Stereo Review's F2.50 TAPE RECORDING & BUYING GUIDE 1978 COMPLETE DIRECTORY OF TAPE MACHINES & ACCESSORIES

HOME • AUTO • PORTABLE • SMALL - STUDIO MODELS
LATEST PRICES • FEATURES • SPECIFICATIONS • PHOTOS

EXTRA TEST REPORTS FROM HIRSCH-HOUCK LABS

ALSO COMPARING THE NEWEST CASSETTES

"Remarkable"

In a recent issue, the authoritative British audio journal "Gramophone" published a detailed and comprehensive analysis of the HK2000 cassette deck. These are its concluding paragraphs:

"The results of my technical investigation can only be summarized by a single word: 'remarkable'. There is no doubt that the Harman Kardon HK2000 is functioning up to such a high standard for the compact cassette system that it has established a new performance level against which other machines will tend to be judged in the future.

"The excellence of the laboratory measurements were reflected in the enjoyment of musical repertoire during the course of practical user tests. Delightfully easy to use and flexible in its interconnection requirements, the machine behaved in an exemplary fashion during the whole of the time it was in use. The reproduction of commercially pre-recorded cassettes revealed a new brilliance and clarity. When recording off-the-air, A/B comparisons showed how difficult it was to detect the difference between the recording and the original.

"The Harman Kardon HK2000 should finally close the argument as to whether or not the compact cassette system is capable of high fidelity performance. Provided the recommendations given in this review on the use and selection of tape formulations are adhered to, there is no doubt that the recorder will offer its fortunate owners the opportunity of realizing a standard of musical reproduction of the very highest order."

If you would like a copy of the complete review, which contains the author's tape recommendations, please write to us. We'll include an illustrated brochure describing how the HK2000 achieves its "remarkable" performance. Harman Kardon Dept.T, 55 Ames Court, Plainview, N.Y.11803

Dolby (III) is a registered trademark of Dolby Laboratories. Inc.

harman/kardon



THE TOSHIBA 3060 WITH DOLBY FM. **BELOW \$200**^{*}

Usually, a tape deck with all these features costs you a lot more. But at Toshiba we make our own parts, so we can add all these extra features without charging you a lot of extra money. Before you buy any tape deck, get all the facts. They're right on this page.

You'll see that with the Toshiba PC-3060, you're playing with a loaded deck.

NOW ALL OUR COMPET CAN DO IS HISS.

TOSHIBA		APCORC.	DDLBY 148	STEREC International Sectors	STEREC CASSITTLE DECK MODEL PC SOO Beneficial and the state of the source of the sourc		
		TAPP.CC		LEFT LEVEL	PROPERTY LEVEL		
	et MEAN > by "YA IP by 1 eth.Allow 1 . 175	PHONE:	S I Mic				
<u>3</u> 3				• NORMAL FURMAL OUT DU	ANN MAX LEFT & Ridert		

AUTO PLAY

Auto Play and Auto Stop Function. This lets the tape play all by itself. With the PLAY and REWIND keys pressed at the same time, the tape will rewind to the beginning of the cassette, stop, and automatically begin playback. The Auto Stop mechanism automatically switches the tape off at the end-so it protects the tape deck and your tapes.



Cue and Review. Your fingers will do less walking on the keys. When you're looking for a certain portion of the tape, just push down to find the place. And lift your finger to start the tape playing.



Timer Setting for absent recording. Now you can record Janis Joplin at home while you're out listening to Mozart. Just use the PC-3060's timer setting switch with your own timer. Recording will begin automatically at the time you set. The Auto Stop mechanism will turn it off at the end.



Switch. On the PC-3060, all you'll hear is the sound of the music. Because the Dolby⁸ noise reduction system cuts hiss level by as much as 10dB -so much that it's virtually nonexistent. And a selector push button instantly gives you the best of Dolby FM broadcasts.



Toshiba America, Inc., 280 Park Avenue, New York, N.Y. 10017

Besides all the extras, the PC-3060 has all the ordinaries: Switched Bias/Equalization. Rotary Master REC Level Control, two recording level meters. an easy-to-operate vertical format, and low wow and flutter.

* THIS VALUE IS SOLFLY FOR THE PURPOSE OF INFORMATION. FACH INDIVIDUAL TOSHIBA DEALER HAS THE OPTION OF SETTING ACTUAL RESALE PRICES CIRCLE NO. 18 ON READER SERVICE CARD

Shereo Review's TAPE RECORDING & BUYING GUIDE 1978

FEATURES	-
TAPE TERMINOLOGY	5
DIRECTORY OF MANUFACTURERS	13
WHAT TO LOOK FOR IN A CASSETTE DECKJulian D. Hirsch	15
WHICH CASSETTE IS BEST FOR YOUR RECORDER?CRAIG STARK	21
GUIDE TO MOBILE AND PORTABLE TAPE RECORDERSIVAN BERGER	26
HOW TO USE TAPE RECORDERS PROPERLY	
AND CREATIVELY	31
THE HOME RECORDING STUDIO TODAY	37
BEST OF RECORDED TAPES	42
TAPE FORMATS: THE CHOICE HAS WIDENEDIVAN BERGER	45
HOW H-H TESTS CASSETTE RECORDERSJulian Hirsch	47
TAPE MACHINE TEST REPORTSHirsch-Houck Laboratories	49
TAPE Q & A	68

PRODUCT INFO	RMATION	
SECTION 1	CASSETTE TAPE MACHINES	71
SECTION 2	OPEN-REEL TAPE MACHINES	83
SECTION 3	8-TRACK TAPE MACHINES	88
SECTION 4	AUTOMOBILE TAPE MACHINES	90
SECTION 5	COMPACT TAPE SYSTEMS	94
SECTION 6	HEADPHONES & MICROPHONES	97
SECTION 7	BLANK TAPE & ACCESSORIES	111
SECTION 8	SMALL STUDIO & SEMI PRO TAPE EQUIPMENT	119

EDGAR W. HOPPER, Publisher

ARTHUR P. SALSBERG, Editorial Director • P. B. HOEFER, Managing Editor IVAN BERGER, Senior Editor • BORYS PATCHOWSKY, Art Director PATRICIA GIRRIER-BROWN, Production Editor • GARY GARCIA, Assistant Editor JAMES J. SULLIVAN, Adv. Dir. • RICHARD J. HALPERN, Eastern Adv. Mgr. CHARLES L. P. WATSON, Eastern Adv. Rep. • LINDA BLUM, Adv. Service Mgr.

TAPE RECORDING & BUYING GUIDE is published annually by Ziff-Davis Publishing Company at One Park Avenue, New York, New York 10016. Hershel B. Sarbin, President; John R. Emery, Senior Vice President-Finance and Treasurer; Charles B. Seton, Secretary.

COPYRIGHT © 1977 BY ZIFF-DAVIS PUBLISHING COMPANY. ALL RIGHTS RESERVED.

Material in this publication may not be reproduced in any form without permission. Requests for permission should be directed to Jerry Schneider, Rights and Permissions, Ziff-Davis Publishing Co., One Park Ave., New York, NY 10016.

World Radio History

Introducing New Quantum by Memorex. Four Reasons It Sounds So Good.

1. Quantum offers low distortion. You get a true recording of any type of music at high output, with virtually no distortion.

2. Quantum has very high sensitivity. This maximizes output and allows you to effectively capture all signals at a greater level.

3. Quantum provides an excellent signal-to-noise ratio because its high sensitivity is obtained with no increase in noise level. This means a pure, brilliant sound.

4. Quantum gives you high saturation, resulting in a wide dynamic range and broad recording flexibility.

Quantum achieves improved recording performance while maintaining a high degree of mechanical excellence. With long life, durability, precision edge quality and excellent oxide adhesion.

The best way to hear the Quantum difference is to try it out for yourself. Available in 7" x 1800', 7" x 2400' and $10\frac{1}{2}$ " x 3600' reels.

MEMOREX Recording Tape. Is it live or is it Memorex?





Cover Photo: Edward M. Haas Cover Equipment, from left to right: JVC CD-S200 cassette deck, Shure Unidyne 515 cardioid microphones, Pioneer Supertuner KP-500 mobile stereo cassette deck with FM, Technics RS-1500US open-reel deck, Harmon-Kardon HK-2000 cassette deck, Superex SRL-3 headphones, Sony from Superscope EL-7 Elcaset deck, Teac Tascam "3" 4-channel mixer. Blank tapes: BASF, Capitol, Maxell, Memorex, TDK and 3M.

Ziff-Devis Publishing Company Hershel B. Sarbin President Furman Hebb Executive Vice President John R. Emery Senior Vice President-Finance and Treasurer Phillip T. Heffernan Senior Vice President, Marketing Edward D. Muhifeld Senior Vice President, Sports Division Philip Sine Senior Vice President Frank Pomerantz Vice President, Creative Services Arthur W. Butzow Vice President, Production Lawrence Sporn Vice President Circulation George Morrissey Vice President Sydney H. Rogers Vice President Sidney Holtz Vice President Albert S. Traina Vice President Philip B. Korsent Vice President Paul H. Chook Vice President, Market Planning Edgar W. Hopper Vice Presiden Robert N. Bavier Jr. Vice President Charles B. Seton Secretary Jerry Schneider Vice President & Administrative Director, Annuals William Ziff Chairman W. Bradford Briggs Vice Chairman Ziff-Davis Publishing Company Editorial and Executive Office: One Park Avenue, New York, New York 10016 212-725-3500 **Midwestern Office** The Pattis Group, 4761 West Touhy Ave Lincolnwood Illinois 60644, 312-679-1100 Midwestern Adv. Manager, Arnold F. Hoffman Western Office 9025 Wilshire Boulevard, Beverly Hills, Cal. 90211 213-273-8050, BRadshaw 2-1161

Western Advertising Manager, Linda Bartlett Japan James Yagi, Oli Palace Aoyama 6 Chome, Minato-Ku, Yokyo 407-1930/6821 582-2851



1978 TAPE RECORDING & BUYING GUIDE is published annually by the Zifl-Davis Publishing Company, One Park Avenue, New York, N.Y. 10016. Also publishers of Stereo Review, Popular Electronics, Electronic Experimenter's Handbook, Communications Handbook, Citizen's Band Handbook and Stereo Directory & Buying Guide.



ALC—See Automatic Level Control

Alignment—Most commonly, Head Alignment, but also used to describe the process of adjusting a recorder's Bias and Equalization for optimum results from a specific tape.

ANRS, Super ANRS—A noise reduction system used by JVC. ANRS operates on principles similar to those used by the *Dolby system*. Therefore, there is a degree of compatibility between recordings made with either system.

Automatic Level Control (ALC)—A circuit which automatically maintains recording level within permissible limits, so that, no matter how loud or soft the sound being recorded, the signal on the tape will not get strong enough to

overmodulate and distort or soft enough to be lost in noise. Also known as Automatic Volume Control (AVC).

Automatic Reverse—The ability of some four-track stereo tape recorders to play the second pair of stereo tracks automatically (in the reverse direction) without the necessity for interchanging the empty and full reels after the first pair of stereo tracks is played. (See also Four-Track Recording)

Automatic Shut-Off—A device (usually a mechanical switch) incorporated into most tape recorders that automatically stops the machine when the tape runs out or breaks.

AVC—Automatic Volume Control— See Automatic Level Control. **Azimuth**—The angle of a tape head's recording gap relative to the tape.

Azimuth Adjustment—See Head Alignment.

Azimuth Loss—High-frequency losses caused by head mis-alignment.

Bias—A constant magnetic field applied to the tape (usually by a high-frequency oscillation of 50–100,000 Hz or more) to minimize distortion and noise and increase frequency response and efficiency in recording. Since every tape formulation has slightly different bias requirements (too much bias cuts high frequency response, while too little increases distortion), modern recorders frequently allow bias to be changed by the user. Some inexpensive



recorders use DC bias instead of a high-frequency; the results are inferior.

Bidirectional—(1) in open-reel or cassette recorders, the ability to play (and, in some cases, record) both stereo track pairs on a tape by reversing the tape's direction of motion without removing and replacing the tape reels or cassette. (2) In microphones, a *Figure-Eight* pick-up pattern.

Blast Filter—A dense mesh screen on a microphone, which minimizes overload caused by loud, close sounds.

Boom—An overhanging arm attached to a microphone stand.

Bulk Eraser—A device used to erase an entire tape at one time. Bulk erasers are usually more effective than recorders' erase heads.

Capstan—The driven spindle or shaft in a tape recorder—sometimes the motor shaft itself—which rotates against the tape (which is backed up by a rubber pressure or pinch roller), pulling it through the machine at constant speed during recording and playback modes of operation. The rotational speed and circumference of the capstan determine tape speed.

Cardioid—The quasi-heart-shaped sensitivity pattern of most uni-directional microphones. Hyper-cardioid and Super-cardioid microphones have basically similar patterns, but with longer, narrower areas of sensitivity at the front, and slightly increased rear sensitivity.

Cartridge—A plastic container that holds tape for easy loading into a matching recorder or player. The term most commonly refers to the *Eighttrack Cartridge*.

Cassette—A tape cartridge in which the tape passes from one hub to another. Most commonly applied to the *Compact Cassette* developed by Philips, but also to the newer *Elcaset* and a variety of new *Micro* and *Mini Cassette* systems which are not compatible with the Compact Cassette or with each other.

Ceramic Microphone—See Piezoelectric Microphone.

Channel—An independent signal path. Stereo recorders have two such channels, quadraphonic ones have four. Mixers generally have a large number of input channels which can be mixed down into a smaller number of output channels.

Chromium Dioxide (CrO₂)—A magnetic material used on some premium tapes.

Closed-loop drive—A tape transport mechanism in which the tape's speed and tension are controlled by contact with a capstan at each end of the head assembly.

Compact Cassette—A small $(4 \times 2\frac{1}{2} \times \frac{1}{2} \text{ inch})$ tape cartridge developed by Philips, containing tape about 1/7 inch wide, running at 1-7% ips. Recordings are bi-directional, with both stereo tracks adjacent for compatibility with monophonic cassette recorders, whose heads scan both stereo tracks at once.

Condenser Microphone—A microphone whose capacitance varies with sound pressure; electronic circuits within the microphone convert this change in capacitance to a varying voltage signal. Condenser microphones, unlike other types, require a battery or other power source.

Counter—A numerical tape-position indicator used to help locate recorded material. Also called digital counter or index counter.

CrO₂—See Chromium Dioxide.

Crossfield Recording—A system in which the *Bias* is not applied to the tape by the recording head, but by a separate head on the tape's backing side, so that the bias signal will not partially erase high frequencies as they are being recorded.

Crosstalk—Undesired signal-leakage from one sound channel or track to another. Opposite of *Separation*.

Cue Control—A switch which temporarily disables a recorder's *Tape Lifters* during fast-forward and rewind, so the operator can judge what portion of the recording is passing the heads.

Decibel—Abbreviated "dB" or "db," it is a relative measure of signal or sound intensity or "volume." It expresses the ratio of one intensity to another. One dB is about the smallest *change* in sound volume that the human ear can detect. (Can also express voltage and power ratios logarithmically.) **Deck, Tape**—A tape recorder designed specifically for use in a high-fidelity music system. It usually consists only of the tape-transport mechanism and preamplifiers for recording and playback. It does not include power amplifiers or speakers.

Degausser—Demagnetizer. See Bulk Eraser and Head Demagnetizer.

DIN Jack—A system of multi-pin jacks and plugs allowing several connections to be made at once. Named after the German Institute for Standards (DIN).

Directional Microphone—One whose sensitivity to sound varies with direction. Such microphones can be aimed so their most sensitive sides face the sound source, while their least sensitive sides face sources of noise or other undesired sound. See *Cardioid*, *Figure Eight*.

Dolby-An electronic device or circuit that reduces the amount of noise (principally tape hiss) introduced during the recording process. It does this by boosting-in carefully controlled amounts-the strength of weak signals before they are recorded. During playback the signals (and the noise) are cut back by an exactly equivalent amount. The original dynamics are thus restored, but the noise is reduced by 10 to 15 dB. At one time found only in recording studios, simplified Dolby circuits designed especially for home tape recording are now available to the audiophile as accessories or built into tape machines.

Dropout—The momentary loss of a recorded signal resulting from imperfections in the tape. These may take the form of non-magnetic foreign particles imbedded in and flush with the tape's surface but are most commonly high spots or dirt on the tape surface that push the tape away from the magnetic head, thereby increasing the area affected (the "umbrella" effect).

Dual Capstan—See Closed Loop.

Dub—To copy another recording, or the copy so made.

Dynamic Microphone-Strictly

speaking, any microphone that generates a signal by the motion of a conductor (*Moving-coil* or *Ribbon*) within a magnetic field; but most often used to describe the moving-coil type. *Impedance* and output are generally lower than those of *piezoelectric* (ceramic or crystal) microphones. Low impedance permits the use of longer connecting cables without high-frequency loss or hum pickup.

Dynamic Range—The ratio (expressed in decibels) between the softest and loudest sounds a tape recorder or other device can reproduce without undesirable distortion in loud passages and excessive noise in soft ones.

Echo—A special facility found in some three-head tape recorders. Part of the slightly delayed output of the monitor head is fed to the recording head and mixed with the signal being recorded. The result is an "echo" of the material recorded a moment before.

Editing—The alteration of a tape recording by physical means to eliminate or replace undesirable portions, add portions not present in the original, or otherwise rearrange the original. Magnetic tape is unsurpassed for editing purposes, since it can be easily cut and spliced.

Eight-Track—Most commonly, a cartridge tape system having eight narrow tracks on ¼-inch tape wound in a continuous loop around a single hub. Stereo 8-track cartridges divide the tape into four "programs" of equal length, all running in the same direction. Quadraphonic (Q8) cartridges are similar, but with two programs using four tracks each. At the end of each program, the recorder's head shifts to the next set of tracks.

Elcaset—A new tape system using a cassette similar in plan to the *Compact Cassette*, but holding ¹/₄-inch tape running at 3-³/₄ inches per second; the tape is looped out of the cassette to reach the heads and capstan during recording and playback. (In other cassette systems, the heads contact the tape through windows in the cassette shell.)

Equalization—The selective amplification or attenuation of certain frequencies. Also refers to recognized industry standards for recording and reproducing "characteristics" (such as the NAB Standard), the proper use of which can assure uniform reproduction of prerecorded tapes and improvement of a system's signal-to-noise ratio.

Erasure—The neutralization of the magnetic pattern on tape by use of a strong magnetic field, thereby re-

moving the recorded sound from the tape. During recording, the erase head on a recorder automatically removes any sound previously recorded on the tape just before the tape reaches the record head. (See also *Bulk Eraser*).

Fast Forward—The provision on a tape recorder permitting tape to be run rapidly through it in normal play direction, usually for search or selection purposes.

Feed Reel—Also called "stock," "supply," or "storage" reel. The reel on a tape recorder from which the tape is taken as the machine records or plays.

Figure-8 Microphone—A microphone, (usually a *Ribbon* type), whose sensitivity is greatest to front and rear, and weakest to both sides. The directional pattern is narrower than that of a *Cardioid*.

Flutter—Very short, rapid variations in tape speed, causing pitch and volume variations that were not present in the original sound. A form of distortion.

details on a different kind of record club

offering... BACH, BEETHOVEN, BRAHMS, CHICAGO, JOHN DENVER, EARTH-WIND & FIRE, C.W. McCALL, FREDDY FENDER, LINDA RONSTADT, GROVER WASHINGTON JR., DONALD BYRD and every other composer and artist in print

You can now own every record or tape that you may ever want at tremendous savings and with no continuing purchase obligations. You can get valuable free dividend certificates, you can get quick service and all the 100% iron-clad guarantees you want

Now you can stop price increases that eave you with less music for your record and table budget. You can guarantee yourself more music for less money through membership in Discount Music Club.

Look at these benefits

TREMENDOUS SAVINGS on every record and tape in print no agree-to-purchase obligations of any kind

DISCOUNTS OF 43% TO 73% off mfg suggested list special catalog features hundreds of titles and artists

ALL LABELS AVAILABLE including most imports through special custom ordering service. If we don't stock it we lliget it for you

SCHWANN CATALOG lists thousands of titiles classical pop jazz ballet operal musical shows folk, rock vocal instrumental country

DISCOUNT DIVIDEND CERTIFICATES. Dividend Gifts Every shipment carries a dividend gift or dividend certificate Certificates redeemable mmediately for extra discounts

NEWSLETTERS. Happenings in the world of music concerts critiques new releases special super-sale discounts of up to 73%.

DISCOUNT ACCESSORY GUIDE. Dramond needles, cloths, tape cleaners, etc. Discount Music Club is your complete one stop music and accessory buying service

World Radio History

QUICK SERVICE. Same day shipping on many orders rarely later than the next several days. Partial shipments always made in the event of unforeseen delay all at no extra cost to you.

100% IRON-CLAD GUARANTEES on all products and services. Everything is guaranteed factory fresh and free of defects or damages of any sort. Your total satisfaction is unconditionally guaranteed.

Discount Music Club is a noobligation membership club that guarantees tremendous discounts on all stereo records and tapes and lets you buy what you want...when you want...or not at all if you choose.

These are just a few of the moneysaving reasons to write for free details. You can't lose so why not fill out and mail the coupon for immediate information.

 41 (- (-	650 Main St	Discount Music Club Department 33-0877 New Rochere N Y 10801	
s	NAME		
of	ADDRESS		
d	CITY		
С	STATE	ZIP	

CIRCLE NO. 1 ON READER SERVICE CARD

Four-Channel Sound—Stereo produced by four loudspeakers, each being fed a different signal. At present four-channel tape machines are equipped with special heads and electronics that enable them to play back and sometimes record—four tracks at a time.

Four-Track or Quarter-Track Record-

ing—The arrangement by which four different channels of sound may be recorded on quarter-inch-wide audio tape. These may be recorded as four separate and distinct tracks (monophonic) or two related (stereo) pairs of tracks. By convention, tracks 1 and 3 are recorded in the "forward" direction of a given reel, and tracks 2 and 4 are recorded in the "reverse" direction. (See also Four-Channel Sound).

Frequency—The repetition rate of cyclic energy, such as sound or alternating electrical current, expressed in cycles per second (hertz or Hz) or thousands of cycles per second (kilohertz or kHz). By convention, "bass" frequencies in music extend from about 20 to about 200 Hz. "Treble" sounds are at the high-frequency extreme of the sound spectrum and may extend from 2 or 3 kHz to the frequency limit of audibility (about 18 to 20 kHz). "Middle" (or mid-range) frequencies occupy the remainder of the spectrum, from 200 Hz to about 3 kHz.

Frequency Range—The span between the highest and lowest pitched sounds that a tape recorder or other sound-system component can reproduce at a usable output or volume level.

Frequency Response—Always specified as a range, such as 50 to 15,000 Hz; but in order to be meaningful it must be further defined in terms of decibel variation from absolute flatness over a specified frequency range (*e.g.*, ± 3 dB from 50 to 15,000 Hz). An indication of a sound system's ability to reproduce all audible frequencies supplied to it, maintaining the original balance among the low, middle (or mid-range), and high frequencies.

Front-to-back ratio—The ratio between a *cardioid* microphone's sensitivity to sounds arriving from the front and from the rear, a measure of its directionality.

Full-track recording—Recording monophonically on one track whose width is essentially the same as the tape's.



Various tape-head adjustments.

Gain—The voltage ratio of the output level to the input level for a system or component of a system. Usually expressed in decibels.

Gap—The effective distance between opposite poles of a magnetic head, measured in microinches or microns. Especially critical for playback heads, in which gaps must be narrow in order to resolve (reproduce) high-frequency (short wave-length) signals. Recording heads generally have wider gaps than reproducing heads.

Harmonic Distortion — Distortion characterized by the appearance in the output signal of spurious harmonics of the fundamental frequency. Usually expressed as a percentage of the output signal, and abbreviated HD or THD.

Head-In a magnetic recorder, the generally ring-shaped electro-magnet across which the tape is drawn. Depending on its function, it either: (a) erases a previous recording, (b) converts an electrical signal to a corresponding magnetic pattern and records it on the tape, or (c) picks up a magnetic pattern already on the tape and converts it to an electrical playback signal. Two-head recorders, such as most cassette recorders, have a separate erase head, but combine the record and play functions in a single unit. Three-head machines have separate heads for erase, record and playback. Four-head machines may have, in addition, an extra playback head for use with a different track format than that which the machine records on the tape, or a separate, *Crossfield* head to carry recording bias only. See also *Monitor Head*.

Head Alignment—Includes all mechanical adjustments necessary to assure proper spatial relationships between the head gaps and the tape—or, more specifically, a properly recorded tape track. It may be separated into five attributes describing correct head attitude.

Head Demagnetizer or Degausser— A device used to neutralize possible residual or induced magnetism in heads or tape guides. Unless the recorder has an automatic head-demagnetizing circuit and non-magnetic tape guides, periodic use of a head demagnetizer may be necessary to avoid addition of hiss noise to, or even partial erasure of, prerecorded tapes.

Hz—The standard abbreviation for Hertz, the unit of frequency, amounting to one complete waveform cycle per second.

IC—Integrated Circuit, a small device incorporating the equivalent of hundreds or thousands of transistors, capacitors, resistors and other components within a small, solid block. IC's are widely used to reduce the cost and increase the reliability of complex circuitry.

Impedance—The resistance to the flow of alternating current in an electrical circuit, generally categorized as either "high" or "low," but sometimes given in ohms or millions of ohms (megohms). Commonly used to rate electrical input or output characteristics of components so that proper "match" can be made when interconnecting two or more devices (such as a microphone, tape recorder, and loudspeaker). Power loss or frequency discrimination can result from a "mismatch" of impedances between two units. Abbreviated as "Z."

Input—The terminals, jack, or receptacle provided for the introduction of the electrical input signal voltage into an amplifier or other electronic component.

Input Signal—An electrical voltage embodying the audio information that is presented to the input of an amplifi-

Now we've mastered a Scotch cassette for every switch position.



Introducing the Master Series. Three totally different tapes. Each developed to deliver the truest, clearest sound possible at each tape selector switch position.

Our Master I cassette is for normal bias recording. It features an excellent dynamic range, low distortion, uniform high frequency sensitivity and output that's 10 dB more than standard tapes.

Our new Master II replaces chrome cassettes and is designed for use on hi-fi stereo systems with chrome bias (70 microsecond equalization). It features some spectacular performance characteristics, including a special coating that gives it a 3 dB better signal-to-noise ratio at low and high frequencies than chrome cassettes, yet it's less abrasive.

Our new Master III is for the ferri-chrome setting. It's formulated with the most advanced technology available, giving a 3 dB output improvement at low frequencies and 2 dB at high frequencies. And the unique dual layer construction increases both low and high frequency sensitivity over chromium dioxide and ferric oxides.

All this, plus unique inner workings you can actually see. Our new Master line has a special bonus feature. A precision molded clear shell that allows you to monitor the inner workings of the cassette. You can actually see the recorder head penetration and the unique roller guides in action. Look closely at the transparent shells above and you'll see the water wheels which were specially designed to move the tape evenly across the head, reducing friction and noise. And two radially creased shims insure smoother wind, improved mechanical reliability and reduced wow and flutter.

Enough said. Now it's time for you to take the true test. Match up the right Master cassette with the bias you prefer. Then just listen.

You'll find that whichever switch position you use, a Scotch Master is the way to get the most out of it.

Scotch Recording Tape. The truth comes out.

World Radio History

er, tape recorder, or other electronic component.

Intermodulation Distortion (IM)—Distortion that results when two or more pure tones produce new tones with frequencies representing the sums and differences of the original tones and their harmonics.

ips—Abbreviation for tape speed (inches per second).

Jack—Receptacle for a plug connector leading to the input or output circuit of a tape recorder or other piece of equipment. A jack matches a specific plug.

kHz—Abbreviation for kilohertz, or one thousand cycles per second. For example, 19 kHz equals 19,000 Hz.

Lavalier—A microphone designed to be worn around the performer's neck.

Leader—Special non-magnetic tape that can be spliced to either end of a magnetic tape to prevent damage and possible loss of recorded material, and to indicate visually where the recorded portion of the tape begins and ends.

Low-Noise Tape—Magnetic tape with a signal-to-noise ratio 3 to 5 dB better than conventional tapes, making it possible to record sound (especially wide-frequency-range music) at reduced tape speeds without incurring objectionable background noise (hiss) and with little compromise of fidelity. Additional characteristics of most lownoise tapes include extremely good high-frequency sensitivity and a heavyduty binder system for reduced ruboff of magnetic oxide and an increase in wear life over ordinary tapes.

Low-Print Tape—Special magnetic recording tape significantly less susceptible to print-through (the transfer of signal from one layer of tape to another), which results when tape is stored for long periods of time. These tapes are especially useful for "master recording" (making an original recording from which copies will be made) on professional-quality equipment.

Memory Counter (or Rewind)—A system which allows the tape to be rewound automatically to any predetermined point on the tape.

Micro-Cassette—A miniature cassette system originated by Olympus and so far adopted mainly by Japanese manufacturers, allowing 30 minutes of recording per side on a capstan-driven tape, 1/7-inch wide, running at 15/16 ips.

Mini Cassette—A miniature cassette system originated by Philips, allowing 15 minutes of recording per side on a narrow tape. The tape is not driven by a capstan, but by the take-up spindle; hence, tape speed is not constant, but increases as the amount of tape on the take-up hub grows.

Mixer—An audio control unit whose basic function is to combine two or more audio signals into a single, composite signal. Mixers typically have separate level controls for each of their input channels, and often level controls for their combined output channels as well.

Modulation—The imposing of a signal on some type of transmission or storage medium, such as a radio carrier or magnetic tape.

Monitor Head—A separate playback head on some tape recorders that makes it possible to listen to the material on the tape an instant after it has been recorded, and while the recording is still in progress. On some cassette decks with monitor capability, the monitor "head" is not completely separate, but is built into the same shell as the record head.

Mono, Monophonic—Single-channel sound.

Motion-Sensing—A type of tape transport in which certain actions which could break or spill the tape are prevented or delayed until the instant the tape has come to a stop or reached a speed which allows the action to take place safely.

Moving-Coil—A microphone whose generating element is a coil which moves within a magnetic gap in response to sound pressure on the diaphragm attached to it, rather like a small loudspeaker in reverse. The most common type of *Dynamic Microphone*, and the one most often referred to by that name.

MPX Filter, Multiplex Filter—Circuits to remove 19kHz tones from a signal to be recorded, in order to prevent audible interference between the tape recorder's bias signal and the 19kHz pilot tone in the output signal from a stereo FM tuner or receiver. Some receivers and tuners have such filters built in, too.

Mylar—Dupont's trademark for Polyester.

NAB Curves, NAB Equalization Standard tape playback *equalization* curves for various tape speeds, developed by the National Association of Broadcasters.

NAB Reel, NAB Hub—Reels and hubs used in professional recording, having a large center-hole, and usually an outer diameter of $10\frac{1}{2}$ inches.

Noise—Unwanted electrical signals produced by electronic equipment, and rough or non-homogeneous oxide coatings on magnetic tape. Mostly confined to the extremes of the audible frequency spectrum where it occurs as hum and/or hiss, it may be reduced by good machine and tape design. (See also *Low-Noise Tape*)

Noise, Weighted—The noise measured within the audio frequency band using a measuring instrument that has a frequency-selective characteristic. The frequency sensitivity of the instrument is adjusted to correspond to that of the average human hearing response.

Omnidirectional—A microphone type that picks up sound relatively evenly from all directions (in practice, nearly all microphones become at least somewhat directional at higher frequencies.)

Output (or Max. Output Level)—The useful signal delivered by a recorder using a particular type of tape, usually at an arbitrarily fixed level of harmonic distortion (1 or 3 per cent) and relative to the performance of a tape with standard characteristics.

Oxide—The magnetic particles which, when properly dispersed in a plastic binder and coated on a backing or base, form the magnetic portion of magnetic tape.

Pause Control—A feature of some tape recorders that makes it possible to stop the movement of tape temporarily without switching the machine from "play" or "record."

Peak Indicator—An indicator, usually of the flashing-light type, showing when transient signal levels exceed a recorder's ability to handle them without distortion. Such indicators are often used to supplement *Recording-Lev*el Meters, which usually indicate average signal levels.

Peak-Reading meter—A type of *Recording-Level Meter* whose needle rises quickly and falls back at moderate speed, permitting the operator to judge the levels of transient peak waveforms.

Piezoelectric microphone—A microphone whose generating element is a crystal or ceramic element, which generates a voltage when bent or stressed; such microphones tend to have lower cost, higher output, more limited frequency response and higher impedance than *Dynamic* microphones. Of the two main piezoelectric types, ceramic microphones are more rugged than crystal ones.

Pinch roller—A rubber or neoprene wheel which presses the tape against the capstan during recording or play, which in turn provides sufficient traction for the capstan to move the tape. Sometimes called an "idler wheel."

Pitch Control—A circuit which permits the speed of a tape transport's motor to be varied slightly. It is used to raise and lower the musical pitch of the recording being played (hence the name), or to slightly lengthen or shorten playing time.

Playback—The reproduction of sound previously recorded on a tape. The opposite of *record*.

Playback Head—Magnetic head used to pick up a signal from a tape. Often the same head as is used for recording, but with its circuits changed by means of a record/play switch which also energizes the erase head. (See also *Head*)

Polyester Base—A plastic-film backing for magnetic tape used for special purposes where strength and resistance to temperature and humidity change are important. (Mylar is a du Pont trade name for their brand of polyester.)

Pop Filter-See Blast Filter.

Portable Recorder—A battery-powered recorder requiring no external power for operation (though usually equipped to accept external power when available).

Prerecorded Tape—Tape recordings that are commercially available and generally embody the same material that is available on phonograph records.

Pressure Pad—A device that forces tape into intimate contact with the head gap, usually by direct pressure at the head assembly. Felt or similar material, occasionally protected with self-lubricating plastic, is used to apply pressure uniformly and with a minimum of drag on the backing (non-coated) side of the tape.

Print-Through—Undesired transfer of magnetic pattern from layer to layer of tape on a reel. In many cases, will make recording unusable.

Program Selector—Control which switches an 8-track recorder from one set of tracks to another.

Pulse-Code Modulation (PCM)—A type of digital recording.

Punch-in Recording—A record button which may be actuated at any time, even when the tape is already moving. This allows the operator to listen to and add to a recording by listening to the tape to find just where the new recorded material should begin, and start recording there. It also, unlike the interlocked record and play controls typical of home machines, makes it easy to accidentally erase a previously-recorded tape.

Q8—A quadraphonic 8-track tape cartridge.

Quadraphonic—See Four-Channel.

Quarter-Track—See Four-Track.

Raw Tape—A term sometimes used to describe tape that has not been used for recording. Also called "virgin" or "blank."

Recorder—A tape machine consisting of a transport, playback and recording electronics, and an amplifier and speaker, as opposed to a *Deck*, which lacks amplifier and speaker. Also used to distinguish a tape machine (which can record) from a player (which cannot).

Recording-Level Meter—An indicator on a tape recorder that provides some idea of the signal-levels being applied to the tape from moment to moment. It is intended as an aid in setting the recording levels to ensure that the tape is neither overloaded with excessive levels or "under-recorded" with too little World Radio History signal, allowing hiss and other noise to intrude. Recording-level meters come in a variety of types, including meters that register the approximate *average* value of the signal (of which the professional VU Meter is an example), those designed to show the instantaneous *peak* levels of the signal, and some not readily classifiable into any group.

Rewind Control—A button or lever for rapidly rewinding tape from the takeup to the supply reel (or hub, in cassette recorders). Not found in 8track, or other continuous-loop cartridge recorders.

Ribbon Microphone—A type of *Dynamic Microphone* whose generating element is a light, metallic ribbon which is moved directly by sound pressure within a magnetic field.

S/N—See Signal-to-Noise Ratio.

Saturation—The condition reached in magnetic tape recording where output does not increase with increased input, and hence distortion increases significantly. Useful for defining reference output levels, since it is independent of bias current.

Sensitivity—A measure of relative output for a given input of a tape, microphone, or electronic component.

Separation—The degree to which two stereo signals are kept apart. Stereo realism depends on the successful prevention of their mixture in all parts of a hi-fi or tape system. Opposite of *Crosstalk*.

Signal-to-Noise Ratio—The voltage ratio, usually expressed in decibels, between the loudest undistorted tone recorded and reproduced by the recorder and the noise reproduced when the audio signal is reduced to zero.

Single-Point Stereo Microphone—A housing containing two, usually directional, microphones angled so that each picks up sound from one side of the stereo field, with both picking up sounds from the middle.

Sound-on-Sound—A method by which material previously recorded on one track of a tape may be re-recorded on another track while simultaneously adding new material to it.

Source/Tape Switch—A control found on control amplifiers with tape monitor

jacks, and on recorders with *Monitor Heads*; allows comparison of the signal being fed to the tape (Source) with the signal just recorded.

Splice—A physical join made between two pieces of tape.

Splicer—A device, similar to a film splicer, for splicing magnetic tape automatically or semi-automatically.

Splicing Block—A type of splicer in the form of a metal or plastic device incorporating a groove which holds the tape ends to be spliced, crossed by additional diagonal and straight grooves providing paths for a razor blade to follow in cutting the tape.

Splicing Tape—A special pressuresensitive, non-magnetic tape used for joining two lengths of magnetic tape. Its "hard" adhesive will not ooze, and consequently will not gum up the heads or cause adjacent layers of tape on the reel to stick together.

Squeal—The audible noise caused by alternate sticking and release of tape. It may occur at heads, pressure pads, or guides where friction develops with the face or back side of a magnetic tape. It is largely eliminated by regular cleaning of suspected surfaces and by using a tape employing a built-in dry silicone lubricant.

Stereophonic, Stereo—Using two or more channels to create a spatial effect. Strictly speaking, quadraphonic sound is therefore a form of stereo. But the term "stereo" is commonly used to distinguish a two-channel recording from a four-channel, quadraphonic one, as well as from a single-channel monophonic one.

Stroboscope—A pattern of markings on a moving or rotating part which appear, under the rapid flickering of an a.c.-powered neon light, to stand still when the part is moving at its correct speed.

Supercardioid—See Cardioid.

Synch, Sync.—The maintenance of correct time relationships between events. Examples in recording include synchronization of sound and film for motion-picture use, synchronization of a slide-changing projector with a tape by means of signals recorded on the tape, and "Selective Synchronization," or "Sel-Sync" as it was originally named by Ampex, used to synchronize several tracks when they are recorded one at a time.

Takeup Reel—The reel on the tape recorder that accumulates the tape as it is recorded or played.

Tape Guides—Grooved pins or rollers mounted between and at both sides of the tapehead assembly to position the magnetic tape correctly on the head as it is being recorded or played.

Tape Lifters—A system of movable guides that automatically prevents the tape from contacting the recorder's heads during fast forward or rewind modes of operation, thus preventing head wear.

Tape Loop—A length of magnetic tape with the ends joined together to form an endless loop. Used either on standard recorders, special "messagerepeater" type units, or in four- or eight-track cartridge devices, it makes possible the repetitive playback of a recording without rewinding the tape.

Tape Monitoring—See Monitor Head.

Tape Player—A unit that is not capable of recording and is used only for playing prerecorded tapes.

Tape Speed—The speed at which tape moves past the head in recording or playback modes. Standard tape speed for home use is 71/2 ips or half that speed (3-34 ips). Speeds of 178 and 15/16 ips are found on some machines, but on reel-to-reel recorders are usually suitable only for non-critical voice recording. Some cartridge machines, using special tape and circuits, achieve very good results at the slow speeds. Professional recording speed (for making original master tapes of music, for example) is usually 15 ips and sometimes higher. Higher tape speeds increase fidelity and simplify editing (the sounds to be edited are spaced farther apart), but increases tape consumption and hence cost.

Tape Splicer—See Splicer.

THD—See Harmonic Distortion.

Three-Head—See Head.

Three-Motor—Having separate motors for the capstan and each of the two reel motors. This simplifies the mechanical design of a recorder, with some increase in reliability, but increases its cost as well.

Track—The path on the magnetic tape along which a single channel of sound is recorded.

Transport—The platform or deck of a tape recorder on which the motor (or motors), reels, heads, and controls are mounted. It includes those parts of the recorder other than the amplifier, preamplifier, loudspeaker, and case.

Tuchel Connector—Brand-name of a manufacturer of *DIN plugs*.

Two-Track Recording—On quarterinch-wide tape, the arrangement by which only two channels of sound may be recorded, either as a stereo pair in one direction or as separate monophonic tracks (usually in opposite directions).

VU Meter—A type of *Recording Leve' Indicator* which shows average signal levels in decibels relative to a fixed 0-dB reference level (and, often, in percent of maximum recommended modulation). While the term is frequently used for any level meter using this scale, it applies most strictly to meters having a specified, standard degree of damping; it is widely used in professional equipment in the United States, because the standardized damping allows the operator familiar with one VU meter to closely judge signal levels on any other true VU meter.

Wave Length—In tape recording (and referring specifically to the tape magnetization created by pure single-tone recording), the shortest physical distance between two peaks of the same magnetic polarity; also, when expressed in mils, the ratio of tape speed (in ips) to recorded frequency (in kilohertz).

Wow—A form of distortion in soundreproducing systems caused by relatively slow, periodic variations in the speed of the medium (such as tape), and characterized by its effect on pitch. Rapid variations are known as *flutter*.

Wrap—The length of the tape's path along which tape and head are in intimate physical contact. Sometimes measured as the angle of arrival and departure of the tape with respect to the head. A "good wrap" means a good tape-to-head-gap relationship. (See also Head Alignment)

DIRECTORY OF MANUFACTURERS

ACE AUDIO 532 5th St., East Northport, NY 11731

ADC, Audio Dynamics Corp. Pickett District Rd., New Milford, CT 06776

ADC PROFESSIONAL PRODUCTS GROUP Pickett District Rd., New Milford, CT 06776

ADVENT CORPORATION 195 Albany St., Cambridge, MA 02139

AIWA, Meriton Electronics Inc. 35 Oxford Dr., Moonachie, NJ 07074

AKAI AMERICA LTD. 2139 East Del Amo Blvd., Compton, CA 90220

AKG, Philips Audio Video Systems Corp. 91 McKee Dr., Mahwah, NJ 07430

ALARON INC. 185 Park St., Troy, MI 48084

AMPEX CORPORATION, Magnetic Tape Div. 401 Broadway, Redwood City, CA 94063

AUDIO-TECHNICA U.S., INC. 33 Shiawassee Ave., Fairlawn, OH 44313

AUDIOTEX, GC Electronics 400 S. Wyman St., Rockford, IL 61101

BASF SYSTEMS Crosby Dr., Bedford, MA 01730

BEYER/DYNAMIC, Hammond Industries 155 Michael Dr., Syosset, NY 11791

BIGSTON CORP U.S.A. 9829 W. Berwyn Ave., Rosemont, IL 60018

BSR McDONALD, BSR (USA) LTD. Rt. 303 Blauvelt, NY 10913

BURWEN RESEARCH, INC. 30 Cross St., Cambridge, MA 02139

CAPITOL MAGNETIC PRODUCTS 1750 N. Vine St., Los Angeles, CA 90028

CENTREX by PIONEER, Pioneer Electronics of America 1925 E. Dominiquez St., Long Beach, CA 90810

CERWIN-VEGA INC. 12250 Montague St., Arleta, CA 91331

CHANNEL MASTER DIV., Avnet, Inc. Ellenville, NY 12428

COLUMBIA MAGNETICS, CBS, Inc. 51 West 52nd Street, New York, NY 10019

CRAIG CORPORATION 921 W. Artesia Blvd., Compton, CA 90220

dbx INCORPORATED 296 Newton St., Waltham, MA 02154

DOKORDER, INC. 5430 Rosecrans Ave., P.O. Box 8, Lawndale, CA 90260

DUAL, United Audio Products, Inc. 120 S. Columbus Ave., Mount Vernon, NY 10553

DUBIE TAPE AID CORPORATION 6717 Tall Oaks Dr., Oklahoma City, OK 73127

EDITALL, Elpa Marketing Industries, Inc. Thorens Building, New Hyde Park, NY 11040

ELECTRO-VOICE INC., Sub. Fulton Industries, Inc. 600 Cecil Street, Buchanan, MI 49107

ESS, INC. 9613 Oates Dr., Sacramento, CA 95827

FUJI PHOTO FILM USA INC. 350 Fifth Ave., New York, NY 10001

1978 EDITION

HARMAN/KARDON 55 Ames Court, Plainview, NY 11803

HEATH COMPANY Benton Harbor, Michigan 49022

HELPINSTILL DESIGNS 5808 S. Rice Ave., Houston, TX 77081

HITACHI SALES CORP. OF AMERICA 401 W. Artesia Blvd., Compton, CA 90220

INFINITY SYSTEMS, INC. 7930 Deering Ave., Canoga Park, CA 91304

IRISH MAGNETIC TAPE, Div. of Morhan National Sales Co., Inc. 270-78 Newtown Rd., Plainview, NY 11803

JENSEN SOUND LABORATORIES, Div. of Pemcor, Inc. 4310 Trans World Rd., Schiller Park, IL 60176

JULIETTE, Topp Electronics, Inc. 4201 N.W. 77th Ave., Miami, FL 33166

JVC AMERICA INC. 58-75 Queens Midtown Expressway, Maspeth, NY 11378

KENWOOD ELECTRONICS, INC. 75 Seaview Drive, Secaucus, NJ 07094

KLARK-TEKNIK, Hammond Industries, Inc. 155 Michael Dr., Syosset, NY 11791

KOSS CORPORATION 4129 Port Washington Ave., Milwaukee, WI 53212

LAFAYETTE RADIO ELECTRONICS CORP. 111 Jericho Turnpike, Syosset, NY 11791

LENCO, Neosonic Corporation of America 180 Miller Place, Hicksville, NY 11801

MAGNESONICS SALES P.O. Box 127, Northridge, CA 91326

MARANTZ CO., INC., Subs. Superscope, Inc. P.O. Box 99, Sun Valley, CA 91352

MARLBORO SOUND WORKS 170 Eileen Way, Syosset, NY 11791

MAXELL CORP. OF AMERICA 130 W. Commercial Ave., Moonachie, NJ 07074

MEMOREX CORPORATION P.O. Box 420, Santa Clara, CA 95052

MERITON ELECTRONICS, INC. 35 Oxford Drive, Moonachie, NJ 07074

MIIDA ELECTRONICS, INC. 205 Chubb Ave., Lyndhurst, NJ 07101

MOTOROLA INC. 1299 E. Algonquin Rd., Schaumberg, IL 60196

MURA CORP. 177 Cantiague Rock Rd., Westbury, NY 11590

MXR INNOVATIONS INC. P.O. Box 722, Rochester, NY 14603

NAGY RESEARCH PRODUCTS P.O. Box 289, McLean, VA 22101

NAKAMICHI RESEARCH (USA), INC. 220 Westbury Ave., Carle Place, NY 11514

NEUMANN, Gotham Audio Corp. 741 Washington St., New York, NY 10014

NORTRONICS COMPANY, INC. 8101 Tenth Ave. N., Minneapolis, MN 55427

OLYMPUS CORPORATION OF AMERICA 2 Nevada Dr., New Hyde Park, NY 11040

OPAMP LABS INC. 1033 N. Sycamore Ave., Los Angeles, CA 90038 (Continued on page 118)

ARE YOU BLAMING YOUR TAPE RECORDER FOR PROBLEMS CAUSED BY YOUR TAPES?

Every day people all over the country go into hi fi dealers with complaints about their tape recorders.

When in reality what they should be complaining about is their tapes.

Because the fact is, a lot of the problems that plague tape recorders can be attributed to bad tape.



HEAD WEAR IS CAUSED BY YOUR RECORDER. OR IS IT?

If you have to clean your tape heads more than usual, for example, it could be your tape doesn't have a special nonabrasive head cleaner.

Maxell has one. If your recorder jams, it can be any number of things. Maxell does something to prevent all of them.

We make our cassette shells of high impact polystyrene. And then so they won't crack



JAMMING IS CAUSED BY YOUR RECORDER. OR IS IT?

even after years of use, we finish them to tolerances as much as 60% higher than industry standards.

Inside, we use free rolling Delrin rollers so the tape doesn't stick.

And finally, we screw instead of weld everything together because screws make for stronger cassettes.

If your recorder frequently suffers lapses in sound, it could be the tape is of inferior quality. And nobody's bothered testing the tape for dropouts before it leaves the factory.



DROPOUTS ARE CAUSED BY YOUR RECORDER. OR ARE THEY? Maxell tape is made of only the finest polyesters. And then every



POOR TRACKING IS CAUSED BY YOUR RECORDER. OR IS IT?

step of the way it's checked for even the slightest inconsistencies.

So if you re having problems with your recorder, try a Maxell cassette, 8-track or reelto-reel tape.

You might find there's really nothing wrong with your tape recorder, just with your tape.



MAXELL. THE TAPE THAT'S TOO GOOD FOR MOST EQUIPMENT. Maxell Corporation of America, 130 West Commercial Ave., Moonachie, New Jersey 07074

Julian Hirsch tells you what to look for in a **CASSETTE DECK**



The Teac 860 cassette deck: what \$1,600 looks like

F YOU number yourself among those who are planning to add a cassette deck to an existing setup or to include one in a brand-new system, you may already have discovered that they come in so bewildering a variety of sizes, shapes, and prices that even the most experienced audio shopper can easily find himself confused. To get right to the heart (which is to say the pocketbook) of the matter, what is one to make of a component whose price range covers a spread from about \$100 to \$1,600? Well, what one does first is to simplify: decide what you need in a cassette deck so you will know roughly where within that broad range to concentrate your shopping energies.

Cassette machines, like other audio components, can be classified according to both their performance specifications and their operating features. The two are not necessarily related, although both can affect the price. The key performance specifications of a recorder are its frequency response, signal-to-noise ratio (S/N), and flutter. The first two of these are closely related to the machine's mechanical alignment, the kind of tape being used, and how closely the bias and equalization circuits have been adjusted to the needs of that tape. Flutter, however, is primarily a function of how well the tape-transport mechanism works.

As might be expected, all aspects of cassette-deck performance tend to improve with increasing price. And, as usually happens with other components, once a certain level of performance is achieved, the law of diminishing returns begins to assert itself and large cash outlays yield only small increments of performance improvement. The question, then, is how good does a recorder have to be to satisfy your needs? Suppose we look for the answer to that question by examining typical performance specifications within the various price categories.

Frequency Response

Home cassette recorders are often used to tape radio broadcasts or to make copies of phono discs. Even the least expensive decks usually have a frequency response of 50 to 12,000 Hz ±3 dB with "standard" ferric oxide tape, and this is usually adequate for making faithful copies of FM broadcasts or records. The upper frequency limit may be extended to about 14,000 or 15,000 Hz with chromium-dioxide (CrO2) tape or with a premium tape that takes the same bias and equalization. Fortunately for the tightly budgeted consumer, this level of performance is found in virtually every deck priced at \$100 or more. The best tapes, however, cannot be used to full advantage on decks priced under \$150.

Recorders in the over-\$300 price range usually have an extended high-frequency response, often reaching 15,000 Hz with ferric tapes and 16,000 to 18,000 Hz with chrome-bias tape. With the extended response, not too important in itself, comes improved flatness at lower frequencies, and this minimizes the slight sonic coloration caused by small response variations within the audible range. Almost all recorders over the \$300 level (and many between \$200 and \$300) can, given the proper conditions, copy a record or FM broadcast so faithfully that it would be very difficult to hear a difference between the original program and the tape playback.

For those who are totally uncompromising or who plan to do live music recording, the best machines have a frequency response up to 18,000 Hz with ferric tape and to 20,000 Hz or beyond with CrO_2 or other premium tapes such as ferrichrome or the new TDK Super Avilyn. This slightly wider range is found in machines selling for \$500 or more.

Flutter

Flutter, once a major limitation of cassette mechanisms, arises from the difficulty of moving the tape smoothly past the heads. Improved tape-drive systems as well as better mechanical construction in the cassettes themselves have reduced flutter in today's machines to acceptable levels, even in some relatively low-price models. In the \$100 class, machines tend to have a flutter specification of 0.2 per cent or more. This may be good enough for most home-recording purposes, but its effect will be audible in music with sustained notes, such as strings, piano, or organ. In the range from \$200 upwards, flutter is usually not more than 0.15 per cent, and above \$400 it is generally 0.1 per cent or less. The best machines claim (and probably deliver) flutter levels as low as 0.08 per cent or less, rivaling the figures for open-reel decks.

Considering the total electromechanical performance of a cassette recorder, it is reasonable to conclude that a machine priced from \$100 to \$150 will be adequate for noncritical recording, while those in the range from \$150 to \$400 will provide progressively better quality for more demanding uses. The audible improvements with *still* more expensive machines may not always be so obvious, but they are real and will prove their worth in the most difficult recording tasks.

Signal-to-noise Ratio

In general, the signal-to-noise ratio (S/N) is probably a more important specification than frequency response, since a quiet recording is going to sound better overall than one with an audible noise level regardless of the frequency response of the machine or the program. The S/N is the difference between the maximum recorded signal level (defined as that which produces distortion of 3 per cent in playback) and the playback noise from a section of tape recorded with no input signal. It is expressed in decibels

(dB), and it generally involves a measurement that includes both hum and hiss.

The specific S/N of a cassette machine is a property of its electronic circuits and of the tape used, as well as the specific adjustment of the machine and, to a slight extent, the heads. Low-price decks (\$100 to \$150) may have a 48-dB S/N, while 50- to 55-dB specifications are more usual at prices of \$200 or more. A few of the finest recorders have S/N ratings as good as 60 dB with their Dolby circuits switched out (note that the accompanying tabulations of selected available cassette machines list S/N with the Dolby circuits in). Since few records or FM transmissions have an S/N exceeding 50 dB, most medium-price machines can do a fine "noise-free" job of recording from these sources. In addition, most of them have Dolby noise-reduction circuits that can improve their basic S/N as much as 10 dB.

For serious recording of live music on cassettes, even the best machine is marginal. Even so, one is more likely to be limited by the quality of the microphones than that of the recorder, and good microphones can cost more than the recorder itself—a whole 'nother story! For live recording, the best possible S/N is a "must," and the 65 to 70 dB achieved by a few very expensive machines with the aid of Dolby circuits or other noise-reduction devices may well justify their cost.

Features and Functions

A recorder's features, whether standard or special, are not necessarily related directly to its sound, but they can be every bit as important as its electrical performance. Often they account for a large percentage of the price, especially in the range from \$500 to \$1,000 or more, but in terms of record/ playback utility and performance it is money well spent. Let us examine the contributions of the most important of these features. reduce the noise that is normally added by the recording and playback processes. The best known and most widely used system is the Dolby "B" device (the "A" system is used in professional recording). Originally found only in the more expensive machines, the Dolby system is now built into almost every deck priced at more than \$150 or so. This advance has been facilitated by the development of inexpensive integrated circuits (IC's) that replace a large number of discrete components and transistors in the Dolby circuits.

The Dolby technique involves using complementary compression and expansion (during recording and playback, respectively) that affect only the higher frequencies and vary with the signal level. The recording and playback characteristics and the operating signal levels are standardized so that tapes made on one machine can be played back on another with correct frequency response and a noise reduction of up to 10 dB (compared with the noise that would have been present without Dolby processing).

Some FM stations use Dolby encoding on their broadcasts, and when the output of an FM tuner is processed by the Dolby playback system the S/N of the FM program is improved just as it is with tape. A few cassette recorders (usually priced above \$350) have Dolby circuits that can be switched in for use in decoding FM, with or without simultaneous taping of the program.

Some cassette decks made by JVC employ their proprietary Automatic Noise Reduction System (ANRS). Its action is somewhat similar to that of the Dolby system, and it is sufficiently compatible with Dolby that tapes recorded with one system can be played back through the other with good results. Another noise-reducing system, the Philips Dynamic Noise Limiter (DNL) is a signal-controlled low-pass filter that reduces hiss already present in the program-unlike the Dolby and ANRS systems. However, it is not as sophisticated a system as either Dolby or ANRS. The DNL system is found in a few cassette recorders. Both the dbx and Dolby systems are present in Teac's \$1,600 machine.



• Noise Reduction. Noise—or, more specifically, hiss—is one of the fundamental problems in cassette recording. The narrowness of the recorded tracks and the slowness of the tape speed are of course responsible. Fortunately, there are relatively inexpensive ways through which noise can be reduced to a level acceptable to most users.

The circuits used to accomplish noise reduction do not affect the noise that is present in the incoming signal; what they do is



• Tape Compatibility. Early cassette decks were designed to work with the available ferric-oxide tape formulations, which were considerably inferior to the newer tapes. Some time later, and almost simultaneously, high-performance ferric-oxide and chromium-dioxide (CrO_2) tapes appeared on the market. The CrO_2 tapes require about 30 per cent more recording bias than other tapes, and some of the premium ferric tapes



also require more bias than the earlier "standard" tapes. As a result, cassette decks almost immediately appeared featuring two-position bias switches to accommodate ferric-oxide and chrome tapes (these days only the least expensive machines lack this facility). However, a single bias adjustment was still expected to serve with widely varying ferric-oxide formulations. This situation still exists to some extent, but many manufacturers now have switch positions for "normal" and "low-noise" tapes, and a growing number recommend specific tapes for which their machine's bias-switch settings are useful. And in many cases, the "super" tapes of a few years ago have become today's "normal" tapes.

To exploit the full noise-level and frequency-response potential of CrO₂ tapes and some other types, both the recording and playback equalization (as well as the bias) should be changed from the values used with ferric-oxide tapes. After a few years without standard equalization characteristics, the industry situation became stabilized, and on most machines a single switch now optimizes both bias and equalization for the two major tape types. A few machines will even switch automatically to CrO₂ bias/equalization when a CrO₂ cassette with the special coding notch is inserted. On some older machines the bias or the equalization could be switched, but not both. Such machines can give fairly satisfactory results with tapes both recorded and played back on them, but the tapes will not be fully compatible for playback on other recorders-and vice versa.

A couple of years ago a new tape formulation appeared with characteristics midway between those of ferric oxide and CrO₂. Called ferrichrome (FeCr for short), this tape is actually a two-layer product, with ferric oxide next to the backing and a thin layer of chromium dioxide on the outside. The tape was first introduced by Sony, and for a time their recorders were the only ones with the necessary bias switching for its use. A good many manufacturers now include FeCr bias and/or equalization, principally on decks selling for \$250 or more. The 3M "Classic" cassette tape is also a ferrichrome formulation, but it is not exactly the same as the Sony FeCr. However, when the bias and equalization switches are separate on a machine, as they often are, it is frequently possible to find a combination of settings that will permit the machine to perform at close to its optimum with almost any type of tape. A few tape decks have useradjustable bias controls (accessible through holes in the case so they will not be inadvertently disturbed) that make it possible to adjust them for almost any tape.



• Memory Rewind. A popular feature on cassette machines in the over-\$300 class is a memory rewind. The index counter is set to 000 at the beginning of a recording (or at any other point on the tape). When the tape is rewound, it stops automatically at the preset point (more often just before it at the 999 counter reading). Some recorders can be set to go automatically into the PLAY mode after stopping. The memory feature is an obvious convenience, for it returns the tape swiftly to the beginning after recording for a playback check.

Within this same utility area, a few decks are now beginning to appear that have the ability to sense blank segments between musical selections even in the fast-wind mode. Some can be programmed to play any sequence of selections desired. As of this writing, Optonica's APFS (Automatic Program Find System) is the only one to have reached the market.



• Microphone Inputs. Most decks have input jacks for two microphones. Lowerprice units have a switch to select either line or microphone inputs, or in some cases plugging in a microphone disconnects the line input for that channel. On many machines selling for \$350 or more, mixing inputs are provided so that both line and microphone sources can be used simultaneously with independent control of their levels. A few machines have an input for a third microphone which feeds both channels, thereby providing a "center" channel signal. And a couple of decks approach the complexity of semiprofessional mixers in their input and level-control facilities.

Cassette-deck microphone inputs are usually designed for medium-impedance dynamic microphones, and microphones are not included as standard equipment with any but the cheapest machines (too, such microphones are always of low quality). The quality of any "live" cassette recording (and of any open-reel recording, for that matter) is determined more by the microphones than by the recorder, and top-quality microphones can easily cost more than the recorder itself. For this reason, machine manufacturers have wisely left the choice of a microphone to the user, who is thus not burdened with an extra expense if he does not plan to make live recordings.

A few deck manufacturers, recognizing the limitations of a typical cassette recorder's microphone-amplifier circuits, do not provide them on some of their machines. Instead, they offer separate optional microphone preamplifiers with the low noise and freedom from high-level overload that make full use of the recorder's basically good performance when doing live recording.



· Peak Limiters. Peak limiters go into action only when program levels exceed the 0-dB mark on the recorder's meters. If the average recording level is kept several decibels below that point (as it should be with most machines), the limiter has no effect. However, an instantaneous and unexpected peak that would otherwise drive the recorder-or more likely the tape itself-into distortion is limited by the circuit to an acceptable value. The limiter recovers almost immediately, and in situations where one does not have full control over the incoming signal it can prevent distortion with no detectable side effects. Peak limiters are found in a number of cassette decks beginning at about the \$200 level, and they operate with varying degrees of effectiveness. Those used in the \$400 class of machines are excellent, and all decks with this feature have a switch with which it can be disabled.



• Meters. One of the most important factors in making good cassette recordings is close control of the recording level. Virtually all recorders have meters to monitor input levels on the two channels; the playback level will also generally register on these meters. Most machines show the recording level before the recording equalization is applied, and this can be misleading if the program contains abnormally high levels of high-frequency material. A couple of units connect the meters after the equalization so that they can show the true program level reaching the recording head. Normally, 0 dB is the recommended maximum for a distortion-free recording, but there are exceptions to this rule.

Recorder meters differ widely in their size and legibility. Not so visible, but perhaps even more important, are the great differences between them in accuracy and speed of response time. Meters respond relatively slowly to rapid changes in signal level, and at best can indicate only a rough average program level. To make sure that program peaks will rarely, if ever, exceed 0 dB, it is best to record with maximum meter readings well below that level. Meters vary widely in their *ballistic* characteristics how fast they rise and fall on transient waveforms and how much their pointers overshoot the correct reading. As one becomes familiar with the behavior of a given machine, however, it is easy to make good recordings with almost any type of meter system.

Many cassette recorders have meters marked "VU," but none meets the total specification for a true VU meter, which is a professional signal-monitoring device built to stringent response and ballistic specifications. On some of the better meters, however, the ballistic characteristics do correspond closely to the VU specifications.

Recently, several decks, principally in the over-\$400 range, have appeared with fastacting meters driven by electronic circuits that can sense a transient as short as a millisecond and "hold" it long enough for a meter to read its true value. The decay time of these meters is an appreciable fraction of a second, so they tend to follow the peaks of a program without excessive pointer movement. On some machines, the meter response can be switched from average to peak reading.

One variation of the peak-reading meter features an expanded scale covering 40 to 50 dB instead of the usual 20 to 25 dB. This type of meter gives a very clear picture of the program dynamics, and it virtually guarantees a good recording when it is properly used.

Sometimes one or two peak-indicating lights (fast-responding light-emitting diodes) are used in conjunction with a meter that reads the "average" levels of the program. The peak light flashes when a program peak reaches a preset level, usually about 5 dB above the meter's 0-dB level. Some lights are set to flash at too high a level (such as +7 dB), so that distortion has already occurred by the time it flashes.

The Advent 201 and Nakamichi 350 machines are unusual in having only a single meter to monitor the levels of both channels, indicating the higher of the two at all times. This gives a very easily interpreted display that many people find more useful than trying to follow *two* independently swinging meter pointers. However, if one channel is missing or becomes disconnected, the meter will not warn the user of the fact (although on the Advent machine it can be switched to read either channel individually as well as both together).



• Tape-drive Systems. No cassette recorder can be any better than the mechanical "transport" system that moves the tape. Constant speed, with a minimum of shortterm fluctuations (flutter) is a fundamental requirement. Since the tape speed is controlled by the capstan that presses against it, the capstan drive system is basic to the recorder's performance.

Also important are the hub drives, which correspond to the supply and takeup reels of an open-reel deck. They must have sufficient torque to wind the tape smoothly under constant tension, but not so much as to place an undue stress on the very thin tape used in cassettes. The type of drive system used on the hubs also determines how fast a cassette can be wound from one end to the other in fast-forward or rewind modes.

Cassette mechanisms, like those of openreel recorders, can use one, two, or three motors. The large majority of low- and medium-price decks use a single motor for all transport functions. Mechanical clutches, idler wheels, and belts are used to reduce the motor speed to that required by the capstan and to drive the hubs at varying speeds and with constant torque. Many singlemotor machines use a d.c. servo-controlled motor whose speed is determined by a stable reference voltage in the electronic circuits. Internal adjustments set the speed, and one or two models (principally in the over-\$400 range) even have a user-adjustable speed vernier that affects only playback speed. This type of recorder drive can also be designed to operate from a low-voltage d.c. source such as an automobile battery or a built-in battery pack; it is therefore found in all recorders intended for use away from commercial power lines.

A different approach to single-motor drive uses a synchronous motor like the ones used to power many record players. These motors are usually more powerful than the d.c. servo motors, and their speed is fixed by the a.c. power frequency. The greater power and torque of a.c. synchronous motors usually enables them to move the tape more rapidly in fast-forward and rewind modes.

A two-motor drive system has a constantspeed motor for turning the capstan and a separate "torque" motor for driving the hubs. Some two-motor machines use a direct-drive capstan motor similar to those found on some turntables. A few of the most advanced cassette decks use three motors so that each hub is driven by its own motor. One of the more obvious characteristics of three-motor transports (but not exclusive to them) is their very fast winding speed. Some models can wind a C-60 (60minute) cassette fully in under 40 seconds.

A growing number of machines in the over-\$350 price range feature closed-loop dual-capstan drives. This system reduces flutter to a minimum by driving the tape with two capstans on opposite sides of the heads. The trailing capstan (nearest the supply hub) is driven at a slightly lower speed than the forward capstan, placing the tape under a controlled tension as it passes over the heads.

Auto-reverse operation, which eliminates the need to turn the cassette over at the end of a side, is offered on a few machines, including models from Akai, Dual, and Uher. This often involves a dual-capstan drive, with the roles of leading and trailing capstans being interchanged when the tape reverses. The reversal is initiated automatical-



"... I said, 'Have you noticed the difference since I been usin' nothin' but ferrichrome on this cassette player?'..."





ly by a motion-sensing or optical system, or it can be made manually at any time. Since a bidirectional mechanism is inherently more expensive than a conventional type, this feature is found only in recorders in the \$400 and higher price range.



• Heads. The heads of a tape recorder share with the tape transport the major responsibility for its overall quality. The cassette was originally designed to employ an erase head and a single combination recording/playback head contacting the tape through two small openings in the cassette case. Most recorders currently manufactured employ a single record/playback head. However, the requirements for optimum performance of a recording head and a playback head are quite different, so a combination head must involve some performance compromises. Specifically, a recording head should have a fairly wide gap to transfer the maximum amount of energy to the tape's magnetic coating, while the playback head needs a very narrow gap to respond to the extremely short high-frequency wavelengths on the slow-moving cassette tape.

When a combination head is used, it is necessary to employ greater amounts of high-frequency boost (equalization) to achieve the required high-frequency response. This in turn hastens the onset of tape saturation, with the result that the impressively flat frequency response achieved by most cassette recorders can be realized only at lower recording levels such as -20dB. At higher signal levels the high-frequency response drops off markedly.

If the head functions could be separated, each could be optimized for its functionerase, record, or playback-and the problems considerably reduced. By the exercise of a great deal of ingenuity, several manufacturers have done just that, adapting the three-head configuration of reel-to-reel to the cassette format. The first to do so was Nakamichi in the very expensive models 1000 and 700 (\$1,300 and \$850, respectively). These machines use completely separate recording and playback heads, with the former contacting the tape through a narrow opening in the cassette somewhat ahead of the pressure pad. Because of the critical requirement for parallelism between the separate recording- and playback-head gaps, it was necessary to make the record-head azimuth adjustable so that it could be precisely matched (given the tape skew likely to occur between the two heads) to the actual azimuth of the playback head.

Another solution to the azimuth problem is to be found in machines made by Akai, Fisher, Hitachi, and Teac. Separate recordand playback-head parts are permanently built into a single housing, their gaps optimized and permanently aligned to each other at the time of manufacture. The combination head fits through the normal head opening in the cassette and contacts the pressure pad in the conventional way. This is a much less expensive technique than using physically separate heads, and it is naturally reflected in the modest prices of machines using "two-in-one" heads-they generally range from \$200 to \$600. Since the gaps are so close, tape skew between them is negligible, and complex and expensive head-alignment adjustment systems can be done away with.

With either approach to the head packaging, a three-head machine uses separate electronic sections for recording and playback so that the program can be monitored from the tape an instant after being recorded. When the heads are in a common housing, the distance between their gaps is so small that no audible time lag is heard when switching from the incoming signal to the playback-head output.

Not all three-head recorders have equal capabilities, however. Aside from the normal differences one would expect in transport quality and basic head performance. there is the matter of the Dolby circuits, which appear in all these machines. Even in IC form Dolby circuits cost money, so the less expensive three-head machines use a single pair of Dolby circuits switched between recording and playback functions just as in the case of a two-head machine. The monitor output from the playback head is not decoded and so does not have the correct frequency response and noise level; it is therefore not fully effective as a check on a recording in progress. Machines selling for more than \$400 use a "double Dolby" system with four separate Dolby circuits so that simultaneous encoding and decoding can take place. The program can be monitored and compared with the incoming program with the assurance that any differences are caused by the taping process (these differences are usually very small in machines of this quality).



• Miscellaneous Features. There are numerous operating features that can make one machine preferable to another for a specific application, even though they may not have any significant effect on its sonic fidelity. For example, many (but not all) cassette decks have headphone outputs. They are found on machines at all price levels, and their presence or absence is not an indication of quality but merely of the designer's philosophy. Tape-recorder headphone

outputs are usually meant to drive lowimpedance phones (8 to 16 ohms) and often cannot give sufficient volume with the higher-impedance (200 to 600 ohms) phones. Most machines with headphone outputs do not provide a separate volume control for headphone listening, but excessive volume is not likely to be a problem with them in any case.

A number of machines also do not offer any control over their output level in playback. The output is generally matched to the input recording level, so a 0-dB recording level will result in playback at a 0-dB meter reading. This may be acceptable, but it is usually more desirable to be able to match the playback level to the incoming signal level present at the tape-output jacks of an amplifier or receiver, and this is best done with a separate playback-level control.

Portability, including battery operation, is sometimes necessary for some cassette users. There are several portable machines of excellent quality available from JVC, Nakamichi, Sony, Teac, Uher, and Yamaha, all of which can also be operated from an a.c. power source. They are not to be confused, however, with the small *mono* portables that sell for \$100 or less, for these are full-feature stereo decks, usually with noise reduction and full metering. Their prices (in the \$300 to \$600 range) reflect their quality.

Most cassette transports have mechanical controls in the familiar "piano-key" configuration. Usually they are interlocked so that the STOP lever must be pressed before going from playing speed to one of the fast speeds or vice versa. Sometimes a fairly high finger pressure is required to operate these controls, and remote control is not possible. There is, however, a strong trend in higher-price machines to use electromechanical solenoids to operate the controls. These are actuated by light-touch pushbuttons or similar controls, and internal logic systems ensure that the tape won't be mistreated when switching between operating modes. Many of these recorders can be controlled remotely through accessory devices.



• Front vs. Top Loading. The locations of the cassette opening and of the machine's controls are probably its most obvious external features. So-called "front-loading" decks have become very popular in recent years, but most manufacturers of a broad line of recorders produce both front-loading and top-loading models. There are no inherent performance advantages (or disadvantages) in either loading style; choice should be made simply on the basis of where the recorder is to be located and to some degree on your own sense of "human engineering" efficiency. When the machine is to be installed at waist level, the top-loading design is superior, since the cassette and all of its controls are visible from the operating posi-



tion. On the other hand, if the machine is to be stacked with other components on a shelf or placed near eye level, a front-loading design is easier to use.

There are numerous variations on the front-loading recorder. In some, the cassette winds up in a nearly horizontal position for play, and a mirror and internal illumination are needed to make the cassette visible (this works with varying degrees of success). Others place the cassette at a more upright angle or even vertically so that it can be seen directly. Several decks (Dual, Tandberg, Yamaha) are really top-loading types, but they are so designed that the entire deck can be installed standing on its front edge, giving these decks some of the advantages (if needed) of true front-loading designs. However, these machines cannot be stacked with other units or placed on a shelf with limited vertical clearance.

• Distortion Reduction. Although distortion in the recording process can be minimized by careful attention to biasing, equalization, and recording levels, it is still an ever-present risk with cassettes, sometimes emerging in tapes of demanding musical material to a degree that would probably not be encountered with a good open-reel machine operating at 71/2 ips or faster.

Two cassette-deck manufacturers have taken steps to reduce distortion in very different ways. Hoping to prevent the distortion from being recorded on the tape in the first place, Akai has incorporated what they call "Automatic Distortion Reduction" (ADR) in their cassette decks priced at \$350 and higher. Little information is given about the feature's operating principles, but apparently the level of excessive high frequencies in the signal to be recorded (as indicated by the overall signal level) is reduced to forestall tape saturation, the major cause of distortion in recording.

