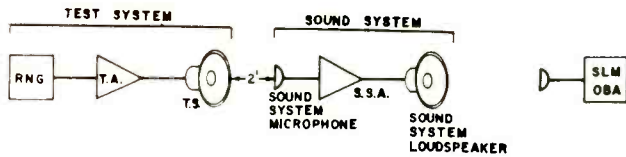
(This must be ascertained at the design stage since such solutions may not always come off the manufacturer’s shelf.)

Finally, you must either receive unimpeachable documentation from the manufacturer (actual anechoic chamber measurements) or else conduct careful tests yourself regarding:

(Continued on page 66)

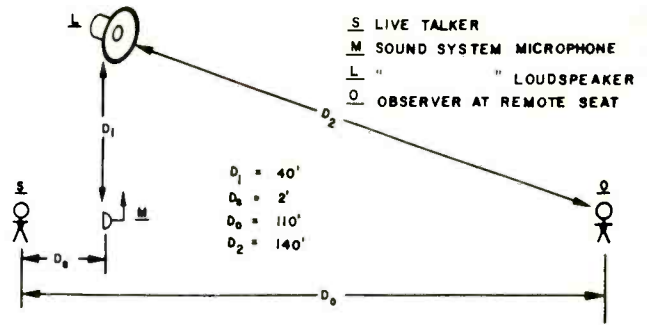
\*Altec Lansing, Anaheim, Calif.





1. Adjust random-noise generator (RNG) and test amplifier (TA) to produce 90 dB SPL at a distance of 2' in front of the test. Locate loudspeaker (TS) at sound-system microphone position.
2. Carry the sound-level meter (SLM) to the most remote listening position used by a regular audience and, with the octave band analyzer (OBA) adjusted to the 2000-Hz octave band, take a SPL reading in dB. (Sound system is shut OFF during these measurements.)
3. Place sound-system microphone 2' in front of test loudspeaker (TS). Adjust sound system's gain to a point just below acoustic feedback. Switch on test loudspeaker. Set at same level as step (1): 90 dB SPL at 2'.
4. Again take SPL reading in dB with SLM at most remote listening position and adjust to 2000-Hz octave band. SLM reading in step (2) subtracted from SLM reading in step (4) equals the acoustic gain in dB SPL.

Fig. 1—A step-by-step description of acoustic gain measurement is shown here. Steps 1 and 2 are effected before the sound system microphone is placed two feet in front of the test loudspeaker.



$$SG = (20 + \Delta) \text{Log}_{10} \left[ \frac{D_1}{D_s} \cdot \frac{D_0}{D_2} \right]$$

EXAMPLE: Large church, 5.5 sec. R.T. at 512 Hz

Assume  $\Delta = 0$  for initial calculation

$$D_1 = 40' \quad (20 + \Delta) \text{Log}_{10} \left[ \frac{40}{2} \cdot \frac{110}{140} \right] =$$

$$D_s = 2' \quad (20 + \Delta) \text{Log}_{10} 15.7 = 24 \text{ dB} \Delta$$

$$D_0 = 110' \quad (20 + \Delta) \text{Log}_{10} 15.7 = 24 \text{ dB} \Delta$$

$$D_2 = 140'$$

$\Delta = 0$  is a realistic goal where detailed narrow band equalization is employed. If broad-band equalization alone is used,  $\frac{1}{2}$  the gain achieved when  $\Delta = 0$  is a conservative estimate.

Fig. 2—Calculation of gain before feedback.

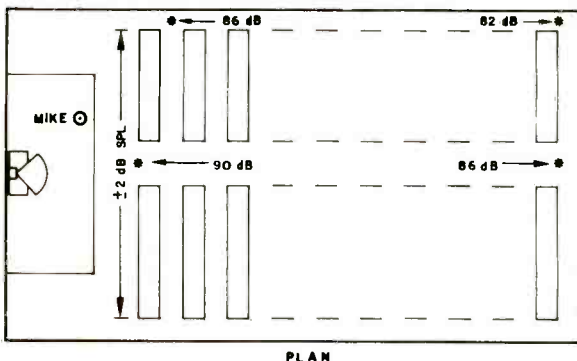
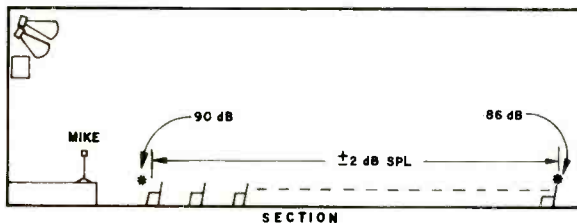
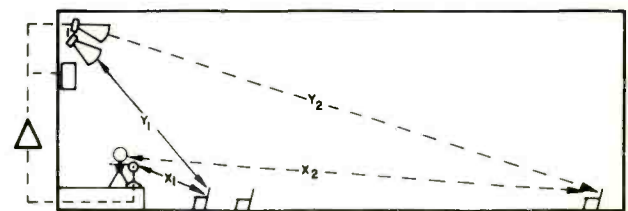
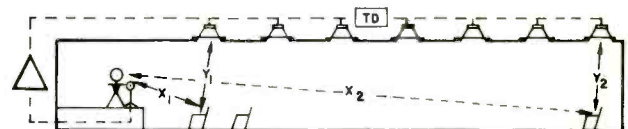


Fig. 3—A criterion of a well-engineered sound reinforcement system is to provide even distribution of sound throughout the listening area.



1. If "live talker" is closer to listener than distance from loudspeaker to listener then:

(a)  $y_1 - x_1$  must be  $\leq 40'$  (45.6 milliseconds)

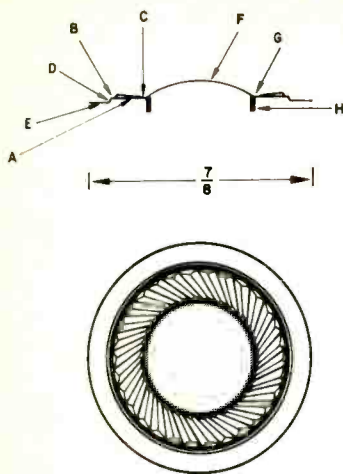


2. If loudspeaker is closer to listener than "live talker" to listener:

(a)  $x_1 - y_1$  must be  $\leq 40'$  (45.6 milliseconds) UNLESS SPL from loudspeaker at listener's ear exceeds SPL from "live talker" by at least 15 dB SPL.

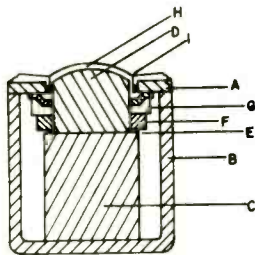
(b) If loudspeaker is not 15 dB SPL higher at the listener's ear than the "live talker" and  $x_2 - y_2 > 40'$  (45.6 milliseconds) then the use of a time-delay mechanism should be given serious consideration.

Fig. 4—Time-distance relationships of a sound system are illustrated.



- A TANGENTIAL COMPLIANCE SECTION
- B HINGE POINT
- C " "
- D SPACER
- E CEMENTING FLAT
- F DOME
- G COIL SEAT
- H VOICE COIL

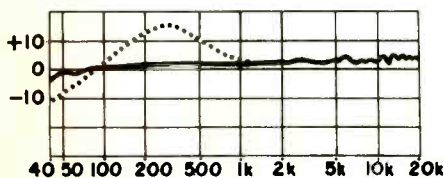
Fig. 5—Cross-section of a dynamic pressure unit.



- A POLE PLATE
- B MAGNETIC RETURN
- C ALNICO V MAGNET
- D POLE PIECE
- E THREADED PORTION
- F THREADED ADJUSTING RING
- G ACOUSTIC RESISTOR (FELT)
- H CAPACITANCE UNDER DIAPHRAGM DOME
- I VOICE COIL

Fig. 6—Omni-directional diaphragm and voice-coil assembly.

Fig. 7—Response curve of diaphragm and voice-coil assembly.



1. Uniformity of frequency response on axis.
2. Uniformity of frequency response on the so-called "dead" side.
3. The separation between the front and the back of directional microphones expressed in dB. (Both in the horizontal and the vertical plane.)
4. The "self noise" level and the "overload" level.

### The moving-coil microphone

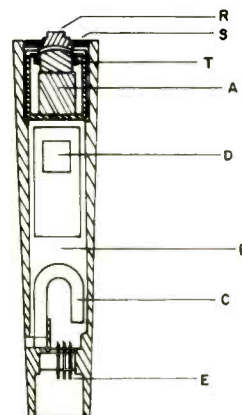
A basic discussion of a pressure-operated omnidirectional moving-coil microphone is in order before exploring the subject further. In a dynamic pressure unit (See Fig. 5) the magnet and its associated parts (magnetic return, pole piece, and pole plate) produce a concentrated magnetic flux of approximately 10,000 gauss in a small gap. Placed into this small gap is the voice coil mounted on the microphone diaphragm. (See Fig. 6.)

The diaphragm positions and supports the voice coil in the magnetic gap, keeping it in the center of a gap only 0.020-in. wide. (Typically, the gap on either side of the voice coil is 0.006-in.) The voice coil is the controlling part of the mass involved in the diaphragm-voice coil assembly inasmuch as it weighs more than the diaphragm. Because the voice coil and diaphragm have mass (analogous to inductance in an electrical circuit) and compliance (analogous to capacitance), the assembly will resonate at a given frequency in the manner of a tuned electrical circuit. The "free-cone" resonance of a typical undamped unit is in the region of 350 Hz.

If it were left in this undamped state, the response of the assembly would be like that shown by the dotted line in Fig. 7. This resonant characteristic is damped out by an acoustic resistor, a felt ring which covers the openings in the centering ring behind the diaphragm. This is analogous to electrical resistance in a tuned circuit, and damps the resonant point down to a flat response. Even with the unit damped, there is a drooping in the lower frequency range from about 200 Hz down (dotted line, Fig. 7). This is cor-

rected by the use of additional acoustic resonant devices inside the microphone case. A cavity behind the unit (analogous to capacitance) helps resonate at the low frequencies with the mass (inductance) of the diaphragm-and-voice-coil assembly.

Still another tuned resonant circuit is added in the form of a tube (Fig. 8) which couples the inside cavity of the microphone housing to the outside. This tube has an acoustic inductance which is tuned to a low frequency, in this case 50 Hz, so that a flat response extending down to 35 Hz may be obtained.



- A ALNICO V MAGNET
- B CASE CAVITY
- C TUBE
- D TRANSFORMER
- E CONNECTOR
- R RESONATOR
- S SINTERED BRONZE FILTER
- T FELT DAMPING RING

Fig. 8—Cross-section of omni-directional microphone.

### Operating limitations

For the purpose of our discussion we are going to assume that the sound pressure the microphone sees is a plane wave in a far field. The relationship of the air particle displacement to its velocity and its acceleration is shown in Fig. 9.

Figure 10 illustrates the effect of a varying sound pressure on a moving-coil microphone. (For this brief and, admittedly, simplified explanation, assume that a massless diaphragm voice-coil assembly is used.) The acoustical waveform (I), is one cycle of an acoustic waveform, where (A) indicates atmospheric pressure, (AT); and (B) represents atmospheric pressure plus a slight over-



# Our microphones are now transistorized.



## And that's not the only good news.

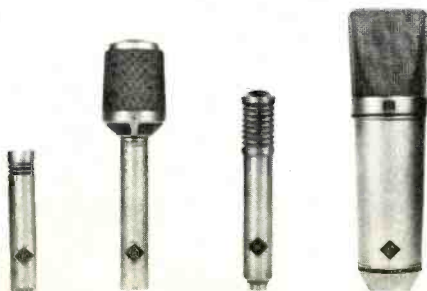
Now, it's easier than ever for you to own the world's finest microphone. Because we've reduced the price of the entire line—by as much as 30%.

Of course, Neumann FET condenser microphones give you several other advantages. Long-life DC battery operation, for example.

The flexibility of central compatible power.

And a two-year guarantee.

Performance? Identical to their tube predecessors. And that's the most exciting news of all.



**Gotham**  
Audio Corporation

2 West 46th St., N.Y., N.Y. 10036 In Canada: J-Mar Electronics Ltd.

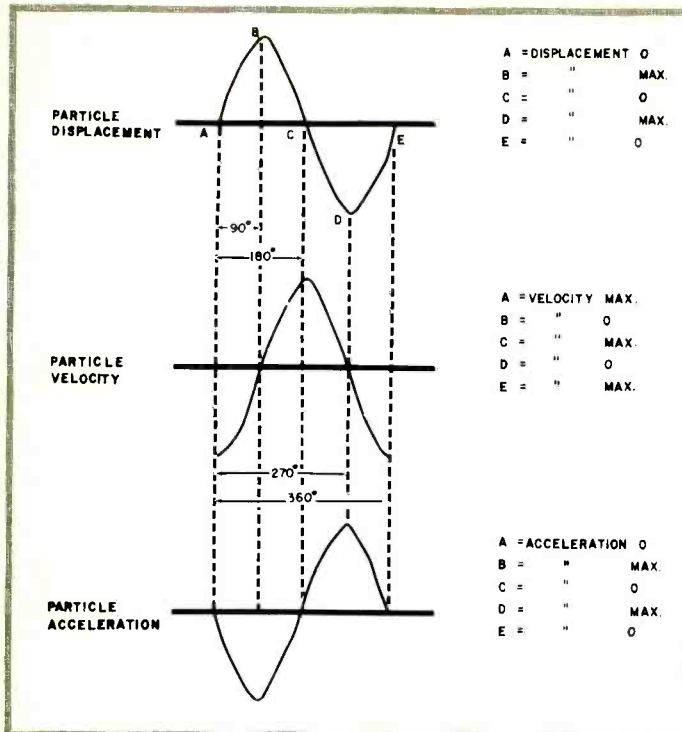


Fig. 9—Air particle motion in a sound field, showing relationship to velocity and acceleration.

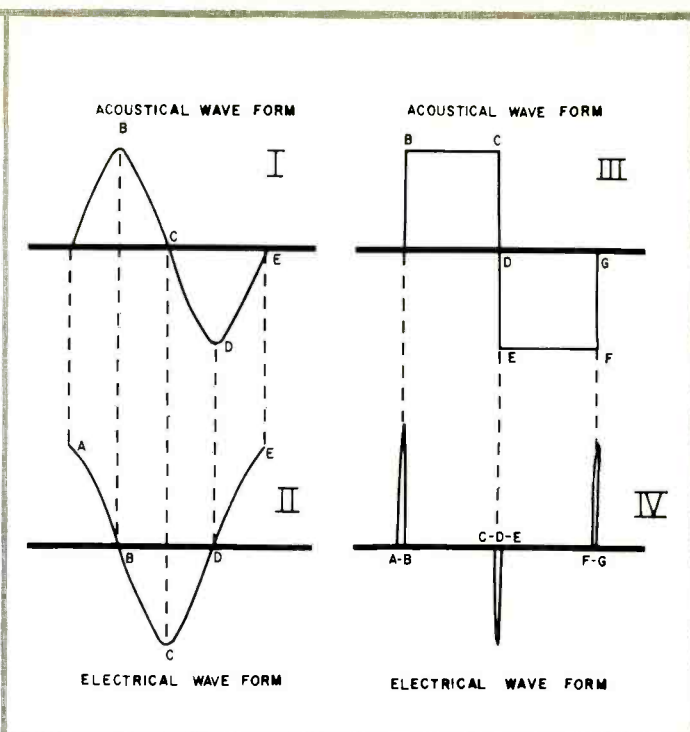


Fig. 10—Effect of a varying sound pressure on a moving-coil microphone. See text.

pressure increment, ( $\Delta$ ) or ( $AT + \Delta$ ).

Looking at (II) on Fig. 10, we see that the electrical waveform output from the moving-coil microphone does not follow the phase of the acoustic waveform. This is due to the fact that at maximum pressure, ( $AT + \Delta$ ) or (B), the diaphragm is at rest (no velocity). Further, the diaphragm and its attached coil reach maximum velocity, hence maximum electrical amplitude, at point (C) on the acoustical waveform. This is of no consequence unless you are using another microphone, along with the moving-coil microphone, in a stereo system where the other microphone does not see the same  $90^\circ$  displacement. Due to this phase displacement, condenser microphones should not be mixed with moving-coil or ribbon microphones. (Sound pressure can be proportional to velocity in many practical cases. See *Handbook of Noise Measurements* by Arnold P. G. Peterson and Erwin E. Gross, Jr., General Radio Co., Page 33.)

Looking at (III) in Fig. 10, let us assume for the moment that we can create a steady overpressure and hold it (generate an acoustic square

wave), and that we still have a massless-diaphragm voice-coil microphone as well as a massless loudspeaker. The result would be as shown in (IV). As the acoustic pressure rises from (A) to (B), it represents a velocity; and voltage output from the microphone appears. Then, as the diaphragm reaches its

maximum displacement and stays there during the time interval represented by the distance between (B) and (C), no voice-coil velocity exists; hence the electrical output voltage ceases. The same situation would repeat itself from (C) to (E), and from (E) to (F) on the acoustic waveform. It can be readily seen

Fig. 11—Effect of a transient condition on a moving-coil microphone.

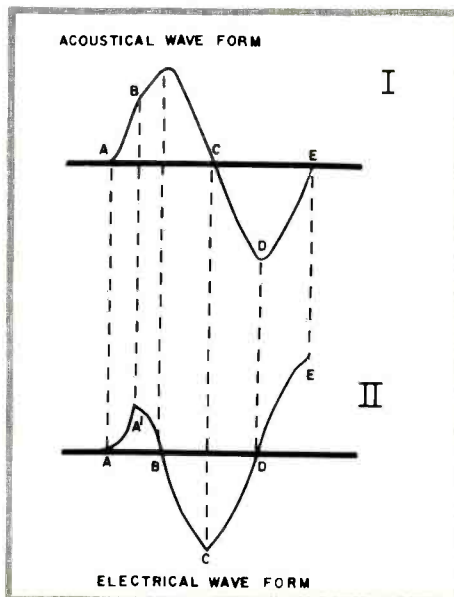
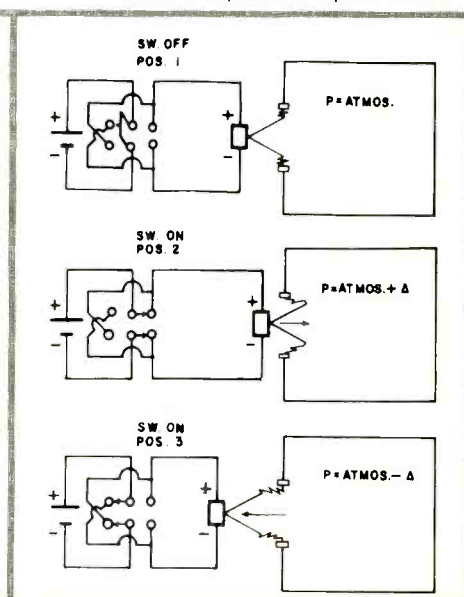


Fig. 12—How a moving-coil loudspeaker can be made to reproduce square waves.





that no moving-coil microphone can reproduce a square wave. *This, again, is of no real consequence*, but it does give some insight into the method of transduction.

Fig. 11 shows still another interesting theoretical consideration of the moving-coil microphone mechanism. In this case, we are going to assume a sudden transient condition. Starting at (A) on the acoustic waveform, the normal atmospheric pressure is suddenly increased by the first wavefront of a new signal and proceeds to the first overpressure peak, (AT + Δ) or (B). The diaphragm will reach a maximum velocity halfway to (B) and then return to zero velocity at (B). This will result in a peak A' in the electrical waveform. From (B) on, the acoustic waveform and the electrical waveform will proceed as before, cycle for cycle, but 90° apart.

In this special case, peak A' represents something extra. It may well be that, due to the myriad other problems (especially mass) encountered in a practical moving-coil microphone, this minute effect is swamped. It does illustrate, however, that given a "perfect," massless, moving-coil microphone, it does not follow that "perfect" electrical waveforms will result.

### Moving-coil loudspeaker

An interesting side note is that, theoretically, a moving-coil loudspeaker can be made to reproduce a square wave. Fig. 12 illustrates how this can be done. If the cone of the loudspeaker is pushed backward it compresses the air in the limited enclosure. If the polarity is reversed, the speaker will move out, creating a slightly larger volume, and thus a lower pressure. If the voltage is removed, the cone returns to its normal position. Such a box, with proper air seals for the intrusion of a measuring microphone and a means to prevent loss of air pressure through the cone, would allow inspection of the phenomenon we have discussed (assuming the measuring system was capable of response down to d.c. and the loudspeaker had no mass).

*(Part II of this three-part series will be continued next month.)*

### Letters from Readers

(from page 18)

that would, we are sure, surprise those who wrote the standard. It is true that the standard allows the amplifier maker to measure either by continuous output or "music output," provided he states which is used.

But when your writer quotes "The results of the sets of measurements resulting in the lowest output per channel shall be rated output" we can only conclude that he read the IHF standard most hastily indeed. The quoted sentence follows this one, and applies to it only: "Measurements should be made with the signal source feeding all sets of input terminals with in-phase signals and with opposing-phase signals." In other words, the choice in this case applies only to a specialized test concerned with the differences, if any, in the amplifier's handling of signals in phase and out of phase in the two channels.

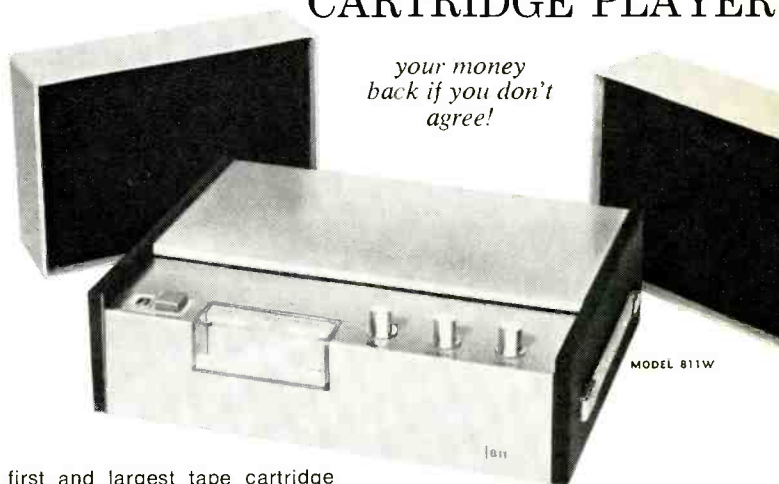
MONTE FLORMAN

Assoc. Technical Director  
Consumers Union of U. S., Inc.  
Mt. Vernon, N. Y.

*We're pleased to publish Consumers Union's views. In reference to our raised eyebrow on CU's use of a test*

*signal that produces only 1/8th of a watt output for audio amplifier frequency-response tests, it is common practice to employ 1 watt output for high fidelity component equipment. With so many owners of hi-fi components using low-efficiency speaker systems, this value has been found to be a realistic one. Other variations include frequency response measurements at full output only or at low output as well as at full output. The importance of reproducing "extra-audio sections of the spectrum," say, to 100 kHz, has never been established. In any case, many hi-fi component manufacturers with equipment designed to operate well beyond 20 kHz use a cutoff filter to prevent possible distortion effects at higher frequencies from interacting with audio frequencies. CU correctly points out that the quotation from the IHF standard, "... measurements resulting in the lowest output per channel shall be rated output," does not apply in this case. It should read in relation to Dynamic Output (Music Output): "... the lowest value of the following two methods: Transient-Distortion Method . . . Constant-Supply Method. . . ." Otherwise, our position, as outlined in AUDIO, September 1967, remains unmodified.—Ed.*

## VIKING MAKES THE BEST-SOUNDING CARTRIDGE PLAYER



*your money  
back if you don't  
agree!*

Viking, first and largest tape cartridge equipment maker, introduces three new solid state 8-track stereo tape players that rival the richness of a component hi-fi system. We're so proud of these new 811 models . . . so confident of their superior sound . . . that we'll give you your money back if you can find another that sounds better!

**Features:** Full fidelity playback of 8-track stereo cartridges; automatic and push-button track selection; 45-15,000 HZ frequency response; 0.3% rms flutter & wow; numerical track indicator.

**MODEL 811** — Table top unit in walnut cabinet with built-in pre-amp for use with existing stereo equipment . . . under \$100

**MODEL 811W** — Table top unit in walnut cabinet, with power amplifier; two speakers; volume, balance & tone controls; 10 watts IHF music power; stereo headphone jack . . . under \$150

**MODEL 811P** — Portable unit; all features of 811W, plus detachable speakers, attractive two-tone vinyl covered case . . . under \$150

PRODUCTS OF SOUND RESEARCH  
**VIKING** tape recorders  
DIVISION OF THE TELEX CORPORATION  
9600 ALDRICH AVE., SOUTH, MINNEAPOLIS, MINN. 55420

Check No. 69 on Reader Service Card

# KING OF INSTRUMENTS

EDWARD T. CANBY



John Browning • Photo courtesy of RCA Victor Records

No less a composer than Johannes Brahms made one of the earliest piano recordings (on an Edison machine). Alas, it isn't available in Schwann. The piano was one of the first "serious" instruments to find its way onto discs and cylinders, after the operatic voice. It has been recorded ever since, in successive waves of better sound quality, as each new major recording system has taken over. Only in the transition periods have things been difficult.

Obviously the voice came first—especially the male tenor—because its tonal spectrum was ideal for the old acoustic system. Its vibrato was bigger than the mechanical wow of the machines, and its sound power at close range

was tremendous. But the piano was not far behind. Unlike the violin, the piano does not emphasize the middle-high color overtones; it sounds like a piano even with a 3 or 4 kHz cut-off. And though its bass thunders, that, too, may be rolled off upwards and still maintain intelligibility and even impressiveness in the reproduction.

The piano came into its own with the electrical process. Then, at last, the entire bass range could be recorded and a good deal of it reproduced, too. Piano transients are the toughest to record in the music business—and yet there are many superb piano recordings from the mid-Thirties in which the transient problem seems to

have been solved astonishingly well. I suspect the real trick was a combination of canny microphone placement and spacious acoustic surroundings—not so much to add enlivening reverberation as to soften the transient impact. A sort of acoustic shock absorber.

There were no "highs." In the Thirties, very little above 4 kHz got reproduced (except distortion!). With the popular cactus needles—I used them regularly—the tone was even "smoother." We loved it, and in fact became so accustomed to the absence of any intelligence at the high end that it took us literally a decade to get used to the real thing, when hi-fi first came in after the War.

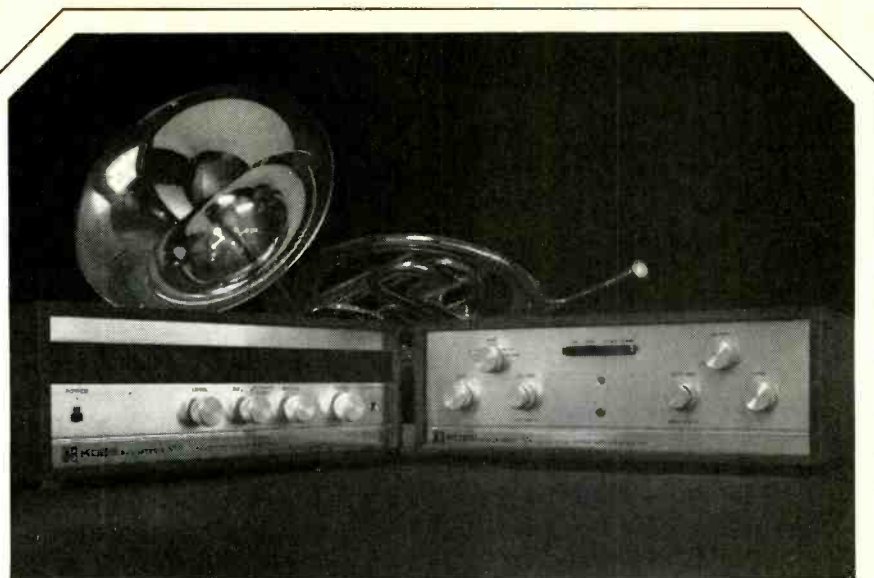


But though orchestral recordings could never shine in those old days as an orchestra should, the old piano records were remarkably effective—and they still are, in many an LP reissue. That is because, in piano sound, the color highs are simply not important. And so they are not missed, even by today's sophisticated listeners.

Perhaps the most difficult aspect of piano reproduction is the simplest—steadiness of pitch. Because it has no vibrato (like the clarinet), it is merciless in showing up the slightest pitch irregularity, the most minute wow or flutter. (Vibrato disguises it.) Oddly, this problem has been much worse in modern times than in the past. At 78 rpm the old heavyweight recording tables did an excellent job and many home machines could produce a reasonably wow-free sound. But the much-slower 33-rpm speed, commercially introduced in 1948 with the LP, brought new wow-flutter problems—will I ever forget the first “LP” attachments! The tape recorder in its early phase was even worse. Not only was there often an alarming mechanical flutter but, with its wider tonal range, it also introduced new kinds of flutter-like electrical distortion. These problems were hugely complicated by the new copying techniques, which passed the faults on cumulatively through numerous generations to the final disc.

Thus the art of piano playing suffered a dreadful decline on records for a number of years after LP. For awhile it seemed as if things would never be the same again, and old hands hung grimly onto their 78s, swearing never to buy another long playing-record.

But look what we have today! It is amazing how the engineers move systematically ahead, year after year making their painstaking improvements, until what once seemed impossible becomes without the least fanfare quite routine and standard. Today the best stereo piano sound is so dead-



Koss-Acoustech VA Solid State Stereo Control Amplifier  
Koss-Acoustech VIII Solid State FM Stereo Tuner

## meet our 2-piece orchestra

*It doesn't look like an orchestra. But turn it on, close your eyes . . . and you're in front of the Boston Pops. The 200 watt amp delivers a surge of full orchestral power, yet uncanny silence between passages. Instant rise time captures the entire cymbal clash and the tympani comes through with dramatic distortion-free power.*

*Want to change the program? Turn the tuning knob and scan the slanted dial (you'll see the dial only when tuner is on). Now check the tuning meter for precise reception . . . and your system becomes the Ramsey Lewis Trio. It's unquestionably pure sound, and plug-in etched circuit boards of glass epoxy guarantee that sound year after year.*

*Got your Stereophones? Turn off the big Amp and plug the phones right into the tuner. It has its own built in amp to drive phones (and high-efficiency speakers).*

*Performance, features, convenience . . . more than you get in "front row center."*

### specifications:

*IHF Measurements Model VA Amplifier. Dynamic Power (1kHz) 4 ohm load: 200 watts; Dynamic Power (1kHz) 8 ohm load: 160 watts; RMS Power—8 ohm load: 80 watts; Frequency Response:  $\pm 1$  db 5 Hz to 200 kHz  $\pm 3$  db 3Hz to 300 kHz. Rise Time: Less than  $1\frac{1}{2}$  microsecond, free of overshoot and ringing; Intermodulation Distortion SMPTE, 60 and 600 Hz mixed 4:1; with 8 ohm load: Less than 0.15% at 2 watts through phono-inputs; Less than 0.45% at 60 watts rms both channels. Model VIII Tuner. IHF Sensitivity: 2 microvolts or better; Volume Sensitivity for Full Signal-to-Noise: 4 microvolts; Cross-Modulation Rejection: Better than 95 db; includes images, cross-modulation and all other unwanted signals; Intermodulation Distortion: 0.3% or better; Stereo Separation at 1kHz: 35 db or better; Capture Ratio: 2 db; Output to Power Amplifier:  $1\frac{1}{2}$  V at 100% modulation.*

*Prices: Model VA Amplifier \$399.00, Model VIII Tuner \$349.00.*

**KOSS**

Koss Electronics Inc., 2227 N. 31st St., Milwaukee, Wis. 53208  
Export Cable: STEREOFONE • Koss-Impetus/2 Via Berna/Lugano, Switzerland

accurate in pitch and so utterly free of transient trouble (credit the phono cartridge for a lot of this) that the entire tonal impact of the instrument can be projected without a trace of strain, no matter how thunderous the impact. It's an impressive sound to hear—more so on records than the sound of the famed “king of instruments,” the big pipe organ. I'd nominate the piano any day as the new King of Hi-Fi Instruments. Æ

## CLASSICAL RECORD REVIEW

EDWARD TATNALL CANBY

### Piano

**Brahms: Variations on a Theme by Paganini, Op. 35; Vars. and Fugue on a Theme by Handel, Op. 24.** Agustin Anievas, piano.