Nakamichi, in its new Model 600 recorder, features an "Intermodulation Suppressor" circuit that can be switched in during playback. Since the distortion characteristics of any tape can be predicted quite accurately, it is possible to create an equal and opposite nonlinearity in the playback process. In effect, this "straightens out" the curvature in the record signal caused by tape saturation. Although this distortion correction can be most effective only with certain tape types, it is at least partly effective with others having similar magnetic properties. The effect of the Nakamichi Intermodulation Suppressor is to permit recording at a level 4 dB higher for the same distortion percentage on playback, or to reduce slightly the playback distortion in a signal recorded at a more normal level.

What to Expect for Your Money

Our emphasis in the foregoing discussion has been on what features are available and in what price ranges they are most likely to be found. Obviously, there is an inexact relationship between many features and the price of a cassette deck, for no machine has all of them and each manufacturer has elected to provide some features in a given price class while omitting others.

One approach for the prospective buyer, therefore, is to discover what overall level of performance, in addition to features, he can expect to find in each of the major price ranges. The least expensive decks, priced between \$100 and \$150, are very few in number and rather basic both as to operating features and technical specifications. They usually have bias switching for ferric and chrome tapes, level meters, and perhaps microphone inputs, but rarely any noise-reducing circuits. You can expect an S/N rating of approximately 45 to 50 dB and perhaps a frequency response from 50 to 12,000 Hz ± 3 dB (slightly wider with CrO₂ tapes). The flutter is always higher on lowprice machines, and whether or not it is acceptable depends on what kind of recording you plan to do. Even 0.25 per cent flutter will not be noticeable on voice and most popular or rock recordings. If you plan to record (or play) piano music, however, these machines are not likely to prove satisfactory.

Between \$150 and \$200, expect to find Dolby noise reduction, which may improve the S/N to 56 dB or better. Some machines in this price range have limiters. Their frequency responses will often not be much different from those of the lower-price recorders, but flutter should be in the 0.15 to 0.2 per cent range-sometimes even lower. Specifications tend to vary considerably from manufacturer to manufacturer at this level, sometimes reflecting differing priorities on the part of the designers, sometimes different ways of rating the same specification. In any case, many of these machines are quite satisfactory for non-critical music recording and playback.

At higher prices you will find more features—memory rewind, front loading, better heads (which sometimes extend the upper frequency limit a bit), and facilities for using a greater variety of tapes (frequently even ferrichrome). Again, lower flutter is the most audible advantage of these machines, with ratings as low as 0.15 or 0.1 per cent. In this price class (\$200 to \$300) there are

relatively few compromises with the standards of true high-fidelity performance. From \$300 to \$400, recorders have wider frequency response, reaching 15,000 to 16,000 Hz with standard tape and 18,000 Hz with better tape. Flutter is typically 0.1 per cent or even significantly lower-figures that are completely negligible for most purposes. The noise level may also be slightly lower, thanks to better heads and electronics, with the S/N surpassing 60 dB (with Dolby). Solenoidoperated controls may be found in machines near the upper end of this price range. Microphone/line input mixing is common, as are peak indicator lights and memory rewind.

Above \$400, the cassette recorder becomes a very refined device indeed. Features, as such, may not differ much from those offered in some lower price categories, but their performance will be better by a small but definite margin. There is probably little advantage in a cassette recorder's having a response extending beyond 16,000 or 18,000 Hz (although some of the best recorders can comfortably surpass these limits), but modest improvements in dynamic range, distortion, and flutter figures are possible-and they are achieved in the most expensive machines. Flutter, for example, can be as low as 0.06 or 0.07 per cent in a number of recorders priced near \$500.

Peak-reading wide-range meters, three heads, and three-motor transports are available in a number of recorders in the \$500-and-up bracket. Owing to the variety of special qualities offered by some of these high-price machines, it is fruitless to generalize. If you are serious enough about cassette recording to consider spending from \$500 to \$1,600, study the available machines in this delightful neighborhood and make your own choice. They are all beautiful products whose precision of construction and overall performance rivals many of the better home open-reel tape recorders.

KNOWING your budget limitations and your performance requirements, you should be in a position to pay your money and make your choice—or vice versa. Given the speed at which the field is expanding, that choice may be somewhat larger than the accompanying tables indicate, but the information presented will provide a uniquely useful understanding of a complicated subject. Good shopping.

WHICH CASSETTE TAPE IS BEST FOR YOUR RECORDER?

By Craig Stark



T'S NOT EASY to pick the best cassette tape for your recording needs from the dozens of "name brand" and hundreds of unknown ones on the market today. Naturally, there is some correlation between price and performance, reflected not only in the tape itself, but also in a host of shell components and their assembly. These can affect performance more than the differences between oxide formulations of the same type. But high price alone will not guarantee satisfaction if your tape deck has not been adjusted for the cassette you select.

Almost all high-fidelity cassette recorders have "bias and equalization" switches designed to accommodate at least two basic tape types: ferric oxide and chromium dioxide. Unfortunately, there are at least *four* major cassette types on the market,



Fig. 1. Results of improper bias vary: (A) DIN bias settings used with typical Japanese ferric tape overemphasize highs due to underbiasing. (B) Correct bias for Japanese ferrics over-biases DIN ferric tapes, causing high-frequency losses.

and very few cassette decks have switch positions for all of them. Let's look at their characteristics.

Ferric Oxides. All pure gamma ferric oxide cassettes today use the same playback equalization (often identified as "120 microseconds"). In terms of their recording needs, however, they tend to fall into two different categories. The first are tapes designed to use "standard," "LN," or "DIN" bias, and include almost all American and European ferric oxides (e.g. 3M, Capitol, Ampex, BASF), as well as such Japanese tapes as Sony, Maxell LN, and TDK SD and TDK D. This is the largest group of ferric oxides, and includes all quality levels.

The other major ferric group is designed to use about 5% to 10% more record bias current than the DIN standard. This group consists almost entirely of premium-quality Japanese tapes (Maxell UD and UD XL I, TDK AD, Nakamichi, and Fuji FX and FL). A recorder that is properly biased for a tape in this latter group will be over-biased for tapes requiring DIN-standard bias, while recorders set up for DIN-standard tapes will be under-biased for Japanese tapes in the "high-bias" group. Fig. 1 shows the effects of such mismatching.

Under-biased tapes have exaggerated treble response; over-biased ones suffer unnecessary treble loss. If you've found the upper frequencies a little "soft" when using a top-quality domestic or European cassette tape on a high-priced Japanese deck, or found the treble too "hot" when using Japanese tapes on European or U.S. recorders, mismatched bias is almost certainly the reason. And while there are many fine tapes in the DIN group, the trend is toward higher-bias ferrics.

Chromium Dioxide. All CrO_2 cassettes use a "70-microsecond" playback equalization curve, which provides about 4.5 dB less treble boost in playback than the 120-microsecond equalization used for ferric oxides. This is made possible by CrO_2 's inherently greater treble output. The decreased treble boost makes possible, in turn, a 4.5-dB reduction in tape hiss.

However, this distinct advantage is partially offset by CrO_2 's lower output in the rest of the frequency range, as well as higher distortion levels compared to the performance of top-grade ferrics. A better known CrO_2 disadvantage—rapid head wear—is actually a myth at cassette speeds and pressures. Believe it only when you find someone who has actually worn out a cassette head using any kind of tape.

Ferrichrome. When ferrichrome cassettes were introduced several years ago, they seemed to offer the best of both worlds: high overall output (provided by a relatively thick layer of ferric oxide) and abundant high-frequency energy (provided by a thin, top layer of CrO₂). The drawback is that there is no standard for ferrichrome; Sony and 3M make radically different FeCr tapes. So even when a recorder has a "ferrichrome" switch position, the only way to find which tape it matches is to consult the instruction book. To add to the confusion, some machine makers recommend that you record ferrichromes with "ferric" bias and equalization and "chrome" playback, while others recommend exactly the opposite. (Neither is really optimum.) Nonetheless, when ferrichrome tapes *are* correctly biased and equalized, they yield spectacularly good results, as the test section of this survey shows.

Cobalt-Treated Ferrics. Another attempt to combine the virtues of two different magnetic materials are the cobalt-treated (or "cobalt-doped") ferric oxides. Here, the two materials are not layered, as ferrichromes are. Instead, each ferric oxide particle is enriched with cobalt ions through a complex molecular-binding process. The result is a tape with much greater overall output than chrome, but with equal high-frequency energy. These new tapes also take advantage of the standard bias and equalization settings used for chrome tapes; that's why they're referred to in our test table as "CrO₂-equivalent" ferrics. TDK's SA ("Super Avilyn") was the first of these tapes, and was followed by Nakamichi SX and Maxell UD XL-II. (3M's Master II is anoth-



Fig. 2a and b. Not all "improved Tapes have the same improvements. Maxell (top) gave its new UD XL-1 tape (upper curve) more output than older UD, but same response. TDK (bottom) gave its new AD tape more high-end response (dash lines) than the earlier Audua.

er tape in this category, but was not available for test at this writing.)

What Makes a Tape "New and Improved?" Improvements to a tape's performance can take many forms, two of them are shown in Fig. 2a and b. Fig. 2a shows the frequency response of Maxwell's now-venerable UD and its new UD XL-I, both recorded with the same signal. Both tapes have the same frequency response, but the higher curve for the UD XL I indicates greater output at all points in the audio spectrum—with a correspondingly improved signal-to-noise ratio.

A second kind of improvement, and one you're likely to see more and more of these days, is an increase in tape coercivity. This raises high-frequency response, as illustrated by the output-vs-frequency curves of Fig. 2b (which compares TDK's older Audua with their brand new "AD" tape). This rising high-end response can be accepted as a "brighter" sound, if you prefer, but it's really intended to be traded off for other benefits. Decks with adjustable equalization and bias let you trade it off for reduced distortion and a slight reduction in noise by diminishing treble boost in the recording. Also, the rising high end can compensate for the drooping treble of an inexpensive system's speakers (it won't compensate for playback-head limitations, though). In other stereo systems, turning down your amplifier's treble control will at one stroke restore proper frequency balance and reduce audible tape hiss.

Test Results. The results obtainable from any tape depend as much upon the recorder and its settings as upon the tape itself. Differences between

my test recorder and your recorder make it almost inevitable that the cassettes I tested would produce somewhat different results if tested on your deck. Where differences between tapes are small, a slight adjustment of bias or equalization can turn the scale in favor of one or the other. So ignore small differences in the results. Only the larger ones give grounds for definitely judging that one tape has a higher performance potential than another, irrespective of the machine used.

Selecting a Tape. The test results here can be used as a starting point in selecting the right cassette for your own use. A glance at the tables will reveal which tapes are of the same type as the tapes your recorder's instructions recommend. The table will also help you weed out those tapes whose requirements differ significantly from that of the factory-recommended tape.

In the last analysis, the most significant tests are those you make on your own machine. To check frequency response for yourself, the interstation hiss from an FM tuner is an excellent and handy test signal. Record and play back a few moments of it, flipping between "source" and "tape"; see which tape comes closest to matching the original sound. If you try this, however, remember to maintain the record level 10 to 20 dB below 0 VU on your recording meters. The high-frequency energy in the hiss signal would otherwise drive the tape into saturation and thereby invalidate the test.

Note that the "best" cassette is not always the best choice for every application! As the results in the chart show, several low- and mid-priced tapes have been improved (some very recently) to the point where they can challenge the premium tapes for anything that doesn't require the full sizzle of a cymbal. But avoid cheap, unbranded cassettes, unless you really enjoy cleaning up the loose oxide they so often shed.

How to Interpret Test Results. Because tape test results are so dependent upon the equipment used to make the tests, you won't find final full specifications listed for tape as often as you will for components. So, many of the specifications listed below will be unfamiliar, while others may seem unfamiliar in their current form. Here is what the numbers in our table mean:

Sensitivity: Here we compare the output of each tape with the output of the DIN Standard Blank test cassette, with each fed an identical input signal. This signal is a mid-frequency tone (333 Hz) of sufficient strength to record a magnetic flux level of 250 nanoWebers per meter on the DIN tape. This particular flux level, higher than the "0 VU" of most (but not all) home cassette decks, is an internation-

ally accepted comparison level. All else being equal, the larger the number in this column, the better.

Distortion at Dolby Level. This is a comparison of the harmonic distortion levels of the various tapes at a standard level of recorded signal. Since tape-deck manufacturers are free to set their "0 VU" point at any level of recorded flux they choose, a measurement made at any one deck's "0 VU" point would not be too meaningful. But as the "Dolby level" marks found on nearly every manufacturer's VU meters is a standard level (200 nWb/m), we used that as our reference point for this test. Since this is only 1.9 dB less than DIN "0 VU" level, it's at least *near* most manufacturers' "0 VU" markings.

The distortion levels may look lower than you're used to seeing for tape. That's because conventional "total harmonic distortion" meters measure everything that isn't signal—which includes not only all harmonics, but also hum and noise. Since the hum and noise on the tape are often greater than the distortion at this recording level, you will rarely see THD measurements of less than 1%. But since tape produces only odd harmonics, of which the 3rd harmonic is the lowest (and hence most prominent), a General Radio 1900-A Wave Analyzer was used to read only the tape's output at 999 Hz, the 3rd harmonic of the 333-Hz input signal.

Maximum Output Level: It is standard practice to consider a tape's Maximum Output Level (MOL) to be, for all practical purposes, the point at which its third harmonic distortion just reaches 3%. Beyond this level, moderate increases in input signal lead to very rapid increases in distortions. Consequently, saturation—at which point the tape's output will increase no further irrespective of increases in input—is only a few dB away.

The number shown in this column is the "signal" part of each tape's signal-to-noise ratio, in decibels above the 250 nWb/m reference level. The higher the number, the better.

Unweighted S/N Ratio: This column indicates the ratio, in decibels, between the Maximum Output Level (MOL) of the tape and the output from a section of the tape which has been recorded with no input signal at all. The higher this number, the better, too.

Weighted S/N: Since the frequency response of the human ear at the low volume levels of tape noise is not "flat," a more meaningful measure of noise audibility is obtained by weighting its various frequency components according to the ear's sensitivity to each.

There are several weighting filters for this pur-

	Sensitivity: (333 Hz "0 VU")	Distortion: (3rd Harm. Dolby level)	Maximum Output: (3% HD 333 Hz)	Signal-to-No Unweighted	bise Ratio Weighted	Saturation: (db below "0 VU" 10kHz)	Frequency Response (see text for code)
DIN bias ferrics DIN Std. cass. Ampex 20/20 + Ampex Plus Ampex 370 BASF Studio BASF Performance Capitol 1 Memorex MRX ₂ Maxell LN Scotch Master I Scotch LN/HD Scotch Highlander Sony UHF Sony Plus 2 TDK SD TDK D	$\begin{array}{c} \pm 0.0 \\ \pm 0.0 \\ + 0.4 \\ - 1.8 \\ \pm 0.0 \\ - 1.8 \\ + 0.5 \\ - 1.1 \\ - 0.7 \\ - 1.8 \\ + 0.1 \\ - 0.6 \\ - 1.1 \\ - 0.5 \\ - 2.3 \\ - 0.9 \\ - 0.5 \end{array}$	0.44% 0.32% 0.39% 2.35% 0.38% 1.22% 0.25% 1.9 % 1.2 % 1.95% 0.6 % 1.75% 1.65% 0.72% 2.28% 0.65% 0.8 %	+2.5 +4.1 +4.6 -0.8 +4.4 +1.1 +3.9 +0.4 +0.8 -0.1 +2.8 +1.2 +0.4 +2.7 -0.7 +2.8 +1.6	51.3 53.0 53.4 49.0 53.4 50.3 52.8 49.3 49.7 48.8 51.9 50.4 49.5 51.4 48.1 51.7 50.1	$\begin{array}{c} 52.9\\ 55.3\\ 55.2\\ 50.9\\ 55.7\\ 53.0\\ 55.4\\ 51.2\\ 52.1\\ 50.9\\ 54.2\\ 52.9\\ 52.0\\ 53.3\\ 50.2\\ 53.6\\ 51.4\end{array}$	-11.2 -12.8 -11.3 -18.2 -13.3 -14.5 -13.6 -19.8 -11.6 -14.5 -10.2 -13.8 -17.5 -10.1 -13.0 -12.8 -12.5	A B A D B C B D A B A D D A B C B
<u>"High" bias ferrics</u> Fuji FX Fuji FL Maxell UD Maxell UD XL-I Nakamichi EX Nakamichi EX-II TDK Audua TDK "AD"	-0.1 -2.4 -0.8 +1.0 -0.6 +0.9 -0.8 -0.7	0.28% 2.5 % 1.1 % 0.35% 0.74% 0.28% 1.15% 0.37%	+4.0 -1.7 +2.5 +6.1 +2.6 +5.7 +1.5 +3.7	52.4 47.9 51.1 54.7 51.2 54.3 49.7 52.4	53.4 49.9 52.8 56.3 52.8 55.8 50.7 54.2	- 9.8 -12.8 -10.4 - 9.8 -10.2 -10.2 - 8.7 - 7.2	A C A A A A A A A
<u>CrQ</u> ₂ BASF CrO ₂ Capitol CrO ₂ Fuji FC Memorex CrO ₂ Scotch Chrome Sony CRO ₂	1.5 1.0 1.4 2.2 1.9 1.9	1.9 % 1.85% 2.2 % 3.2 % 2.4 % 2.45%	+0.2 +0.2 -0.2 -2.1 -0.8 -0.7	52.6 52.6 52.4 50.3 51.9 51.5	54.8 54.6 55.5 52.5 54.4 53.3	- 9.2 -10.5 -10.5 -11.5 -11.1 - 8.4	A A B B Ar
<u>CrO₂ Equivalent ferrics</u> Maxell UD XL-II Nakamichi SX TDK SA	+1.9 +1.3 +1.0	0.6 % 0.85% 0.9 %	+4.0 +2.8 +2.3	55.6 54.5 53.7	57.4 55.7 55.6	- 8.2 - 8.7 - 8.8	A A B
FeCr bias & eq Scotch Master III Sony FeCr	1.7 2.6	0.45% 0.71%	+4.9 +3.2	57.2 55.5	59.4 57.5	-11.2 - 9.4	AA
Ferrichromes, <u>DIN*</u> Scotch Master III Sony FeCr	+0.8 -1.2	0.64% 1.52%	+3.0 +1.2	51.8 49.8	53.9 52.2	- 6.5 - 5.4	*
Ferrichromes, "High"* Scotch Master III Sony FeCr	+1.2 -0.8	0.52% 1.03%	+4.5% +2.9	53.2 51.5	55.5 53.7	- 6.8 - 5.0	*

CASSETTE TAPE TEST RESULTS

*Neither ferrichrome tape is designed for this bias/equalization, but it may be all the consumer has to use with them. Frequency response, however, rises from 1 kHz to 19 kHz, to between +10 and +12 dB.

pose. The most common one used is the NAB "A" weighting curve, which is derived from the famous Fletcher-Munson "equal-loudness" curves. More recent studies, however, suggest that a slightly different weighting curve, the CCIR curve, corresponds more closely to the perceived obtrusiveness

of noise such as tape hiss. This weighting system, widely adopted abroad (and used by Dolby measurements of noise-reduction effectiveness), was used for our measurements in this column. The larger the number, the less perceptible tape hiss will be. This makes it a slightly more significant measure

World Radio History

of tape performance than the unweighted S/N in the preceding column.

Saturation (10 kHz): Tape saturation level varies with signal frequency. At high frequencies, saturation occurs much earlier (see Fig. 3). For this reason, and because the high-frequency content of most program material is far below the "0 VU" level, frequency response (next column) is usually



Fig. 3. Measured at low recording levels, modern cassettes are capable of extended frequency response.

measured at a level far below "0."

While dramatic in itself, Fig. 3 does not tell the whole story about high-frequency saturation. Although a tape's middle- and lower-frequency output will not increase past saturation even if input level

HOW TESTS WERE MADE

In making these tests, three C-60 samples of each cassette were checked, and an average of the two more similar samples is reported. In most cases, where the thickness of the oxide coating is the same, C-90 versions of the same tapes should perform essentially identically. Where a manufacturer chooses to use a thinner oxide layer in his long-play length, however, low-frequency sensitivity and distortion figures may suffer.

The tapes in this survey were tested on a new Technics RS-9900US cassette deck. In addition to its three-head design (a practical necessity where machine-run frequency response curves are to be made), this deck offers continuously variable bias and equalization controls on the front-panel, as well as the usual fixed bias and EQ switch positions. It would thus have been possible to "optimize" the deck for every tape tested. But since this would represent an unrealistic picture of the performance to be expected from typical home cassette decks, a practical compromise was employed. For the tapes listed in the charts as "DIN bias and equalization," the machine was optimized for the new DIN Standard Blank Cassette (TP 18 LHS), a special cassette made for test purposes. For the "high bias" Japanese ferrics, the deck was set up using Maxell UD XL-I. For CrO₂ and the cobalttreated "chrome equivalent" ferrics, the set-up tape was Fuji FC.



Fig. 4. When saturation occurs, high-frequency output actually declines if the input signal increases further.

increases, its high-frequency output actually *declines* when input levels are increased beyond the saturation point (Fig. 4).

Consequently, the figure shown in the "10-kHz Saturation" column represents the tape's absolute peak response and the onset of saturation. Distortion occurs long before this point (by about 10 dB), but is difficult to measure because the third harmonic generated (30 kHz) is outside the recorder's passband. The audible distortion products caused by high-end saturation are all too obvious, however, so the closer the negative number (in decibels below DIN "0" level) is to zero, the better.

Frequency Response: Individual frequencyresponse charts were made for each tape tested. But since the response patterns were so similar, they have been summarized in five categories here. An "A" curve indicates a response within $\pm 1 \text{ dB}$ over the 100-20,000 Hz range. Three tapes (Sony CRO, TDK Audua, and TDK AD) showed a response that rose gradually above 1 kHz, reaching a maximum between +3 and +5 dB at approximately 19 kHz. Because, as explained previously, this may be looked upon as an advantage rather than as a defect, these tapes have been given an "Ar" (A, rising) denomination. Category "B" covers a span of ±2 dB over the same range. With only minor adjustments of the bias and/or equalization, any of these tapes could have been made to show an "A" characteristic. Class "C" encompasses a ±3 dB variation over the 100-20,000 Hz range, but would certainly be suitable for all but very critical applications. Class "D" tapes are definitely "limited performance" products whose response (even at the -30 VU test level employed on all the frequency response measurements) was typically down by about 5 dB at 10 kHz. Π

GUIDE TO AUTO & PORTABLE TAPE MACHINES

T TOOK the cassette, solid-state electronics and new motor-speed regulators to make portable tape both practical and popular. But now that you can choose from perhaps a hundred tape machines that mount in your car, and another hundred or so that you can carry in your hand or in your pocket, how do you choose?

It's not that difficult. Once you know what you need from your portable or mobile tape machine, and what features and specifications will give it to you, those hundreds will shrink down to dozens or less. And unless you shop at every dealer for miles around, that number will shrink still further to fit the brands you can find locally. Then it's just a matter of comparing prices, styling and manufacturer brand appeal before you make your choice.

Tape in Your Car. The car is a great place to hear stereo sound. The sound perspective is dramatic in this small environment. Bass response, for example, generally appears to be firm and deep, even

By Ivan Berger

from small speakers. And ambient noise masks a host of deficiencies that would be noticeable in a quieter home surrounding.

The car-stereo boom began with 8-track tapes, a system initially designed for use in the car. Eighttrack's selling point has always been its convenience: pop a cartridge into the slot and it plays and plays, demanding no attention on the driver's part. If the tape ends and no one pulls it out, it just starts over again. And though autoreversing cassette units can match that convenience now, an autoreverse function costs extra. Eight-track is also the only car-tape medium offering true quadraphonic sound. Furthermore, 8-track has a more extensive library of prerecorded tapes than does the cassette format.

Nonetheless, cassette tape is taking over half the car stereo market this year, and its share will probably continue to grow. In the car, its main advantage is greater compactness—it's easier to find room for a whole trip's worth of cassettes than the same number of cartridges. And it offers the advantage of rewind (not available on 8-track) and a truly *fast* fast-forward (8-track's is only about twice as fast as normal playing speed), so you can home in on any part of the music you want to hear.

More important, the compact cassette has become an almost universal system, encompassing not only car players (and a few in-car recorders), but high-fidelity recording decks for use with home stereo systems, tiny portables that slip into your pocket for on-the-go dictation or taping class lectures, even portables that double as car-stereo units. That means you can record your own cassettes at home to play in the auto, or use your inauto listening time to review class lectures, or take your taped sound with you on a picnic. Since cassettes are also more popular than 8-track for home high-fidelity recording, advances in recording and reproduction show up first in cassette equipment, later (if at all) in 8-track.

Though prerecorded 8-track cartridges are more available than cassettes, especially in popular music, blank tapes and tapes with classical recordings are easier to find in cassette form.

Whether you select 8-track or cassette, you'll find most models fall into one of three basic types: tapeonly units meant to hang beneath the dash or mount on your car's transmission hump; under-dash units with FM stereo tuners; and in-dash units combining tape, FM and AM. (Why AM only in dash-mounted models? Because an in-dash unit is presumably your car's only radio.)

In-dash models don't take up extra space in a car, are usually easier for the driver to reach, and are much harder to steal than under-dash ones. But the reason they're difficult to remove is that installation is more challenging. In contrast, under-dash units are a snap to mount (but should always be removed and locked safely away when you leave the car).

Once you've settled on the tape format and type of player you want, here are some features to consider: Automatic Eject at the end of the tape is a minor convenience on cassette players, but a major one on 8-track, since the tape might otherwise play on past its end, making it difficult for you to hear it next time from its beginning. Fast-forward, a very useful feature, becomes even more convenient when it can both be held down lightly without locking, for short searches, and locked down for longer ones. Next best is a control that just locks down, especially in 8-track, with its long, slow fast-forward. The same holds true for rewind controls, save that these are only found on cassette units.

Eight-track tapes consist of four stereo pairs of tracks (or two sets of four tracks, in quadraphonic cartridges), which play in automatic sequence. *Track-indicator lights* and manual *track-change switches* are vital in getting to the track you want. A *track-repeat switch* can also be useful if you like to hear the same part of the tape over and over.

Cassette players have a few distinctive controls, too. Either an *end-of-tape shutoff*, to prevent wear on the tape and mechanism, or *automatic reverse* to

play the other side of the tape without need to remove, flip and reinsert the cassette, should be included in any car-cassette unit. Auto-reverse models should also have *direction indicators*, so you can tell which direction is fast-forward and which is rewind. A few auto cassette models *record* as well as play; this is useful if you want to tape notes while you drive.

If you're getting a tape unit with radio facilities, consider its tuning ease. Look for large, clear dial scales; and in in-dash units look for *pushbutton station selectors* (preferably the 10-station type that preselects 5 FM and 5 AM stations), or automatic, signal-seeking tuning.

For satisfactory sound quality, you'll want reasonably high *power*—4 watts per channel is reasonable, but more can help reduce distortion. Higher power is also desirable if you're driving lowefficiency speakers or plan to use your tape deck in a sports car, or one of the new T-top open coupes. You'd be surprised at how much more power is required to overcome the external noise that topdown driving generates. If the tape unit you want has less power than you need, or if you decide after buying it that its power is insufficient, don't despair. Booster audio amplifiers are widely available that can be connected between nearly any car-stereo unit and its speakers.

Portables. Portable tape recorders fall into several clear-cut categories: pocket-size, book-size, stereo entertainment packages, and serious recording instruments.

Pocket-size models are the most portable of portables. And though their fidelity is often limited for music, they're extremely handy for dictating on the go, for taking down one-handed notes (paper and pencil take two hands), for taping lectures, and so on. Some of them even do a creditable job of *recording* music, though their tiny speakers limit playback sound quality.

There's a bigger choice than ever in this category. Pocket portables using the standard Philips Compact Cassette had already gotten virtually as small as the tapes themselves, so manufacturers have taken the next step to shrink them, building recorders around new, smaller cassette tapes. These new micro and mini machines average less than half the size and weight of compact-cassette pocketables. Fidelity suffers, but it's still good enough for speech and dictation. The catch, though, is in the tapes. They're not as widely sold as regular cassettes; and because there are at least four types of these tiny cassettes, you must take extra care to be sure you're buying tapes which fit your machine. To date, DeJur and Sankyo use separate tape systems all their own, while a capstan-less "mini-cassette" is shared by GE Norelco, Philips, Dictaphone and Radio Shack, and the capstan-driven "micro-cassette" is shared by Olympus, Sony and Panasonic.

Convenience counts for more than fidelity in pocketables, but fidelity is worth checking, too. To determine fidelity, record and playback someone else's voice (you can't judge recordings of your own) and decide whether the distortion, noise and frequency limitations are acceptable for your use. Check this at both the nearest and farthest recording distances that you're likely to use. Make sure the tape speed doesn't vary as you tilt or move the machine, and that the built-in microphone doesn't pick up "brushing" noises from the friction of your hand on the case.

Next come convenience checks: are the controls easy to locate, and activate and adjust? And are they designed so they won't snag your pocket? Other convenience factors depend on how you'll use the unit. If you're taping your own thoughts, you'll want controls that are handiest when the mike is facing you; for interviews, you'll want them handy when the microphone is facing away. If you're taping lectures, look for a machine that can stand up unsupported, and a *jack* that lets you use a directional mike when the speaker is far away. If you'll use the machine much of the time near a.c. power lines, provision for an *a.c. adapter* will save you money on batteries; availability of rechargeable nickel-cadmium battery packs will save you even more. If you'll be walking around recording for long stretches, you'll appreciate replaceable battery holders that snap in and out.

Some extra features are usable no matter what your application: a *meter* tells you how well the microphone is picking up sound when you record; in playback, it shows the charge state of your batteries. "*Cue-and-review*" controls permit you to quickly check on something you've just recorded; *index counters* and fast-forward *cue* facilities (which make tape output audible during fast fastforward) help you find something you've recorded some time back.

Most portable recorders offer automatic recording level control (ALC), to keep the level within proper limits without your having to watch the meter and control level manually. A few may offer manual control, too, for special situations; but these situations are covered just about as well by *music-speech* switches which adjust the ALC's response time so it will react more slowly when taping music in order not to undercut the music's own dynamic shifts from loud to soft. But the same slow response allows you to tape speech in noisy surroundings without the noise's swelling up each time the speaker pauses for breath.

Voice activation is another useful feature, starting the recorder automatically when you start talking, and stopping it when you stop, to avoid long pauses on the tape while you pause between thoughts. Few recorders have built-in voice activation, but microphones with voice-activated switches are available for many models. There is one catch, however: since it takes an instant for the switch to start the tape, the first syllable of each speech burst may be lost, especially if it starts with a soft vowel rather than a sharp consonant.

Handy, but with Handles. The book-size portables offer a little more in features and fidelity than the pocket-size ones. Also, they cost a little less. You can expect bigger speakers, and hence better sound in playback, plus built-in a.c. converters. Otherwise, features are about the same as those you'll find in smaller machines except for *aux or line inputs* (for recording from hi-fi systems or other tape recorders) and tone controls, both of which are a lot more common in the bigger machines.

Next up the line in cost and bulk are portables designed for still more pleasing playback. These contain still *larger speakers* (hence their bigger bulk) more powerful amplifiers and more elaborate *tone controls.* Sometimes they incorporate FM/AM radios, too, usually with provision for taping directly off the air, as well as from microphones.

From here, your choices branch two ways: to stereo versions of these playback-oriented portables, and to more compact, monophonic ones whose emphasis is on recording:

Portable entertainment centers is probably the best description for the stereo, playback-oriented units. Obtaining stereo playback from a portablesized package is accomplished by making one or both speakers detachable so they can be physically spread out; others do it by matrix circuitry that spreads the sound from two fixed speakers. Again, FM/AM tuners are common extra. Sound quality is not "hi-fi," though.

Serious Recording Instruments. These incorporate many of the same refinements as the best non-portable tape decks, for the best possible recording quality, including: servomotor control, monitor heads that let you check your recordings as you make them, built-in noise reduction, extra-large VU-type recording meters, and even inputs for three microphones (the third one is a center-channel fill-in mike). Usually, these models offer manual as well as automatic record-level control.

Note that the built-in electret microphones found in virtually all other portables are often omitted.



External speaker flush-mounted in car's rear deck.

INSTALLING CAR TAPE

Most car-stereo units come with reasonably clear instructions for installation. But there are a few points worth knowing that are frequently omitted. For instance, few instructions mention slide-out mounts, but they're a valuable theft-deterrent. A thief can remove a bolted-down car-stereo unit almost as fast as he can remove one on a slide-out mount-but the mount makes the unit easy for you to remove, so you can lock it in the trunk or hide it elsewhere. Another consideration not covered by many manuals is where to connect the unit's power lead. If you connect it to a circuit that's always "hot," you run the risk of weakening your car's battery should you forget to turn off your stereo when you leave the auto. If you connect it to a circuit that's switched on and off by the ignition key, you chance shutting off the power while a tape is playing; this leaves the pinch roller jammed against the capstan, which can leave that roller with flat spots that cause wow or flutter. If your unit is a tape-only model that automatically shuts off when the tape finishes, you should connect it to an unswitched circuit; otherwise, you must decide which hookup you prefer.

Speakers are a thornier problem. A spot has to be found where the speakers will fit, will not be in the way, will have a cavity behind them for good bass and will face you directly for good treble. The upper front corners of the doors make excellent loca-

The assumption is that, if you are buying such a machine, you care enough about recording quality to prefer the flexibility of separate microphones that you've selected yourself. The big speakers and enclosures that add rich playback tone to the portable "entertainment centers" are missing, too, sacrificed for increased portability. Carrying this farther, stereo models only have one speaker for monitoring, though stereo headphones can be used. To leave your hands free to hold microphones or operate controls, most machines in this class have shoulder straps instead of carrying handles.



Trunk view of flush-mounted speaker enclosure.

DECKS AND SPEAKERS

tions-but check first by taking off the door trim panel to make sure the back of the speaker will not interfere with the window-winder mechanism or other door parts. Mounting speakers in the rear shelf is easy (many U.S. cars have holes already cut into the shelf's support), but these rear speakers tend to bake in the sunlight. So be sure that such speakers can handle high (as well as low) temperatures and high humidity. If you do mount your speakers in the shelf, make sure their grilles are flat, non-reflective black, or their reflection in the rear window will be distracting. Surface-mount speakers, usually in small, wedge-shaped enclosures can solve many mounting problems. Just make sure they won't get in the passenger's way, and that they won't obstruct the driver's rear-window vision. The cavities behind most automobile panels are far bigger than the ones built into surface-mount enclosures, so surface-mounted speakers usually lack the bass of flush-mounted ones. You can improve the surface-mount's bass, though, by butting a large hole in the panel you mount the speaker to, so that the speaker's back wave will have access to the cavity.

Remember to use a centerpunch to start any holes you're drilling in the car's metal, remember, too, to line those holes with rubber grommets so that edges of the holes won't wear through the wire's insulation.

Though virtually all portables today use some type of cassette, the only open-reel exceptions can be found in the serious-recording category. When you're *really* serious, the editing ease and greater dynamic range of open-reel tape are often worth the extra cost—and weight.

The foregoing basic considerations must be weighed against your personal application needs and what you're prepared to spend, of course. But the range of types and models are so broad that there is at least one tape machine available that can meet anyone's balance of requirements.

Sometimes it just doesn't add up

You want to be able to record a fuller sound, with more precision, less distortion. But, the expense of replacing your whole system just isn't reasonable. MXR has a way to upgrade your recordings significantly without starting from scratch. The MXR Compander can double the dynamic range of most open reel and cassette tape decks to allow professional results in home recording. The Compander increases the overall fidelity of your system while reducing noise. The softest sounds can be heard while musical peaks can be reproduced without distortion.

The Compander compresses the dynamic range of the signal going onto the tape and expands it upon playback. The resulting increase in dynamic range allows your present system to produce the depth of sound that you want to have when you record. MXR products have become the standard for signal processing in professional recording and live musical performances. The reputation that MXR has earned for engineering excellence assures you of a superior product.

At \$129.95, the MXR Compander and the equipment you already have can add up to the sound that you want at a reasonable price.

For more information, see your nearest MXR dealer or direct inquiries to MXR Innovations, Inc., 277 N. Goodman St., Rochester, New York 14607, (716) 442-5320.





CIRCLE NO. 11 ON READER SERVICE CARD



HOW TO USE TAPE RECORDERS PROPERLY AND CREATIVELY

By William S. Gordon

THERE'S a difference between knowing how to use a tape recorder and knowing how to get the most from it. A little know-how makes even such simple jobs as taping off the air or from records easy to do really well—not to mention the fun you can have doing live recordings. Learn just a few tricks of the trade, and your tapes will sound as though you'd traded in your recorder for a newer, more expensive one.

Know Your Meter. The main trick in making a good tape is to keep the recording level within an optimum range, even though the control setting for that optimum range keeps changing. That's because tape's dynamic range is limited: set the recording gain too high, and the tape will be distorted; set it too low, and it will be noisy.

Your guides to correct level are your recording meters. Meters come in two basic varieties: average reading and peak reading; your tape deck's instructions should tell you which you have. Amateur tape equipment is turning more and more to peak-reading meters, which respond rapidly to high-level transients. Some tape decks utilize average-reading meters that are supplemented by LED indicators which flash when excessive peak levels are encountered, warning of overload transients too brief to be captured by the meter. The exact level to set will depend on your meter, your recorder, and the nature of the sound you're recording.

Dubbing Tapes and Discs. Though there are no absolute rules to follow in setting recording levels, here are some general guidelines. In dubbing a tape or disc, preview it to find the loudest section. With a tape, this means playing it through on one machine whose output is connected to the second, the recording machine. The recorder should be set up in the record mode (so that the meters will be activated) but with the "pause" switch locked in so that the tape is stationary. In this manner, you can now adjust the record level for an appropriate indication on the meters (discussed later) before you record. With a disc, you can frequently find the loudest sections by looking at its surface. Loudly modulated grooves have a grey appearance, while quiet passages are a more shiny black. This trick can save you time when previewing a disc.

As a first crack, set the recording levels so that the meters occasionally hit about +3 on peaks (Fig. 1). Play back the tape. If the sound is distorted or lacks highs on the loudest sections, try a lower recording level. If it still sounds very clean, you might push the level up a little more. The idea is to get the strongest recording level possible with acceptable distortion and response. On some decks (especially the more expensive ones), you may be able to record with the peaks "into the red" on occasion. On others, you may not be able to even let the meters hit zero without experiencing poor sound. Thus,



Fig 1. For best results, try to keep the meter needle moving within the white portion of the meter scale.

you must experiment with your deck to get the best compromise between distortion and hiss.

The most critical test is to compare the playback directly against the original disc. Cue both the tape and the disc up to the beginning and play both, switching between them with the source monitor switch on your preamp. Any flaws in your recording will be obvious. If your deck has a separate (third) playback head, you can compare while you're recording—a great time-saver (and a lifesaver when it comes to live recording). But, beware! Some "three-head" cassette decks have very poor response from their auxiliary playback heads and simultaneous monitoring might lead you into thinking you're making a poor tape recording when you're not. In normal playback, the sound may be much better.

Don't be surprised to find that the meters barely move off the stop much of the time. Some meters, calibrated down to -20, will only start to give you readings during the loudest passages, especially when the source program has a wide dynamic range. Here's where wide-range meters (extending down to -40) show their mettle.

Now that you have some idea of how the meters on your deck act, you must temper your experience with foresight. Because the high frequencies are boosted, or pre-emphasized in recording, tape generally overloads first on the highs. This leads to dull sound. Most recording meters, however, indicate the program level before pre-emphasis. So if the material has a lot of highs—cymbals, bells, etc. you may have to maintain the level readings lower than usual. A program with relatively little high-frequency content can be boosted above normal levels. Therefore, experiment with a wide variety of music until you get the hang of setting the level at its best position for different types of music.

When it comes to overload, cassette recorders are much more touchy than open-reel decks. The frequency response of a cassette system is measured at a recording level of 20 dB below zero. At higher recording levels, the upper frequencies saturate, and treble response is diminished. This is why you must consider the type of music you're recording when reading meters. Human judgement is important. Open-reel decks are measured at -10 dB, but the better ones will deliver pretty much the same response at zero dB—at least when using a good tape at 7½ ips.

The choice of tape is very important. The bias and recording equalizations of every deck are set up for a specific tape or tapes. The performance will be different (and usually worse) when using other tapes, especially for cassette equipment. Changing to a "better" tape will *not* necessarily improve performance unless the deck is readjusted to accommodate it. So stick with one tape, preferably the one recommended by the deck manufacturer. If you wish to switch to a different tape, have a qualified serviceman check the deck out with the new tape and make whatever internal adjustments are necessary.

Recording FM. Recording FM broadcasts is pretty much the same as dubbing a disc, except that you have no opportunity to preview. Thus, setting the recording level is even more a matter of experience than with discs. There are a few methods that can help, however. You're in luck if there is a station in your area that broadcasts a Dolbyized signal. Sometime during the day (or week) they *should* broadcast a Dolby calibration tone. (Unfortunately, not all FM stations do, and the test tone may come at an odd hour. Check with the station to ascertain their policy.) The Dolby tone is at a modulation level of precisely 50%. It will serve as a bench mark in setting your recording levels.

For an initial trial, set the record level so that the calibration tone reads -3 on the meters of a cassette deck. (On an open-reel deck, try a "0" indication.) You can be assured that no peak will be greater than 6 dB above the tone (a +3 reading on the cassette deck meter and +6 on the open reel). You may want to try slightly higher or lower meter indications on the test tone, depending on how your FM tapes sound after the initial set up. Once you've established the best control settings, jot them down and return to them whenever you're recording FM. You might wish to affix colored tape, cut to simulate a triangular pointer, near the desired setting to simplify locating proper control settings in the future.

Since the strength of an FM signal does not affect the output level from the tuner (unless the signal is extremely weak), that one calibration will serve, not only for the Dolby station, but for all other stations in your area. Some tuners have built-in test tone generators that produce an output corresponding to 50% (or some other) modulation level. This serves the same purpose as the Dolby tone and is a great help in achieving the proper recording level for best FM taping.

A final point on FM stereo recording. If your copies exhibit a whistle that wasn't present in the original broadcast, it is likely that some of the 19-kHz transmitted pilot tone and the 38-kHz subcarrier generated in the receiver during stereo FM reception are leaking into the recorder and intermodulating with its bias. Most recorders today have multiplex filters to prevent this, as do some tuners. If you have the problem, you may have switched your recorder's filter off; if not, you may need to readjust

Fig. 2. Shown graphically are some effects encounterd when making recording-level adjustments while actually taping. See text for explanations.



the filters in your tuner or deck, or add one if your equipment has no filters of its own. Sometimes, using a slightly lower recording level reduces the undesirable effect.

Riding Gain. While most discs, tapes and FM broadcasts have a limited dynamic range and can be accommodated by a good tape recorder with a judicious setting of the record level control, you will occasionally find a really good disc that is just too



Fig. 3. Compressors reduce gain gently, acting with only moderate input levels. Limiters work only on loud sounds.

much for the deck to handle (Fig. 2A). Then it's time to "ride gain." To ride gain means to make adjustments in the recording level while the recording is going on. The idea is to raise the recording level of quiet passages so that they are lifted above the tape hiss and/or to reduce the level of loud passages to avoid overloading the tape. It is important not to overdo this technique or you will end up with some artificial-sounding tapes. Of course, to do an effective job of riding gain, you must know where the quiet passages and the loud passages occur so you will be prepared to intervene. A dry run on a disc, preferably while jotting down notes, will help. On a live recording, you'll just have to do the best you can, but familiarity with the music to be recorded is a sine qua non.

The secret to successful gain riding is to hide your tampering. Whatever gain adjustments you make, keep them to the minimum and don't continually move the gain up and down. Make your adjustments slowly and a little behind the music. During a crescendo, reduce the gain just enough to ensure that the tape won't overload when the crescendo hits its peak (Fig. 2C), but not enough to prevent the music from growing louder (Fig. 2D). Don't try to whip the gain down during a fortissimo. You'll be too late and much too obvious (Fig. 2B). Don't quickly change gain down or up during a rest, either. The change in noise level will be a dead giveaway. Do try to flow with the music.

There are a number of accessory compressors and limiters (especially on the professional market) that will help you to ride gain, or at least automate the process (see Fig. 3). A compressor is a device whose output increases (or decreases) proportionately less than its input so that a doubling of its input level produces *less* than a doubling of its output. Usually, the action takes place only above a certain

Fig. 4. Crossed, directional microphones, give a natural stereo effect. Make sure both mikes pick up center sounds.



threshold signal level, and is relatively gentle. Such a recording compressor functions as you would in reducing the gain during loud passages. A limiter is somewhat similar, but with a much faster and more drastic action. It reduces the gain just below the overload point of the tape to prevent saturation. Sometimes a limiter is built into a tape recorder, but the best ones are professional accessories.

Live Recording. The real fun begins when you try your hand at live recording. It's your chance to show off your skills. A deft hand at the controls is imperative, for the dynamic range of many live programs exceeds the capability of the recorder. For the same reason, a good compressor and limiter are handy to help cover up your mistakes.

One of the first considerations in recording live is the selection and placement of the microphones. This is a topic so vast that entire books have been written about it. For this reason, we'll have to discuss this superficially here, but we will tell you of several schemes that can produce good stereo tapes and alert you to some problem areas.

One of the simplest microphone placement schemes is the so-called X-Y method (see Fig. 4). Two directional (cardioid or figure-eight) microphones are placed close together, but angled with respect to each other. The microphone facing the left of the ensemble feeds the left channel; the other, the right channel. The distance between the ensemble and the pair of microphones is up to you, and some experimenting is in order. The closer the microphones are placed, the greater the sense of presence, but instruments at the center of the group may be unduly emphasized. Placing the mikes farther back reduces the ratio of direct-to-reflected sound. This increases the ambience but reduces clarity.

The angle between the microphones is also a variable. If it is too narrow the stereo effect will be reduced. When the angle is too great, a "hole-in-themiddle" effect may occur. So it's up to you to set the angle and placement for best results. Start off with a 90° angle and a placement where each mike faces a point about a quarter of the way in from the end of the ensemble. Then experiment. As you move the mikes farther back, pivot them in closer together. If you bring them in closer for greater presence, angle them farther apart.

The X-Y recording scheme is simple, and produces very realistic stereo imagery with an unusually good sense of depth. Its only real drawback, if that be one, is that there is no means of emphasizing any one instrument or vocalist. It records it like it hears it. Further, you have no control over the amount of ambience, short of moving the mikes closer to or farther from the group.

An alternate scheme that is still relatively simple is a three-mike setup. A simple mixer is required, since the center, or blend microphone, will have to feed both left and right channels simultaneously. This center mike can be used to accentuate a soloist when placed relatively close to him, while the left and right mikes are placed farther back and to the sides. When recording a large group, the center mike can be placed well behind the other two to pick up the hall sound. By adjusting the level of the blend mike input, the degree of ambience in the recording can be controlled. Using one microphone close to each instrument of a trio yields interesting if unrealistic sound, with one instrument in the center of the recorded sound field, one at the far left, and one at the far right.

Omnidirectional or directional mikes can be used in 3-mike setups, but microphones placed close to a soloist or other performer should usually be omnidirectional types. Directional microphones tend to overemphasize the bass of sound sources within a few inches of their diaphragms; this is called the "proximity effect."

Multi-Track Recording, Mixers and Tricks. This brings us to multi-mike recording. For better or worse, most modern pop and rock records are taped with many microphones. Each instrument or section has its own mike(s) and recording channel(s). The actual blend or mixdown occurs later in the re-


Fig. 5. Echo is easy on any 3-head deck. Just feed the signal from the playhack head into the record circuit.

cording studio. What results isn't a true replica of what went on, but it does leave the way open for special effects—echo, reverb, etc.

You can try the same thing if you have a 4-channel deck. Although professional studio decks are 8-, 16-, or even 32-channel recorders, you can produce some fine tapes with four. By recording the instruments separately, you can add echo (reverb) or frequency equalization to one, but not to the others; you can shift instruments from front to back . . . all in mixdown, after the recording session is over. One advantage to tricks done at mixdown time: you can play to your heart's content without tying up the time of the musicians.

Most open-reel decks today have separate record and play heads and provision for simulated echo. Echo effects are achieved by mixing the playback output with the signal being recorded (Fig. 5.). The result varies from the pleasant to the grotesque, depending upon the amount of signal you feed back and the spacing between the record and play heads. The echo is seldom as convincing as that from a good artificial reverb unit, so keep it subtle. Used properly, however, it can enhance a recording.

Some open-reel (but not cassette) decks are equipped so you can simultaneously record on one track or pair of tracks while reproducing another track or pair. This opens the way to more fun. Using a technique called "sound-on-sound," (see Fig. 6.) you can turn a single performer into an ensemble. First, record one instrument (usually the rhythm section). Then, as you play that recording back, listening through headphones, you can sing or

SOUND EFFECT TIPS TO ENHANCE YOUR RECORDINGS



"Rain" is simulated by pouring salt or sugar down an aluminum-foil chute.

Record a hand mixer. Play it back at a lower speed for a boat-motor effect.





For a crackling fire, break wooden matchsticks and crumble cellophane.

For a babbling brook effect, just blow bubbles in a glass of water.





Screeching car brakes? Pull nail-studdea wood across a pane of glass.

For a windstorm, let the air escaping from a balloon go past the microphone.





Fig. 6. Sound-on-sound recordings are made by mixing the playback signal from one channel with new material.

play along with it, mix the new sound with the old, and record it on the alternate channel or channel pair. Some recorders have built-in switching for this application; others require patchcords from the output of the first track to the line input of the second. If your recorder can't mix line and microphone inputs, you may have to use an external mixer.

You can build up quite a one-man "group" this way, but there are limits to the number of times you can do it. Each time you re-record a signal, you retain the noise of the original recording and add some more noise. Thus, the number of generations you can take this through depends on the signal-tonoise ratio of your recorder. Note that, when using this technique, you need a four-channel deck to get a stereo tape.

An alternate approach that keeps the number of tape generations (and the noise) down is to record several, individual tracks that are synchronized. On "two-head" decks, where the same head is used alternately for record and playback, this is simply a matter of recording the first track, then having the performers listen to it through headphones while they perform for the second track's recording. Decks with separate record and playback heads, though, require some further trickery, as follows. Since an inch or so of tape separates the playback and record heads, performances synchronized with the playback head's output will wind up trailing, by that distance, the sounds they're supposedly synchronized with on the other track. To make synchronized recordings with a three-head deck, that deck must have a switch that lets you temporarily monitor from the record head of the track you're trying to synchronize with. Manufacturers all have their own names for this feature, Ampex's "Sel-Sync" being the oldest and best known. Since the old information is not mixed with the new recordings, the noise level is not compounded-all recordings are first-generation, right up to the final mixdown. The only limitation is the number of possible tracks: two for a stereo machine, four for a fourchannel one. (After that, if you want more doublings of the instruments, revert to the sound-onsound technique described above; you'll still have at least one generation less noise than you would have if you'd used sound-on-sound from the first.)

With either of these methods, if an instrumentalist goofs, only the track he's just recorded need be done over. All previous information remains undisturbed on the other tracks. With Sel-Sync, though, bad tracks can be re-recorded any time; with soundon-sound, mistakes must be corrected before the errors are re-recorded onto the next track. And using Sel-Sync, pop records can be made without ever getting all the performers into the same studio at the same time.

Whether the mixing takes place on-site before recording, or subsequently after a multi-track take, there are several tricks you should know to get the best mix. First of all, whenever possible, listen to the mix on loudspeakers-not on headphones! The stereo perspective on headphones is totally different from that on speakers. Since you will probably be listening to the final product on speakers, use them in setting the mix. For on-site work, that means finding a room in which you can set up your mixer and recorder that's isolated from the hall. If that's not possible, and you *must* use headphones, choose the tight-seal type rather than the open-back type. They're not as comfortable, but the circumaural seal will block out the direct sound, allowing you to monitor the recording through the microphones with less confusion. And, when using headphones, shoot for a wider stereo image than you think you ultimately desire. It will shrink when played through speakers.

Taping can be lots of fun. It's the one area of high fidelity in which you can develop real skills and demonstrate your personality. Why play a recording when you can create one?



THE HOME RECORDING STUDIO TODAY

By Tony Sabatino

T ONE TIME, home tape recording meant copying records onto tapes, recording the baby's first words and—if you were really adventurous—making live recordings of the local high school band in concert. With the advent of fourtrack tape machines, however, it became possible to actually create music at home much as it is professionally created in a studio.

With a modest cash outlay, one can now set up a home studio that's capable of making tapes which sound "professional." This revolution has made it possible for amateur musician/recordists to develop their musical skills and techniques, enabling them to create complete, organized musical concepts without using a fully equipped professional recording studio. As one platinum-record musician stated: "Without a four-channel tape machine, I wouldn't be in the composing business, since I cannot express myself musically on paper." And, as a drummer of another "Top Ten" group opined: "It allows me to develop a concept and work it out fully before I present it to the group for rehearsal."

The Tape Deck. Although much can be done with a stereo tape deck, the trend in home studios is toward *four-channel* machines. This is seldom due to a desire to record quadraphonic sound, but rather to be able to record several tracks which can be mixed down to stereo at the user's convenience. This allows easy experimentation with instrumental balance and other qualities in the final recording without tying the musicians down for endless retakes. It also permits easy correction of an individual track should mistakes occur. Such corrections, and "over-dubbing" (recording material from one track to another while adding new material to it) require the facility to temporarily use the record head as a playback monitor for the previously recorded track. This is often referred to as *Sel-Sync*, the name originally given it by Ampex, but is also known as *simul-sync* or by other, similar names.

A home studio recorder's tape speeds are generally higher than those incorporated in most home recorders. Recorders with speeds of $7\frac{1}{2}$ or 15 ips are often chosen instead of the more prevalent $3\frac{3}{4}$ or $7\frac{1}{2}$ -ips tape machines. Faster tape speed, of course, provides better high-frequency reproduction, lower noise, and less likelihood of overloading the tape. Higher speeds make editing easier, too, spreading magnetic impressions of sound on the tape farther apart. On the minus side, doubling the tape's speed also doubles the rate of tape consumption. This may lead you to choose a machine that can hold $10\frac{1}{2}$ " reels, with double the tape capacity of the 7" reels normally used on home tape decks.

Another very useful feature is remote control. This allows you to be away from your tape deck—at your instrument or merely in a more convenient spot (like the mixing board)—and still control the unit. For those who do not plan to add an external mike mixer, an important feature to look for is *mike/line mixing* with separate input controls for both the microphone and line inputs. *Output level* controls are useful, too.

One final, but rare, feature to look for is an *edit* control which allows you to turn off the take-up reel motor and feed long, unwanted sections of the tape directly into the wastebasket while listening for the beginning of the next tape section worth keeping.



Four-channel decks like this TEAC are very flexible.



Recording Track 2 while listening to playback of Track 1 (above) causes time lag between tracks. Sel-Sync (below) lets you use Track-1 record head gap for temporary playback.



(Not all controls marked "edit" do this. Find out what functions any such control performs before you let it influence your choice of tape deck.)

Microphone Mixers. Microphone mixers give one the ability to dictate what goes on the tape: the proportions, tonality and placement of the stereo image. Many tape decks provide limited mixing facilities but even these are usually limited to one microphone input per channel and rarely provide the ability to "mix down" two tracks to one track.

The first consideration in a mixer is its micro-

phone *input impedance:* low (50–100 ohms), or high (20,000–100,000 ohms). Low impedance costs a bit more (about \$20 per input channel), but gives you the ability to run long lines between your microphones and mixer without losing high frequencies or picking up hum. With high impedance, on the other hand, microphone lines must usually be limited to 20 feet at most. You will also need either low-impedance microphones or impedance-matching transformers for any high-impedance microphones you already have, and three-conductor cables and plugs (which also cost a bit more). But the flexibility in microphone placement this provides is well worth the extra expense.

Ideally, a microphone mixer should have as many output channels as there are channels on the tape deck. Mixers with four output channels, though, are quite expensive; you can get by with a stereo mixer if you must.

Tone controls, though not too common on mixers, are useful. Ideally, there should be separate tone controls for every input channel, and these controls should be as flexible in their response as possible. This allows you to get almost any sound you want from an instrument or vocal, either correcting for peculiarities of microphone and room response or altering the tone deliberately to obtain a desired effect.

Effects outputs or echo outputs are spare channels through which you can feed signals for processing by echo units, graphic equalizers, or other sound modifiers, before returning them to the mix. Some mixers have only one such output, or one per output channel; others may have one per input channel, or even separate "equalization" and "echo" loops for each microphone input.

High-level inputs allow you to combine signals from another tape deck, a stereo system's output, or other amplified sources. Many mixers have both high-level and mike-level inputs on several of their input channels, with a switch selecting which input that channel will control.

Mixdown facilities should include, at a minimum, switches allowing several of the input channels to be positioned in either the right or left output channel. More elaborate mixers will have such switches on all input channels, and will often allow some signals to be switched to feed both output channels at once, positioning these signals in the center of the stereo image. On four-channel boards, you get the added ability to mix inputs and assign output channels without changing connections.

Echo, Reverb, Analog and Digital Delay Units. These are the units a professional studio sound engineer uses to produce the "full" sound you associate with most records. Their purpose is to add reverberance to the music, the effect you associate with echos in a large room. This effect can turn one person into a complete background vocal section, or make an instrument or vocal part sound more "thick" or "wet" (as it is termed in the trade).

Echo units, predominantly using loops of magnetic tape, have been around for a number of years. These delay the sound by recording the incoming signal on the tape, then picking it up with a second head mounted farther along the tape path. The time delay for the echo is the amount of time it takes for the tape to move from one head to the other. Older units adjust the delay by moving the playback head, while newer machines have multiple heads or tape speeds to change the delay.

There are a number of problems you might encounter when using these units that you should be aware of. The first is that most commonly available units are designed to be used with guitars, not with tape decks. They are designed for very low input and output levels. Consequently, they distort easily if you overdrive them, and their low level outputs can pick up a lot of noise if not shielded properly. A second problem is that the quality of cheap tapeecho units is not very good; many are prone to much hiss and distortion. You are better off paying for a good unit than choosing an inexpensive, inadequate one.

Spring-type reverb units work by passing the signal, wave-fashion, along a coiled spring, picking it up where it emerges, delayed, at the spring's far end. Since the signal bounces back and forth a few times before it dies away, this produces multiple echoes, but the reverberation time is fixed. Lowcost spring reverbs suffer from many ills, most notably a "metallic" sound. If overdriven, they clatter as the springs knock against the case or each other. They're also sensitive to vibration and shock.

Solid-state analog and digital delay units use more modern technology, delaying the audio signal



Tapco spring-type reverb has built-in equalizer.

electronically without the problems that older, mechanical echo and reverb units exhibit. Digital delays work by sampling the voltage of the incoming signal about 40,000 times per second, storing the digital value of each sample, then converting it back to analog form after the desired delay period. These units accurately reproduce the incoming signal, and can be electronically set to any desired delay. Their one real problem is cost: digital storage costs about \$3000 per second (plus the cost of the associated electronics), so even a one-tenth second delay is quite expensive. Analog delay units produce similar results at about 20 percent the cost of digital ones. These employ "bucket-brigade" or similar devices. They, too, sample the incoming signal. But instead of converting from analog to digital and back, they actually save a portion of the input signal for the desired period of time before sending it on its way. However, they are not really practical for periods longer than one-tenth of a second due to the signal's tendency to "leak away" within the device. This is not a great drawback since the delays commonly used for "doubling" vocal parts are between 20 and 40 thousandths of a second.

An interesting variation of the digital delay is the "Harmonizer" by Eventide Clockworks. This digital delay allows you to vary the rate at which the signal is read out of its memory, which shifts the pitch of the music up or down by as much as an octave. One "Top Ten" group successfully used a



Eventide Harmonizer digital delay also changes pitch.

Harmonizer and a digital delay unit together to make one person sing three-part harmony with himself.

Compression, Expansion and Limiting. Compression, the process of "squeezing" more sound onto tape (by reducing loud sounds and boosting soft ones), is one of the greatest aids in home studio recording. This process can overcome the problem of a performer speaking softly one minute and loudly the next. Perhaps this is caused by turning away from microphones, which reduces input levels. A performer might also play music which is occassionally soft and frequently *very* loud. This can lead to nervous breakdowns when trying to get enough signal on the tape without overloading it or making

input level corrections that are obvious on the finished tape. Two devices designed to correct this problem are *limiters*, which only "compress" the signal after it starts becoming very loud, and *compressors* which both boost soft sounds and soften loud ones.

Limiters find their greatest use in preventing tape overload. However, they can also be used to automatically reduce the level of the music as a vocalist starts singing, or to reduce background sound when actors begin speaking in a soundtrack. To do this, the limiter is set so that the music or background sound is just below its threshold; adding the voice to the mix raises the signal level just enough to trigger the limiter.

Compressors boost low-level signals and reduce high-level ones to fit the dynamic range of music within the dynamic range of the tape used. This permits the recordist to place a much "hotter" signal on the tape without worrying about pinning the meters or distorting the signal. However, one pays a penalty for this convenience: with the dynamic range compressed, the recording sounds flatter and less exciting. This can be compensated for during playback by using a complementary expander, which boosts the loud passages whose level the compressor has reduced and reduces the soft signals that the compressor has boosted. When a compressor and expander are to be used together in this fashion, they are often combined into a single unit called a compander.

Noise Reduction. Although the advantages of noise reduction in overcoming the limitations of cassette decks have been amply demonstrated, its utility with modern, semi-professional tape decks, especially at a tape speed of 15 ips, might seem questionable. Open-reel decks already exhibit far better high-frequency response, dynamic range and signal-to-noise ratios than cassettes. Is the small (but sometimes noticeable) adverse effect of the extra noise-reduction circuitry worth it when the noise to be reduced is already so low?

If your original tape will be your final result, it probably won't be worth it. But noise builds up with every "generation" of overdubbing, copying and mix-down that the signal goes through. So, since your home studio tapes will probably go through several generations, noise reduction all along the line will pay its way.

At present, there are two major noise-reduction systems, Dolby and dbx. Both are "encodedecode" or "closed-loop" systems; that is, they must be used both in recording, to condition the signal for low-noise playback, and again in play to make the signal sound natural again. The Dolby system is the best known in the home as well as in the studio. It works primarily by compressing the higher audio frequencies, boosting



dbx 128 combines noise reduction and expander.

them above the noise level when they're soft, and leaving them unaltered when they're already strong enough to mask tape hiss. In playback, the highs are expanded again. Reducing the high-frequency gain to restore soft high overtones to their natural level lowers high-frequency hiss as well. Dolby used only in playback dulls the sound, much as a high-cut filter would; used only in recording, it makes the tape sound a bit sharp, its highs accentuated.

The dbx system also uses complementary compression and expansion, but over the whole frequency range at once. This allows an even greater increase in dynamic range than Dolby does. However, its effect, like that of any compander, is faintly audible as "breathing."

Other noise-reduction systems now in use are "open-loop" types, designed to reduce noise in playback only. The Burwen system reduces noise by "gain riding," reducing gain, or volume, when high amounts of noise would be noticeable (as during rests between notes), and increasing it when the noise would be masked by the source material. The Phase Linear "Auto-correlator" works on a totally different principle. Since musical sounds are correlated with harmonics that are multiples of each tone's fundamental frequency the Auto-correlator senses the frequency content of the signal, opening and closing gates to let through only the appropriate harmonic overtones, and to block out the random noise in between. These systems are useful in rescuing old recordings, though their application to home studio "live" recording is more limited since the most important consideration is to keep noise out of the original tape.

Parametric Equalizers. Equalizers are nothing new in studio use (studios had them years before they entered the home). But *parametric* equalizers are new. Where conventional graphic equalizers offer variable boost and cut at several, fixed frequencies, the parametrics also let you change frequency and contour. (Some recently introduced graphic equalizers feature some degree of parametric control, such as center-frequency or "sharpness" controls for each slider or for the group as a whole.) This added versatility makes it possible to tailor vocals or instrumentals, eliminating unwanted resonances and adding treble or bass without introducing frequency boosts or cuts where they're not wanted. Properly done, this permits a great deal of frequency enhancement without making the sound seem unnatural.

Special Effects. Phasing and flanging are some of the special effects that can turn common instrumental or vocal tracks into very special recordings. They're the professional recordist's stock in trade.

Phasing and flanging are two similar effects once generated by different processes. They're often considered to be synonomous today. They produce a different sound by cancelling and adding certain frequencies in the output signal. These cancellations and reinforcements create special sound effects as they sweep up and down across the audio spectrum. In earlier days, "flanging" was obtained by physically applying varying pressure by a hand or finger to the supply reel's flange to change tape speed. Nowadays, phase-shift networks are used to achieve the same result or, to more closely resemble tape recorder flanging, a variable digital delay line.

There's a wide range of listening effects that can be generated by phasor/flangers. Some examples are: a tremolo sound or the Doppler-shift sound of a rotating speaker; fading in or out; a swishing sound from drums; a disembodied or hollow type of sound for vocals. It all depends on how much phase shift delay time is employed.

Harmonic modification describes a whole family of devices that reshape notes electronically. Some use frequency doubling, some add harmonic distortion ("fuzz" is simply the process of clipping input peaks), and some use variable feedback techniques. Most such devices are used in the output lines from electric guitars and the like, and are controlled by the musicians (unlike phasers and flangers, which are under the engineer's control), but they're worth having in the studio to add effects when they're needed.

To control these effects properly, there is only one word of advice here—Play! The only way you'll learn what an effect does (and this is true for even such simple effects as tone controls) is to experiment. Combine different effects together. Try playing a prerecorded tape or a record through them and see if you can do things even the professionals missed. Become familiar with how each effect sounds at different settings on the controls. When you discover ones you like, write them down for later reference.

General Procedures. The most important consideration in any serious recording endeavor is to get the basic tracks recorded properly, from both technical and artistic points of view. If you don't have the basic beat and flow of the piece correct, whatever you do later will not make it come out properly; it'll be too late to completely remove noise, distortion or other technical defects.

To get the beat and flow, it's usual to record rhythm guitars, drums and bass guitars first, then use them for timing when laying down the other tracks. If your performers aren't used to working that way, you can record them all together in a "scratch" first version, and have them synchronize with that as they try to make more polished renditions. Whatever you use as the first track, its rhythm and spirit are more important than anything else, since they affect the tracks made after it. The original tracks can always be re-recorded later, if need be.

It's conventional studio practice to record in four tracks (or more, if you have them), then mix down to stereo. Decisions on where the instruments will go in the stereo field, and how loud they'll be in relation to each other aren't usually finalized until the mix-down stage. But if you're recording directly in stereo, you'll have to make these decisions *before* you start. Once the instruments are mixed, you can't separate them again. A general guide is to put bass, drums and lead vocal in the center, backup vocalists to the sides, and lead guitar in the center when it's soloing and at one side the rest of the time.

Locate the quietest possible place in which to record, as far as possible from traffic, air-conditioning ducts and other noise sources. If you can, set up a separate, sound-insulated control booth so you can listen to the signal through speakers while you're taping. Otherwise, you'll have to monitor the recording through headphones so the sound won't feed back to the microphones. But remember, true stereo perspective sounds too wide through headphones, while recordings with good headphone (binaural) perspective will sound thin or narrow through speakers. So always listen to speakers, not headphones, during playback.

You'll learn a lot more fine points as you go along. But the first thing you'll learn is something you've probably suspected all along: making really good recordings yourself is fun and the end results can be a source of pride. $\hfill \Box$

World Radio History

BEST OF Recorded Tapes

A roundup of some of the most outstanding recordings issued in tape format during the past year.