Seraphim S 60049 stereo, \$2.49

Brilliant young (28) composer—Johannes Brahms. Brilliant young (32) pianist—Agustin Anievas. Good combination.

The two sets of piano variations are from the impetuous virtuoso period of the composer's life, when he was still first of all a spectacular pianist. The “Paganini” Variations, two sets of them, are a pianist's standard graduation-piece—when you can play these, you are “in.” The Handel Variations, less spectacular, test your musicianship just as fully.

Anievas is a New Yorker, Spanish-Mexican descent, and his brilliant piano betrays a bit of the familiar U.S. style hard brilliance. In New York, you have to blast your way to fame. Nevertheless, the man's ear and understanding are impeccable—which is what matters. That is to say, he gets over the sense of these splendid piano pieces with real musical intelligence. Yep—it says here he won four major piano prizes. It takes brass and guts to win those things. E. T. C.

Performance: A— Sound: B+

**Marie-Aimée Varro at Paderewski's Piano.** (Dvorak, Schumann, Liszt.)

Baroque 2837 stereo, \$5.79

This is a quite fascinating and rather mysterious record.

As for P.'s piano (located in Canada), it is, I'm afraid, only a gimmick. Sounds like somebody's neglected and maltreated relic, and it isn't even in tune.

But the lady pianist is something. When? Well, she studied with Alfred Cortot. He made piano 78s back in the earliest electrical days. And also with Emil Von Sauer, who was a pupil of Liszt and Nicholas Rubinstein maybe *more than eighty years ago!* Who is this gal?

In her picture she looks about 40. When, though? In the sound, she plays a big, flamboyant style, straight out of the turn of the century. Unmistakeable. Something we rarely hear. Her technique is a bit blousy and blurred, yet underneath is a colossal brilliance and drama. In other words, she could be an elderly virtuoso of another age, long past her prime but still connecting. But is she?

The recording itself adds to the mystery. The stereo is indistinguishable from mono. I have my doubts. And the sound, while very good of its sort, has an indefinitely antique quality, that *might* be anywhere from, say, fifteen years ago to as much as thirty or forty. (A reissue from 78 masters would be clean and scratchless.)

So—maybe this was recorded just last month, or maybe a life-time in the past. Can't tell from the info on the record. *Somebody* knows, but they aren't telling. Anyhow, she's well worth listening to, she's obviously a tremendous pianist of the old school—even if she turns out to be only 25. E. T. C.

Performance: B+ Sound: B

**Stockhausen: Complete Piano Music.** Alloys Kontarsky.

CBS 32 21 0008 stereo, \$5.79

Karlheinz Stockhausen is surely one of Germany's leading minds in this century and no musician would care to under-rate the power of his thinking. It is, to put it mildly, overwhelming. But also unmistakably chilly—at least as we hear it. I mean the personality, of course. The music expresses the person.

These works are both important and extremely “advanced”—which means that for most of us they simply make no sense whatsoever. An endless series of squeaks, crashes, twiddles, elephants-on-the-keys, mice-on-the-strings—and

silences. This goes on and on, four big LP sides.

I'm not ashamed that I do not (yet) understand the music's shape and intent, via my ears. They aren't (yet) trained in this particular language. But I would gladly accept a bit of help from Mr. S., as one reasonably intelligent being to another. I'm not ashamed of *wanting* help.

Instead, with a sort of annoying perversity, Stockhausen takes up the whole inside cover describing the precise menu at the hotel where the pianist stayed, the number of hours and minutes of rehearsal, the serial numbers of the two pianos used, the temperature and humidity figures, the creaking left studio numbers, all in a bone dry, su-technical details concerning mikes, pedal on one piano, not to mention the percillious tone (as I read it) which says, by implication, “you wouldn't know what this music is all about: so why waste time explaining.” Frankly, I was sore. I don't enjoy being talked down to.

Of course I may have misinterpreted him grievously. Maybe there's a good reason for all that stuff, and nary a word about the music. And it is surely true that in the long run all music must speak in its own language—whatever language.

So maybe you will want to give it a whirl. E. T. C.

Performance: A(?) Sound: B+

**Granados: Goyescas; Escenas Romanticas; El Pelele.** Alicia De Larrocha, piano.

Epic B2C 165 (2) stereo, \$11.58

**Granados: Twelve Spanish Dances for Piano.** Alicia De Larrocha.

Epic BC 1343 stereo, \$5.79

On these six LP sides—four in an album, two on a single—you'll find a major portion of the near-salon-style music of the Spanish pianist and composer who died in a submarine sinking in 1916. It is a graceful, lush, comfortably old fashioned music now, full of a Spanish elegance, as of the turn of the century, that seems a long, long way from the Flamenco we now so often hear—yet not so far from it, either. For Granados knew how to “evoke” that sultry, moody Spanish atmosphere that is as typical of elegant Spanish life as of the lowly peasant existence.

No one has ever split such a hair-fine division between salon music and “classical” as this composer. After ten minutes, or a half hour of him, you find yourself drifting off into a sort of din-



ing-out, restaurant mood; it makes superb background music. It is almost too pretty, like the Spanish atmosphere of a Spanish night spot on 52nd Street. And yet the stuff has guts, too. Piece by piece, these works are solid music. It's only after the third or fourth in a row that they begin to merge and blend into the lush Spanish background.

De Larrocha, from Barcelona herself, says just about all there is to say about Granados. She has him down to perfection, to the last lovely hesitation, the ultimate fiery burst of passion. If she sounds old fashioned, it's only because Granados is not yet a rediscovered "antique," yet not a modern composer either. If you want to set up an elegant, old-world Spanish décor in your sonic environment, this is the music for it, decidedly.

The Epic-CBS piano recording is technically flawless but suffers mildly from a common microphoning fault (if you feel that way about it): too much mechanical thumping in the louder tones. The mikes are too close. You shouldn't hear that much of a wooden percussiveness, even if it is flawlessly reproduced. The proof of it is easy: just listen to De Larrocha at a moderate distance, say around the corner in another room. Perfection! The thumps don't carry and are properly inaudible.

E. T. C.

Performance: A— Sound: B—

Ives: Piano Sonata No. 1 (1902-1910). Wm. Masselos, pianist.  
RCA Victor LM/LSC 2941 \$5.79  
Odyssey 32 16 0059 (mono only) \$2.49

Here's a pretty commentary on the present record situation! Two recordings of the same music, played by the same pianist and issued the very same month. It couldn't have happened before. But it can happen now.

The RCA Victor job is brand new, and released on the first-line, high-priced label. The Odyssey is a reissue of an older recording and appears on Columbia's new low-priced Odyssey label, at less than half the cost of the RCA. The comparison is extremely interesting any way you listen. If RCA wins on points, both musically and technically, Odyssey at half the price is definitely a lot more than half the value. I'd put it musically closer to nine-tenths; and the older Odyssey engineering provides a very usable piano sound in spite of flutter here and there and a less "clean" array of percussive transients.

# The pre-recorded cassette explosion.

Here's how Norelco can help you hear it.

Norelco has four distinctly different cassette machines. They all play back the new pre-recorded cassettes. And they all record on blank ones.

There's the improved portable Carry-Corder® '150'—the first cassette recorder. The new '175'—the first monaural cassette port-

able with a big speaker. And the first two home cassette recorders—the monaural '350' and the stereo '450'.

You're in the middle of the pre-recorded cassette explosion. Let Norelco help you hear it with any one of the first and finest line of cassette recorders.



**Norelco**®

the re-inventor of tape recording

North American Philips Company, Inc., High Fidelity Products Department,  
100 East 42nd Street, New York, N. Y. 10017

This is a little-known huge work by the amazing Ives, that crusty old genius who wrote what he wanted back after the turn of the century, and managed in the process to anticipate a large segment of our much later music today. William Masselos was the first ever to play the piece and has managed to maintain pretty much of a monopoly on it ever since then, back in 1949. He has performed it, thus, for years, and his interpretation has steadily evolved, as is immediately evident in these two versions. The older *Odyssey* is more spread out, more Romantic, with less of an over-all conciseness and economy—but many passages are for that reason very attractive in themselves.

In the RCA version Bill Masselos has concentrated the music, boiled down the effects and brought more of the sprawling piece into a sense of over-all shape.

Tell the truth—if you're interested enough to want to buy Ives at all (and you ought to be), then splurge and get both. The two together are worth more than either version by itself. E.T.C.

*Performances:*

(RCA Victor) A; (*Odyssey*) B+

*Sound quality:*

(RCA Victor) B+; (*Odyssey*) C

**John Browning plays Beethoven and Schumann** (*Sontat Op. 110; Symphonic Etudes, Op. 13*)

RCA Victor LSC 2963 stereo, \$5.79

It's astonishing how quickly certain kinds of music go up and down in their effectiveness as times change. Schumann, the essence of mid-nineteenth century Romanticism, became almost impossible to play for the young pianists of the Thirties and the early post-war generation—he's too gentle, too soft, too emotional. (The older pianists could still do him up fine.)

Now, the latest generation is eating Schumann up, playing him with marvelous pathos and a genuine feeling for the old man. John Browning is no flower-person, but he has precisely the serious, Romantic gentleness of approach (plus fabulous technique) that makes Schumann really sing. I was amazed at the way the war-horse "*Symphonic Etudes*" came across. Terrific.

Beethoven is a slightly different story. Beethoven, of course, is a Romantic too; but he is all architecture, structural tension. Browning (and many of his generation) tend to play him episodically, with much loving and

beautiful emphasis on detail but surprisingly little awareness of the big shapes.

Even so, I like this better than the unmercifully hard pounding of the last "young generation," now going on to middle age. Gorgeous piano sound from RCA here. Best I've heard in a long time. E. T. C.

*Performance:* A— *Sound:* A

## New label debuts

**Brahms: Symphony No. 1.** Hamburg Philharmonic, Charles Mackerras.

Checkmate C 76001 stereo only, \$3.50

**Beethoven: Symphony No. 3 ("Eroica").**

South German Philharmonic Orch., Ristenpart.

Checkmate C 76003 stereo only, \$3.50

The Checkmate label, a new member of the Elektra-Nonesuch family, offers original recordings by Elektra, in contrast to Nonesuch's largely licensed or reissued offerings. I find these two Checkmate releases worthwhile. (I wrote the liner annotations but did not hear the records until after their public release.)

The Checkmate engineering is rather special—all Dolby tapes, miked for stereo only; discs cut direct from original master tapes, at half speed for better rhigs. The mike set-up is controversial and interesting; music is standard symphonic fare (at least to begin with), in contrast to the wide range of unusual material released on Nonesuch. And because of all this, Checkmate's price is higher—a whopping \$3.50 list (Subtract your own local discount.)

The performances are inevitably something less than Toscanini or Bruno Walter or Leonard Bernstein. That was a calculated risk in this venture into the high-cost symphonic repertory. These two conductors, moreover, are not known for this music; both are ordinarily heard in earlier and more chamber-style repertory. But what is really interesting here is the odd effect—the striking effect—that the Elektra-style "pops" microphone placement has on the music itself. If you know Beethoven and Brahms, you may be shocked outright on first hearing.

I was—definitely. But I listened on, and was rewarded. These are good, middle-of-the-road performances of both works, given a startling sound by the mikes, all violent close-up, multi-

miked (if I guess correctly), stunningly sharp and clear—utterly unlike any conceivable concert hall sound. The insides of the music are turned out for you, inches before your ears. There is no distance—though there *is* liveness; everything is equally near, equally prominent. (The solo violin in the Brahms symphony, normally a thin, distant little thread of sound in space, is here loudly placed a few feet away from you.)

No—it isn't ideal. A lot of detail that is basically uninteresting is brought forward much too clearly, where it should be blended into the whole. The sound is rendered coarse and—at first—unmusical beyond its actual deserving.

Nevertheless, I call it constructive. This is the trend in recording technique; it is progressive and it has much to offer for the future. Columbia does it, Phase 4 does it, so do others who experiment in order to widen and deepen the recording art in its own terms. Even if imperfect, I am all for this sound in principle.

Remember—a recording is an interpretation of a musical score *in home-listening terms*, not concert-hall sound. Forget about the concert hall! That is the progressive approach to recording.

E. T. C.

*Performance:* B (both)

*Sound:* B+ (both)

## Segovia

**Segovia on Stage.** Andrés Segovia, guitar.  
Decca DL 710140 Stereo (\$5.79)

I must say that Segovia, the Grand Master of the classical guitar, is un-failing in his powers over the six gut strings. These works of Purcell, Scarlatti, Handel, Bach, John Duarte, and Gaspar Cassado, are all eminently good listening and well played. The last two are contemporaries. Duarte composed this three-part, seven-odd minute work for Segovia. It is British/Irish in flavor and exploits the guitarist's ability to make of his instrument a guitar or harpsichord—as he wills it. The Cassado work is modern Spanish in feel and quite delightful. Musically, the entire recording is pleasurable. It is always pleasant to hear Segovia play. His taste is impeccable and he can translate what he feels into what you can hear.

Concerning technical quality of the disc, surfaces are truly quite—very im-



# SOUND SENSE

portant in recording such a low-output instrument as the classical guitar. Due to the low sound output, however, Decca had to place their mikes up close, thus you will hear occasional finger scraping. There's no quarrel with this, but it's apparent that this is a studio recording no matter what the record title says. The result has been that Decca has added reverberation to the sound to give it a bigger quality. This tends to muddy and distribute the stereo spacial effect, making it impossible to bring the sound into believable focus. As an experiment, I switched my preamp to mono. Gone is the reverb. Turn down the volume and you can believe that there *is* a guitar in the room with you.

So the fact is that I suggest the mono recording, listed in Schwann at \$4.79, as the preferable, and very worthwhile purchase. M. R.

*Performance:* A      *Sound:* B—

**Schütz: Kleine Geistliche Konzerte, Book I (1636).** Soloists, instrumentalists, Westphalian Choral Ensemble, Ehmann. Nonesuch HN 73012 (2) stereo \$5.00

Having reached bottom forty or fifty years ago, Heinrich Schütz' reputation is making a very fast come-back. If you have "discovered" him, then this series is for you, decidedly. Wonderfully musical performances in unique German style.

The many "Little Sacred Concertos" were composed during the devastations of the Thirty Years War in the first half of the 17th century, which reduced church music-making to bare essentials; the little works are big in spirit but economical in performance, a very happy combination (and especially for recording). Book I, a collection that was, of course, cumulative, is laid out in gradually increasing complexity, the earlier books for simple solo voice and continuo, the last few requiring numerous solos and a chorus. Considering the means, there is immense and colorful variety—you will not be bored by repetitiousness.

The performance has that dedicated, intensely musical quality that the Germans alone can give to this sort of music—one senses always that the music is more important than the performers, the "message" bigger than the vocal or instrumental sound. Exhaustive and beautifully translated notes and complete texts, also with translations. E.T.C.