ARTIST/COMPOSER	TITLE	LABEL	CAT. NO.	FOI MA
ABBA	Arrival	Atlantic	CS-18207	(C)
Allen, Peter	Taught by Experts	A&M	CS-4584 8T-4584	(c) (c)
Andersen, Eric	Sweet Surprise	Arista	8301-4075	(8)
Astaire, Fred	Attitude Dancing	UA	EA-580-H	(8)
Atkins, Chet, & Paul, Les	Chester & Lester	RCA	APK1-1167 APS1-1167	(c) (8)
Bach	Cantatas #7, #44, #101	Advent	D1016	(c)
Bach	Organ Concertos, BMV 592/7	DGG Archiv	/3310128	(c)
Baez, Joan	From Every Stage	A&M	CS 3704 8T 3704	(c) (8)
Baez, Joan	Gulf Winds	A&M	CS 4603 8T 4603	(c) (8)
Band, The	Best of The Band	Capitol	4XT-11553 8XT-11553	(c) (8)
Bartz, Gary	Ju Ju Man	Catalyst	CLT-7610	(8)
Beethoven	Piano Sonatas Ops. 52&110	Philips	7500351	(c)
Beethoven	Piano Sonata #21 Eroica Variations	RCA	ARK 1-2083 ARS1-2083	(c) (8)
Beethoven	Piano Sonatas	Columbia	MT 34218	(c)
	#s 23, 57 v 18		MA 34218	(8)
Beethoven	#4, Grosse Fugue	Philips	7300 456	(c)
Berlioz	Harold in Italy	Philips	7300441	(c)
Berlioz	Romeo et Juliette	DGG	3370 011	(c)
Berlioz	Symphonie Fantastique	Angel	4XS-37138	(c)
Billo's Caracas Boys	Billo '77	TH	THS-2010	(8)
Bizet	Carmen	London	J-13115	(c)
Bizet	Carmen & l'Arlesienne Suites	Columbia	MT 34503 MA 34503	(c) (8)
Blake, Eubie	Wild About Eubie	Columbia	MT 34504 MA 34504	(c) (8)
Bound for Glory	Soundtrack	United Artis	tsUA-CA695 UA-CA695	(c) (8)
Brahms	Violin Concerto, Op. 77	DGG	3300592	(c)
Brown, Clifford	The Quintet Vol. 1	EmArcy	EMT-4-2-403 EMS-2-403	(c) (8)
Browne, Jackson	The Pretender	Asylum	TC5-1079 ET8-1079	(c) (8)
Buchanan, Roy	A Street Called Straight	Atlantic	CS-18170 TP-18170	(c) (8)
Buffett, Jimmy	Havana Daydreamin'	ABC	5022-914H 8022-914H	(c) (8)
Bugsy Malone	Soundtrack	RSO	CT1-3501 871-3501	(c) (8)
Butterfield, Paul	Put It in Your Ear	Bearsville	M5 6960 M8 6960	(c) (8)
Caballe, Montserrat	Music of Spain	London	OS 5-26435	(c)
Captain & Tennille	Song of Joy	A&M	CS-4552 8T-4552	(c) (8)
Carter	Quartets # 1 & 2	Advent	D-1007	(c)
Carter, Benny/Gilles-	Carter, Gillespie, Inc.	Pablo	K10-781	(c)
pie, Dizzy	-		S10-781	(8)
Charles, Tina	I Love to Love	CBS	PCT-34424	(C)
Chopin	Etudes (One 10 8 25)	London	CS5_6044	(0)
Clapton, Eric	No Reason to Cry	RSO	CT1-3004	(0)
	the tradestrip on y		8T1-3004	(8)

ARTIST/COMPOSER	TITLE	LABEL	CAT. NO.	FOR- MAT
Cole, Natalie	Natalie	Capitol	4XT-11517	(C)
Columbo, Russ	Legendary Performer	RCA	CPK1-1756 CPS1-1756	(c) (8)
Concert of the Century Cooder, Ry	Original Cast Chicken Skin Music	Columbia	M2T 34256 M52254 M82254	(c) (c) (B)
Crosby, Bing	That's What Life Is All About	UA	UA-EA-554-F	4(8)
Crosby, Bing/Astaire, Fred	A Couple of Song & Dance Men	UA	UA-EA-588-H	1(8)
De Larrocha, Alicia Denver, John	Mostly Mozart, Col. II Spirit	London RCA	5-7008 APK1-1694 APSI-1694	(c) (c) (8)
Dr Feelgood Donizetti Dukas/Roussel Dvorak Eagles, The	Malpractice Maria Stuarda La Peri/Symphony #3 String Quartet, Op. 106 Hotel California	Columbia London Columbia Telefunken Asylum	PCA 34098 813117 MT 34201 441933 TC5-1084 ET8 1084	(8) (c) (c) (c) (c)
Edwards, Jonathan	Rockin' Chair	Reprise	M5-2238 M8-2238	(c) (c) (B)
Electric Light Orch.	A New World Record	UA	UA-CA679-H UA-EA679-H	(c) (c) (8)
Evans, Gil	There Comes a Time	RCA	APK1-1057 APS1-1057	(c) (8)
Falla (Boulez) Feliciano, Jose	Three-Cornered Hat Sweet Soul Music	Columbia Private	M1 33970 PV\$5300-20	(c) 22(c)
First Choice	So Let Us Entertain You	Warner	PVS8300-20 M52934 M82034	(C)
Fitzgerald, Ella & Armstrong, Louis	Porgy and Bess	Verve	CT2-2507 8T-2507	(C) (B)
Fitzgerald, Ella & Peterson, Oscar	Ella and Oscar	Pablo	S10759	(8)
Flamin' Groovies	Shake some Action	Sire	5147-7521H 8147-7521H	(c) (8)
Frampton, Peter	Frampton Comes Alive!	A&M	8T-3703	(C) (8)
Garrett, Kelly Gayle, Crystal	Crystal	UA	UA-CA614-H	(8) I(C)
Gaynor, Gloria	Experience	MGM	5H-4997 8H-4997	(c) (8)
Getz, Stan	Chick Corea/Bill Evans Sessions	Verve	CT2-2510 8T2-2510	(C)
Gilbert & Sullivan	Trial by Jury	London	5-1167	(C)
Gilbert & Sullivan	Utopia Limited	London	5-12105	(c)
Gillespie, Dizzy &	Atro-Cuban Jazz Moods	Pablo	K10-1771	(c)
Machito Gimble, Johnny	Johnny Gimble's Texas	Columbia/	S10-771 CA 34284	(8) (8)
Goodman, Steve	Words We Can Dance To	Asylum	TC5-1061	(C)
Green, Al	Full of Fire	Hı	SHL5-32097	(C) (C)
Guthrie, Arlo	Amigo	Reprise	M5 2239	(c) (8)
Haggard, Merle	Roots of My Raising	Capitol	4XT-11586 8XT-11586	(c) (8)
Handel	Messiah	Argo	K-18K32	(c)
Harris, Emmylou	Luxury Liner	Warner	M5 2998 M8 2998	(c) (8)
Harrison, George	Best of George Harrison	Capitol	4XT-1158 8XT-1158	(c) (8)
Havens, Richie	End of the Beginning	A&M	CS-4598 8T-4598	(c) (8)
Hines, Earl	Live at Buffalo	Improv	5337-7114 8337-7114	(c) (8)

Christopher Parkening





Gladys Knight and the Pips

ARTIST/COMPOSER	TITLE	LABEL	CAT. NO.	FOR- MAT
Isley Brothers	Harvest for the World	T-Neck	PZT-33809	(c)
Jackson Five	Moving Violation	Motown	7-829HC	(C) (R)
Jennings, Waylon Jennings, Waylon	Best of Waylon Jennings Dreaming My Dreams	RCA RCA	APS-1577 APK1-1062	(8) (c)
Jennings, Waylon	Good Hearted Woman	RCA	APS-1886	(8) (C)
Jennings, Waylon	Honky Tonk Heroes	RCA	APK1-0240	(0) (C) (8)
Jennings, Waylon	Ladies Love Outlaws	RCA	APK-2016	(0) (C) (8)
Jennings, Waylon	Lonesome, On'ry and Mean	RCA	QPK-2136 APS-2136	(c) (8)
Jennings, Waylon	Ramblin' Man	RCA	APK1-0734 APS1-0734	(c) (8)
Jennings, Waylon	This Time	RCA	APK1-0539 APS1-0539	(c) (8)
Joel, Billy	Turnstiles	Columbia	PET33848 PEA33848	(C) (8)
John, Elton	Here and There	MCA	C-2197	(C) (B)
Kelly, Roberta	Trouble Taker	Oasis	NBL5-5005	(C) (R)
Knight, Gladys, &	Bless This House	Buddah	5320-5651 5320-651H	(C) (B)
Knight, Gladys &	2nd Anniversary	Buddah	5320-5639H 8320-5639H	(c) (8)
Kuhn, Steve	Ecstasy	ECM	CT-1-1058	(c)
Lightfoot, Gordon	Summertime Dream	Reprise	M5 2246 M8 2246	(c) (8)
Liszt	Piano Concertos #s 1, 2	DGG	3300 770	(C)
Liszt	Piano Concertos #s 1,2	Angel	4X\$37145	(C)
Lynn, Loretta	Somebody Somewhere	MCA	C-2228	(C) (8)
Mahler	Symphony #1	DGG	923-070	(C) (B)
Mahler	Symphony # 1	RCA	RK-1153	(C) (C)
Mahler	Symphony #3	RCA	CRS2-1757	(8)
Mahler	Symphony #3	Advent	E-1009	(c)
Mahler	Symphony #4	London	5-2228	(c)
Mahler	Symphony #8	London	5-1295	(c)
Mahler	Symphony #8	RCA	CRK2-0359 CRS2-0359	(c) (8)
Manilow, Barry	This One's for You	Arista	5301-4090H 8301-4090H	(c) (8/8)
March, Steve	Lucky	UA	UA-CA674-H	l (c) l (8)
Massenet	Esclarmonde	London	5-13118	(c)
Matthews, Ian	Go for Broke	Columbia	PCA 34102	(8)
McCartney, Paul &	Wings over America	Capitol	4X3C-11593	(c)
Wings McLean, Don	Solo	UA	8X3C-11593 UA-CA-652-	(8) J(c)
McLoone, Annie	Fast Annie	RCA	UA-EA652-J APK1-1326	(8) (c)
MuDae Cormon	Car't Mide Louis	Dive Nute	APS1-1326	(8)
Melanie,	Photograph	Atlantic	CS-18190	(0) (C)
Mitchell, Joni	Нејга	Asylum	TC5-1087	(0) (C)
Muldaur, Maria	Sweet Harmony	Reprise	M5 2235	(c) (c)
Nascimento, Milton	Milton	A&M	CS-4611	(8) (C)
National Lampoon	Good-bye Pop. 1952-1976	Epic	PEA 33956	(8)
Nelson, Willie	Troublemaker	Columbia	CT 34112 CA 34112	(c) (8)
Nielsen Ochs, Phil	Symphony #5/Saga-Dream Chords of Fame	Advent A&M	D-1005 CS-4599	(c) (c)
	-		8T-4599	(8)
Olivor, Jane Parkening, Christophe	First Night r Music of Two Centuries	Columbia Angel	PCA 34274 4XS-36053 8XS-36053	(8) (c) (8)
			5.00 00000	(~)

ARTIST/COMPOSER	TITLE	LABEL	CAT. NO.	
Pizzarelli, Bucky & Freeman, Bud Prokofiev (Ashkenazv)	Buck & Bud Piano Concertos #s 1-5	Flying Dutchman London	BDK1-1378 BDS1-1378 5-2314	(c) (8) (c)
Prokofiev/Rachman-	Class Symph, etc. Piano Sonata #8/Six Mo- mente Missicaux	DGG	3300 678	(c)
Rachmaninoff	Piano Concerto #3	RCA	ARK1-1324 ARS1-1324	(c) (8)
Ravel	Ma Mere l'Oye/Tzigane/ Valses Nobles	Angel	4XS-37149 8XS-37149	(C) (C) (8)
Robinson, Vicki Sue	Never Gonna Let You Go	RCA	APK1-1256 APS1-1256	(c) (8)
Rolling Stones	Black and Blue	RS	CS 79104 TP 79104	(c) (8)
Romeo, Max & the Upsetters	War Ina Babylon	Island	ZC1-9392 Y81-9392	(c) (8)
Rossini	Stabat Mater	Vox	7300 368 CT-2118	(C) (C)
Saint-Saens	Symphony #3 ("Organ")	DGG	3300 619	(c)
Sancious, David	Transformation (Speed of	Epic	PEA 33949	(8)
Schubert/Wolf	Quartet #14 ("Death and	RCA	441862 ARK1-1994	(C) (C)
00.10011110	The Maiden")/Ital Serenad	de	ARS1-1994	(8)
Scriabin (Ashkenazy) Seals & Crofts	Piano Sonatas #s3, 4, 5, 9 Get Closer	London Warner	5-6920 M5-2907	(c) (c)
Short, Bobby	My Personal Property	Atlantic	CS-1689	(C) (C)
Shostakovich/Gla-	Cello Concerto #2/Chant du Menestrei	DGG	3300 653	(C)
Side by Side by Sond-	Original Cast	RCA	CBK2-1851	(C)
Silver Convention	Save Me	Midland	BKK1-1129	(C) (R)
Simon, Carly	Another Passenger	Elektra	TC5-1064	(C) (C)
Sly & the Family Stone	Heard Ya Missed Me	Epic	PET-34348	(C)
Smith, Patti	Radio Ethiopia	Arista	5301-4097H	(0/0) (C)
Southside Johnny &	I Don't Want to Go Home	Еріс	PEA 34180	(8)
Staples	Pass It On	Warner	M5 2945	(C)
Steeleye Span	Rocket Cottage	Chrysalis	M5C-1123	(C) (C)
Stewart, Rod	Night on the Town	Warner	M5 2938	(C) (C)
Stills-Young Band	Stills-Young Band	Reprise	M5 2253 M8 2253	(c) (8)
Stravinsky Sutherland, Joan &	L'Histoire du Soldat Operatic Duets	DGG London	3300 609 5-26437	(c) (c)
Pavarotti Summer, Donna	Love to Love You Baby	Oasis	NBL5-5003	(c)
Summer, Donna	Love Trilogy	Oasis	NBL8-5003 NBL5-5004	(8) (c)
Syms, Sylvia	Syliva Syms, Lovingly	Atlantic	NBL8-5004 CS 18177	(8) (c)
Tchaikovsky	Symphony #4	Columbia	XMT 33886 XMA 33886	(0) (C) (8)
Tchaikovsky	Violin Concerto/Serenade	Philips	QAX 33886 7300490	(4/8) (c)
Telemon	Melancolique	Telef	TEL AMORE	(-)
Telemann	Pimpinone	Lelefunken	1EL 441953	(C)
Verdi	Macbeth	Angel	4X3S 3833	(C)
Vıvaldi (Holliger)	Oboe Concertos	Philips	7300 443	(c)
Vivaldi (Rampal)	Il Pastor Fido	RCA	FRK1-5467	(C)
Von Stade, Frederica Wagner	Rossini & Mozart Arias Gotterdammerung (Orches-	Philips RCA	FRS1-5467 7300 511 ARK1-1317	(8) (c) (c)
14/0-00-	tral Excerpts)	Landan	ARS1-1317	(8)
Wagner	Die Meistersinger Der Ring des Nibelungen	London	5-1512 RING \$ 5-1	(C) (C)
Watson, Doc	Doc and the Boys	UA	EA601-H	(8)
Weill	Three Penny Opera	Columbia	KST-34326	(c)
Wheeler, Kenny	Gnu High	ECM	CF-1069	(8) (C)
White, Robert	When You and I were Young	RCA	ARS1-1698	(8)
Wiebbone Ach	New England	Atlantic	M8 6964	(8)
Woodor Stowe	Songe in the Kow of Life	Tampa	TP 18200	(8)
Woode Deal	The New Phil Woods Aller	RCA	T15-340ET	(8)
Zevon Warren	THE NEW FIN WOUDS MOUTH	Acylum	BGS1-1391	(C) (8)
Zevon, warren		~3910111	ET8-1060	(8)





Nothing. Because what you should hear on a cassette is nothing more than you record and nothing less. No noise, no hiss, no distortion, no wow or flutter, no hyped high end. That's what total accuracy is all about. And that's what BASF is all about. Since 1932, when we invented recording tape, BASF has worked toward one goal: the purest, most accurate sound that tape can reproduce.

There are no shortcuts. We use the best quality ferric oxide, milled by a patented process, for maximum packing density and uniform coating. We use an exclusive polymer binding, which will never deteriorate and cause frictional noise or wow and flutter. Even our cassette case is different, incorporating our patented Special Mechanism, for years of smooth and dependable tape feed. Compared to most cassettes, it's over-engineering. But what would you prefer to buy... under-engineering? At BASF, we're purists. We've dedicated the efforts of the world's largest magnetic tape research and development staff to the goal of totally accurate sound. When you use our Studio Series cassettes, we want you to hear nothing ... nothing more than you record, and certainly nothing less.

Nothing is everything

• BASF The Purist.

Nothing less than total accuracy will ever satisfy us.



TAPE FORMATS: THE CHOICE HAS WIDENED

By Ivan Berger

Easy-loading tapes come in 7 formats now. Clockwise from top left are: 8-track Cartridge, Elcaset, Compact Cassette, Olympus Microcassette, Sankyo M-cassette, Norekco Mini "Idea Capsule," and DeJur Grundig Steno-Cassette 30.

APE buyers used to have three tape formats to choose from. Now they have eight! In addition to open-reel, cassette, and 8-track, new formats have been added: the large Elcaset and four sub-compact cassette systems, the latter designed primarily for portable dictation and note-taking.

Compact Cassette System. The standard compact cassette system uses thin tape about 1/7 inch wide, running at 17% inches per second from one hub within the cassette to the other. Monophonic cassettes have two tracks, one in each direction. To play the second side, the cassette must be removed, flipped over, and reinserted, unless the machine can play in two directions. Stereophonic cassettes have four tracks, each stereo pair side by side so that both will be picked up and reproduced together when a stereo tape is played on a monophonic machine, and so that both will produce the same output from a monophonic tape when it is played on a stereo deck. Four-channel cassettes have been demonstrated, but due to disagreements over possible track formats they have never really reached the market. Tapes are available in several lengths: C-30 (15 minutes per side, 30 minutes total), C-60, C-90, and C-120 being the most common.

Cartridge System. The 8-track cartridge system uses tape ¹/₄ inch wide, running at 3³/₄ inches per second in an endless loop that feeds back into the hub of the cartridge's single, built-in reel. The tape's eight tracks all run in the same direction. The tape heads shift position as each set of tracks is played, sequencing automatically to the next set. Stereo 8-track cartridges have four pairs of tracks, playing tracks 1 and 5 together, then tracks 2 and 6, and so on. Quadraphonic 8-track cartridges have two sets of four tracks. Stereo recordings can also be played on quadraphonic tape machines.

Recorders for 8-track tapes are far less common, as the frequent breaks required for track-switching make it difficult to fit music in without unwanted interruptions, and the absence of rewind or truly fast fast-forward (it's only about double normal playing speed) make rechecking what's been taped most inconvenient. Blank tapes are available, in 30- to 100minute lengths, though the blanks are not as widely available as cassettes are. Prerecorded tapes, on the other hand, are probably easiest to find in this tape format, though classical selections are rare.

Open-Reel System. Open-reel recorders normally use 1/4-inch tape, too, which must be manually threaded from one reel, over the tape deck's heads and capstan, and onto another reel. Most home machines record in stereo on four tracks, interleaved so that tracks 1 and 3 make a stereo pair going in one direction, while tracks 2 and 4 carry another stereo program going the opposite way. Some machines reverse automatically to play the second track pair. Running speeds of 71/2 and 33/4 inches per second, and a maximum reel size of 7 inches are also typical. There are many variants to suit special needs, however. Many decks now use all four tracks in one direction, either for quadraphonic use or to record four synchronized tracks for later mixdown to a stereo pair. Still other decks divide the tape into two, wider tracks for improved signal-tonoise ratio. "Full-track" monophonic recorders, using the whole tape for one channel, are also available though they're hardly common nowadays.

Reel size and tape speed vary, too. While the 7inch reel carries from 1200 to 3600 feet of tape, de-

pending on the tape's thickness (thicker tapes are sturdier and less prone to "print-through" of signals from one layer to another), more and more machines carry 10¹/₂-inch reels with double this capacity. Battery-operated, open-reel portables usually have a 5-inch maximum reel size capacity, with half the capacity of the normal reel. Most recorders offer two speeds, but many offer three: these speeds may range from a high of 15 inches per second to a low of 15/16 inch-per-second. With each halving of speed, fidelity diminishes but the amount of time a given tape will play is doubled. A standard 7-inch reel will play for 30 minutes in each direction at 7¹/₂ inches per second. Timings for other speeds, tape thicknesses, and reel sizes can be calculated from this.

Open-reel tape is the preferred medium for truly serious recordings for several reasons. Its wider track and higher speeds mean greater fidelity, including more extended frequency response, better signal-to-noise ratio, more "headroom" for high recording levels without distortion (especially at higher frequencies), and lower wow and flutter. And open-reel tape is easily edited. Open-reel is also easily adapted to a multiplicity of special uses. Broadcasters, for instance, use 10¹/₂-inch-reel machines operating at 15/16 inch-per-second to record up to 24 hours of programming on a single reel as an automatic log of what has gone out over the air. Most commerical recordings originate on open-reel tape, and a trend is growing towards semi-professional home studios using the larger open-reel decks.

The major inconvenience of open-reel tape is the necessity of threading it.

Elcaset System. The Elcaset, a new arrival, seeks to combine the major advantages of open-reel and cassette tape. Operating at 3¾ inches per second on ¼-inch tape, it offers higher fidelity than is possible from cassette tape at a similar level of development. Stereo recordings are made in a format similar to the cassette's, with the two tracks of each stereo pair running side by side, each pair running in a different direction. However, a fifth track between the two stereo pairs can be used for control signals, such as digital location markers for each taped selection.

The tapes load like cassettes, which they resemble in all but size. But where the cassette player's heads must enter the cassette shell for playing or recording, the Elcaset machine pulls the tape out of the shell and brings it to the heads. This allows for more accurate tape positioning, increasing fidelity again. It also means that Elcaset tapes can be edited more easily than cassettes, at least with regard to removing undesired sections. Splicing tapes from one reel onto another may be more difficult than with open-reel, however.

Elcaset tapes are available in lengths of 60 and 90 minutes; prerecorded tapes are not yet available. Also, there are few machines available to play Elcaset tapes, and they are quite expensive.

Sub-compact Systems. Sub-compact cassettes are the Elcaset's opposite in many ways. Smaller than conventional cassettes, and with noticeably less fidelity, they were developed for dictation and note-taking on the run. Here, their low fidelity is little disadvantage, and their ultra-small size is a major benefit.

So far, however, there are at least four sub-compact tape systems, each incompatible with the others. The two most popular such systems are the Philips Mini-cassette and the Olympus Micro-cassette. The Philips system, used by Norelco, Dictaphone, Unitrex, Radio Shack, and GE (who calls its version a "micro") uses a ½-inch tape whose speed varies. The tape is pulled by the take-up spindle, and the amount of tape pulled through by each spindle revolution increases as the tape builds up on the take-up reel. The mini-cassette is a monophonic system that records for 15 minutes on one track, then must be flipped over to record 15 more minutes on the other one.

The Olympus Micro-cassette system, shared by Lanier, Panasonic, and Sony, is capstan-driven like most other tape recorders. It operates at a steady speed, in this case 15/16 inch per second. The tape is 1/7 inch wide, and plays for 30 minutes per side, for a 60-minute total. Panasonic has a two-speed version which can also run 60 minutes per side at 15/32 ips.

Sankyo's Micro-mini is a similar cassette, so far not shared with any other company, which also records 30 minutes per side. Tape width is 5/16 inch and it runs at a speed of 15/16 inch per second.

Another one-company tape is the DeJur Amsco Stenocassette 30 which records for 30 minutes straight through; it records on one side only. A tape-position counter is built into the cassette, not the machine.

When selecting a sub-compact system, be sure that it will be compatible with sub-compacts owned by any others you intend to exchange tapes with. Take extra care when buying blank tapes, too, to be sure they are the type that fits your machine. Prerecorded tapes are not available for any of these miniaturized tape systems, as in their present state of development they're not too suitable for music reproduction. However, neither was the compact cassette when it was first introduced.

TAPE MACHINE TEST REPORTS FROM HIRSCH-HOUCK LABORATORIES

ERTAIN measurable characteristics of a recorder, especially its frequency response, signal-tonoise ratio, and distortion, are critically dependent on the type of tape used during the measurements. A recorder is (or should be) adjusted at the factory to give optimum results with some specific type of tape. If a different tape is used during later lab tests, there is a good chance that there will be substantial differences between the manufacturer's ratings and the test lab's data.

This being so, one would expect the instruction manual of every cassette recorder to state clearly that the machine should be used with brand "XYZ" tape for best results. A few do, but most of them simply ignore the whole matter, perhaps in the hope that no one will notice the difference anyway. The consumer might not, but a test lab would find it hard to miss. For this reason, STEREO REVIEW always asks the recorder manufacturer to make a tape recommendation and, if possible, to supply as well the actual cassette(s) used to check out the machine in his own service laboratory before it is sent to us. Again, some comply, but many do not.

When confronted with a machine whose adjustments are unknown, we try several representative cassette

How H-H Tests Cassette Recorders

by Julian Hirsch

brands, especially when the recorder has bias and/or equalization switching for more than one type of tape. These switch positions are sometimes cryptically marked, with some common nomenclature being NORMAL, LH, LN EX, FeCr, and CrO₂. The last three are fairly unequivocal, referring to Nakamichi EX, ferrichrome tapes, and (fortunately) any brand of chromium-dioxide tape. The first four, however, are less well defined.

It seems that no tape manufacturer

likes to admit that he makes a "normal" tape, preferring to be known for his "low noise" or "high energy" formulations. Many recorder manufacturers expect their products to be used with these premium tapes, and therefore assume that the NORMAL bias will be applied to them. On the other hand, others recognize that not all tapes are the equal of such premium types as TDK SD and ED, Maxell UD, etc., and design the NORMAL bias for normal run-of-the-mill tapes and the LH (or whatever) bias for tapes requiring higher than normal bias. In the absence of other information we (like any consumer) must depend on trial-and-error methods to discover the optimum combination of tape and recorder bias.

Let us assume that we have solved the tape puzzle. Because of the considerable amount of recording equalization (boost) used in cassette recording, it is very easy to saturate (overload) the tape at high frequencies. The overall record-playback frequency response is measured at a low input-signal level (usually -20 dB) to check the response below the saturation point. We also measure the response at a 0-dB recording level to judge overall susceptibility to tape saturation. It is interesting tc observe that the "0-dB" curve, which begins to drop rapidly above a few

World Radio History

thousand hertz, frequently crosses the -20-dB curve at some frequency between 10,000 and 15,000 Hz. In other words, above that frequency there is less playback output from a 0-dB signal than from a signal 20 dB weaker. On a given recorder, the frequency at the "crossover" area can serve as a rough figure of merit for comparing the saturation characteristics of different tapes. When the same tape is used on different recorders, it can provide an indication of the amount of recording equalization used in a specific machine (which cannot actually be measured without getting into the machine's circuits) and thus, by inference, the high-frequency effectiveness of the recording head.

The overall record-playback frequency response of the recorder is measured with an automatically sweeping signal covering the 20- to 20,000-Hz range in about one minute. The playback response is plotted by a graphic level recorder whose chart movement is automatically synchronized to the frequency sweep. Almost all cassette recorders have a cyclic variation in their low-frequency response due to the head design. Usually beginning at about 300 Hz, this can become quite large at frequencies below about 100 Hz (although we have never been able to hear its effects on actual program material). Our frequency-response figures include this low-frequency variation, although we suspect that many manufacturers average the fluctuations to come up with a more attractive curve.

Since the recorder's own meters are generally the user's only guide in setting and monitoring signal levels, we believe that they should be the reference for other aspects of the recorder's performance. However, enough data is provided in our reports to enable the interested technical reader to convert our data to any of the other reference levels. We therefore initially measure playback distortion (at 1,000 Hz) with the recorder's meters indicating a 0-dB recording level. Then we increase the input signal until 3 percent total harmonic distortion (THD) is measured. We also note the meter reading when playing standard Dolby-level reference tape with a standardized (200 nanowebers per meter) flux reference.

Actually, the record-playback frequency-response curve does not change appreciably when switching from one of the three reference levels to another, since they all fall within a span of several decibels. When we measure the signal-to-noise ratio (S/N) of the recorder we also use the meter's 0-dB point as a reference, but adding the meter-reading differences corresponding to either 3 percent THD or a known flux level to our S/N figures converts them to any of the other references.

To measure the S/N ratio, we record a 1,000-Hz tone at the unit's 0-dB meter point, then remove the input signal and continue to record with only the bias current applied to the tape. On playback, the output noise in the latter portion of the tape is compared with the reference output. Since a measurement with a wideband meter includes considerable noise beyond the audible frequency range, we also measure through an IEC "A" weighting filter, which rolls off the inaudible low and high frequencies to give a better correlation with subjective effects. The same measurement is repeated with the Dolby or other noise-reduction system in use, if available.

Aside from requiring a set input-signal reference level, the Dolby-B circuits depend on having an essentially flat frequency response withing the recorder over its operating frequency range. Any aberrations in the basic recorder response (and/or the tape's response) will be exaggerated by the Dolby playback processor, which continuously adjusts the playback frequency response in accordance with the signals it receives from the tape. To judge the accuracy of the "tracking" of the Dolby record and playback functions, we repeat the frequency-response measurements at levels of -20 and -30 dB. both with and without the Dolby system in the circuit. If everything is working well, the two sets of curves should be alike within about 2 dB. In practice, there is frequently a difference at the low-level higher frequencies. Even if there are no obvious audible effects from this lack of tracking, it can reduce the effectiveness of the Dolby noise reduction by several decibels.

It is also important that the recorder's playback equalization conform to industry standards (120 microseconds for ferric-oxide tapes and 70 for CrO_2 tape) if it is to produce a correct playback frequency response from tapes made on other machines or duplicated commercially. The playback response is measured with a standard test tape having "spot" frequencies recorded at intervals from 30 or 40 Hz to a high of 10,000 Hz. The flux levels on these cassettes are supposed to be accurately controlled so that a correct playbackequalization characteristic will give a flat response. The azimuth of the recording head used to make these tapes (which are all first-generation, or master, recordings) is also set very accurately, so the tape can be used for adjusting the recorder's head azimuth. At present, technical limitations restrict the highest frequency of these test cassettes to 10,000 Hz, although almost any home machine can go higher than that.

We use several makes of test cassettes and find surprising differences between them. Although these differences rarely amount to more than about 3 dB and tend to occur at the frequency extremes, sometimes the various response curves they yield on the same machine bear little resemblance to each other. Since cassette-recorder manufacturers generally do not specify playback frequency response separately, this does not cause a conflict in verifying specifications, but it could explain the differences between the "playback-response" curves provided by different test labs.

Other cassette-recorder measurements involve the mechanical aspects of its operation. Ideally, flutter (a rapid, "fluttery" speed variation) should be measured with a standard low-flutter test tape. Unfortunately, most flutter test cassettes have a minimum flutter specification of 0.1 to 0.2 percent, so they are of little value for testing recorders whose flutter ratings are at about the same percentage level. We therefore also measure the combined record-playback flutter directly on a cassette made from the 3,000-Hz signal output of our flutter meter. This type of measurement usually gives a somewhat higher reading than a "single-pass" test-cassette playback flutter measurement (assuming that the residual tape flutter in the test cassette is considerably less than that of the machine being tested) since some flutter is always introduced during recording and some during playback. However, when we get a lower figure in a combined measurement than with the test cassette, we accept it as being more representative of the recorder's true performance. Our flutter meter gives an unweighted rms reading, which is greater (by 20 to 50 percent) than the weighted readings currently used by many manufacturers. Nevertheless, a reader can validly use the unweighted readings for

comparing different recorders tested by us.

Absolute tape speed is difficult to measure without a test cassette having a precisely known frequency. Many flutter tapes have a tolerance of as much as 1 percent on their 3,000-Hz tones, but some are more accurate and can be used with a frequency counter to give a fair indication of the recorder's speed accuracy. It is not possible to check this by recording a known frequency and playing it back on the same machine, since the same speed error would be present during both recording and playback and would therefore cancel out. Fortunately, even the 1 percent speed error generally considered acceptable for cassette recorders is not likely to cause a noticeable pitch shift, and most of the machines we have

checked appear to be much more accurate than that (0.5 percent or better being typical).

Our other cassette-recorder tests include such items as input sensitivity at the various inputs (for a 0-dB recording level), playback signal-output level from a 0-dB input-signal recording, the increase in recorded noise level through the microphone inputs, overload level of microphone inputs, and the time required to handle a C-60 cassette in fast forward and rewind. We check the meter movements' ballistic response by applying a 0.3-second tone burst and comparing readings with a constant signal of the same level. A true "VU" meter will read within 1 percent of its steady-state value on such a signal burst, but very few recorder meters meet that requirement.

Summarizing, until there is "complete disclosure" by cassette-recorder manufacturers of the relationship between their bias/equalization switch settings and specific tape brands, or at least of one brand and type for which their performance specifications can be guaranteed, there is little chance of our measurements' precisely matching the manufacturer's published specifications (unless, of course, his ratings are so conservative as to represent "worst case" conditions). But, unlike the situation with some other audio components (speakers and tuners, for example), once the conditions of the tests are tightly specified in respect to the tapes and the weightings used, there is no great problem in correlating measurements made in different laboratories-or factories.

Aiwa AD-6500 Cassette Deck



HE Aiwa AD-6500 is a front-loading cassette deck with a single d.c. servo-controlled motor driving the capstan and both tape hubs. It features a novel automatic tape-loading mechanism. The hinged door, with its large window, swings upward into the cassette opening when the OPEN key on the panel is pressed (or when it is lifted manually). This exposes a flat carrier tray on which the cassette is placed. A slight push on the cassette (or closing the door) causes the cassette to disappear with a soft whirring sound into the depths of the machine, where it is automatically placed into playing position about two inches behind the panel. The cassette is angled upward at about 30 degrees, and it is well illuminated so that the status of its tape pack can be

seen easily from outside the machine.

Seven flat keys extending from the front panel below the cassette opening control all transport functions. Following the OPEN key are RECORD, REW/ REVIEW, FWD, F.FWD/CUE, STOP/ EJECT, and PAUSE keys. They can be distinguished by standardized markings above them as well as by color stripes on the RECORD, STOP/EJECT, and PAUSE keys (the FWD key is considerably wider than the others). Pressing the STOP/ EJECT key stops the tape and disengages the mechanism; releasing it and pressing again moves the cassette forward and opens the door so that it can be withdrawn easily.

To the right of the transport controls are two levers that select the input source (LINE or MIC/DIN) and activate the Dolby system (simultaneously inserting the low-pass multiplex filter into the recording signal path for recording stereo FM broadcasts). There is a DIN socket in the rear near the phono jacks that carry the line inputs and outputs. A second DIN socket on the front panel replaces the rear DIN circuit when a plug is inserted into it. Plugging a microphone into one of the front-panel MIC jacks disconnects both DIN inputs.

Separate three-position lever switches adjust the bias and equalization for ferric (LH), ferrichrome (FeCr), and chromium-dioxide (CrO_2) tapes. Separate control over bias and equalization gives the machine added flexibility in accommodating almost any type of tape formulation.

To the right of the switches, a small knob adjusts the playback level on both channels and a larger pair of concentric knobs controls the recording levels. Above them are two large illuminated VU meters, between which are two peak lights set to flash at levels of +3 and +7 dB. To the left of the meters is a three-digit index counter, a MEMORY button that causes the tape to stop in the REWIND mode when the counter returns to a 000 reading, and a movinglight strip that shows when the tape is in motion.

At the far left of the panel is a square POWER switch button, the headphone



jack, and the two microphone jacks. The red RECORD indicator light is behind the tinted plastic cover of the cassette compartment. The Aiwa AD-6500 has a rated frequency response (no tolerance given) of 30 to 14,000 Hz with LH tape and 30 to 17,000 Hz with CrO₂ and FeCr tapes. The S/N, using Dolby with FeCr tape, is rated at 62 dB, and the weighted rms flutter is 0.07 percent. The record/playback head is of ferrite construction. The recorder is about 18 inches wide, 12 inches deep, and 6½ inches high; it weighs 18.7 pounds. Price: \$370.

Laboratory Measurements. The playback equalization of the Aiwa AD-6500 was checked with Nortronics AT200 and Teac 116SP test tapes for the 120- and 70-microsecond equalization characteristics, respectively. After correcting for the differences in low-frequency equalization between the recorder and the Nortronics tape, we came up with a response curve (over the limits of the two tapes) that was flat within ±0.5 dB from 80 to 10,000 Hz and up about 2 dB at 31.5 Hz: The 70-microsecond (CrO₂) response, using the Teac tape, was within ± 1 dB from 40 to 10,000 Hz.

The recorder had been adjusted at the factory for three types of Aiwa tape: a high-grade ferric tape (LH), a chromium-dioxide tape (CrO₂), and a ferrichrome tape (FeCr). Samples of these tapes were supplied to us by Aiwa and were used for our performance checks. With LH tape, at a -20dB recording level, the playback response was flat within ±0.5 dB from 55 to 14,000 Hz and down 3 dB at 28 and 15,000 Hz. The CrO₂ tape produced the expected extension of high-frequency response, though it was not quite as flat above 10,000 Hz as the LH tape. Overall, it was down 3 dB at 27 and 16,500 Hz. Ferrichrome tape was slightly better, flat within ± 1 dB from 28 to 15,500 Hz and down 3 dB at 27 and 17,000 Hz.

To judge the compatibility of the AD-6500 with more widely available tapes, we checked its frequency response with Maxell UD-XL I and II (LH and CrO₂ equivalents) and with Sony Ferrichrome. The results were close to those obtained with the Aiwa tapes. The Dolby circuits tracked well, with no more than 2 dB of difference between the response curves made with Dolby in and out at levels of -10and -30 dB. The Dolby-level mark on the recorder's meters is at +3 dB, so these test levels were actually 23 and 33 dB below 200 nW/m. The crosstalk between channels, playing the TDK AC-352 tape, was -35 dB at 1,000 Hz.

A line input of 45 millivolts (mV) was needed for a 0-dB recording level. The microphone inputs required 0.24 mV and overloaded at 27.5 mV. The maximum playback output from a 0-dB recording was 0.67 volt with LH tape (it varies somewhat with the tape used). The meters had VU ballistics, reading 100 percent of steady state on 0.3second tone bursts. The +3-dB light flashed at +4 dB and the +7-dB light came on at the indicated level.

The distortion in the playback of a 1,000-Hz signal recorded at a 0-dB level was a very low 0.45 percent with LH tape. With FeCr tape it was 0.89 percent, and with CrO_2 it was 1.4 percent. The recording levels corresponding to 3 percent distortion were respectively +8.5, +6, and +3 dB with the three tapes, in that order.

The S/N, referred to the 3 percent distortion playback level, was 51, 53, and 50 dB with LH, FeCr, and CrO_2 tapes, respectively. With IEC "A" weighting, these improved to 54.2, 55, and 51 dB. With CCIR/ARM weighting (the characteristic preferred by Dolby Laboratories), the S/N readings were within 1 dB of the "A" weighted mea-

surements, and with the Dolby system in use they improved to 63, 66, and 61.5 dB. Through the microphone inputs the noise increased by 12 dB at maximum gain, but at normal gain settings the increase was negligible.

The wow of the AD-6500 was lower than the residual of our test tapes and instruments (about 0.015 percent); the unweighted rms flutter was about 0.12 percent playing the Aiwa TTA-111A test tape and also in a combined recordplayback measurement. The tape transport moved a C-60 cassette from end to end in 87 (rewind) to 95 (fast forward) seconds.

• Comment. The Aiwa AD-6500 impressed us with its smooth mechanical operation and with the quality of its sound. The automatic loading, though hardly necessary as a labor-saving device, worked perfectly (it reminded us of the picture ejection from a Polaroid SX-70 camera in reverse). The transport controls operated lightly and positively (they are mechanical, but they need only a light touch). The mechanism shut off automatically at the end of a tape in any mode of operation. The peak-reading LED's were an ideal adjunct to the meters. The instructions suggest appropriate peak indications for different tape types (although the LH tape had far more headroom than these suggestions implied). In any case, it is hard to imagine making a recording at an incorrect level if the +3-dB light flashes occasionally and the +7-dB light hardly at all.

The REVIEW and CUE features of the rewind and fast-forward modes are a great convenience for locating a specific portion of a tape. When the FWD (play) key is engaged, the tape can be shuttled in either direction at high speed with the rewind and fast-forward keys, with sufficient coupling to the playback head so that recorded segments can easily be identified. In this mode, the fast keys are nonlatching, so that releasing them returns the machine to normal playing speed instantly. The headphone volume from the AD-6500 was more than sufficient for comfortable listening with medium-impedance phones.

As for the sound quality, it could hardly have been better. Recording interstation FM tuner hiss and comparing the playback to the tuner output, we were pleasantly surprised to discover that at a -20-dB level (on the rocorder's meters) there was no difference whatever between the two signals, and at -10 dB there was only a trace of dulling of the extreme high frequencies. This is a very severe test for a cassette machine (not too long ago, few open-reel machines designed for home use could pass it), and it served to underline the audible benefits of the rulerflat frequency response we measured on this machine.

When the features and performance of the Aiwa AD-6500 are considered,

its price is surprisingly low (we would have guessed it to be considerably higher). It is a first-rate product, unique in some respects and better than good in *every* respect.

Dual C919 Cassette Deck



DUAL's second cassette deck, the Model C919, is a top-loading, single-motor, two-head machine based on the drive components used in the slightly more expensive Dual Auto-Reverse deck. The a.c. "continuouspole" synchronous motor that powers the C919 is the same one that drives Dual's 1249 automatic turntable. The hard Permalloy record/playback head is said to have a life expectancy of at least 3,000 hours of operation.

The black and silver control panel of the Dual C919 contrasts with a walnutfinish wooden base that makes the machine look somewhat larger than it really is. The cassette well has a clear window that exposes almost the entire cassette to view. An angled mirror reflects the tape hubs of the cassette so that they can be seen from almost directly in front of the deck as well as above it.

Near the three-digit index counter is a reset pushbutton and a button that engages the MEMORY, which stops the tape when the counter reaches 000 in rewind mode. A plastic lens above the digits hinges upward to magnify them slightly and make them more visible when viewed from the front of the machine.

The transport controls are conventional "piano-key" levers in a row across the front of the panel. They can be operated in any sequence without

going through STOP. The RECORD and PLAY keys are coded with red and green stripes for easy identification; all the others are black and can can be identified by the symbols and words on the panel above them. Pressing the EJECT key causes the cassette-well door (carrying the cassette) to rise slowly under damped control. The cassette is retained in place even when the door is opened with the machine in a vertical position.

The right side of the panel contains two pairs of slider controls. These individually set the recording level of each channel for the LINE/DIN and microphone (MIC) inputs (LINE and MIC sources can be mixed when recording). To the rear of the sliders are the two meters, illuminated softly in green when the recorder is on. They can be tilted upward slightly for better visibility. In addition to showing recording levels, they indicate the playback level before it is adjusted by the output-level control.

In the center of the panel are two pairs of screwdriver-adjusted controls and two small knobs that control headphone volume. One pair of screwdriver controls sets the recording gain for FM-Dolby operation, using the 400-Hz tone transmitted periodically by Dolbyequipped stations for calibration purposes. The other pair are line-output

controls, setting the playback level supplied to the associated amplifier. A red RECORD light and a green DOLBY light are also located near the meters.

At the bottom front of the panel are five small black pushbuttons. Three set the bias and equalization for standard (Fe), chromium-dioxide (Cr), and ferrichrome (FeCr) tapes. The other two are Dolby controls, one of them turning on the Dolby circuits for recording or playback and the other setting up the machine for processing Dolbyized FM signals. To record these, only the FM button is used. Since proper recording levels will presumably be the same for all such broadcasts, one simply presets them once with the screwdriver adjustment and thereafter forgets them. The C919 can also be used to decode FM Dolby broadcasts, without recording them, by engaging both the FM and NR DOLBY buttons as well as the RECORD key with no cassette in the machine. (Of course, the receiver's TAPE MONI-TOR switch must be set to include the C919 in the signal path.)

There are two quarter-inch jacks for medium-impedance dynamic microphones and a stereo headphone jack for phones rated from 4 to 2,000 ohms impedance. When microphones are plugged into both jacks, stereo recordings are made. When a single microphone is plugged into either jack, its output can be recorded in mono on either or both channels at the same time.

The Dual C919 has no on-off switch as such. Pressing any of the tapemotion keys also turns on the power to the machine. At the end of the tape, the transport disengages mechanically and shuts off. Preliminary recording-level adjustment can be done with just the RECORD key engaged or with both RE-CORD and PLAY engaged (the normal condition for making a recording) and the PAUSE key depressed as well. The deck can be installed either horizontal-

World Radio History

ly or vertically (legs are supplied for vertical mounting); it can even be hung on a wall with the hardware supplied. The Dual C919 is 16¹/₂ inches wide, 4³/₄ inches high, and 10 inches deep. It weighs approximately 14¹/₄ pounds. Price: \$450.

• Laboratory Measurements. The playback frequency response of the Dual C919 was measured with the Nortronics AT 200 test tape for the Fe equalization mode (120 microseconds). It was within ± 1 dB over the 31.5- to 10,000-Hz range of the tape. The FeCr and Cr equalization (70 microseconds)

sured with Sony CrO_2 tape, and it was ± 1.5 dB from 20 to 16,500 Hz. Ferrichrome tape (Sony) gave a rather similar result, within ± 2 dB from 20 to 15,500 Hz. Other high-quality tape formulations (including TDK SA and Audua, Maxell UD-XL II, and BASF LH Super) were also tested and found to give generally similar results.

The playback distortion for a 1,000-Hz, 0-dB recording level was 0.75 percent with Fe, 1.4 percent with Cr, and 1.6 percent with FeCr tape. The reference 3 percent distortion level was reached at recording inputs of +6.5 dB, +4 dB, and +3 dB for the



was measured with a Teac 116SP tape. The response was ± 1.5 dB from 80 to 10,000 Hz, down about 3.5 dB at 40 Hz. The stereo crosstalk from the left to the right channel was -46 dB at 1,000 Hz.

To reach a 0-dB indicated recording level, a LINE input of 43 millivolts (mV) or a MIC input of 0.2 mV was needed. The corresponding playback output, with Maxell UD-XL I tape, was 0.8 volt. The overload points for LINE and MIC were, respectively, 3.3 volts and 21 mV. The Dolby calibration marks are at +3 dB on the meters, and a standard Dolby-level tape indicated within 0.5 dB of that reading on both channels. The meters also had accurate VU ballistics, so that a 0.3-second tone burst of 1,000 Hz, repeated once per second, gave exactly the same meter indication as a steady-state signal of the same level-the standard test for VU characteristics.

The record-playback frequency response with Maxell UD-XL I tape (Fe) was within ± 1 dB from 45 to 13,500 Hz at a -20-dB recording level and within ± 2 dB from 20 to 14,500 Hz. The chromium-dioxide tape response was meathree tapes. At a 0-dB recording level, the high-frequency saturation was somewhat less with Cr than with Fe tape, and much less with FeCr than with either of the others.

The signal-to-noise ratio (S/N) was referred to the signal level corresponding to 3 percent playback distortion. The unweighted S/N for Fe, Cr, and FeCr tape was 56.5 dB, 55.5 dB, and 52 dB, respectively. With IEC "A" weighting these figures improved to 60.7, 60, and 57.2 dB. With CCIR weighting, the S/N measurements were essentially the same as the unweighted readings. Using the Dolby system, the "A"-weighted S/N was 66.7, 65.5, and 63 dB. Finally, with CCIR weighting and Dolby, the S/N was 67.5, 65.5, and 62.5 dB. Through the MIC inputs, at maximum gain, the noise increased by 16 dB. At normal settings of the microphone gain, the increase was much less.

The C919 had one of the fastest wind-rewind modes we have seen in a cassette deck. It moved a C-60 cassette from end to end in 44 seconds (forward) or 47.5 seconds (rewind). The unweighted rms flutter was a very low 0.075 percent; it was 0.1 percent in a combined record-playback measurement.

The tracking of the Dolby circuits (between record and playback modes) was very good. With the Maxell UD-XL I tape, switching the Dolby system in and out changed the record/playback frequency response at levels of -20 and -30 dB by less than 1.5 dB at any point. At -40 dB the change was under 0.5 dB up to about 13,000 Hz.

• Comment. In its individual specifications such as frequency response, S/N, flutter, and distortion, the Dual C919 compares very favorably with the most highly regarded cassette decks. In its totality, it easily earns a place as "one of the best" (a somewhat overworked phrase, but valid nevertheless).

The C919 is a bit different from most of its competitors. For one thing, to load the cassette one does *not* place it directly into the well but rather slides it into a pair of clips on the underside of the door. Otherwise, this is an easy deck to get used to, and quite difficult to misuse. It is obvious that humanengineering aspects have received careful attention. For example, linking the power switch to the tape-transport controls makes good sense—no more forgetting to shut off the machine.

The PAUSE control works exceptionally well, with no sign of a "chirp" or speed change on start-up. Unlike most pause keys, which start the tape when they are *released* after being pressed, the Dual device operates as it is being *pressed*, with a positive "click."

In the design of the C919, Dual engineers have taken pains to make it entirely usable in either vertical or horizontal installations. Not only the removable mounting feet, but the tilting meters and index-counter lens contrbute to this versatility. A bar across the cassette-well window at first annoyed us by partially blocking our view of the cassette from above, but it turned out to be part of a mirror assembly that makes the brightly marked hub shafts and their rotation clearly visible from directly in front of or above the deck as well as from all intermediate angles.

Another nice feature was the memory stop's being set to halt the tape at a counter reading of 000 instead of 999 as most such systems are. Thus, none of the program is lost on the replay, and there is less repetition of preceding material. We also noted that the headphone volume available from the jack was more than adequate, even with 200-ohm phones. Although we were not evaluating tapes, it seemed evident that a top-grade ferric-oxide tape such as Maxell UD-XL I gives the best overall results with this machine. Slightly extended high-frequency response and headroom can be had with CrO_2 or FeCr tape, but at some sacrifice of overall dynamic range and S/N and with increased distortion.

All in all, the Dual C919 is a pleasure to use. In its listening and handling characteristics it can hold its own with any comparable machine, and it tops most of them. It is a special pleasure for us to work with a product in which everything works "just right"—and that certainly describes the Dual C919.

Hitachi D-3500 Cassette Deck



MOST of the few three-head cassette recorders to reach the market have been notable for both their high performance and correspondingly high price. The new D-3500 cassette deck from Hitachi is dramatically less expensive than the typical three-head machine, and it has an overall performance level that falls between that of a high-quality two-head machine and the very expensive three-head models.

The Hitachi D-3500 has separate recording and playback heads within a common housing. This assures that their alignment relative to each other will be permanent. The combined head structure is small enough to fit through the center opening in the edge of the cassette where the conventional record/play head goes, the two distinct gaps being close enough to share the cassette's built-in pressure pad. The playback gap is 1.2 microns (µ) wide, while the head's recording gap is 4μ wide, both dimensions being optimum for their application. There are separate recording and playback electronic sections, including separate Dolby encode and decode systems for both functions (Hitachi refers to these as "Double Dolby"). This permits a program to be recorded with Dolby encoding and monitored from the tape in decoded form with the correct frequency balance and improved signal-to-noise ratio.

The tape transport is driven by a four-pole hysteresis-synchronous motor. The controls are fairly conventional "piano keys" along the front edge of the horizontal control panel. The STOP/ EJECT key stops the transport when pressed once; releasing it and pressing again ejects the cassette. It is possible to go from normal speed to fast speed in either direction or to shuttle between the two fast-speed modes without using the STOP button, but the tape must be stopped before it can be put into PLAY or RECORD. A hinged cover in front of the cassette door lifts to expose the heads for cleaning. On the sloped rear of the panel are REC (record) and PLAY signal lights and the pushbutton-reset index counter. To their left are two large illuminated level meters.

Along the left front of the panel are six slider level controls—two each for the line and microphone inputs (which can be mixed) and two for playbackoutput level. The pushbutton POWER switch is at the left front. A row of six large pushbuttons behind the level sliders controls MONITOR (from source or tape), INPUT SELECT (line only, or line and microphone mixed), DOLBY, TAPE (bias and equalization for "normal" and chromium-dioxide tape), MEMORY (an automatic stop in rewind at the point where the index counter reads 000), and METER. The last, in its VU position, gives the meters the ballistic properties of a true VU meter, while in the PEAK position they have a very fast rise and a much slower decay time, permitting them to respond to very brief program peaks. The status of each button is indicated by an adjacent light. With CrO₂ (chromium-dioxide) cassettes having the special rear-edge notching (most current production does), the CrO₂ bias and equalization are selected automatically when the cassette is inserted. There is no way to defeat this action manually unless the notch itself is blocked by a piece of tape.

Recessed into the front of the recorder's wooden base are the microphone and headphone jacks, an MPX button that cuts off input signals above 15,000 Hz to prevent FM pilot-carrier leakage from affecting the Dolby calibration controls. The ability to monitor from the tape while recording makes the Dolby calibration a very simple process-the noise-reduction system can be adjusted for any kind of tape in a few seconds. In the rear of the machine are the line inputs and outputs, a DIN socket, and a switch that removes the source program from the line outputs. The Hitachi D-3500 is approximately 17 inches wide, 11 inches deep, and 51/2 inches high; it weighs about 151/2 pounds. Price: \$400.

• Laboratory Measurements. The playback frequency response of the Hitachi D-3500 was measured with the Teac 116SP (CrO_2 equalization) and Nortronics AT-200 ("standard" equalization) test tapes. The CrO_2 test-tape response was within ±2 dB from 40 to

World Radio History

10,000 Hz; the "standard" tape response was smooth and free of sharp peaks or dips, but sloped downward slightly with increasing frequency above 1,000 Hz and showed the expected rise below 200 Hz because of the older equalization characteristic of the Nortronics tape. Referred to the 1,000-Hz level, it varied +0 to -6 dB over the range for which the tape's equalization is correct.

All tests of the recorder's overall record-playback response were made with Hitachi "Low Noise" (LN) and "Chrome Dioxide" (CrO₂) casettes, which were supplied with the machine. Both were C-90 cassettes. The response with the LN tape was ±1.5 dB from 30 to 12.500 Hz at a -20-dB level. It dipped to a minimum at about 15,000 Hz, and then rose at higher frequencies. From 20 to 20,000 Hz, the variation was only about ±3 dB. The CrO₂ tape gave an extremely flat response: ±2 dB from 30 to 18,000 Hz and ±3.5 dB from 20 to 20,000 Hz. The 0-dB response curves, as expected, rolled off at a much lower frequency than the -20-dB curves, but unlike the usual case, neither fell below the -20-dB response for any significant portion of the frequency range; even more surprisingly, the LN tape had at least as good a 0-dB response as did the CrO₂ tape.

The MPX filter had almost no effect in the audible range, reducing the 15,000-Hz output only about 1 dB, and, as it should, it attenuated the 20,000-Hz response by about 20 dB. The Dolby tracking was good, with an effect of less than 2 dB on the response at any frequency when the Dolby system was used during recording and playback at levels of -20 and -30 dB.

A line input of 45 millivolts (mV) produced a 0-dB recording level, and the line inputs overloaded at a safe 3 volts. The microphone sensitivity for 0 dB was 0.26 mV, but the microphone preamplifier overloaded at a rather low 19 mV, which means that external attenuators should be used with high-output microphones. The output from a 0-dB recorded signal, which also read 0 dB during playback, was 0.78 volt. The headphone volume was quite low with 200-ohm phones.

The total harmonic distortion at a 0-dB recording level was 1.4 percent with LN tape and 2.1 percent with CrO₂ tape. The reference 3 percent distortion level was reached at a high +6 dB with LN tape and +2 dB with CrO₂ tape. The unweighted signal-to-noise

ratio of both tapes, referred to those levels, was 51 dB, and it improved to 56 dB with IEC "A" weighting. With the Dolby system in use, this improved further to an impressive 65 dB, one of the best S/N measurements we have measured on a cassette recorder.

A standard Dolby level tape gave a +2-dB reading, coinciding with the Dolby marks on the recorder's meters. In the vu mode, the meter ballistics were close to those of a true VU meter, the playback from the tape and not merely the input signal. In every case where we recorded from a disc or an FM broadcast, there was *no* audibly detectable difference between the signal from the source and the signal played back from the tape! Even when recording interstation hiss from an FM tuner, we heard only the slightest modification of the hiss frequency spectrum.

We preferred to use the PEAK meter



with a rapid rise and return on 0.3second tone bursts and an overshoot of about 10 percent. In the PEAK mode, the meter read 100 percent of its steady-state value on the bursts, and returned to zero quite slowly (with a time constant on the order of a second or two). Wow of the transport was unmeasurably low (0.01 percent, which is the residual of our test equipment), and the unweighted rms flutter was 0.14 percent. In fast forward, a C-60 cassette was handled in 74 seconds, and rewinding required 81 seconds.

• Comment. When we received the Hitachi D-3500 for testing, we did not know its price. From its features, we judged that it would be an excellent value at \$500, and estimated that it would sell between \$500 and \$550. Needless to say, we were surprised by its very modest (by today's standards) cost.

The D-3500 is a very easy, unfussy machine to use. Once the Dolby system is calibrated (it takes less time to do than to describe), it handles like any other cassette recorder. When we first used the MONITOR button to compare the original and recorded programs, we had to use the pause lever to convince ourselves that we were really hearing mode exclusively, seeing no advantage to the vu mode. When the maximum peak meter reading is kept below 0 dB, there is almost no likelihood of tape saturation or distortion; with VU indications, the "safe" readings must be kept considerably lower and are not as unambiguously related to the recorder's or the tape's limits.

The Hitachi D-3500 would seem to be an excellent choice for the cassette enthusiast who is not quite enthusiastic enough to invest several hundred dollars more than the price of this recorder, yet would like to enjoy the benefits of separate recording and playback heads (which are every bit as applicable to cassette recording as to the openreel format).

As far as we can tell, nothing has been skimped on this machine, which has just about every useful feature we have seen on competitively priced twohead machines, with the possible exception of FM Dolby decoding and solenoid-operated controls. We would gladly sacrifice these features, attractive as they are, in favor of top-quality three-head cassette recording, with full "Double Dolby" circuitry, at a \$400 price. No doubt there will be others coming to somewhat the same conclusion.

Marantz Model 5220 Stereo Cassette Deck



THE Marantz model 5220 is a frontloading cassette deck whose styling matches that of other audio components in the company's line. More than half of the satin-gold front panel is devoted to a blackout area that corresponds to the dial portion ordinarily found on tuners and receivers. When the power is on, two level meters. (illuminated in blue and red). become visible behind the blackout window.

The cassette compartment occupies the left portion of the panel and is internally lighted to permit visibility of the cassette while playing or recording. The compartment is covered by a tinted plastic window that swings open for inserting or removing the tape and closes by operating a lever near the cassette well.

The deck measures $16\frac{3}{8}$ "W × $12\frac{1}{2}$ "D × $5\frac{3}{8}$ "H (41.6 × 31.8 × 13.7 cm) and weighs $19\frac{1}{2}$ pounds (8.9 kg). Price is \$370.

The deck's control section includes an index counter for the tape, accompanied by pushbuttons to reset the counter and engage a MEMORY feature. When the latter is engaged, the tape automatically stops when the counter reaches 000 in the rewind mode. This is convenient when you want to return to a previously selected point on the tape.

Six levers provide control of the tape transport. They are labelled EJECT, REC, REW, FF, STOP, and PAUSE. Except for REC, any control can be operated at any time without first stopping the tape. At the end of the tape, or if the cassette jams or breaks, the mechanism shuts off and disengages automatically in any operating mode.

Slide-type controls provide a means for separately adjusting the recording levels for each channel from the microphone and line sources. (The two can be mixed.) A single slide potentiometer serves as the master level control. The playback level is normally fixed, but it can be adjusted via screwdriver controls located in the rear of the deck. The two MIC jacks are located below their level controls, and a stereo jack for 8-ohm headphones is below the power switch.

The deck's remaining functions are controlled by seven pushbutton switches located below the gain controls. Two switch in and out the Dolby FM decoding system for listening to broadcasts with the benefits of noise reduction and correct frequency balance. Screwdriver controls on the deck's rear are provided for calibrating the Dolby circuits to a standard level tone transmitted by the FM station by setting the meter pointers to the Dolby (+2-dB) marks on the scales. A slide switch on the rear of the deck can be used to insert a compensating network to convert the normal 75-µs tuner deemphasis to the 25-µs used in Dolby transmissions. (If your tuner has its own 25-µs de-emphasis network, this switch should be left in the 75-us position.)

Another pushbutton turns on and off the Dolby circuits themselves for FM decoding or for recording and playing tapes. Separate pushbuttons for NOR-MAL (low-noise ferric-oxide tapes), CrO₂, and FeCr tape formulations simultaneously select the correct bias and equalization required for each type of tape. The final pushbutton engages a recording LIMITER that goes into operation at levels above 0 dB to prevent tape saturation and distortion from unexpected high input levels. A red PEAK light, located between the meters, flashes when instaneous recording levels exceed "safe" limits. A REC light glows red when the deck is in the recording mode.

The tape transport employs a servocontrolled d.c. motor for driving the capstans and tape hubs. Plug-in circuitboard assemblies are used in the deck for easy serviceability, and extra shielding and bias traps keep the 100kHz bias oscillator signal out of the line outputs when recording. The deck's circuits, including the Dolby noise reduction section, are built with discrete components to reduce distortion at high signal levels. Ferrite tape heads provide long life and wide frequency response.

• Laboratory Measurements. The playback frequency response was measured with both 120- and 70- μ s test tapes for the NORMAL and CrO₂/FeCr tape selector settings. The 120- μ s response was flat to within ±1 dB from 31.5 to 10,000 Hz. The 70- μ s response rose slightly in the several thousand hertz range but was within ±2 dB from 40 to 10,000 Hz.

The record/playback frequency response was checked with the three tapes for which the deck had been specifically adjusted. Sony Low Noise (LN) was used as a NORMAL tape, Sony CRO for chromium-dioxide tape and Sony FeCr for the ferrichrome. Response checks were also made with other standard tapes to verify compatibility: Maxell UD and Scotch Classic. (Most CrO_2 tapes have very similar magnetic properties.)

The Sony LN tape yielded a frequencv response within ± 2 dB from 45 to 13,500 Hz. The CrO₂ tape, as expected, produced a slightly extended response: ± 3 dB from 22 to 14,500 Hz. The best response was obtained with the ferrichrome tape: ±3 dB from 23 to 16,500 Hz. The recorder was evidently slightly under-biased for Maxell UD tape, since the response had a gentle upward slope above 1000 Hz. However, it was still quite usable with the NORMAL tape setting. The Scotch Classic ferrichrome has different properties from the Sony ferrichrome, and its output was emphasized below 1000 Hz compared to the high-frequency level. It was still within ±4 dB from 20 to 14,000 Hz.

All response measurements were made at a -20-dB level. At 0 dB, high-frequency response suffers due to tape saturation, with the high-frequency performance improving markedly as we progressed from LN to FeCr tape.

A line input of 58 mV or a micro-

phone input of 0.16 mV was needed for a 0-dB recording level at 1000 Hz. The microphone input overloaded at a very high 95 mV. The playback output depended on the tape used, varying from a low of 0.65 volt with Sony LN to a high of 0.81 volt with CrO_2 . The meters had ballistic characteristics close to those of professional VU meters, indicating about 95% of steady-state levels on a 0.3-second tone burst. A Dolby level tape played back with meter indications within 0.5 dB of the Dolby markings.

The NORMAL tapes had the lowest distortion and greatest recording headroom at 1000 Hz. Both Sony and Maxell tapes were quite close in their performance, with the Sony LN having 1.8% distortion at 0 dB and reaching the 3% reference distortion level at +6 dB. Corresponding figures for Maxell UD were 1.6% and +7 dB. The CrO₂ tape saturated at a much lower level, with 3% distortion occurring at +1 dB. The two ferrichrome tapes reached 3% distortion at +2 dB. Since the PEAK light flashed at $+7 \, dB$, it can be used as an overload indicator only with ferricoxide tapes. Other tapes would be driven into saturation long before the lamp would flash.

The signal-to-noise (S/N) ratio was

measured with the three tapes relative to the recording level that gave 3% playback distortion. Measurements were made unweighted (wide-band), with IEC "A" weighting to reduce the effect of less audible low and high frequencies, and again with the Dolby system switched in. The three S/N figures for Sony LN tape were 50.8, 56.0, and 62.5 dB. With Sony CRO tape, they were 50.5, 56.0, and 61.5 dB, and with Sony FeCr tape, they were 50.0, 55.0, and 60.5 dB. The Scotch Classic ranked close to the Sony FeCr and the Maxell UD was similar to the Sony LN in their distortion and noise characteristics.

Through the microphone inputs at maximum gain, the noise increased by only 4.5 dB, which is considerably less than the noise added by most cassette recorder microphone amplifiers. The combined unweighted rms wow and flutter was 0.11% in playback only and 0.13% in a combined record/playback measurement. The tape transport required 93 seconds to wind a C-60 cassette in the fast speeds. The recording limiter had a very fast attack and a slow decay. Although it had no effect on signal levels below 0 dB, it virtually eliminated all possibility of overload distortion. (Even a 50-volt input signal, at



maximum gain, was held to safe levels.) The headphone output was too low to be really useful with high-impedance (200 ohms) phones, which are much more common these days than the 8-ohm phones for which the recorder was designed. The Dolby circuits tracked well, affecting the overall record/playback response by less than 2 dB at any frequency, at recording levels of -20 and -30 dB.

• Comment. Our tests confirmed the specifications for the tape deck. The Model 5220 is extremely versatile in its ability to use different tape formulations, mix signal sources, and properly decode FM Dolby transmissions.

We liked the front-loading feature. The casette can be seen clearly in the compartment if it is close to eye-level. Below eye-level, however, there may be some fumbling encountered in seating the cassette in its support. When the EJECT lever is operated, the door swings up and the cassette slides down to the front of the compartment for easy removal.

Although the meters are accurate and have good ballistic response, their illumination is rather dim. The low-level blue light used for the "safe" portion of the scale provides almost no contrast with the meter pointer. On the other hand, once the level has been set, there is little need to refer to the meter, especially if the limiter is used. When the limiter is switched out, the flashing PEAK light is visible anywhere in the room.

From our distortion and S/N measurements, we conclude that a good low-noise, ferric-oxide tape, such as the Sony LN, gives the most satisfactory overall results with this recorder. The distortion and noise for LN were marginally better than for CrO₂ and FeCr tapes, but its frequency response was not quite as wide. What we consider important is the extra 4 to 6 dB of recording "headroom" of the ferricoxide tape. This allows the recording gain to be set for maximum program levels of 0 to -3 dB, with an occasional flash of the PEAK light indicating when a +7-dB level has been reached. With other tapes, the average maximum recording level should be reduced to between -5 and -8 dB, at which time, the PEAK light conveys no useful information since the tape distortion could be excessive before the light would flash.

All in all, the laboratory and listening results reveal that the Model 5220 represents good value for the money.

Nakamichi 600 Stereo Cassette Deck



AKAMICHI'S new Model 600 represents a distinct departure from current trends in cassette-deck styling and features, and some of its innovations appear to be quite successful from both aesthetic and functional standpoints. One thing that stands out is the performance of the Model 600, which, it seems safe to say, is representative of the best of the two-head cassette decks. An example is its record-playback frequency response of 40 to 18,000 Hz \pm 3 dB—attributable in large measure to the use of crystal Permalloy heads. The most striking feature of the machine is its styling, which will certainly keep it from being confused with any other on the market.

The satin-aluminum front panel is angled away from the operator at 30 degrees when the recorder is placed on a horizontal surface. It is fitted with two handles that suggest the possibility of rack mounting; although the panel dimensions are not compatible with standard 19-inch racks, the design of the tape-loading area incorporates a cassette-retaining device that permits vertical installation.

The cassette well and transport controls (which are conventional "pianokey" levers matching the panel finish) occupy the left half of the deck. The cassette opening is not covered; the cassette loads onto a horizontal platform that is then pushed down parallel with the sloping panel. Above this opening is the index counter and a MEMORY button that engages an automatic tape-motion stop in rewind when the 000 counter reading is reached. The control keys are mechanically interlocked so that STOP must be pressed before changing from normal to fast speeds or vice versa. Releasing STOP and pressing it again ejects the cassette.

Along the right front of the panel are three small knobs (for adjusting playback output and the left- and rightchannel recording-level controls) plus a larger master recording-level knob. At the top of the panel are two large illuminated meters calibrated over the unusually wide range of -40 to +7 dB. The 0-dB marks correspond to the standard Dolby level of 200 nanowebers per meter. The meters, which monitor levels ahead of the recording equalization, are fast-responding peak-reading indicators.

Immediately in front of the meters are seven small black pushbuttons. One is the power switch, and two are tape selectors that change bias and equalization for different tape types. The bias switch is marked EX and SX, referring to tapes marketed by Nakamichi: EX (actually EX II) is a high-performance ferric-oxide tape similar in its magnetic properties to such premium tapes as Maxell UDXL and TDK Audua, while the SX equalization is effective for chromium-dioxide tape (similar to TDK Super Avilyn). Chromiumdioxide tapes can be used with the SX control settings, but Nakamichi recommends SX for best results. The equalization switch has two positions, marked 120 and 70 microseconds, the latter being used with SX and CrO_2 tape.

The next three buttons relate to the Dolby noise-reducing system. One activates the Dolby circuits, another inserts the MPX (multiplex) filter in the recording signal path (to eliminate any 19-kHz pilot carrier from an FM tuner output that might affect the operation of the Dolby system), and the third turns on a 400-Hz Dolby-level test tone for calibrating the machine with other tapes.

The last button is marked "IM Suppressor," and the circuit it inserts into the playback path is unique to Nakamichi. In cassette recording, unforseen high signal peaks can severely overload the tape. While many machines (including other Nakamichi decks) have peaklimiter circuits that are generally successful in preventing overload distortion (with the possible sacrifice of some dynamic range), the IM suppressor attacks this problem in quite a different way. Magnetic tapes saturate (overload) in a predictable fashion (for any specific tape), so that the waveform recorded on the tape is distorted by saturation in a way that can be anticipated in advance. The IM suppressor applies an equal and opposite playback characteristic, which theoretically "undistorts" the waveform that comes off the tape.

In practical terms, the IM suppressor reduces distortion by 6 to 10 dB over most of the fundamental frequency range (40 to 7,000 Hz) at recorded levels from about -4 dB to the +7-dB maximum shown on the meters. Looked at another way, it adds more than 3 dB to the dynamic range of the machine, measured from the level that produces 3 percent playback distortion. Since the IM suppressor is in the playback circuit only, it can function on tapes that have been made on other machines with an effectiveness that depends on how closely the particular tape matches the saturation characteristics of the Nakamichi EX II and SX tapes for which the Model 600 has been calibrated. The 600 can, of course, be optimized for use with other types of cassette tape.

Between the control buttons and the

recording-level knobs there is an array of twelve small black buttons. Each lifts out easily, revealing a screwdriveradjustable control. One group of four adjustments sets the recording bias for EX and SX tapes (separately for each channel) and can be used to set the machine up for most other high-quality tapes as well. Another group of controls matches the playback level from the tape to the input requirements of the Dolby system with the aid of the built-in test oscillator. The final group optimizes the IM suppressor for minimum distortion with the aid of the built-in test oscillator. The final group optimizes the IM suppressor for minimum distortion with any tape (an external distortion meter or spectrum analyzer must be used for this).

On the rear of the Nakamichi 600 are the line inputs and outputs (phono jacks plus a DIN socket) and a signalflow block diagram that shows the function of each control and major circuit element. The Nakamichi 600 has no microphone inputs, that function being reserved for the company's companion Model 610 control preamplifier (whose size and styling match those of the recorder). The panel dimensions of the Model 600 are 1534 inches wide by 91/4 inches deep. The recorder is 91/2 inches deep (plus connectors) and stands 7 inches high. A removable clear plastic dust cover is included. Price: \$500.

 Laboratory Measurements. Our tests of the Nakamichi 600 were made with Nakamichi EX II and SX cassettes, although we also checked its frequency response with other well-known tapes. The playback response, measured with the Nortronics AT-200 tape, was impressively flat with the standard (120microsecond) equalization setting. It varied less than ± 0.5 dB from 40 to 10,000 Hz. The CrO₂ (70-microsecond) equalization was checked with the Teac 116SP tape. The response was flat up to 2,000 or 3,000 Hz, and it rose smoothly at higher frequencies to a maximum of +4.2 dB at 10,000 Hz. This characteristic of the Nakamichi 600 has also been noted by some other reviewers. As we understand it, Nakamichi claims that some commonly used test tapes are made with an artificially enhanced "high end" to compensate for the losses inherent in the record/ play heads of most available cassette decks. However, the Nakamichi crystal Permalloy head is said to be so efficient at high frequencies that such

compensation is not required, and thus a rising high-end response results with commercial test tapes which is not heard on normal material. We are in no position to verify or refute these claims.

In any case, the record-playback frequency response of the Model 600 proved to be remarkable. Using either type of tape, it was well within ± 1.5 dB from 40 to 19,000 Hz for a -20-dB recording level. A check with TDK Audua and chromium-dioxide confirmed that the response was almost identical to that measured with Nakamichi tapes. back distortion from 1,000-Hz test signals recorded at levels between -10and +10 dB, using both EX II and SX tapes with and without the IM suppressor. Although there were minor differences between the two tapes, the final result was much the same. The IM suppressor increased the maximum recorded level for 3 percent playback distortion from +7 to +8.5dB. At levels between 0 and +7 dB, the distortion was reduced by 4 to 8 dB with SX tape. With EX II tape, the effect was limited to levels of +5 dB or higher. As the third-harmonic distortion (which the circuit is designed to reduce) dropped off, the second harmonic rose, but it

Even at a 0-dB recording level, satu-



ration effects were much less than on most other recorders, with a strong response being maintained to well beyond 10,000 Hz. The Dolby circuits tracked very well, with less than 1 dB of difference in frequency response between the Dolby on and off conditions over the full frequency range of the recorder at levels of -20 and -30 dB. The multiplex filter affected the response by less than ± 0.5 dB up to 15,000 Hz and cut off very sharply above that frequency.

For a 0-dB meter indication, 66 millivolts were required at the line input. The maximum playback output at 0 dB was 0.55 volt. The meters read 100 percent of their steady-state values on 0.3second tone bursts (this fulfills one of the requirements of VU meters, although these are fast-responding, slowdecaying peak-reading meters). A 200nanoweber-per-meter Dolby-level test tape played back at +1 dB on the recorder's meters.

With the aid of our Hewlett-Packard 3580a spectrum analyzer (a "must" for accurate distortion measurements on a tape recorder) we measured the playwas always far below the third-harmonic level and could be ignored.

Even though the IM suppressor worked well (though our measurements did not show the 4-dB improvement in dynamic range claimed by Nakamichi), we were frankly more impressed with how low the distortion was without the suppressor. At a 0-dB level, the distortion was a mere 0.5 percent, and at -6dB it had dropped to about 0.3 percent. By the time the signal level had dropped to -10 dB, the distortion was well below 0.1 percent and was no longer measurable in the presence of playback noise, even with the spectrum analyzer.

The unweighted signal-to-noise ratio (S/N) referred to the 3 percent distortion level was about 50 dB with EX II tape. With IEC "A" weighting it was 56 dB, and it improved to about 64 dB with Dolby. With SX tape, the S/N was typically about 3 to 6 dB greater, reaching about 67 dB with Dolby and "A" weighting. This is already outstanding performance for a cassette recorder, but with the addition of the IM suppressor (permitting a higher recording level for 3 percent distortion) the total S/N of the SX tape with Dolby was between 68 and 69 dB!

The combined record-playback flutter (weighted rms) was 0.08 percent (as rated), and in playback only it was 0.1 percent. The "fast" speeds were relatively leisurely: it look about 110 seconds to move a C-60 cassette from one end to the other. The mechanical operation of the recorder was smooth and very quiet.

• Comment. Aside from styling and human-engineering considerations, the Nakamichi 600 matches or exceeds the highest level of performance we have yet seen in a two-head cassette recorder in respect to frequency response, S/N, and distortion, and in many respects it rivals the much more expensive three-head recorders made by Nakamichi and others.

Many cassette recorders can achieve a frequency response well beyond anything that will ever be required by their users. True, the 600's response is a bit wider and flatter than that of almost any of its competitors, but it seems to us that its most unique characteristic is the extraordinary "headroom" of at least 7 dB over standard Dolby level. Most cassette decks—even very good ones—begin to saturate at levels of +3 or +4 dB.

The sloping panel design gives the Nakamichi 600 some of the installation advantages of both top-loading and front-loading designs. It is very easy to use over a wide range of operating heights, although of course it cannot be stacked with other components like a true front-loading deck. In our judgment, the row of black pushbutton switches could benefit from auxiliary indicator lights to show their status. In a dim light it takes a close examination (or running one's finger along the row of buttons) to find which are depressed.

Nakamichi states (and we confirm) that the audible benefits of the IM suppressor are extremely subtle, and they usually cannot be heard on complex musical material. The simpler the signal waveform, the more apparent are the effects of the suppressor, and with a sine-wave signal recorded at 0 dB or higher the drop in harmonic distortion is immediately audible when the suppressor is engaged.

When using the Nakamichi 600 as a recorder of musical material and wideband FM noise, we were unable to detect any difference between the input and the output. We also used the machine to play some of the Advent CR/70 CrO₂ prerecorded cassettes to determine their compatibility with the 600's playback equalization. These tapes sounded slightly crisper than we are used to, with a little more "edge" on string sounds. They also gave an impression of better definition, but of course that is the normal result of a slightly accentuated high-end response. Since the Advent cassettes undoubtedly conform to the equalization characteristics of standard CrO_2 test tapes (which Nakamichi takes issue with), the findings were entirely expected. Fortunately for those who might object to the slight high-frequency emphasis, many amplifier treble tone controls can easily correct the playback response of the 600 to "flat" with the Advent cassettes.