*Performance:* B+      *Sound:* B

Broadcasting and recording studios throughout the world know that their efforts will be judged by millions of listeners and they take care that their own monitoring and listening rooms use the best equipment available. It is not surprising that the more discerning listeners use the same equipment in their own homes.



*The new Listening and Demonstration Room of the BBC Transcription Service, fitted with QUAD 22 control unit, QUAD II power amplifiers and QUAD electrostatic loudspeakers.*

## QUAD

for the closest approach  
to the original sound.

*Ask your Hi-Fi Dealer or write direct to: Ref. Aud.*

**ACOUSTICAL MANUFACTURING CO. LTD.**  
HUNTINGDON, ENGLAND.

Check No. 75 on Reader Service Card

# JAZZ & SOUNDS OF THE SOUTH

BERTRAM STANLEIGH



JELLY ROLL MORTON



FATS WALLER

Photos courtesy RCA Victor Records



EARL "FATHA" HINES

FROM ITS AWESOME ARCHIVES, RCA-VICTOR has extracted a set of jazz piano performances that not only make for an entertaining and varied collection but also serve as a worthwhile study of four keyboard styles that developed out of the New Orleans piano rags. Six musicians are included: Jelly Roll Morton, Jimmy Yancey, Fats Waller, Earl Hines, and the four-hand team of Albert Ammons and Pete Johnson.

In its Vintage series, Victor has been extremely generous in placing eight selections on a side, rather than the more usual six, and on the present set the cover promises "16 definitive piano solos by men who made the piano a jazz instrument." But an inventory reveals only 15 numbers, and one is left to speculate uneasily as to which of the fabled waxings from its vaults the Victor staff decided to delete. But it would be a mistake to dwell on thoughts of short measure when the material offered has so much merit. Indeed, the numbers chosen have been picked with such care, that it is not at all out of place for Victor to indulge in the use of so extravagant a term as "definitive."

Earliest of the recordings are three

waxings by Morton who cut *Freakish*, *Fat Frances*, and *Pep* in Camden, New Jersey in 1929. While they certainly show Morton's New Orleans Manner, they are far more than demonstrations of a style. "Mr. Jelly Lord" was one of the most imaginative and creative of jazz musicians, and these three original compositions are good examples of the sure, deft skill and swagger he brought to all of his performances. Morton was a frequent visitor to record studios, both as a soloist and band leader, and the three present discs were the product of some of the best engineering he managed to encounter.

In contrast to Morton, Fats Waller was neither as original a personality nor so brilliant a performer, but he was nonetheless one of the most facile, clever, and amusing of keyboard entertainers, and he had a rare ability to achieve rapport with an audience. His art has remained popular, as witness the success of the half-dozen reissues of his discs on the Vintage series. On the present set he contributes a 1939 recording of *Tea for Two* and three 1935 waxings of original compositions: *Handful of Keys*, *E-Flat Blues*, and *Rus-*

*sian Fantasy*. These four recordings were taken from Associated Program Service transcriptions, and the sound is somewhat more cramped and shallow than much of the material Waller cut for the Victor label. But enough comes through for one to enjoy thoroughly the Waller tomfoolery and infectious good humor.

Jimmy Yancey had the peculiar ability to bring deep-felt emotion to the kind of vigorous, stomping piano sound that later became known as boogie woogie. His recordings of *Yancey Stomp* and *State Street Special* are more revelatory of his influence in the development of boogie than they are of Yancey's emotional depths, but they date from a 1939 session that is generally considered his most successful.

Earl Hines offers four performances dating from 1939 to 1941: *Rosetta*, *Body and Soul*, *On the Sunny Side of the Street*, and *My Melancholy Baby*. These are all fine examples of "Fatha" Hines solo work at that period and make interesting comparison with the more advanced style of his later work.

Two 1941 recordings by the great four-hand team of boogie woogie specialists, Pete Johnson and Albert Ammons: *Boogie Woogie Man* and *Cuttin' the Boogie*, bring to a close this delightful survey of the major piano styles of the thirties. What emerges is not a portrait of an era or even of its greatest performers, but a set of towering jazz statements so strong that they transcend any strict historical concept and speak with a freshness and immediacy that we don't expect from period pieces. It is the strength of each statement, rather than the relationship to the New Orleans stride style, that holds these fifteen performances together and makes it a marvelous collective experience. Mike Lipskin, who produced and annotated this reissue, was at the top of his form, and the transfers are consistent with the high standard of the Vintage series. If you let this one slip by, you'll be very sorry.

Classic Jazz Piano Styles

RCA Victor Mono LPV-543, \$4.79

Performance: A

Sound: B



## Three four-trackers

**Ray Charles: A Man and His Soul**  
ABC ABF 590 (\$9.95)  
(4-track stereo tape)

All of the recently reviewed two-disc album on a single reel of tape at 3¾ ips. Quality is every bit as fine as the disc edition except for some of the brighter percussion sounds. Boosting the treble a bit helps, particularly since tape hiss is very low.

Performance: A      Sound: B+

**Swingle Singers & Modern Jazz Quartet: Encounter**  
Phillips PTC 6225 (\$7.95)  
(4-track stereo tape)

It was inevitable that these jazz-oriented classical singers and this classics oriented jazz quartet should get together. Bach's *Air for G String* and *Ricercare* and Purcell's *Dido's Lament* combine well with Lewis' *Little David's Fugue*, *Vendome*, *Alexander Fugue*, and *Three Windows*. A most worthwhile collaboration with promise for the future.

Performance: A      Sound: A

**Doc Severinsen: Command Performances**  
Command CMC 904  
(4-track stereo tape)

This is another set of bright, swinging material from trumpeter Severinsen and his band of topflight sidemen. The mixed bag of a dozen titles range from *When the Saints Come Marching In*, to *In a Little Spanish Town*, *Love for Sale*, *Summertime*, and *Blue-ette*. However, it's the sound that demands chief attention here, and great sound it is — balanced, wide-spread, solid-centered, bright, clean, and with wide dynamics. Not very much on tape, and nothing on discs, sounds quite as good as this 36 minutes of lively music making.

Performance: C      Sound: A

## One mono disc

**Freddie Hubbard: Backlash**  
Atlantic Mono 1477 (\$4.79)

One of the finest technicians among young trumpet players, Freddie Hubbard has been associated on discs with such advanced performers as Wayne Shorter, Herbie Hancock, Eric Dolphy, and Ron Carter. He has also performed in a more conservative manner with Art Blakey and the Jazz Messengers.

On his latest release, he's definitely playing right down the middle of the road. Indeed, the tuneful trumpet swagger and Motown beat on the title tune sound straight out of the Tijuana Brass, and throughout this platter Hubbard swings in an overt, unself-conscious fashion.

Of the six tunes offered, *Little Sunflower*, *On the Que-Tee*, and *Up Jumped Spring* are all Hubbard originals. The title tune is by Donald Pickett, and the two remaining offerings

are Harold Ousley's *The Return of the Prodigal Son* and *Echoes of Blue* by Bob Cunningham who is heard on bass in this set. The other performers are James Spaulding, flute and alto, Albert Dailey, piano, Otis Ray Appleton, drums, and Ray Barretto, percussion. Atlantic is one of those jazz labels that can generally be counted on for superior sound, and the present set is up to its high standard.

Performance: A      Sound: A

**THE PRO'S PORTABLE**  
**New Tandberg Model 11**  
**Transistorized Tape Recorder**

Three separate heads, half- or full-track, with Pilotone head optional. Frequency response @ 7½ ips — 40-60,000 cps ±2dB; S/N ratio @ 7½ ips — better than 56dB; distortion less than .5%. Weight 7 lbs.; dimensions: 13" x 10" x 4". Batteries: "D" cell or rechargeable; 7" reel capacity. Servo-type speed control (1 per mil accuracy); immediate AB Test; built-in mixer and limiter; Cannon plug microphone input; 3-speed, DC motor. Price: \$599.

Now at your Tandberg franchised dealer.

**Tandberg**® OF AMERICA, INC.  
P.O. BOX 171 8 THIRD AVENUE  
PELHAM, NEW YORK 10803

© HULORA IS A REGISTERED TANDBERG TRADEMARK

Check No. 77 on Reader Service Card

# LIGHT LISTENING

CHESTER SANTON  
ROBERT SHERMAN

## Four-trackers

### Percussive Mariachi

Solid State Tape UAC 1812 (Stereo),  
7½ ips \$7.95

Today's astute record or tape buyer will be able to figure out a great deal about the contents of this reel merely by scanning the title and label heading this review. Since the label is that of United Artists' subdivision using solid-state recording equipment for the master tape, there is ample assurance of sound quality that is geared to an audio buff's demands.

The title given this particular album indicates that United Artists is hopeful of riding two waves of popularity simultaneously. Most of the releases under the Solid State banner have leaned heavily in the direction of percussion since this type of instrumentation still strikes most buyers as the ideal material for use in showing off their sound gear. The Mariachi influence that rocked the Tijuana Brass to fame is still a potent musical factor in the record and tape market. So you hardly need a computer to tell you a recording such as this should sell in healthy quantities. This tape's a very good candidate for popularity solely on the merit of its sound alone. After comparing it with some of the discs in the Solid State project, I find that I prefer this label's sound in the tape version. It stands to reason that in the Ampex tape duplicating process most tapes go through these days, some of the razor-edge sound I've mentioned in reviewing past Solid State stereo discs is lost in the shuffle, leaving a commercial reel that is considerably mellower to the ear.

Musically, this album is on safest grounds when it deals with material you would logically expect to hear from a Mariachi band. Most of the release, luckily, is given over to music of this type. *The Watermelon Man*, with its impressions of street noises and whistles, is ideal fare for the scoring found in this album. Mexican trumpets and a host of Latin percussion instruments also find themselves at home in the bustling rhythms of *La Bamba* and Bonfa's *Carnival*. The same composer's

long-popular *Samba de Orfeu* from the movie "Black Orpheus" does very well for itself in a version somewhat more assertive than most I've heard. *Brasilia* and *Dark Eyes* respond well to the conducting of Ted Sommer. Some listeners may question the inclusion of Broadway show tunes in an album such as this. Even a doubting Thomas, however, may agree that a pseudo-Mariachi treatment brings out fresh bite and personality in *The Apple Tree* by Harnick and Bock, as well as their *If I Were a Rich Man* from "Fiddler on the Roof." c.s.

Performance: B Sound: A

### Fiesta Mexicana

Monitor Tape MRX 472 (Stereo), 3¾ ips  
\$5.95

The Monitor label takes considerable pride in the authenticity of the music to be found on its recordings made on foreign soil. The light entertainment offered here by Javier de Leon's "Fiesta Mexicana" troupe will find favor among listeners who place greater value on authentic performance than they do on the nature of the recorded sound. This collection of old and new music of Mexico receives sleek professional treatment from the singers, dancers and instrumentalists of the Mexicana ensemble but the sound is only so-so by our standards.

As a rule, a commercial tape release issued at a speed of 3¾ ips requires a whale of a good master tape in order to compete with the sound of a 7½ ips commercial reel taken from an average master (assuming we're talking about wide dynamic range material). The problem here seems to stem from the nature of the CBS studios in Mexico City where the recording was made. These studios have a drier and deader sound than those we're accustomed to in the States.

I tried this tape at several volume settings to see if experiment along this line might help the sound. Results were considerably better when I played this reel at a volume about one third higher than I normally use at either speed. At higher volume of playback, the stomping of the dancer's heels pushes out the low bass wallop one looks for in a good tape.

The singing of Raul Hernandez and a small group called the Rio Blanco Singers has the raw-sounding quality often found in Mexican voices. The first half of the reel recalls in song and dance some of Mexico's very colorful musical past. Among the original string instruments of an earlier day are the harp, the jirana (a small guitar) and the requinto (a four-string guitar).

The sonic highlight of the album is found in the dances from the Mayan and Aztec days. Here the tonal spectrum stretches from a high-pitched bamboo flute in the upper range down through the mid-bass sound of a big drum made from a tortoise shell and finally ends at the other end of the scale with the low-bass throb of the teponaxtli—an instrument made of a carved tree. The second half of the reel strikes a more contemporary note with the inclusion of such well-known bits of musical confectionery as the *Jerabe Tapatio* (*Hat Dance*). *Las Chiapanecas* and *La Cucaracha*.

Tape hiss in the background is a shade less apparent than the familiar distraction found too often in recorded tapes. c.s.

Performance: B Sound: B—

### Claudine Longet

A & M Tape AMC 121 (Stereo), 7½ ips  
\$7.95

Talk about departures from past practice. Here is Herb Alpert's A & M label trying its hand in an album of mood music and succeeding where others have attained only indifferent results. The challenges in this recording, from both a technical and performance standpoint, are formidable. Claudine Longet would seem to be a very young French gal vocalist whose voice seldom rises above a whisper. Where she comes from and what she's done in show business is not explained by A & M. Like most pop tapes these days, this one comes without a word of liner notes to identify the performer. This is hardly a problem in a reel by someone such as Ella Fitzgerald but it can be frustrating in this case—for the purchaser as well as the reviewer. Knowledgeable tape fans will simply have to place their trust in the quality of production the A & M label has put into its past releases. Luckily, they won't be disappointed.

The program of music is a relatively sophisticated one, the voice—however soft—is smoothly continental, the orchestra is discreet and the job of balancing instrumental timbres with a very soft voice is remarkably well done. It's obvious that a considerable part of the label's Tijuana Brass profits are being plowed back into current releases. There are first-rate musicians behind the subdued strings and cool, subtle woodwinds. Claudine Longet's ancestry, hinted at by her name, is borne out in the slight French accent found in the lyrics. This gives an extra touch of continental appeal to the South American rhythms of the Jobim tunes (*Meditacao* and *A Felicidade*).



# Some of the Soundest Ideas come from England



THE HAMMOND M-100  
CONDENSER  
MICROPHONE  
IS ONE OF THEM

- Flat Frequency Response
- Extended Frequency Range
- NuVistor Preamplifier
- 60 ohms source impedance
- Stabilized AC power unit
- Miniature size
- Unique extended warranty



The price of this sound idea:

Stereo Model: \$229.50  
Mono Model: \$149.50

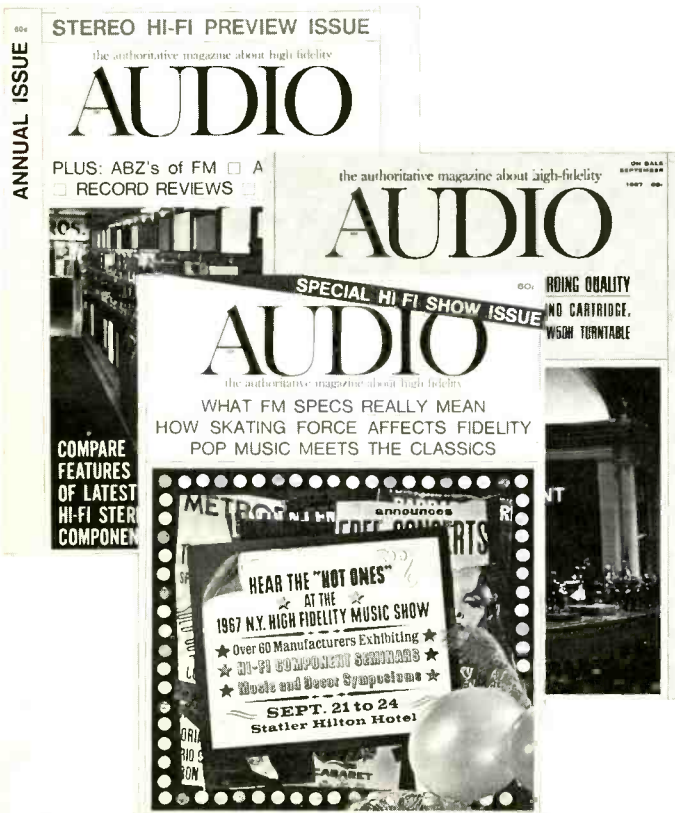
May we send you a brochure?