Without making any comparative judgments between the Nakamichi 600 and any other machine we have used, we can still say truthfully that it sounds superb in every respect. If there is still someone out there who doubts that cassettes can be high-fidelity, he should be exposed to the Nakamichi 600 for a while. Furthermore, we liked the general styling of the Nakamichi 600 and found its mechanical transport controls as easy to use as any of that genre. Incidentally, the 600 can be set up in advance to make an unattended recording if an external timer is installed in the power line.

All in all, the Nakamichi 600 is one of the best two-head cassette recorders you can buy. Naturally, more than sheer performance is involved, and other recorders may have specific features that appeal to you more than those of the 600. In any event, any other machine we know of that can offer serious competition costs as much or more. Overall, we were greatly impressed with the performance of the Nakamichi 600.

Pioneer Model CT-F8282 Cassette Deck



PIONEER'S Model CT-F8282 frontloading cassette deck has a twomotor, solenoid-operated tape trans-

port, with a servo-controlled d.c.motor capstan drive. A separate hightorque d.c. motor operates the tape

hubs in fast-forward and rewind. The transport controls are short levers that extend horizontally from the front panel below the cassette well. They operate with a very light touch, since they merely energize the solenoids that perform the actual mechanical and electrical switching operations. The levers can be operated in any sequence, without going through STOP, obviating the risk of damaging the tape. A separate PAUSE switch is located to the right of the control levers. The deck can be set up in advance for unattended recording or playback, and will go into operation when power is applied by an external timer switch. It shuts down mechanically and disengages the heads when

World Radio History

the tape ends.

The styling of the cassette deck matches other Pioneer components. The control panel and controls are satin-finished aluminum, and the wooden case is finished in walnut-grain vinyl. The deck measures $1734''W \times 1312'''D \times 754''H (45 \times 34.3 \times 19.4 \text{ cm})$ and weighs 27 lb (12.3 kg). Price: \$400.

The cassette is installed vertically through a large opening in the front panel and can be covered by a swingdown clear-plastic window. Unlike other cassette decks, this one does not have an EJECT lever. Instead, with the tape stopped (even in the PAUSE mode) the cassette is simply pulled off the drive hubs and removed by hand. This is just about the simplest and easiest withdrawal system we have seen. It leaves the cassette completely visible while it is in the machine. The record/ playback and erase heads feature ferrite construction.

To the right of the cassette well, the upper portion of the control panel contains two large illuminated level meters that are calibrated from -20 to +3 dB, the latter indicated as the Dolby level for calibration purposes. During playback, the meters show the level actually present at the LINE outputs and are controlled by the OUTPUT level controls. Between the meters, a red LED indicator comes on when the deck is in the RECORD mode and another flashes when program peaks reach +5 dB to warn of potential distortion from overrecording.

Below the meters are a three-digit index counter and four pushbutton switches. One switch activates the MEMORY REWIND feature, stopping the tape in **REWIND** when the index counter returns to a previously set 000 reading. Another turns on and off the DOLBY system, and an indicator light above the button. The remaining switches are labelled BIAS and EQ, with STD settings for high-performance ferric-oxide tapes and cmy settings for chromium-dioxide tapes or the cobalt-treated equivalent tapes, such as TDK SA and MAX-ELL UD-XL II. When both buttons are depressed, a cro2 indicator above them lights. For recording on ferrichrome tapes, the STD bias and Croy EQ settings are used; Cro2 EQ should be used for their playback. A chart in the instruction manual suggests switch settings for most popular tapes.

Below the pushbutton switches are concentric INPUT level controls for the two channels and another concentric pair of OUTPUT playback level controls. At the right side of the panel are



two ¼" (6.35-mm) MIC and PHONES jacks. At the lower left of the panel is the pushbutton POWER switch.

On the rear panel of the deck are the input and output phono jacks, a DIN socket, and a switch that connects the recording inputs to either the phono jacks or the DIN socket. The DIN switch also inserts a 10-dB attenuator in the recording inputs and can be used when high-level output microphones are plugged into the front panel jacks (replacing the LINE inputs with the MIC signals) to prevent overloading the input stages. There is also a single unswitched ac outlet on the rear panel.

• Laboratory Measurements. Although the instruction manual suggests control settings for many tape types, there was no indication of which specific tapes had been used at the factory for bias adjustments. Therefore, we measured the record/playback frequency response with a number of high quality tapes, including TDK Audua, SA, and KR (CrO₂), Maxell UD-XL I and UD-XL II, Scotch Master, and two ferrichrome tapes, Scotch Classic and Sony FeCr.

The response varied little among the several ferric-oxide tapes, but TDK Audua seemed to yield a bit better high-frequency response and was chosen for further tests with the STD bias and Eq settings.

The TDK SA and Maxell UD-XL II tapes gave identical responses, but TDK KR gave the flattest overall response and was used with the CrO_2 bias and Eq. The Sony FeCr gave good results with the recommended FeCr settings, but Scotch Classic exhibited the loss of high frequencies, which we have observed in machines that have

been biased for the Sony tape. Playback frequency response was measured using the new TDK AC-331 test tape for STD (120 μ s) equalization, and with a Teac tape for CrO₂ (70 μ s) equalization.

The playback equalization was accurate with both switch settings, varying less than ± 1 dB over the 63- to 10,000-Hz range of the TDK tape and between +1.5 and -3 dB over the 40to 10,000-Hz range of the Teac tape. Most of the variation in both cases took place below 100 Hz. The record/ playback response with TDK Audua tape was flat within 0.5-dB overall from 60 to 8000 Hz, dropping off to -3 dB at 35 and 12,000 Hz. Overall, the variation was ± 3 dB from 20 to 13,5000 Hz. TDK KR tape gave an almost ruler-flat response of ±1 dB from 37 to 13,500 Hz. The other tapes were generally similar to the TDK Audua in their response, with the output sloping off gently above 10,000 Hz and more rapidly above 13,000 Hz.

For a recording level of 0 dB, an input of 57 mV was required at the LINE inputs and 0.14 mV at the MIC inputs. The MIC circuit overloaded at a fairly safe 105 mV, which could have been increased to more than 300 mV with the DIN switch. The maximum output level from a 0-dB recording was between 0.6 and 0.75 volt, depending on the tape used. With the OUTPUT control set for a 0-dB meter deflection, the output was 0.5 volt. The PEAK indicator flashed at exactly +5 dB, with an abrupt switching characteristic that eliminated the ambiguity sometimes associated with LED-type peak indicators. The meter ballistics were slightly underdamped, giving a 2-dB overshoot with 0.3second tone bursts. The crosstalk from track 2 to track 1 at 1000 Hz, measured

with a TDK AC-352 test tape, was -40 dB.

At a 0-dB recording level (3 dB below the Dolby standard level of 200 nW/m), the harmonic distortion on playback was a very low 0.5% with TDK KR, about 0.9% with TDK Audua, and 1% with TDK SA tapes. The distortion increased gradually up to +5 dB, where it was respectively 0.9%, 2%, and 0.9%. To achieve a 3% playback distortion level, we had to record at +7 dB with Audua, +8 dB with KR, 64 dB with the other tapes. Using Dolby's preferred CCIR weighting, these figures were improved by 0.5 to 1.5 dB. Through the MIC inputs, at maximum gain, the A-weighted noise level increased by 10 dB, but at normal settings of the gain control the increase was much less. On our test unit, the Dolby circuit "tracking" error at a -20-dB level caused a dip of about 5 dB in the response in the 3000- to 6000-Hz range. At other recording levels, this effect was much less.



Response with TDK KR tape using CrO_2 bias and equalization.



Playback response with two tapes at different equalization settings.

and +8.5 dB with SA tapes. These levels are far off scale on the meters giving the assurance that, so long as the PEAK indicator does not flash more than occasionally, the distortion should be negligible.

The S/N ratio was checked with the three tapes with and without Dolby and unweighted and with IEC "A" and CCIR weighting. The unweighted S/N, referred to the 3% distortion level, was 48 dB with Audua and 54 to 55 dB with the KR and SA tapes. Using "A" weighting and the Dolby system, the S/N was 61.5 dB with Audua and 63 to The wow was 0.02%, which is approximately the residual of the test tape and flutter (unweighted rms) was 0.1%. In a combined record/playback measurement, the results were identical.

In the fast-forward and rewind modes, a C-60 cassette was moved from end to end in 59 seconds.

• Comment. The "human engineering" that went into the design of the deck makes it very easy to use, especially since there is almost literally nothing one can do to operate it improperly, other than selecting the incorrect bias or equalization. Tape loading and removal procedures are ideal for eye-level operation and nearly as good at waist level. We appreciated not having the cassette pop out noisily as it does on some tape decks, and its insertion and removal are as simple as reaching into the roomy compartment and grasping the sides of the cassette. In addition, the transparent cover allows the exact playing status of the cassette to be seen at a glance, including how much tape remains to be played.

Even though most solenoid-operated tape transports use pushbuttons of one type or another to energize the solenoids, the lever system on this deck is equally convenient to use, with the advantage that the levers remain mechanically depressed after they are pushed. Hence, the operating status of the machine can be seen without recourse to signal indicators. The very light finger pressure required to operate the levers is an immediate "giveaway" to their electromechanical operation. Another nicety, which we have not seen on many recorders, is the access hole in the cassette head cover for azimuth alignment.

Although, technically speaking, the published record/playback frequency response ratings of the deck were met in our tests, it is clear that the response beyond 13,000 Hz has been slightly sacrificed in favor of low distortion and high-frequency "headimproved room." From the user's point of view, this is the proper compromise to make (and some compromise is always necessary in designing a cassette recorder) since frequencies beyond 13,000 Hz are rarely present in the program material. Their absence will rarely be noticed, whereas distortion, noise, and high-frequency tape saturation will. This deck has above-average performance in each of these respects.

The meters read line output levels in playback, rather than showing the playback level ahead of the OUTPUT control as in most recorders. Also, the usual Dolby level of 200 nW/m as a 0-dB reference is not employed. Pioneer uses -3 dB, or 160 nW/m. These criticisms, to be sure, are minor and do not in any way detract from the fact that the Pioneer CT-F8282 is a fine-sounding, easyto-use, and handsomely styled tape deck. In the popular-price range (for top-quality two-head machines), the deck compares favorably with any competitive decks in sound and performance.

World Radio History

Sony TC-756 Stereo Tape Deck



HE Sony TC-756 is a deluxe 10¹/₂inch-reel stereo tape machine with many of the performance qualities and features of professional recorders, yet it is suitable for the serious amateur recordist. It is a two-speed machine (71/2 and 15 ips) with an a.c. servo-controlled capstan motor and an eight-pole induction motor for each of the two reels. The transport controls are mechanically latching push-buttons that operate the mechanism through solenoids. A logic control system permits the buttons to be operated at any time and in any sequence without risk of tape damage. The separate RECORD buttons for the two channels can be retained in their "in" positions by a REC TIMER LOCK so that the machine can be set up in advance for recording and turned on by an external timer. Small levers select the tape speed and set the reel torque for 101/2- or 7-inch reels. The PAUSE lever also lights an indicator when engaged.

The tape-loading path is a fairly straight line, passing over tension arms near each reel. Although the head cover is not readily removable, its design makes tape threading a simple matter and permits sufficient access to the heads for cleaning or demagnetization as well. The heads are Sony's "Ferrite and Ferrite" design (available in either two- or four-track), and a dual-capstan, closed-loop drive reduces the flutter to very low levels. A four-digit index counter is located between the tape reels. The lower portion of the recorder's panel contains the electronic controls as well as the RECORD buttons and the TIMER-LOCK lever. Two separate switches adjust the recording bias to a low or high level and the recording

equalization for NORMAL or SPECIAL tapes. The instruction manual suggests the settings for most popular tapes. Two MONITOR switches connect each of the output channels to either the source or the tape-playback signal, and a pushbutton controls the power to the recorder.

Two large, illuminated VU meters monitor either recording or playback levels according to the setting of the monitor switches. Playback levels are monitored at the line outputs, where they are affected by the settings of the playback level controls. Recording status is indicated by red lights in each of the two record-interlock buttons. Concentric knobs control the recording levels for the line inputs; another pair is used for the microphone inputs, and the two sources can be mixed. A frontpanel microphone-input attenuator switch can be used to reduce microphone levels by 15 or 30 dB ahead of any preamplifier stages, if needed, to prevent overload from very-high-level mike signals. Another pair of concentric knobs sets the playback levels; one of the knobs is detented at its center to provide a reference setting for overall record-playback gain. There are two standard 1/4-inch microphone jacks on the lower left edge of the panel for unbalanced low-impedance dynamic microphones, and a jack at lower right for 8-ohm stereo headphones. In the rear of the recorder are the line inputs and outputs (through standard phono jacks) and a single unswitched a.c. outlet. The Sony TC-756 is housed in a walnutfinish wooden case; it measures approximately 17 inches wide, 18 inches high, and 9 inches deep and weighs about 53 pounds. It can be operated either horizontally or vertically. Price: \$900.

• Laboratory Measurements. We tested a half-track version of the recorder, the Model TC-756-2, with a variety of tapes, using the recommended bias and equalization settings. In general, they proved to be optimum. A line input of 45 millivolts (mV) or a microphone input of 0.13 mV was needed for a 0-dB recording level. The microphone input at the "zero" attenuator setting overloaded with 74 mV input; the 15- and 30-dB attenuator settings increased this to 0.38 and 2.4 volts. The playback output from a 0-dB level, with the playback-level controls centered, was 0.43 volt (as rated), and it could be increased to about 0.8 volt at maximum control settings. Based on the meter readings when playing a standard Dolby-level tape, the 0-dB calibration corresponds to a flux level of about 240 nanowebers per meter on the tape.

At a 0-dB recording level, the playback distortion was exceptionally low. measuring 0.45 percent at both tape speeds. To reach a reference 3 percent distortion level it was necessary to record at +9 dB. The unweighted signalto-noise ratio (S/N), referred to that level, was 64.5 dB at 71/2 ips and 60.5 dB at 15 ips. We suspect that much of the noise, especially at 15 ips, is ultrasonic and shows up in the measurement only because of the phenomenally extended high-frequency response of the recorder at that speed (see below). A measurement with IEC "A" weighting, which rolls off low and high frequencies, tended to confirm this theory. With weighting, the S/N at the two speeds improved to 71 and 70.5 dB, respectively. At maximum microphoneinput gain, the unweighted noise increased by 16 dB; with IEC weighting the increase was 10 dB (at lower, more typical, gain settings the noise was much less, of course).

The 7½-ips NAB playback frequency response over the 50- to 15,000-Hz range of the Ampex test tape was within ± 0.7 dB. The overall recordplayback frequency response was better than Sony's specifications; in fact, it was by far the widest we have ever measured on a tape recorder. At 7½ ips, the response at a -10-dB level was ± 1.5 dB from 36 to 27,000 Hz, and at 0 dB it was ± 1.5 dB from 36 to 18,500 Hz. At the 15-ips speed the response was identical at the -10-dB and 0-dB levels: within ± 1.5 dB from 36 to beyond 40,000 Hz, the upper limit of our test capability. Although the low-frequency response sloped off smoothly below 40 to 50 Hz at both tape speeds, the highs were remarkably flat and extended.

Combined wow and flutter measured 0.055 percent at 7½ ips (the wow alone was unmeasurable at less than 0.01 percent). At the 15-ips tape speed, the only way we could measure flutter was through the combined record-playback process, and the resulting 0.025 percent figure also set a new mark in our experience with tape recorders. When we measured the record-playback flutter at 7½ ips in the same manner, the reading was 0.04 percent, which was slightly better than the playback-only results using an Ampex flutter test tape.

The tape speeds were exact, and since the capstan drive is servo-controlled, a simple internal adjustment will correct any errors that may develop over time. In fast forward and rewind, a 1,800-foot reel of tape was handled in just under 2 minutes. The VU meter response was slower than professional VU standards, a 0.3-second tone burst producing 70 percent of the continuous-signal reading instead of the standard 99 to 101 percent. Headphone volume was adequate with 8ohm headphones, but unusably low with the high-impedance headphones (200 to 600 ohms) made by several manufacturers.



• Comment. In many important respects, the Sony TC-756 set new records for performance of home tape decks we have tested. In fact, for any recording other than from a "live" source, using top-grade microphones and auxiliary equipment, the dynamic range, distortion, flutter, and frequency-response performance of this machine are so far beyond the limitations of conventional program material that its virtues can hardly be appreciated.

The two-track format, 15-ips tape speed, and 10¹/₂-inch reel size imply intended professional applications, but the use of consumer-oriented phonotype connectors and unbalanced microphone inputs clearly shows that this machine is intended for the serious amateur. The quarter-track version would doubtless be more convenient for many users, and should offer essentially the same level of performance. The performance of this machine at high frequencies is a convincing demonstration of the inherent advantage of high-speed, open-reel recording over either cassette or lower-speed openreel systems. The relative absence of high-frequency tape saturation, even at a 0-dB recording level, is obvious from the measurements. When recording and playing interstation FM tuner hiss at a 0-dB level, no differences could be heard between the input signal and the output of the recorder—a fairly severe test of the effect of tape saturation on actual listening quality.

Although no claims are made for the TC-756-2 in this regard, it is the first machine we have seen whose frequency response (*not* necessarily its phase characteristics, however) should allow it to copy CD-4 discs in their encoded form, for later decoding through a suitably modified demodulator.

Tandberg TCD 330 Stereo Cassette Deck



TANDBERG tape recorders, both open-reel and cassette, have long been noted for their extended frequency response, very low noise levels, and attractive styling. In their Model TCD 330, Tandberg has set itself the goal of making a true state-of-the-art cassette deck.

The TCD 330 is a three-head machine, and its three-motor transport features a dual-capstan, closed-loop system that maintains a uniform tension on the tape as it passes over the heads. All transport functions are solenoid-controlled through light-touch pushbuttons. A foolproof logic system

World Radio History

interlocks the controls so that they can be operated in any sequence without risk to the tape. Each button has its own indicator light, either within it or just above it, so that the operating status of the machine can be seen at a glance.

The TCD 330 can be operated either horizontally or vertically. The cassette door, which opens sideways (when the machine is vertical) is at the right of the silver-colored panel. It is opened by touching a nearby EJECT button which acts through a solenoid so that the door will not open unless the machine is turned on (there is a mechanical release in the rear, however). The cassette loads through the right side of the door and is positively retained in the loading tray, where the entire tape pack can be seen through a tinted plastic window.

What appears to be a solid trim plate to the right of the cassette door is actually the cover for the record head's azimuth-adjustment system. It is opened by pressing down on its top edge (there is no external indication of this facility, but it is, of course, discussed in the instruction manual). The panel then opens slowly, under hydraulic damping, revealing the instructions for the head adjustment printed on its inside.

In order for a three-head cassette machine to have a proper high-frequency record playback response, it is necessary that the azimuths of the record and playback heads be matched exactly. (Actually, this is true of *any* threehead tape machine, but it is much more critical in the case of cassettes.) Because of the normal skewing of the tape within a cassette, this adjustment is usually required every time a cassette is inserted or even when it is turned over to record on the other side.

The TCD 330's playback head is a fixed azimuth "reference," having been factory aligned. Under the adjustment panel is a small knob that adjusts the azimuth of the recording head to match it to that of the playback head. A slide switch turns on a 10,000-Hz signal to be recorded on the right channel (closest to the center of the cassette tape) at a fixed level. The machine is put into the record mode with the monitor switch set to TAPE so that the playback from the 10,000-Hz tone is indicated on the right-channel meter. The record-head azimuth knob is then slowly adjusted for a maximum reading, indicating that the recording and playback heads are in alignment for a particular cassette.

The upper portion of the panel contains the two large meters flanked by

two pairs of slider controls for setting recording and playback levels. The meters follow Tandberg's practice of indicating peak program levels after the recording equalization so that the true program levels applied to the tape are shown. Since they can respond to transients shorter than 50 milliseconds, the meters eliminate the need for the auxiliary LED peak lights that are sometimes used to supplement slowresponding meters on other cassette decks. The meters are electronically switched to read incoming program levels when recording and line output levels when playing back, regardless of what the particular setting of the monitor switch may be.

Seven black pushbutton switches form a row under the meters. From left to right, they are the POWER switch. DOLBY NR, FM DOLBY, tape bias and equalization selector (marked NORMAL and SPECIAL), MEMORY (which stops the tape in rewind when the index counter reaches 000), MONITOR (which supplies either the incoming SOURCE or the TAPE playback signals to the line outputs), and a REC. PRESET button that must be engaged in order to make a recording. The last is a necessary safety feature, since the transport of the TCD 330 does not require simultaneous operation of two buttons in order to enter the recording mode.

Across the lower portion of the panel are flat switch plates that control all tape-transport functions. They are PLAY, REWIND, STOP, WIND, and RE-CORD, each having a colored light on its surface to show when it has been engaged. Completing the front-panel features are jacks for headphones and two microphones, the cassette EJECT button, and the index counter. Inserting a microphone plug into one of the microphone jacks disconnects that line input and replaces it with the microphone signal.

The line inputs and outputs are recessed into the top (or back, if the machine is positioned horizontally) together with a DIN socket and a socket for an optional remote-control accessory. There is also an MPX FILTER switch, used when making Dolbyized recordings from stereo FM broadcasts.

There are several facets of the operation of the Tandberg TCD 330 that are not immediately obvious but which contribute greatly to its versatility and general utility. As on other Tandberg recorders, the gain of the input amplifiers, used for both line and microphone inputs, is automatically adjusted according to the impedance of the program source to optimize the S/N of the machine and to make high-level signal overload of the electronics a practical impossibility.

The Dolby FM switch is used when recording a Dolbyized program through an FM tuner having the standard 75µsec de-emphasis. It converts the signal to a 25-µsec characteristic and records it directly without Dolby decoding. During playback, the recorder's Dolby circuits restore the signal to its proper frequency response with full Dolby noise reduction. With this button engaged the TCD 330 also serves as a Dolby decoder, for listening to broadcasts without recording them, simply by setting the amplifier or receiver to its tape-monitor mode. For proper operation, of course, the recording-level controls should be set so that the Dolby-level tone transmitted periodically by the station gives a meter indication at the Dolby mark (-2.5 dB relative to the recorder's 0-dB calibration).

When a cassette is inserted into the TCD 330, any slack in the tape is automatically taken up before the machine goes into operation. This eliminates the problem of tape wrapping around a capstan, as sometimes happens when the tape pack is loose inside the cassette. To either record or play the tape. the appropriate button(s) is pressed. At any time during recording, touching the PLAY button restores the machine to the playback mode without interrupting the tape motion. Similarly, a "flyingstart" recording can be made at any time while playing a tape by holding down the PLAY button while the RE-CORD button is pressed. The transition is always smooth and free of clicks or thumps, making easy editing possible while assembling a tape from other program sources.

The REWIND or WIND modes can be engaged at any time, and one can go directly from either of them to PLAY (the tape comes to a stop swiftly and pauses a moment before going into PLAY). However, the EJECT button will not function unless the tape is at a stop.

The electrical performance specifications of the Tandberg TCD 330 are as impressive as its other features. The TAPE switch optimizes the machine for high-performance ferric-oxide tapes or chromium-dioxide tapes (or equivalents such as TDK SA and Maxell UD-XL II). With either category of tape, the rated frequency response is at least 20 to 20,000 Hz, the weighted rms flutter is less than 0.12 percent, and the Aweighted signal-to-noise ratio (S/N) is better than 65 dB (with Dolby). The TCD 330 is a surprisingly compact machine considering its features. It is approximately $18\frac{1}{2}$ by $9\frac{1}{4}$ by $4\frac{1}{4}$ inches, and it weighs $15\frac{3}{4}$ pounds. Price: \$999.

• Laboratory Measurements. The Tandberg TCD 330 was delivered with its bias set for Maxell UD-XL-I (NOR-MAL) and Maxell UD-XL-II (SPECIAL) tapes, and these were used in our tests. With the input signal supplied from a 600-ohm generator impedance, the line and microphone sensitivities for a 0-dB meter reading were, respectively, 83 and 0.16 millivolts, with the microphone input overload being 23 millivolts (different source impedances would affect all these readings).

The maximum playback output from a 0-dB recorded level was 1.28 volts. The meters had a fast rise time and a slight overshoot of about 5 percent. The headphone output level (controlled by the playback level sliders) was fully adequate with medium-impedance as well as low-impedance phones.

The TCD 330, unlike most cassette recorders, is designed so that a 0-dB recording input is approximately the maximum permissible level, giving 3 weighted, it was about 51 dB; it improved to 57 dB with IEC "A" weighting and to 54.8 dB with CCIR weighting. When the Dolby system was used, the XL-I tape gave a slightly better S/N-66 dB with "A" weighting and 64.8 dB with CCIR weighting. The measurements with XL-II tape were both 64 dB. The unique nature of the Tandberg input circuit was emphasized by the noise performance through the microphone circuit at maximum gain. With the inputs open-circuited (corresponding roughly to the use of a highimpedance microphone) there was no increase in noise compared with the line-input noise level. With a 2,200ohm input termination, the noise increase was 2 dB, and with the input short-circuited (worst case) the noise increased 4.5 dB.

The playback frequency response, using the Nortronics AT 200 test tape with NORMAL equalization, was ± 0.5 dB from 100 to 10,000 Hz and ± 1 dB over the full 31.5- to 10,000-Hz range of the tape. The SPECIAL equalization, tested with the Teac 116SP tape, was ± 1 dB from 90 to 10,000 Hz and better than ± 2 dB from 40 to 10,000 Hz. The crosstalk between channels was -53



percent playback distortion. This was the case with the UD-XL-II tape, 2 percent distortion being measured at 0 dB and 3 percent at +1 dB. With the "normal" UD-XL-I tape, the 0-dB distortion was only 0.8 percent, and it reached 3 percent at +5 dB. With both tapes, the playback distortion with recording levels of -10 dB was about 0.2 percent, and with -20 dB it was unmeasurable, being less than 0.1 percent and masked by noise even when examined with a spectrum analyzer.

The S/N of the TCD 330, referred to the 3 percent distortion signal level, was fairly similar with both tapes. UndB at 1,000 Hz.

The record-playback frequency response for a -20-dB recording level with UD-XL-I tape was ± 1.5 dB from 20 to 20,500 Hz. WithUD-XL-II tape it was ± 1.5 dB from 20 to 22,000 Hz. The tracking of the Dolby circuits on a combined record-playback measurement was checked at recording levels of -20, -30, and -40 dB. There was a net response change of 2 to 3 dB centered at about 3,500 Hz at -20 and -30dB, and a somewhat higher error at -40 dB centered at about 1,700 Hz. Mistracking effects could not be heard.

The tape transport had extremely

low flutter, measuring 0.06 percent unweighted rms. In fast wind it moved a C-60 cassette from end to end in 48 seconds; in rewind it took 50 seconds. This places the TCD 330 among the fastestwinding units available.

• Comment. The performance of the TCD 330 speaks eloquently for the success of the Tandberg effort to reach the "state of the art" in cassette performance. When a cassette deck combines a virtually flat response from 20 to 20,000 Hz and beyond, an unweighted flutter of 0.06 percent, and an S/N of 65 to 66 dB, it is in very select company indeed.

For all its remarkable performance, the TCD 330 is very comfortable in the home, handsome enough to occupy a prominent place in one's living room and quite easy to use once one becomes familiar with its special characteristics.

The record-head azimuth adjustment system serves as an evaluator of tape quality and of head cleanliness in addition to its primary function. The playback reading from the 10,000-Hz tone shows whether a tape is compatible with the recorder's bias setting. If it reads appreciably over 0 dB it is probably underbiased, and if it fails to reach 0 dB it is either overbiased or is simply not a very good tape. If the meter reading fluctuates, the tape may have excessive drop-outs or a bad cassette shell. If one notes the maximum reading with a given tape formulation when the machine is new, a future drop in maximum output may indicate a need for head cleaning.

The process of aligning the heads for every cassette insertion (only for recording, though) is basic to the operation of all three-head cassette machines that have physically separate recording- and playback-head structures. In actual practice, it takes less time to do than to describe.

The Dolby FM decoding provided by the TCD 330 was excellent, and by using it we were able to hear a consistent and worthwhile improvement in the S/N of some of the Dolby FM broadcasts in the New York area.

It is difficult to criticize the performance of a machine as refined as the TCD 330, and, frankly, we found nothing significantly amiss or not to our liking. The Tandberg TCD 330 is obviously a worthy addition to available cassette decks in every respect. It is expensive, but we know of nothing at a lower price that can match it or even come close.

Teac Model PC-10 Portable Recorder



THE Model PC-10 portable cassette recorder is part of Teac's new "Esoteric" line. It is one of the new breed of true high-fidelity portable stereo recorders with all the features and performance quality expected of deluxe home cassette decks. It comes with a separate a.c. power supply for line operation and can be operated in the field from six D cells within its case.

The recorder measures $11\frac{1}{2}$ " W × $9\frac{1}{2}$ " D × $3\frac{1}{2}$ " H (29.2 × 24.1 × 8.9 cm) and weighs 11 lb (5 kg). Nationally advertised value is approximately \$500.

The recorder features a direct-drive d.c. capstan motor that is servo-controlled through a phase-locked loop (PLL). This eliminates belts and flywheels; it starts up and brings the transport to final operating speed rapidly. (There is a separate d.c. motor for the tape hubs.) The PLL motor drive makes the recorder's operating speed relatively independent of supply voltage and temperature, the latter specified over a range of 32° to 140°F (0° to 60°C).

The cassette well is on what would be the top of the recorder when it is placed on a shelf or table. When the recorder is carried over a shoulder via its built-on strap, the cassette well is on the side for convenient loading and unloading. A small lever opens the cassette cover, while a firmer push on the lever ejects the cassette. Located near the cassette well is a pushbutton-resettable index counter.

The control panel is dominated by two large VU meters, whose scales are labelled with the standard Dolby level mark at the +3 indexes. Between the meters is a PEAK LEVEL LED that flashes when momentary peaks reach +6 dB. The meters and PEAK LEVEL indicator function in playback as well as in the record mode.

The transport mechanism is controlled by two slide-type levers. The upper lever has STOP and PLAY positions, and next to it is the REC button that must be pressed before going to PLAY if a recording is to be made. The second lever has three positions. The left position is for rewind, center position for off, and right position for fastforward tape motion. Neither lever can be moved unless the other lever is in its stop (center) position. A PAUSE button is located just below the REC button. A red indicator comes on for the record mode.

The REC level controls for the left and right channels are concentrically ganged together. The lowest quarter of their adjustment range is marked in white as a warning that input signal levels are excessive if the controls must be set so low. Otherwise, the rest of the scales are in red for the right channel and green for the left channel. A small button below the level controls can be pressed to momentarily illuminate the VU meters or pressed and twisted to lock on the illumination. A similar button connects the right-channel meter to give an indication of battery condition.

Separate BIAS and EQ (equalization) switches are provided for setting the operating conditions to suit most tape formulations. The bias levels roughly correspond to those used with lownoise ferric-oxide and CrO_2 (or the chrome equivalent) tapes. The EQ characteristics conform to the standard 120and 70- μ s curves for these tapes. (The instruction booklet that comes with the recorder lists a number of suitable tapes and recommended switch settings.) The DOLBY NR switch turns on and off the Dolby B noise-reduction system, and the LIMITER switch turns on and off a peak limiter that takes effect at levels over +3 dB.

The positions on the MIC ATT switch are labelled 0, 15, and 30 (dB). With this switch properly set, it is possible to record very high sound levels without overloading the microphone preamplifier stages.

Set into the right side of the recorder is a well that contains the various input and output connectors, a slide switch for selecting either the microphone or line inputs, playback output jacks, a headphone jack, and a small volume control for the built-in speaker. There is also a jack for connecting the external a.c. power supply to the recorder.

The published performance specifications of the recorder are similar to those for a better-quality line-operated cassette deck. The recorder can be operated continuously for approximately two hours with six fresh D cells installed.

• Laboratory Measurement. We used TDK AC-331 tape with 120- μ s equalization and Teac 116SP tape with 70- μ s equalization during our playback frequency response tests. In both cases, the response was flat within ± 0.5 dB from 150 to 10,000 Hz, with a maximum departure from flatness of only 1 dB at the lower frequencies (which extended, respectively, to 63 and 40 Hz with the two tapes).

Several types of tapes were used to measure the overall record/playback frequency response. The curves obtained with Maxell's ferric-oxide UD-XL I and cobalt-treated ferric-oxide UD-XL II (designed to be used with "chrome" bias and equalization) tapes were typical of the recorder's performance with other high-quality tapes. The frequency response was a nearly straight line that sloped downward with increasing frequency. The total variation was ± 3 dB from 35 to 12,500 Hz using UD-XL I tape and from 35 to 15,500 Hz with UD-XL II tape. The principal difference between the two tapes was not in their frequency responses but in their high-frequency saturation characteristics. When the measurement was made at 0 dB instead of the usual -20 dB, the UD-XL II tape delivered a much better high-frequency response.

The tracking error of the Dolby circuits between the recording and playback conditions (they are supposed to be exactly balanced at all levels and frequencies) was excellent. At levels of -20 and -40 dB, there was no more than 1 dB of change in response at any frequency when using the Dolby system.

A line input of 62 mV or a microphone input of 0.22 mV was needed for a 0-dB recording level. The latter increased to 1.6 and 8 mV when the міс ATT switch was set to its 15- and 30-dB positions, respectively. The microphone overload levels were 82, 550, and 1550 mV in the three positions of the MIC ATT switch. The playback output from a 0-dB recording level varied somewhat with the tape used. The premium ferric-oxide tapes-Maxell UD-XL II and TDK SA-gave about a 0.7to 0.8-volt output, which roughly corresponds to the rated 0.775-volt output. However, the UD-XL I tape yielded a higher output at 0.93 volt.

The playback distortion from a 0-dB recording at 1000 Hz was 0.63% with UD-XL I and 0.8% with UD-XL II tapes. The 3% THD level was reached with respective recording levels of +5dB. The PEAK indicator flashed at +5 dB. The recording limiter had no effect at 0-dB or lower levels, but it made a worthwhile reduction in playback distortion when the recording levels were well off-scale on the meters. For example, at +7 dB, with UD-XL II tape, the distortion reduced from 5.3% to 2.1% with the limiter switched in. At +10dB, the distortion was a still-tolerable 3.5%, but at 20 dB it reached an unacceptable 10%. It is clear that the presence of the limiter is not a justification for entirely ignoring recording levels.

We were pleased to note that the VU meters were correctly named, at least with respect to their performance. Their ballistics matched the specifications for professional VU meters, with a 0.3-second, 1000-Hz tone burst occurring once per second to give exactly the same meter indication as a continuous tone of the same level.

With UD-XL I tape, the S/N referred

to the 3% THD level was 56.5 dB unweighted, 60.5 dB with IEC "A" weighting, and 56.5 dB with CCIR/ ARM weighting (the type preferred by Dolby Laboratories). With the Dolby system switched in, these figures improved to 61, 68, and 66.5 dB. With UD-XL II tape, the S/N was not quite as good, yielding readings of 55 dB unweighted, 59 dB IEC "A" weighted, and 56 dB CCIR weighted. The Dolby system improved these figures to 56.5, 65.5, and 66 dB. The noise level operated smoothly and reliably and moved a C-60 cassette from end to end in about 84 seconds. The crosstalk between stereo channels was -45 dB at 1000 Hz, measured with a TDK AC-352 test tape. All these tests were made using an a.c. power supply

• Comment. The overall performance of this recorder is squarely in the class of the better component-type cassette decks used in home hi-fi systems. In fact, with respect to distortion and



Playback frequency response tests using two different types of tape.



Overall record/playback frequency responses at 0 dB and -20 dB.

through the microphone inputs was 14.5 dB greater at full gain but much less with normal settings of the recording gain. Playing a 200-nanoweber/ meter standard Dolby level tape provided meter readings within 0.5 dB of the Dolby calibration marks on the meters.

The measured wow was the 0.01% residual of our test equipment and tapes. Unweighted rms and flutter measured 0.145% in both the playback and combined record/playback tests. These figures cannot be compared to Teac's own rating, which was based on a weighted measurement. The transport

noise levels, almost perfect playback equalization, and virtually ideal Dolby tracking, this recorder was superior to all but a handful of the component cassette decks we have tested.

Used in a fixed home hi-fi system, the recorder's sound quality and handling convenience left little to be desired. Our only criticism of its operation concerns the eject lever. With the recorder slung over a shoulder, it is very easy to brush against the lever and inadvertently open the cassette door. Otherwise, this fine little recorder offers the best of portable and fixed operation, albeit at a price.



Answers to a selection of the most common tape-recording questions from Stereo Review readers

Dolby and 0 VU

Ol thought that Dolby levels were standardized. But when I look at the meters of various cassette decks, some have the Dolby mark at 0 VU, some at +2 or +3 VU, and others as low as -5 VU. How can the Dolby system work on all these very different record/ playback levels?

A^{The} Dolby-B system does have a single reference: a recorded test tone with a flux level of 200 nanowebers/meter. The relation between this specified flux level and the tape deck manufacturer's decision as to where, on his meters, he wants to put the "0 VU" indication depends on a number of variables. One is the question of how much "headroom" to allow between the nominal 0 VU and the onset of serious distortion. Another is the question of whether the tape deck uses a peak-reading or an average-reading indicator.

Setting your recorder so that its built-in Dolby tone generator (if your machine has adjustment facilities) records at a level that plays back at the Dolby reference mark calibrates the recorder for proper Dolby encode/ decode action no matter where "0 VU" falls on the meter scale. In other words, the Dolby mark on the meter always corresponds to a specific level; it is the 0 VU point and other calibrations that can and do vary from one machine to another.

Too Good a Tape

Q^{Is} there any sense in using a high-quality tape capable of, say, a 65-dB signal-tonoise ratio when the tape deck it's going to be used on (for both recording and playback) is rated at, say, a 50-dB S/N?

A^{There} could well be, since the signal-tonoise ratios you cite may have been obtained using very different measuring methods. Much of what is measured as "noise" in a recorder, for example, could consist of very low-frequency hum, which can reach relatively high levels (in decibels) without becoming audibly obtrusive. Further, unless you know the spectral frequency distributions of the noises, you can't be sure that hiss from a poor tape would be fully masked by the recorder's own electronic noise. So try a sample of the good tape before you assume that your recorder is worthy only of a lower-quality Brand X.

X-Ray Damage?

O^{Does} radiation from a color television set affect prerecorded tapes, and if so, how far away should they be stored?

A. Some years ago, the question of X-ray damage to recorded tapes was rather thoroughly investigated—by Memorex, if memory serves—in connection with problems that might arise in very high-flying aircraft. Radiation levels far in excess of any encountered either in the upper atmosphere or in the vicinity of misbehaving color TV sets were tested, and no damage either to the recorded material or to the tape itself was found.

On the other hand, many color sets contain degaussing coils that are activated each time the set is turned on. While I haven't measured the field strength of these demagnetizers, I'd recommend keeping recorded tapes about as far away from a TV as you would from a loud speaker (three feet or so), just to be on the safe side.

DIN Jack Sensitivity

O. The test reports on various products with DIN connectors usually state that they are paralleled with the normal phono-jack connectors. However, when I attempted to use its DIN socket input, my tape recorder overloaded and distorted severely. What happened?

A. The input pins of the DIN socket in some tape recorders are connected in parallel with the *microphone* jacks rather than the high-level "line" or "aux." inputs. Feeding a high-level signal of 0.5 volt into a mike input designed to accept perhaps a 0.005-volt signal is going to produce just what you got-severe overload distortion. So, either you'll have to rewire the DIN socket on your recorder or install some signal-attenuating resistors at the plug to reduce the tape-output signal voltage from your preamplifier to a suitable level. The exact values of the resistors will have to be determined by trial and error, or possibly your recorder manufacturer may have some recommendations. This strange state of affairs comes about because many DIN inputs have been designed to accommodate the very low signal levels provided by some European equipment.

Buying Microphones

Are there any special rules for buying mikes that are to be used for rock recording?

A. Since the "proper" microphone for anysonal taste even among professionals, it's best that you do a little experimenting with different types before you buy. More often than not, once you've established rapport, a reputable dealer will let you try out various mikes before you make your final decision. Have confidence in your own ears; if you like the way a certain mike *sounds* on the electric guitar, that's reason enough for using it.

High volume instrumental playing can overload the tape recorder (or console) if the microphone has a fairly high sensitivity. The same is true for vocalizing in a raucous manner. So check this out with your dealer. Also, be sure that pop and wind filters are available for the mikes you select and that the mikes are ruggedly constructed if they're to be used by vocalists. For the latter purpose, a dynamic moving-coil mike is generally desirable. There are some ribbon types today, however, that can handle this type of sound very well, although most ribbons are too fragile for such applications. Condenser mikes should have switchable attenuator pads, if this type of mike is chosen.

There are a few other basics to keep in mind while you are doing your experiments, however. For example, the cardioid microphone is most sensitive to sounds coming from directly in front, and that seems to make it a good choice if you wish to focus on just one instrument within a group. But most inexpensive cardioid mikes have other characteristics that may rule them out even for that: the "proximity effect" causes low-frequency response to rise as the mike is moved closer to the instrument, and "off-axis coloration" is another hazard-sounds from surrounding areas are picked up with (at times) severely distorted frequency response. A cardioid mike that is perfectly satisfactory in other respects may nonetheless give you too much bass when it gets too close and too much offaxis coloration when it is backed off. You may get better results with an omnidirectional mike which has neither of these weaknesses. As I said, experiment.

Try a Fuji. It's worth the difference.

Next time you pick up a few cassettes, splurge. Get a Fuji or two, the world's finest cassette. A cassette that's made with the superior know-how and technology of Fuji. A cassette that's so superior in sound that you will notice the difference immediately. A cassette with virtually no drop-outs. A cassette with a strong, clean and clear response over the entire range of your hearing.

Fuji engineers have been able to develop ferric oxide particles which are completely solid and not plagued by microscopic imperfections as the particles of other cassette formulations, and they are just the right size so as to record easily the finest nuances even at high frequencies, and still maintain long-term stability.

Fuji cassettes have completely uniform oxide coating and give perfect performance from the first second to the last. Fuji cassettes are completely reliable and virtually indestructible for years to come. No snapping, no jamming, no stretching. The world's most perfect cassette.

So spend a few pennies more and indulge yourself. Get a Fuji. It's worth it. It's the best.



LET TANDBERG IMPROVE YOUR HEARING.

TANDBERG

Shown here are the new Tandberg TCD-330, "the world's most sophisticated cassette tape recorder," with three heads, three motors and dual Dolby" systems. The new 10XD, the world's first and only 10½" reel tape recorder that operates at 15 ips and combines Tandberg's unique Cross-Field recording technique with Dolby[•] B to completely eliminate audible tape hiss. And the new TR-2075, a compact receiver that combines a highly sensitive tuner and pre-amp with an extremely powerful amplifier—all on one chassis.

But you also ought to see – and listen to – the Tandberg 10X and 3500X open reel tape decks, the new TCD-310 Mark II cassette deck and the new TR-2055, TR-2040, TR-2025 and TR-2025 Multi-Band receivers. From the top of the line down, you'll find that Tandberg brings a wide selection of products that offer consistent high auality at a broad range of prices.

For a complete demonstration of all the remarkable Tandberg instruments, see your Tandberg dealer. For a color catalog full of facts and figures, write to us. It's worth \$1.50—but we'll send you a copy absolutely free!



Tandberg of America: Inc., Labriola Court, Armonk, N.Y. 10504 🗌 A. Allen Pringle-Ltd., Ontario, Canada *Dolby is a trademark of Dolby Labaratories, Inc.

CIRCLE NO. 15 ON READER SERVICE CARD


CASSETTE TAPE MACHINES

ADVENT

201A Cassette Deck

Stereo record/play Dolbyized cassette deck; Sendust alloy record/play head; wow and flutter



0.15% (IEEE/DIN weighted peak), 0.08% (JIS weighted); S/N (0-dB ref., Dolby on, A-weighted) 57 dB (standard tape), 60 dB (CrO₂ tape); 0.1% dist. (electronic): trequency response 28-15,000 Hz ± 2 dB; input sensitivity 35 mV for 0 dB; input imp. 25,000 to 100,000 ohms; output 1 V at 2000 ohms from 0 dB tape level; fastwinding time 45 sec (C60 tape); automatic shutoff; high-performance headphone amp; 120-V a.c., 60 Hz, 25 W \$399.95

AWIA

AD-1800 Cassette Deck

AD-1600 Cassette Deck

Stereo cassette deck with Dolby noise-reduction system; hysteresis synchronous motor; wow and flutter 0.07%; S/N 62 dB (Dolby on, FeCr tape); frequency response 30-14,000 Hz (LH tape), 30-17,000 (CrO₂ and FeCr tape); fast-winding time 90 sec (C-60); interlocked Dolby-MPX filter switch; ferrite guard head; full automatic stop; LED tape-run indicator; cue and review; oil-damped cassette ejection; 120-V a.c., 60 Hz; 6" H $\times 16^{10}$ /he" W $\times 115$ /e" D

AD-6300 Cassette Deck

Front-loading cassette deck with Dolby noisereduction system; d.c. servomotor; wow and flutter 0.09%; S/N 60 dB (Dolby on, FeCr tape); frequency response 30-14,000 Hz (LH tape), 30-16,000 Hz (CrO, and FeCr tapes); fast-winding time 85 sec (C-60); interlocked Dolby-MPX filter switch; three-step bias and equalization; oil-damped cassette ejection; peak level indicator signals +5 dB level; cue and review; full automatic stop; $6\frac{3}{16}$ " H $\times 16\frac{9}{16}$ " W $\times 11^{13}$ 1.6" D

AD-1250 Cassette Deck

AF-3030 AM-FM Stereo/Cassette Deck

AKAI

GXC-570D Stereo Cassette Deck

Vertical-style front-loading stereo cassette deck with Dolby; dual-process Dolby noise reduction; GX combination record/playback head for tape/source monitoring plus one erase head; a.c. servo capstan motor plus two d.c. motors for fast-forward and rewind; closed-loop dual capstan drive system, Sensi-Touch full-logic function controls; automatic playback repeat, pitch control for playback (±5%); meters switchable from VU to peak level; memory re-



wind; mic/line mixing; detent-type input/output controls; remote-control operation (with optional RC-18); electrically operated top control panel; damped cassette carriage; wow & flutter 0.06% wrms; S/N 62 dB (with Dolby above 5 kHz); frequency response 30-19,000 Hz (FeCr tape); dist. 1% (1000 Hz); 10" H×17.3" W × 9" D \$800.00

GXC-730D Bi-Directional Stereo Deck

Auto/manual reverse record and playback; GX head; Dolby noise reduction; ADR system; memory rewind; limiter; tape selector; autostop; locking pause; solenoid-assisted fuil-function change controls; illuminated direction indicators; VU meters; peak level indicator lamp; output level control; reverse selector switch for continuous play or shut-off; wow and flutter 0.08% wrms; S/N 50 dB at +3 VU; dist. 1.5% (1000 Hz 0 VU); Dolby improves up to 10 dB above 5000 Hz; 6.9" H × 17.3" W × 11.9" D.... \$500.00

CS-707D Front-Load Cassette Deck

Dolby noise reduction; memory rewind; limiter; peak level indicator; full-release auto-stop; tape selector switch; locking pause; full-function operating controls; multiplex filter switch; vertical headblock assembly; illuminated VU meters; mike/line mixing; output level control; electronically controlled d.c. motor; wow and flutter 0.08% W rms; S/N 50 dB at +3 VU; dist. 1.5% (1000 Hz 0 VU); walnut-grained vinyl cover; 6.4" H × 17.3" W × 12.0" D...... \$275.00 C\$-702D. Same as 707D except does not have memory rewind, peak-level indicator, or mike/ line mixing; 6.2" H × 15" W × 11.3" D.. \$200.00

ALARON

B-40 Mini-Cassette Recorder

Shirt-pocket-size cassette recorder; built-in condenser mike; self-contained speaker; single-hand operation; play, rewind, record operation; ANL; slide-open tape compartment door; jacks for earplug and footswitch; comes with carrying case, 30-min mini tape, batteries, earplug; $5V_{2^{c}}H \times 2V_{2^{r}}W \times 1^{s_{6^{c}}}D \dots$ \$44.95 FS-40. Optional footswitch \$3.95

BIGSTON

BSD-400 Stereo Cassette Deck

Dolbyized cassette deck; vertical slot loading; frequency response 30-15,000 Hz (chrome), 30-13,000 Hz (standard); THD 1.5%; wow and



flutter 0.07% wrms, S/N 58 dB (with Dolby), 52 dB (without); fast forward/rewind 75 sec (C-60); features memory rewind with automatic playback, cue and review, separate bias and equalization for standard, chrome, ferrichrome tapes, tape counter, mechanical lock pause, a.c. bias and erase, twin VU meters, LED peak

1978 EDITION



indicator, mike mixing, two mike inputs, 1/4-in stereo headphone jack under \$250.00

BSD-300 Stereo Cassette Deck

Dolbyized cassette deck; front-load; frequency response 40-13,000 Hz (chrome), 40-12,000 Hz (regular); THD 2%; wow and flutter 0.08% wrms; S/N 55 dB (with Dolby), 48 dB (without); fast forward/rewind 80 sec (C-60); features cue and review, mechanical lock pause, two VU meters, a.c. bias and erase, automatic rewind, tape counter, two-position tape selector, automatic shutoff, LED record light, automatic eject, V_4 -in stereo headphone jack; comes with two patchcords, C-30 tape; $5V_2^{\prime\prime\prime}$ H \times 14 $V_{1/16}^{\prime\prime\prime}$ W \times 10 $V_{1/16}^{\prime\prime\prime}$ D under \$170.00

CENTREX by PIONEER

RK-888 AM-FM/Cassette Recorder

Portable combines AM-FM radio with cassette recorder/player; frequency response 50-10,000 Hz (standard tape), 50-12,000 Hz (chrome tape); wow and flutter 0.1% rms; auto/manual recording; cue and review; pause control; sleep feature; automatic shut-off; built-in condenser mike; selector switch for chrome/standard tape; meter for tuning signal, recording level, battery life; memory tape counter; mike mixing with source and microphone separate level control; line-in, line-out and monitor jack; separate bass, treble, loudness controls; headphone jack; two-way speaker with 61/2" woofer; audio output 2 W at 1 kHz, 0.5% THD; threeway power: a.c., battery, or car cigarette lighter; 93_{4} " H × 143_{4} " W × 41_{4} " D; weight 10 lb, 2 oz\$199.95-\$239.95

KD-12 Portable Cassette Recorder

DOKORDER

MK-550 Cassette Deck

Stereo record/play Dolbyized cassette deck; molybdenum Permalloy record/play head, ferrite erase head; servo-controlled d.c. motor; wow and flutter 0.15% W rms; S/N 50 dB (Dolby off); dist. 2% at 400 Hz, 0 dB (FeCr tape); frequency response 30-12,000 Hz (standard tape), 30-14,000 (CrO, or FeCr tape); channel separation 25 dB; crosstalk-40 dB; bias frequency 60 kHz ±5 kHz; fast-winding time 100 sec (C-60); input 0.775 mV at 10,000 ohms (mike), 77.5 mV at 47,000 ohms (line), 30 mV at 10,000 ohms (DIN); output 1.3 V ±2 dB at 10,000 ohms (line and DIN), 2 mW into 8 ohms (headphone); MPX noise filter; average-reading VU meters and peak-indicating LEDs; cue and review; tape travel indicator; normal/chrome switchable equalizer circuit; bias adjustable for standard, CrO2, or FeCr tapes; 110-120 or 220-240-V a.c., 50/60 Hz, 25 W \$259.95

DUAL

C919 Cassette Deck

Separate mic and line-level controls for mixing; 72

Autoreverse Cassette Deck

Features automatic reverse, continuous playback, and bi-directional recording; Dolbyized, with test oscillator; continuous-pole/synchronous motor with double-capstan drive system; slide-type controls; ballistically damped VU meters; automatic selector for ferrous and chromium-dioxide tapes; lighted indicators for all functions; ALC; features complete automatic shut-off; two mike inputs; response 20-16,500 Hz ± 3 dB (to 17,000 Hz with CrO₂ tape); 20-14,000 Hz ± 1.5 dB (to 15,500 Hz with CrO₂ tape); wow and flutter 0.07% wrms... \$450.00

HARMAN/KARDON

HK2000 Dolby Cassette Deck

Stereo cassette deck with built-in Dolby noisereduction circuit; front-panel bias switch for



standard, low-noise, and chromium-dioxide tapes; features memory relay, peak-reading VU meters, sliding controls for playback & record level, and mike/line mixing; response 30-17,000 Hz (CrO₂); wow & flutter 0.07% (weighted); speed variation 1%; hard Permalloy head; peak-reading VU meters with LED overload indicator. $5\eta_6$ " H × 15" W × 101/4" D ... \$399.95

HEATH

AD-1530 Cassette Deck Kit

Dolbyized stereo cassette deck kit; pre-assembled tape transport; wow and flutter 0.25% rms; hum and noise -58 dB (Dolby on); 0.2% dist. (electronic); frequency response 40-14,000 Hz (CrO₂ tape); fast-winding time 45 sec for C-60 tape; mic input 0.2-10 mV hi-Z; aux. input 0.05-10 V hi-Z; built-in test circuit to adjust Dolby system; bias and equalization adjustable for standard or CrO₂ tape; VU meters; walnut-stained veneer base; 120-V a.c., 60 Hz, 15 W; 51/2" H × 14" W × 91/2" D \$279.95 ADA-1530-1. Dust cover for AD-1530 ... \$6.95

HITACHI

D800 Cassette Deck

Front-loading stereo cassette deck with Dolby noise-reduction system; three-head design with unitized record/play head; phase-controlled d.c.





servomotor drive; wow and flutter 0.05% wrms; S/N 63 dB (Dolby on), 55 dB (Dolby off); frequency response 20-20,000 Hz ±5 dB (CrO, tape), 20-16,000 Hz ±5 dB (Fe-CrO, tape), 20-15,000 Hz ±5 dB (UD tape); crosstalk -35 dB (ch/ch), -60 dB (track/track); bias frequency 105 kHz: erasure ratio 65 dB min.: fast-winding time 90 sec (C60); input sensitivity 0.25 mV at 300-5000 ohms (mic), 50 mV at more than 100,000 ohms, 0.25 mV at 12,000 ohms (DIN); output level more than 0.5 V; load imp. more than 50,000 ohms (line and DIN), 8-2000 ohms (headphones); dist. less than 2% at 1 kHz (0 VU); tape-select switch; three-digit tape counter; two peak-reading/VU meters; pause control; supplied with UDC-60 cassette tape, patch cord, and cleaning kit; 120-V a.c., 60 Hz, 18 W; 5¾" H × 17¼" W × 11½" D.

D3500 Cassette Deck

Stereo cassette deck with Dolby noise-reduction system; three-head function with unitized record/play head; hysteresis synchronous motor: wow and flutter 0.05% wrms; S/N 63 dB (Dolby on), 55 dB (Dolby off); frequency response 20-20,000 Hz (CrO, tape), 20-15,000 Hz (standard tape); bias frequency 105 kHz; fast-winding time 90 sec (C60); dist. 2% (1 kHz, 0 dB); input 0.18 mV at 300-20,000 ohms (mic), 35 mV at 100,000 ohms or more (line), 0.18 mV at 2000 ohms (DIN); output 0.5 V at 50,000 ohms or more (line), 0.5 V at 50,000 ohms or more (DIN). 8 ohms (headphones); tape-select switch; three-digit tape counter; pause control; two peak-reading/VU meters: supplied with two stereo patch cords, UDC-60 cassette, and headcleaning kit; 120-V a.c., 50/60 Hz, 20 W; 5¾" H × 16⁷/₈" W × 11⁷/₈" D \$399.95

D410 Cassette Deck

Front-loading stereo cassette deck with Dolby noise-reduction system; two-head design with Permalloy record/play head; d.c. servomotor drive; wow and flutter 0.08%; S/N 60 dB (Dolby on), 52 dB (Dolby off); frequency response 30-13,000 Hz (normal tape), 30-16,000 Hz (CrO₂ tape); three-digit tape counter; full automatic stop; two VU meters; separate output control; stop; two VU meters; supplied with patch cord; $5^{5/1}a'' H \times 16^{3/1}a'' W \times 10^{7} D \ldots$ \$199.95

JVC

LD-777 Stereo Elcaset Deck

Front-loading deck with 3-head configuration (record, play and erase); FG servomotor for capstan drive and d.c. control motor for reel drive; 2-track monaural and 4-track stereo compatibility; logic-control transport system for direct change of modes; automatic noise reduction system; built-in signal oscillator; bias adjust switch; twin VU meters; multipoint peak level indicators; input and output level control knobs; record and pause indicator lights; play/ stop on/off memory \$799.95

KD-95 Stereo Cassette Deck

Front-loading deck with automatic noise reduction system; features 2-motor, solenoid operation; 3 electromagnetic plungers for pause, brake and play; logic control transport system for direct change of modes; dual-ball cassette hold system; adjustable head azimuth, height and tilt; three bias and equalization positions; built-in 400 Hz signal oscillator; memory play and stop; mic/line mixing; removable cassette lid; dual-gap ferrite head for erase; output volume control; switchable 5-LED peak level indicators; twin VU meters; recording equalizer

There Are Bigger, Chromier, Knobbier, More Expensive Cassette Machines Than The Advent 201A. But...



If you are going to buy a high-performance cassette deck, you ought to know that no cassette machine will make more satisfying recordings (and keep on making them for year after year) than the Advent 201A.

The Advent 201A is a new version of the machine that made cassettes the high-fidelity medium they are today.

It is a uniquely simple, precise, and durable piece of recording machinery that will make cassette tapes that sound essentially identical to the best material you will find to put on them with an ease (and repeatability) that is approached by very few cassette decks at any price and surpassed by none.

The 201A is designed to be *used*, not worshipped. Its unique single VU meter (which continuously scans both stereo channels and reads out the louder at any given moment) and its precise recording controls make it the same kind of day-after-day joy to operate as a fine camera.

If you will send us the coupon, we will be

happy to send full information on the Advent 201A (including a description of the new features, such as the Sendust tape head, that distinguish it from the original 201).

In the meantime, we suggest that before you buy *any* tape machine, cassette or open reel, you give the 201A the performance test it deserves. And check with anyone who owns an Advent on the kind of satisfaction it gives year after year. Thank you.

Name Address City State	 TO: Advent Corporation, 195 Albany Street, Cambridge, Massachusetts 02139. Please send information on the Advent 201A, including a list of your dealers. 	
Address City State Zin	Name	
City	Address	
State Zip	City	
StateDip	StateZip	

Advent Corporation, 195 Albany Street, Cambridge, Massachusetts 02139.



switch; timer recording facility; full and automatic stop; illumination for easy tape checking; frequency response 20-17,000 Hz with normal tape, 20-18,000 Hz with chrome tape; S/N 56 dB (from peak level) without ANRS, improved 5 dB at 1 kHz and 10 dB above 5kHz with ANRS; wow and flutter 0.05% wrms; crosstalk -65 dB at 1 kHz; channel separation 35 dB at 1 kHz; power requirements 120 V, 60 Hz; $8^{3}/_{16}$ " H × 16½" W × 12½" D \$499.95

KD-75 Stereo Cassette Deck

Front-loading cassette with frequency-controlled d.c. servomotor; features automatic noise reduction system; dual-ball cassette hold system; full automatic and memory stop; separate switches for bias and equalization; switchable 5-LED peak level indicators; mirrored VU meters; separate controls for mic/DIN and line inputs; dual-gap ferrite head for erase: output volume control; timer recording facility; recording equalizer switch; frequency response 20-17,000 Hz with normal tape, 20-18,000 with chrome tape; S/N 56 dB (from peak level) without ANRS, improved 5 dB at 1 kHz and 10 dB above 5 kHz with ANRS; wow and flutter 0.06% wrms; crosstalk -65 dB at 1 kHz; channel separation 35 dB at 1 kHz; power requirements 120 V, 60 Hz; 65/16" H × 161/4" W × 131/4" D \$379.95

CD-1636 Portable Cassette Deck

For home or portable applications: 12 hrs continuous recording on one set of "D" batteries or auto battery; stabilizer circuits for maintaining exact power; "Sen-Alloy" head; stereo/ mono mode switch permits recording mono sound on both left and right channels simultaneously; electronic all-mode auto-stop mechanism; bias and equalization independently selectable; master recording level control with 20 detent stop positions; VU meter check light and battery checker switch; 4" monitor speaker; headphone jack; frequency response 25-18,000 Hz (45-16,000 Hz ±3 dB) with chrome tape; S/N 54 dB at 1 kHz (from peak levels) without ANRS; crosstalk-65 dB at 1 kHz, channel separation 35 dB at 1 kHz; power requirements 120 V, 60 Hz a.c.; six "D" cells, 9 V d.c.; 3⁷/₈" H × 14⁵/₈" W × 9⁵/₈" D; weight 10.1 lbs without batteries \$349.95 KD-2. Similar to the CD-1636 except more compact; 3¾" H × 10%" W × 11¾" D; weight

CD-S200 Stereo Cassette Deck

Front-loading cassette deck; frequency response 20-18,000 Hz (40-16,000 Hz ± 3 dB)



with chrome tape; S/N 52 dB at 1 kHz (from peak level) without ANRS; crosstalk -65 dB at 1 kHz; channel separation 35 dB at 1 kHz; HD 1.7% (chrome tape), 1.3% (normal tape) both at 1 kHz; wow and flutter 0.09% wrms; features "Sen-Alloy" head for record/play, ferrite head for erase; electronic governor d.c. motor; $6V_4$ " H × 19 $\frac{3}{4}$ " W × 12 $\frac{5}{6}$ " D ... \$299.95

KD-35 Stereo Cassette Deck

Front-loading deck features Dolby noise reduction; "Sen-Alloy" head for record/play; doublegap ferrite head for erase; 5-LED peak indicators; twin VU meters; mic/DIN and line input selector; 2-position bias/equalizer selectors; full automatic stop; output volume control; timer recording facility; frequency response 20-15,000 Hz with normal tape, 20-16,000 Hz with chrome tape; S/N 56 dB (from peak level) without Dolby, improved 5 dB at 1 kHz and 10 dB above 5 kHz with Dolby; wow and flutter 0.09% wrms; crosstalk --65 dB at 1 kHz; channel separation 35 dB at 1 kHz; power requirements 120 V, 60 Hz; 5^{15} /1.6" H × 15%" W × 12¹³/1.6" D \$259.95

CD-1770 Stereo Cassette Deck

Frequency response 20-18,000 Hz (30-16,000 Hz ± 3 dB) with chrome tape; S/N 52 dB at 1 kHz (from peak level) without ANRS; crosstalk –65 dB, channel separation 35 dB, HD 1.5% (chrome tape), 1.2% (normal tape) all at 1 kHz; wow and flutter 0.5% wrms; "Sen-Alloy" head for play/record, ferrite head for erase; frequency controlled d.c. servomotor; 4^19_{16} " H $\times 163_{4}$ " W $\times 10^{7}$ /e" D \ldots \$229.95

KD-15 Stereo Cassette Deck

KENWOOD

KX-920 Cassette Deck

Four-track, two-channel, Dolbyized record/play cassette deck; super-ferrite core record/play head and separate erase head; high-torque d.c. servomotor; precision drive belt; wow and flutter 0.08% wrms; S/N 62 dB (Dolby on, CrO₂ tape); frequency response 40-14,000 Hz (CrO₂ tape); bias and equalization for all tape types; extra 10 dB recording headroom; memory rewind; cue and review; built-in 25- μ s de-emphasis for Dolby FM; pitch control; VU meter with two-position time constant; mic/line mixing...

KX-620 Cassette Deck

Dolbyized front-load cassette deck; electronically controlled d.c. servomotor; critical-tolerance capstan and triangular capstan shaft support; wow and flutter 0.09%; S/N 61 dB (Dolby on, CrO, tape); auto stop disengages capstan drive and turns off motor; two-position bias switch; three-position equalization switch to accommodate all tape types; extra 10 dB recording headroom above 0 VU; $51/_2$ H \times 16 $^{15}/_{16}$ " W \times 11 $^{19}/_{16}$ " D \lesssim 219.95

LAFAYETTE

RK-D200 Dolbyized Cassette Deck

RK-D100 Dolbyized Cassette Deck

Play/record deck; automatic shutoff in play and record modes; separate record/playback level' metérs; left/right channel record-level controls; switchable record bias; response 5012,000 Hz; wow and flutter 0.25%; S/N 55 dB (with Dolby); channel separation 30 dB; d.c. motor; 3-digit tape counter; headphone jack; $3\frac{3}{8}$ " H $\times 14$ " W $\times 9\frac{3}{8}$ " D \ldots \$159.95

RK-735 Record/Playback Deck

Deck featuring a low-impedance stereo amplifier for stereo headphone listening; response 50-13,000 Hz; (S + N)/N 45 dB; channel separation 30 dB; input sensitivity: mike 1 mV; aux. 100 mV; wow and flutter 0.25% rms; has standard/chromium-dioxide level control; illuminated VU record-level meters; 3-digit tape counter with reset button; front panel left- and right-channel mike and input jacks; six pushbutton tape functions including pause; walnut wood case, brushed aluminum front panel; $3^{3}/_{16}'' \times 12^{7}/_{8}'' \times 9^{1}/_{16}'''$.

RK-715 Record/Playback Deck

Designed for recording from stereo consoles, phonos, and tape recorders; includes record and output-level controls; LED level indicator; cables; cannot be used with microphones; response 60-10,000 Hz; S/N 40 dB. 5^{3} / $_{8}$ " \times 8⁵/ $_{8}$ " \ldots \$69.95

MARANTZ

5420 Stereo Cassette Deck

5220 Stereo Cassette Deck

Ferrite heads; d.c. servomotor; wow and flutter 0.08% NAB (weighted); response 35-16,000



5120 Stereo Cassette Deck

Ferrite heads: d.c. servomotor; frequency response 35-16,000 Hz \pm 3 dB (FeCr), 35-14,000 Hz \pm 3 dB (chrome), 45-13,000 Hz \pm 3 dB (standard tape); wow and flutter 0.09% NAB (weighted); S/N 58 dB (Dolby on), 50 dB (Dolby off); left and right channel line and mic inputs; mic/line mixing; master level control; three-digit tape counter; total shutoff, peak overload indicator; built-in adjustable stand \$329.95

5020 Cassette Deck

Front-load stereo cassette deck with Dolby noise-reduction system; super-hard Permalloy record/play head; d.c. motor system; wow and flutter 0.09% wrms; frequency response 35-16,000 Hz ± 3 dB (FeCr tape), 35-14,000 Hz ± 3 dB (crO, tape), 45-13,000 Hz ± 3 dB (standard tape); S/N 58 dB (Dolby on), 50 dB (Dolby off); input 70 mV at 70,000 ohms (line), 23 mV (-72 dB) at 10,000 ohms (mike); output 0.775 mV at

6000 ohms (line), 0.75 mW at 8 ohms (head phone); mike/line mixing; three-position bias and equalization controls; separate master gain control; defeatable peak limiter circuit; VU meters; total shut-off; 120-V a.c., 50/60 Hz, 16 W; $5\frac{3}{8}$ " H × $17\frac{3}{8}$ " W × $11\frac{1}{2}$ " D \$249.95

MERITON

HD-500 Stereo Cassette Deck

Plays/records stereo; features tape selector for standard/chromium-dioxide tapes; response 30-15,000 Hz (CrO₂), 30-12,000 Hz (standard); illuminated VU meters; pause control; limiter switch; pushbutton keyboard controls. Walnut veneer hardwood cabinet with brushed aluminum; 31/2" H × 14" W × 95/8" D \$109.95

NAKAMICHI

1000 II Cassette Deck

Stereo record/play cassette deck; three-head design with crystal Permalloy PB head; dual



capstan closed-loop transport with d.c. servomotor drive; wow and flutter 0.05% wrms, 0.1% weighted peak; S/N 65 dB (400 Hz, 3%) THD with Dolby and SX tape); THD under 1.5% (400 Hz, 0 dB); frequency response 35-20,000 Hz ±3 dB (Dolby in); inputs 0.2 mV at 10,000 ohms (mike), 50 mV at 50,000 ohms (line); outputs 1 V max. (line, variable), 300 mW/ch max. at 8 ohms (headphone); Dolby noise-reduction system plus DNL; record head azimuth alignment beacon; full IC logic transport controls; auto shut-off; spill-proof system; memory and auto rewind; playback pitch control; two 50-dB range peak-reading meters; separate bias and equalization switches; left, right, and blend wide dynamic range mike inputs; phasecorrected low-noise electronics; 1117/16" H x 2011/16" W × 8%16" D 700 II Cassette Deck. Same as 1000 II but without auto rewind or DNL; 1011/16" H × 201/2" W × \$950.00 51/a" D..... DS-170 Digital Timer. Allows unattended record/ play with 1000 II and 700 II cassette decks; start/stop times may be set for 10-min intervals; connects to remote control socket of cassette decks; aux. power outlets for other components \$170.00 Remote Control Box. Electronic touch control (duplicates control system of 1000 II and 700 II cassette decks); controls all tape motion including record with 15 ft \$50.00

600 2-Head Cassette Console

Stereo record/play deck; IM suppressor cir-cuitry; user-accessible bias, record level, and IM suppressor calibration controls; separate bias and equalization switches; built-in 400-Hz test tone; Dolby noise reduction circuitry; MPX filter switch; master record-level control; tape counter with memory; 47-dB peak-level meters; d.c. servomotor drive and self-start for unattended recording; frequency response 40-18,000 Hz ±3 dB; wow and flutter 0.08% wrms (0.12% weighted peak); S/N 68 dB (400 Hz, 3% THD with Dolby); THD 0.5%, 0 dB with IM suppressor; input 50,000 ohms, 60 mV; output 580 mV (400 Hz, 0 dB); 6¥4" H × 15¥4" W × 9¹/₃" D..... \$500.00

1079 EDITION

600B. Same except in black matte finish. . \$520.00

500 2-Head Cassette Deck

Stereo record/play cassette deck; response 40-17,000 Hz +3 dB; wow and flutter 0.13% WTD peak; S/N 63 dB (CrO₂ tape with Dolby); THD 1.5% at 1000 Hz, 0 dB; inputs: mike and blend mike 600 ohm, 0.2 mV; line 150,000 ohm, 70 mV; outputs: line 1.0 V (max.) variable; headphones 8 ohm 1 mW, 0 dB; features focusedgap head with crystal Permalloy core; fullrange 45-dB peak-reading meters; Dolby noise reduction system; d.c. servomotor drive; automatic shut-off and memory rewind; three-point sound pickup for live recording; peak limiter; three-position tape selector; variable output level control; $4^{1/2}$ " H × 15" W × 10" D . . \$400.00 550. Similar to Model 500 except S/N 65 dB (SX tape with Dolby); outputs: line 580 mV; headphones 300 mW (1 kHz at 0 dB); three-way power supply (117-V a.c., 12-V battery, car jack); tape end alarm with preset timer; $31/2^{"}$ H × $121/4^{"}$ W × $137/4^{"}$ D; 111/4 lb without battery (battery life 15 hours continuous use) \$500.00

350 Universal Cassette Deck

Stereo record/playback deck; operates from a.c. power pack (included), 12-V d.c. source in cars, boats, planes (mounting bracket included), or from built-in rechargeable battery (in optional carrying case); Dolby noise-reduction circuitry; tape selector; full automatic shutoff; three low-imp. mic inputs with mixing; d.c. servomotor drive; frequency response 40-15,000 Hz ±3 dB; wow and flutter 0.08% 40-15,000 HZ = 3 (B; wow and 31/2" H × 71/3" W × wrms; S/N 58 dB (with Dolby); 31/2" H × 71/3" W × \$350.00 91/2" D; weight 7 lb Carrying Case. Includes built-in 12-V lead-acid battery and recharging circuit; 12 hr charge for 6 hr continuous recording (with 350); 101/2" H × 9¹/₂" W × 3³/₄" D; 4.5 lb \$100.00

OLYMPUS

Pearlcorder-S Deluxe Set

Consists of microcassette tape recorder, four "AA" cells, three MC-60 micro-cassettes, earphone, plug adapter, connecting cord for recording and playback through other tape recorders, clip-on microphone, speaker with amplifier, telephone pickup, a.c. adapter, carrying case, and wrist strap; capstan drive; fre-quency response 300-7000 Hz; 0.89" × 2.6" × 5.51"; weight 12 oz with batteries \$239.95 Standard Set. Similar to Deluxe set but without connecting cord, clip-on mike, speaker/ amplifier, telephone pickup \$199.95 Basic Set. Similar to Standard Set but with two "AA" cells, one microcassette, no a.c. adapter, carrying case, or wrist strap \$179.95

PIONEER

CT-F9191 Dolbyized Cassette Deck

Front-loading cassette deck; ferrite record/ playback and erase heads; electronically controlled d.c. motor plus d.c. torque motor for fast-forward and rewind drive; response 25-16,000 Hz (standard, LH tapes), 20-17,000 Hz (chromium-dioxide tapes); wow and flutter 0.07% wrms; S/N 62 dB (Dolby on), 52 dB (Dolby off); features Dolby on/off with indicator; MPX filter on/off; tape selector; mixing control for mic and line input; tape counter with rewind memory switch; recording limiter; wide-scale level meter; recording peak-level indicator; level memory marker for inputs and outputs; comes with stereo connecting cords, head cleaning kit, operating instructions; 77/8" H x 17⁷/₈" W × 12³/₈" D \$450.00

CT-F8282 Dolbyized Cassette Deck

Front-loading 2-motor solenoid-operated cassette deck with Dolby noise-reduction circuit; peak-level indicator; ferri-chrome/chrome/standard bias and equalization; memory stop; fast

World Radio History

wind, within 65 seconds for C-60; frequency response 20-16,000 Hz (standard tape), 20-17,000 Hz (chromium-dioxide tape), 20-17,000 Hz (ferri-chrome tape); wow and flutter 0.07% wrms max; S/N 53 dB (Dolby out), 63 dB (Dolby in); HD 1.5% max; sensitivity: line input 60 mV; mic 0.2 mV; line output 0.45 V; $7^{19/32}$ H \times 17^{3/4}

CT-F7272 Dolbyized Cassette Deck

Front-loading cassette deck with Dolby noisereduction system; automatic chrome detection; memory stop; fast wind, within 85 seconds for C-60; frequency response 30-14,000 Hz (standard tape), 30-17,000 Hz (chromium-dioxide tape), 30-16,000 Hz (ferri-chrome tape); wow and flutter =0.2% (DIN); S/N 52 dB (Dolby out), 62 dB (Dolby in); HD 1.7% max.; sensitivity: line input 64 mV; mic 0.23 mV; line output 0.45 V; $6^{31}/_{32}$ " H × $15^{27}/_{32}$ " W × $13^{1}/_{2}$ " D \$320.00

CT-5151 Dolbyized Cassette Deck

Dolbyized cassette deck with independent bias and equalization circuit selection for regular, low-noise, or chromium-dioxide tapes; features solid ferrite heads; twin VU meters; LED peak indicator (calibrated to light when level exceeds reference level by +4 dB); switchable level limiter; electronically controlled d.c. motor; electromagnetic automatic stop circuit; tapemotion pilot light; skip button for locating desired program material; three digit tape counter and tape memory rewind button for precision cueing; response 30-16,000 Hz (CrO₂); 30-13,000 Hz (standard) tape; (S + N)/N 58 (with Dolby), 48 dB (without); wow & flutter 0.12% wrms; bias frequency 85 kHz; 120-V, 60-Hz operation; 3³/₄" H × 15⁵/₈" W × 9¹/₂" D \$270.00

CT-F6262 Dolbyized Cassette Deck

Front-loading cassette deck with exclusive vertical cassette holding mechanism so that



tape movement and labels on all cassette tapes are visible during operation; flat belt drive and electronically controlled d.c. servomotor; hard Permalloy record/playback head, ferrite erase head; fast winding 85 sec (C-60); wow and flutter ±0.2% (DIN), 0.08% wrms; frequency response 30-14,000 Hz (standard) 30-16,000 Hz (chrome and ferrichrome); S/N 52 dB (Dolby off), 62 dB (Dolby on); HD 1.7%; features Dolby on/off switch with indicator lamp, tape selector switch, tape compartment illumination; complete complement of inputs and outputs; 6³¹/₃₂" H × 16¹/₄" W× 12¹³/₃₂" D \$270.00

CT-4141A Dolbyized Cassette Deck

Stereo design featuring d.c. brushless motor; 85 kHz bias and a.c. erase; bias change for standard and chromium-dioxide tape; response 30-12,500 Hz with standard tape (30-15,000 Hz with chromium-dioxide tape); S + N/N 58 dB with Dolby; wow and flutter 0.13%; inputs: line 50 mV; mike 0.5 mV; line output 0.775 V; 120 V, 60 Hz operation; $3^{3}\!\!\!/_{4}$ " H \times 15 $^{5}\!\!/_{9}$ " W \times 9½" D \$250.00

CT-F2121 Dolbyized Cassette Deck

Front-loading cassette deck; Permalloy record/ playback head, ferrite erase head; electronically controlled d.c. motor; frequency response 30-13,000 Hz (standard, LH tapes), 30-16,000 Hz (chromium-dioxide tapes); wow and flutter 0.12% W rms; S/N 58 dB (Dolby on), 48 dB (Dolby off); full complement of inputs and outputs; controls: Dolby on/off; tape selector with selectable bias and equalization; full automatic stop in all modes; comes with stereo con-



necting cords, head cleaning kit, operating instructions. Overall size: $5\frac{5}{6}$ " H × $13\frac{3}{4}$ " W × $11\frac{1}{6}$ " D \$200.00

REALISTIC

SCT-11 Cassette Deck

Front-load cassette deck with Dolby noisereduction system; Permalloy record/play head,



ferrite erase head; electronically controlled d.c. motor; wow and flutter 0.12% wrms; S/N 58 dB (CrO₂ tape, Dolby on); THD 2% at 1 kHz (0 VU); frequency response 30-15,000 Hz (CrO₂ tape); bias/equalization switch for CrO₂ and standard tapes; illuminated VU meters; dual-concentric record level control knob; output level control; push levers for fast forward, rewind, pause; full automatic stop; simulated walnut-finish metal case with brushed-aluminum front panel; $5^{11}/_{16}'' \times 15^{7}/_{16}'' \times 10^{1}/_{16}''' \dots$

SCT-15 Cassette Deck

SCT-14 Cassette Deck

Top-load cassette with Dolby noise-reduction system; Permalloy record/play head, ferrite erase head; electronically controlled d.c. motor; wow and flutter 0.15% wrms, S/N 59 dB (CrO₂ tape, Dolby on); THD 2% (0 VU); frequency response 40-13,000 Hz; bias select for standard and CrO₂ tapes; illuminated VU meters; calibrated Glide-Path level controls; automatic end-of-tape stop; push-push keys for record, rewind, fast forward, play, pause, and stop; digital tape counter; function indicator lights; mike, aux., and headphone jacks; scaled output level controls; simulated walnut-finish case with brushed-aluminum front panel; 3%"× 11%"×9" \$149.95

SCT-10 Stereo Cassette Deck

Pushbutton control of all functions including on/off, pause and rewind, stop/eject; hysteresis synchronous motor; response (with Supertape) 20-10,000 Hz ± 2 dB; wow and flutter 0.25% rms; S/N 48 dB; features dual lighted VU meters; left and right channel record-level controls; three-digit instant reset counter; stereo headphone jack; walnut-grained vinyl veneer end panels with brushed aluminum trim; $4Y_{16}$ " H \times 147/8" W \times 83/4" D \$99.95

RHAPSODY

RY-1230 AM-FM/Cassette Recorder

Combines AM-FM radio, cassette recorder, and built-in mike; recorder has push-button controls, automatic stop, pause button, and automatic level control; features sleep switch, LED

RY-292 Cassette Recorder

ROYAL SOUND

RS-5800 Cassette Deck

Front-loading stereo cassette with Dolby noisereduction system; Sen/Alloy record/play head, ferrite erase head; servomotor capstan drive; wow and flutter 0.08% wrms; S/N 58 dB (with Dolby); frequency response 38-13,000 Hz ±2 dB (standard and low-noise tapes), 38-17,000 Hz ± 2 dB (high-density and chrome tapes); fast-winding time 60 sec (C-60); inputs 0.27 mV/-69 dB at 600 ohms (mic), 60 mV/-22 dB at 10,000 ohms (line); outputs 0.775 V max. at 47,000 ohms (line), 100 mV at 8 ohms (headphones); eject, memory stop, auto play, auto repeat, timer record and play, three-way bias and equalization selection, mic and input level volume controls, two VU meters and peakindicating lamp; 120-V, 60-Hz or 220-V, 50-Hz a.c.; 5.5" H × 18.5" W × 12.6" D \$400.00

RS-5700 Cassette Deck

Stereo cassette deck with Dolby noise-reduction system; Permalloy record/play head, ferrite erase head; wow and flutter 0.15% wrms; S/N 50 dB (play), 48 dB (record); 2% dist. at 1 kHz; frequency response 40-12,000 Hz ± 3 dB; full complement of inputs, outputs, and controls; 117-V, 60-Hz or 240/220-V, 50-Hz a.c.; 95 mm H \times 395 mm W \times 250 mm D \ldots \$225.00

SANKYO

STD-2000 Cassette Deck

Automatic front-loading stereo cassette deck with Dolby noise-reduction system; super-hard Permalloy record/play head; electronically controlled d.c. motor; wow and flutter 0.2% (DIN), 0.07% (JIS wrms); S/N 47 dB at playback, 45 dB at record/playback (both with standard tape, Dolby off without filter); THD 1.5% (standard tape), 2.5% (CrO, tape); frequency response 30-14,000 Hz (normal tape), 30-17,000 Hz (CrO2 and FeCr tape); crosstalk -35 dB interchannel, -55 dB intertrack; fastwinding time 90 sec (C-60); input 0.5 mV at 5000 ohms (DIN/mic), 50 mV at 50,000 ohms (DIN/line); output 580 mV ±1 dB at Dolby level (DIN/line), 10 mV at 8 or 150 ohms (headphone); total automatic shut-off; three-position bias and equalization switches; LED peak indicator; record, Dolby, and tape running indicators; mechanical pause; twin VU meters; three-digit memory tape counter; 51/2" H × 17" W × 113/4" D \$299.95 STD-1900. Similar to STD-2000 but frequency response 30-13,000 Hz (normal tape), 30 16,000 Hz (CrO, and FeCr tape); without peak and mode indicators and memory \$249.95 STD-1800. Similar to STD-1900 but without automatic loading; wow and flutter 0.08% (JIS wrms); S/N 46 dB at playback and record/ playback (standard tape, Dolby off without filter); THD 2.5% (standard tape), 3% (CrO2 tape); frequency response 40-12,500 Hz (normal tape), 40-15,000 (CrO, and FeCr tape); crosstalk -- 28 dB interchannel; output 400 mV (DIN), 900 mV (line), 1 mV (headphone); twoposition bias and equalization switches;



 $\begin{array}{l} 5\gamma_{4''} \; H \times 15\gamma_{4''} \; W \times 9\gamma_{4''} \; D \ldots \qquad \$ 199.95 \\ \textbf{STD-1700.} \; Similar \; to \; STD-1700 \; but \; wow \; and \\ flutter \; 0.22\% \; (JIS \; wrms); \; frequency response \\ 40-12,000 \; Hz \; (normal \; tape), \; 40-14,000 \; Hz \\ (CrO_{2} \; and \; FeCr \; tape); \; output \; 650 \; mV \; (line); \\ 5\gamma_{4''} \; H \times 14\gamma_{4''} \; W \times 9\gamma_{4''} \; D \ldots \qquad \$ 149.95 \\ \end{array}$

STD-1610 Cassette Deck

Stereo cassette deck with Dolby noise-reduction system; ferrite play/record head, Permalloy erase head; d.c. servomotor; wow and flutter 0.09% W rms; S/N 55 dB (CrO_2 tape, Dolby on); dist. less than 1.5%; frequency response 30-14,000 Hz; input 350 mV at 200,000 ohms (line), 0.15 mV at 600 ohms (mic); output 0.58 V at 10,000 ohms (line), 0.07 V at 80 ohms (headphones); record/play DIN jack; total automatic shut-off; automatic and manual bias controls; two VU meters; peak indicator; separate input and output controls; pause control; limiter switch; three-digit tape counter; dust cover; 120-V a.c., 60 Hz, 15 W; 31/7" H \times 15" W \times 10" D \$179.95

STD-1510 Cassette Deck

Stereo cassette deck with Dolby noise-reduction system; ferrite play/record head, Permalloy erase head; d.c. motor; wow and flutter 0.12%; S/N 55 dB (CrO₂ tape, Dolby on); dist. less than 1.5%; frequency response 30.14,000 Hz; input 350 mV at 200,000 ohms (line), 0.15 mV at 600 ohms (mic); output 0.58 V at 10,000 ohms (line), 0.07 V at 80 ohms (headphones); record/ play DIN jack; total automatic shut-off; automatic and manual bias controls; separate input and output controls; pause control; limiter switch; two VU meters; three-digit tape counter; 120-V a.c., 60 Hz, 15 W; 31/7 H \times 15[°] W \times 10° D \$159.95

STD-1410 Cassette Deck

Dolbyized cassette deck; Permalloy head; d.c. motor; wow and flutter 0.2%; S/N 55 dB (CrO₂ tape, Dolby NR on); dist. 1.5%; frequency response 40-14,000 Hz; input 350 mV at 200,000 ohms (line), 0.15 mV at 600 ohms (mic); output 0.58 V at 10,000 ohms (line), 8-ohm head-phones, two VU meters; CrO₂ tape switch; three-digit index counter; pause control; total automatic shut-off; 120-V a.c., 60 Hz, 9 W; 3'/r[°] H × 15" W × 10" D..... \$129.95

SANSUI

SC-5100 Cassette Deck

SC-3100 Cassette Deck

"Direct-O-Matic" front-loading stereo cassette deck with Dolby noise-reduction system; Permalloy record/play head, ferrite erase head; FG-equipped servomotor drive; wow and flutter 0.06%; frequency response 25-14,000 Hz (30-13,000 Hz \pm 3 dB) with normal tape, 25-16,000



Hz (30-14,000 Hz \pm 3 dB) with CrO₂ tape; S/N 57 dB before Dolby; features "Tape Lead-in," separate bias and equalization switches for CrO₂, normal, and FeCr tapes; automatic memry; mixing capability; VU meters; tape countar; 7¹³/1⁶ H \times 17¹⁵/1⁶ W \times 12⁷/8[°] D \$430.00

SC-3000W Stereo Cassette Deck

Front-loading stereo deck with fail-safe insertion device; 4-track/2-channel record/playback; Permalloy record/play head, ferrite erase head; electronically controlled d.c. motor; directchange mode levers; auto shutoff; memory rewind; IC Dolby circuitry; selectable equalization circuit; LED peak-level indicators; two VU meters; wow and flutter 0.09% W rms; frequency response 30-11,000 Hz ± 3 dB (normal), 35-13,000 Hz ± 3 dB (chrome); S/N 50 dB (Dolby out), 60 dB (Dolby in); simulated walnutgrain cabinet; 71/3" H $\times 183$ %" W $\times 117$ %" D \$380.00 SC-2000W. Similar to SC-3000 except wow and

flutter 0.1% W rms; frequency response 35-12,000 Hz ±3 dB (chrome); no memory rewind;\$310.00

SC-2100 Cassette Deck

SC-1100 Cassette Deck

SANYO

RD8400 Cassette/8-Track Deck

RD5300 Dolbyized Cassette Deck

Front-loading stereo cassette recorder deck with built-in Dolby noise-reduction circuit; frequency response 30-14,000 Hz; S/N 57 dB (Dolby out), 63 dB (Dolby in); wow and flutter 0.10% rms; separate input and output level controls; CrO₂/standard tape pushbutton equalization control and LED indicators; bias high/ low control; limiter on/off control; two large VU

1070 EDITION

meters \$179.00

RD4553 Dolbyized Cassette Deck

Front-loading stereo cassette recorder with built-in Dolby noise-reduction circuits; frequency response 50-13,000 Hz; S/N 53 dB (Dolby out), 60 dB (Dolby in); wow and flutter 0.2% rms; CrO₂/standard tape selector; two VU meters\$149.95

RD4153 Stereo Cassette Deck

Stereo record/play; response 30-12,000 Hz; S/N 45 dB; wow and flutter 0.24% max.; features two VU meters; mike and line inputs; automatic end-of-tape stop; CrO₂/standard tape selector; $3V_{2}$ " H \times 11 $3V_{8}$ " W \times 9" D \$99.95

SONAB

C500 Dolbyized Cassette Deck

Features servo-controlled d.c. motor; two hard Permalloy heads; Dolby noise-reduction circuitry; tape selector for standard and chromium-dioxide tapes; two peak-reading record-level meters; mixing facilities left/right channels; memory rewind; built-in headphone amplifier; response 30-15,000 Hz (standard); 30-16,000 Hz (chromium-dioxide) tapes; wow and flutter 0.13% (weighted); S/N 51 dB (Dolby out), 58 dB (Dolby in) with standard tape; 53 dB (Dolby out); 60 dB (Dolby in) with chrome tape; black enclosure. 4" H × 15" W × 10" D \$399.00

SONY from SUPERSCOPE

EL-7 Elcaset Deck

Front-load stereo cassette component deck; Dolby noise-reduction system; ferrite-and-fer-



rite heads; d.c. servomotor for capstan drive, d.c. motors for reel drive; 3¾ ips tape speed; wow and flutter 0.04% wrms; S/N (Dolby off) 59 dB (SLH tape), 62 dB (FeCr tape), Dolby on improves S/N by 10 dB over 5 kHz; frequency response 25-20,000 Hz ±3 dB (SLH tape), 25-22,000 Hz ±3 dB (FeCr tape); fast-winding time 60 sec (LC-60); distortion 0.8% (FeCr tape); bias frequency 160 kHz; input 0.095 V at 100,000 ohms (line-three inputs), -68 dB (Io-Z mike); output 0.775 V at 10,000 ohms (line), 8-ohm headphone; illuminated VU meters; "Symphase" recording capability; threeposition equalization and bias selection; pause control; three-digit memory rewind tape counter; 120-V a.c., 60 Hz, 35 W; 6.75" H × 17" W × 12.625" D \$899.95 RM-30. Full-function remote control for Sony Elcaset tape decks; record mute; color-coded feather-touch controls; deck function may be switched without depressing stop button; silent controls; 13-ft extension cord; standard camera tripod mount \$59.95

TC-177SD Cassette Deck

EL-5 Elcaset Deck

Front-load stereo cassette component deck; Dolby noise-reduction system; ferrite-and-ferrite heads; FG d.c. servomotor; 3¾ ips tape speed; wow and flutter 0.06% wrms; S/N

TC-209SD Dolbyized Cassette Deck

Front-load stereo cassette deck; Dolby noisereduction circuit; ferrite-and-ferrite head; FeCr equalization; frequency response 20-15,000 Hz (standard tape), 30-17,000 Hz ±3 dB (chrome and FeCr tape); S/N 53 dB (standard), 55 dB (FeCr and chrome): hysteresis synchronous motor; wow and flutter 0.07%; features "Symphase" recording capability, built-in multiplex filter; three-pos. equalizer selector, two-pos. bias selector; mic/line mixing; record interlock; stereo headphone monitor jack; two illuminated VU meters plus one peak indicator; pause control; three-digit tape counter; memory tape counter; automatic total mechanism shutoff; mic and aux. inputs; two a.c. convenience outlets; Dolby indicator; front-panel mic jacks; front-panel line-in; comes with two RK-74 patchcords, head cleaning tips, FeCr-60 cassette; $6^{11}/_{16}$ " H × 17 $\frac{5}{16}$ " W × 12 $\frac{7}{32}$ " D . . \$519.95

TC-229SD Cassette Deck

Front-load stereo cassette deck; ferrite-and-ferrite head; Dolby noise-reduction system; servomotor for capstan drive; wow and flutter 0.06% wrms; S/N 60 dB (FeCr tape); frequency response 20-15,000 Hz (standard tape), 30-16,000 Hz ± 3 dB (FeCr tape), 30-15,000 Hz (CrO₂ tape); fast-winding time 70 sec (C-60); bias frequency 105 kHz; input 0.06 V at 100,000 ohms (line, three inputs), 0.2 mV (lo-Z mike); 0.775 V at 10,000 ohms (line), 8-32 ohm headphone; "Symphase" recording capability; three-position bias and equalization switches; illuminated VU meters; LED peak level indicator; pause control; three-digit tape counter; $6^{3}/_{a}$ " H $\times 17$ " W $\times 12^{1}/_{a}$ " D ... \$519.95

TC-138SD Dolbyized Cassette Deck

Stereo cassette deck with Dolby noise-reduction system; ferrite-and-ferrite head; FeCr equalization; built-in multiplex filter; three-pos. tape select switch; pushbutton operation; mic/ line mixing; straight-line record level controls; record interlock; separate line-out volume control; stereo headphone monitor jack; two calibrated VU meters, peak limiter; peak level indicator; three-digit tape counter; automatic total mechanism shutoff; four function- indicator lamps; locking fast-forward and rewind; frequency response 20-15,000 Hz (standard), 30-15,000 Hz ±3 dB (chrome and FeCr tape); induction motor drive; wow and flutter 0.07%; comes with two RK-72 patchcords, dust cover, FeCr-60 cassette; $5\gamma_{16}$ " H × $16\gamma_{16}$ " W × $11\gamma_{16}$ " D\$399.95

TC-158SD Cassette Deck

Portable stereo cassette deck with Dolby noisereduction system; ferrite-and-ferrite head; wow and flutter 0.08%; S/N (peak level, Dolby off) 53 dB (normal tape), 55 dB (CrO₂ tape), 59 dB (FeCr tape); frequency response 20-14,000 Hz (normal tape), 30-15,000 Hz \pm 3 dB (CrO₂ and FeCr tape); fast-winding time 90 sec (C-60); bias frequency 105 kHz; input 0.06 V at 100,000 ohms (line), 0.2 mV (lo-Z mike); output 0.435 V at 10,000 ohms, 8-32 ohm headphones; "Symphase" recording capability; three-position bias and equalization switches; illuminated VU meters; peak level indicator; built-in speaker; pause control; three-digit tape counter; automatic total mechanism shutoff; 120-V a.c., 60 Hz or 6-V d.c.; 4" H \times 13 $%_4$ " W \times 9%" D....

TC-206SD Stereo Cassette Deck

Front-load stereo cassette deck; Dolby noise-



reduction system; ferrite-and-ferrite head; FeCr equalization; d.c. servo-controlled motor; "Symphase" recording capability; three-pos. tape select switch; three-pos. bias selector switch; push-button operation; mic/line mixing; record interlock; stereo headphone monitor jack; two calibrated VU meters; peak level indicator; three-digit tape counter with reset button; mic and aux. inputs; two a.c. outlets; Dolby indicator lamp frequency response 20-14,000 Hz ±15 dB; 20-16,000 Hz ±15 dB (FeCr), 30-15,000 Hz ±3 dB (chrome); wow and flutter 0.08%; comes with two RK.74H patchchords; 6%" H × 17" W × 12¼" D... \$369.95

TC-136SD Stereo Cassette Deck

Stereo cassette deck; Dolby noise-reduction system; ferrite-and-ferrite head; "Symphase" recording capability; built-in multiplex filter; three-pos. tape select switch; pushbutton operation; mic/line mixing; straight-line record level controls; record interlock; two illuminated VU meters; peak limiter; three-digit tape counter; automatic total mechanism shutoff; Dolby and record indicator; frequency response 30-12,000 Hz (standard), 40-15,000 Hz ±3 dB (chrome and FrCr tapes); comes with two RK 74 patchcords, head cleaning tips, FeCr cassette; 5" H × 15V4" W × 9V2" D...... \$299.95

TC-186SD Stereo Cassette Deck

TC-135SD Stereo Cassette Deck

TC-118SD Cassette Deck

Stereo cassette deck with Dolby noise-reduction system; servo-control motor; wow and flutter 0.15% wrms; S/N (Dolby off) 50 dB; frequency response 40-10,000 Hz ± 3 dB (standard tape), 40-13,000 Hz (FeCr and CrO₂ tape); fast-winding time 90 sec (C-60); bias frequency 85 kHz; input 0.06 V at 100,000 ohms (line), -72 dB (lo-Z mike); output 0.435 V at 10,000 ohms (line), 8-ohm headphones; three-position tape selector switch; illuminated VU meters; peak limiter; pause control; three-digit tape counter; automatic shutoff; 120-V a.c., 60 Hz, 7 W; 4.13" H × 14.25" W $\times 9.37$ " D.... \$209.95

TC-117 Stereo Cassette Deck

Stereo cassette deck; FeCr equalization; servocontrolled motor; tape select switch; pushbutton operation; straight-line record level controls; record interlock; two illuminated VU meters; pause control with interlock; threedigit tape counter, high filter switch; frequency response 40-10,000 Hz; 40-13,000 Hz (chrome and FeCr); comes with walnut base and two RK-74 patchcords; $4V_{\theta}$ " H × $14V_{4}$ " W × $9V_{\theta}$ " D \$159.95

SUPERSCOPE

CRS-152 AM-FM/Cassette Recorder

Portable AM-FM radio combined with stereo cassette recorder; PA/play mix mode; record monitor; automatic shut-off at end of tape; two detachable speakers with built-in condenser microphones; stereo headphone jack; line in-put/output jacks; four-way powering available with optional rechargable battery pack \$219.95

CD-310 Cassette Deck

Front-loading cassette deck with Dolby noisereduction system; bias and equalization selection switches; pause control; tape counter; Permalloy head; peak limiter switch; VU meters \$199.95

CS-200S Portable Cassette Recorder

Stereo/mono record/play portable cassette recorder; two-head design; d.c. governor-controlled motor; wow and flutter 0.16% wrms; S/N 54 dB (CrO₂ tape); frequency response 40-12,000 Hz (standard tape), 60-14,000 Hz (CrO₂ tape); bias frequency 70 kHz; fast-winding time 80 sec (C-60); input 0.1 mV at 100,000 ohms (aux.), -72 dB (lo-Z mike); output 1 V (line), 8-ohm headphone; three-digit tape counter; built-in condenser microphone; tape select switch; record level/battery strength indicator; supplied with external speakers; 120-V a.c., 60 Hz, 9 W or 6-V d.c.; $3^{21}/3^{2'}$ H × $6^{11}/4a''$ W × $10^{53}/4a''$ D \$199.95

CD-304 Cassette Deck

Stereo cassette deck with Dolby noise-reduction system; auto stop; pause control; tape counter; Permalloy head; standard/CrO₂ tape selector switch; peak limiter switch; VU meters \$167.95

CD-302A Cassette Deck

Stereo cassette deck with Dolby noise-reduction system; two-head design; d.c. governor-



CD-303 Cassette Deck

CD-301A Cassette Deck

Same as CD-302A but without Dolby noise-

reduction system; frequency response 40-10,000 Hz (standard tape), 40-14,000 Hz (CrO₂ tape); wow and flutter 0.2% W rms . . \$119.95

CR-1400 AM-FM/Cassette Recorder

CR-1000 AM-FM/Cassette Recorder

Lightweight cassette recorder with AM-FM radio; S/N 50 dB (playback), 47 dB (record/ play); frequency response 63-10,000 Hz; 4-in PM speaker; built-in electret condenser microphone; 120-V a.c.; $8^{1}/_{2}^{"}$ H \times 13" W \times 3 $^{3}/_{4}^{"}$ D \$109.95

C-190 Cassette Recorder

C-180 Cassette Recorder

C-170 Cassette Recorder

TANDBERG

TCD-330 Cassette Deck

Stereo record/play Dolbyized cassette deck; three heads (for tape/source monitoring during recording); three-motor, dual-capstan, closedloop drive system, hysteresis synchronous record/play motor; wow and flutter 0.12% (wrms), 0.18% (DIN 45500); S/N (Dolby on, ref. 3% third harmonic dist.) 64 dB (DIN 45500, IEC A curve rms), 52 dB (DIN 45500, IEC linear); 0.3% dist. (electronic with 0-dB rec. level); frequency response 20-20,000 Hz (DIN 45500), 30-18,000 Hz ±3 dB (FM/MPX filter off); channel separation 60 dB (side 1/side 2), 35 dB (track 1/track 2) at 1 kHz; input sensitivity 0.15-20 mV (mic), 0.08-10 V (line), 0.008-1 V (radio); input imp. automatically adjusts 100-800 ohms (mic), 470,000 ohms (line), 47,000 ohms (radio); output 775 mV unloaded, 5000ohm imp. (radio), 1.5 V unloaded, 100-ohm imp. (line), 5 mW at 8 ohms (headphone); 230-V a.c., 50 Hz or 115-V a.c., 60 Hz, 40 W; 41/8" H × 181/3 $W \times 9^{1/8''} D \dots$ \$999.00

TCD 310 Mk II Cassette Deck

Stereo record/play Dolbyized cassette deck; three-motor, dual-capstan, closed-loop drive



system, synchronous record/play motor; wow and flutter 0.2% (DIN 45500 weighted peak); S/N (Dolby on, ref. 3% third harmonic dist., Tandberg Tape) 65 dB (DIN 45500, IEC A curve), 55 dB (DIN 45500, IEC linear rms); 0.3% dist. (electronic with 0-dB rec. level); frequency response 30-16,000 Hz (DIN 45500, MPX filter off); channel separation 60 dB (side 1/side 2), 35 dB (track 1/track 2) at 1 kHz; input sensitivity 0.15-0.20 mV (mic), 0.04-5 V (line), 0.008-1 V (radio); input imp. automatically adjusts 100-800 ohms (mic), 220,000 ohms (line), 47,000 ohms (radio); output 775 mV at 10,000 ohms (radio/line), 2 mW at 8 ohms (headphone); 240-V a.c., 50 Hz or 115-V a.c., 60 Hz, 34 W; $4^{1/4''}$ H × 17" W × $9^{1/4''}$ D

TEAC

A-650 Stereo Cassette Deck

Front-loading cassette deck; phase-lockedloop d.c. servo capstan motor, mechanically governed d.c. reel motor; two heads; wow and flutter 0.06% (NAB weighted); S/N 57 dB at 3% THD (without Dolby), 62 dB at 1 kHz and 67 dB at 5000 Hz (with Dolby); frequency response 30-16,000 Hz (chrome and FeCr tapes), 30-13,000 Hz (hi-energy tape); inputs: two line 60 mV/50 k; two mic 0.25 mV/-72 dB (600 ohms or more); outputs: two line 0.3 V/load imp. 50 k or more; one 8-ohm stereo headphone; two VUtype loudness meters; two LED peak-reading indicators; Dolby circuit has FM/copy and MPX functions so unit can decode any external Dolby-encoded source for monitoring while recording that source signal still encoded; individual input level controls; memory stop system; digital tape counter; independent threeposition bias and equalization selectors; 7" H × 17⁵/₁₆" W × 12¹³/₁₆" D \$550.00

A-640 Cassette Deck

Front-load stereo cassette deck with Dolby noise-reduction system; PLL servo-controlled motor capstan drive; wow and flutter 0.06%; frequency response 30-16,000 Hz (CrO, and FeCr tape); S/N 57 dB (Dolby off), improved by 10 dB above 5 kHz with Dolby in; recording and record/mute functions; memory counter with play feature; three-position independent bias and equalization switches; mic/line mixing; recording time function; peak-reading dB meters \$500.00

A-303 Cassette Deck

Front-load stereo cassette deck with Dolby noise-reduction system; two-head design; wow and flutter 0.06%; frequency response 30-16,000 Hz (CrO2 or FeCr tape); S/N 57 dB (Dolby out), improved by 10 dB at 5 kHz with Dolby in; record/mute function; memory switch for easy search of recorded material; phototransistor-controlled auto-stop; three-step independent bias and equalization switches; timer control permits automatic recording or playback \$350.00

A-400 Dolbyized Stereo Deck

Features Dolby noise-reduction system; twin rotary lever transport-control system; separate bias/equalization switches; LED peak indicator; response 30-16,000 Hz (CrO2 tape); S/N 60 dB (WTD with Dolby); wow and flutter 0.08%\$350.00

A-420 Dolbyized Cassette Deck

Vertical front-load deck; two heads; d.c.; servomotor; wow and flutter 0.07% Wrms (NAB weighted); S/N 55 dB at 3% THD (without Dolby), 60 dB at 1 kHz and 65 dB at 5000 kHz (with Dolby); frequency response 30-16,000 Hz (chrome and FeCr tapes); two VU-type loudness meters; two LED peak-reading indicators; inputs: two line 60 mV/50 k; two mic 0.25 mV/ -72 dB (600 ohms or more); outputs: two line 0.775 V/load imp. 50 k or more; one 8-ohm stereo headphones; digital tape counter; threepos, bias and equalization selectors; switchable timer function; $6 {\it V_8}"~H \times 17 {\it V_8}"~W \times 11 {\it V_4}"~D$ \$350.00

A-170 Dolbyized Cassette Deck Features Dolby noise-reduction system; sepa-

1978 EDITION

rate bias and equalization switches; straightline level controls; automatic shut-off; response 30-16,000 Hz (CrO, tape); wow and flutter 0.09% (wtd with Dolby) \$250.00 A-150. Similar to A-170 except frequency response 30-15,000 Hz (chrome and FeCr tapes), 30-12,000 Hz (hi-energy tape); two VU-type loudness meters; one LED peak-reading indicator; dual concentric input-level controls; 6³/₈" H × 16¹/₈" W × 11⁷/₈" D \$250.00

A-100 Stereo Cassette Deck

Front-load deck; d.c. servomotor; two heads; wow and flutter 0.10% wrms (NAB weighted); S/N 50 dB at 3% THD (without Dolby), 55 dB at 1 kHz, 60 dB at 5 kHz (with Dolby); frequency response 30-14,000 Hz (chrome and FeCr tapes), 30-11,000 Hz (hi-energy); two VU-type loudness meters; $6\frac{3}{8}$ " H × $16\frac{1}{8}$ " W × $11\frac{1}{8}$ " D \$200.00

A-105 Cassette Deck

Stereo cassette deck with Dolby noise-reduction system; two permaflux heads; wow and flutter 0.09%; frequency response 30-15,000 Hz (CrO, tape); S/N 53 dB (Dolby out), improved by 10 dB at 5 kHz with Dolby in; two-step bias and equalization switches; separate left and right record level controls; mic/line input switch; pause control; three-digit tape counter; VU meters; 711/16" H × 175/16" W × 95/8" D.

A-103 Cassette Deck

Front-load stereo cassette deck with Dolby noise-reduction system; two permaflux heads; wow and flutter 0.1%; frequency response 30-14,000 Hz (CrO₂ tape); S/N 50 dB (Dolby out), improved by 10 dB at 5 kHz with Dolby in; twostep bias and equalization switches; three-digit tape counter; two VU meters; separate left and right record level controls; mic/line input switch: 711/16" H × 175/16" W × 95/8" D.. \$180.00

Esoteric Series

860 Stereo Record/Reproducer

Three-motor dual-capstan drive transport system; dbx II noise reduction system for 30 dB noise reduction over entire audio frequency spectrum; three heads; wow and flutter 0.04% wrms; frequency response 20-20,000 Hz (chrome and FeCr tapes); 20-18,000 Hz (hienergy tape); S/N 60 dB at 3% THD (without Dolby), 65 dB at 1 kHz & 70 dB at 5000 Hz (with Dolby), 80 dB (with dbx II); two VU-type loudness or peak-reading meters (selectable); four line and four mic inputs; test input for test tone generator; mic attenuation 0/20 dB (selectable on mixer panel); built-in 4-in/2-out mixer; three-pos. bias and equalization selectors; cue control; memory circuit; pitch control for ±4% speed adjustment; $91/_2"$ D \times 173/_8" W \times 14¾" H \$1600.00

AL-700 Elcaset Deck

Stereo Elcaset deck with Dolby noise-reduction system; erase, record, and playback heads; FG



servo-controlled d.c. capstan motor, two coreless d.c. reel motors; wow and flutter 0.04% (NAB weighted). S/N: Type I, 59 dB; Type II, 62 dB; Type III, 62 dB (improved by 5 dB at 1 kHz, 10 dB over 5 kHz with Dolby). Frequency response 25-20,000 Hz (Type I), 25-22,000 Hz (Types II and III); inputs 0.25 mV (-72 dB) at 600 ohms or more (mic), 60 mV at 50,000 ohms (line); outputs 0.3 V at 50,000 ohms (line), 1 mW at 8 ohms (headphones); seven touchbutton control; switchable noise-reduction system for Dolby or dbx; automatic adjustment of

World Radio History

bias and equalization; automatic stop; record mute; memory stop/play function; optional accessories include RX-10 dbx unit and RC-90 remote controller; 117-V a.c., 60 Hz, 126 W; $10^{13}/_{16}$ " H × $18^{1}/_{2}$ " W × $13^{3}/_{6}$ " D \$1100.00

PC-10 Portable A.C./D.C. Deck

Features PLL d.c. servo direct-drive capstan motor and mechanically governed d.c. reel motor; two heads; wow and flutter 0.07% wrms (NAB weighted); frequency response 30-16,000 Hz (chrome and FeCr tapes), 30-13,000 Hz (hienergy tape); S/N 58 dB at 3% THD (without Dolby), 63 dB at 1 kHz, 68 dB at 5000 Hz (with Dolby); two VU-type loudness meters and one peak-reading indicator; mic attentuation 0/15/ 30 dB (selectable); built-in monitor speaker with 300 mW amplifier; locking pause control; locking meter illumination button; battery check circuit; comes with PA-2 a.c. adapter, heavy-duty shoulder strap, input/output connecting cords; 117-V a.c., 60 Hz/9-V d.c. (six "C" cells}; $3'_{2}$ " H \times 11 $'_{2}$ " W \times 9 $'_{16}$ " D; 11 lb including batteries \$500.00

TECHNICS BY PANASONIC

RS-686DS Portable Cassette Deck

Four-track stereo record/play portable cassette deck with Dolby noise-reduction system; HPF head for record/play, Super-Alloy head for monitoring, ferrite head for erase; wow and flutter 0.07% wrms; S/N 63 dB (above 5 kHz, Dolby in), 53 dB (Dolby out); frequency response 50-16,000 Hz (CrO, tape), 50-14,000 Hz (standard tape); fast-winding time 80 sec (C-60); input 0.25 mV at 400-10,000 ohms (mike), 60 mV at 100,000 ohms (line); output 0.42 V at 22,000 ohms, (line), 0.2 W (monitor speaker), 65 mV at 8-125 ohms (headphone), 65 mV at 8 ohms (earphone); bias and equalization selectors; left/right peak-check indicators; tape selector/ monitor switch; mike attenuator; audio-stop and tape end alert eye (silent); 9-V d.c. (battery, car or a.c. adapter); $3'' H \times 9'' W \times 7 \frac{1}{2}'' D$. \$599.95

RS-677US Cassette Recorder Deck

Vertical design with front-loading; features Dolby circuit (including switch selector and calibrator for pre-encoded Dolby FM broadcasts); two motors including electronic control for capstan drive; solenoid operation; hotpressed territe head; meter peak-check switch; selectable MPX filter; chromium-dioxide/normal tape selector (either manual or automatic); full auto-stop in any mode; mechanical pause; single level control for record mode with aux. left/right balancer; digital counter; memory rewind with automatic replay; mike/line/tuner inputs with a mic level control for mixing; remote-control box included; vinyl-over-wood cabinet; guaranteed minimum specifications: record/play frequency response 30-15,000 Hz ±3 dB (chromium-dioxide tape); 30-17,000 Hz ±3 dB (standard tape); wow and flutter 0.07% wrms; S/N 52 dB (Dolby out), 65 dB (Dolby in); dist. 2.0% with regular tape; $5^{3}/_{8}$ " H × 17 $1/_{4}$ " W × 13¼″ D \$499.95

RS-671AUS Cassette Recorder Deck

Front-loading design with front-panel controls; features Dolby circuit; two motors including electronic control for capstan driver; solenoid operation; hot-pressed ferrite head; meter peak-check switch; separate bias and equalization selectors; full auto-stop in any mode; mechanical pause; digital counter; memory rewind; output level control; mic/line inputs; guaranteed minimum specifications: response 30-17,000 Hz (chromium-dioxide tape), 30-15,000 Hz (standard tape); wow and flutter 0.075% W rms; S/N 52 dB (Dolby out, standard tape), 65 dB (Dolby in, CrO, tape); 55/8" H× 17¹/₄" W × 13" D \$399.95

RS-640US Cassette Recorder Deck

Horizontal design with Dolby circuit; standard and chromium-dioxide tape selection; hotpressed ferrite heads; tape-end alert eye gives



three-minute warning before tape runs out; peak-level meters with checking switch; memory rewind; separate mic/line level controls; response 30-16,000 Hz (chromium-dioxide tape), 30-14,000 Hz (standard tape); wow and flutter 0.08% wrms; S/N 51 dB (Dolby out, standard tape), 64 dB (Dolby in, CrO₂ tape); 5½^s H × 17" W × 11½^s D \$349.95

RS-646DS Portable Cassette Deck

Four-track stereo record/play portable cassette deck with Dolby noise-reduction system; Super-Alloy record/play head, ferrite erase head; wow and flutter 0.1% wrms; S/N 65 dB (above 5 kHz, Dolby in), 55 dB (Dolby out); frequency response 50-14,000 Hz ± 3 dB (standard and CrO₂ tape); fast-winding time 130 sec (C-60); input 0.25 mV at 400-10,000 ohms (mike), 60 mV at 47,000 ohms (line); output 0.42 V at 50,000 ohms (line), 0.8 W (monitor speaker), 65 mV at 8 ohms (headphone); bias and equalization selectors; 4-in PM dynamic speaker; mike attenuator; battery check meter; 120-V a.c., 50/60 Hz, 9 W or 12-V d.c. (battery or car adapter); $4V_4$ " H × 14 V_4 " W × 11" D ... \$299.95

RP-905 Recording Timer Adapter

For use in conjunction with a timing on-off clock and solenoid-controlled Model RS-677US and RS-640US recorders; may be used to initiate recording or playback at pre-selected time; may also provide turn-off and restart (depending on clock capability) \$69.95

RS-630TUS Cassette Deck

Four-track stereo record/play front-loading cassette deck with Dolby noise-reduction system; Super-Alloy head for record/play, ferrite head for erase; wow and flutter 0.09% wrms; S/N 63 dB (CrO, tape, above 5 kHz, Dolby in), 50 dB (normal tape, Dolby out); frequency response 30-16,000 Hz (CrO, tape), 30-14,000 Hz (standard tape); fast-winding time 90 sec (C-60); input 0.25 mV at 600-20,000 ohms (mike), 60 mV at 47,000 ohms (line); output 0.42 V (0 VU) at 50,000 ohms (line), 60 mV at 8 ohms (headphone); automatic play/record with timer stand-by mechanism; left/right duallevel input/output controls; bias and equalization settings for all major tapes; digital tape counter; pause control; 120-V a.c., 50/60 Hz; 5⁵/₈" H × 17¹/₈" W × 12⁵/₈" D \$249.95

RS-630US Cassette Recorder Deck

Front-loading design with front-panel controls, features Dolby circuit; chromium-dioxide/ standard tape selector; dual output-level controls; mic/line input selector; lockable pause control; auto-stop; peak-level meters with checking switch; response 30-16,000 Hz (chromium-dioxide tape), 30-14,000 Hz (standard tape); wow and flutter 0.09% wrms; S/N 50 dB (Dolby out, standard tape), 63 dB (Dolby in, CrO₂ tape); 5%" H × 17½" W × 12½" D.... \$249,95

RS-263AUS Cassette Recorder Deck

Dolbyized stereo design with standard tape and chromium-dioxide selection; wow and flutter 0.2%; response 30-13,000 Hz (standard tape); 30-14,000 Hz (chromium-dioxide); (S + N)/N 45 dB (55 dB Dolby); has peak level check switch; separate output level adjustments, mike and line inputs, automatic stop, memory rewind and pause control; $14'' \times 5'' \times 9\%''$ D. \$199.95

RS-615US Cassette Deck

Four-track stereo record/play front-loading cassette deck with Dolby noise-reduction system; Super-Alloy head for record/play, ferrite head for erase; wow and flutter 0.1% wrms; S/N 63 dB (CrO₂ tape, Dolby in), 50 dB (standard tape, Dolby out); frequency response 30-15,000 Hz (CrO₂ tape), 30-14,000 Hz (standard tape);

fast-winding time 90 sec (C-60); input 0.25 mV at 600-20,000 ohms (mike), 60 mV at 47,000 ohms (line); output 0.42 V at 50,000 ohms (line), 65 mV at 8 ohms (headphone); three-position tape selector; timer stand-by mechanism; pause control; level meters; 41-step L/R dual input control; auto stop; recording indicator lamp; tape counter; 120-V a.c., 50/60 Hz, 10 W; $5y_2$ " H × 16¹/₆" W × 12" D \$199.95

TOSHIBA

PC-6030 "Feather-Touch" Deck

Dual-capstan system; PLL controlled d.c. servomotor for capstan, d.c. bridge servomotor for reel drive; "Feather-Touch" operation with IC logic and solenoid; has ferrite record/play and erase heads; frequency response 30-17,500 Hz; S/N 58 dB; features auto rewind; auto play; automatic counter; external timer.... \$750.00

PC-5060 Dolbyized Cassette Deck

Front-loading; electrically controlled servomotor; tape selector with independently switchable bias and equalization; chrome tape auto selector; editing switch; limiter switch; input selector switches; frequency response 40-15,000 Hz (chrome); S/N 58 dB (Dolby off); wow and flutter 0.08% wrms; dist. 1.5%; 5%" H × 17¹%₁₆" W × 13%" D...... \$319.95

PC-4360 Cassette Deck

PC-4030 Dolbyized Cassette Deck

Electrically controlled bridge servo d.c. motor; tape selector; chrome tape auto selector; autoplay; cue and review; input selector switch; fader control for recording; frequency response 40-15,000 Hz (chrome); S/N 57 dB (Dolby off); wow and flutter 0.09% wrms; dist. (standard tape) 2.0%; $5^2/_5$ " H × 15 $^3/_4$ " W × 11 $^4/_5$ " D...... \$229.95

PC-3060 Dolbyized Cassette Deck

UHER

CG-362 Cassette Deck

Stereo record/play Dolbyized cassette deck; three-motor drive system; wow and flutter 0.15% wrms; S/N 68 dB (Dolby on, chrome tape); frequency response 20-18,000 Hz (MPX filter off); DNL; switchable MPX filter; automatic bias and equalization switch; threeposition tape selector; RCA and DIN input-output connectors; digital IC logic controls; digital tape counter; auto-stop; tape-flow control; input mixing and three-position replay program selector; aux. output (0.5 W at 4 ohms) for driving motional feedback speakers ... \$1200.00

CR-210 Portable Cassette Recorder

Four-track mono/stereo record/play cassette recorder; wow and flutter 0.12% wrms; S/N 58 dB (chrome tape); frequency response 20-16,000 Hz (chrome tape); built-in condenser microphone; self-contained power stage; internal monitor speakers; photoelectric tape-drive control; on/off ALC switch; automatic bias switching for CrO₂ tape; operates from 115-V a.c. or 12-V battery supply; supplied with carrying case; 2" H × 7" W × 7" D \$600.00

CG-320 Cassette Recorder

WEBCOR

102 Cassette Recorder/Player

Features Dolby noise-reduction circuitry; fastforward, pause, capstan drive, a.c. bias record-



ing, a.c. erase, mechanical auto stop on record/ play; two mike jacks; headphone jack \$169.95

220 Micro-Cassette Recorder

Features built-in condenser mike, buzzer alarm in record mode to signal end of tape; will handle 30 to 40 min. tapes; fits into palm of hand......\$59.95

YAMAHA

TC-800GL Dolbyized Cassette Deck

Designed to operate from a.c. and 12-volt battery; Super Permalloy record/playback head; two meters (display from -40 dB to +6 dB); push-button tape selector switches bias, equalization, and record-level automatically; line and mike mixing circuit; memory rewind; variable pitch control ±3%; built-in headphone amplifier; fully automatic shut-off; wow and flutter 0.06% wrms; speed fluctuation 1.0%; fast-forward and rewind; response 30-13,000 Hz (standard), 30-15,000 Hz (chromium-diox-.....\$390.00 TC-800D. Same as TC-800GL except a.c. operation only; meter display from -20 dB to +3 dB.\$310.00

TC-511S Cassette Deck with Dolby

Front-loading stereo play/record deck with Dolby noise-reduction circuit and Super Permalloy record/playback head; two meters (display from -40 dB to +6 dB); precision line, mic and playback controls; wow and flutter 0.07% wrms; HD 1.5% (1000 Hz, 0 VU); response 30-13,000 Hz (standard tape), 30-15,000 Hz (CrO₂ and FeCr); S/N 50 dB (Dolby out), 50 dB (Dolby in); $6'_{4''}$ H × 17'/_{4''} W × 13" D . . \$260.00



take along your copy of this Guide when shopping for hi-fi components. It is a comprehensive reference to complete technical details and prices. INES

auto-loading The tape goes in perfectly every time and ends torn tape worries for all time.

SYSTEM

AUTO LOADING

REW

FND

This isn't just another deck. It's the Sankyo STD-2000. And for a lot of reasons it's one of a kind.

Jaxellos. C60

REC

EJECT

Reason number one: the automatic front loading system. It practically takes the cassette out of your hand and glides it into the perfect playing position. Torn tapes and damage head problems are now a thing of the past.

Reason number two: our one-year full warranty. It lets you buy with confidence. Reasons three to six: the STD-2000 has a S/N 66 dB at 5kHz with Dolby. Wow and Flutter at less than 0.65% WRMS. A total harmonic distortion that's less than 1.5%. And a frequency response of 30-17,000 Hz with $Cr0_2$ and FeCr tapes. And there's much more.

PALISE

STOP

San

All these reasons and a price that's still under \$300 makes the Sankyo STD-2000 truly one of a kind.

Write to Sankyo, Dept. D, for the name of your nearest dealer.

.....

No other deck offers all these features for under \$300.

Dolby noise reduction system with MPX filter switch Automatic front loading Total automatic shutoff
 3-digit memory counter Separate 3 position bias and equalizer switches Peak indicator Twin VU meters
 Record, Dolby and tape running indicator Permalloy head Rich wood cabinetry with chrome accents

If the others had quality like ours, they'd have a Full Warranty like ours.



Sankyo The Full Warranty Company

Sankyo Seiki (America) Inc., 149 Fifth Avenue, New York, N.Y. 10010 CIRCLE NO. 12 ON READER SERVICE CARD



We still make them like we used to! We also still price them like we used to!

Two interesting events just happened that will change everything you thought about the price of tape recorders. Most other machines will cost more. As new 15% tariffs push their price higher, those flashy inexpensive tape recorders will become just plain flashy tape recorders.

Revox machines will cost less. As we switch to direct US distribution, we are able to reduce prices to our 1974 level. Which will save you money on every product in our Revox line.

Times are rapidly changing. So you have to really keep your eyes open as well as your ears. When less costs more, and more costs less, here is the one name to remember.

Revox. You can't buy better at any price. Especially now that our price is less.

For more information about Revox contact: STUDER REVOX



OPEN-REEL TAPE MACHINES

AKAI

GX-650D Stereo Tape Deck

Three-speed (15, 71/2 & 31/4 ips), four-track, twochannel stereo/mono system; will handle up to 101/2" reels; features closed-loop double capstan mechanism; three motors with a.c. servocontrolled capstan drive; glass and crystal ferrite heads; response 30-30,000 Hz ±3 dB at 15 ips, 30-26,000 Hz ±3 dB at 71/2 ips (both with LN-150 tape); dist. 0.4% at 15 & 71/2 ips (1000 Hz 0 VU); has line/mike mixing; soundon-sound recording facilities; dual-monitoring system; remote control (with optional RC-17 accessory); automatic stop; pause lever switch; cue switch; individual line-output volume control; tape selector switch (low noise/wide range); 4-digit tape index counter, two VU meters; two mike input jacks; stereo headphone jack; RCA-type line input and output jacks; record and pause indicator lamps; 20.6" H × \$995.00 17.4" W × 10" D

GX-630D Stereo Tape Deck

GX-265D Stereo Tape Deck

Two-speed (71/2 & 33/4 ips), four-track, twochannel stereo/mono system; will handle up to 7" reels; features automatic reverse record & playback; direct capstan-drive a.c. servomotor; three-motor transport; six-head function; dual monitoring system; glass and crystal ferrite heads; line/mike mixing; individual recording safety-lock buttons; pause lever switch; automatic stop; line-output volume control; 4-digit tape index counter; DIN connector; RCA-type line input/output jacks; stereo headphone jack; two mike inputs; two VU meters; directional indicator lamps in recording and playback modes; 8.2" D × 15.9" H × 17.4" W \$675.00 GX-270D. Similar to GX-265 but with three heads (four-head function): peak-level indicator lamp; add-on recording; 15.9" H \times 17.4" W \times 8.3" D \$599.95

GX-230D Stereo Tape Deck

1978 EDITION

4000 DS Mk-II Stereo Tape Deck

Two-speed $(3\frac{3}{4} & 7\frac{1}{2} \text{ ips})$, 4-track, 2-channel stereo; wow & flutter 0.07% rms at $7\frac{1}{2} \text{ ips}$; response $30-26,000 \text{ Hz} \pm 3 \text{ dB}$ at $7\frac{1}{2} \text{ ips}$; THD 1.5%; (S + N)/N 50 dB; bias frequency 100 kHz; has separate record, play, and erase heads; line output 1.23 V; inputs: mike (0.8 mV) and line (60 mV); features selector switch for regular or low-noise tape; sound-on-sound; sound-with-sound; mixing; automatic shut-off; pause control; $16^{\circ} \times 12\frac{1}{2}^{\circ} \times 7\frac{5}{6}^{\circ} \dots 299.95 40000B. Same as 4000DS but with Dolby built in\$379.95

1722W Tape Recorder

Two-speed $(3\frac{3}{4} & 7\frac{1}{2} \text{ ips})$, 4-track, 2-channel stereo; wow & flutter 0.14% rms at $7\frac{1}{2} \text{ ips}$; response 30-21,000 Hz ±3 dB at $7\frac{1}{2}$ ips; THD 2%; S + N/N 50 dB; bias frequency 63 kHz; has one record/playback and one erase head; inputs: mike (0.5 mV) & line (150 mV); two built-in 5" × 7" speakers; features PA capability, automatic shut-off, equalizer preamp for direct phono input, selector switch for regular or low-noise tape; $14\frac{1}{8}$ " × $14\frac{1}{2}$ " × $9\frac{1}{8}$ ". \$349.95

4-CHANNEL

GX-630DSS 4-Channel Tape Deck

Four-channel or stereo record and playback; features four GX glass and single crystal heads; A-B monitoring in either mode; two-speed ($7^{1/_2}$ & $3^{1/_4}$ ips); full-logic function controls; "Quadrasync" recording; mic/line mixing; left/right track selector; pitch control (±5%); tape select switch; line output control; auto-stop, pause control with lock; will handle up to $10^{1/_2}$ " reels. \$995.00

GX-270DSS 4-Channel Tape Deck 4-track, 4 and 2 channel record/play deck; will handle 7" reels; a.c. servo direct-drive capstan



motor plus two eddy current motors for fastforward and rewind; four GX heads; 3-head function; full logic solenoid functions controls; automatic stereo reverse playback: tape/ source/monitoring; Quadra-Sync recording; pitch control for record/playback (±5%); line output control; mic/line mixing; auto stop; tape speed: 7½ & 3¾ ips; wow and flutter 0.07% rms (7½ ips); S/N 54 dB (measured via tape World Radio History with peak recording level of +6 VU); frequency response 30-21,000 Hz \pm 3 dB; distortion 1% (1000 Hz, 0 VU); 18.3" H \times 17.3" W \times 7.5" D\$\$875.00

DOKORDER

1120 Open-Reel Deck

Two-speed $(7 \frac{1}{2}, 3\frac{3}{4} \text{ ips})$ two- or four-track stereo record/play open-reel deck; three-motor drive system, wow and flutter 0.06%; S/N 60 dB; frequency response 25-24,000 Hz; cross-talk -58 dB at 1 kHz (all at 7¹/₂ ips); synthetic echo; sound-on-sound; sound-with-sound; lock-ing pause control for editing during record or playback; 10¹/₂-in max reel size \$649.94

8100 Open-Reel Deck

Two-speed (71/2, 33/4 ips) four-track stereo record/play open-reel deck; MBD hardened Permalloy record and play heads; three-motor drive system, quartz-synchronized two-speed d.c. capstan drive motor, eddy-current outerrotor reel drive motors; wow and flutter 0.06% wrms (71/2 ips), 0.1% W rms (31/4 ips); S/N 60 dB (W rms) at $7\frac{1}{2}$ ips; frequency response 30-15,000 Hz ($3\frac{3}{4}$ ips), 30-23,000 Hz ($7\frac{1}{2}$ ips); crosstalk -60 dB at 1 kHz; bias frequency 130 kHz; input 1 mV at 10,000 ohms (mike), -20 dB at 200,000 ohms (line), 30 mV at 80,000 ohms (DIN); output 0 dB at 47,000 ohms (line), 300 mV at 47,000 ohms (DIN); VU meters; separate switchable equalization and bias circuits; pause switch; four-digit tape counter; 117-V a.c., 60 Hz, 80 W; 173/4" H×167/6" W×63/4" D\$549.95

7700 Open-Reel Deck

Two-speed (71/2, 33/4 ips) four-track stereo record/p'ay open-reel deck; MBD hardened Permalloy record and play heads; three-motor drive system, two-speed d.c. servomotor capstan drive, eddy-current outer-rotor reel drive motors; wow and flutter 0.07% wrms (71/2 ips), 0.1% wrms (3% ips); S/N 60 dB at 71/2 ips; frequency response 40-14,000 Hz (3³/₄ ips), 40-22,000 Hz (71/2 ips); crosstalk -60 dB at 1 kHz; bias frequency 130 kHz; input 1 mV at 10,000 ohms (mike), -20 dB at 200,000 ohms (line), 30 mV at 80,000 ohms (DIN); output 0 dB at 47,000 ohms (line), 260 mV at 47,000 ohms (DIN); VJ meters; switchable equalization circuit; pause switch; four-digit tape counter; 117-V a.c., 60 Hz, 75 W; 173/4" H×167/6" W× 6¾″ D \$399.95

4-CHANNEL

1140 Open-Reel Deck

Two-speed (15, 7½ ips) two- or four-channel record/play open-reel deck; wow and flutter 0.04% (15 ips), 0.06% (7½ ips); S/N 60 dB; frequency response 25-26,000 Hz (30-23,000 Hz ± 3 dB) at 15 ips, 25-24,000 Hz (30-20,000 Hz ± 3 dB) at 7½ ips; crosstalk—58 dB; full logic control; Multi-Sync feature permits recording of separate *racks and instruments individually and re-recording any individual track at any time in perfect sync with other tracks; separate

83



playback controls to balance four-channel output for listening or mix-down dubbing four VU meters; separate tape/source monitoring switches for each channel; four-channel mike and line mixing; 20° H × $173'_{4}$ " W × $15'_{4}$ " D \$1299.95

8140 Open-Reel Deck

Two- or four-channel open-reel deck; threemotor drive system, hysteresis synchronous



PIONEER

RT-2022 Stereo Tape Deck

Two-speed (71/2 & 15 ips), 2-track, 3-motor, 3-head stereo deck; will handle up to 101/2' reels; 4/8 pole hysteresis synchronous motor; solenoid-operated direct-change function buttons: separate transport and amplifier units: plug-in head assembly; scrape filter; continuously variable tape bias, 2-step tape equalizer and tape selector with time-constant switch mechanism for use with all types of tape; widedynamic-range playback amplifier; independent recording amplifier for line and mike input/output; "synchromonitor" mechanism for sound-on-sound, sound-with-sound; wow and flutter 0.04% (wrms) at 15 ips; 0.08% (wrms) at 71/2 ips; S/N 53 dB; THD 0.8% max. at 15 ips, 1.0% max. at 71/2 ips; response 30-28,000 Hz ±3 dB at 15 ips, 40-20,000 Hz ±3 dB at 7 1/2 ips; full complement of inputs and outputs; $21_{4''}$ H × 18_{7} W × 10_{13} D \$1250.00

RT-1050 Stereo Tape Deck

Two-track, two-speed (15 & 7_{12} ips), threemotor, three-head stereo deck; has 4/8 pole, two-speed hysteresis synchronous motor (capstan drive) and 6-pole inner-rotor induction motor (reel drive); response 30-22,000 Hz ± 3 dB at 15 ips; 40-20,000 Hz ± 3 dB at 7_{12} ips; wow and flutter 0.04% wrms at 15 ips; (S + N)/N 57 dB; stereo channel separation 53 dB at 1000 Hz; 125 kHz bias frequency; features 3-step bias selector; 4-step EQ selector; dual-scale level meters; recording peak indicator; lockable electronic controls (including pause); two pairs of line inputs; 120 V, 60-Hz operation; $17'_{16}$ " H $\times 18'_{16}$ " W $\times 9'_{16}$ " D... \$700.00

RT-1011L Stereo Tape Deck

Four-track, two-speed (71/2 & 33/4 ips), three-motor, three-head stereo deck; 4/8 pole hys-

teresis synchronous motor; solenoid-operated direct-changeable function buttons; mechanically lockable function buttons for automatic



recording facility; wow and flutter 0.07% wrms; S/N 55 dB; dist. 1%; response 40-20,000 Hz ± 3 dB; crosstalk 50 dB; has full complement of inputs and outputs; will handle up to 10½" reels; 167_{ls} " H $\times 167_{\text{ls}}$ " W $\times 87_{\text{ls}}$ " D \ldots \$600.00

4-CHANNEL

RT-2044 Four-Channel Tape Deck

RT-1020L Tape Deck

Three-motor, 3-head stereo tape deck with 4channel reproduction capability; has 4/8 pole two-speed hysteresis synchronous motor (capstan drive) and 6-pole inner-rotor induction motor (reel drive); operates at 71/2 & 33/4 ips; wow and flutter less than 0.08% (wrms) at 71/2 ips. (S + N)/N 55 dB; dist. less than 1%; response 40-20,000 Hz ± 3 dB at 71/2 ips; crosstalk 60 dB, stereo channel separation 50 dB both at 1000 Hz; inputs: mike 0.25 to 80 mV; line 50 mV to 25 V; DIN 15 mV; outputs: line 316 mV; DIN 316 mV; headphone 40 mV (4 to 16 ohms); features 3-position bias selector, 2position equalizer selector, lockable pause lever, 4-digit tape counter, independent left/right tape monitor switches, 4-ch./2-ch. playback mode selector, independent right/left recording mode selectors, 4-ch front, rear monitor mode selector, independent mike & line recording level controls, output level controls; will accept up to 101/2" reels; 17" H × 175/16" W × 87/8" D.....\$650.00

REVOX

A700 Stereo Tape Recorder

Three-motor, three-speed (15, 71/2, 33/4 ips) recorder; features computer-type digital control logic with memory circuits; quartz-crystal speed-control reference; frequency and phase servo system for capstan speed control; two tape-tension sensors governing servo-controlled reel motors; has logic-controlled tape tension which is automatically maintained even with mixed reel sizes; electronic tape-motion sensor; minutes and seconds readout on tape counter; plug-in head assembly (1/4 or 1/2 track available); three heads (with fourth control head optional); fail-safe auto stop logic to eliminate possibility of tape breakage; electronic pause control operating on all functions; instant repeat play control; continuous unattended record or play function; solid-state switching of audio circuits; features built-in four-input mixer; switched selection of 12 input sources including four balanced hi/lo mike inputs; builtin magnetic phono preamp; master record-level slide fader; stereo echo; five independent stereo outputs; standard zero-level line outputs and level and tone-controlled outputs; VU meters with instantaneous over-modulation indi

A77 MkIV 1102 Tape Deck

Two-speed (11/8/33/4, 33/4/71/2 or 71/2/15 ips), 2track, 3-motor, 3-head deck; will handle up to 10¹/₂" reels; response 30-20,000 Hz ±2.5 dB at 71/2 ips; wow and flutter 0.08% peak at 71/2 ips; (S + N)/N 61 dB at 71/2 ips; has a servo braking system, VU meters, automatic shut-off, relay and solenoid operation, full remote control, and off-the-tape monitoring; options include plugin power amplifiers, a suitcase version with built-in speakers, metal cage for rack or custom mounting; 163/9" H × 143/16" W × 71/8" D \$959.00 Model A77 MkIV 1104, A 4-track version of Model 1102: same options available . . \$959.00 A77 MkIV Dolby B Deck. Same as 1102 or 1104 but with Dolby B noise-reduction system; has separate compressors and expanders for each channel; (S + N)/N 70 dB (ASA A curve weighted) at 71/2 ips, 2-track \$1259.00

SONY from SUPERSCOPE

TC-880-2 Open-Reel Deck

Two-speed (15, 71/2 ips) two-track (rec/play), four-track (play), stereo record/play deck; a.c. servomotor capstan drive, induction motor reel drive; wow and flutter 0.02% wrms (15 ips), 0.03% W rms (71/2 ips); S/N 59 dB (standard tape), 62 dB (SLH-180 tape), 65 dB (FeCr tape); frequency response 25-30,000 Hz ±2 dB (15 ips), to 20,000 Hz (71/2 ips) with standard tape; 20-45,000 Hz ±2 dB (15 ips), 25-25,000 Hz (71/2 ips) with SLH-180 tape; 20-47,000 Hz ±2 dB (15 ips) with FeCr tape; fast-winding time 150 sec (2400 ft); bias frequency 160 kHz; input 0.06 V at 100,000 ohms (line), -72 dB (lo-Z mike); output 0.435 V at 10,000 ohms (line), 8-ohm headphone; 101/2-in max. reel size; four-head (ferrite-and-ferrite) design; "Symphase" recording capability; three-position equalization selection; two-position bias selection; VU meters (VU, peak, peak hold modes); four-digit tape counter; pause control; 120-V a.c., 60 Hz, 135 W; 20% "H × 18%" W × 10%2" D.

TC-766-2 Open-Reel Deck

Two-speed (15, 71/2 ips) two-track (rec/play), four-track (play), stereo record/play deck; a.c. servomotor capstan drive; wow and flutter 0.018% W rms (15 ips), 0.04% wrms (71/2 ips); S/N 64 dB (FeCr tape); frequency response 30-22,000 Hz (15 ips), to 18,000 Hz (71/2 ips) with standard tape; 30-30,000 Hz (15 ips), to 25,000 Hz (71/2 ips) with SLH and FeCr tape; fast-winding time 150 sec (2400 ft, 10-in reel); bias frequency 160 kHz; input 0.06 V at 100.000 ohms (line), -72 dB (lo-Z mike); output 0.435 V at 10,000 ohms (0.775 V when PB level is set to detented position), 8-ohm headphone; 101/2-in max. reel size; four head (ferrite-and-ferrite) design; "Symphase" recording capability; three-position equalization and bias switches; illuminated VU meters; four-digit tape counter; pause control; 20% " H × 17 ½" W × 9¼" D.