The Microsound Company

Box 4591 D

Colorado Springs, Colo. 80909

Check No. 79 on Reader Service Card



# AUDIO IS A WELCOME CHRISTMAS GIFT!

Send a subscription to a friend or relative for a year-long remembrance. A beautifully-engraved gift card in your name will be sent before Audio is mailed.

Special Gift Rates:

1st Order (can be your renewal) ..... \$5.00  
Each additional order ..... \$3.00 (1st year)  
\$5.00 (2nd year)

Use post-paid card opposite page 90

and *Until It's Time For You to Go* by folk singer Buffy Sainte-Marie. The one prominent Broadway show tune, *Sunrise Sunset* from "Fiddler on the Roof," is made doubly poignant in the Longet treatment, but purists may draw the line at the French lyrics in the middle of the song.

The opening selection of the album is even more fanciful with its interpolated spoken French dialogue by a man and a woman in the song from the movie "A Man and a Woman." A carefully-modulated chorus appears in some of the selections, whispering along with Miss Longet. The only really incongruous note in the program is the tempt to whisper the words of *Hello, Hello* while a honky-tonk piano and percussion of the Twenties accompanies the singer in the left channel. *My Guy* offers a sample of rocking beat favored by today's Parisian teen-ager. When it comes to bestowing a rating on the sound quality A & M has given the soloist, I'm afraid I'll have to take a rain check. Until such time as they record her in full voice, I'll merely say that the Longet voice comes through with all the frequency range I've ever heard in recordings by girl vocalists using a whispering style. The orchestra is very clean sounding in everything it does—possibly because it is operating at half the usual performing volume. C. S.

*Performance: A Sound (orchestra): A*

#### Bullfight!

London Tape 70482

Someone rates an "A" for effort on the basis of what has been attempted on Side One of this reel. According to London Records this album captures for the first time the incidental sounds of a bullfight as they occur before mikes placed in or about the bull ring. London's claim to being the first to record such sounds is a rather difficult point to argue. There have been plenty of recordings made "on location" in the past at bullrings in Europe and our own continent. Just how many of the incidental sounds of a typical bullfight are unique to this record, I'm not prepared to say. Let's merely call this release the first "location" example of a bullfight heard in the London Phase 4 stereo process. As such, it has its moments of excitement within a good framework of realistic sound.

The solo trumpet sounds very natural way up in the stands as it signals the start of the afternoon's action. This is one occasion when complaint of too close microphone pickup cannot be lodged against the Phase 4 process. Side Two of the reel is given over solely

to music. Throughout the recording can be heard such Spanish favorites as *Macarenas*, *Espana Cani*, and the *Ritual Fire Dance*. For added color, London has included a flamenco troupe in some of the selections. The musical items taped in a studio by the Roger Laredo orchestra are rich and full in sonic terms. Despite its promise, the only unusual feature this recording can claim are the faint sounds made by the combatants in the ring. The bullfight still remains a spectacle. C.S.

*Performance: B Sound: B+*

### Folk

**French Songs from the Provinces:** Sonia Malkine, accompanying herself on the lute.

**Folkways FW 8743 mono only**

Born in Paris, raised in Provence, and resident now in New York State, Sonia Malkine sings the songs of France with loving, quiet simplicity. Her voice is sweet and gentle, her settings refreshingly unsophisticated, her whole approach modest and totally devoid of high-pressure showmanship. Naturally this doesn't make for an exciting album (indeed, the preponderance of slow, reflective songs sometimes results in dull stretches), but Miss Malkine's loving care gives most of the music a special glow. She has also chosen completely unhackneyed fare, including a 15th century troubador's romance called *Celle qui m'a demande*—a flirtacious I-want-to-get-married ditty from Languedoc—*Dis moi Janelle*, and *Sur le pont de Morlaix*—a curious sea shanty from Bretagne which incorporates an English line into the chorus. L.R.

*Performance: B+ Sound: B+*

**The Weavers' Songbag:** Pete Seeger, Fred Hellerman, Ronnie Gilbert and Lee Hays.

**Vanguard SRV 73001 (Stereo), \$2.50**

Vanguard has just re-released six folk albums in its "Everyman" series. Five of them are just that—repressings of previously-issued albums, fitted out with bright new covers, but musically identical with the earlier editions. The price is lower and the discs are now available in (sometimes reprocessed) stereo, so the foregoing is not to be construed as a complaint, merely an observation.

This sixth album offers something more, however: it not only is a compilation of highlights from two of the best recordings by the original Weavers (*Traveling On* and *The Weavers at Home*), but it boasts a lively version

of *Joshua Fought the Battle of Jericho* that I don't ever recall hearing on disc before. As I listened to the album, I realized that I hadn't sat down and spent an hour with the Weavers in a year or more; what's more, I was captivated all over again by the freshness and spontaneity of their arrangements, the spirit and sparkle of their singing. And those marvelous Weavers songs: *Howard's Dead and Gone*, *I Never Will Marry*, *This Land Is Your Land!* There are a dozen in all, and all are delightful as ever.

The sound is a bid deadish, by modern standards, and the stereo balance is sometimes a little off, but these are petty trifles indeed in light of the vigor and joy of these vintage performances. The other albums in the "Everyman" series, incidentally, are fine too: they feature Odetta, Martha Schlamme, Alfred Deller, Cisco Houston and (in one of the most delectable children's discs on the market) *The Baby Sitters*.

R. S.

*Performance: A Sound: B*

**Songs of My Russia:** Ivan Petrov, with the Russian Folk Instrument Orchestra, and the Osipov Folk Chorus, Vitaly Gnutov conducting.

**Melodiya/Angel R 40013, \$4.79; SR 40013 (stereo), \$5.79**

Basso Ivan Petrov, who has been represented on sundry American labels in Russian art songs, operatic arias and even a performance of the Verdi Requiem, here makes his bow on Melodiya/Angel with a newly recorded collection of folk and folk-style material. It's a fine album. Petrov has one of those booming, resonant voices, and in the time-honored manner of Chaliapin, Kipnis and (more recently) Boris Christoph, he brings it tellingly to bear on ten soulful Russian ballads. Essentially, he sings "straight," without frills or fussing, and that's just dandy too. Such gloriously lyrical numbers as *The Pretty Girl Has Fallen Out of Love* (presented in an arrangement by Alexander Borodin!) and the famous *Monotonously Rings the Little Bell* need no special effects, and when Petrov occasionally takes on bouncier stuff, like the teasing *Ah, Nastasya*, he does so with the kind of lightness and humor that belie the grandeur of his vocal equipment. The stereo spread is rather limited—singer and orchestra both stay pretty much on dead center, with a stray accordion or balalaika once in a while feeding in from one side or the other—but the quality of sound otherwise is rich and well-balanced. R. S.

*Performance: B+ Sound: B+*



## Irish plays

**Syngé: The Playboy of the Western World.**

Siobhán McKenna, Cyril Cusack et al.

Seraphim IB-6013 (2) mono (\$4.98)

**O'Casey: Juno and the Paycock.** Siobhán

McKenna, Cyril Cusack, Maire Kean,

Seamus Kavanagh et al.

Seraphim IB 6014 (2) mono (\$4.98)

Ah—this is the pleasure of the low-cost LP reissue! These two marvelous Irish plays (which have come to be thought of together as arch-examples of an Irish realist school) were my favorite listening back in 1955 when they were first recorded, and I remember being ecstatic over the superb microphone technique, which, in particular, made the crowded action scenes so vivid and so intelligible. Well, here they are again, at less than half the original price. If you're an Eireophile, a Hibernian, a follower of the brogue and of the green, if a bit of an Irish lilt in the voice sets you off—then go quick and buy!

The "Playboy" is a comedy, centering around a village tavern and its loveable inhabitants, including the starry eyed young man, the Playboy himself, and his gravel-voiced old father who refuses to be killed off—a character you will never forget. "Paycock" (Irish-Elizabethan pronunciation of peacock) is a tragedy, centering on a dreadful, loveable old drunk of a family head, the paycock (usually called "Himself," in true Irish fashion) and his wife Juno, plus Dublin tenements, Irish revolutionism, young love frustrated and much more. Both plays are what the movies used to call gripping. Once you get the sense and drift of what's going on, you are hooked. The two are perhaps Ireland's finest drama to date and these are outstanding all-Irish performances with the authentic lilt and cadence of Irish speech. "Legendary" recordings, as Columbia would put it. Definitely.

Only minor problems crop up in the reissues. The sound is of good quality but, with no texts, of course, you'll have to do some careful listening, though excellent notes help a lot. The lead actors are the same in the two—same voices, different characters—and you may get confused if you play the two albums one right after the other. In this stereo age, the mono mike technique already seems somewhat strange, with all those voices coming invariably from the same spot. Stereo helps intelligibility, no doubt about it. But these little difficulties aren't likely to stop you.

E. T. C.

*Performance: A*

*Sound: C+*



ENJOY A  
\$1,000  
SOUND  
FOR UNDER \$60

TELEX SERENATA

To discriminating listeners who want maximum purity, adjustable tonal balance and a complete absence of distracting background noise, the home hi-fi set is superior to the concert hall. And for this very same reason, TELEX SERENATA stereo headphones are actually superior to a \$1,000 speaker system. If you really love transparent sound, try stereo listening through Telex

high fidelity headphones. It's a thrill meant for your ears alone. Telex headphones start as low as \$15.95 at better hi-fi dealers everywhere.

PRODUCTS OF SOUND RESEARCH  
**TELEX**acoustics  
DIVISION OF THE TELEX CORPORATION  
3054 EXCELSIOR BLVD., MINNEAPOLIS, MINN. 55416

Check No. 80 on Reader Service Card

Live Better Electronically With

**LAFAYETTE** RADIO ELECTRONICS

150 WATT AM-FM STEREO SUPER RECEIVER  
with Integrated Circuits (IC's) & FET'S



LR-1500T

Only

**279<sup>95</sup>**  
99-0190WX

No Money Down

Inc. Walnut grained  
Metal Case



99-1530WX

RK-860

PROFESSIONAL  
SOLID STATE  
RECORDER

**219<sup>95</sup>**

No Money Down



**FREE**

1968 CATALOG NO. 680  
512 Pages

LAFAYETTE RADIO ELECTRONICS  
Dept. AK-7, P.O. Box 10  
Syosset, L.I., N.Y. 11791

Send me the FREE 1968 LAFAYETTE Catalog 680

AL-7

Name .....

Address .....

City .....

State ..... Zip .....

Check No. 81 on Reader Service Card

## INSTALLATION PROFILE

(Continued from page 32)

sing A-7 speaker systems, AR-3A speaker systems, Eico HFT-90 FM tuner with a Pilot Multiplex adapter, AR manual turntable with a Grado Lab cartridge and Shure SME tone arm, Rek-O-Kut 16-in. BGH turntable with a Westrex cutting head.

A sketch of the wood framework that houses much of this equipment



## EQUIPMENT PROFILE

(Continued from page 63)

Hum and noise measured 87 dB below a 0.5-volt input signal on the high-level inputs. This was measured by feeding in a 0.5-volt signal, adjusting the volume control to a 2-volt output, then removing the signal, shorting the input, and measuring the output. Similarly, the hum and noise measured 73 dB below a 10-mV signal on the phono input.

The LO PHONO input required a signal of 4 mV to produce a 2-volt output, and the overload signal was 80 mV. The HI PHONO input required 23 mV for the 2-volt output, and it overloaded at 480 mV. The tape-head input required 7.6 mV and its overload figure was 39 mV. The ceramic phono input required 160 mV, and overloaded at 2.9 V.

The high-level inputs required 2 volts in for a 2-volt output, and channel separation was 41 dB at 1000 Hz, 23 at 10 kHz. Phono separation was 39 dB at 1000 Hz, 22 at 10 kHz. Just for the fun of it, we measured IM at 5 volts output, and the figure was 0.26%, which is remarkable. The remainder of the performance information is shown in the curves of Figs. 2, 3, and 4.

## Conclusion

We cannot help but compliment Dynaco for the performance of the PAT-4. There are possibly one or two preamps with a shade better performance figures, and a handful with more switches and controls, but they can't be bought for \$129.95 factory wired, or only \$89.95 and nine hours of work. The unit is neat and attractive (pale gold finished panel and knobs, brown finished case), compact (13½" wide, 4¼" high, and 9" deep), lightweight (10 lbs.), and an excellent performer.

Driving a high-quality power amplifier with the PAT-4, sound reproduction was as transparent and crisp with all sound sources as one could wish. And a lot of money is saved by giving up some control frills featured by higher-priced units. Considering all this, the PAT-4 can only be called superb. Check 60

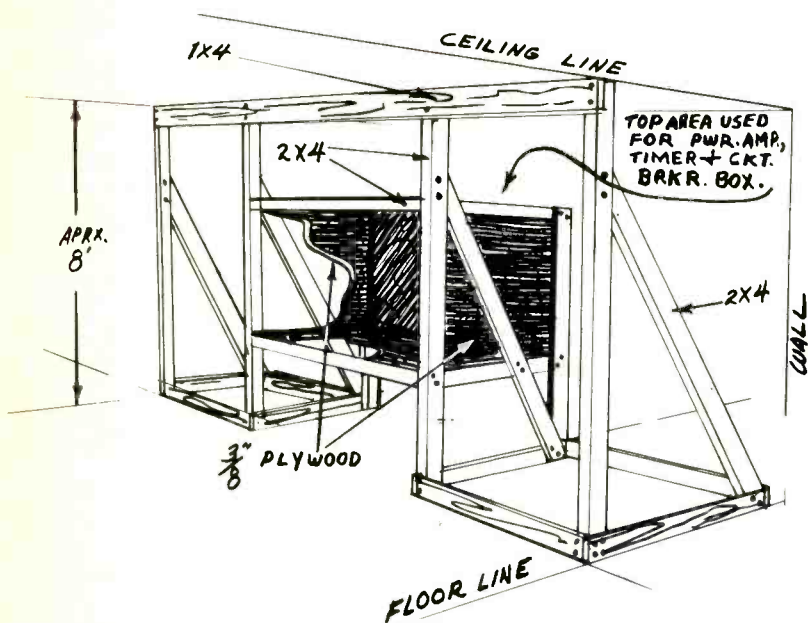


Fig. 3—The drawing here illustrates how the housing for hi-fi equipment and supplies was constructed. One of the large speaker systems is shown above before its grille-cloth/hinged frame covers it.

accompanies the article. It cost less than \$75. The shelves, however, added another \$50, plus plastic covering at about 50 cents per yard.

The basic framework consists of 2 x 4 lumber, with some of the frames constructed with 1-in. x 4-in. fir with burlap stapled to the backside after it was stained. It is interesting to note that nothing is nailed to the floor or wall. Thus the entire unit can be unbolted.

The false front is supported above

the equipment cabinet by four "A" frames of 2 x 4 lumber. It provides storage space for a power amplifier, circuit breaker panel, and automatic clock timer. Speaker cover sections on both sides of the equipment cabinet are hinged for easy access.

Mr. Simpson's quest for higher-quality equipment has not ended. For example, he is presently building a solid-state microphone mixer, expecting to complete it in two years. Æ



## AKG Two-Way Cardioid Dynamic Microphone, Model D-200E

### MANUFACTURER'S SPECIFICATIONS—

Frequency Range: 30 Hz to 15 kHz  $\pm$ 3 dB. Sensitivity: -55 dB (re 1 mW/10 dynes/cm<sup>2</sup>). Impedance: 200 ohms. Pattern: Cardioid. Dimensions: 7-5/16-in. long  $\times$  1<sup>5</sup>/<sub>8</sub>-in. diameter. Weight: 8 oz.

Considering the enormous market for microphones, one is likely to wonder where so many microphones can be used. But just go out "on the town" for an evening and at least one microphone will be in evidence at almost every place.

Most of these will be dynamics—by far the most commonly-used type in general applications, such as night clubs and most public address installations. In the lowest-cost installations, some ceramics will be found, and in many professional studios, there will be a preponderance of condenser types. But the dynamic microphone is the one which enjoys the greatest use in sound reinforcement.

The reasons for this are myriad. It is normally a rugged unit, one which will stand considerable abuse and rough handling. It requires no power supply, either external or integral with the unit itself. It has an adequate output level which does not require boosting before feeding into a conventional amplifier. It is not particularly susceptible to external fields if properly designed. And it is of a sufficiently low impedance in itself to permit the use of relatively long lines from microphone to amplifier.

All this is by way of introduction to a new series of dynamic microphones from AKG, one model of which is the subject of this Profile. This series incorporates some radically new features, the most unusual being the use of separate units for the highs and the lows, combining their outputs with a network to provide the advantage of wide frequency range with a flat response throughout. Crossover is at 500 Hz. Another feature is the use of a "floating" rubber suspension system which reduces noise from handling to a minimum, and which protects the microphone units from severe shocks.

The three models in this series are the D-202E, the D-224E, and the D-200E. Similar in concept, these models differ in external appearance and in some extra features. The D-202E has a sintered bronze cap which serves as a windscreen and pop filter. It has a multi-position low-frequency attenua-



Fig. 9—Slim-design AKG D-200E two-way cardioid microphone.

tor which can reduce 50-Hz response as much as 20 dB. This is desirable because of its excellent low-frequency response which extends down to 30 Hz at a level not more than 2 dB below the average output.

Figure 10 shows the internal appearance of the two-way microphones of this series, with the high-frequency unit mounted on top of the protective cap of the low-frequency system, and also incorporates a compensating winding designed to eliminate the effect of stray magnetic fields. The excellent low-frequency response results from the use of a rear mass tube of adequate size which is vented to the outside air through a series of slots on the housing. These slots are covered with a damping material to reduce wind sensitivity at the rear.

Another important feature is the uniformity of the frequency response over the front 180-deg. solid angle covered by the microphone. All of this series of microphones are cardioids, with the usual attenuation at 180 deg. from the front, but from an angle of incidence from 0 to 90 deg., the response is quite uniform.

The D-224E employs most of the same principles, but is the studio version. It is of the usual slim design, measuring only 1<sup>5</sup>/<sub>16</sub> in. in diameter by 7<sup>3</sup>/<sub>4</sub> in. long. It also incorporates the low-frequency attenuation switch

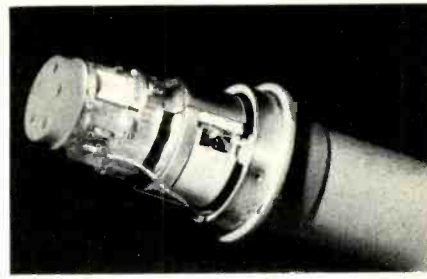


Fig. 10—Internal structure of two-way AKG microphone series.

which will roll off 50 Hz by either 7 or 12 dB.

The model we tested is the D-200E, also a two-way unit with a 500-Hz crossover. Shown in Fig. 9, this model offers an attractive appearance, and, finished in a matte studio gray, is suitable for TV or motion picture use. A quick-disconnect stand adapter permits easy removal when hand-held use is desired.

### Performance

Microphone measurement is at best a difficult procedure, and we aim only to make comparison measurements. Our system is to feed an oscillator to a speaker-amplifier unit (which has a

(Continued on page 85)

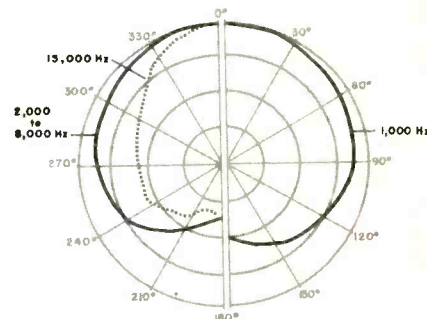
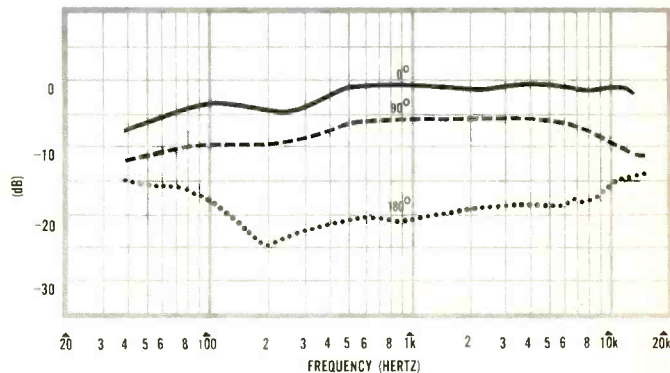
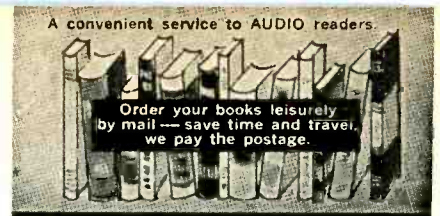


Fig. 11—Polar diagram of D-200E.

Fig. 12—Frequency-response curves illustrate excellent off-axis response.





A convenient service to AUDIO readers.  
Order your books leisurely  
by mail — save time and travel,  
we pay the postage.

**Maintaining Hi-Fi Equipment**

Joseph Marshall

A valuable reference for anyone whose living or hobby is servicing hi-fi equipment. Outlines the professional approach for servicing all types of hi-fi components. Covers trouble-shooting of electronic, mechanical and acoustic problems. 224 pages.

No. 58 Paperback \$2.90\*



**Designing and Building Hi-Fi Furniture**  
Jeff Markel

Written by a professional hi-fi furniture designer who has taught furniture design at leading colleges, this book is an authentic reference of value to the hi-fi fan and professional custom builder. Covers everything from types of woods to furniture finishing for the mechanically adept; design principles, styles and arrangements for the decor minded. 224 pages.

No. 79 Paperback \$2.90\*



**HI-FI TROUBLES**

By Herman Burstein

**HOW YOU CAN AVOID THEM**  
Just published! At last, a book which deals directly with the problems you face in maintaining your audio system in peak condition. Tells you how to locate troubles, what to do about them and how to do it—and, just as important: what NOT to do. Helps you to achieve the best in listening pleasure from your equipment.

No. 120 \$3.95



**The 5th AUDIO Anthology**

Edited by C. G. McProud, publisher of AUDIO. An anthology of the most significant articles covering: stereo recording and reproduction; stereo multiplex; measurements; stereo technology, construction and theory — which appeared in AUDIO during 1958 and 1959. The 5th is truly a collectors' item and a valuable reference for the professional engineer, teacher, student, hobbyist and hi-fi fan. 144 pages.

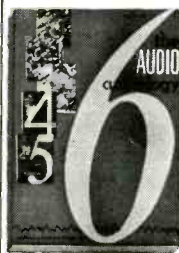
No. 125 \$3.50



**The 6th AUDIO Anthology**

Edited by C. G. McProud, publisher of AUDIO. Includes articles on the two most significant milestones in the field of high fidelity: FM STEREO and TRANSISTORS IN AUDIO EQUIPMENT. A meaningful reference for everyone in the fields of audio engineering, recording, broadcasting, manufacturing and servicing of components and equipment. A necessary book for the high fidelity enthusiast. 144 pages.

No. 130 \$3.95

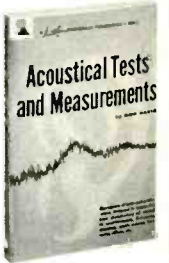


**NEW!**

**ACOUSTICAL TESTS AND MEASUREMENTS**

Don Davis

The author covers in great detail a variety of tests needed to determine sound quality in large listening areas: concert halls, auditoriums, factories, bus stations, and similar locations. This is a practical book, written on a technical level, though neophytes will find the text and illustrations easy to understand. Chapters include: Instrumentation for Acoustical Tests, Charts and Criteria, How to Measure Ambient Noise, How to Measure Reverberation Time, Pulse Testing, Testing the Sound System, How to Write the Survey Report, and Measuring Specifications. 192 pages.

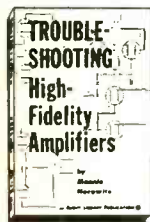


No. 121 \$4.95

**TROUBLESHOOTING High Fidelity Amplifiers**  
Mannie Horowitz

Written specifically for the serviceman and audio hobbyist who wants to get into the profitable field of stereo hi-fi service. 12 fact-filled chapters with a plain and simple approach to troubleshooting all types of stereo and mono amplifiers—a direct text on curing both, vacuum tube and transistorized amplifier ills. Easy to read—includes data on test instruments and procedures. 128 pages.

No. 128 \$2.95



**McProud High Fidelity Omnibook**

Prepared and edited by C. G. McProud, publisher of Audio and noted authority and pioneer in the field of high fidelity. Contains a wealth of ideas, how to's, what to's, and when to's, written so plainly that both engineer and layman can appreciate its valuable content. Covers planning, problems with decoration, cabinets and building hi-fi furniture. A perfect guide.

No. 115 \$2.50\*



**Harold Burreis-Meyer and Vincent Mallory**



No. 126 \$6.95

**SOUND in the THEATRE**

First book of its kind . . . nothing like it has ever been published before! It is an authoritative text on electronic sound control for theatres, auditoriums, concert halls and other large enclosed areas where the source and the audience are present together. Contains complete procedures: For planning, assembling and testing sound control installations — Articulating sound control with other elements of production — Operation and maintenance of sound control equipment. Describes and illustrates 32 specific problems.

**SAVE • MONTHLY SPECIAL • SAVE**

Save over 35% with this collection of AUDIO books  
5th AUDIO ANTHOLOGY (\$3.50) — 6th AUDIO ANTHOLOGY (\$3.95)  
McProud HIGH FIDELITY OMNIBOOK (\$2.50)  
TROUBLESHOOTING HIGH FIDELITY AMPLIFIERS (\$2.95)

**Total Value All Four Books . . . \$12.90**

**YOUR COST ONLY . . . \$8.95 POSTPAID in U.S.A. & Canada**  
**CIRCLE OS500**

This Offer good only on direct order to the Publisher

**AUDIO Bookshelf**

134 N. 13th Street, Phila., Pa. 19107

Please send me the books I have circled below. I am enclosing the full remittance of \$..... (No C.O.D. or billing.)

58	79	115	120	121	125
126	128	130	142	251	OS500

NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_ STATE \_\_\_\_\_ ZIP \_\_\_\_\_

\*All U.S.A. and Canadian orders shipped postpaid.

**High Fidelity Simplified**  
Harold D. Weiler

3rd Edition

The complete hi-fi story — answers all questions about tuners, changers, amplifiers, tape recorders, speakers, record players, etc. Lots of ideas for custom installations. Tells how to achieve concert hall reception in your home. 216 pages.

No. 142 \$3.30



**Getting The Most Out Of Your Tape Recorder**  
Herman Burstein



Written in "plain talk" for the man who has, or wishes to buy, a tape recorder. It answers the myriad questions raised by tape recording enthusiasts. Its chapters cover every phase of operation and maintenance—from adding a tape recorder to the hi-fi system, to a thorough dissertation on microphones. Lots of practical information on how to buy. 176 pages.

No. 251 \$4.25



## EQUIPMENT PROFILE

(Continued from page 83)

fairly flat output up to 20 kHz), monitoring its sound output by a calibrated condenser microphone and then recording the output of the microphone under test. Both the monitoring microphone and the unit under test are located 4 feet from the speaker, and spaced about a foot apart to avoid interaction. The entire operation is done outdoors in a location where there is little reflection from buildings, trees, and so on, and it is done at a relatively low level. Using this method, we came up with the following performance data on the D-200E.

Frequency response:  
±3 dB from 30 to 15,000 Hz.

(See Fig. 12)

Sensitivity:  
-56 dB (from the specs.)

Directional characteristics:  
See Fig. 11

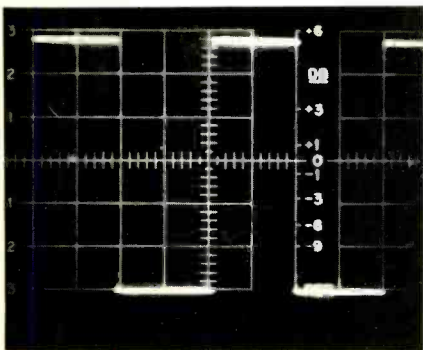
All three models in this series are designed to accept Cannon XLR-3 female cable receptacles, with terminal 1 the shield, terminal 2 the positive (phase), and terminal 3 the negative connection. The impedance of all three models is 200 ohms, and they are designed to feed into a minimum load impedance of 500 ohms. All models employ non-metallic Microfol diaphragms and all will accept a maximum sound pressure level of at least 120 dB.

The performance of the D-200E makes it a desirable high-quality microphone for use where its flat frequency response is needed, and where the uniform directional response is desirable, even if not an absolute necessity.

The D-200E is priced at \$69.00, the D-202E at \$130.00, and the D-224E at \$185.00. A useful array of accessories are available for each type. Check 62

### Erratum

The 25 kHz square wave shown below was incorrectly labeled 25 MHz in the November 1967 profile on the Knight-Kit KG-2100 triggered-sweep oscilloscope kit.



## AUDIO ETC.

(Continued from page 16)

The one-roll cartridge is the kind used as original equipment in autos. (Not one-reel—there aren't any reels, the cartridge itself acts as the flanges that keep the tape roll in place.) Inside these cartridges, of several types, you will find a single roll of tape; when they play, tape is drawn out from the center, next to the hub, and simultaneously fed back on the outside. The roll never gets any smaller. It just turns, and plays and plays, 'round and 'round, forever. An endless loop. This, then, is the 4-track and 8-track continuous loop cartridge.

The one-roll cartridge won't reverse, it can't "rewind" and it doesn't like to go fast forward (though a few new systems are said to incorporate program selector facilities). It just plays. Period. Hence, a minimum of controls, and a minimum of option.

In auto listening the attention is necessarily minimal and the need for choice (and controls) almost nil. Or should be. Your hands must stay on the wheel and you should be minding the road.

So, though there were horrendous tape friction problems in this type of cartridge, now said to be solved, the thing works in its special way like a super charm, as thousands of buyers have found. It does a unique and specialized job—for background music.

### Two-roll

The other type of cartridge is now exemplified by the little cassette, with its revolutionary 1/8-inch tape and 1 7/8-inch speed. (It seems to have combined the two-roll configuration of the earlier and much larger RCA cartridge with the tiny, new-style tape of the 3M-

Revere automatic cartridge—which is a "half-two-roll" system, the second roll being inside the playing machine.)

The two-roll cartridge is simply an ingenious modification of standard reel-to-reel tape, enclosed is an automatic and flangeless cartridge. As in reel-to-reel, there are two rolls and a beginning and end; you play the tape through in both directions, and you also run it either fast-forward or fast-reverse. In fact, the cassette will do anything that a standard reel-to-reel tape will do in playing position. An utterly different configuration, this two-roll system, and its values are also utterly different from those of the one-roll types.

As you can guess, I personally find the cassette concept *very* much to my liking. It offers me a great deal, and even more for the future. It isn't a passive but an active device. It asks for attention, control and selective choice, both in playing and in recording. And its capabilities in the amateur recording area are the greater for of its tiny size and relatively huge capacity. It's my baby, all right.

As for the one-roll cartridge, I personally look upon it with a jaundiced eye and I listen with an unsympathetic ear. That's me.

But look! Don't feel you ought to agree with me. Physical attributes of these systems are one thing, and personal significances another.