TC-758 Stereo Tape Deck

Three-motor, automatic-reverse stereo tape deck; $7\frac{1}{2}$ and $3\frac{3}{4}$ ips speeds; will handle up to $10\frac{1}{2}$ " reels; response 30-20,000 Hz ± 3 dB (standard tape), 30-25,000 Hz ± 3 dB (SLH-180 tape), both at $7\frac{1}{2}$ ips; features 4-digit counter; illuminated pause control with lock; illuminated VU meters; full complement of inputs and outputs; ferrite-and-ferrite heads; walnut base. $17\frac{1}{6}$ " H $\times 17\frac{3}{4}$ " W $\times 8\frac{3}{4}$ " D

TC-765 Open-Reel Deck

Two-speed (7½, 3¾ ips) four-track stereo record/play deck; three-motor drive system, a.c. servo control motor; wow and flutter 0.08% (3¾ ips), 0.04% (7½ ips); S/N 61 dB (FeCr

tape); frequency response 30-18,000 Hz (7½ ips) and 30-15,000 Hz (3¾ ips) with standard tape, 30-25,000 Hz (7½ ips) and 30-18,000 Hz (3¼ ips) with SLH tape, 30-25,000 Hz (7½ ips) and 30-18,000 Hz (3¼ ips) with FeCr tape; fastwinding time 150 sec (2400 ft, 10-in reel); bias frequency 160 kHz; input 0.06 V at 100,000 ohms (line), -72 dB (lo-Z mike); output 0.435 V (0 VU) at 10,000 ohms (0.775 V max. when PB level is set to detented position), 8-ohm headphone; 10-in max. reel size; three-head (ferrite-and-ferrite) design; "Symphase" recording capability; three-position bias and equalization selection; calibrated VU meters; pause control; four-digit tape counter; sound-on-sound; 110 W; 20%" H × 17%" W × 9%" D ... \$999.95

TC-756-2 Open-Reel Deck

Two-speed (15, 71/2 ips) two-track stereo record/ play deck; three-head (ferrite-and-ferrite) design; three-motor drive system, a.c. servomotor for capstan drive; wow and flutter 0.04% (15 ips), 0.06% (71/2 ips); S/N 56 dB (standard tape) 59 dB (SLH-180 tape); frequency response 30-22,000 Hz ±3 dB (15 ips) and 30-15,000 Hz (71/2 ips) with standard tape, 30-30,000 Hz (15 ips) and 30-25,000 Hz (71/2 ips) with SLH-180 tape; fast-winding time 150 sec (2400 ft); bias frequency 160 kHz; input 0.06 V at 100,000 ohms (line), -72 dB (lo-Z mike); output 0.775 V at 10,000 ohms (line), 8-ohm headphone: 101/2-in max. reel size; record equalization selection switch; calibrated VU meters; pause control; four-digit tape counter; "Symphase" recording capability; mechanical memory capability with timer; bias select switch; 120-V a.c., 60 Hz, 110 W; 173/4" H × 17¹/₈" W × 8³/₄" D \$899.95

TC-645 Stereo Tape Deck

Three-motor, three-head stereo deck with ferrite-and-ferrite heads; $71_2 \& 33_4$ ips; will handle up to 7" reels; response $30-20,000 \text{ Hz} \pm 3 \text{ dB}$ (standard tape), $30-25,000 \text{ Hz} \pm 3 \text{ dB}$ (SLH-180 tape), both at 71_2 ips; features four-digit tape counter; illuminated VU meters; full complement of inputs and outputs; wow and flutter 0.07% at 71_2 ips, 0.11% at 33_4 ips; comes with two RK-74 stereo patchcords, 7" plastic reel; 145%" H $\times 147\%$ " W $\times 87\%$ " D...... \$499.95

TC-270 Open-Reel Recorder

Three-speed $(7\frac{1}{2}, 3\frac{3}{4}, 1\frac{7}{8} \text{ ips})$ four-track stereo/mono record/play open-reel recorder; wow and flutter 0.12% $(7\frac{1}{2} \text{ ips})$; frequency response 30-18,000 Hz $(7\frac{1}{2} \text{ ips})$; S + N/N 50 dB; input 0.06 V (aux.), -72 dB (lo-Z mike); output 0.43 V (0 VU); straight-line record and playback; VU meters; automatic end-of-tape shut-off; sound-on-sound; two lid speakers; supplied with carrying case; $10\frac{1}{4}$ " H $\times 20\frac{1}{4}$ " W $\times 15\frac{1}{4}$ " D

TC-377 Open-Reel Deck

Three-speed (7 $\frac{1}{2}$, 3 $\frac{3}{4}$, 1 $\frac{1}{6}$ jps) four-track stereo record/play deck; three-head design; one induction motor; wow and flutter 0.09% (7 $\frac{1}{2}$ jps); S + N/N 52 dB (standard tape), 55 dB (SLH-180 tape); frequency response 30-20,000 Hz ±3 dB (7 $\frac{1}{2}$ jps); bias frequency 160 kHz; input 0.06 V (aux.), -72 dB (mike); output 0.775 V (line); VU meters; mike-line record level mixing controls; tape select switch for Sony standard or low-noise, high-output tape; pause control; automatic total mechanism shutoff; reversible base for vertical or horizontal operation; 8 $\frac{1}{6}$ " H × 16 $\frac{1}{2}$ " W × 15 $\frac{1}{2}$ " D \$419.95

TC-105A Open-Reel Monaural Recorder

Three-speed (7¹/₂, 3³/₄, 1⁷/₈ ips) four-track play/ record monaural recorder; two-head design; one induction motor; wow and flutter 0.12% (7¹/₂ ips), 0.15% (3³/₄ ips), 0.2% (17⁴/₈ ips); S/N 46 dB (standard tape); frequency response (standard tape) 40-18,000 Hz (7¹/₂ ips), 40-13,000 Hz (3³/₄ ips), 50-6000 Hz (17⁴/₆ ips); fastwinding time 140 sec (1200 ft); 7-in max. reel size; input 0.034 V at 100,000 ohms (aux.), -77dB (lo-Z mike); output 5 W rms at 8 ohms (extension speaker), 3.5 V at 10,000 ohms (earphone/monitor); VU meter; built-in speaker; PA capability; pause control; three-digit tape counter; automatic shutoff; 117-V a.c., 60 Hz, 45 W; $13y_8$ " H × $14y_4$ " W × $7y_4$ " D \$329.95

4-CHANNEL

TC-788-4 Quadradial Deck

Two-speed (15, $7\frac{1}{2}$ ips) four-track quadradial, stereo, mono open-reel deck; three-head de-



sign; a.c. servomotor capstan drive; wow and flutter 0.04% (15 ips), 0.06% (71/2 ips); S/N 53 dB (standard tape), 56 dB (SLH-180 tape); frequency response 20-30,000 Hz (15 ips), 30-22,000 Hz ±3 dB (15 ips), 20-23,000 Hz (71/2 ips), 30-17,000 Hz \pm 3 dB (7 $\frac{1}{2}$ ips) all with standard tape, 20-35,000 Hz (15 ips), 30-28,000 Hz ± 3 dB (15 ips), 20-28,000 Hz (7 $^{1\!/_2}$ ips), 30-23,000 Hz ±3 dB (71/2 ips) all with SLH-180 tape; fast-winding time 150 sec (2400 ft); bias frequency 160 kHz; input 0.06 V at 100,000 ohms (line), -72 dB (lo-Z mike); output 0.775 V at 10,000 ohms (max. PB volume), 8-ohm headphones; 101/2-in max. reel size; tape/source monitoring; record equalization selector switch; VU meters; pause control; four-digit tape counter; automatic total mechanism shutoff; "Syncro-Trak"; mechanical memory capability; four record mode switches and pan pots; 120-V a.c., 60 Hz, 120 W; 22" H \times 17³/₈" W × 8³/₄" D \$1450.00

TC-388-4 Quadradial Deck

Two-speed (71/2, 33/4 ips) four-track guadradial, stereo, mono open-reel deck; three-head design; one induction motor; wow and flutter 0.09% wrms (71/2 ips), 0.12% wrms (33/4 ips); S/N 52 dB (standard tape), 55 dB (SLH-180 tape); frequency response 20-25,000 Hz (71/2 ips) and 30-17,000 Hz (3% ips) with standard tape, 20-30,000 Hz (71/2 ips), 20-25,000 Hz ±3 dB (71/2 ips), 30-19,000 Hz (31/4 ips) with SLH-180 tape; fast-winding time 100 sec (1800 ft); bias frequency 160 kHz; input 0.06 V at 100,000 ohms (line), -72 dB (lo-Z mike); output 0.775 V at 10.000 ohms (line), 8-ohm headphone; 7-in max. reel size; tape/source monitoring; record equalization selector switch; illuminated VU meters; pause control; four-digit tape counter; pan pot on/off switch; automatic total mechanism shutoff; vertical or horizontal operation; 120-V a.c., 60 Hz, 30 W; 193/4" H × 167/16" W × 87/8" D \$679.95

TC-277-4 Quadradial Deck

Three-speed (7 $\frac{1}{2}$, 3 $\frac{3}{4}$, 1 $\frac{1}{8}$ ips) four-channel open-reel deck; wow and flutter 0.12% (7 $\frac{1}{2}$ ips); S/N 52 dB; frequency response 50-16,000 Hz ±3 dB (7 $\frac{1}{2}$ ips); two-head design; four inputs; four line outputs (one per channel); input sensitivity 0.06 V; 15 $\frac{1}{2}$ " H × 15 $\frac{3}{4}$ " W × 7 $\frac{3}{4}$ " D\$469.95

TANDBERG

10XD Open-Reel Deck

Three-speed (15,03/2,336,093),4/2 track, stereo

record/play Dolbyized open-reel deck; crossfield heads; three-motor drive system; wow 0.04% at 15 ips (weighted); frequency response 30-25,000 Hz ± 2 dB, 25-27,000 Hz ± 3 dB, both at 15 ips; crosstalk attenuation 50 dB stereo at 1 kHz; peak-reading meters; microphone and line mixing capabilities; logic circuit with memory; supplied with 10½-in empty reel, NAB adapters, input-output connection cord; remote control, pitch control kit, and rack mounting kit available as optional extras; 45 cm H \times 43.5 cm W \times 18.5 cm D \dots \$1399.00

10X Open-Reel Deck

Three-speed (15, $7_{1/2}^{-}$, $3_{3/4}^{-}$ ips), 4/2 track, stereo record/play open-reel deck; cross-field heads;



three-motor drive system, Hall-e*fect capstan motor; includes features of 10XD except Dolby\$1099.00

Series 15 Open-Reel Recorder

Three-speed (7¹/₂, 3¹/₄, 1⁷/₈ ips), mono record/ play open-reel recorder; wow 0.1% at 7¹/₂ ips; frequency response 40-18,000 Hz ± 2 dB at 7¹/₂ ips; S + N/N 55 dB at max. rec. level; 5 W/ch continuous, both channels driven; preamp output 0.75 V; low-Z mic; high- and low-level inputs; 6³/₄" H × 13³/₈" W × 11⁷/₈" D. 1541F Four-track \$600.00

1	5411.	Four-track	٠		٠		+	٠	٠	٠	٠	-	٠	•	٠	\$000.00
1	521F.	Two-track			•	•	•			•	•		•	•	•	\$600.00

3500X Open-Reel Deck

Three-speed (7½, 3¾, 1½, ips) stereo play/ record open-reel deck; four heads; peak-reading meters; sound-on-sound and echo capabilities; A-B tests for recording; mixing for mono; photoelectric stop; front-panel headphone jack \$599.00

TEAC

A-7300 Stereo Tape Deck

Two-speed ($7 \frac{1}{2}$, $3^{\frac{3}{4}}$ ips), $\frac{1}{4}$ -track, two-channel deck: features direct-drive o.c. capstan/ servo control motor; two a.c. reel motors; builtin mixer to blend up to four mikes or lines; separate master input level control for all mike/line inputs; separate output evel control; has two sets of output jacks; dual VU meters; three-position bias/equalization switches; pitch control; cue facility; push-button transport control; logic circuitry; response 40-24,000 Hz; wow and flutter 0.05%, both at 7 $\frac{1}{2}$ ips. S/N 65 dB (wtd at 3% THD)...... \$1400.00

A-6300 Auto-Reverse Stereo Deck

Two-speed (7 V_2 , 3: V_4 ips), V_4 -track, two-channel stereo with four heads (erase, record, playback, reverse playback), three motors: will handle 10: V_2 " and 7" reels; features mike/line mixing, automatic repeat by memory counter, total remote-control capability; response 40-24,000 Hz; wow and flutter 0.06% both at 7 V_2 ips; S/N 65 dB (wtd at 3% THD)...... \$1100.00

A-6100 Stereo Tape Deck

Two-speed (15, $7\frac{1}{2}$ ips), two-track, two-channel stereo with four heads (erase, record, play-



A-2300SD Dolbyized Stereo Deck

Two-speed (7 $\frac{1}{2}$, $3\frac{3}{4}$ ips) $\frac{1}{4}$ -track, two-channel deck; features push-button transport control with logic circuitry; dual VU meters; separate bias/equalization switches; record/pause lights; total remote-control capability; Dolby noise-reduction circuitry and lights; three motors; response 40-24,000 Hz at $7\frac{1}{2}$ ips; wow and flutter 0.08% at $7\frac{1}{2}$ ips; S/N 74 dB (wtd, at 3% THD, with Dolby); $17\frac{1}{1}\frac{1}{3}\frac{1}{6}^{\prime\prime} \times 5\frac{1}{2}\frac{1}{2}$\$750.00

A-3300SX-2T Stereo Tape Deck

Two-speed (15. 7½ ips), ½-track, two-channel stereo or mono deck; one dual-speed hysteresis synchronous capstan motor; two eddy-current induction reel motors; three heads; will handle $7^{\prime\prime}$ and 10½" reels; wow and flutter 0.04% (15 ips), 0.06% (7½ ips) NAB weighted; S/N 60 dB; frequency response 30-26,000 Hz ±3 dB at 15 ips, 30-24,000 Hz ±3 dB at 7½ ips; THD 1% at 1 kHz; independent left/right channel source/ tape selectors; VU-type level meters; manual cue lever; separate bias and equalization selectors; 173_{16} " H $\times 175_{16}$ " W $\times 85_{16}$ " D ... \$750.00

A-4300SX Auto-Reverse Stereo Deck

Two speed ($7 \frac{1}{2}$, $3\frac{3}{4}$ ips), $\frac{1}{2}$ -track, two-channel stereo deck; dual-speed hysteresis synchronous capstan motor; two eddy-current induction reel motors; four heads (erase, record, forward play, and reverse play); will handle 7" and 5" reels; wow and flutter 0.06% at 7 $\frac{1}{2}$ ips; S/N 58 dB; frequency response 30-28,000 Hz; 40-24,000 Hz ±3 dB at 7 $\frac{1}{2}$ ips; THD 1% at 1 kHz; VU-type level averaging meters; automatic reverse; independent level controls for mic/line mixing; left/right channel record mode

selectors for making mono recordings and adding sound-on-sound effects with external equipment; $17\frac{5}{16}$ " H $\times 19\frac{1}{4}$ " W $\times 8\frac{1}{2}$ " D \$700.00

A-3300S Stereo Tape Deck

A-2300SX Stereo Tape Deck

Two-speed (7 $^{1}\!\!\!/_{2_1}$ 3 $^{3}\!\!/_4$ ips), $^{1}\!\!/_4$ -track, two-channel stereo deck; dual-speed hysteresis synchronous capstan motor; two eddy-current induction reel motors; three heads; will handle 77 reels; wow and flutter 0.08% wrms at $^{7}\!\!/_2$ ips; S/N 58 dB; frequency response 40-24,000 Hz ± 3 dB at 7 $^{1}\!\!/_2$ ips; THD 1% at 1 kHz; two-pos. bias and equalization selectors; independent dual-concentric input level controls for mic/line mixing; VU-type level averaging meters; $157\!\!/_{16}$ " H \times 17 $^{5}\!\!/_{16}$ " M \times 88 $^{1}\!\!/_{0}$ " D \$600.00

4-CHANNEL

A-3340S 4-Channel Tape Deck

Multi-channel, three-motor, three-head stereo tape deck with 15 and 7 ½ ips speeds; features "Simul-Sync" which allows recording four discrete but fully synchronized channels on each track of a four-track tape; permits synchronized overdubbing, professional mix-down and special effect tapes; up to eight inputs (four mike, four lines) can be recorded simultaneously; push-button transport control with logic circuitry; has 4/8 pole dual-speed hysteresis synchronous motor and two eddy-current induction reel motors; unit includes separate bias level and EQ switches; cue control, total remote-control capability; four expanded-scale VU meters; 2-ch/4-ch play switch; front and rear

NOTICE TO READERS

We consider it a valuable service to our readers to continue, as we have in previous editions of Tape Recording & Buying Guide, to print the price set by the manufacturer or distributor for each item described as available at presstime. However, almost all manufacturers and distributors provide that prices are subject to change without notice.

We would like to call our readers' attention to the fact that during recent years the Federal Trade Commission of the U.S. Government has conducted investigations of the practices of certain industries, in fixing and advertising list prices. It is the position of the Federal Trade Commission that it is deceptive to the public, and against the law, for list prices of any product to be specified or advertised in a trade area, if the majority of sales of that product in that trade area are made at less than the list prices.

It is obvious that our publication cannot quote the sales price applicable to each trading area in the United States. Accordingly, prices are listed as furnished to us by the manufacturer or distributor. It may be possible to purchase some items in your trading area at a price that differs from the price that is reported in this edition.

The Publisher

stereo headphone jacks; pause control with indicator light; Quik-Lok reel holders; response 35-22,000 Hz at 15 ips; 35-20,000 Hz at 71_2 ips; wow and flutter 0.04% at 15 ips; 0.06% at 71_2 ips; S/N 65 dB (wtd at 3% THD); $201_{2'}$ H × $17_{2'}$ W × $83_{4'}$ D \$1200.00

A-2340SX Multichannel Tape Deck

Two-speed (7½, 3¾ ips), four-track with "Simul-Sync;" one dual-speed hysteresis syn-



chronous capstan motor; two eddy-current induction reel motors; three heads; will handle 7" and 5" reels; wow and flutter 0.08% at 7½ ips; S/N 55 dB; frequency response 30-22,000 Hz at 7½ ips; THD 1.0% at 1 kHz; independent source/tape output selector each channel; four VU-type level averaging meters; four independent record mode selectors; four independent input level controls for mic/line mixing for each for four channel; record indicator lights for each channel; digital tape counter; 2-channel/4-channel playback selector; 17½16" H × 18¾" W × 8¾" D.... \$850.00

TECHNICS BY PANASONIC

RS-1500US Open-Reel Deck

Three-speed (15, 7½, 3¾ ips) two-track record/ play, four-track play stereo open-reel deck; PLL controlled direct-drive servomotor capstan drive; wow and flutter 0.018% W rms (15 ips), 0.3% W rms (7½ ips); S/N 60 dB; frequency response 30-30,000 Hz \pm 3 dB (15 ips), 30-25,000 Hz \pm 3 dB (7½ ips); distortion 0.8%; fast-winding time 150 sec (2500 ft); channel separation 50 dB; input 0.25 mV at 400-20,000 ohms (mike), 60 mV at 150,000 ohms (line); output



420 mV at 22,000 ohms (line), 60 mV at 8 ohms (headphone); built-in stroboscope; full IC logic tape transport; three-way adjustment of bias and equalization; average-reading VU meters with switchable scale (+3 dB/+6 dB); real-time tape counter; edit dial; 10^{1} /₂-in max. reel size; 120-V a.c. or 24-V d.c.; 17^{1} /₂" H × 18" W × 10^{1} /₈" D \$1500.00

TOSHIBA

PT-862D Stereo Tape Deck

Three-head system for either tape or source monitoring, echo recording; mechanical automatic shut-off; tape selector switch, recording bias control; sound-on-sound; four-digit tape counter; three speeds $(7^{1}/_{2}, 3^{2}/_{4}, 1^{2}/_{8} \text{ ips})$; will handle up to 7" reels; 4-track, 2-channel stereo record and playback; universal power supply. 50-60 Hz; inputs: mike, line input, DIN; outputs: line-output, headphone, DIN; four-pole condenser motor; controls: tape selector, speed change, power switch, volume control, noise suppressions; response 20-25,000 Hz; wow and flutter 0.09% wrms; crosstalk 60 dB; 121/4" H × 15 h 6" W × 73'8" D \$309.95

UHER

SG-630 Logic Open-Reel Deck

SG-560 Open-Reel Recorder

Four speed (71_2 , 33_4 , 17_8 , 17_{16} , ips) two- or four-track stereo record/play recorder; wow and flut-



ter 0.02%; S/N 68 dB (rms A curve at 7½ ips); frequency response 20-22,000 Hz; reverberation and concert-hall effects. sound-on-sound; sound-with-sound; two integrated stereo input mixing facilities; built-in "Dia-Pilot" for recording signal impulses and automatic slideprojector control; electronic section (with tape drive system off) serves as stereo amplifier (10 W/ch continuous power output); 7-in max. reel size; four-digit counter; operates in horizontal or vertical position; 110-130 or 220-240-V a.c., 50-60 Hz\$1019.50

4000 Report IC Recorder

Four-speed (71 2, 33 4, 17 8, 15 16 ips) two-track mono record/play recorder; wow and flutter 0.2% (DIN), 0.15% (rms); S/N 64 dB (rms A curve); frequency response 35-20,000 Hz (all at 71/2 ips); input 0.12-40 mV at 200 ohms (mic), 2.4-700 mV (radio), 0.045-20 V at 2 megohms (phono); three-digit counter; direct tape monitoring with earphones or speaker; electronic start and stop with remote switch, manual, or foot-switch operation; 5-in max. reel size; 12 V \$565.95 d.c. powered portable 4200. Same as 4000 but stereo; S/N 56 dB (DIN weighted), 62 dB (weighted rms A curve) \$705.95 4400. Same as 4200 but four-track; S/N 54 dB

(DIN weighted), 62 dB (weighted rms A curve) An extensive line of accessories is available for use with all three models. For Tape Care, it's...

CASSETTE EDITOR and Winder Unit AK-84



An extra strong metal base containing attached splicer and winding sprocket makes this unit an outstanding editing product. The winder is as fast as an electrically operated one.

Attractively packaged, the Cassette Editor and Winder Unit will give you many years of enjoyment as you save your favorite cassettes from obsolescence.

Comes complete with splicing tape, tape cutter, spare empty cassette and full instructions. Suggested List Price \$14.95

TAPE HEAD MAINTENANCE KIT AK-99

Contains all that is necessary for tape head cleaning—anti-static cleaning liquid, cleaning brush and cleaning cloth, inspection mirror and cleaning tool has interchangeable heads which permit easy access to tape heads regardless of the angle of entry. Can accommodate all cassette, cartridge, & reel-to-reel tape machines on the market today. Suggested List Price \$ 7.95

TAPE HEAD CLEANER AK-1

The Audio-Kare Tape Head Cleaner cleans without touching head surfaces. Ensures peak frequency response. Just spray on. Safe on delicate surfaces, Exceptionally pure and leaves no residue. 4oz. spray can only \$3.89 suggested list price.



At Selected Audio Stores or write: 155 Michael Drive Syosset, NY 11791 (516) 364-1900



8-TRACK TAPE MACHINES

AKAI

CR-83D 8-Track Record/Play Deck

Features illuminated elapsed-time record indicator, locking pause, fast-forward, inde-



pendent dual-record level controls, combination record/play and erase head, auto-stop, continuous playback selector switch; d.c. motor, illuminated record interlock, automatic a.c. on when cartridge is inserted; wow & flutter 0.15% rms; S/N 48 dB, frequency response 60-14,000 Hz ± 3 dB (low-noise tape); dist. 2% at 3³/₄ ips; 4.3" H × 16¹/₂" W × 9¹/₂" D \$220.00

BSR McDONALD

TD8SW-2 8-Track Playback Deck

Stereo 8-track player; straight-line stepping cam tape-head mounting for intimate contact



with tape; simulated walnut-grained cabinet; comes with connecting cables; $8^{1/6''} H \times 10^{1/4''} W \times 3^{1/6''} D$\$39.95

CENTREX by PIONEER

RH-65 8-Track Record/Play Deck

Record/playback deck with Dolby; frequency range 30-15,000 Hz; wow and flutter 0.15%;



time counter; three-position function switch; two VU record level meters; fast-forward and pause controls; illuminated track indicator; automatic or manual track change; dual mike

TH-30 8-Track Playback Deck

Frequency range 40-10,000 Hz; wow and flutter 0.25%; automatic/manual track change; illuminated track indicators; vertical headshift mechanism for positive tape/head contact; 43/4" H \times 77/8" W \times 11" D..... \$49.95-\$59.95

CHANNEL MASTER

HD 6075 8-Track Deck

Stereo 8-track play/record deck; pushbutton auto stop, fast forward, pause, record, and manual track selection; automatic track changing; right and left record level controls; two illuminated record meters; auto stop, record, and track indicators; input for right and left mics and aux.; output for tape monitor stereo headphones. left and right aux.; supplied with patch cords and microphones; wood product construction cabinet with outer wood-grained vinyl veneer; 5" H \times 15½" W \times 10" D ... \$89.95

LAFAYETTE

RK-899 8-Track Record/Play Deck

Selectable automatic stop for play/record modes; dual illuminated level meters; individual



left/right mic input jacks; record-level controls on front panel; pause control; response 50-10,000 Hz; output level 0.5 V max; crosstalk and channel separation 40 dB; S/N 40 dB; wow and flutter 0.3%; input sensitivity: mic 0.8 mV, aux. 250 mV; walnut vinyl covered wood cabinet; 4½" H \times 16½" W \times 18½" D \$139,95

RK-885 8-Track Record/Playback Deck

Record/play deck designed to be used with any stereo receiver or amplifier with tape in/out jacks; has mike input jacks for "live" stereo recording with optional microphones; dual VU meters; recording volume controls; mode switch; record indicator light; illuminated channel indicator lights; comes with connecting cables; 5^{4} /6" H \times 13" W \times 8% " D \$119.95

MERITON

HD-830 8-Track Play/Record Deck

Response 40-13,000 Hz, wow and flutter 0.15% wrms (playback), 0.25% Wrms (record/playback); S/N 45 dB; features pause control switch; two illuminated VU meters; eject button; program selector switch; vertical-slide

World Radio History

record level controls for left/right channels, automatic shut-off/continuous play switch; fast-forward; stereo headphone and mike jacks; walnut cabinet with brushed chrome face; $5\frac{1}{96}$ " H \times 14 $\frac{1}{4}$ " W \times 9 $\frac{5}{6}$ " D \$139.95

HD-800 8-Track Playback Deck

Designed to be used with any stereo system; features program selector button; repeat button; response 30-12.000 Hz; wow and flutter 0.17% wrms; channel indicator lights; walnut veneer cabinet with brushed chrome face. $5_{3/8}$ " H $\times 10^{5/8}$ " W $\times 8^{3/4}$ " D \ldots \$54.95

REALISTIC

TR-802 8-Track Record/Play Deck

Features digital timer; push-button control of continuous play, program repeat, auto-stop,



push-button eject, program change, fast-forward, and pause; response 50-12,000 Hz; wow and flutter 0.2%; front-panel mike input for live recording; walnut wood cabinet; $4\frac{3}{4}$ " × $16\frac{3}{2}$ " × 10" \$179.95

TR-882 8-Track Record/Play Deck

Features dual VU meters; level controls; pushbutton fast-forward, pause, and record interlock; program select button; response 50-10,000 Hz; wow and flutter 0.2%; front-panel mike input for live recording; walnut-finish wood-grain case; $3\gamma_{e^{''}} \times 13\gamma_{a^{''}} \times 83\gamma_{e^{''}} \dots$ \$99.95

TR-700 8-Track Record/Play Deck

SANYO

RD8020 8-Track Record/Play Deck

Frequency response 30-12,000 Hz; S/N 42 dB; wow and flutter 0.3%; features automatic stop at program-start point; two calibrated VU meters; latching fast-forward control; latching pause control; restart button; lighted channel indicators; inputs for right/left mike and aux.; 5" H \times 12¹/₂" W \times 10" D \ldots \$99.95

SONY from SUPERSCOPE

TC-208 8-Track Playback Deck

8-track playback deck; wow and flutter 0.25% W rms; frequency response 50-10,000 Hz; pro-

gram select and repeat buttons; fast-forward button; program indication light; automatic track switching; 120-V a.c., 60 Hz; 41/16" H x

4-CHANNEL

TC-258 Quadradial 8-Track Deck

8-track playback deck for four- or two-channel cartridges; wow and flutter 0.25%; frequency response 40-12,000 Hz; program select and repeat buttons; fast-forward button; program indication light; four- and two-channel indication light; automatic four- and two-channel switching; 120-V a.c., 60 Hz; 41/16" H × 83/4" W × 9%16" D \$119.95

SUPERSCOPE

TDR-830 8-Track Deck

8-track record/play deck with Dolby noisereduction system; pause/restart button; auto-



stop selectors; LED program indicator; threedigit tape counter; headphone, mike, line in/out jacks \$219.95 TDR-820. Same as TDR-830 but without Dolby \$179.95

TD-28 8-Track Player Deck

Frequency response 30-10,000 Hz; S + N/N 48 dB; built-in automatic tape program selector which plays all four programs; illuminated program indicators; program selector switch; fast-forward switch; repeat switch; walnutgrained vinyl veneer cabinet; 47/8" H × 71/4" W × 9¾" D \$74.95

4-CHANNEL

TD-48 8-Track Player Deck

Automatic four- and two-channel switching deck: frequency response 30-10.000 Hz; S + N/N 48 dB; illuminated four-channel indicator; built-in automatic program selector; illuminated program indicators; fast-forward, repeat, and program selector switches; walnut-grained vinyl veneer cabinet; 41/8" H × 71/8" W × 93/4" D\$99.95

TECHNICS BY PANASONIC

RS-858US 4-Channel 8-Track Deck Will record/play all 2- or 4-channel cartridge programs; has four separate input level controls, four VU meters, mike and line inputs plus pause control and noise-suppressor switch: response 30-12,000 Hz; wow and flutter 0.2%; 8¼4"×21¼8"×11¼4" \$329.95

WEBCOR

101 8-Track Recorder/Player

Features built-in preamp, capstan drive, a.c. bias recording, a.c. erase; will repeat selection at end of each recording and at end of fourth recording; simulated wood-grain case with silver front \$119.95



Circle No. 19 on Reader Service Card

Circle No. 5 on Reader Service Card

89



AUTOMOBILE TAPE MACHINES

CHANNEL MASTER

AC 6826 AM-FM/Cassette Player

Combines stereo cassette player and AM-FM stereo radio; fast forward, rewind, manual tape eject, volume, balance, tone, local/distance switch, and AM/FM selector switch; automatic tape eject at end of tape; FM stereo and tape indicator lights; automatic FM stereo switching; 12-V d.c. negative ground; 1%" H × 7" W ×

AC 6825 Cassette Player

Compact cassette car player; fast forward, rewind, manual eject, manual selector, volume, balance, and tone; auto reverse; tape direction indicator light; supplied with mounting bracket, speaker/power connector cable, and mounting hardware; 12-V d.c. negative ground; 2" H ×

AC 6821 Cassette Player

Compact stereo cassette car player; fast forward, manual eject, tone, volume, and balance; automatic stop; tape running indicator light; supplied with mounting bracket, speaker/ power connector cable, and mounting hardware; 12-V d.c. negative ground; 113/16" H ×

AE 6811 AM-FM/8-Track Player

Combines 8-track player and AM-FM stereo radio; five pushbutton station selectors; or/off



volume, tone, balance, fader, manual cartridge eject, AM/FM switch, local/distant switch, and manual track selector; AM/FM, FM stereo, and tape indicators; automatic track changer; indash mounting; 12-V d.c. negative ground; 2% $H\times 7"~W\times 5\%"~D\ldots \qquad \149.95

AE 6810 AM-FM/8-Track Player

Combines 8-track player and AM-FM stereo radio; volume, balance, tone, AM/FM switch, radio on/off, local/distant switch, and manual track selector; track indicator lights; automatic track changer; in-dash mounting; 12-V d.c. negative ground; $2'' H \times 67/_8'' W \times 57/_4'' D$.

AE 6803 8-Track Player

Stereo 8-track car player; manual eject, repeat switch, volume, balance, tone, and manual track selector; track indicator lights; courtesy map lamp with switch; automatic track changer; supplied with mounting bracket, speaker/ power connecting cable, and mounting hardware; 12-V d.c. negative ground; $2\frac{1}{9}$ " H \times $6\frac{3}{9}$ "

AE 6802 8-Track Player

Compact stereo 8-track car player; volume,

tone, balance, and manual track selector; track indicator lights; automatic track changer; supplied with mounting bracket, speaker/power connecting cable, and mounting hardware; 12-V d.c. negative ground; $2\frac{1}{8}$ " H \times 5%" W \times 7¼4″ D..... \$34.95

AE 6801 8-Track Player

Compact stereo 8-track car player; volume, tone, and manual track selector; power indicator light; automatic track changer; supplied with mounting bracket, speaker/power connecting cable, and mounting hardware; 12-V d.c. negative ground; $2\frac{1}{8}$ " H \times $5\frac{1}{16}$ " W \times $7\frac{3}{4}$ " D

CRAIG

T631 AM-FM/Cassette Player

In-dash stereo cassette player with AM-FM radio; digital channel display; preset tuning for five stations: separate balance and fader controls; automatic rewind at end of tape; stereo/ mono pushbutton; fast forward and locking rewind; wow and flutter 0.3% rms; frequency response 40-10,000 Hz; stereo separation 35 dB; S/N 40 dB; audio output 4 W average continuous sine wave per channel \$259.95

3520 FM/Cassette Player

Stereo cassette player with FM radio; automatic cassette ejection and power cut-off at end of program; fast forward and rewind; quickrelease mounting bracket; wow and flutter 0.25% rms; frequency response 70-10,000 Hz; S/N 45 dB; channel separation 40 dB; crosstalk -45 dB; power output 12 W continuous sine wave per channel at THD 5%, 4-ohm load, both channels driven; 12-V d.c. negative ground, 4-A max. current drain \$215.95

T600 AM-FM/Cassette Player

AM-FM stereo radio with cassette player; autoreverse; stereo/mono switch; manual eject; separate balance and fader controls; wow and flutter 0.2% rms; audio output 3.5 W average continuous sine wave per channel; frequency response 40-10,000 Hz; S/N 50 dB; crosstalk -40 dB; channel separation 35 dB; 12-V d.c. negative ground; supplied with customizer trim plate, gasket, hardware, and knobs; indash mounting; 2" $H \times 7 \gamma_{16}$ " $W \times 8 \gamma_2$ " D...\$199.95

3516A AM-FM/Cassette Player

Combines AM-FM stereo radio with cassette tape player; in-dash mounting; automatic cassette ejection at end of tape and when power to unit is stopped; locking fast forward; AM, FM, stereo, and tape indicator lights; fast-forward time 120 sec (C-60); wow and flutter 0.3%; audio output 4 W average continuous sine wave per channel; frequency response 40-10,000 Hz; crosstalk -35 dB; channel separation 35 dB; 12-V d.c. negative ground; supplied with trim plate, gasket, and mounting hardware; 23/4" H × 7½" W × 6¼" D \$199.95

3514 AM-FM/Cassette Player

Combines AM-FM stereo radio with cassette

player; automatic shut-off at end of tape; indash mounting; mono/stereo switching; illuminated tape/stereo indicators; momentary and locking fast forward; stereo matrix circuitry for four-channel effect; wow and flutter 0.3% rms; audio output 4 W continuous per channel; frequency response 70-10,000 Hz; S/N 40 dB; crosstalk -40 dB; channel separation 35 dB; 12-V d.c. negative ground; supplied with trim panel, gasket, and knobs; 2" H \times 7" W \times 5¼ " D

T281 FM/Cassette Player

Combines FM stereo radio and cassette tape player; fast forward and rewind; end-of-tape indicator light; stereo matrix circuitry for fourchannel effect; wow and flutter 0.3% rms; audio output 12 W average continuous sine wave per channel; S/N 40 dB; stereo separation 30 dB; crosstalk -35 dB; 12-V d.c. negative ground; size (bracket with unit) 21/4" H × 8¹/₂" W×10¹/₄" D \$179.95

T180 Cassette Player

Cassette tape player with auto-reverse; reversible quick-release slide-out bracket; illuminated direction signals: auto and manual program change; separate bass and treble controls; manual or automatic eject; locking fast forward; loudness pushbutton; wow and flutter 0.25% rms; frequency response 70-10,000 Hz; S/N 45 dB; stereo separation 30 dB; crosstalk -45 dB; audio output 12 W average continuous sine wave per channel (5% THD, 4-ohm load, both channels driven); 12-V d.c. negative ground; 3⁷/₁₆" H × 7" W × 8¹/₂" D \$169.95

T601 AM-FM/Cassette Player

Combines AM-FM stereo radio with cassette tape player; automatic shut-off at end of cassette; locking fast forward and rewind; indash mounting; stereo matrix circuitry for fourchannel effect, wow and flutter 0.3% rms; audio output 4 W average continuous per channel; frequency response 70-10,000 Hz; S/N 40 dB; crosstalk -40 dB; channel separation 35 dB; 12-V d.c. negative ground; supplied with customizer trim plate, gasket, knobs, and hardware; $1^{15/16}$ H × $6^{15/16}$ W × 5^{110} D\$164.95

T680 AM-FM/Cassette Player

Combines AM-FM stereo radio and cassette



T605 AM-FM/Cassette Player

T200 FM/Cassette Player

Combines FM stereo radio and cassette tape player; locking fast forward and rewind; LED stereo and end-of-tape indicators; stereo matrix circuitry for four-channel effect; wow and flutter 0.3% rms; S/N 35 dB; stereo separation 35 dB; crosstalk -35 dB; audio output 4 W average continuous sine wave per channel; 12-V d.c. negative ground; supplied with quick-release bracket and mounting hardware; 2^{3}_{16} " H × 7^{3}_{16} " W × 7" D \$144.95

T602 AM-FM/Cassette Player

3519 Cassette Player

Stereo cassette player; automatic cassette ejection and power cut-off at end of program; illuminated Powerplay and tape running indicators; quick-release slide-out mount; wow and flutter 0.25% rms; frequency response 70-10,000 Hz; S/N 45 dB; channel separation 40 dB; crosstalk -45 dB; power output 12 W continuous sine wave per channel (5% THD, 4-ohm load, both channels driven); 12-V dc. negative ground; $21/2^{"} H \times 61/2^{"} W \times 83/4^{"} D$ \$144.95

T202 FM/Cassette Player

T102 Cassette Player

T201 FM/Cassette Player

Stereo cassette player and FM radio; slide-out bracket; volume, balance, and tone controls; locking fast forward; tape running indicator \$99.95

T100 Cassette Player

3517 FM/Cassette Player

T101 Cassette Player

3515 Cassette Player

S681 AM-FM/8-Track Player

Combines AM-FM stereo radio, emergency and weather information channel, and 8-track tape player; automatic or manual program change; repeat pushbutton for continuous program indicators; wow and flutter 0.3% rms; audio output 12 W continuous sine wave per channel; frequency response 40-10,000 Hz; stereo separation 30 dB; crosstalk -35 dB; S/N 40 dB; power source 12-V d.c. negative ground; supplied with customizer trim plate, gasket, mounting hardware, and knobs; $2^{3}_{4''}$ H \times 7" W \times 5½e" D (main unit), $1^{3}_{4''}$ H \times 4¹⁵½e" W \times 4³/4" D (amplifier unit).

S280 FM/8-Track Player

Combines FM stereo radio with 8-track tape player; illuminated Powerplay and numbered program indicators; manual and automatic eject when power to unit is removed; separate balance and fader controls; manual and automatic program changing; stereo indicator light; loudness pushbutton; fast forward with muted sound; repeat pushbutton; separate bass and treble controls; wow and flutter 0.3% rms; S/N 40 dB; crosstalk -35 dB; frequency response 40-10,000 Hz; 12-V d.c. negative ground; supplied with reversible quick-release bracket and mounting hardware; $3V_2''' H \times 9V_{16}''''$ $W \times 10V_6''' D \dots 215.95

S630 AM-FM/8-Track Player

3149 AM-FM/8-Track Player

S680 AM-FM/8-Track Player

S281 FM/8-Track Player

Combines FM radio and 8-track player; stereo matrix circuitry for four-channel effect; fast forward; numbered program indicators; manual and automatic program changing; repeat pushbutton; wow and flutter 0.25% rms; audio output 12 W continuous sine wave per channel (5% THD, 4-ohm load, both channels driven); frequency response 50-10,000 Hz; S/N 40 dB; crosstalk -45 dB; stereo separation 30 dB; supplied with quick-release slide-out bracket; 12-V d.c. negative ground; 21/4" H × 81/2" W × 101/4" D (bracket with unit) \$154.95

S601 AM-FM/8-Track Player

Combines AM-FM radio and 8-track player; stereo matrix circuitry for four-channel effect; repeat pushbutton; four LED program indicators; manual and automatic eject when power is removed from unit; separate balance and fader controls; wow and flutter 0.3% rms; audio output 4 W average continuous sine wave per channel; frequency response 70-8000 Hz; stereo separation 35 dB; crosstalk -40 dB; S/N 50 dB; 12-V d.c. negative ground, 2.5-A max. current drain; supplied with customizer trim panel, gasket, knobs, and hardware; 17ø H \times 7" W \times 5½° D \$154.95

S180 8-Track Player

Quick-mount Powerplay 8-track stereo player; manual and automatic eject when power is removed from unit; locking fast forward; automatic and manual program changing; repeat mode; loudness button; separate balance and fader controls; illuminated program indicators; separate bass and treble controls; wow and flutter 0.3% rms; frequency response 40-10,000 Hz; S/N 40 dB; stereo separation 30 dB; crosstalk –35 dB; audio output 12 W continuous sine wave per channel (5% THD, 4-ohm load, both channels driven); 12-V d.c. negative ground; supplied with reversible quick-release bracket for console or under-dash mounting; $2^{4}a'' H$ $\times 6^{1}a'' W \times 9^{3}a'' D$

3145 AM-FM/8-Track Player

Combines AM-FM radio and 8-track stereo tape player; separate balance, volume, and tone controls; illuminated program indicators; automatic or manual program change; stereo matrix for four-channel effect; wow and flutter 0.3% rms; audio output 3.5 W continuous sine wave per channel; frequency response 50-8000 Hz; stereo separation 35 dB; crosstalk -40 dB; S/N 50 dB; 12-V negative ground, 2.5-A max. current drain; supplied with trim plate, gasket, and mounting hardware; $2^{9}_{4''}$ H $\times 7^{1}_{4''}$ W \times $5^{3}_{8''}$ D \$144.95

S600 AM-FM/8-Track Player



S200 FM/8-Track Player

Combines FM radio and 8-track stereo tape player; stereo matrix for four-channel effect; repeat mode; fast forward; numbered program indicators; manual and automatic program change; wow and flutter 0.25% rms; output power 4 W average continuous sine wave per channel; frequency response 50-10,000 Hz; S/N 45 dB; crosstalk -45 dB; stereo separation 40 dB; supplied with quick-release slide-out bracket; 12-V d.c. negative ground, 1.5-A max. current drain; 21/8" H × 71/2" W × 7" D \$119.95

3148A AM-FM/8-Track Player

Combines AM-FM radio and 8-track stereo tape player; repeat mode; stereo matrix for fourchannel effect; illuminated program indicators; wow and flutter 0.3% rms; audio output 4 W average continuous sine wave per channel; frequency response 70-8000 Hz; stereo separation 35 dB; crosstalk -40 dB; S/N 40 dB; 12-V d.c. negative ground, 2.5-A max. current drain; supplied with trim panel, gaskets, knobs, underdash mounting brackets; 2.6" H × 7.5" W × 6.5" D \$119.95

3153 FM/8-Track Player

Combines FM radio and stereo 8-track player; illuminated program indicators; automatic or manual program change; volume, balance, and tone slide controls; wow and flutter 0.3%; frequency response 40-10,000 Hz; S/N 50 dB; stereo separation 35 dB; crosstalk -40 dB; audio output 3.5 W continuous per channel; 12-V d.c. negative ground; 21/4" H \times 73/8" W \times 7¼₄″ D \$94.95

S101 8-Track Player

Stereo 8-track tape player; stereo matrix for four-channel effect; repeat mode; fast forward; wow and flutter 0.3% rms; frequency response 40-10,000 Hz; S/N 40 dB; stereo separation 35 dB; audio output 4 W average continuous sine wave per channel; ultra-compact size \$84.95

3143 8-Track Player

8-track stereo tape player; illuminated program indicators; repeat and fast forward; power-off eject; wow and flutter 0.25% rms; output power 7 W per channel; frequency response 70-10,000 Hz; S/N 45 dB; crosstalk -40 dB; stereo separation 35 dB; 12-V d.c. negative ground, 2.8-A max. current drain; supplied with quick-release mounting; 21/2" H × 7" W × 8" D \$84.95

S100 8-Track Player

8-track stereo tape player; numbered program indicators; stereo matrix for four-channel effect; automatic and manual program changing; repeat mode; locking fast forward; wow and flutter 0.3% rms; S/N 45 dB; audio output 4 W average continuous sine wave per channel; frequency response 100-8000 Hz; stereo separation 35 dB; crosstalk -40 dB; 12-V d.c. negative ground, 1.5-A max. current drain; supplied with quick-release bracket and mounting hardware; 23/6" H × 45/8" W × 7" D \$77.95

3144A 8-Track Player

8-track stereo tape player; automatic program selection with repeat mode; illuminated program indicators; L/R volume and balance slide controls; wow and flutter 0.25% rms; S/N 50 dB; output power 3.5 W continuous sine wave per channel; frequency response 40-8000 Hz; stereo separation 35 dB; crosstalk -50 dB; 12-V d.c. negative ground, 2-A max. current drain; supplied with quick-release bracket; 21/8" H × 57/8" W × 63/4" D \$59.95

R500 Powerplay Booster

Powerplay booster offers 25 W continuous sine

wave per channel; automatic power switching; for use with any Craig unit; compatible with stereo matrix systems; dist. 1%; frequency response 50-10,000 Hz; S/N 50 dB; crosstalk-70 dB; input 4 ohms; output 4 ohms; 10-dB gain; 12-V d.c., 5-A max. current drain; 21/4" × 61/2 W × 5¹/₂" D \$69.95

9405

51/4-in round flush-mount speaker with chromefinish metal grille; 2.9-oz magnet; 8 W music power rating; 4-ohm imp.; 3/4-in dia. voice coil; 11.7-ft detachable connecting leads; 5-in dia. cutout size, 1% in deep; two per kit . . .

9413

4-in rectangular flush-mount speaker with black padded vinyl grille; 3.6-oz magnet; 8 W music power rating; 4-ohm imp.; 3/4-in dia. voice coil; 11.7-ft detachable connecting leads; 3%in dia. cut-out size, 1% in deep; two per kit .

9414

5¼-in round flush-mount speaker with black padded vinyl grille; 3.6-oz magnet; 8 W music power rating; 4-ohm imp.; 3/4-in dia. voice coil: 11.7-ft detachable connecting leads; 5-in dia. cut-out size, 13/4 in deep; two per kit . . \$19.95

9420

5%-in square flush-mount speaker with black grille; 11-oz magnet; 25 W music power rating; 8-ohm imp.; 1-in dia. voice coil; 161/2-ft detachable connecting leads; 5-in dia. cut-out size, 2 in deep; two per kit \$34.95

9422

6 in × 9 in oval flush-mount speaker; 11.6-oz magnet; 25 W music power rating; 8-ohm imp.; 1-in dia. voice coil; 161/2-ft detachable connecting leads; 6 in × 9 in oval cut-out size, 31/16 in deep; two per kit \$29.95

9425

61/2-in surface-mount enclosed speaker; 10-oz magnet; 25 W music power rating; 8-ohm imp.; 13/16-in dia. voice coil; 161/2-ft detachable connecting leads; enclosure size $5^{1/6''}$ H \times $9^{5/6''}$ W \times 91/2" D; two per kit \$39.95

9426

4-in rectangular flush-mount speaker with black grille; 5.4-oz magnet; 10 W music power rating; 4-ohm imp.; 3/4-in dia. voice coil; 16-ft detachable connecting leads; 33/4-in dia. cutout size, 17/16 in deep; two per kit \$23.95

9427

51/4-in round flush-mount speaker with black grille; 5.4-oz magnet; 10 W music power rating; 4-ohm imp.; 3/4-in dia. voice coil; 16-ft detachable connecting leads; 5-in dia. cut-out size, 1¹³/16 in deep; two per kit \$24.95

9428

51/4-in convertible-mount speaker, black wedgebox or black rectangular grille; 2.9-oz magnet; 10 W music power rating; 4-ohm imp.; 3/4-in dia. voice coil; 16-ft detachable connecting leads; 415/16-in dia. cut-out size, 13/8 in deep; enclosure size 4" H × 8" W × 75/8" D; two per kit . . . \$27.95

9429

6 in × 9 in oval speaker; flush mount; dual imp., 4 and 8 ohms; 30-oz magnet; 25 W music power rating; 1-in dia. voice coil; 16-ft detachable connecting leads; 6 in × 9 in oval cut-out size, 31/16 in deep; two per kit \$54.95

9430

51/4-in surface-mount speaker with black naugahyde-covered wedge enclosure; 11-oz magnet; 4-ohm imp.; 25 W music power rating; 1-in dia. voice coil; 161/2-ft detachable connecting leads; enclosure size $5\frac{1}{8}$ " H $\times 10\frac{1}{4}$ " W $\times 8\frac{3}{16}$ D; two per kit \$54.95

9432

6 in × 9 in coax flush-mount speaker with black custom grille; 10-oz magnet; 4-ohm imp.; 25 W music power rating; 1-in dia. voice coil; 161/2-ft detachable connecting leads; 6 in × 9 in oval cut-out size, 35/16 in deep; two per kit . . \$59.95

9433

3 in \times 5 in oval surface-mount speaker with black enclosure; 3.6-oz magnet; 8 W music power rating; %16-in dia. voice coil; 16-ft detachable connecting leads; enclosure size 33/16" H × 7%16" W × 5%" D; two per kit \$19.95

R780

5%-in super full range Trans-Rib acoustical driver; surface-mount enclosure in black molded, rib-braced plastic; frequency response 80-17,000 Hz ±6 dB; 50 W music power rating; 41oz magnetic structure; 1.4-in dia. voice coil; 4-ohm imp.; 12-ft connecting leads; enclosure size 67_{6} " H × 11 $\frac{5}{6}$ " W × 9" D; two per kit . .

V140

6 in × 9 in speaker; moisture-resistant cones and dust-sealed voice coils; flush-mounts in standard 6 in × 9 in cut-out; 4-ohm imp.; two per kit \$29.95

V400

4-in round speaker; 25 W music power rating; moisture-resistant cones; 8-oz magnet; 8-ohm imp.; $4\frac{5}{16}$ " H × $5\frac{9}{16}$ " W × $\frac{1}{2}$ " D; two per kit . .

V440

6 in \times 9 in oval speaker; all-weather design; dual cone; 25 W music power rating; 10-oz magnet; 8-ohm imp.; fits standard 6 in × 9 in cutouts; 6% " H × 91/2" W × 7/16" D; two per kit .

V460

6 in × 9 in oval speaker; coaxially mounted 3-in tweeter; 25 W music power rating; 10-oz magnet; 8-ohm imp.; fits standard 6 in × 9 in cutouts; $6\frac{5}{6}$ " H × 9 $\frac{1}{2}$ " W × $\frac{1}{16}$ " D; two per kit .

V461

6 in × 9 in oval speaker; coaxially mounted 3-in tweeter; 25 W music power rating; 20-oz magnet; 8-ohm imp.; fits standard 6 in × 9 in cutouts; 65/8" H × 91/2" W × 7/16" D; two per kit .

MOTOROLA

TC876AX AM-FM Radio/Cassette

Combines AM-FM stereo radio with cassette player; designed to fit in-dash in domestic cars;



features fast-forward, automatic tape shut-off, manual eject control, fader control; "Pow-R-Boost" circuitry which changes audio response to boost sound level and improve "highs;" supplied without speakers \$229.95 TC877AX. Similar to TC876AX except designed for in-dash mounting in many imported cars; without speakers \$170.00

NAKAMICHI

250 Cassette Play-Only Deck

Designed for use with ADS subminiature biamplified speaker systems; Dolby noise-reduction circuitry; selectable playback equalization; full auto shutoff; d.c. servomotor drive; volume, tone, and balance controls; includes bracket for underdash mounting and cable for interfacing with ADS system; playback response 40-17,000 Hz ± 3 dB; wow and flutter 0.08%

wrms; S/N 62 dB (with	Dolby); output	580 mV;
$3^{1/2}$ " H \times $7^{1/2}$ " W \times $9^{1/2}$ "	D	\$275.00
With a.c. power pack .		\$300.00

PIONEER ELECTRONICS

KP-8000. Same except designed to DIN standard to fit European cars; nose dimension $1^{4_{8''}}$ H × 4 $^{4_{8''}}$ W × $^{4_{4''}}$ D; shaft spacing $5^{4_{8''}}$ \$189.95-\$229.95 **KP-5005.** Same as KP-8005 but with manual



tuning...... \$169.95-\$199.95

KP-4000 AM-FM Stereo/Cassette Unit

In-dash AM-FM stereo receiver with cassette player; 8 W max. rms output power; frequency range 40-10,000 Hz; wow and flutter 0.3%; automatic stop and eject; rotary mode selector; local/distance switch; FM stereo indicator; tape play lights; 2" H \times 7½" W \times 6½" D; nose dimension 1¾" H \times 4½" W \times 1¾" D. \$149.95-179.95

TP-9006 AM-FM Stereo/8-Track

TP-7006 AM-FM Stereo/8-Track

Combines AM-FM stereo receiver with 8-track player; 8 W max. rms output power; FM usable sensitivity 1.1 μ V at 75 ohms; 50 dB quieting sensitivity 1.4 μ V at 75 ohms; alternate channel selectivity 74 dB; capture ratio 1.7 dB; wow and flutter 0.25%; five-station preset tuning; automatic stereo/mono switching; local/distance switch; separate bass and treble controls; $3'_{4''}$ H \times 7'₉₆" W; designed primarily for GM cars.....

\$179.95-\$219.95 **TP-7005.** Same except designed primarily for Ford cars \$179.95-\$219.95 **TP-7004.** Same except designed primarily for Chrysler cars \$179.95-\$219.95

TP-7000 AM-FM Stereo/8-Track

In-dash AM-FM stereo receiver with 8-track player; 8 W max. rms output power; frequency range 40-10,000 Hz; wow and flutter 0.3%; pushbutton tuning; volume/balance/tone controls; lighted FM and stereo indicators; stereo/ mono switch; 2" H \times 7/₈" W \times 6/₄" D; nose dimension 1³/₄" H \times 4/₄" W \times 1/₈" D.......\$159.95-\$189.95

TP-6001. Similar to TP-7000 except automatic and manual program change; nose dimension $1_{4''} H \times 4_{4'} W \times 1_{4''} D \dots$ \$119.95-\$139.95

1978 EDITION

KP-500 FM-Stereo/Cassette

KP-292 Under-Dash Cassette Player

Cassette system with locking fast-forward and rewind; automatic replay after rewind; automatic eject; tone and balance controls; loudness switch; slide volume control; 8 W min. rms output power; frequency range 30-12,000 Hz; wow and flutter 0.3%; 2" H × 4¾" W × 6⅛" D.:

TP-900 FM Stereo/8-Track

Under-dash FM stereo with 8-track; PLL multiplex demodulator; FET front end; local/distance switch; loudness switch; muting; separate bass, treble, balance controls; FM usable sensitivity 1.1 μ V; 50 dB quieting sensitivity 1.4 μ V; alternate channel selectivity 74 dB; capture ratio 1.7 dB; automatic stereo/mono switching; wow and flutter 0.25%; fast forward; program repeat; 3" H × 75%" W × 71/2" D

TP-200. Similar to TP-900 but automatic/manual program change; frequency range 40-10,000 Hz; illuminated track indicator; 21/6" H $\times 71/2$ " W $\times 73/6$ " D \$99.95-\$119.95

TP-727 8-Track Player

Under-dash 8-track player; 8 W max. rms output power; frequency range 30-10,000 Hz; wow and flutter 0.25%; separate bass and treble controls; loudness switch; fast-forward; automatic/manual program change; repeat option; $2\frac{5}{6}$ " H × $6\frac{1}{2}$ " W × $6\frac{1}{4}$ " D..... \$79.95-\$94.95 **TP-252.** Similar to TP-727 but frequency range 40-10,000 Hz; slide volume and tone controls; separate balance control; 2" H × $4\frac{3}{4}$." W × $6\frac{1}{6}$ " D..... \$49.95-\$59.95

ROYAL SOUND

RS-2500 AM-FM/Cassette Player

Combines AM-FM stereo radio and cassette tape player; tape section has 55-dB S/N ratio,



less than 2% dist., wow and flutter 0.2% wrms, channel separation 55 dB; frequency response 40-12,000 Hz; 16-W output power; 11-to 16-V d.c. negative ground; 50 mm H \times 178 mm W \times 158 mm D \ldots \$275.00

RS-2010 AM-FM/Cassette Player

Combines AM-FM stereo radio and cassette tape player; tape section has 45-dB S/N ratio and less than 3% dist.; fast forward and manual eject controls; tape indicator light; frequency response 40-12,000 Hz; 6 W per channel into 4-8 ohms; 11- to 16-V d.c. negative ground, reverse polarity protected; 1.62" H \times 6.8" W \times 4.75" D \$160.00

World Radio History

RS-6040 Car Speaker System

Ultra-compact two-way car speaker system; 4-in long-throw miniature woofer and $2\eta_{4}$ -in wide-dispersion dome-type tweeter; frequency response 50-22,000 Hz; crossover frequency 2.8 kHz; 4- to 8-ohm imp.; supplied with 9-ft connecting cable with DIN-type plug; black or satin aluminum finish; 6.8" H \times 4.25" W \times 4.33" D..... Per pair, \$200.00

RS-805 Car Speaker System

Flush-mount speakers; frequency response 50-13,000 Hz; max. input 30 W; 4- to 8-ohm imp.; 10-oz magnet; 6½-in speaker; includes water protection for flush in-door mounting; supplied with integral baffling, mounting hardware, and speaker cable; high-impact plastic case with black textured finish \$64.00

RS-705 Car Speaker System

SONY from SUPERSCOPE

TC-30 Stereo Cassette Player

Car stereo cassette player with automatic reverse; dual capstan tape drive; wow and flutter 0.25%; frequency response 50-10,000 Hz (standard tape); S/N 50 dB (standard tape); tape pilot directional lamp; individual tone, volume, and balance controls; locking fast-forward and rewind buttons; dual differential-balanced flywheels; supplied with spare fuse and mounting hardware; 12-V d.c. negative ground; 2^{13} /16" H × 7½" W × 9½" D... \$189.95

TC-26F FM/Stereo Cassette Player

TC-24FA AM-FM/Stereo Cassette Player

In-dash car cassette tape player with AM-FM stereo radio; wow and flutter 0.35% rms; frequency response 125-8000 Hz (standard tape); S/N 43 dB (standard tape); stereo balance, tone, and volume controls; automatic shut-off in forward tape mode; locking fast forward; tape travel indicator; mono/stereo switch; 17/s" H \times 67/s" W \times 57/s" D (body), 17/s" H \times 39/16" W \times 74" D (nose)...... \$149.95

SUPERSCOPE

CA-20 AM-FM/Cassette Player

In-dash AM-FM radio with stereo cassette deck; auto-stop at end of tape; tape indicator light; pushbutton fast-forward and rewind; manual stop/eject; 1%" H \times 7" W \times 5%4" D ... \$159.95

CA-15 Cassette Player

Under-dash cassette player; auto-reverse; locking fast-forward and rewind pushbuttons; manual tape direction switch; tape direction indicator lights; manual stop/eject pushbutton; straight-line tone, volume, and balance controls; 12-V negative ground; $2Va^{"}$ H × $67a^{"}$ W × $67a^{"}$ D \$119.95

CA-10 Cassette Player

Under-dash cassette player; locking fast-forward; straight-line volume, tone, and balance controls; manual eject; 12-V negative ground; $2V_{8}$ " H \times 5 $3V_{4}$ " W \times 6 $4V_{8}$ " D \$59.95

93



COMPACT TAPE SYSTEMS

AWIA

AF-5080A 3-in-1 Music System

Combines AM-FM stereo receiver, Dolbyized cassette deck, single-play/automatic turntable; 22 W rms/ch at 8 ohms (20-20,000 Hz) at 0.3% THD; complementary SEPP OTL circuit; FM sensitivity 2.0 µV (IHF); frequency response 30-15,000 Hz; stereo separation 38 dB at 1000 Hz; cassette deck wow and flutter 0.1% wrms; frequency response 30-11,000 Hz (normal tape), 30-15,000 Hz (CrO2, FeCr tapes); Permalloy head; d.c. servomotor; belt-driven turntable with automatic tonearm return; S/N 45 dB; wow and flutter 0.1% wrms; static-balance tonearm; MM type cartridge; frequency response 20-20,000 Hz; turntable/cassette deck synchronized for automatic recording; tuning meter; two VU meters; 3-step tape selector; 8^{1}_{16} " H $\times 23^{1}_{4}$ " W $\times 16^{9}_{16}$ " D \$570.00

CENTREX by PIONEER

RH-626 AM-FM Stereo/8-Track

System combines 8-track record/playback, AM-FM stereo receiver, and two-way acousticsuspension speaker systems; min. rms output power 4 W/ch; frequency range 90-20,000 Hz at 2% HD; wow and flutter 0.25%; twin VU meters; time/tape counter; auto/stop switch for one or four programs or endless playing; separate bass, treble, and volume controls; loudness switch; control center 4½," H × 18½" W × 11¾" D; speakers 22½" H × 13" W × 8" D.....

\$259.95-\$309.95 RH-6611. Similar to RH-626 except includes BSR record changer, magnetic cartridge with diamond stylus; control unit $9\%' H \times 18\%_2 W \times 15\% D$ \$319.95\$384.95

TH-323 AM-FM Stereo/8-Track

Combines 8-track playback, AM-FM stereo receiver, and two full-range speaker systems; min. rms output power 4 W/ch; 80-20,000 Hz at 2% THD; wow and flutter 0.25%; stereo signal indicator; separate bass and treble controls; balance control; headphone and record output jacks; control center 4¾," H × 18¾," W × 11" D; speakers 22½" H × 13" W × 8" D...... \$159.95-\$189.95

TH-3311. Similar to TH-323 except includes BSR record changer with interchangeable automatic and manual center spindles; calibrated and adjustable anti-skate mechanism; calibrated stylus pressure gauge; control center $10^{1}/_{2}$ " H × 18³/₄" W × 15" D... \$219.95-\$259.95

RH-7744 AM-FM/8-Track/Phono

Combines AM-FM stereo receiver, 8-track record/playback, and 3-way speaker system; 12 W rms min/ch into 8 ohms from 40-30,000 Hz at 0.8% THD; FM usable sensitivity 1.9 μ V; FM muting; flywheel tuning; center tuning meter; stereo/mono switch; loudness contour; click-stop bass and treble; A + B selector; head-phone jack; 11-in, 3-speed automatic changer; moving magnet cartridge; diamond stylus; 45



KH-767 AM-FM Stereo/Cassette

Combines AM-FM stereo receiver, cassette record/playback, and 3-way speaker system; 12 W rms min/ch into 8 ohms from 40-30,000 Hz at 0.8% THD; FM usable sensitivity 1.9 μ V; FM muting; flywheel tuning; center tuning meter; stereo/mono switch; loudness contour; click-stop bass and treble; A + B speaker selector; headphone jack; tape deck has twin VU meters; chromium dioxide tape switch, dual mike jacks, aux. input, resettable tape counter; 10-in 3-way speaker system in walnut cabinets; speakers 13" W $\times 20^{1/3}$ " D; control center 5%" H $\times 20^{\circ}$ W $\times 15^{\circ}$ D....

KH-7766. Same as KH-767 except with 11-in, 3-speed automatic changer, moving magnet



cartridge, diamond stylus, 45 rpm adapter, sleep feature, damped cue lever; control unit 10° H \times 20' W \times 15' D \$429.95-\$514.95

CHANNEL MASTER

HP 6896 AM-FM/Phono/8-Track

HR 6869 AM-FM/8-Track

Combines AM-FM stereo receiver, speaker system, and stereo 8-track recorder/player; pushbutton tape function selectors for fast forward, repeat, auto stop (end of all, end of one), pause, and record; automatic track changing; manual track selector; left and right record level controls; track, recording, and pause in-

end of one), jacks f

HP 6857 AM-FM/Phono/Cassette

Combines AM-FM receiver, full size record changer, speaker system, and cassette re-



corder/player; piano key tape selectors for fast forward, rewind, play, record, stop/eject, and pause; three-digit tape counter with reset button; separate volume, balance, bass, and treble controls; 4-D sound switch; aux. and left and right recording mic input jacks; tape record, stereo headphones, right, left, and 4-D speaker output jacks; unit size 10" H \times 21½" W \times 15½"D, speaker size 23" H \times 12" W \times 7" D \$239.95

HP 6861 AM-FM/Phono/8-Track

Combines AM-FM receiver, record changer, speaker system, and 8-track player; "4-D" sound capability; volume, balance, treble, and bass controls; automatic track changing; manual track selector; aux. input jack; output jacks for tape record, stereo headphone, left, right, and 4-D speakers; unit size $9'z^r$ H $\times 19'z^r$ W $\times 15'y^{4r}$ D, speaker size 23^r H $\times 12^r$ W $\times 7^r$ D..... \$189.95

HR 6873 AM-FM/8-Track

Combines AM-FM receiver, speaker system, and 8-track recorder/player; "4-D" sound capability; pushbutton tape function selectors for fast forward, pause, repeat, and record; volume, blance, bass, and treble controls; automatic track changing; manual track selector; input jacks for aux., phono (ceramic), right and left recording mics; output jacks for tape record, stereo headphones, right, left, and 4-D speakers; unit size 51/4" H \times 194/4" W \times 111/2" D, speaker size 20" H \times 114/4" W \times 7" D .. \$149.95

HE 6852 AM-FM/8-Track

HITACHI

SDP/9600 Compact Music System

Combines record/play stereo cassette deck, AM-FM stereo receiver, BSR record changer with ADC magnetic cartridge, and two threeway speakers (8" woofer, 8" passive radiator, and 3" tweeter); two recording VU meters; five function LED indicators; pause control; threedigit tape counter......\$300.00

SDT/8700H Compact Music System

Combines record/play stereo cassette deck, AM-FM stereo receiver, BSR C-123R2 record changer and ceramic cartridge with diamond/ sapphire stylus, and two three-way bass reflex speakers (8" woofer, 2" tweeter); aux. frequency response 40-18,000 Hz; left and right channel VU meters and record controls; pause control; digital tape counter; automatic stop; supplied with dust cover, microphone, and 45 rpm spindle; speaker size 23" H \times 13" W \times 8" D; unit size (with dust cover) 83/4" H \times 235/6" W \times 153/6" D.

SDP/8500H Compact Music System

Combines 8-track record/play deck, AM-FM stereo receiver, BSR C-123R2 record changer and ceramic cartridge with diamond/sapphire stylus, and two three-way bass reflex speakers (8" woofer, 2" tweeter); aux. frequency response (40-18,000 Hz, two VU meters; record, program, and auto-stop indicators; pause, fast forward, repeat, and manual and automatic program selection functions; supplied with dust cover, microphone, and 45 rpm spindle; speaker size 23" H × 13" W × 8" D; unit size (with dust cover) $8\frac{3}{4}$ " H × $23\frac{3}{6}$ " W × $15\frac{3}{6}$ " D...... \$279.95

SDT/8600H Compact Music System

Combines record/play stereo cassette deck, AM-FM stereo receiver, BSR C-129R2 record changer and creamic cartridge with diamond/ sapphire stylus, and two two-way bass reflex speakers (8" woofer with whizzer cone); aux. frequency response 50-15,000 Hz; pause control; digital tape counter; automatic stop; supplied with dust cover and 45 rpm spindle; speaker size $20^{3}4''$ H \times 12'' W \times $7^{1}4''$ D; unit size (with dust cover) $8^{3}4''$ H \times $22^{1}2''$ W \times $15^{3}4''$ D (with dust cover) $8^{3}4''$ H \times $22^{1}2''$ W \times $15^{3}4''$ D

SDP/8400H Compact Music System

Combines 8-track record/play deck, AM-FM stereo receiver, BSR C-129R2 record changer and ceramic cartridge with diamond/sapphire stylus, and two two-way bass reflex speakers (8" woofer with whizzer cone); aux. frequency response 50-15,000 Hz; record, auto-stop, and program indicators; pause control; supplied with dust cover and 45 rpm spindle; speaker Size 2074" H \times 12" W \times 774" D; unit size (with dust cover) 874" H \times 2272" W \times 1576" D......\$229.95

SDP/8300H Compact Music System

Combines 8-track play deck, AM-FM stereo receiver, BSR C-129R2 record changer and ceramic cartridge with diamond/sapphire stylus, and two two-way bass reflex speakers (8" woofer with whizzer cone); aux. frequency response 50-15,000 Hz; program indicator and selector; automatic/manual program selection; supplied with dust cover; speaker size 203_{4} " H \times 12" W \times 7½" D; unit size (with dust cover 89_{4} " H \times 22½" W \times 15¾" D...... \$199.95

SDP/8200H Compact Music System

JULIETTE

C958-172 Home Entertainment System 1978 EDITION

Combines stereo 8-track and cassette tape players and recorders, FM/AM/FM receiver, turntable, air suspension speaker system and microphones; records directly on cassette and 8-track simultaneously; includes automatic recording level control; speaker control for 2channel or quad effect; automatic and manual 8-track program changer (lamps indicate program recording and automatic stop); pause control for 8-track tape; recording safety interlock; a.c. bias recording and erasing systems; full keyboard cassette controls include record, fast forward, stop, rewind, play, eject; entertainment system $101/4^{"}$ H $\times 211/2^{"}$ W $\times 161/2$ D; speakers $231/4^{"}$ H $\times 12^{"}$ W $\times 9^{"}$ D.... \$359.00

C652-182 Home Entertainment System

Includes stereo 8-track recorder/player, FM/ AM/FM receiver, turntable, 6-way air suspension speaker system, and microphones; records direct from receiver, phono, microphones or other source; has automatic and manual tape program changer; separate recording volume controls; twin lighted recording VU meters; pushbutton controls for record, fast forward, auto stop, repeat and pause; a.c. bias record and erase system; comes with two microphones and stands; entertainment system $10^{1/4}$ " H × $21^{"}$ W × $18^{3/4}$ " D; speakers $26^{1/2}$ " H × $14^{"}$ W × 9" D\$349.99

C-956-172 Home Entertainment System

Combines front-loading cassette recording system, FM/AM/FM stereo receiver, phonograph, air suspension speaker system and microphones; features automatic recording level control; digital tape counter with reset button; keyboard controls for record, play, rewind, pause, fast forward, stop and eject; a.c. bias record and erase system; entertainment system $10^{\prime\prime}$ H $\times 21^{\prime}$ ₃^{''} W $\times 16^{\prime\prime}$ D; speakers 23^{\prime} ₄^{''} H $\times 12^{\prime\prime}$ W $\times 9^{\prime\prime}$ D...... \$299.99

C954-92 Home Entertainment System

Combines stereo cassette recorder/player; AM-FM stereo receiver, automatic record player, two air-suspension speaker systems, and two dynamic microphones; pushbutton selects regular 2-channel stereo or 4-speaker "quad" effect; full complement of controls; control center 9^{y}_{a} " H $\times 20^{y}_{2}$ " W $\times 16^{y}_{a}$ " D, speakers 19" H $\times 11$ " W $\times 6^{y}_{2}$ " D... \$259.99 C650.92. Similar to C954-92 except has builtin 8-track cartridge recorder/player; control center 10" H $\times 19^{y}_{a}$ " W $\times 16^{\alpha}$ D; speakers 19" H $\times 11$ " W $\times 6^{y}_{2}$ " D......\$259.99 C440-92. Similar to the C954-92 except 8-track cartridge player\$219.99

MERITON

HF-1008 AM-FM/8-Track/Phono

HR-108 AM-FM Stereo/8-Track Player

Combines AM-FM stereo receiver, 8-track tape player, and pair of speaker systems; FM sensitivity 4 μ V for 30 dB quieting; S/N 60 dB; HD 1.0% stereo; response 20-15,000 Hz ±6 dB at 1 W; features back-lighted tuning dial; aux. tape input and output jacks; phono input for ceramic cartridges; automatic/manual track switching of cartridges; built-in loudness compensator; 6 $^{1}2''$ full-range speaker in each simulated walnut-veneer cabinet (18 $^{1}8''$ H \times $11^{1}2'' W \times 63^{1}4''$ D); control center simulated walnut-veneer cabinet; $5^{1}2'' H \times 187'_{10}'' W \times$ $13'' D \dots$ \$159.95

SANYO

DXT4512 Compact Stereo System

Combines 8-track play deck, cassette record/ play deck, AM-FM stereo receiver, three-speed World Radio History automatic record changer, and pair of matched three-way acoustic-suspension speakers; features built-in 4-channel matrix circuit for future use; back-lighted receiver tuning dial; 8-track deck has fast-forward and pause controls; record-level indicator; cassette deck has fastforward and rewind, separate recording amplifiers, auto-stop at end of tape; 8-track tapes can be played while recording them on cassette; phono has cue and pause control, calibrated tracking-force adjustment, diamondstylus cartridge; speaker size $21V_{2}^{\prime}$ H $\times 13V_{2}^{\prime}$ W $\times 10V_{2}^{\prime\prime}$ D \$299.95

GXT4512 Cassette/Phono/Receiver

Combines AM-FM stereo receiver; stereo cassette record/play deck; three-speed automatic record changer; pair of matched acousticsuspension speakers; features built-in 4-channel speaker matrix circuitry for future use; cassette unit has pushbutton fast-forward and rewind; record interlock; calibrated VU meter; separate recording amplifiers; phono has antiskate mechanism, adjustable tracking force; cueing control; ceramic cartridge with diamond stylus; speaker size 191/2" H × 12" W × 8" D.... \$249.95

TELEX

TXC 1201 AM-FM Stereo/8-Track

Combines an AM-FM stereo receiver, an 8-track tape player, with pair of speakers; receiver has FM stereo light, AFC blackout dial with sliderule indicator; selector switch for phono, tape, aux., multiplex, FM and AM; frequency response 20-20,000 Hz; dist. 2% at rated output; manual track selection for tape player; slide controls for loudness, balance, bass, and treble; each speaker contains 8" duocone; 18" H \times 10" W \times 6³/₄" D; control center 4¹/₄" H \times 22¹/₈" W × 11¹/₂" D \$189.95 TXC R1201. Same as TXC 1201 but with 8-track recorder/player \$224.95 TXC 1200. Similar to TXC 1201 except includes automatic record changer; tinted hinged dust cover; 8-track storage compartment; 41/4" H × 22¹/₈" W × 14⁹/₁₆" D \$239.95 TXC R1200. Same as TXC 1200 but with 8-track recorder/player \$264.95

WEBCOR

111 AM-FM Stereo/8-Track/Cassette

Combines AM-FM stereo receiver with single receptacle which accepts both 8-track and cassette tapes; 5 W/ch output; comes with two speakers; wood-grain case with silver front ... \$159.95 112. Same as 111 except includes built-in turn-table and dust cover\$199.95

121 AM-FM Stereo/8-Track

ZENITH

HR596W-30 Phono/8-Track/Receiver

Combines AM-FM stereo receiver, built-in record changer, built-in 8-track recorder/player and a pair of Allegro 3000 speaker systems; cartridge unit features sequential program selector, fast-forward, dual record-level meters; 3-speed automatic changer handles 7", 10", and 12" discs; each speaker has 10" woofer and $3V_2$ " treble horn, RLC crossover network response 40-18,000 Hz; 8 ohms; control unit 10" H x 26" W × 18'/₄" D; speakers 24'/₄" H × 15'/₆" W × 10" D \$530.00



Revolutionary! Sound-shaping taping mike.



Never before — a single microphone that gives you the versatility of 16 microphones! Four tiny frequency filter switches built into the new Shure 516EQ E-Qualidyne Microphone let you tailor sound for studio effects in virtually any recording situation: flick a switch to add sizzle to vocals . . . flick another switch to highlight the sound of a bass drum. You can even compensate for the acoustic response of a room - right from the microphone! In all, the 516EQ creates 16 different response variations that can add a new, professional sound to every tape you make. Available singly or in pairs for stereo recording. Ask to hear a recorded demonstration at your participating Shure dealer.

Shure Brothers Inc. 222 Hartrey Ave., Evanston, IL 60204 In Canada: A. C. Simmonds & Sons Limited



Manufacturers of high fidelity components, microphones, sound systems and related circuitry. 96 CIRCLE NO. 13 ON READER SERVICE CARD World Radio History

TAPE RECORDING & BUYING GUIDE



HEADPHONES & MICROPHONES

AKG

K-240 Free-Field Headphones

Free-field stereo headphones; dynamic movingcoil transducer and six passive radiators; frequency response 16-20,000 Hz; 600 ohms $\pm 20\%$ imp. over 16-20,000 Hz; sensitivity 13 μ bar/V (96.5 dB SPL at 1V) per channel; power requirements 1 mW (0.775 V) for 10 μ bar (94 dB SPL) per channel, 50 mW (5.5 V) for 72 μ bar (111 dB SPL) per channel; max. continuous power for 1% THD or less at 100 Hz 200 mW (11 V) for 143 μ bar (117 dB SPL) per channel; supplied with 3-m four-conductor cable and γ_{a} -in phone plug; 295 g.... \$69.50

K-140 Stereo Headphones

Stereo headphones with dynamic sound transducers; frequency response 20-20,000 Hz; 600 ohms $\pm 20\%$ imp. over 20-20,000 Hz; ensitivity 15 μ bar/V (97.5 dB SPL); power requirements 0.75 mW (0.67 V) for 10 μ bar (94 dB SPL); 50 mW (5.5 V) for 80 μ bar (112 dB SPL); max. continuous power for 1% THD or less at 100 Hz 240 mW (12 V) for 119 dB SPL per system; supplied with 3-m four-conductor cable and γ_4 -in phone plug; 175 g... \$34.50

AUDIO-TECHNICA

AT-706 Headphones

Electret condenser headphones; frequency response 10-22,000 Hz ± 2 dB; sensitivity 98-dB SPL at 1 kHz (0 dB = 0.0002 μ bar/V); max. output 114 dB; imp. 4-16 ohms; includes impedance-matching adapter with headphone/speaker switching; 6-ft cord; adapter size 3 V_4 " H \times 3 V_8 " W \times 8 V_2 " D; headset weight (less cord) 9 oz.....\$129.95

AT-705 Headphones

AT-703 Headphones

Dynamic headphones; frequency response 20-20,000 Hz; sensitivity 94-dB SPL at 1 kHz; imp. 4-16 ohms; coiled cord; 10.5 oz \$69.95

AT-702 Headphones

Dynamic headphones; frequency response 25-20,000 Hz; sensitivity 97-dB SPL at 1 kHz; imp. 4-16 ohms; coiled cord; 10.5 oz \$49.95

AT-701 Headphones

Dynamic headphones; frequency response 30-20,000 Hz; sensitivity 97-dB SPL at 1 kHz; imp. 4-16 ohms; coiled cord; 10.5 oz \$39.95

AUDIOTEX

Professional Stereo Headphones

Frequency response 30-20,000 Hz; imp. 8-16

1978 EDITION

ohms; padded earpieces with adjustable padded headband; comes with 10-ft coiled cord, black vinyl carrying case. 30-5207 ... \$59.95

Deluxe Stereo Headphones

Frequency response 20-25,000 Hz; imp. 8 ohms; adjustable padded headband; padded earpieces; matches amps with output from 4 to 16 ohms; comes with 10-ft coiled cord, black vinyl carrying case. 30-5203 \$49.95

Marquis Stereo Headphones

Headphone Remote Control

Plugs directly into amplifier to control volume and balance of headphones; noise-free slide controls for each earpiece permit adjustment of volume and balance; special switch allows for mono/stereo selection; has 5-ft cord and 3-conductor stereo phone plug. 30-5250 \$12.95

BEYER/DYNAMIC

DT-48 Dynamic Headphones

DT-480 Dynamic Headphones

Moving-coil type dynamic headphones; frequency response 20-18,000 Hz; sensitivity 1 mW at 400 Hz for 115 dB (re $2 \times 10^{-4} \mu$ bar); 25-200 ohms imp.; 1 W max. input per phone \$99.95

DT-202 Dynamic Headphones

DT-100 Dynamic Headphones

DT-220 Dynamic Headphones

DT-96-A Dynamic Headphones

DT-302 Lightweight Headphones

4-CHANNEL

DT-204 4-Channel Headphones

Frequency response 20-20,000 Hz; imp. 4 \times 200 ohms (4-channel), 2 \times 100 ohms (stereo); independent volume controls for each front channel; 4-channel/stereo slide switch; 10-ft detachable cable with two plugs \$120.00

ESS

Mark 1 Stereo Headphones

INFINITY

ES-1 Stereo Headphone System

System consists of one headphone set and walnut-enclosed adapter housing power supply & matching transformers; front-panel output accommodates two headsets; frequency response 20-25,000 Hz ± 2 dB: THD 0.3% at 100 dB SPL; sensitivity: 98 dB SPL (2 V at 1000 Hz); max. output 118 dB SPL at 1000 Hz; max. input 50 W at 100 Hz; imp. 4-16 ohms; phones operate in push-pull mode; Polyurethin diaphragms; adjustable headband; 98-in headphone cord; adapter size 3" H \times 51/4" W \times 71/4" D ... \$275.00

JENSEN

230 Stereo Headphones

Frequency response 15-22,000 Hz; 0.8% HD at 1 kHz, 100-dB SPL; max. input power 50 mW; imp. 4-600 ohms; ambient noise isolation 40 dB at 1 kHz; patented dual cavity; liquid-filled ear cushions; volume control for each earphone; 14-ft coiled cord with strain relief; chromeplated headband; 19 oz without cord. \$59.95 **200.** Similar to 230 except frequency response 18-20,000 Hz; 0.9% HD; weight 18 oz. \$49.95

210 Stereo Headphones

Frequency response 20-18,000 Hz; 0.9% HD at 1 kHz, 100-dB SPL; max. input power 50 mW; imp. 4-600 ohms; ambient noise isolation 18 dB at 1 kHz; foam-filled ear cushions; polypropylene headband; 14-ft coiled cord ... \$29.95

KOSS

"Auditor" ESP/10 Stereo Phones

Electrostatic design with energizer; headset



bandpass response 10-22,000 Hz ±2 dB; sensitivity for 100-dB SPL: 1.9 V rms at 1 kHz into E/10 energizer, 2.0 V rms pink noise; THD at 1 kHz and 100 dB SPL 0.5%; radiating surface area of electrostatic element 25 cm²/ch; semivented design; black with silver accents; energizer bandpass response 3 dB down at 15 Hz and 24 kHz; hum and noise 75 dB below sensitivity reference level (100 dB SPL); phase response at 20 Hz +30 degrees, at 15 kHz -30 degrees; input imp. 3 ohms min. at 20 Hz and 20 kHz, 180 ohms max. at 800 Hz; min. recommended amp power 35 W/ch; overload voltage (for relay cut-out) 5.3 V rms pink noise into energizer; semi-peak-reading VU meters; LED overload indicators; automatic overload de-range 15-15,000 Hz ±5 dB; sensitivity for 100dB SPL 6.15 V rms at 1 kHz; energizer connects directly to low-Z speaker terminals; Pneumalite ear cushions; adjustable stainless-steel headband; self-adjusting yokes; 2-m cord; weight 19.3 oz (less cord) \$175.00

Technician/VFR Headphones

Phase/2 Stereophones

Frequency response 10-22,000 Hz; will operate from outputs of 3.2 to 600 ohms; dist. 1% at 100-dB SPL; will handle 5 V rms continuous with provision for 14-dB SPL transient peaks; Pneumalite ear cushions for high-ambient noise isolation; two rotary panoramic source controls on each earcup; slide-type ambience expander on right earcup; comparator switch on left earcup; extendible stainless steel headband with self-adjusting pivoting yokes. \$75.00

PRO/4AA Dynamic Headphones

Frequency response 10-22,000 Hz; sensitivity 0.4% at 100-dB SPL; 3.2 to 600 ohms impedance; 10-ft coiled cord; 20.5 oz; Pneumalite ear cushions for noise isolation \$65.00

HV/1A Stereophones

Features low-mass "Decilite" driver elements for coverage 15-30,000 Hz; will operate from outputs of 3.2 to 600-ohms; dist. 0.5% at 100dB SPL; will handle 5 V rms continuous with provision for 14-dB SPL transient peaks; acoustical sponge ear cushions; extendible headband with self-adjusting, pivoting yokes and soft padded vinyl cover; 3-conductor coiled cord (10-ft extended); 10 oz \$49.95 HV/1LC. Same except volume/balance control per earcup; 10.8 oz \$54.95

K/145 Dynamic Stereophone

Features 1.5-in polyester driver; frequency response 20-20,000 Hz; imp. 90 ohms at 1 kHz; level controls; "Pneumalite" ear cushions; padded simulated leather earcups, adjustable brushed stainless steel yokes and sidebars; 10ft coiled Y cord; molded plug; sensitivity at 100dB SPL 0.25 V rms sine wave at 1 kHz, 0.10 V rms pink noise; THD 0.5% at 1 kHz for 100-dB SPL; weight (less cord) 12.6 oz \$45.00 K/135. Similar to K/145 except response 10-18,000 Hz; 2.5-in dynamic elements; imp. 100 ohms at 1 kHz; sensitivity at 100-dB SPL 0.09 V rms sine wave, 0.11 V rms pink noise; THD 1% at 1 kHz for 100-dB SPL; weight (less cord) 13.4 oz\$35.00 K/125. Similar to K/135 except response 10-16,000 Hz; sensitivity at 100-dB SPL 0.14 V rms sine wave, 0.13 V rms pink noise; weight (less cord) 12.8 oz\$25.00

"Easy Listener" Stereophones

Frequency response 20-20,000 Hz; 2" dynamic elements; imp. 161 ohms at 1 kHz; sensitivity 0.8 V rms sine wave at 1 kHz, 0.5 V rms pink noise (for 100-dB SPL); THD 0;5% at 1 kHz, 100 dB SPL; acoustical sponge ear cushions; extendible headband with self-adjusting yokes and soft denim cover; 3-conductor 10-ft coiled cord; weight (less cord) 10 oz \$44.95

HV/1 Dynamic Headphones

Has 2" dia. driver and will operate from 3.2 to 600 ohm outputs; response 20-20,000 Hz; capacity 5 V continuous with provision for 14 dB SPL transient peaks; 10 oz; 10-ft. coiled cord. \$39.95

KO/727B Dynamic Headphones

Frequency response 10-18,000 Hz; THD 1.0% at 100-dB SPL; 3.2 to 600 chms impedance; 10-ft coiled cord; 16.5 oz; black \$34.95

K/6LC Dynamic Headphones

K/7 Stereo Headphones

4-CHANNEL

Phase/2 + 2 Quadraphone

Incorporates one Decilite driver element and one high-velocity dynamic element in each earcup; response 20-20,000 Hz; programmer permits 127 personal listening perspectives in 4-channel sound without adjusting amp controls; features comparator switch for normal 4-channel mode vs Phase/2 + 2 mode; soft acoustical sponge ear cushions; vinyl-covered headband with pivoting self-adjusting yokes; 17.3 oz \$145.00

K/2 + 2 Four-Channel Headphones

Dynamic type; features four separate drive elements (2 in each phone) for 4-channel re-



K/6LCQ Four-Channel Quadrafones

Can be used for either 2- or 4-channel opera-

LAFAYETTE

RP-50 Criterion Polymer Headphones

F-750 "Lighthead II" Headphones

Lightweight design; nylon-type diaphragms; frequency response 18-22,000 Hz; max. input 100 mV; imp. 4-100 ohms; adjustable vinyl headband; 6½-ft cable with plug \$49.95

F-700 Lightweight Headphones

F-600 Open-Acoustic Headphones

4-CHANNEL

F-4400 4-Channel Headphones

MARANTZ

SE-1S Electrostatic Headphones

Response 20-20,000 Hz \pm 3 dB; dist. 0.5% 40-20,000 Hz at 100 dB SPL, 1.5% at 20 Hz; impedance 30 ohms; energizer has built-in head-phone/speaker switching; facilities for additional set of phones; protective circuit for regulating extremely loud passages; overload protection; 14 oz \$129.95

SD-5 Dynamic Headphones

Response 30-15,000 Hz; THD 1% at 30 Hz, 0.18% at 1000 Hz, 0.25% at 10,000 Hz (all at 100 dB SPL); 8-ohms imp.; sensitivity: 0.15 V rms for 200 dB SPL; Mylar diaphragm dynamic transducers; soft ear cushions; 16 oz. \$39.95

MIIDA

HX-140 Headphones

Electrostatic stereo headphones; frequency response 20-25,000 Hz; SPL 96 dB/10 V rms; max. sound pressure 115 dB/400 Hz; dist. 0.5% at 200 Hz; power supply 6 W (400 Hz) continuous max. input; 35 W inst. max. input; response 10-30,000 Hz ± 2 dB; dist. 0.2% at 50 Hz, 0.02% at 1 kHz; comes with $6^{1}/_{2}$ -ft cord; 9.17 ounces (headphones) \$129.95

HX-130 Dynamic Headphones

MURA

SP-205 Dynamic Headphones

Stereo headphones; Mylar cone elements: separate volume and tone controls on each earcup; stereo/mono switch; frequency response 30-20,000 Hz ±5 dB; imp. 8 ohms; padded adjustable headband, cushioned earcups, 15-ft coiled cord with plug \$62.50

HB-1500 Polymer Headphones

Stereo headphones; high-polymer diaphragm transducers; sensitivity: 100 dB SPL/1 mW; frequency response 18-22,000 Hz; imp. 8 ohms; open-air design; max. input 0.1 W; 10ft coiled cord with plug; 4 ounces \$59.95

SP-505 Dynamic Headphones

Stereo headphones; 3" dynamic speakers; separate volume and tone controls on each earcup; stereo/mono switch; frequency response 20-20,000 Hz; imp. 8 ohms; padded headband, vinyl-covered earcups, 10-ft coiled cord with plug \$39.95

SP-504 Dynamic Headphones Stereo headphones; 3" dynamic speakers; separate slide-type volume and tone controls; stereo/mono switch; frequency response 20-18,000 Hz; imp. 8 ohms; adjustable padded headband, 10-ft coiled cord with plug . . \$29.50 SP-502. Similar to SP-504 but without tore controls; cushioned headband and earcups; response 30-18,000 Hz \$19.95

SP-94 Stereo Headphones

Lightweight dynamic headphones; 21/4" speakers; frequency response 35-15,000 Hz; imp. 8 ohms; 8-ft cord with plug \$9.95

4-CHANNEL

QP-280 Quad Headset

Two 21/4" dynamic speakers in each earcup; stereo/quad switch; frequency response 20-20,000 Hz; max. input 0.2 W; 8 ohms imp; adjustable padded headband and earcups; 10-ft coiled cord with coded dual plugs \$39.95

NAKAMICHI

HP-100 Monitoring Headphones

Dynamic type designed primarily for monitoring; response 20-20,000 Hz; imp. 8 ohms \pm 20% (1 kHz); output SPL 90 dB \pm 3 dB per mW at 1 kHz; max. input power 500 mW (117-dB SPL); channel balance within 3 dB at 1 kHz; vinyl-covered, foam-padded earpieces; adjustable headband; 8-ft coiled cord with molded plug and strain relief; weight 14.3 oz

PICKERING

OA-7 Headphones

Lightweight open-audio design; REE used in permanent magnet compound: foam-cushioned headband; earpiece yokes incorporate pivoting system enabling snug fit; nominal input imp. 100 ohms; frequency response 20-22,000 Hz ±5 dB sensitivty 110-dB SPL at 0.2 V; max. input 0.1 W rms; dist. 0.5% at 110-dB SPL; supplied with flat 10-ft cord; 6 oz \$69.95

4955 Headphones

Dynamic type; 8-ohms impedance; response 40-11,000 Hz ±3 dB, 30-18,000 Hz ±6 dB; sensitivity 100-dB SPL; max. input 0.5 W rms; distortion 1% at 115-dB SPL; 10-ft coiled cord; 28 oz \$64.95

OA-3 Headphones

Lightweight, open-audio design, 15 ohms $\pm 10\%$ at 1000 Hz; max. power input 0.2 W rms/ch; response 20-20,000 Hz; dist. 0.5% at 100 dB

1978 EDITION



Theirs:

Julian S. Martin HI-FI STEREO BUYERS' GUIDE, March-April, 1976

"Superb from every viewpoint. An outstanding achievement in headphone design. One of the most comfortable."

> The Len Feldman Lab Report TAPE DECK QUARTERLY, Winter, 1975

"Response of these phones extends uniformly from 20 Hz to over 22,000 Hz with no more than $\pm 2dB$ variation over this entire range...this is nothing short of incredible."

New Equipment Reports HIGH FIDELITY, January, 1976

"The sound quality the AT-706 presents [to you] is exceptional: very wide range and smooth....Within this excellent operating range the sound is exceedingly clean and open...an extremely fine stereo headset."

If you asked the critics they'd tell you to listen critically to a variety of products before you buy. We agree. Because the more carefully you listen, the more you'll be impressed by the sound of Audio-Technica.





PIONEER

SE-700 Stereo Headphones

Monítor 10 Stereo Headphones

Dynamic type covering a frequency range of 20-20,000 Hz, with 2½" free-edged polysterfilm cone speaker in each earpiece; sensitivity 100 dB/mW; max. input power 700 mW/ch; comes with 16-ft, 5-in coiled cord; 23 oz..... \$70.00

SE-505 Headphones

SE-500 Stereo Headphones

SE-4 Hear-Through Headphones

Features super-thin polyester film dome drivers; frequency range 20-20,000 Hz; hearthrough earpads; imp. 250 ohms; sensitivity 96 dB/mW (1000 Hz); max. input power 200 mW/ch; comes with 9-ft, 5-in Y-type cord; weight 7³/₅ oz (without cord, 9¹/₅ oz with...... \$50.00

SE-405 Stereo Headphones

Dynamic type covering a frequency range of 20-20,000 Hz; 8 ohms imp.; input power 500 mW each channel; unit features polyester-film diaphragm; special ear pads with sliding-type adjusting headband and clickstops for easy listening; volume controls for both left and right channels; 16½-ft coiled cord \$45,00

SE-305 Stereo Headphones

SE-205 Stereo Headphones

Dynamic type covering a frequency range of 20-20,000 Hz; cone-type speaker in each earpiece; matching imp. 4 to 16 ohms; max. input power 500 mW each channel; comes with 8.2-ft cable; 16 oz\$25.00

REALISTIC

Pro-2 Headphones

LV-10 Headphones

Features electroacoustical design with 2-in dynamic elements; frequency response 20-

Nova-Pro Headphones

Stereo dynamic design; volume controls on each earcup; frequency response 20-20,000 Hz; 8-ohm impedance; 10-ft coiled cord \$34.95

Custom-Pro Headphones

Dynamic-type headphones; frequency response 20-20,000 Hz; 4- to 16-ohm impedance; bass port\$24.95

Nova-15A Headphones

Dynamic-type headphones; ported open-back earcups; frequency response 20-20,000 Hz; 4- to 16-ohm impedance; 10-ft cord... \$21.95

Nova-30 Headphones

3¹/₂-in speakers for wide response; frequency response 30-18,000 Hz; separate controls on each earcup; soft cushion earcups; padded adjustable headband; 4- to 16-ohm impedance; supplied with 10-ft coiled cord and ¹/₄-in plug\$19.95

RECOTON

ST31 Stereo Headphones

Frequency response 50-19,000 Hz; 3-in speakers; separate volume control with stereo/mono switch; imp. 8 ohms; foam-filled headband and ear cushions; 10-ft coiled cord \$36.95

ST26 Stereo Headphones

Frequency response 20-21,000 Hz; 2V₄-in Mylar speakers; foam ear cushions; adjustable padded headband; separate slide volume controls; stereo/mono switch; imp. 8 ohms; 10-ft coiled cord\$31.95

ST18 Stereo Headphones

Frequency response 25-18,000 Hz; $2^{1/4}$ -in dynamic speakers; foam-padded adjustable headband and ear cushions; separate volume controls; imp. 8 ohms; 8-ft coiled cord ... \$20.95

ROYAL SOUND

HP-60 Stereo Headphones

Expanded frequency response through 20,000 Hz; 100 g; 10-ft coiled cord; γ_{4} -in thick at earcups\$75.00

SANSUI

SS100 Stereo Headphones

Omni-dynamic driver full-range speaker in each earpiece; matching amp imp. 4-100 ohms, 600 ohms nominal; frequency response 20-20,000 Hz; HD 0.3% at 94 dB SPL; max. input power 250 mW; sensitivity 94 dB/mW (at 200 Hz); 6.5-ft cord; weight 13.2 oz .. \$90.00

SS-50 Stereo Headphones

SH-15 Stereo Headphones

Non-isolating headphones with \mathcal{Y}_4 " full-range dome speakers; matches amplifier impedances 4-32 ohms; nominal imp. 25 ohms; frequency response 20-20,000 Hz; max. input power 65

SS-10 Stereo Headphones

Mechanical 2-way speaker in each earpiece; max. input 500 mW; imp. 8 ohms; SPL 110 dB; frequency response 20-20,000 Hz; separate volume controls; 9.8-ft coiled cord, Y-shaped extension cord (6.5 ft); 22 oz \$40.00

SS-2 Stereo Headphones

Dynamic stereo phones; imp. 8 ohms; frequency response 20-18,000 Hz; dist. 1% at 1 mW input; input power 1 mW; max. rated power input 500 mW; 6-ft cord; 12.6 oz \$20.00

4-CHANNEL

QH-44 4-/2-Channel Headphones

Features four ¾" high-velocity speakers (one front/one back each housing); matches 4-25 ohm amplifier impedances; 25 ohms nominal imp.; frequency response range 20-20,000 Hz; maximum input power 100 mW; sensitivity 98 dB at 1000 Hz; acoustical foam urethane earpads; adjustable headband; 8.2-ft cord; weight 15.2 ounces (headphones only) \$70.00

SENNHEISER

HD424 Headphones

HD414 Headphones

"Open aire" design dynamic headphones; frequency response 20-20,000 Hz; sensitivity 17.7 μ bar/V; 1 mW (1.41 V) per channel for SPL of 102 dB; dist. 1% at 22 V, 1 kHz; 2000-ohm imp. per channel; 10-ft cable; 5 oz (without cable) \$52.96

HD400 Headphones

"Open aire" design dynamic headphones; frequency response 20-18,000 Hz; sensitivity 1 mW for SPL of 88 dB; 600-ohm imp. per channel; 10-ft cable; 3 oz (without cable) \$32.95

HD44 Headphones

"Open aire" design dynamic headphones; under-the-chin configuration; frequency response 52-10,000 Hz; 600-ohm imp. per channel; 10-ft cable; 1.2 oz (without cable) \$31.95

STANTON

Stereo/Wafers XXI Headphones

Dynaphase Sixty Headphones

Dynaphase Forty Headphones

Dynamic headphone; frequency response 60-

10,000 Hz ±3 dB; dist. 1% at 115-dB SPL; 8-ohm imp. at 1 kHz; max. power input 0.5 W rms per phone; blue-black and chrome finish; 10-ft cord; 21 oz. \$44.95

Dynaphase Twenty-Eight Headphones

Open audio headphones with plug for AM-FM/ tape recorder listening; frequency response 30-19,000 Hz; 8-ohm imp.; dist. 1% at 100-dB SPL; 10-ft coiled cord: 11 oz \$27.95

4-CHANNEL

Dynaphase Sixty-Five Four C

Two speakers in each earpiece; frequency re-sponse 20-20,000 Hz; sensitivity 0.1 V per channel for 100-dB SPL (1 kHz); max. power input 1.25 V rms continuous; dist. 0.5% at 110dB SPL; 15 ohms ±20% input imp. at 1 kHz; vinyl-covered foam ear cushions; adjustable headband; two plugs (front and back); quad/ stereo switch; 11-ft coiled cord; 19 oz . . \$69.95

STAX

SRX-III Earspeakers

Electrostatic push-pull type; response 20-27,000 Hz ±1 dB; SPL 95 dB at 100 V rms in-



put; maximum level 115 dB; weight 370 g including cord; comes with SRD-7 energizer, a polarizing supply and signal source; response 10-30,000 Hz ±2 dB; distortion 0.02% at 1 W, 1000 Hz; 4¾ H × 2⅔ W × 8" D \$230.00

SR-5 Earspeakers

Electrostatic push-pull type; response 30-25,000 Hz ±1 dB; SPL 95 dB at 50 V rms input; maximum level 115 dB; weight 432 g including cord; comes with SRD-6 energizer, a polarizing supply and signal source; response 20-20,000 Hz ± 1 dB; dist. 0.1% at 1 W, 1000 Hz; overall size $2^{5}/_{8}$ " H $\times 2^{1}/_{16}$ " W $\times 6^{1}/_{2}$ " D \$130.00

SR-44 Earspeakers

Electret condenser system combines SR-40 headphones with SRD-4 adapter; features wide-latitude in headband adjustment; requires a.c. power source \$85.00

SRA-12S Headphone Preamp/Amp

Input sensitivity; phono 2.0 mV, tuner, tape, aux. 250 mV; phono overload 100 mV; hum and noise: phono 58 dB, tuner, aux. 80 dB; frequency response 10-60,000 Hz \pm 1.5 dB; THD 0.05%; DIN output jacks; preamp can be used separately; designed specifically for use with Stax Earspeakers \$500.00

SUPEREX

PEP-81 Electrostatic System

Consists of PEP-81 headphones and CC-81 control console; headphone frequency response 15-18,000 Hz ±2 dB; 10-22,000 Hz ±5 dB; dist. 0.2%; impedance-matched to CC-81 for 4-16 ohms; isolation-type headphones with fully adjustable vinyl-covered headband and foam cushions and 15-ft coiled cord; control console has level controls for both channels (20-dB range), speaker/phone rocker, on/off switch; can accommodate two sets of head-

19 8 EDITION



phones; requires 5 W per channel min. drive; console size $11'' \times 3^{1/4''} \times 6^{1/2''} \dots$ \$150.00

PEP-79E Electrostatic System

Consists of PEP-74 headphones and CC-79E control console; headphone frequency response 15-18,000 Hz ±2 dB, 10-22,000 Hz ±5 dB; negligible dist.; impedance-matched to CC-79E for 4-16 ohms; trans-air lightweight headphones with fully adjustable vinyl-covered headband and foam cushions and 15-ft coiled cord; control console is designed for use with main amp level controls, has self-protecting circuits; console size $2^{1}/_{2}$ " H \times 7" W \times 4" D.... \$90.00

PRO VII Headphones

Features woofer and tweeter in each earcup; frequency response 15-23,000 Hz; 80-ohm imp.; 0.5% dist. at 110-dB SPL (400 Hz) 2³/₄-in Mylar dynamic woofer and ceramic tweeter; padded fully adjustable steel head-band and foam-filled vinyl cushions; 15-ft (extended) retractable cable with clothing clip. 18 oz \$65.00

Classic CL-1 Headphones

Lightweight, isolating-type headphones; frequency response 10-20,000 Hz; 35-ohm imp.; 0.3% dist. at 110-dB SPL (400 Hz); sensitivity 10 mW (0.6 V) for 110-dB SPL at 400 Hz; padded fully adjustable steel and aluminum headband with foam-filled vinyl cushions; 15-ft (extended) retractable cable with clothing clip and molded stereo plug; 10.6 oz (without cable) \$55.00

TRL-3 Trans-Linear Headphones

Open design headphones; frequency response 40-20,000 Hz ±5 dB, 5-dB bass boost between 70 and 200 Hz; 80-ohm imp.; 0.6% dist. at 110 dB (400 Hz); sensitivity 6 mW for 100-dB SPL: max. input 5 V; padded, fully adjustable aluminum and steel headband; urethane foam, snapon cushions; 15-ft (extended) retractable cable with clothing clip, molded plug, and strain relief; 8.5 oz (without cable) \$40.00

TRL-77 Trans-Linear Headphones

Open design headphones, frequency response 45-20,000 Hz; 80-ohm imp.; max. input 5 V; adjustable, continuous padded stainless steel headband and open foam; snap-on cushions; 7-ft Y cord with molded plug and strain relief; 11.5 oz (without cable) \$30.00

DP-903 Monitor Phone

Single hand-held earphone with swivel grip; blends left and right channels into single ear-phone; frequency response 20-19,000 Hz; 180-ohm imp.; brown with gold trim; 7-ft cord with stereo plug \$20.00

SC-3 Control Box

For use with receivers and amps without headphone jacks; left and right channel level controls; speaker/headphone switch; speakers off when phones are on \$9.95

STEX-10R Coiled Cord

15-ft extension coiled cord for stereo headsets; supplied with special stereo jacks and plugs\$5.50

STEX-20 Cord

20-ft extension cord for stereo headsets; supplied with special stereo jacks and plugs . . \$4.50

You Can't **Do Better ForTwice The Price**

STAX SR-44—Incomparable frequency response, efficiency and transient rise time for \$85.







TECHNICS BY PANASONIC

EAH-80A Electret Headphones

4-CHANNEL

EAH-420 4-Channel Headphones

Dynamic type using six drivers; each earpiece has center-mounted 3-in woofer with two isolated front-back 1^{3}_{4-} in tweeters; high efficiency; independent tone and volume controls on each earpiece; 4-ch/2-ch selector switch; input imp. 4-16 ohms; response 20-20,000 Hz; max. input 1000 mW; sensitivity (1 mW, 200 Hz) = 104 dB; 9.1-ft cord; 23.8 oz \$79.95

YAMAHA

HP-1 Stereo Headphones

ZENITH

839-34 2/4-Channel Headphones

839-44 2/4-Channel Headphones

Dynamic headphones; 2- or 4-ch compatible; 8-ohm imp.; max. input power 250 mW; frequency response 20-19,000 Hz; sensitivity 104 dB \pm 3 dB/mW at 200 Hz; two rotary controls serve as volume controls on 2-ch material, balance controls on 4-ch material- 2-ch/4-ch selector switch; 10-ft coiled cord; 16 oz. \$48,95



AKG

D-109 Omnidirectional Microphone

Omnidirectional dynamic microphone; frequency response 50-15,000 Hz \pm 3.5 dB; sensitivity -56 dB ASA; 200-ohm imp.; supplied with lavalier, dust filter or windscreen, and 30-ft cable (less connector); chrome finish . \$60.00

D-120E Cardioid Microphone

102

Cardioid dynamic microphone; frequency re-

D-140E Cardioid Microphone

D-160El Omnidirection'al Microphone

Omnidirectional dynamic microphone; frequency response 50-15,000 Hz ±3 dB; sensitivity -55 dB ASA; 200-ohm imp.; supplied with slip-in stand attachment, dust filter or windscreen, and XLR connector \$64.00

D-170E Cardioid Microphone

Cardioid dynamic microphone; frequency response 50-15,000 Hz \pm 3 dB; sensitivity -53.5 dB ASA; 200-ohm imp.; built-in windscreen; supplied with slip-in stand adapter and XLR connector; chrome finish...........\$95.00

D-109E Cardioid Microphone

D-200E Cardioid Microphone

Cardioid dynamic microphone; frequency response 30-15,000 Hz \pm 3 dB; sensitivity -55 dB ASA; 200-ohm imp.; supplied with slip-in stand attachment, dust filter or windscreen, and XLR connector; matte gray finish.. \$90.00

D-1000E Cardioid Microphone

D-2000E Super Cardioid Microphone

Electret Condenser Mike System

Modular system consisting of one basic powering module, four interchangeable capsules, and accessories. Powering module has battery compartment for 5.6-volt battery, "on-off" switch for shifting battery to clean contact points, 550-hour continuous operation, and adaptability for phantom powering off d.c. supply. Interchangeable capsules include: CE-1 cardioid capsule plus condenser mike preamp; CE-2 omnidirectional capsule with preamp; CE-5 cardioid capsule with integral suspension and wire mesh screen plus preamp; CE-10 miniature lavalier attachment with integrated FET preamp.

 SE-5E. Powering module
 \$60.00

 CE-1
 \$45.00

 CE-2
 \$45.00

 CE-5
 \$55.00

 CE-10
 \$85.00

 CE-501E. For cardioid operation; consists of
 CE-1 capsule, SE-5E powering module, SA-11/1

 stand adapter, W-3 windscreen
 \$120.00

 CE-502E. For omnidirectional operation; consists of CE-2 capsule, SE-5E powering module, SA-11/1

 sists of CE-2 capsule, SE-5E powering module, SA-11/1

AUDIOTEX

Electret Condenser Microphone

Dynamic Microphone

Omnidirectional Microphone

Omnidirectional Microphone

Response 55-13,000 Hz; output -62 dB (on high impedance); rugged construction; comes with 15-ft cable, standard phone plug, swivel holder, on-off slide switch, and windscreen for outdoor use; dual (hi/lo) impedance. 30-2312 \$31.25

Tie Tack Lapel Microphone

For PA and voice taping; frequency response 40-16,000 Hz; imp. 1000 ohms; sensitivity –65 dB ±3 dB; comes with 13-ft cord with mini-plug, tie-tack holder, mercury battery. 30-2318 \$29.95

Low-Impedance Microphone

Designed as a replacement unit for many tape recorders built prior to 1969 as well as some later models; cord terminated in miniature and subminiature plugs to fit most tape recorders; adapter for recorders using concentric jack included; 200 ohms. 30-2300\$7.30 **30-2302.** Same except 50,000 ohms impedance

\$9.75 **30-2304.** Same except equipped with 5-pin and 3-pin DIN plugs found on all European and some American and Japanese recorders; 200 ohms\$9.75

Microphone Mixer

Allows combination of up to four mikes mono or two mikes to each stereo channel; separate control for each mike; on-off switch; stereo/ mono selector switch; 9-volt battery operated; standard ¼" phone jack inputs, phono pin jack outputs. 30-2320\$27.95

Microphone Boom

Fits all standard mike floor stands; has adjustable counterweight; movable clamp and hinge design for any desired position; standard $\frac{5}{8}$ -27 thread. 31" long. 30-2370...... \$21.50

Floor-Type Stand

Folding Microphone Stand

Folds and unfolds in seconds; weight $3\frac{1}{2}$ pounds; chrome-plated tubing extends to 60"; folded size 33"; legs have rubber tips to prevent skidding and scratching. 30-2362 \$21.00

BEYER/DYNAMIC

M-160 Double-Ribbon Microphone

Super-cardioid dynamic type; response 40-18,000 Hz \pm 2.5 dB; sensitivity -152 dBm (EIA); 200-ohm impedance; low sensitivity at 120 degrees to axis; suitable for stereo record-

M-88 Moving-Coil Microphone

M-201 Moving-Coil Microphone

M-500 Dynamic Ribbon Microphone

Super-cardioid; response 40-18,000 Hz ± 2.5 dB; sensitivity -153 dBm (EIA); 200-ohms imp.; has four-stage integral blast filter and Cannon XLR termination; especially designed for rock vocals; low pop and breath noise even when singer's lips touch microphone \$159.95

M-260 Dynamic Ribbon Microphone

M-101 Moving-Coil Microphone

Omnidirectional type; response 40-20,000 Hz; sensitivity -150 dBm (EIA); 200-ohms imp.; withstands pressures associated with modern music (modulated voltages up to 2V); low handling noise; $4V_{2''} \times \gamma_{6''}$; Cannon XLR termination \$127.50

M-69 Moving-Coil Microphone

"Soundstar" X1N Dynamic Microphone

Dynamic cardioid design; response 30-18,000 Hz \pm 2.3 dB; sensitivity -146 dBm (EIA); 200ohms imp.; front-to-back attenuation greater than 20 dB; for tape recording, music, and vocals; has built-in pop screen and hum compensation coils; Cannon XLR termination ... \$85.00 "Soundstar" X1HL. Same as X1N except with high/low imp. switch...... \$100.00

M-810-N Moving-Coil Microphone

M-550S Moving-Coil Microphone

ELECTRO-VOICE

1776 Cardioid Microphone

644 Cardiline Microphone

Cardiline very directional dynamic microphone; flat response 40-12,000 Hz; -53 dB output;



switchable high and low impedance; on/off switch; MC4F-type mic connector and 15-ft cable with matching connector; gray finish \$134.10

672 Cardioid Microphone

661 Super Cardioid Microphone

664 Cardioid Microphone

Variable-D cardioid dynamic microphone; shaped response 60-15,000 Hz; -58 dB output; switchable high and low impedance; on/off switch; MC4F-type mic connector and 15-ft cable with matching connector; satin chrome finish.......\$81.30

670A Cardioid Microphone

Single-D cardioid dynamic microphone; shaped response 60-14,000 Hz; -61 dB output (hi-Z), -60 dB output (lo-Z); switchable high and low impedance; on/off switch; A3M-type mic connector and 15-ft cable with matching connector; supplied with stand clamp; gray finish....

636 Omnidirectional Microphone

Omnidirectional dynamic microphone; flat response 60-13,000 Hz; -58 dB output; switchable high and low impedance; on/off switch; MC4F-type mic connector and 15-ft cable with matching connector; satin chrome finish \$78.30

660 Super Cardioid Microphone

671 Cardioid Microphone

Single-D cardioid dynamic microphone; shaped response 60-14,000 Hz; -61 dB output (hi-Z), -60 dB output (lo-Z); switchable high and low impedance; on/off switch; A3M-type mic con-

nector and 15-ft cable with matching connector; supplied with stand clamp and integral windscreen/pop filter; satin chrome finish..... \$76.50 **671P.** Same but with 25-ft cable with two professional connectors\$79.50

647A Omnidirectional Microphone

Omnidirectional dynamic microphone; shaped response 60-12,000 Hz; -60 dB output; highand low-impedance models available; integral cable; supplied with lavalier neckcord, belt clip, and stand clamp; gray finish..... \$69.60

630 Omnidirectional Microphone

Omnidirectional dynamic microphone; flat response 60-11,000 Hz; -55 dB output; switchable high and low impedance; on/off switch; MC4F-type mic connector and 15-ft cable with matching connector; satin chrome finish..... \$64.80

627C Cardioid Microphone

631B Omnidirectional Microphone

607 Noise-Cancelling Microphone

Noise-cancelling dynamic microphone; shaped response 200-4000 Hz; -54 dB output; cancels sound more than ¼ in from face; high- and lowimpedance models available; MC1M-type (lo-Z) or MC2M-type (hi-Z) mic connector and 15-ft cable with matching connector; gray finish.... \$52.50

626A Cardioid Microphone

624 Omnidirectional Microphone

Omnidirectional dynamic microphone; shaped response 100-7000 Hz; -56 dB output (hi-Z), -58 dB output (lo-Z); high- and low-impedance models available; integral cable; supplied with lavalier neckcord; gray finish \$42.60

634ASRL Omnidirectional Microphone

Omnidirectional dynamic microphone; shaped response 70-10,000 Hz; -57 dB output; low impedance; on/off switch with relay contacts; intergral cable; supplied with windscreen; gray and chrome finish.....\$39.60

634A Omnidirectional Microphone

HELPINSTILL

Model 65 Guitar Sensor

Acoustic guitar sensor; hybrid design combines advantages of conventional magnetic pickup and guitar body transducer; mounts on guitar body by means of pressure-sensitive adhesive strip; control box clips on performer's belt and has a volume control and standard phone jack output\$79.50



MICROPHONES

Extra sensor

..... \$49.50 Model 66. Similar to Model 65 but without control box; low impedance; connects directly to sound system via Cannon XLR-3 type male connector; designed specifically for concert stage applications \$59.50

LAFAYETTE

Tie-Tac Lavalier Mike

Ultra-miniature omnidirectional mike; 1%44" dia. × 3/4" long; switchable high/250-ohm imp.; response 20-15,000 Hz; 55 dB output; has FET/ IC power supply with professional XLR connector; battery operated; comes with 15-ft cable; mike weighs 1/2 ounce, power supply 3 ounces.\$49.95

MU-101 Dynamic Microphone

Unidirectional pickup; output -56 dB; response 200-10,000 Hz; user selects high or low impedance; hand-held with Switchcraft connector to body; "on/off" switch; shockmounted transducer and Mylar diaphragm for rugged use; use for speech, rock vocals, and tape recording; cable end free; die-cast case; non-glare finish \$34.95 M0-102. Same as MU-101 except response 50-13,000 Hz; -58 dB output; for use where feedback or background noise is not a problem.

Electret Condenser Microphone

Unidirectional cardioid pattern with high frontto-back rejection ratio and flat frequency response from 30-16,000 Hz; impedance 600 ohms but can be used with inputs up to 20,000 ohms; FET circuitry; powered by one "AA" penlite cell; foam windscreen, 20-ft shielded cable, standard 1/4" phone plug, metal tripod-type desk stand, floor-stand adapter, and battery are included \$34.95

Cardioid Dynamic Microphone

Dual-impedance, general-purpose microphone: unidirectional pickup; response 100-10,000 Hz; output level -57 dB; dual impedance switch selected; on/off switch; chrome finish; pop-proof wire mesh grille; 20-ft detachable cable; stand swivel adapter. 8" long × 1" dia. \$24.50

Deluxe Ball Dynamic Microphone

General-purpose, omnidirectional, dual-impedance (50,000 & 250 ohms), selectable at cable end; output at high impedance -59 dB; frequency response 100-10,000 Hz; has "on-off" switch; includes ball screen, 20-ft cable, phone plug, black metal desk stand, and floor-stand adapter; die-cast case finished in satin aluminum; case is $6\frac{1}{4}$ " long $\times 2\frac{1}{8}$ " max., dia. of ball \$24.95

ML-1 Lavalier Condenser Mike

Response 50-15,000 Hz; -80 dB output; tieclasp holder; noise-reducing cable to FET preamp & power supply; 600-ohm output imp.; $1^{1/2}$ " \times $2^{1/3}$ " dia; comes with "AA" battery, shielded cable, phone plug \$19.50

MARLBORO

M400 Cardioid Microphone

Cardioid condenser microphone; electret element; built-in FET preamp and 11/2-V battery; frequency response 40-18,000 Hz ±3 dB; sensitivity 51 dB ±3 dB; high impedance; 20-ft detachable cable with heavy duty Cannon-type connector \$49.00

M300 Cardioid Microphone

Cardioid dynamic microphone; frequency re-

104

sponse 60-15,000 Hz ±3 dB; sensitivity 58 dB ±3 dB; high impedance; 20-ft detachable cable. with heavy duty Cannon-type connector . . .

M200 Cardioid Microphone

Cardioid dynamic microphone; frequency response 60-13,000 Hz ±3 dB; sensitivity 61 dB ± 3 dB (high impedance), 80 dB ± 3 dB (low impedance); 10-ft heavy duty detachable cable.

M50 Dynamic microphone

Dynamic microphone; frequency response 60-13,000 Hz ±3 dB; sensitivity 61 dB; ±3 dB; high impedance; 10-ft heavy duty cable . .

M30 Dynamic Microphone

Dynamic microphone; frequency response 70-12,000 Hz ±3 dB; sensitivity 56 dB; high impedance; 10-ft heavy duty cable \$14.00

MERITON

CNM-75 Condenser Microphone

Unidirectional electret unit; frequency range 50-15,000 Hz; has built-in bass roll-off switch to attenuate low-end response during close miking; sensitivity -73 dB ±3 dB; imp. 600 ohms: FET circuitry: comes with stand adapter. 16-ft, 5-in cable, 1/4" dia. plug; 7/8" dia. × 613/16" H \$99.95

CNM-70 Condenser Microphone

Omnidirectional electret unit; frequency range 40-20,000 Hz with tone separation; FET circuitry; sensitivity -73 dB \pm 3 dB (0 dB = 1 V/ µbar at 1 kHz); imp. 600 ohms; comes with stand adapter, 16-ft, 5-in cable, 1/4" dia. plug;

DNM-40 Dynamic Microphone

Unidirectional dynamic unit; features three windscreens; dual-impedance matching; flat response, film diaphragm; standard connectors for studio or home recorders; built-in on-off switch; comes with holder for stand use, 16-ft, 5-in cord, 1/4" dia. plug; 111/16" dia. × 6%16" H\$39.95

DNM-25 Dynamic Microphone

Unidirectional dynamic unit; response 150-10,000 Hz; sensitivity -78 dB ±3 dB; imp. 250 ohms (unbalanced); built-in on-off switch; comes with table stand with mini plug. 1%" dia.

DNM-20 Dynamic Microphone

Omnidirectional dynamic unit; features polyester film diaphragm; built-in on-off switch; response 70-12,000 Hz; imp. 250 ohms (unbalanced) comes with table stand; 11/32" dia × 5³/₄" H \$19.95

DNM-10 Dynamic Microphone

Omnidirectional replacement unit for use with cassette recorders; response 100-10,000 Hz; imp. 250 ohms (unbalanced); comes with table stand, windscreen, mini plug; 1" dia. × 415/16" H

MURA

DX-129 Cardioid Microphone

Ball-type cardioid dynamic mike: dual imp. 600/ 50 k; on-off switch; sensitivity: -58 dB at 1000 Hz; frequency response 40-14,000 Hz; built-in pop and blast filters; comes with stand adapter, 20-ft cable; black satin and chrome finish\$41.95

DX-285 Electret Condenser Mike

Omnidirectional pattern; for general recording and vocal work; frequency response 50-13,500 Hz ±3 dB; imp. 600 ohms; sensitivity: -71 dB at 1000 Hz (0 dB 1 V/1 µbar); removable windscreen; comes with 1.5-V battery, 20-ft cable with $\frac{1}{4''}$ phone plug, desk stand \$39.95

DX-247 Dynamic Microphone

Omnidirectional pattern: for vocals and recording; dual imp. 600/50k (sw. on mike); sensitivity: -57 dB at 1000 Hz; frequency response 50-14,000 Hz; removable windscreen; on/off switch; comes with 20-ft cable with $\frac{1}{4}$ phono plug; black satin/chrome finish \$39.95

DX-242 Dynamic Microphones

Matched set of two ball-type omnidirectional mikes for stereo recording; frequency response 60-12,000 Hz; sensitivity: -70 dB at 1000 Hz; imp. 500 ohms; comes with adapters to convert from miniature to standard phone plug, 5-ft cable \$24.95 DX-211. Similar to DX-242; single omnidirectional mikes with miniature plug, adapter to convert to standard plug \$7.95

DX-118 Dynamic Microphone

Replacement unit for most cassette recorders; dual plugs (audio and remote) plus remote switch; frequency response 60-12,000 Hz; imp. 500 ohms; sensitivity: -70 dB at 1000 Hz . .

.....\$7.95

NAKAMICHI

CM-1000 Condenser Microphone

Features interchangeable capsules; resistant to extremes of temperature and humidity; comes with battery power supply, CP-101 unidirectional capsule, windscreen, connecting cables with XLR connectors, case, 10-dB and 20-dB attenuators, proximity effect compensator; response 20-20,000 Hz ±2.5 dB; impedance 600 ohms balanced; sensitivity -67 dB ±1.5 dB; max. SPL at 3% dist. 139 dB; dynamic range 115 dB; S/N 50 dB (weighted). . \$290.00 Optional CP-102 super-omni capsule. \$100.00

DM-1000 Dynamic Microphone

Dynamic moving-coil mike designed especially for vocals; special low-mass diaphragm and voice coil for extended high-end response; triple metal screen filter eliminates pops, blasts, and wind noise; cardioid directivity pattern; double-casing and foam suspension reduces sensitivity to vibration; immune to hum and mag. fields; frequency response 30-20,000 Hz ±3.5 dB; sensitivity: -76 dB at 1 kHz (0 dB = 1 V/ μ bar); imp. 250 ohms; Cannon-type XLR-3 connector; anodized matte black finish; 10.4 oz . \$200.00

CM-300 Electret Condenser Microphone

Studio-type system featuring interchangeable capsules; basic set comes with CP-1 cardioid and CP-2 omnidirectional capsules; windscreen; 15-ft cable; XLR connector; battery; stand adapter; optional capsules: CP-3 smalldiameter super-omnidirectional; CP-4 superdirectional (shotgun); built-in 10 dB attenu-ating pad; "lo-cut" proximity effect com-pensator; response 30-18,000 Hz (CP-1), 20-15,000 Hz (CP-2), 20-18,000 Hz (CP-3), 30-20,000 Hz (CP-4), all at ±3.5 dB; imp. 200 ohms balanced; sensitivity; $-76 \text{ dB} \pm 2.5 \text{ dB}$ (CP-1, CP-2, CP-4), $-74 \text{ dB} \pm 2.5 \text{ dB}$ (CP-3); max. SPL at 3% dist.: 138 dB (CP-1, CP-2), 136 dB (CP-3), 118 dB (CP-4); dynamic range: 114 dB (CP-1, CP-2), 107 dB (CP-3), 94 dB (CP-4) \$110.00 Optional CP-3 capsule \$30.00 Optional CP-4 capsule \$50.00 CM-300 × 3 Tri-Microphone. Three CM-300 microphone sets combined in one package; designed for use in the company's tri-microphone recording system; comes with special carrying case with space for headphones, cables, accessories \$300.00

NEUMANN

fet-80 Condenser Microphones

A line of studio microphones that comes in many configurations from omni, figure-8, cardioid, multiple pattern to multiple pattern



FREE INFORMATION SERVICE

Here's an easy and convenient way for you to get additional information about products advertised in this issue. Just follow the directions below...and the literature will be sent to you free of charge from the manufacturer.

- **a** Tear out one of the perforated postage-free cards. Please print or type your name and adress where indicated. Use only one card per person.
- b Circle the numbers on the card that correspond to the key numbers at the bottom of the advertisement that interests you. (Key numbers for advertised products also appear in the Advertiser's Index.)
- C Simply mail the card. No postage is required.
- C This address is for our "Free Information Service" only. All other inquiries are to be directed to, Tape Recording & Buying Guide, One Park Ave., New York, N.Y. 10016.



									(Vo	oid af	fter N	/lar. :	23, 1	97
1	2	3	4	5	6	7	8	9	10	11	12	13	14	1
16	17	18	19	20	21	22	23	24	25	26	27	28	29	-
46	32 47	33 48		50	51	52	53	54	40 55	41 56	4Z	43 58	- 44 - 59	6
61	62	63	64	65	66	67	68	69	70	71	72	73	74	-
76	77	78	79	80	81	82	83	84	85	86	87	88	89	9
91	92	93	94	95	96	97	98	99	100				Mar. 23, 1 13 14 28 29 43 44 58 59 73 74 88 89 TR Insure deli Iar. 23, 11 13 14 28 29 43 44 58 59 73 74 88 89 TR Iar. 23, 11 13 14 28 29 43 44 58 59 73 74 88 89 TR 13 13 14 28 29 43 44 58 59 73 74 88 89 TR 13 14 28 29 43 44 58 58 59 73 74 88 89 TR 3	78
Use	e only	y one	car	d per	pers	ion.								
I 2 3 4 5 6 7 8 9 10 11 12 13 14 1 16 17 18 19 20 21 22 23 24 25 26 27 28 29 3 31 32 33 34 35 36 37 38 39 40 41 42 43 44 46 47 48 49 50 51 52 53 54 55 56 57 58 59 69 77 78 79 80 81 82 83 84 85 86 87 89 91 91 91 91 92 93 94 95 96 97 98 9100 11 12 13 14 17 18 19 20 21 22 32 42 25 26 27 28 29 3 31 32 33 43 35 36 37 38 39														
ADI	DRES	SS												
СІТ	Y						ΓΑΤΕ				ZIF	>		
						(z)p	c ode	mus	t be ir	elud	ed to	iosu	e del	ive
									(Vc	oid af	ter N	/lar. 1	23, 1	97
1	2	3	4	5	6	7	8	9	10	11	12	13	14	1
16	17	18	19	20	21	22	23	24	25	26	27	28	29	11
31	32	33	34	35	36	37	38	39	40	41	42	43	44	4
46 61	47 62	48 63	49 64	50 65	51	52 67	53	54 69	55 70	56 71	5/ 72	58 73	59 74	
76	77	78	79	80	81	82	83	84	85	86	87	88	89	ç
91	92	93	94	95	96	97	98	99	100				TR	78
Use	only	/ one	e caro	d per	pers	on.								
PRI	NTN		E					-						
AD	DRES	SS												_
CIT	Y						ATE				_ZIF	>		
						ZID	COde	must	be ir	nclud	ed to	insur	e deli	ve
1	2	2	4	F	6	7	0	0	10	nd al	ter I	/lar. :	23, 1	9,
16	17	5 18	19	5 20	21	22	23	9 24	25	26	27	28	14 29	
31	32	33	34	35	36	37	38	39	40	41	42	43	44	-
46	47	48	49	50	51	52	53	54	55	56	57	58	59	6
61	62	63	64	65	66	67	68	69	70	71	72	73	74	
76 91	92	78 93	79 94	80 95	81 96	82 97	83 98	84 99	85 100	86	87	88	89	-
		/ 004	e carr	1 nor	nere	on	50	55	200				IR	1
030	. UT N		r cart	a hei	PEIS	ort.								
r KI	1911 2055		E											
AUI	JRES	55											-	
CIT	Y					51					710	2		

Iz nicode thust be included to insure delivery)

World Radio History

FIRST CLASS PERMIT NO. 217 CLINTON, IA.

BUSINESS REPLY MAIL NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

POSTAGE WILL BE PAID BY -

1978 TAPE RECORDING & BUYING GUIDE-

P.O. BOX 2910 CLINTON, IA. 52732

> FIRST CLASS PERMIT NO. 217 CLINTON, IA.

BUSINESS REPLY MAIL

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

POSTAGE WILL BE PAID BY -

1978 TAPE RECORDING & BUYING GUIDE-

P.O. BOX 2910 CLINTON, IA. 52732

> FIRST CLASS PERMIT NO. 217 CLINTON, IA,

World Radio History

BUSINESS REPLY MAIL NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

POSTAGE WILL BE PAID BY -

1978 TAPE RECORDING & BUYING GUIDE-

P.O. BOX 2910 **CLINTON, IA, 52732**



The most complete... most sophisticated... most versatile Test Disc available today... For Just \$695!

Who needs the New Model SR12? You do. Whether you're an avid audiophile, a casual listener, or a professional technician . . . the new MODEL SR12 will be the most im-portant disc in your entire collection. MODEL SR12 has been produced by Stereo Review Magazine for music lovers who want imme-diate answers to questions about the per-formance of their stereo systems and how to not the bast neasible sound reproduction formance or mer stereo systems and now to get the best possible sound reproduction It is the most complete test record of its kind-containing the widest range of checks ever included on one test disc.

Make these important stereo checks BY Make these important stereo checks BY EAR ... (no test instruments required) • Frequency response • Separation • Cart-ridge tracking • Channel balance • Hum and rumble • Flutter • Cartridge and Speaker Phasing • Anti-Skating Adjustment • "Gun Shot Test" for Stereo Spread • Multi-purpose Musician's "A" • Equal-tempered Chromatic Octave • Guitar-tuning Tones

Attention professionals: For the ultimate in stereo testing, 7 critical TEST EQUIPMENT checks . . .

1,000-Hz square waves to test transient and high-frequency response phono pickups

- 500 to 20,000 Hz frequency-response sweep
- Sine-wave tone-bursts to test transient response of pickup Intermodulation test using simultaneous 400-Hz and 4.000 Hz signals
- Intermodulation sweep to show distortion caused by excessive res-onances in tone arm and cartridge
- 1,000-Hz reference tones to determine groove velocity

3,000-Hz reserve to be a for deminine group endotry 3,000-Hz rene for fuller and speed resis Sample waveforms-illustrating both accurate and faulty responses are provided in the instruction Manual for comparison with the patterns spearing on your own oscilloscope screen

FREE Instruction Manual Includes Detailed Instructions, Charts, Tables and Diagrams

HERE'S HOW TO ORDER

CASH: Mail your order along with your name, ad-dress and remittance in the amount of \$6.95. Residents of CA, CO, FL, IL, MI, MO, NY STATE, DC and TX add applicable sales tax.

CHARGE: To your American Express, BankAmeri-card, Master Charge or Diners Club account! Mail your order, name, address, credit card # and expiration date (Master Charge customers include 4-digit Interbank # above your name). Be sure your signature is on your order. You will be billed at \$6.95.

OUTSIDE U.S.A. RECORD IS \$8.95.

ORDER FROM: STEREO TEST RECORD, CONSUMER SERVICE DIVISION, 595 BROADWAY, NEW YORK, N. Y. 10012.
stereo; all can be either battery or phantom (separate power supplies) powered.

 KM-83. Omnidirectional
 \$260.00

 KM-84. Cardioid
 \$260.00

 KM-85. Cardioid, with low-frequency roll-off
 \$260.00

 KM-86. Three-pattern, switchable
 \$735.00

 N-80. 117-V
 a.c. portable power supply for powering one or two fet-80 microphones.

PIONEER

CM-1 Electret Microphone

CM-2S Electret Microphone

Dual-element electret condenser unit; hypercardioid pattern; response 20-20,000 Hz; output impedance 1000 ohms; sensitivity -68 dB at 1 kHz (0 dB = 1 V/ μ bar); maximum SPL 126 dB; S/N 46 dB; 1.5-V "AA" cell power supply; 6.06" H × 4.33" W; weight 11.2 oz; 21-ft cable pair comes mounted on desk stand ... \$60.00

REALISTIC

Highball Dynamic Microphone

"All-Pro" Cardioid Microphone

Cardioid microphone; frequency response 30-15,000 Hz; 600-ohm impedance; supplied with 10-ft cord, V4-in plug, desk stand adapter, mike stand adapter, and "AA" battery \$29.95

Dual Pattern Stereo Microphone

Super Cardioid Dynamic Microphone

Cardioid dynamic microphone; frequency response 80-12,000 Hz; switchable impedance, 600 and 50,000 ohms; on/off switch; output levels -77 dB (low), -60 dB (high); supplied with cable, slip-on stand adapter, and plug....

Omnidirectional "On-Stage" Mike

Featherweight Condenser Microphone

Electret condenser-type featherweight omnidirectional microphone; frequency response 20-13,000 Hz; ultra-slim design, 9₁₆-in dia.; supplied with windscreen, 9-ft cable, 9₄-in plug, battery, and stand; 2.8 oz \$15.95

RECOTON

MM740 Dynamic Microphone

MM730 Dynamic Microphone

Features boom and feedback suppression;

1978 EDITION

600 ohms; sensitivity 69 dB; frequency response 50-15,000 Hz; brushed gold finish; comes with 18-ft cord with plug and desk stand\$49.95

MM720 "Echo" Microphone

MM220 Dual-Impedance Microphone

Dynamic type; 500 ohm/50,000 ohm imp.; popproof wire mesh grille; frequency response 100-10,000 Hz; sensitivity 58 dB at 50,000, 74 dB at 600 ohms; comes with 20-ft cable, $\frac{1}{16} \times$ 27 adapter\$25.95

SENNHEISER

MD441 Dynamic Microphone

Super cardioid dynamic microphone; frequency response 40-20,000 Hz; sensitivity 0.2 mV/ μ bar ±3 dB; brilliance switch for nominal 5-dB boost at 5 kHz; five-position bass attenuator; front-to-back ratio 20 dB, -3 dB; supplied with cable and quick-release mount for floor stand or MZT-441 table stand; takes MZW441 windscreen; 1.3" H × 1.4" W × 9.6" L \$275.00

MD-211U Dynamic Microphone

Omnidirectional dynamic microphone; frequency response 40-20,000 Hz; sensitivity -58 dBm (0.13 mV/µbar) ± 2.5 dB; supplied with Cannon XLR connector and cable; 1" dia. × 4¾" L \$214.50

When fidelity is the issue, MURA is the microphone.

Mura offers a full range of quality microphones, four of which we are featuring below. From our DX-109 to the DX-30V and a dozen other models in between, Mura is sure to have just the microphone your application requires. Every one is designed and manufactured to provide years of carefree, top level performance at prices that are amazingly affordable.

If your microphone has to meet the high standards you demand of your other equipment you owe it to yourself to look at Mura.

MURA DX-30V

Our professional quality wideband electret condenser mike features output impedances of 600 and 50,000 ohms, 20-18,000 Hz frequency response sensitivity: -48 dB high, -62 dB low. Shielded 20-ft cable with standard ¼" phone plug, 1.5 v battery, microphone holder included.

MURA DX-118

Dynamic microphone

replacement for most cassette recorders; dual plugs (audio & remote)

plus remote switch; frequency response 60-12,000 Hz; imp. 500 ohms; sensitivity:

-70 dB at 1000 Hz.

MURA DX-129

Ball-type cardioid dynamic mic; dual imp. 600/50K; on/off switch; sensitivity: --58 dB at 1000 Hz; frequency response 40-14,000 Hz; built-in pop and blast filters; comes with stand adapter, 20-ft cable; black satin & chrome finish.

MURA DX-211

An economy replacement mike for tape recorders requiring a high quality microphone with a single miniature plug. Supplied with an adapter to convert from miniature to standard ¼" phone plug. Impedance: 500 ohms. Sensitivity: --70 dB @ 1 KHz. Response: 60-12,000 Hz. With 5-ft cable.

> For the finest in audio and communication products, visit your local Mura dealer today.



Westbury, New York 11590







MICROPHONES

MD421U Dynamic Microphone

Cardioid dynamic microphone; 200-ohm imp.; frequency response 30-17,000 Hz \pm 5 dB; sensitivity 0.2 mV/µbar \pm 3 dB at 1 kHz; ElA rating -145.8 dB; output level -53 dBm (1 mW/10 dynes/cm²); front-to-back ratio 18 dB, -2 dB; variable bass attenuator; supplied with XLR connector and cable; 7" × 1½"s" × 1¹³/1s"..... \$193.00

MD416 Dynamic Microphone

MD21N Dynamic Microphone

Omnidirectional dynamic microphone; 200ohm imp.; frequency response 50-15,000 Hz ± 3 dB; sensitivity 0.2 mV/µbar at 1 kHz; EIA rating -145.8 dB; output level -53 dBm (1 mW/ 10 dynes/cm²); balanced output; supplied with small DIN connector; $43/_4$ " $\times 17/_8$ " $\times 17/_8$ "; 10 oz \$126.00

Electret Condenser Mic System

One common powering module in balanced version (K2U) or unbalanced version (K1) serves three different compact heads: ME20 omnidirectional head, response 50-15,000 Hz, sensitivity 49 dBm, S/N 64 dBm min.; ME40 super-cardioid head, response 50-15,000 Hz, sensitivity 49 dBm, S/N 64 dBm min.; ME80 shotgun head, response 50-15,000 Hz, sensitivity 45 dB, S/N 70 dB min.

K2U. Powering module	\$79.00
K1. Powering module	\$71.50
ME20. Omnidirectional head	\$55.00
ME40. Super-cardioid head	\$78.00
ME80. Shotgun head \$	\$108.00

SHURE

300 Ribbon Microphone

546 "Unidyne III" Microphone

Dynamic type; sensitivity -154 dB (EIA); response 50-15,000 Hz; user selects high or low impedance; cardioid pattern; hinge mount to stand; use for speech, rock vocals, and music; comes with 20-ft. cable and connector; chrome finish\$122.40

548SD "Unidyne IV" Microphone

565 "Unisphere 1" Microphone

516EQ Dynamic Equalizer Microphone

Unidirectional type designed for tape record-

545 "Unidyne III" Microphone

Dynamic type; sensitivity -149 dB (EIA); response 50-15,000 Hz; user selects high or low impedance; cardioid pattern; with slip-in stand attachment and hinge mount to stand; designed specifically for speech, music, and tape recording; supplied with 15-ft. cable and Amphenol-type MC4M connector; chrome finish . \$75.00 Model 545S. Similar to Model 545 but has cable connection through hinge and "on-off" switch in upright \$80.40 Model 545SD. Same as Model 545 but has "on-off" switch on microphone barrel . . \$80.40 Model 545L. Similar to Model 545 but has lavalier cord and clip \$63.00

55S "Unidyne II" Microphone

578 "Omnidyne" Microphone

Sensitivity –154 dB (EIA); response 50-15,000 Hz; user selects high or low impedance; omnidirectional pattern; hand-held; use for speech and music; has 'on-off' switch, a 15-foot cable, and connector; supplied with chrome finish......\$72.00 **Model 578S.** Similar to Model 578 except has swivel assembly\$80.40

579SB "Vocal Sphere" Microphone

585SA "Unisphere A" Microphone

589S "Unidyne C" Microphone

Unidirectional dynamic type; response 90-13,000 Hz; 150 ohm imp. to match any input from 20-200 ohms, also high impedance; built-in "on-off" switch with lockplate; internal rubber vibration-isolator shockmount; 15-ft two-conductor shielded with 3-pin female connector on mike end; zinc die-casting housing with silver-metallic finish, stainless steel grille; $7" \times 19'_{16}"$; weight 12 ounces less cable \$61.20

588SA "Unisphere B" Microphone

515SA "Unidyne B" Microphone

Dynamic type; sensitivity -154 dB (EIA); re-

SONY from SUPERSCOPE

ECM-54P Condenser Microphone

Cardioid condenser microphone, three-position on/off switch plus bass roll-off switch; supplied with mike stand adapter, windscreen, vinyl case, and 20-ft cadmium-bronze two-conductor shielded cable; for use with internal batteries or phantom power supply..... \$169.95

ECM-50 Tie Tack/Lapel Microphone

Tie-tack/lapel omnidirectional Condenser microphone \$159.95

ECM-280 Condenser Microphone

ECM-990 Condenser Microphone

F-115A Dynamic Microphone

Heavy-duty omnidirectional dynamic microphone; double windscreen; supplied with 20-ft cable, mike holder, vinyl carrying case . \$99.95

ECM-270 Condenser Microphone

ECM-170A Condenser Microphone

ECM-99 Condenser Microphone

ECM-250A Condenser Microphone

ECM-220A Condenser Microphone

Dual-impedance unidirectional microphone; 200/10,000 ohm imp.; for live music recording; sensitivity -57/-41 dB; frequency response 50-12,000 Hz; on/off switch; impedance switch; built-in windscreen; supplied with battery, microphone holder, and cable \$39.95

ECM-16 Tie Clasp/Lapel Microphone

SUPERSCOPE

EC-9P

EC-15P

Professional electret condenser miniature tieclasp microphone; standard Cannon XLR3-12C output; internal battery operation or optional phantom powering; IC FET electronics \$79.95

EC-7

Cardioid condenser microphone; FET electronics; internal battery operation; low-cut filter; on/off switch\$49.95

EC-5

Cardioid condenser microphone; FET electronics; internal battery operation; desk stand \$39.95

EC-12B

Electret condenser tie-clasp microphone with attachable telescopic rod for hand-held or podium use; FET electronics; internal battery operation\$39.95

TEAC

ME-120 Microphone

ME-50. Same except cardioid; unbalanced or balanced 10,000 or 200-ohms; response 50-14,000 Hz\$50.00

109-A Mike Input Transformer

Matches low-impedance makes to high-impedance inputs; will terminate low-impedance balanced signal to allow interfacing with most consumer tape recorders and mixes . . . \$19.50

TECHNICS BY PANASONIC

RP-3850 Electret Condenser Mike

TURNER

TC20H Dynamic Microphone

Dynamic multi-port cardioid microphone; 40,000-ohm imp.; output level: open circuit voltage 53 dB (0 dB = 1 V/ μ bar), power level 55 dB (0 dB = 1 mW/10 μ bar), EIA sensitivity 149 dB; frequency response 50-15,000 Hz; discrimination 22 dB over frequency range at 180 degrees, -6 dB at 90 degrees; supplied with detachable 20-ft, two-conductor, shielded cable, Switchcraft three-pin A3F mic connector, V₄-in shielded phone plug terminal connector, and case; 1V₂" head dia., V₄" handle dia., 6" length; 7 oz (without cable)... \$140.00 **TC20L.** Same but 150-ohm imp.; standard three-pin A3M male terminal connector.....

1978 EDITION

..... \$140.00

TC12H. Same as TC20H but with on/off switch; gold satin baked enamel finish \$135.00 TC12L. Same as TC20L but with gold satin baked enamel finish \$130.00

966HVC Dynamic Microphone

556H Dynamic Microphone

666H Dynamic Microphone

266H Dynamic Microphone

Dynamic cardioid microphone; on/off switch; 40,000-ohm imp.; output level 58 dB; frequency response 50-15,000 Hz; discrimination 20 dB over frequency range; supplied with de tachable 20-ft, one-conductor, shielded cable, three-pin A3F mic connector, standard ¼-in phone plug terminal connector, and case; 1¼" head dia, 6" length; 8 oz (without cable).....

\$95.0C **266L.** Same but 150-ohm imp.; output level 57 dB; detachable 20-ft two-conductor, shielded cable, three-pin A3M terminal connector \$95.0C

766HVC Dynamic Microphone

Dynamic cardioid microphone; volume control. 40,000-ohm imp., output level 55 dB; frequen cy response 50-15,000 Hz; discrimination 20 25 dB over frequency range; supplied with de tachable 20-ft, one-conductor, shielded cable. MC1F screw-on type mic connector, standard V₄-in phone plug terminal connector, and case. 2" head dia., 6" length; 12 oz (without cable)..... \$100.00 766H. Same but with on/off switch in place of volume control.......\$85.00

366H Dynamic Microphone

Dynamic cardioid microphone; on/off switch: 40,000-ohm imp.; output level 58 dB; frequency response 50-15,000 Hz; supplied with removable 20-ft, one-conductor, shielded cable, MC1F screw-on type mic connector, standard V₄-in phone plug terminal connector, and case; 1V₄" head dia., 5" length; 7 oz (without cable).....\$75.00

THEY'RE EVERY MICROPHONE YOU EVER WANTED.

We've taken the latest advances in electret technology one step further. By combining them with advanced acoustic technology to make professional condenser microphones more portable, more practical and less costly. A lot less.

The secret is our "family" concept. One common powering module (K2U) serves three different compact heads: omnidirectional (ME20), cardiod (ME40) and mini-shotgun (ME80). Thus, for most studio and location situations. it's no longer necessary to carry three different microphones. Or pay for three different complete units Each head contains its own microphone capsule and "front-end" electronics, all exactly matched to its own preciselycontrolled acoustical environment. Resulting in the first electrets with response and directionality to rival our famous RF condenser models in all but the most critical applications.

The Powering Module, runs on a single 5.6V battery, or phantompowered directly from your recorder, preamp or other auxiliary equipment. A miniature LED monitors power and indicates proper voltage. Connection to preamps, mixers, etc. is balanced* low-impedance via a 3-pole Cannon XLR connector. Best of all, of course, is the great versatility. In a matter of seconds, you screw on whichever head you need and go!

If all this sounds good to you, call or write us. We have a lot more good things for you to hear.

Powering module and heads available separately. Prices subject to change without notice.

*Unbalanced version also available



-

These cassette deck manufacturers are highly biased for SA: AIWA · AKAI · DOKORDER · JVC KENWOOD · MERITON · NAKAMICHI **OPTONICA · PIONEER · SANSUI** SHARP · TANDBERG · TEAC TOSHIBA · UHER · YAMAHA

And are joined by these in recommending SA for use in their decks: **BANG & OLUFSEN · DUAL · FISHER** HARMAN/KARDON · LAFAYETTE **ROYAL SOUND · SANKYO** AND MANY OTHERS.



There's been a quiet revolution going on in the cassette world.

Leading makers of quality cassette decks have adopted TDK SA as their reference standard tape for high (CrO₂) bias and equalization settings. Why TDK SA? Because TDK SA's advanced tape formulation and super precision cassette mechanism let them (and you) take full advantage of today's advanced cassette deck technology.
In addition, a growing number of other companies are recommending SA for use with their machines.
So for the ultimate in cassette sound and performance, load your deck with SA and switch to the "High" or "CrO2" bias/EQ settings. You'll consistently get less noise, highest saturation and output levels, lowest distortion and the widest dynamic range to let you get the best performance from any quality

machine.
But you needn't believe all this just because we say so. All you have to do is check our references.



TDK Electronics Corp., 755 Eastgate Blvd., Garden City, N.Y. 11530. In Canada: Superior Electronics Industries, Ltd. CIRCLE NO. 1000 RELATERVICE CARD

The machine for your machine.



BLANK TAPE & ACCESSORIES

ADVENT

Chromium-Dioxide Cassettes

Comes in screw-type housing with special leader tape that cleans heads.

000			
- C90	• •	• •	, \$3.50
C120	• •		. \$4.55

AMPEX

364 Series 20/20+ Cassettes

364-C45.45	min	 	 				\$3.09
364-C60. 60	min		 				\$3.49
364-C90. 90	min	 	 				\$5.09
364-C120. 1	20 min		 	• •			\$6.79

363 Series Chromium-Dioxide Cassettes

363-C60.	60	min		•	•					•	•		\$3.49
363-C90.	90	min											\$5.19

370 Series Cassettes

.0\	v-noise/h	nigh	outp	วน	t	t	y	р	e							
3	70-C45.	45	min						•							\$1.79
3	70-C60.	60	min													\$1.99
3	70-C90.	90	min													\$2.89
3	70-C120). 1	20 m	in								,	,			\$4.19

350 Series "Super" Cassettes

350-C45.	45	min											\$1.19
350-C60.	60	min											\$1.49
350-C90.	90	min											\$1.99
350-C120). 1	20 m	ú	n									\$3.19

371 Plus Series Cassettes

Ε

xtended low-noise/high-output	typ	e.	
371-C45. 45 min			\$2.49
371-C60. 60 min			\$2.89
371-C90. 90 min			\$4.19
371-C120. 120 min			\$5.79

381 Series 8-Track Cartridges

381-45E.	45	min									\$1.99
381-90E.	90	min									\$2.29

382 Plus Series Cartridges

Extended low-noise/high-output type.	
382-45. 45 min	\$2.89
382-90. 90 min	\$3.39
299 Carica 20/20+ Cartridaas	

	20/20	-	-	• •	 	- 5	9`				
388-45E.	45 min										\$3.39
388-90E.	90 min										\$3.99

20/20+ Series Open-Reel Tapes

Back-coated professional mastering tape.	
372-15. 1200 ft, 7" reel, 1.5 mil \$7.79	
373-15. 1800 ft, 7" reel, 1.0 mil \$9.69	
373-17. 3600 ft, 101/2" NAB reel, 1.0 mil	
\$26.39	

Plus Series Open-Reel Tapes

Extended low-n	oise/high-output type.	
332-151111.	1200 ft, 7" reel, 1.5 mil	\$5.89
342-151111.	1800 ft, 7" reel, 1.0 mil	\$7.79

PRT Series Open-Reel Tapes

High-frequ	Jency	polyest	er.		
331-13.	600 f	t, 5" ree	еl, 1.5 п	nil	. \$3.09
341-13.	900 f	t, 5″ ree	el, 1.0 n	nil	. \$3.49

1978 EDITION

331-15.	1200 ft,	7″	reel,	1.5	mil	\$4.69
341-15.	1800 ft,	7"	reel,	1.0	mił	\$5.89
351-15.	2400 ft,	7"	reel,	0.5	mil	\$10.29
361-15.	3600 ft,	7″	reel,	0.5	mil	\$10.49

Demagnetizer/Head Cleaner

E3220BL.	For cassette	players/recorders
		\$6.29
E3228BL.	For 8-track	players/recorders

BASF

Professional Series Reel-to-Reel

7" × 1800 ft										\$14.99
101/2" × 3600	ft			• •		•		•		\$29.99

Studio Series Reel-to-Reel

7" × 1800 ft														. \$9.99
7" × 2400 ft														\$14.99
10½" × 3600	H	ft				•	•	•	•		•			\$19.99

Performance Series Reel-to-Reel

7" × 1800 f	t i									•				\$7.·	49
7" × 2400 f	t i												. :	\$9.	99
7" × 3600 f	t	•	•	•			•			•	•		\$	15.	99

Chromium-Dioxide Cassettes

60 min																					\$2.99
90 min																					\$4.49
120 min	•	•		•	•		•		•	•	•	•	•	•	•	•	•	•	•	•	\$5.99

Studio Series Cassettes

60 mi	n.			•			4											•	\$2.99
90 mi	n.				,														\$4.49
120 m	n.	 ,	•		•		•			•		•		•	•	•	•	•	\$5.99

Performance Series Cassettes

45 min								•						\$2.29
60 min														\$2.49
90 min														\$3.59
120 min	•							•		•		,		\$4.99

Studio Series Cartridges

45	min			•			•	•								\$3.29
64	min										6					\$3.59
90	min															\$3.99

Performance Series Cartridges

45 min							•						•				•	•			,			\$2.89
64 min													,			,	•	•	•	•	•	•	•	\$3.19
90 min	•	•	•		•	•		•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	\$3.99

Accessories

8-Track Headcleaner .								\$1.99
Cassette Headcleaner				•				\$1.79
7" Plastic Storage Box								\$2.69
7" Plastic Reel			•					\$1.59

CAPITOL

Capitol 1 Cassettes

apitor i Gassettes	
C-45. 22.5 min/side	\$0.89
C-60. 30 min/side	\$0.99
C-90. 45 min/side	\$1.49
C-120. 60 min/side	\$1.99
C-30. Three pack	\$1.99
C-60. Three pack	\$2.39
Cassette head cleaner	\$0.99
World Radio History	

Capitol 1 8-Track Cartridges

32 min/150 ft	\$1.69
40 min/190 ft	\$1.79
64 min/300 ft	\$1.99
80 min/380 ft	\$2.09
100 min/470 ft	\$2.49
4 pk of 40 min	\$4.99
4 pk of 60 min	\$5.49
4 pk of 80 min	\$5.99
4 pk of 90 min	\$6.39
Cartridge head cleaner	\$1.09

Capitol 1 Open-Reel Tape

-				
Sta	ndard	nlav	1 5.mil	nolvector
JIC	nuaru	LING V.	1.J. 1.	DUIVESLEL

600 ft., 5" reel	\$2.69
1200 ft., 7" reel	\$3.49
Extra play, 1.0-mil polyester.	
900 ft., 5" reel	\$2.89
1800 ft., 7" reel	\$3.99
0.5-mil polyester, tensilized.	
1800 ft., 5" reel	\$4.19
2400 ft., 7" reel	\$5.19

"the music tape" Cassettes

High-output/low	noise	with	"cushion-aire"
backing.			
C AE AE min			¢1 70

- C+40, 40 mm	\$1.1J
C-60. 60 min	\$2.19
C-90. 90 min	\$3.29
C-120. 120 min	\$4.39
C-45. Stak-pak (2 cassettes)	\$3.59
C-60. Stak-pak (2 cassettes)	\$4.39
C-90. Stak-pak (2 cassettes)	\$6.99
C-120. Stak-pak (2 cassettes)	\$8.79

Chromium-dioxide

C-60.	60	min				,		,			,	,		•		\$2.79
C-90.	90	min									•					\$4.09

"the music tape" Cartridges

High-output/low noise.	
8T-45. 45 min	\$2.29
8T-60. 60 min	\$2.49
8T-90. 90 min	\$2.69
8T-100. 100 min	\$2.79
8T-120. 120 min	\$3.39
4-min test cartridge	\$2.09

"the music tape" Open-Reel

High-output/low noise with "cushion-aire" backing.