If you happen to go in strong for background music, like so many people, then I know you will be pleased with the excellent one-roll cartridge systems—any one of them—whether in your car or, even, in the living room. The system is a natural for you. Just decide *which* one-roll system you prefer, and forget the cassette. (Even if there is background music in cassettes—as I say, everybody is trying to get into every act, these days.) Æ

### NEW! SOLID STATE CONDENSER MICROPHONE VEGA/SYNCRON S-10



- Linear frequency response to 20,000 Hz
- Cardioid pattern — 25 dB front-to-back ratio
- Superb transient response — 15 microsecond risetime
- No external power supply
- Price \$260

### VEGA ELECTRONICS CORPORATION

1161 RICHARD AVENUE  
SANTA CLARA CALIFORNIA  
A Subsidiary of  
Computer Equipment Corporation

# Subject Index/1967

## AMPLIFIERS

Build a Mixer-Meter Amplifier, Hal Margale. Dec. p. 23

## BROADCASTING

Musical Broadcasting in the 19th century, Elliott Sivowich. June, p. 19

## CONSTRUCTION PROJECTS

Build a Mixer-Meter Amplifier, Hal Margale. Dec. p. 23

Build a Solid-State Stereo Limiter, Wayne B. Denny. Sept. p. 25

Convert your Audio Analyzer to Stereo, William B. Fraser. Nov. p. 26

End-Table Loudspeaker, C. G. McProud. April, p. 19

Transistorized Square- and Triangular-Wave Generator, Winthrop S. Pike. June, p. 24

## CONTROLS

Professional Tone Controls, Arthur C. Davis and Don Davis. Pt. 1, Feb. p. 27; Pt. 2, Mar. p. 36; Pt. 3, May, p. 60

## DECIBELS

Get to Know the dB Better, George H. R. O'Donnell. June, p. 44

## DECOR

Decorating with Stereo Hi-Fi. July, p. 35  
Sound and Decor Styles, Jerry Joseph. Nov. p. 21

## DIRECTORIES

Annual Product Preview. Aug. p. 24  
Loudspeaker Compendium. Apr. p. 38  
Record Player Compendium. Mar. p. 26  
Tape Recorder Directory. Dec. p. 34

## ELECTRONIC MUSICAL INSTRUMENTS

A Twelve-Tone Tuner, James B. Hays. Jan. p. 19

## EQUIPMENT PROFILES

AKG Two Way Cardioid Microphone, Model D-200E, Dec. p. 83  
Altec A7-500 Loudspeaker System. Jan. p. 34  
Beyer Stereo Headphones, Model 48S, Apr. p. 51

Concertone A.C./Battery-Powered Tape Recorder, Model 770. Sept. p. 48

Dynaco Solid-State Power Amplifier, Model Stereo 120, Apr. p. 50

Dynaco PAS-3X Stereo Preamplifier, Apr. p. 50

Dynaco PAT-4 Stereo Preamplifier, Dec. p. 60

EICO Multiplex Generator, Model 342. Jan. p. 35

Elac Stereo Cartridge, Model STS-322. Nov. p. 76

Electro-Voice Dynamic Microphones, Models 635A, 667A, and 636. Oct. p. 84

Fisher XP-55 Speaker System. July, p. 38

Heathkit "Magnecord" Tape Recorder, Model AD-16. July, p. 36

Heathkit Solid-State Receiver, Model AR-15. May, p. 76

IMC Boxer Fan. Feb. p. 58

Kenwood Stereo Receiver, Model TK-55. Nov. p. 50

Knight-Kit Integrated Amplifier and Stereo Tuner, Models KG-895 and KG-790. Feb. p. 56

Knight-Kit Triggered Scope, Model KG-2100. Nov. p. 56

Leak "Mini-Sandwich" Loudspeaker System, June, p. 50

Marantz Stereo Amplifier, Model 15. Jan. p. 32; Addendum, Mar. p. 50

Miracord Automatic Turntable, Model PW-50H. Sept. p. 46

Norelco "Carry Corder," Model 150. June, p. 49

Ortofon Stereo Phono Cartridge. Model SL-15, Sept. p. 44

Pioneer Stereo Receiver, Model SX-1000 TA. June, p. 46

H. H. Scott Speaker System, Model S-11. Mar. p. 50

Sharpe Stereo Headphones, Model PRO-660. July, p. 38

Sherwood FM Stereo/AM Receiver, Model S-7600-FET. Oct. p. 80

Shure Microphone Mixer, Model M68. June, p. 50

Shure Stereo Cartridge, Model V-15 II. Feb. p. 58

Superex Stereo Headphones, Model ST-PRO. May, p. 80

University Compact Speaker System, Model "Ultra-D." May, p. 80

Wharfedale Compact Speaker System, Model W-20. Mar. p. 52

## EXHIBITIONS

Thirty-Third Convention, Audio Engineering Society, List of Exhibitors, Technical Papers. Oct. p. 98

New York High Fidelity Music Show, Seminar Schedule. Oct. p. 115

Here Come the '68s, (N. Y. Hi Fi Show) Arthur P. Salsberg, Oct. p. 25

## FM TUNERS

ABZ's of FM: Tuner Measurements, Leonard Feldman. Oct. p. 58

ABZ's of FM: Secondary Tuner Measurements, Leonard Feldman. Nov. p. 32

ABZ's of FM: FM Stereo Measurements; Leonard Feldman. Dec. p. 52

Third Generation Hi-Fi, Lawrence W. Fish Jr. Jan. p. 26

## HEADPHONES

Forum on Headphones and Microphones, Arthur P. Salsberg. Pt. 1, July, p. 20; Pt. 2, Aug. p. 17

## HISTORICAL

Musical Broadcasting in the 19th Century, Elliott Sivowich. June, p. 19

20 Years of AUDIO. C. G. McProud. May, p. 25

## HI-FI INDUSTRY

What the Next 20 Years Will Bring, Industry Executives. May, p. 44

## INTEGRATED CIRCUITS

Third Generation Hi-Fi. Lawrence W. Fish, Jr. Jan. p. 26

## LIMITERS

Build a Solid-State Stereo Limiter, Wayne B. Denny. Sept. p. 25

## LOUDSPEAKERS

End-Table Loudspeaker, C. G. McProud. Apr. p. 19

Inside an Electrostatic Speaker. Sept. 32  
Loudspeaker Compendium, Apr. p. 38

Forum on Loudspeakers, Larry Zide. Apr. p. 28

Loudspeaker Directional Characteristics, David L. Klepper. Apr. p. 22

## MEASUREMENTS

Audio Measurements Course, Norman H. Crowhurst. Pt. 12, Jan. p. 36; Pt. 13, Feb. p. 36; Pt. 14, Mar. p. 44; Pt. 15, Apr. p. 44; Pt. 16, May, p. 44; Pt. 17, June, p. 34; Pt. 18, July, p. 26

Convert Your Audio Analyzer to Stereo, William B. Fraser. Nov. p. 26

FM Stereo Measurements; Leonard Feldman. Dec. p. 52

FM Tuner Measurements, Leonard Feldman. Oct. p. 58

Secondary FM Tuner Measurements; Leonard Feldman, Nov. p. 32

Transistorized Square- and Triangular-Wave Generator; Winthrop S. Pike. June, p. 24



## MICROPHONES

Microphones for Sound Reinforcement Systems, Arthur C. Davis and Don Davis. Dec. p. 64

## MUSIC PERSONALITIES

Jazz in Greenwich Village, Larry Zide. Feb. p. 42  
Robert Preston says: I was raised on Red Seal Records, Larry Zide. May, p. 38  
Jimmy Rushing and Dickie Wells Reunite, Bertram Stanleigh. Oct. p. 76  
Isaac Stern and his Music, Leonard Silke. June, p. 30

## MUSIC & RECORDINGS

Electronic Organ "Demo" Records, Edward T. Canby. Nov. p. 60  
Jimmy Rushing and Dickie Wells Reunite, Bertram Stanleigh. Oct. p. 76  
King of Instruments, Edward T. Canby. Dec. p. 70  
The Mothers, Bertram Stanleigh. Nov. p. 66  
Pop Meet Classic, Edward T. Canby. Oct. p. 64  
Sounds of the South, Bertram Stanleigh. Dec. p. 76

## RECORD PLAYERS/CARTRIDGES

Program Your Listening for Up to Thirty Hours, C. G. McProud. Mar. p. 32  
Record Player Compendium. Mar. p. 26  
Skating Force—Mountain or Molehill? R. S. Oakley, Jr. Mar. p. 40  
Skating-Force Phenomenon, James H. Kogen. Pt. 1, Oct. p. 53; Pt. 2, Nov. p. 38  
Tracking Capability of Phonograph Pick-ups, J. G. Woodward. Mar. p. 19

## SOUND REINFORCEMENT

Microphones for Sound Reinforcement Systems, Arthur C. Davis and Don Davis. Pt. 1. Dec. p. 80  
Sound Reinforcement in Concert Halls, Martin L. Borish. Sept. p. 30

## SYSTEMS

Decorating with Stereo Hi-Fi. July, p. 35  
Installation Profile. Dec. p. 32  
Youth's Pre-College Project. Jan. p. 28

## TAPE RECORDING

Automobile Tape Cartridges, Larry Zide. May, p. 66  
Build a Mixer-Meter Amplifier, Hal Margargle. Dec. p. 23  
Build a Solid-State Stereo Limiter, Wayne B. Denny. Sept. p. 25  
New NAB Magnetic Tape Standards, Herman Burstein. Pt. 1, July, p. 17; Pt. 2, Aug. p. 22; Pt. 3, Sept. p. 38; Pt. 4, Oct. p. 92; Pt. 5, Nov. p. 44; Pt. 6, Dec. p. 48  
Tape Recorder Directory. Dec. p. 34  
Why Look-Alike Recorders Can Be \$\$\$ Apart, Herman Burstein. Dec. p. 26

# Author Index/ 1967

### Borish, Martin L.

Sound Reinforcement in Concert Halls, Sept. p. 30.

### Burstein, Herman

The New NAB Magnetic Tape Standards. Pt. 1, July, p. 17; Pt. 2, Aug. p. 22; Pt. 3, Sept. p. 38; Pt. 4, Oct. p. 92; Pt. 5, Nov. p. 44; Pt. 6, Dec. p. 48.  
Tape Recorder Buying Checkpoints, Dec. p. 26.

### Canby, Edward T.

Electronic Organ "Demo" Records, Nov. p. 30.  
King of Instruments, Dec. p. 70.  
Pop Meet Classic, Oct. p. 64.

### Crowhurst, Norman H.

Audio Measurements Course, Pt. 12, Jan. p. 36; Pt. 13, Feb. p. 36; Pt. 14, Mar. p. 44; Pt. 15, Apr. p. 44; Pt. 16, June, p. 34; Pt. 17, July, p. 26.

### Davis, Arthur C. and Davis, Don

Microphones for Sound Reinforcement Systems, Pt. 1, Dec. p. 64.  
Professional Tone Controls, Pt. 1, Feb. p. 27; Pt. 2, Mar. p. 36; Pt. 3, May, p. 60.

### Denny, Wayne B.

Build a Solid-State Stereo Limiter. Sept. p. 25.

### Feldman, Leonard

ABZ's of FM Tuner Measurements: Pt. 1, Primary Measurements, Oct. p. 58; Pt. 2, Secondary Measurements, Nov. p. 32; Pt. 3, FM Stereo Measurements, Dec. p. 52.

### Fish, Lawrence W., Jr.

Third Generation Hi-Fi. Jan. p. 26.

### Fraser, William B.

Convert Your Audio Analyzer to Stereo, Nov. p. 26.

### Hays, James B.

A Twelve-Tone Tuner, Jan. p. 19.

### Joseph, Jerry

Sound and Decor Styles, Nov. p. 21.

### Kogen, James H.

The Skating-Force Phenomenon. Pt. 1, Oct. p. 53; Pt. 2, Nov. p. 38.

### Klepper, David L.

Loudspeaker Directional Characteristics, Apr. p. 22.

### Margargle, Hal

Build a Mixer-Meter Amplifier, Dec. p. 23.

### McProud, C. G.

End-Table Loudspeaker, Apr. p. 19.  
Program Your Listening for Up to Thirty Hours, Mar. p. 32.  
20 Years of AUDIO, May. p. 25.

### Oakley, Robert S., Jr.

Skating Force—Mountain or Molehill? Mar. p. 40.

### O'Donnell, George H. R.

Get to Know the dB Better, June, p. 44.

### Pike, Winthrop S.

Transistorized Square- and Triangular-Wave Generator, June, p. 24.

### Salsberg, Arthur P.

Forum on Microphones and Headphones, Pt. 1, July, p. 20; Pt. 2, Aug. p. 17.  
Here Come the 68's, Oct. p. 25.

### Sivowich, Elliott

Musical Broadcasting in the 19th Century, June, p. 19.

### Silke, Leonard

Isaac Stern and his Music, June, p. 30.

### Stanleigh, Bertram

Jimmy Rushing and Dickie Wells Reunite, Oct. p. 76.  
The Mothers, Nov. p. 66.  
Sounds of the South, Dec. p. 76.

### Woodward, J. G.

Tracking Capability of phonograph pick-ups, Mar. p. 19.

### Zide, Larry

Automobile Tape Cartridges, May, p. 66.  
Forum on Loudspeakers, Apr. p. 28.  
Jazz in Greenwich Village, Feb. p. 42.  
Robert Preston says, "I was raised on Red Seal Records." May, p. 38.

If you're around  
Greenwich, Conn.  
and like shopping  
great Hi-Fi stores -  
see this man...



## HE'S OUR DEALER!

Bob Bonoff, Owner of The Sound Gallery  
56 West Putnam Ave., Greenwich, Connecticut  
Bob Bonoff specializes in some of the most  
elaborate custom installations in an area where  
customers usually specify "the best". Mr.  
Bonoff has a reputation as a man who knows  
his equipment and is an uncompromising critic  
of what he sells. He states: "I chose Pioneer  
because I found their products meet or exceed  
the printed specifications. They do not lie."

**PIONEER** 

PIONEER ELECTRONICS U.S.A. CORP.  
140 Smith St., Farmingdale, L.I., N.Y. 11735  
(516) 694-7720

Check No. 88 on Reader Service Card

HOW  
TO FIT  
TWO db  
INTO  
ONE



Use the  
**FAIRCHILD  
COMPACT  
COMPRESSOR!**

Now you can have apparent loudness on every microphone channel. The FAIRCHILD COMPACT COMPRESSOR can give you the extra "punch" of apparent loudness - the sound that makes hits. It has built-in flexibility through variable threshold and variable release (.3 to 7 seconds) located on the front panel. The FAIRCHILD COMPACT COMPRESSOR will provide up to 20 db compression and will not introduce distortion. It is no larger than a slide type attenuator . . . only 1 1/2" NARROW . . . and can be easily integrated into all types of equipment.

An Integra/Series Component—Model 663

**FAIRCHILD**  
RECORDING EQUIPMENT CORPORATION  
10-40 45th Ave., Long Island City 1, N.Y.

# CLASSIFIED

Rates: 25¢ per word per insertion for noncommercial advertisements; 50¢ per word for commercial advertisements. Frequency discounts as follows: 2 times, less 15%; 6 times, less 20%; 12 times, less 30%. Closing date is the FIRST of the second month preceding the date of issue.

## SERVICES

### HIGH FIDELITY SPEAKERS REPAIRED

AMPRITE SPEAKER SERVICE

168 W. 23rd St., New York, N. Y. 10011  
CH 3-4812

### HI-FI SPEAKERS REPAIRED

OLD SPEAKERS UPDATED

AUDIO SPKR TECHNICS

#3 Walker St., New York, N. Y. 10013  
CA 6-7785

**PROTECT YOUR LPS**—Heavy poly sleeves for jackets 5¢, Round bottom for records 3 1/2¢ ea. New LP jackets, White 20¢, Colors 25¢. Min. order \$5.00. LP Supplies, Hillburn, P.O. New York.

**CUSTOM RECORDING SERVICE**—Tape or disc recordings made from live or recorded material. High quality. Reasonable rates. Audio-Tech Laboratories, 2819 Newkirk Avenue, Brooklyn, N. Y. IN 9-7134.

**M. RETTINGER**, Consultant on Acoustics. Analysis. Room Design. Noise Reduction. 5007 Haskell Ave., Encino, Calif. Tel: (213) 784-3985.

**RECORDING SERVICES**—Tape, Disc, and Duplication. Reasonable Rates. Jones and Associates, Box 142, Dayton, Indiana 47941.

**IMPORTS: TELEVISION SETS, RADIOS, RADIOGRAMS, TRANSISTOR RADIOS, AND TAPE RECORDINGS.** Manufacturers who are interested to sell through our Agency and are anxious to introduce their merchandise into our market should contact us by sending their price lists, catalogue, and samples to us directly. Amodu Akanbi & Sons, 17, Adagun Street, Lagos, Nigeria.

**RECORDS TO TAPE:** Write William G. Baumann, Dept. A; 1219 East Singer Circle; Milwaukee, Wisconsin, 53212.

## FOR SALE

**GLOBAL WRISTWATCH**—London, New York, Tokyo, etc. Free catalog West Coast Sales, 2631 29th Ave., Sacramento, Calif.

**BACKGROUND MUSIC** tapes and cartridges. 4 hr. 1 7/8 Viking carts: \$7.50 & \$10.00; 2 hr. 3 3/4 Fidelapac carts: \$5.00 ea.; 4 hr. 1 7/8 cart. tape on reels: \$2.50 ea.; 2 and 4 hr. 3 3/4 reel to reel: \$2.50 & \$5.00; 4 hr. 1 7/8 Xmas Music carts: \$10.00. All used-good values—\$10.00 min. order-post-paid. Ed Davison, 135 N. Illinois St., Springfield, Ill. 62702.

**2 FAIRCHILD CONDENSER MICROPHONES** F-22 (Both \$300.00 new); 1 RCA 44BX Ribbon microphone (excellent) \$100.00; 1 E-V 635A Dynamic (New—\$45.00); 1 Berlant BAX-2P Studio Tape Recorder—7 1/2, 15 ips (1/2-track stereo), Excellent, \$500.00. Douglas C. Smith, 2321 Riverlawn Drive, Clarkston, Washington 99403.

**AMPEX 400** recorder just overhauled excellent condition/\$350.00. Richard Miles, 131 Farrington St., Wollaston, Mass. 02170.

**AMPEX 620** Speaker Amplifier, used (red), \$85.00; Sony C-37 Condenser Microphone, new, \$185.00; Marantz 10B FM Tuner, new, \$525.00; Revox Mono 1/2 track, as is, \$85.00. Howard Lundy, 50 Greene Street, New York, 10013. 212 966-0834.

**ELECTRO-VOICE** 15" speaker system in mahogany regency cabinet \$125.00. C. L. Hamm, 2 Clifton Ave., Marblehead, Mass. 01945.

**JBL DELFI** equipment cabinet. Oiled walnut. Perfect, No scratches. \$225 plus shipping. F. C. Filippone, 543 Joralemon St., Belleville, N. J. 07109.

**PERFECTIONISTS.** Simple modification improves sound quality of Dynaco Stereo 70. Send \$3.00 for kit. David Hadaway, 1115 Ave. C, Galveston, Texas 77550.

**RECORDS MADE** from your tapes on famous Scully lathe, using all Solid-State equipment. No order too small. For more information write Triangle Recording Studio, 1091 Thirza Place, Rahway, New Jersey 07065.



**TAPE RECORDER SALE.** Brand new, nationally advertised brands, \$10.00 above cost. Arkay Sales Company, 1028-H Commonwealth Avenue, Boston, Mass. 02215.

**MARANTZ Stereo Tuner, No. 10B-2888,** two years old. \$475. Guaranteed and freight prepaid. Steve Shepard, 212 Santa Anita Dr., Starkville, Mississippi 39759.

**KIT EXPERTS** — Dynaco Specialists — Kits at reasonable prices are our specialty. Also custom-wired kits guaranteed to exceed factory standards at substantial savings. Beautiful handcrafted walnut cases for complete Dynaco line, plus everything in audio. Kitcraft, Dept. A1167, 738 Washington Avenue, Brooklyn, N. Y. 11238. Tel: MA 2-5230.

**SHACKMAN ELECTROSTATIC SPEAKERS.** British. 180° dispersion. This mid-range treble can be used with any woofer. Brochure, reports, and prices sent on it and full-range systems manufactured in Canada. Olson's Audio House. Box 1075. Wetaskiwin, Alberta, Canada.

**DISC RECORDING EQUIPMENT:** Cutter-heads, Recording Amplifiers, and Lathes. New and used. From Rek-O-Kut to Scully. Send requirements. Wiegand Audio Labs, 221 Carton, Neptune, N. J. 07753.

**SCULLY Professional Tape Recorders,** from 1 to 12 tracks, complete recording studios available in prewired console cabinets starting at \$8,000.00. 70% financing. WIEGAND AUDIO LABORATORIES, 221 Carton, Neptune, N. J. 07753.

**FRANCHISED: DEALER FOR THE FOLLOWING:** KLIPSCHORN, MARANTZ, ALTEC, DYNACO, SHERWOOD, KENWOOD, BENJAMIN, GARRARD, EMPIRE, WHARFEDALE, SUPERIOR SOUND. 621 S. MAIN ST., N. SYRACUSE, N. Y. 13212.

**FREE!** Send for money saving stereo catalog AM and lowest quotations on your individual component, tape recorder, or system requirements. Electronic Values, Inc., 200 West 20th St., New York, N. Y. 10011.

**FOR SALE:** Bound volumes of AUDIO, one each of 1950 and 1951 only. \$10.00 each, ppd. First order received is only one that can be supplied. AUDIO, 134 N. 13th St., Philadelphia, Pa. 19107.

**EXPERIMENTERS! HAMMOND** Reverberation mechanism—\$4. Cal's Box 234. Dearborn, Michigan 48121.

**HARPSICHORD:** Same as owned by Philadelphia Orchestra and RCA Victor. In kit form for home workshop assembly, \$150. Clavichord kit, \$100. Free brochure. Write: Zuckermann Harpsichords, Dept. R. 115 Christopher St., New York, N. Y. 10014.

**TAPE RECORDERS,** Hi-Fi components, Sleep Learning Equipment, tapes. Unusual Values, Free Catalog. Dressner, 1523T, Jericho Turnpike, New Hyde Park, N. Y. 11040.

**MODEL 210 CRAFTSMEN TV tuner.** Excellent condition, including 21-inch tube, 35 feet coaxial cable, all mounting hardware, schematics. Best offer. Joseph Mazoff, 3720 Cambridge, El Paso, Texas 79903.

## EQUIPMENT WANTED

**WANTED:** Large horn system (used) Klipschorn, Patrician 18" woofer model, Lansing Hartsfield, Brociner Transcendent, state price and condition. MI Hyman, 5225 Trojan Apt. 33, San Diego, Calif.

**CAMERA** Miranda Automex Two, or Three Automex Lenses. Tape Recorder: Ampex 4460, Sony 200, 600, or 77754. T. A. McIntire, 3267 Wilmington, N. C. 28401.

### SPECIAL DEMONSTRATION RECORD



**NEW! 361C Audio Equalizer \$49.95**

Variable equalizer necessary for professional quality recording or playback. Ideal for use between mixer and tape recorder or tape to tape, etc. Write for details or send \$2.00 for LP demonstration record. Covers tape and disc recording techniques. Refunded with purchase.

**Order direct or write for information**

**KUHN ELECTRONICS**  
20 Glenwood Cincinnati 17, Ohio

Check No. 91 on Reader Service Card

**CANADA**  
High Fidelity Equipment  
Complete Lines • Complete Service  
Hi-Fi Records — Components  
and Accessories

**ELECTRO-VOICE**  
**SOUND SYSTEMS**

126 DUNDAS ST. WEST. TORONTO, CANADA

Check No. 92 on Reader Service Card

**SAVE  
25%**



This is our

### GROUP SUBSCRIPTION PLAN

Now you, your friends and co-workers can save \$2.00 on each subscription to **AUDIO**. If you send 6 or more subscriptions for the U.S., Possessions and Canada, they will cost each subscriber \$3.00 each, 40% less than the regular one year subscription price. **Present subscriptions may be renewed or extended as part of a group. Remittance to accompany orders.**

**AUDIO is still the only publication devoted entirely to**

- Audio
- Broadcasting equipment
- Acoustics
- Home music systems
- Recording
- PA systems
- Record Reviews

(Please print)

Name.....  
Address.....

New.....  Renewal.....

Name.....  
Address.....

New.....  Renewal.....

Name.....  
Address.....

New.....  Renewal.....

Name.....  
Address.....

New.....  Renewal.....

Name.....  
Address.....

New.....  Renewal.....

Name.....  
Address.....

New.....  Renewal.....

U. S., Possessions, and Canada only

**AUDIO MAGAZINE**

134 N. Thirteenth St.  
Philadelphia, Pa. 19107

**If you're around  
New York City  
and like shopping  
great Hi-Fi stores -  
see this man...**



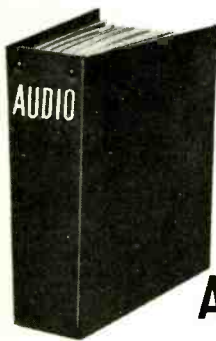
**HE'S OUR DEALER!**

Allan Pearlman, Manager Audio Department,  
Sam Goody (West Side store)  
250 West 49th St., New York, N. Y.  
Sam Goody is one of the largest high fidelity  
retailers in the country. Sam Goody's clientele  
is largely composed of knowledgeable audio-  
philes. Concerning Pioneer, Allan Pearlman  
states: "Sam Goody chose Pioneer for one of  
its receiver lines because Pioneer's top quality  
and moderate price give our customers the  
value Sam Goody is noted for."

**PIONEER**   
PIONEER ELECTRONICS U.S.A. CORP.  
140 Smith St., Farmingdale, L. I., N. Y. 11735  
(516) 694-7720

Check No. 90 on Reader Service Card

**your own reference library  
CLOTH BOUND BINDERS**



**\$4.95**  
post paid  
**HOLDS**  
**12**  
**ISSUES**  
**OF**  
**AUDIO**

The valuable information in this publication will continue to serve you, month after month, year after year, when you file each issue in this easy-to-use, stiff-cover binder. Keep your copies safe from damage, safe from dust and discoloration, yet instantly available. Binding mechanism makes it simple to insert new issues, yet holds 12 copies firmly. Attractively finished in green cloth, with the publication title stamped in gold. Check must accompany order.

Order from **AUDIO**  
134 North Thirteenth Street  
Philadelphia, Pa. 19107

**ADVERTISING  
INDEX**

Acoustech .....	71
Acoustic Research, Inc. ....	55
Acoustical Manufacturing Co. ....	75
AKG .....	7
Altec Lansing .....	49
Audio Bookshelf .....	84
Audio Dynamics Corp. ....	56-57
B S R (USA) Ltd. ....	41
Benjamin Electronic Sound Corp..	19, 47
Bogen Communications .....	Cover III
Bozak .....	39
British Industries Corp. ....	3
Classified .....	88-89
Crown International .....	37
Dolby Laboratories .....	43
Dynaco, Inc. ....	9
E-V Sound Systems .....	89
Electro-Voice, Inc. ....	1, Cover IV
Elpa Marketing Industries .....	6
Empire Scientific Corp. ....	13
Fairchild Recording Equipment Corp..	88
Finney Company, The .....	12
Garrard Sales Co. ....	3
Gotham Audio Sales Corp. ....	67
Harman-Kardon, Inc. ....	59
Kuhn Electronics .....	89
Koss Electronics, Inc. ....	71
Lafayette Radio Electronics .....	81
Lansing, James B., Sound, Inc. ....	45
3M Company .....	31
Marantz Company .....	27
Microsound Company .....	79
McIntosh Laboratory, Inc. ....	4
Norelco .....	7, 73
Nortronics .....	10
Pickering & Company, Inc. ....	21
Pioneer Electronics U.S.A. Corp. 5, 88, 90	
Sansui Electronics Corp. ....	53
Scott, H. H., Inc. ....	Cover II
Sherwood Electronic Labs, Inc. ....	22
Shure Brothers, Inc. ....	15, 61
Sony Corporation of America .....	51
Sony/Superscope .....	11
Stanton Magnetics .....	29
Tandberg of America, Inc. ....	77
Telex Acoustic Products .....	81
United Audio Products .....	33
University Sound .....	35
Utah Electronics .....	8
Vega Electronics Corp. ....	85
Viking Div. of Telex Acoustic Products	17, 69

**MANUFACTURERS  
LISTED IN DIRECTORY  
(pgs. 34-46)**

<b>Allied Radio Corp.</b> 100 N. Western Ave. Chicago, Ill. 60680
<b>Ampex Corporation</b> 2201 Lund Ave. Elk Grove Village, Illinois 60007
<b>BSR (USA) Ltd.</b> Rt. 303 Blauvelt, N. Y. 10913
<b>Bell and Howell Photo Sales Co.</b> 7100 McCormack Rd. Chicago, Ill. 60645
<b>Classic Industries, Inc.</b> 3962 Landmark St. Culver City, Calif. 90230
<b>Concertone</b> (See <b>Classic Industries, Inc.</b> )
<b>Concord Electronics Corp.</b> 1935 Armacost Ave. Los Angeles, Calif. 90025
<b>Crown International</b> P.O. Box 1000 Elkhart, Indiana 46517
<b>Dual (see <b>United Audio</b>)</b>
<b>Dynaco, Inc.</b> 3916 Powelton Ave. Philadelphia, Pa. 19104
<b>Elpa Marketing Industries</b> New Hyde Park, N. Y.
<b>Heath Company</b> Benton Harbor, Mich. 49022
<b>Knight-Kit (see <b>Allied Radio</b>)</b>
<b>Lafayette Radio</b> P.O. Box 10 Syosset, N. Y. 11791
<b>Magnecord (see <b>Telex</b>)</b>
<b>Martel Electronic Corp.</b> 2339 S. Cotner Ave. Los Angeles, Calif. 90064
<b>Matsushita Electric Corp. of America</b> 200 Park Ave. New York, N. Y.
<b>3M Co.</b> 2501 Hudson Rd. St. Paul, Minn. 55119
<b>Norelco (see <b>North Amer. Philips Co.</b>)</b>
<b>North American Philips Co.</b> 100 E. 42nd St. New York, N. Y. 10017
<b>Panasonic (see <b>Matsushita</b>)</b>
<b>Premier Electronic Labs.</b> 382 Lafayette St. New York, N. Y.
<b>Revox (see <b>Elpa Marketing</b>)</b>
<b>Roberts Electronics, Inc.</b> 5920 Bowcraft Ave. Los Angeles, Calif. 90016
<b>Sony Corp. of America</b> 41-47 Van Dam St. Long Island City, N. Y. 11101
<b>Sony Superscope, Inc.</b> 8150 Vineland Ave. Sun Valley, Calif. 91352
<b>Tandberg of America, Inc.</b> P.O. Box 171 Pelham, N. Y. 10803
<b>Tapesonic (see <b>Premier Electronics</b>)</b>
<b>Teac Corp.</b> 1547 18th St. Santa Monica, Calif. 90404
<b>Telex Acoustic Products</b> 9600 Aldrich Ave., South Minneapolis, Minn. 55420
<b>Uher (see <b>Martel</b>)</b>
<b>United Audio Products</b> 535 Madison Ave. New York, N. Y. 10022
<b>Viking of Minneapolis, Inc. (see <b>Telex</b>)</b>
<b>Wollensak (see <b>3M Co.</b>)</b>