FDS-1200.	1200 ft,	7" reel \$	5.79
FDS-1800.	1800 ft,	7" reel \$	6.99
FDS-2500.	2500 ft,	10 1/2" reel \$1	7.29
FDS-3600.	3600 ft,	10 1/2" reel \$1	9.98

COLUMBIA

Cassette Tapes

Each side color-coded for easy identification; high-output/low-noise gamma-ferric oxide; response 20-20,000 Hz; tensilized polyester base; Delrin rollers; constant-tension pressure pad for consistent tape-to-head contact; mounted in three-sided Mumetal shield to prevent pickup of hum and noise; two re-recording labels included.

2CB-80040.	40	min								\$1.99
2CB-80060.	60	min								\$2.29
2CB-80090.	90	min								\$3.49



2CB-80012.	120 min	 \$4.49
2CB-800HC.	Head cleaner	 \$1.49

8-Track Tapes with "ConvertaQuad"

000-00740.40 1010	ΨZ.29
8CB-80750. 50 min	\$2.59
8CB-80780. 80 min	\$2.99
8CB-80710. 100 min	\$3.49
8CB-807HC. Head cleaner	\$1.49

FUJI

FC Chromium-Dioxide Cassettes

C60-FC.	30	min/side		,			•	•		\$3.50
C90-FC.	45	min/side								\$4.70

FX Cassette Series

Low-distortion,	wide-dy	namic-r	ange	tape	for
music recordin	g and	reprodu	ction;	flat	fre-
quency response	e; exten	ded free	quency	/ rang	ge.
C46FX. 23 mi	n/side .			\$3	3.10
C60EX_30 mi	n/side			¢:	1 50

C60FX.	30	min/side						•		\$3.50
C90FX.	45	min/side								\$4.70

FL Low-Noise Cassettes

Track Cartridges												
C120FL. 60 min/side		•	•	•	•	•				•	•	\$5.00
C90FL. 45 min/side	,	,										\$3.60
C60FL. 30 min/side												\$2.50
C30FL. 15 min/side					•							\$2.00

8-Track Cartridges

8T-45																		,					,	\$3.20
8T-90	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		\$4.20

FB-151 Audiophile Open-Reel Tapes

Ultra-low-noise, high-output, back-coated master recording tape; for use on tape recorders equipped with bias selector.

1200-ft,	7" ree	1		 	. \$8.50
1800-ft,	7" ree	Ι		 	\$11.00
3600-ft,	101/2"	meta	l reel	 	\$30.00

FG High Fidelity Open-Reel Tapes

7/4-inch, 1.0	0-mil mastering tapes.	
1200-ft,	7" reel	. \$6.00
1800-ft,	7" reel	. \$8.00
3600-ft.	10 ¹ / ₂ " metal reel	\$22.50

FM Open-Reel Tapes

Low noise/	hig	ςh οι	Jt	p	u	t;	;	1	.()	n	ni	il;		1/	4	i	n	1	a	ıр	es.		
900-ft,	5″	reel																				\$5	.0	0
1200-ft,	7″	reel																				\$5	.7	0
1800-ft,	7"	reel							•					•	•	•						\$6	.5	0

FB-101 Professional Tape

Backcoated high-speed mastering tape; γ_4 -in, 1.5 mil.

2400 ft, 10 ¹ / ₂ -in reel \$	24.00
---	-------

HITACHI

"Ultra-Dy	namic''	Cassettes
-----------	---------	-----------

UDC-60. 60 min									\$3.45
UDC-90. 90 min									\$4.75
UDC-120. 120 min							,		\$5.95

Low-Noise Cassettes

C-30. 30 min										\$1.95
C-60. 60 min										\$2.45
C-90. 90 min										\$3.45
C-120. 120 min								,		\$4.95

IRISH

200 Series Professional Tape

Standard, 11/2-mil, polyester base, 1/4".

- 241-173. 3600 ft., 10¹/₂" NAB aluminum reel \$19.55
- Double-length, 1/2-mil polyester tensilized base. 251-151. 2400 ft., 7" reel \$10.60

0.5-mil, polyester tensilized base, 1/4". 261-151. 3600 ft., 7" reel \$10.95

270 Series Tape

ow-noise, high-output, back coated.
276-151. 1200 ft, 7" reel \$8.75
276-173. 2500 ft, 101/2" NAB aluminum reel
\$22.45
276-273. 2500 ft, 101/2" NAB aluminum reel
\$34.15
277-151. 1800 ft, 7" reel \$11.50
277-173. 3600 ft, 101/2" NAB aluminum reel
\$27.00

Professional-Series Cassettes

In album/mailer.

261-C45.	22 1/2	min/s	ide						\$1.15
261-C60.	30 n	hin/sid	е.						\$1.40
261-C90.	45 m	hin/sid	е.						\$2.10
261-C120	60	min/si	de						\$3.25

Low-Noise, Extended-Range Cassettes

lip-top plas	tic box.					
262-C45.	221/2 min/side		 			\$1.85
262-C60. 3	30 min/side	 	 			\$2.10
262-C90. 4	15 min/side	 	 			\$3.10

Chromium-Dioxide Cassettes

Flip-top plastic box.	
263-C60, 30 min/side	\$3.65
263-C90, 45 min/side	\$5.35
8-Track Cartridges	
8T42, 42 min	\$2.00
8T84, 84 min	\$2.30

Cassettes in Polybag

Three C-60			,										\$2.95
Three C-90.	•	,			•	•			1				\$3.49

LAFAYETTE

Criterion XHE Reel-to-Reel Tapes

On plastic reels. I	-or	recorders	with	swit	chable
bias and equalization	tior	٦.			
1200 ft, 7" reel,	1.5	5 mil			\$5.79

	180	0 ft,	7″	ree	el,	1.0	mil	•	•	•	• •	•	•	•	•	•	•	\$6.99
_																		

Criterion XHE Series Cassettes Low-noise, (XHE) extra high energy, high-out-

put. Wide dynamic range with high-frequency response of 30-20,000 Hz. Gamma ferric-oxide formulation. Hard, clear plastic storage box. C-60. 30 min/side

0-00. 30 mm/side		٠	٠	۰	٠	٠	٠	٠	٠	٠	٠	٠	٠	٠	٠	PC.33
C-90. 40 min/side																\$3.99
C-120. 60 min/side	е								•		•					\$4.99

Criterion XHE 8-Track Cartridges

Criterios		c	۰,				_		•.																	
90 min	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	ł	•	•	•	•	\$3.39
45 min	,			,			•			•							•	•	•						,	\$2.69

C-60. 30 min/side .									\$1.49
C-90. 40 min/side .									\$1.99
C-120. 60 min/side									\$2.49

Low-Noise Cassettes

C-60. 30 min/side .										\$0.99
C-90. 40 min/side .										\$1.49
C-120. 60 min/side		•	•	,			•			\$1.99

8-Track Low-Noise Cartridges

45	min							,						•												\$1.99
90	min	•	•	٠	٠	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	\$2.49

MAXELL

UD-XL I Epitaxial Cassettes

Normal	bias; 120-µs	equalization	
C-60.	30 min/side		\$4.60

C-90 45	min/side		\$6.50

UD-XL II Epitaxial Cassettes

Chrome type; high-level bias; 70-µs equaliza- tion. C-60. 30 min/side
Ultra-Dynamic Cassettes (High Bias) UDC-46. 23 min/side \$3.25 UDC-60. 30 n.in/side \$3.60 UDC-90. 45 min/side \$5.30 UDC-120. 60 min/side \$7.20
Ultra-Dynamic 8-Track (High Bias) UD8T-46. 46 minutes
Low-Noise Cassettes (Normal Bias) LNC-46. 23 min/side
Low-Noise Tape (Normal Bias) 1.5 mil polyester LNE-50-60. 1200 ft., 7" reel \$7.35 LNE-50-120. 2500 ft., 10 ¹ / ₂ " reel \$16.10 1-mil polyester
LNE-35-90. 1800 ft., 7" reel \$8.00 LNE-38-180. 3600 ft., 10 ¹ / ₂ " reel \$22.00 0.5-mil polyester LNE 25-120. 2400 ft., 7" reel \$12.35 0.5-mil polyester LNE-18-180. 3600 ft. 7" reel \$15.35
Back-Coated Extended-Range Back-coated, ultra-dynamic, high-energy, high- bias type. 1.5-mil polyester UD50-60B, 1200 ft, 7" reel
UD50-120B. 2500 ft, 10 ¹ / ₂ " reel \$28.50 1-mil polyester UD35-90B. 1800 ft, 7" reel \$11.35 UD35-180B. 3600 ft, 10 ¹ / ₂ " reel \$32.30
Extended-Range Tape (High Bias) Ultra-dynamic, high-energy type. 1.5-mil polyester UD50-60. 1200 ft., 7" reel \$8.05 UD50-1200. 2500 ft., 101/2" reel \$21.70 1-mil polyester

UD35-90. 1800 ft., 7" reel...... \$9.35 UD35-180. 3600 ft., 10¹/₂" reel...... \$25.00

8-Track Cartridges (Normal Bias)

LN8T-46. 46	minutes											\$3.10
LN8T-60. 60	minutes											\$3.35
LN8T-90. 90	minutes	•	•	•	•	•	•	•		•	•	\$3.75

MEMOREX

"Quantum" Open-Reel Tape

90. 1800 ft, 7" reel		 . \$8.59
120. 2400 ft, 7" reel		 \$11.39
180. 3600 ft, 10 ¹ / ₂ " reel		 \$21.49

Low-Noise, High-Output Tape

Standard play, 1.5-mil polyester, 1/4".	
1200 ft, 7" reel	\$5.49
Long-play, 1-mil polyester, 1/4".	
1800 ft, 7" reel	\$6.59
Double-play, tensilized polyester, 1/4".	
2400 ft, 7" reel	\$8.99

MRX₂ Cassettes

C-30. 15 min/side	\$2.19
C-45. 221/2 min/side	\$2.39
C-60. 30 min/side	\$2.59
C-90. 45 min/side	\$3.69
C-120. 60 min/side	\$5.09

Chromium-Dioxide Cassettes

C-45.	221/	/2 min/sid	de	e													\$2.99
C-60.	30 (min/side					,		•				•				\$3.19
C-90.	45 (min/side	,	•	•	•	,	,	•	•	•	•		•	•	•	\$4.69

8-Track Cartridges

					 -										
45	min														\$2.99
50	min		,												\$3.29
90	min														\$3.59

MERITON

Ferri-Chrome Cassette

recr c-ou. 51 mm/side	\$J.79
Chromium-Dioxide Cassette	
CrO, C-60. 31 min/side	\$3.19

Low-Noise, High-Output Cassettes

FOM-MOID			۰P		 -	-			-	-	
LH C-60.	31	min/side	÷	•					•		\$2.49
LH C-90	46	min/side									\$3.59

Low-Noise Cassettes

LN	C-60.	31	min/side								\$1.49
LN	C-90.	46	min/side								\$2.29
-EN	C-120). 6	1 min/side	e							\$3.49

NAKAMICHI

EX Cassette Tapes

Specially formulated ferrocrystal tape for improved frequency response, S/N ratio, and dynamic range; special binder for even particle distribution and reduced head wear. C-60\$3.70

0.00								٠	٠	٠	٠	٠	٠		٠	•	٠	۰						٠	ΨU./ U
C-90	•	•	•	•	•		•	•	•	•	•	•	•	•		•	•		•	•	•	•	•	•	\$4.80

EX II Cassette Tapes

Single-coated ferricobalt formulation; has same bias and EQ (120 μ s) as EX; extra-low noise, high output.

0.00	•		•	•	•	•	•	•	•		•	•	•		٠		•	•	•	•			Ψ T1 T Φ
C-90		•	•			•				•				•	•	•		•			,		\$5.80

SX Cassette Tapes

Single-coated formulation of ionized cobalt and ferric oxide; high coercivity permits use of chromium-dioxide bias and EQ (70 μ s) for 4-5 dB better S/N.

C-60																				\$4.60
C-90		•	,	•	,	•	•	•	•	•		•		•	•	•	•	•	•	\$6.00

RECOTON

Cassettes

Low-noise, ferric-oxide tape.

CD-40.	40	min											\$1.49
CD-60.	60	min											\$1.79
CD-90.	90	min											\$2.29
CD-120). 12	20 mii	n										\$2.79

8-Track Cartridges

8T-35. 35 min										\$2.25
8T-40. 40 min				•	•					\$2.45
8T-70. 70 min		,								\$2.95
8T-80.80 min										\$3.25
8T-100, 100 min										\$3.75

Head Cleaners

ROYAL SOUND

Chromium	Dioxide		C	a	\$ 5	e	tl	e	15	\$			
CDC-60. 6	0 min	,									,		\$2.99
CDC-90. 9	0 min								,	•			\$4.49

Ultra-Linear Cassettes

High-density ferric-oxide tape. ULC-60. 60 min	\$3.50 \$5.00
Low-Noise Cassettes	
APC-30. 30 min	\$1.49
APC-45. 45 min	\$1.75

SPC-60. 60 min APC-90. 90 min	•	•	•	• •	•	•	•	•		\$1.98 \$2.98
APC-120. 120 min APC-CH Auto head cleaner	•	•	•	• •	•	•	•	•		\$3.98 \$2.00

8-Track Cartridges

e 2 70

45	min																				,	\$2.50
60	min																					\$3.00
90	min																					\$4.00
Au	toma	ti	ic	;	h	e	а	d	(21	e	а	n	e	r				•			\$1.95

Open-Reel Tape

Polyester, 1-mil extra play.	
AP5900. 5" reel, 900-ft	\$3.60
AP7180. 7" reel, 1800-ft	\$6.20
Polyester, y2-mil tensilized.	
AP7240. 7" reel, 2400-ft double play	\$9.50
Polyester, 1/2-mil standard play.	
AP5600. 5" reel, 600-ft	\$2.85
AP7180. 7" reel, 1200-ft	\$4.25

SCOTCH

Master Cassettes

Features professional oxide; improved cassette shell for critical mechanical performance and three-head recorder design; "Posi-Trak" back treatment; album or "C-Box" packaging (40 cents additional for C-60 and C-90 "C-Box"). 45 min \$2.69 60 min \$2.69 90 min \$3.99 120 min \$5.49

Master II Cassettes

Features chrome equivalent modified ferric oxide for use with recorders operating in the CrO_2 or $70 \,\mu$ sec equalization position; improved cassette shell for critical mechanical performance and three-head recorder equipment; 3-dB S/N improvement over current CrO_2 cassettes; album or "C-Box" packaging (40 cents additional for "C-Box" packaging).

45	min	(a	lb)L	Iľ	n	(Df	۱I	ly)	,						,		\$3.69
60	min																				\$3.99
90	min				•			,					•	•							\$4.99

Master III Cassettes

Features improved FeCr dual-layer construction which provides 3-dB improvement in output at low frequencies, 2-dB boost at high frequencies over existing tapes; improved cassette shell for critical mechanical performance and three-head recording equipment; album or "C-Box" packaging (40 cents additional for "C-Box" packaging).

45	min	(а	lb	Ð	ır	n	(10	۱I	ly)									\$3.69
60	min																				\$3.99
90	min							•					•								\$4.99

Dynarange Low-Noise/High-Density

Multi-purpose cassette featuring full dynamic range throughout the audible sound spectrum; "Posi-Trak" back treatment; album package (60 and 90 also in "C-Box" package for 35 cents additional).

45 min	\$2.19
60 min	\$2.49
90 min	\$3.49
120 min	\$4.99
Highlander/Low-Noise	
For all-purpose cassette use; pol	vester base.
AE min	61.00

45 min .															•		\$1.29
60 min .																	\$1.49
90 min .													•				\$2.19
120 min	•			,	,	•	•	•			,	,	•	,	,	,	\$4.35

Chrome Cassettes

Features chromium-dioxide tape for extended high-frequency range; designed specifically for tape decks equipped to handle CrO_2 ; "Posi-Trak" back treatment; album.

					_	_	_						_		_	_												
45	min																			,						,		\$2.29
60	min																									,		\$2.59
90	min																											\$3.59
12	0 mir	1	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•	•		•	•				\$4.99
90 12	min 0 mir	1	•	•		•	•	•		•	:	:	•	•	•		:	:	•	•	•	:	•	•	•		•	\$3.5 \$4.9

Open-Reel Tapes

High-Output/Low Noise adio History

Provides 50% increase in signal output and additional 3 dB in dynamic range over conventional low-noise tapes.

No. 206. Polyester base, "Posi-Trak" backing, leader, and trailer. 1.5-mil. 60 min. at 7½ ips (7" reel) \$5.99 No. 207. Polyester base, "Posi-Trak" backing, leader, and trailer, 1-mil. 90 min at 7½ ips (7" reel) \$7.49 Low-Noise/Dynarange

Provides high-fidelity recording even at $3\frac{3}{4}$ ips; multi-purpose tape providing full dynamic range throughout audible spectrum; S/N is 4 to 6 dB better than standard tapes.

No. 211. Polyester backing, white yellow trail-
ers. 1.5-mil. 30 min at 71/2 ips (5" reel) . \$2.99
60 min at 7 1/2 ips (7" reel) \$4.49
No. 212. 1.0-mil. 45 min at 7 1/2 ips (5" reel);
\$3.49
90 min (7" reel) \$5.49
No. 213, 0.5-mil tensilized. 120 min at 71/2 ips
(7" reel) \$8.99
No. 214. 0.5-mil tensilized. 90 min at 71/2 ips
(5" reel) \$5.99
180 min (7" reel) \$11.39
Highlander/Low-Noise

All-purpose economy tape for vocals as well as speech.

No. 228.	1-5 mil. 60 mi	n at 7½ ips (7" ree	el)
		\$3.9	9
No. 229.	1-mil. 90 min	at 71/2 ips (7" ree	el)
		\$5.4	9

"Classic" Open-Reel Tapes

High-frequency performance 3 dB higher than No. 206-207; S/N 8 dB higher than standard recording tape; polyester base; "Posi-Trak" backing; leader, trailer; padded book-style box. Cl 7860, 15-mil 60 min, at 7/2 ins (7" reel)

CE.7100. 1.5-mil, 00 mill. at 7 /2 lps (7 Teel)
\$6.99
CL-7R90. 1.0-mil, 90 min. at 71/2 ips (7" reel)
CL-7R120. 0.5-mil, 120 min. at 71/2 ips (7"
reel) \$10.99
CL-10R120. 1.5-mil, 120 min. at 71/2 ips (10"
reel) \$17.99
CL-10R180. 1.0-mil, 180 min at 71/2 ips (10"
reel) \$20.99
CL-10R240. 0.5-mil, 240 min at 71/2 ips (10"
reel) \$27.99

"Classic" 8-Track Cartridges

Features special low-noise ferric-oxide coating for high-frequency sensitivity of 7 dB higher, S/N at low frequencies 6 dB higher than standard cartridges; fully compatible, oxide coating heavy-duty lubricated polyester backing.

	·													~	
8TR-45.	45	min	,				•								\$3.79
8TR-90.	90	min				•	•	•		•	•	•	•		\$4.49

8-Track Cartridges

Features low-noise oxide coating on heavy-duty lubricated polyester backing.

н	ıgi	1-0	utp	ut/	Low-Noise
diam.					

Full	2-dB	increase	ın	output	over	premium
tape	s.					

8TR-45 HO/LN. 4	5 min		 	 	\$3.29
8TR-90 HO/LN. 9	0 min		 	 	\$3.99
Low-Noise/Dynarang	ge				
All-purpose cartridg	e				
8TR-45. 45 min			 	 	\$2.79
8TR-90. 90 min		•	 	 	\$3.49

ERK-130 Cassette Edit/Repair Kit

Pre-Cut Tabs

SPT-7/32.36.	36	pre-cut	1.0-mil	polyester
plicing tabs				\$1.19
SST-7/32-18.	18	pre-cut a	aluminized	t sensing
abs				\$1.19

Head Cleaners

S-C-HC. Ca	assette l	head o	leaner	• •	• •			\$1.69
S-8TR-HC.	8-track	head	cleaner	•	• •	•	•	\$2.99



BLANK TAPE

"Classic" Tape Indexing System

 $1'' \times 8'' \times 8'_{2''}$ bookshelf index for cataloguing 288 tapes; easy access to any tape through complete cross reference to individual titles by artist or music/sound style; CL-TIS \$7.99

C-Box Cassette Storage System

Stackable/interlocking cassette storage/carrying boxes with pushbutton drawers; easy access and index label for quick identiflcation.

Sleeve of three empty C-Box units \$2.49
C-Box wall bracket \$1.19
C-Box carrying handle \$1.19
Box of 10 empty "C-Box" units with handle
and bracket \$9.99
25 drawer labels and insert cards \$1.99

SONY from SUPERSCOPE

Professional Recording Tape

Extra-heavy-formula Oxi-coat homogenized oxide coating; polyester back, "lubri-cushion" impregnated lubricant.

PR-150-3. 300 ft, 31/4" reel, 1 mil §	\$1.99
PR-150-9. 900 ft, 5" reel, 1 mil	\$3.49
PR-150-18. 1800 ft, 7" reel, 1 mil 9	6.49
PR-150-36. 3600 ft, 101/2" reel, 1 mil. \$1	7.95

Low-Noise, High-Output Tape

On 1-mil polyes	iter base.	
SLH-180-18.	1800 ft. 7" reel	\$7.99

										-
SLH-180-36.	3600	ft,	101/2"	reel	•	 	\$ 62	2	.9)5

Low-Noise Cassette Tape

C-45 Plus 2. 23 min/side	\$1.59
C-60 Plus 2. 31 min/side	\$1.69
C-90 Plus 2. 46 min/side	\$2.49
C-120 Plus 2. 61 min/side	\$2.99

Ultra-High-Fidelity Cassette Tape

UHFC-60 Plus 2. 31 min/side	\$2.69
UHFC-90 Plus 2. 46 min/side	\$3.79
UHFC-120 Plus 2. 61 min/side	\$4.99

Chromium-Dioxide Cassettes

CRO-60.	60	min																			\$3.49
CRO-90.	90	min	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	\$4.29

Ferri-Chrome Cassettes

8-Track Cartridges	
FeCr-90 Plus 2. 46 min/side	\$5.29
FeCr-60 Plus 2. 31 min/side	\$3.99

Ferri-Chrome Recording Tape

FeCr-11-3600. 3600 ft \$39.95

Ferri-Chrome 1/4-in Elcaset

FeCr-LC-60. 30 min/side \$9.95

Low-Noise, High-Output 1/4-in Elcaset SLH-LC-60. 30 min/side \$6.95

TDK

"Super Avilyn" Cassettes

Features new magnetic particle (Avilyn); high S/N; low distortion; uses CrO₂ bias and equalization. \$3.29

"Audua" Cassettes

Normal bias tape with superior performance; added high-end brilliance; broad dynamic range; high output; minimum noise; uses high or normal bias and equalization settings.

~	nonnan	0.03	unu	~		14	• •	**	• 6	-6	••	-	.,	r.	3	ç	۰.	u	ъ	,э	
	AD-C60.	60 I	min .																		\$2.69
	AD-C90.	90 ı	nin .	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	\$3.99

"Dynamic" Cassettes

Features dynamic performance and durable mechanics; polyester back.

D-030.	30	mi	Π.		٠	٠		٠		٠	٠		٠			٠	\$1.49
D-C45.	45	mi	n.														\$1.69
D-C60.	60	mi	n,														\$1.89
D-C90.	90	mi	n.														\$2.59
D-C120). 12	20	mi	n													\$3.29
D-C180). 18	80	mi	n													\$4.79

"Endless" Cassettes

Endless-loop design with safety features to prevent accidental reversal; usable in conventional cassette machines; polyester backing; packed in plastic boxes.

EC-20S. 20 sec									6	\$3.99
EC-30S. 30 sec										\$3.99
EC-1. 1 min									,	\$3.99
EC-3. 3 min										\$4.19
EC-6. 6 min										\$4.59
EC-12. 12 min .										\$5.49

"Audua" 8-Track Cartridges

Full-fidelity 8-track cartridges with gamma ferric oxide; frequency response 20-23,000 Hz; high saturation and output level (MOL); has broad dynamic range; high S/N; minimum distortion.

8TR-45AD.	45	min.									\$2.99
8TR-90AD.	90	min.									\$3.99

Dynamic 8-Track Cartridges

Full-fidelity	8-track	Ca	ari	tri	id	lg	e	5.					
8TR-45D.	45 min												\$2.29
8TR-90D.	90 min												\$2.79

"Audua-L" Open-Reel Tape

High-density ferric-oxide coating for high output, low noise, stability, and durability.

L1200. 1200 ft, /" low-torque reel \$4.	99
L-1800. 1800 ft, 7" reel	99
L-3600P. Plastic reel \$15.	49
L-3600M. Metal reel \$19.	95

"Audua-LB" Open-Reel Tape

Back-treated open-reel tape; high bias/equalization.

LB-1800. 1800-ft, 7" plastic reel \$8.69 LB-3600. 3600-ft, 10 ½" NAB metal reel

S Open-Reel Tape

Open-reel tape with reproduction characteristics of SD cassettes.

S-1200	\$4.99
S-1800	\$5.99
S-3600P. Plastic reel .	\$13.99
S-3600M. Metal reel	\$17.49

HC-1 Head Cleaner

Cassette tape machine head cleaner ... \$1.19

5/		٦
//	ACCESSORIES	
	Contractor of the state of the	

ACE AUDIO

AE-2002 Audio Equalizer

ADVENT

MPR-1 Microphone Preamplifier

For use with low-impedance balanced or un-

AUDIOTEX

The company carries a complete line of tape accessories for use with open-reel, cassette, and 8-track equipment.

30-126. Kleentape for open-reel recorder heads \$2.45 30-129. Tape Care Kit, Jr. contains head cleaner, cotton swabs, and cleaning cloth 30-630. "Blast-off" tape head cleaner, 3-oz aerosol can \$1.95 30-128. Same except in 6-oz aerosol can\$3.00 30-124-1. Recording head cleaner, 2-oz bottle . \$1.25 30-124-2. Recording head lubricant, 2-oz bottle\$1.25 30-636. Tape player care kit contains cleaner and head lubricant, two 6" brushes, 10 plastic pouches to protect tape reels, cassettes, or cartridges \$4.40

BURWEN

DNF 1201A Dynamic Noise Filter

Processes any 2-channel or matrix encoded material from turntable, tape deck, cassette deck, receiver or tuner; pushbutton controls select proper noise reduction; sensitivity control with LED readouts; frequency response (minimum bandwidth) -3 dB at 500 Hz, -10 dB at 1 kHz, -20 dB at 2.5 kHz; (maximum bandwidth) ± 0.5 dB max. 10 Hz to 20 kHz, -3 dB at 30 kHz, -25 dB at 100 kHz; attenuation rate 9 dB/octave; noise reduction levels up to 30 dB above 5 kHz, 14 dB above 400 Hz; HD 0.2% max.; 0.0 dB gain at 1 kHz adjustable to 10 dB; internal noise 100 μ V rms 20 Hz to 20 kHz; has 8 phono jacks and tape deck connectors; 2%" H × 8½" D × 17½" L... \$379.00

CERWIN-VEGA

GE-2 Stereo Graphic Equalizer

Covers 13 frequency bands (from 31.5 Hz to 16,000 Hz) \pm 12 dB; response 20-20,000 Hz \pm 1 dB with equalizer controls at center detent; rated output 2 V rms (2000 ohms or greater load imp.); control accuracy with 1 dB of calibrations; hum and noise 0.05% at rated output; inputs: two each source and tape input, line; tape output (phono jack); half-octave control below middle C, octive control above; $5V_4''$ H \times 19" W (rack mount) \times 7 V_4'' D (inc. knobs) \$470.00

DM-1 Audio Mixer

For semi-pro recording setups; frequency response 20-20,000 Hz ±1 dB (RIAA phono inputs), 20-20,000 Hz ±0.5 dB (line inputs); THD 0.05% at rated output at any frequency; IM 0.05% at rated output (SMPTE standard); noise (ASA standard "A" weighting, shorted inputs) high-level inputs 85 dB; phono inputs 80 dB both below full output; input imp. 47k (RIAA phono inputs), 100k (line inputs); output level/ imp. 2.5 Vrms (program and monitor), clipping level 8.7 Vrms (+21 dBm), load imp. 2k, output source imp. 100 ohms or less; tone controls ±10 dB at 50 Hz, and 5k, turnover freq. 500 Hz; Autofade rate variable from 2 to 20 sec typically; talkover/mute: mute level 0-20 dB typically, on/off rate 2 sec typically; headphone output



1 W into 4 ohms; meter calibration +3 dB at 2.0 Vrms at program output; illuminated VU meters for both output channels; bass/treble/ stereo balance controls; $11/2^{"}$ H (less feet and knobs) × 19" W × 8" D \$649.00

dbx

118 Dynamic Range Enhancer

120 Series Noise Reduction Systems

Provides 30 dB noise reduction and 10 dB additional headroom when recording with openreel, cartridge, or cassette recorders; eliminates tape hiss and noise in live recording; prevents additional noise build-up in tape duplicating or recording off-the-air; also decodes dbx encoded discs.



play \$399.00

150 Series Noise Reduction Systems Allows recordists to make noise-reduced tapes to studio standards on better-grade audiophile recorders; fully compatible with company's studio professional models but with single-ended inputs/outputs and RCA-type phono connectors to facilitate connections to audiophile recorders, amplifiers, etc.; provides 30 dB noise reduction with 10 dB more headroom; extruded aluminum and solid walnut cabinet. $3V_2^{"} H \times 9^{"}$ $W \times 10^{1}/s^{"} D$.

 Model 157. Two-channel simultaneous record and play
 \$600.00

 Model 152. Two-channel switchable record or play
 \$475.00

 Model 154. Four-channel switchable record or play (may also be used as two-channel simultaneous record and play)
 \$750.00

DUBIE

CD-5 Recording Control System

Combines mixing, fading facilities to integrate up to three recorders; frequency response d.c. to 100 kHz on all functions; input and output imp. for use with most amp/recorder combinations; max. input signal 10 V at 1 kHz; recorder control: four-position rotary control with off/ amp. in/out positions for each recorder for signal routing; monitor control: five-pos, select control, off/rec. #1, #2, #3/mix; fade control: two separately controllable stereo inputs; no patchcords required; 4" $H \times 91/4$ " $W \times 41/2$ " D... **CD-10.** Same as CD-5 but will handle six recorders; has eight-pos. monitor control; 4" $H \times$ $13^{13}/16" W \times 53/6" D 129.95

EDITALL

KP-2 Editing Kit

Complete kit includes plastic splicing block, 30 CX-1 EDItabs; for V4" audio tape ... \$4.50

1978 EDITION

KS-2 Editing Kit

KS-3 Editing Kit

Same as KS-2 except includes larger block $(5^{3}/_{a'} \times 1'' \times 3^{3})$ with countersunk mounting holes\$14.00

KS-1 Editing Kit

For cassettes, 0.150 mil audio tape; S-I aluminum splicing block $(5\gamma_4" \times 1" \times \gamma_8")$; 30 CX-3 EDItabs\$14.00

EDItab Pre-Cut Splicing Tabs

For splicing open-reel, cartridge, and cassette tapes; eliminates trimming of tape overhang; smooth, tapered edges prevent wow.

HEATH

TM-1626 Mixer Console Kit

Stereo mike mixer console; frequency response 40-20,000 Hz ± 1 dB; 0.5% max. dist.; hum and



noise -50 dB from 20-20,000 Hz (controls set at max.); input sensitivity for 1 V output: 1 mV (lo-Z mike), 14 mV (hi-Z mike), 150 mV (aux.); input impedance 1100 ohms (lo-Z mike), 170,000 ohms (hi-Z mike), 100,000 ohms (aux.); output impedance 150 ohms; six inputs; backlighted meters and peak-indicating LED indicators; 120/240-V a.c., 60/50 Hz, 15 W; 53/16" H \times 16" W \times 97/8" D\$129.95

AD-1305 Stereo Equalizer Kit

Five-band, two-channel graphic equalizer kit; matches Heath AP-1615 preamp; HD and IM less than 0.05%; hum and noise 90 dB below rated output; slide controls, switches for tone flat, tape monitor; 47_{32} " H \times 17 $\frac{1}{2}$ " W \times 8" D\$119.95

KLARK-TEKNIK

DN22 Equalizer

DN27 Equalizer

One-third octave graphic equalizer; harmonic dist. less than 0.05%; frequency response 20-



20,000 Hz; S/N 90 dB; 27 controls centered on ISO frequencies; up to 6-dB gain \$695.00 World Radio History

MAGNESONICS

Erase-Sure Tape Eraser

Will erase a cassette or 8-track cartridge to -65 dB from 0 reference; battery operated (four "AA" cells, included); $4" \times 3^{1/2}" \times 2^{3/4}"$.. \$19.95 A.C. adapter\$7.50

Rapid Rewinder

Will rewind a C-60 cassette in 30 seconds; battery operated (four "AA" cells, included); $4" \times 3 \frac{1}{2}" \times 2 \frac{3}{4}"$ \$19.95 A.C. adapter \$7.50

Tele-Cord Electronic Secretary

Records telephone calls automatically; works with any standard cassette recorder ... \$39.95

MURA

Muradapter

Converts cassette into 8-track cartridge; cassette loads directly into unit, which then functions as regular 8-track cartridge; includes fastforward\$59.95

MXR

Stereo Graphic Equalizer

Dynamic range 110 dB; control range ± 12 dB; gain: unity ± 1 dB (controls centered); max output level: ± 15 dBm (600 ohms), ± 22 dBm (unloaded); input imp. 47k; equiv. input noise ± 95 dBm; frequency response 20-20,000 Hz ± 1 dB at 0 dBm; THD 0.05% at 0 dBm (20-20,000 Hz); IM 0.05% at 0 dBm (60/7000 Hz 4:1); center frequencies (per channel) 31, 62, 125, 250, 500, 1000, 2000, 4000, 8000, and 16,000 Hz; eight rear-panel phono jacks: two inputs, two low-imp. outputs, two tape-record outputs, two tape-monitor inputs; two switches control tape monitor function and equalizer bypass \$199.95

Compander

Can be used with open-reel and cassette decks; dynamic range 100 dB; max. signal level +12 dBV (compress in, expand out); output imp. will drive 600 ohms or higher; equiv. input noise -88 dBV (20-20,000 Hz); input imp. 100k; compress/expand ratio 2:1; tracking accuracy ±1 dB per 20 dB; frequency response 30-20,000 Hz ±1 dB at 0 dBV, 3 dB down at 20 Hz and 40 kHz; THD 0.15% (200 Hz-20 kHz, 0.75% at 0 dBV (50-200 Hz); IM 0.75% at 0 dBV (60 Hz/7 kHz, 4:1); level match range +6 dB to infinity; compatible with dbx encoded material; bypass switch for cutting unit out of system; black anodized aluminum housing with walnut side panels \$129.95

NAGY

TS250 Shearing Tape Splicer

H-50-S Shearing Tape Splicer

Designed to splice V_2 -in magnetic tape; cuts by shearing; Teflon-coated flat springs insure proper tape positioning; non-slip rubber base and countersunk mounting holes; aluminum block $V_2^* \times 1V_2^* \times 3V_4^*$ \$24.95

6S25 Shearing Tape Splicer

Designed to splice V₄-in magnetic tape; cuts by shearing; dovetail groove secures tape in block; ron-slip rubber base and countersunk mounting holes; self-sharpening shear; adjustable; extension rod for marking tape for editing;



NAKAMICHI

Head Demagnetizer

NORTRONICS

5600 Quadrasonic Record/Play Heads

Four-track, four-channel, laminated core heads with all-metal hyperbolic face construction. **5601**. Special record-only head, low imp., 50 mH, 500 µin gap spacer; for use with vacuumtube or transistor circuits; no-mount type....

Replacement Tape Heads

Replacement heads are available for 4100 models of recorders; universal head 5800 for 8-track players; 5130 and 5230A for cassette recorders.

PIONEER

SG-9500 Audio Frequency Equalizer

Stereo graphic octave equalizer for tone control with ten elements: 32, 64, 125, 250, 500, 1000, 2000, 4000, 8000, 16,000 Hz; level control range ± 10 dB; frequency response 5-70,000 Hz +0/-1 dB; S/N 90 dB; input impedance 200,000 ohms; output impedance 600 ohms; THD 0.04% at 1 V (20-20,000 Hz); max. output 6 V; 57/a" H × 161/2" W × 13%1a" D...... \$300.00

RH-1 Dynamic Range Expander

Dynamic processor provides improvements in dynamic range to enhance realism in reproduced music and noise reduction to eliminate unwanted tape and record noise; automatic operation; max. output 6.5 V; THD 0.1% at 1 V; dynamic expansion 6, 8, 10, 12, 14 dB; impulse response: attack time 0.5 ms, release time 80 ms; input impedance 70,000 ohms; output impedance 300 ohms; constant loss -3 dB; residual noise 65 μ V; S/N 100 dB (1 kHz, dynamic expansion 14 dB); twin meters; 5¹/₃₂" W × 12¹/₃₂" D \$175.00

MA-62 6-Channel Mixing Amp

Has input facilities for up to six mikes; each channel has alternative terminal for line or phono inputs; two channels equipped with pan pots; four with location switches; mike attenuators for each channel; low-cut filters for mike input; portable design; has two stereo output terminals; pointer-index markers for each of the six long-throw faders (plus master volume faders); 5^{3} /1° H $\times 15^{3}$ /4″ W $\times 10^{3}$ /4″ D ... \$250.00

SF-850 Electronic Crossover

Provides ten crossover points (125, 250, 500,

116

SR-202W Reverberation Amp

POLYFUSION

QP-1 Sound-A-Round

Quadraphonic panner; permits control of sound shift speed, direction, and channel levels; joystick balance control; four LED quadrant level indicators; dynamic range 80 dB; S/N 70 dB; frequency response 10-50,000 Hz ± 1 dB; THD less than 0.5%; max. input level 16 V p-p; input imp. 100,000 ohms; output level 0-100% of input; output imp. 600 ohms; speed range 0.05-6 Hz; depth range 0-120%; control input imp. 100,000 ohms; control input level 0 to +5 d.c.; 95-135 V a.c., 60 Hz, 130 W max; 4.5" H $\times 10"$ W × 8.5" D \$299.95 FP-1. Foot pedal control voltage source. \$49.95

POWERCOM

Program Control Center

Program control center has 10 switchable inputs and four output channels, inputs and outputs may be reversed; mono/stereo switch; output level switch; accepts standard phonotype plugs \$19.95

RUSSOUND

QT-1 Audio Control Center/Patchbay

..... \$149.95

TMS-2 Tape Recorder Selector

SANSUI

QSD-1 Four-Ch Decoder/Synthesizer

Features three separate QS "Vario-Matrix" decoders; 20 dB separation between adjacent channels, 30 dB across diagonally opposite channels; QS synthesizer for deriving four channel sound from stereo records, tapes, and FM stereo signals; frequency response 20-

World Radio History

30,000 Hz; dist. 0.1% (1000 Hz); 3¹/₂" H × 19" W (rack mount) × 12" D \$350.00

QSD-2 Vario-Matrix Decoder

Decoder/synthesizer adapter; permits any fourchannel receiver/amplifier to be used for Type-A QS decoding of QS-encoded sources, including FM broadcasts; master volume control for all four channels; source/playback jacks; function control: two-ch, QS synthesizer-hall, QS synthesizer-surround, QS, SQ; frequency response 20-30,000 Hz; dist. 0.1% at 1000 Hz; separation 20 dB (adj. channels), 30 dB (diagonal channels); $4\gamma_4$ " H \times 5" W \times 11 γ_6 " D \$140.00

RA-500 Reverberation Amplifier

Continuously adjustable reverb time with visual indication; can handle two tape recorders simultaneously; adds echo effects during recording or playback; frequency response 20.30,000 Hz ± 2 dB (at reverb time min.), 20.30,000 Hz ± 10 dB (reverb max.); S/N 65 dB at 300-mV output; reverb time 1.9-3.2 sec (at 1000 Hz); input/output jacks; tape recording A and B, tape playback A and B; load imp. 100,000 ohms; simulated walnut-grain enclosure; $6\%_{6}$ " H $\times 117\%$ " W $\times 107_{16}$ " D. \$150.00

SONY from SUPERSCOPE

MX-20 Mixer Console

16-input (eight balanced mike, eight unbalanced line) eight-output (four fixed, four variable) mixer console; four illuminated VU meters; each channel has four-position mike attenuator/line switch, five-position equalization switch, output channel assign switch, and straight line gain control; straight line master gain control; pan pot; three-position headphone channel selector; 120-V a.c., 60 Hz, 20 W; $73/_{16}$ " H $\times 18^{1}/_{16}$ " D \$1095.00

MX-16 Stereo/Mono Mixer

16-input (eight mike, eight line) eight-output (four fixed, four variable) mixer console; four illuminated VU meters; each channel has an input selector switch, straight line gain control, four-position step attenuator pad switch, output channel assign switch; straight line master gain control; rear-panel patch bay, preamp out, line amp in; three-position headphone channel selector; 120-V a.c., 50/60 Hz, 18" W; 6'/4" H × 16'/4" W × 16'/16" D. . \$650.00

MX-650 Stereo/Mono Mixer

MX-510 Stereo/Mono Mixer

Active five-channel mixer with variable pan pot; a.c./d.c. operation (with optional AC-12 power adapter); five channels in, two channels out; slide master volume control; input selector (ea. ch.): mic in/line in 1, 2, and 5; mic in/phono in 3 and 4; -20 dB mic attenuator (ea. ch.); two VU meters; stereo headphone jack; pan pot (channel 5); battery check button; slide indicator for straight-line level control; comes with one RK-74 patchcord, eight "C" cells; 3" H \times 13¹/₄" W \times 9¹/₂" D \$169.95

NR-115 Dolby Adapter

SOUND CONCEPTS

3D-50R Audio Delay System

SOUNDCRAFTSMEN

TG2209-600 Equalizer

PE2217 Preamp-Equalizer

Provides continuous visual monitoring of inputto-output balance as well as overload warning using LED's; discrete ten-octave equalizers for each channel; push-button patching for control flexibility with interlocked push-buttons to prevent inadvertent program destruction; has 39 separate front-panel control functions permitting simultaneous tape-dubbing into two recorders with output equalized or unequalized while monitoring either input or output; fullspectrum gain controls for each channel; automatic equalizer-defect when line or tape equalization is not in use; six a.c. outlets; dual outputs for scope, bi-amp, 4-ch hookup, or other special applications; response 10-100,000 Hz ±0.25 dB; THD and IM 0.05%; walnut grained cabinet; 71/4" × 20" × 111/4" \$529.50

SG2205-600 Equalizer

Provides front-panel push-button control of line or tape equalization for conventional hi-fi systems or separate stero outputs for multiplesystem equalization; tape monitor circuit provides monitoring equalized program material during use; environmental test record for listening environment equalization; four LED's for front-panel display controlled by zero-gain level controls for input vs output level balancing; S/N 96 dB; THD 0.1% at 2 V, 0.05% at 1 V (typical); ±12 dB boost or cut each octave; 600 ohm output; black anodized aluminum panel 19" wide for rack mounting \$370.00

RP2212 Record/Playback Equalizer

RP-2204 Tape Playback Equalizer

Can be used for equalization of tape recordings; environmental test record included for listening environment equalization; designed to be connected to tape monitor circuit of any stereo receiver or preamp; has tape monitor inputs and outputs with front-panel pushbuttons; two

SOURCE

Noise Suppressor

Suppresses noise independently in three frequency bands; provides 20-dB quieting at 10 kHz and 17 dB at 4 kHz with no signal, 20 dB at 12 kHz and 14 dB at 4 kHz with 300-3000 Hz signal, 15 dB over 9-20 kHz with 300-7000 Hz signal; masking isolation 30 dB at 1 kHz for 3-7 kHz, 30 dB at 3 kHz for over 7 kHz; suppression range -60 to -20 dB; insertion gain/ loss (-60 to -30 dB settings) 0 dB ± 1 dB; dist. (-60 dB setting) less than 0.1% THD products below 20 kHz, less than 0.1% IM at 60 and 7000 Hz (4:1); internal noise (20-20,000 Hz) at least 20 dB below setting; input imp. 51,000 ohms: HF output imp, 100 ohms; min, recommended load resistance 22,000 ohms; ref. level (0 dB) 0.316 V rms \$250.00

UEA Equalizing Amplifier

Provides high-level outputs from modern stereo magnetic cartridges for reproduction of 78's, radio transcription discs, as well as fine-groove records; five-position mode switch and variable treble control allow wide variety of equalization patterns to be obtained; ref. gain (1 kHz) 39 dB/ch (RIAA), 29 dB (other modes, common L and R); input imp. 75,000 ohms/ch (RIAA), 37,000 ohms (other); overload 80 mV at 1 kHz and 450 mV at 10 kHz (RIAA), 250 mV at 1 kHz and 250 mV (max. treble) or 1.2 V (min. treble) at 10 kHz (other); bass hinge freq. standard (RIAA), A mode 500 Hz, B mode, ffrr 250 Hz, acoustic none; noise (ref. 10 mV input) -76 dB; THD and IM dist. less than 0.1%; may be powered from Source Noise Suppressor or 22-33-V d.c. source, 5 mA current drain; 21/4" × 31/2" × 25/16" \$78.00

Model M

SPECTRO ACOUSTICS

210 Ten-Band Stereo Equalizer

Provides 10 bands of equalization with ± 15 dB boost or cut in each of the 10 audible octaves; uses gyrator synthesized inductors; features full line or tape equalization with lockout to prevent program destruction; unity gain controls for each channel or audible adjustments; distortion 0.1% of 1 V (20-20,000 Hz) with any combination of equalization adjustments, 0.05% of 1 V with equalizer bypassed or set flat; S/N 90 dB below 2 V rms; output impedance 600 ohms; dynamic range: noise floor is over 100 dB below full output; 6" H \times 17" W \times 7" D \$295.00

TASCAM

Model 3 Mixing Console

8-in/4-out mixing console; input section: 0, 20, or 40 dB of mic padding; mic/line input selector; 15 dB boost or cut at 3 or 10 and 75 or 200 Hz; pan automatically engages for multioutput assignment; straight-line fader; threeposition output-to-headphone (off/monitor/submix); master fader; PA mixing capability; six Io-Z balanced mic inputs; two hi-Z unbalanced mic inputs; aux. outputs in parallel with line outputs; accessory send and receive; VU-type level averaging meters and top neak indicators; frequency response 30-20,000 Hz ±2 dB; S/N 60 dB weighted min.; crosstalk -60 dB at 1 kHz; 0.3% THD max.; 117-V a.c., 60 Hz, 18 W; 6¹/₄" H × 18¹/₄" W × 20¹/₂" D \$900.00

Model 1 Mixer

8-in/2-out line level mixer; independent gain and pan for each input channel; master gain; foldback for each channel; aux. outputs in parallel with line outputs; separate buss inputs; contains 1-W amp with level control for two stereo headphone feeds; S/N 78 dB weighted; frequency response 30-20,000 Hz ± 1 dB; crosstalk -50 dB at 1 kHz; 0.3% THD max.; 117-V a.c., 60 Hz, 8 W; 4%^a" H × 17%^a" W × 4" D\$150.00

MB-20 Meter Bridge

TEAC

Model 2 Audio Mixer

Features six inputs (mike or line in any combination), four outputs; level controls for each input channel; master output level control; cue out jack on each input channel; accessory send/ receive patch points on each output bus for reverb units, graphic equalizer, limiters, compressors, noise-reduction units, other signal processing equipment; four aux. outputs in parallel with four line outputs; selectable high-cut filters at 5 kHz or 10 kHz; low-cut filters at 100 Hz or 200 Hz; color-coded push-push channel; $3V_4 " H \times 13V_4" W \times 10V_4" D...350.00

MB-20 Meter Bridge

For line-level applications; four VU meters; LED peak-level indicator; built-in 4 × 2 monitor mixer; headphone amp; independent monitor switches; variable input sensitivity selector \$175.00

TECHNICS BY PANASONIC

SH-9090P Frequency Equalizer

WHITE INSTRUMENTS

140 Sound Analyzer

Real-time sound analyzer with 11 by 28 LED graphic array display; 27 one-third octave channels on standard ISO centers covers over 40-16,000 Hz; double-tuned filter for each one-third octave; high-gain front end can be calibrated for display of true dB-SPL using standard dynamic microphone, provides a dynamic range from 40 to 110-dB SPL in six 10-dB steps; built-in pink noise generator provides flat output over 40-16,000 Hz at high or microphone level; line input for analyzing line level signals; built on standard 31/2" × 19" rack panel for rack mount and optionally furnished with wood-grained carrying case for portable use; self-contained three-microphone multiplexer is available for remote averaging SPL



150 Octave Band Analyzer

Precision battery-operated hand-held octave band analyzer; incorporates triple-tuned filters (ANSI 1.11, Class II specs); 10 by 14 LED matrix display; 10 ISO octave bands centered over 31.5-16,000 Hz; display ranges 14 and 28 dB for 1 or 2 dB resolution; acoustic sensitivity ranges calibrated over 34-110-dB SPL; flat or A-weighted measurement capability; supplied with precision microphone (detachable), Model 151 pink noise source, battery charger, and carrying case; Model 150 operates about five hours between charges, Model 151 operates at line or mike level for 30 hours. ... \$1400.00

Series 4000 Active Equalizers

Based on combination of LC tuned circuits and

latest IC op-amps for high linearity and stability; equal Q in both cut and boost conditions; 27 channels on ISO one-third centers over 40-16,000 Hz; continuously variable controls for 10 dB boost or cut; variable low-end roll-off control, 20-160 Hz with 12 dB/octave slope; 20,000 ohm input imp.; 0 dBm recommended operating level; max. output before clipping +18 dBm; noise and hum -92 dBm; 0.2% dist. up to +18 dBm; dual independent outputs, each capable of driving 600-ohm or greater load; accessory socket allows insertion of lowlevel crossover network for bi-amped systems; equalizers by-pass switch; $3V_2$ " H × 17" W × $8V_2$ " D.

4001. For sound reinforcement; transformer input with floating primary; barrier-type terminal strip for connections; supplied with rack-mounting end pieces and security panel

4100 Stereo Equalizer

Based on combination of LC tuned circuits and latest IC op-amps for high linearity and stability; each channel has 10 bands on ISO octave centers over 31.5-16,000 Hz; continuously variable controls for 10-dB boost or cut; equal Q in both boost and cut conditions; each channel has low-cut control for 12 dB/octave rolloff, 20-160 Hz; front-panel input-level attenuators and overload indicators for each channel; EQ In-Out and Power switches control both channels simultaneously; input imp. greater than 40,000 ohms; recommended operating level 0 dB; +18 dBm max. output before clipping; 100-ohm output imp.; output circuits capable of driving 600-ohm or greater loads; noise and hum -92 dBm; 0.1% dist. up to +18 dBm: accessory socket allows insertion of lowlevel crossover network for bi-amped systems; 12 or 18 dB/octave crossover networks available for virtually any frequency; supplied with security cover; 115- or 230-V a.c., 50 to 60 Hz; 3¹/₂" H × 18¹/₂" W × 6³/₄" D \$599.00

Directory Of Manufacturers (Continued from page 13)

ORBAN/PARASOUND PRODUCTS

680 Beach St., San Francisco, CA 94109

OTARI CORPORATION 981 Industrial Rd., San Carlos, CA 94070

PICKERING AND COMPANY, INC. 101 Sunnyside Blvd., Plainview, NY 11803

PIONEER, U.S. Pioneer Electronics Corp. 75 Oxford Dr., Moonachie, NJ 07074

PIONEER ELECTRONICS OF AMERICA 1925 E. Dominiquez St., Long Beach, CA 90810

POLYFUSION, INC. 160 Sugg Rd., Buffalo, NY 14225

POWERCOM CORPORATION P.O. Box 454, Troy, NY 12181

RADIO SHACK, Div. of Tandy Corp. 2617 W. 7th Street, Fort Worth, TX 76107

RECOTON CORPORATION 46-23 Crane St., Long Island City, NY 11101

REVOX, Willi Studer America, Inc. 1819 Broadway, Nashville, TN 37203

RHAPSODY, Alaron, Inc. 185 Park St., Troy, MI 48084

ROYAL SOUND COMPANY, INC. 409 N. Main St., Freeport, NY 11520

RUSSOUND/FMP, INC. Foot of Canal St., North Berwick, ME 03906

SANKYO SEIKI (AMERICA) INC. 149 Fifth Ave., New York, NY 10010

SANSUI ELECTRONICS CORP. 55-11 Queens Blvd., Woodside, NY 11377

SANYO ELECTRIC INC. 1200 W. Walnut St., Compton, CA 90220

SCOTCH, 3M Company 3M Center, St. Paul, MN 55101

SENNHEISER ELECTRONIC CORP. 10 West 37th St., New York, NY 10018

SHARP ELECTRONICS 10 Keystone Place, Paramus, NJ 07652

SHURE BROTHERS, INC. 222 Hartrey Ave., Evanston, IL 60204

SONAB ELECTRONICS CORP. 1185 Chess Dr., Foster City, CA 94404

SONY FROM SUPERSCOPE, Superscope, Inc. 20525 Nordhoff St., Chatsworth, CA 91311 SOUND CONCEPTS INC.

P.O. Box 135, Brookline, MA 02146

SOUNDCRAFTSMEN 1721 Newport Circle, P.O. Box 2361, Santa Ana, CA 92705

SOUND WORKSHOP 1040 Northern Blvd., Roslyn, NY 11576

SOURCE ENGINEERING Box 506, Wilmington, MA 01887

SPECTRO ACOUSTICS, INC. 1308 E. Spokane St., Pascoe, WA 99302

STANTON MAGNETICS, INC. Terminal Dr., Plainview, NY 10803

STAX, American Audioport, Inc. 1407 N. Providence Rd., Columbia, MO 65201

SUPEREX ELECTRONICS CORP. 151 Ludiow St., Yonkers, NY 10705

SUPERSCOPE, INC. 20525 Nordhoff St., Chatsworth, CA 91311

TANDBERG OF AMERICA INC. Labriola Court, Armonk, NY 10504

TASCAM, Teac Corporation of America 7733 Telegraph Rd., Montebello, CA 90640

TDK ELECTRONICS CORP. 755 Eastgate Blvd., Garden City, NY 11530

TEAC CORP. OF AMERICA 7733 Telegraph Rd., Montebello, CA 90640

TECHNICS BY PANASONIC, Matsushita Electric Corp. of America One Panasonic Way, Secaucus, NJ 07094

TELEX COMMUNICATIONS, INC. 9600 Aldrich Ave., Minneapolis, MN 55420

TOSHIBA AMERICA, INC. 280 Park Avenue, New York, NY 10017

TURNER DIV., Conrac Corp. 909 17th Street, N.E., Cedar Rapids, IA 52402

UHER OF AMERICA INC. 621 S. Hindrey, Inglewood, CA 90301

WEBCOR, Leisurecraft Products Ltd. Plainview, NY 11803

WHITE INSTRUMENTS, INC. P.O. Box 698, Austin, TX 78767

YAMAHA INTERNATIONAL CORP. Box 6600, Buena Park, CA 90620

ZENITH RADIO CORPORATION 1000 Milwaukee Ave., Glenview, IL 60025





ADC PROFESSIONAL PRODUCTS

500 Frequency Equalizer

SLM-100 Sound Level Meter

Designed to be used with its companion R-100 test record with bands of pink noise that correlate with controls on equalizer; SLM-100 measures signal strength from each band on test record then slide controls on equalizer are raised or lowered to bring all measured levels to same approximate value; comes with 20-ft interconnecting cable for use with 500 equalizer \$59.95

ELECTRO-VOICE

DL42 Cardiline Microphone

RE20 Cardioid Microphone

667A Cardioid Microphone

Continuously Variable-D cardioid dynamic microphone; shaped response 40-10,000 Hz; -51 dB output; boom or fishpole use; low impedance; passive equalizer switch provides three LF and two HF variations; A3M-type mic connector and 15-ft cable with matching connector; supplied with integral windscreen/ pop filter and shock mount; gray finish...... \$302.40

CS15 Cardioid Microphone

Single-D cardioid dynamic microphone: shaped response 40-18,000 Hz; -45 dB output; remote powering or use PS8 battery supply; low impedance; A3M-type mic connector and 15-ft cable with matching connector; supplied with windscreen, stand clamp, and metal carrying case; nonreflective fawn beige finish. \$227.10

RE55 Omnidirectional Microphone

Omnidirectional dynamic microphone; flat re-1978 EDITION

RE16 Super Cardioid Microphone

CO85 "Tie-Tac" Microphone

RE51 Omnidirectional Microphone

RE11 Super Cardioid Microphone

DS35 Cardioid Microphone

RE85 Omnidirectional Microphone

Omnidirectional dynamic microphone; shaped World Radio History

RE50 Omnidirectional Microphone

Omnidirectional dynamic microphone; shaped response 80-13,000 Hz; -55 dB output; doublewall, shock-isolated case and special cable for noise-free operation; low impedance; A3Mtype mic connector and 15-ft cable with matching connector; supplied with stand clamp, metal carrying case, and integral windscreen/ pop filter; nonreflective fawn beige finish \$95.10

649B Omnidirectional Microphone

D054 Omnidirectional Microphone

635A Omnidirectional Microphone

OPAMP LABS

1204RS Recording Studio Console

12-in/4-out, 4 echo buss, 8-track mixdownmonitor system; input channels: mix slide pot



(film type) with 90-dB attenuation; input select: 0, -10, -20, -30 dB and mic level, line 1, 2, and 3; 12 echo send, 4 echo return, 4 echo return assign controls for 4 echo busses; low-frequency equalization (+12 dB): 1500 Hz (peaking), 3000 Hz (peaking), 5000 Hz (peaking), and 10,000 Hz (shelf); 4 output assign lighted atternate action switches; four $4^{1}/_{2}^{\prime\prime}$ lighted VU



Small Studio & Semi-pro Tape Equipment

ORBAN/PARASOUND

418A Stereo Limiter

Stereo limiter/compressor; left and right ganged output and input attenuators; release time control; switchable high-frequency limiter time constant (75, 50, 37.5, 25 µsec, flat); multifunction meter (left and right input and output, gain reduction, ±15-V power supply); overload indicator; frequency response 20-20,000 Hz ±0.5 dB; high-frequency limiter controls HF peaks attempting to exceed a threshold defined by single-time-constant roll-off; broadband limiter: 1-2 msec attack time, programcontrolled release time, 15-dB gain reduction range, 200:1 compression ratio, ±1.5 dB max. interchannel tracking; 50-dB separation at 20-20,000 Hz; noise -75 dB max. below limiting threshold at 100 Hz, 20-20,000 Hz bandwidth; 115/230-V a.c., 50/60 Hz, 6 W; 3½" H \times 19" W \times 10" D \$950.00

621B Parametric Equalizer

Two-channel parametric equalizer allows continuously variable control over center frequency, bandwidth, and amount of peak or dip; controls: equalization, bandwidth, and tuning for each of four sections, equalization in/out for entire equalizer, gain; frequency response 20-20,000 Hz ±0.25 dB; available gain ±11.5 dB max; input 10,000 ohms unbalanced; output less than 1 ohm unbalanced; slew rate 2V/ msec; noise (equalization controls flat) -86 dBm in 26,000 Hz noise bandwidth; Q range 0.29 to 3.2; equalization range +16 to $-\infty$ dB; tuning range 30-600 Hz, 90-1800 Hz, 250-5000 Hz, 750-15,000 Hz, tuning dials calibrated at ISO standard third-octave frequencies; ±18-28 V unregulated or ±15 V regulated \$739.00 621A. Same but single channel \$479.00 Power Supply. For 621A/B \$59.00

111B Dual-Spring Reverb

Two-channel (independent) dual-spring reverb; delay time 300 msec between direct sound and first reflection; accepts input levels from -30 to +4 dBm; limiter controls overloads up to 25 dB before clipping and distortion; 10,000 ohms unbalanced input imp.; output level nominally 0 dBm; 600-ohm output imp.; limiter attack time 100 msec; fixed mode compression ratio 10:1, limiter-induced harmonic dist. 0.2% at 5000 Hz; shelving-type bass equalizer, 500-Hz turnover frequency, ±12 dB (reciprocal) equalization range; quasi-parametric peaking midrange equalizer, 1.5-5.5 kHz variable peaking frequency, ±12 dB (reciprocal) equalization range; 0.5-5.0 adjustable Q; S/N 76 dB (weighted); 115/230-V a.c., 50/60 Hz, 10 W; 31/2" H × 19" W × 12" D \$695.00

516EC Dynamic Sibilance Controller

For use with vocal tracks with 8000 Hz min. bandwidth; three independent de-essing channels; threshold and in/out controls for each channel; 5400-ohm (unbalanced) input imp.; output imp. 1 ohm, will drive 500-ohm or higher; 0 dB ± 1 dB gain (below de-essing threshold), can be modified to ± 10 dB; ± 19 -dBm min. output clipping point; output noise ± 80 dBm max.; 107-dB typical dynamic range; frequency response (below de-essing threshold) 20-20,000 Hz ± 0.5 dB; attack time 1 msec; release time 15 msec; THD 0.5% at 18 dBm into 600 ohms, 20-20,000 Hz; max. gain reduction 25 dB; LED de-essing indicator; 115/230-V a.c. 50/60 Hz, 7 W; requires $1 \frac{1}{4}$ " rack space, standard 19" relay rack\$595.00

245E Stereo Synthesizer

OTARI

MX-5050-FL Tape Recorder

Full-track, one channel, two-speed (71/2 & 33/4 ips); three full-track heads plus extra half-track reproduce head and reproduce amp to play back half-track stereo; motors: two-speed hysteresis synchronous or d.c. servo-controlled capstan motor, two induction torque reel motors; wow and flutter (NAB weighted) 0.06% at 71/2 ips, 0.15% at 33/4 ips; handles 101/2-in EIA or NAB reels; 5- or 7-in plastic reels; rewind time less than 90 sec for 2500-ft reel; connectors: line in/out, three-pin XLR, mike, standard Va-in phone jack; inputs: line 15 dBm unbalanced 50 k, balanced 600 ohms; mike 70 dB unabalanced, nominal 50 k, balanced 150/250 (with optional transformer); outputs: line variable or fixed level; headroom +19 dBm before clipping; headphone jack -24 dB nominal 8 ohms unbalanced; NAB equalization; S/N 69, 66 dB (unweighted, weighted) at 71/2 ips, 68 and 65 dB at 3¾ ips; frequency response 50-18,000 Hz ±2 dB, 30-20,000 Hz ±3 dB (both at 71/2 ips); 50-12,000 Hz ±2 dB, 30-15,000 Hz (both at 33/4 ips); vertical or horizontal operation; walnut-finish cabinet; 215/8" H × 213/8" W ×\$1450.00 MX-5050-2S. Same except half-track, twochannel; 15 and 71/2 ips or 71/2 and 33/4 ips \$1450.00 MX-5050-4S. Same as MX-5050-2S except quarter-track, two-channel \$1420.00

4-CHANNEL

Mark II Four-Channel Recorder

Incorporates features of MX-5050 plus separately packaged transport and electronics, d.c. capstan servo with pitch control, plug-in electronics, complete accessibility to electronics adjustments, and interface jack for adding dbx or Dolby noise-reduction system; tape speeds 15 & 71/₂ ips; heads: three four-track in-line stacks for erase, record, reproduce; wow and flutter 0.05% at 15 ips, 0.06% at 71/₂ ips; frequency response 50-20,000 Hz ±2 dB, 35-25,000 Hz ±3 dB (15 ips at 0 VU), 50-18,000 Hz ±2 dB, 40-20,000 Hz ±3 dB (71/₂ ips at -10 dB); 101/₂ in NAB reels; 1/₂-in tape, 0.075-in track width; 251/₄" × 19" standard rack mount standard rack mou

Two-Channel. Same as Mark II but uses V_4 -in tape; will handle 5- and 7-in plastic reels or 10 V_2 -in EIA or NAB; 21 V_4 " × 19" standard rack mount \$2195.00

MX-5050-QX Four-Channel Compact

Two-speed (15 & 71/2 ips), 4-channels; four



World Radio History

head stacks: erase (tracks 1 and 3), erase (tracks 2 and 4), record (four track), reproduce (four track), variable speed d.c. servo controlled capstan motor; two induction torque reel motors; wow and flutter 0.05% (15 ips), 0.06% (7 $^{1}\!\!\!/_2$ ips); frequency response 50-20,000 Hz ± 2 dB, 35-25,000 Hz ± 3 dB (15 ips at 0 VU), 50-18,000 Hz ± 2 dB, 40-20,000 Hz ± 3 dB (7 $^{1}\!\!\!/_2$ ips at -10 dB); vinyl-covered wood case (rack mounting kit and floor corsole optional); 5- and 7-in plastic reels or 10 $^{1}\!\!/_2$ in EIA or NAB reel; 12 $^{1}\!\!/_2$ " H \times 81/4" W \times 91/2" D \ldots \$2495.00

SOUND WORKSHOP

1280 Recording Console

12-in/8-out recording console; 8×2 stereo control room monitor mix; 8×1 musicians' cue



mix; independent 2-track mixdown buss; each input has three-band equalization, 35 dB trim control, push-button track assign, full panning, echo send, locking solo and mute switches, straight-line fader, and pre- and post-fader patch points; Tri-Lite LED readout for all 10 output busses; 105-125-V a.c., 50/60 Hz, 20 W; 5¹/₂" H × 27" W × 20" D \$2850.00 1280B. Same but with studio-quality balanced transformer mic-pres \$3200.00 1280 Expander. Provides additional 12 inputs for 1280 .. \$2150.00 1280B. Expander. Same but with mic input transformers \$2500.00

840 Recording/PA Mixing Console

220 Doubler/Limiter

421 Broadcast/Disco Mixer

Mixing console; two stereo phono, two stereo tape, and one microphone inputs; any or all stereo inputs may be assigned to cue buss; low-end equalization on mic input; switchable low-cut filter; Tri-Lite LED readout; cue or program buss may be fed to headphones or ext. monitor amp; program output +20 dBm into 600 ohms; or greater, +26 dBm into 300 ohms; access or system equalization or other effects devices while maintaining line drive capabilities; $\pm 8 \, dB$ at 100 Hz shelf mic equalization; 20-dB max. talkover with timed slope; crosstalk –70 dB; frequency response 20-20,000 Hz $\pm 0.25 \, dB$; frequency frequency from Hz $\pm 0.25 \, dB$; frequency frequency from Hz $\pm 0.25 \, dB$; frequency frequency from Hz $\pm 0.25 \, dB$; from Hz $\pm 0.25 \, dB$; from Hz $\pm 0.25 \, dB$; from Hz $\pm 0.25 \, dB$;

Stereo Review's

Whether you are about to buy your first high-fidelity component or your fifteenth, you need to have all the facts you can get your hands on if you want to insure your complete satisfaction. Yes, the audio field is a complicated one, but *Stereo Review* has been running a kind of monthly seminar on the subject for almost two decades now, furnishing the kind of basic buying, installation, and operating guidance you can get nowhere else. Today, over 450,000 readers use it monthly as the first, best textbook in their on-going audio educations. If you have come a little late to class, here's your chance to catch up. Any questions you may have about *How to Buy, How to Set Up, How to Use,* or *How to Understand* audio equipment are probably answered in one or more of the reprints listed below.

- ¹. ROOM ACOUSTICS (How to Correct Your Room Acoustics)
- ^{2.} GUIDELINES TO SPEAKER SHOPPING
- ^{3.} RECORD DEFECTS (Their Causes & Cures)
- 4. LOUDSPEAKER POWER NEEDS (How Much Power Do You Need for Your Speakers)
- * ^{5.} HOW IMPORTANT IS AUDIO-COMPONENT COMPATIBILITY?
 - ^{6.} GUIDE TO UPGRADING YOUR COMPONENTS
 - 7. HOW TO SELECT A MICROPHONE
 - ^{8.} HOW TO CHOOSE AN AMPLIFIER
 - ^{9.} HI-FI TROUBLESHOOTING CHARTS
- ^{10.} SPEAKER MYTHS (How to Avoid Bad Choices)
- ^{11.} TURNTABLE BASICS (How to Buy a Turntable)
- ^{12.} HOW TO SELECT AN FM TUNER
- ^{13.} HI-FI DEMONSTRATION DISCS
- ^{*14.} AUDIO EQUALIZERS (Understanding and Choosing Equalizers)
- ^{15.} CLEAN UP AND TUNE UP YOUR AUDIO SYSTEM
- ^{*16.} HOW TO BUY A CASSETTE DECK
- ^{17.} USING FM INTERSTATION HISS TO TEST RECORDERS AND SPEAKERS
- ^{18.} HOW TO BUY A RECEIVER
- ^{19.} HOW TO BUY A PHONO CARTRIDGE

Reprints marked with Asterisk \$1.50. All others, \$1.00. Minimum order \$2.00.

	TR-78					
Stereo Review Information Center	NUMBER OF REPRINTS ORDERED:					
Consumer Service Division 595 Broadway, New York, N.Y. 10012	@ \$1.00@ \$1.50					
Please send the reprints circled below: \$1.00 each	TOTAL ENCLOSED (MINIMUM ORDER \$2) †Residents of CA, CO, FL, IL, MI, MC, NY, D.C., and T) add applicable sales tax.					
1 2 3 4 6 7 8 9 10 11 12	Print Name					
13 15 17 18 19 \$1.50 each	Address					
5 14 16	StateZip					

242A Stereo Reverb

Stereo reverberation system; line and mic level inputs; input level controls and peak-reading LED's; active input mix allows mixing of one or two mono signals while creating true stereo effect; output mixing allows any ratio of dry to reverberant signal; independent channel equalization; full drive level into 600 ohms; equalized drivers and preamps; noise level --70 dBm (20-20,000 Hz); ±15 dB at 4300 Hz equalization; nominal 2.5-sec decay time; 117-V a.c., 50/60 Hz; 35/6" H × 19" W × 9" D \$450.00

TASCAM

90-16 Recorder/Reproducer

16-track, 16-channel open-reel recorder/reproducer; transport, heads, and electronics are completely integrated; full IC logic circuits for transport plus motion sensing; a.c. servo-controlled direct drive capstan is capable of ±30% variable speed operation; output and function select; remote operation capability; 16 VUtype averaging meters plus 32 adjustable level LED indicators; 1-in tape width; wow and flutter 0.03% rms (NAB) weighted, ±0.04% peak (ANSI) weighted; 15-ips tape speed; fast-winding time 120 sec (2400 ft); overall frequency response 40-18,000 Hz ±3 dB; S/N 65 dB weighted, 60 dB unweighted referenced to 3% THD level (10 dB over 0 VU) at 1 kHz; dist, 1% at 1 kHz (0 VU); 3% overall THD at 10 dB over 0 VU; crosstalk -45 dB at 400 Hz; erasure -65 dB at 1 kHz, +10 VU reference; record level calibration 0 VU referenced to 3 dB over 185 nWb/m of tape flux, adjustable; line input -10 dB (0.3 V) or -20 dB (0.1 V) switchable, 20,000ohm imp., unbalanced; line output -10 dB (0.3 V), 10,000-ohm imp., unbalanced; 117-V a.c., 60 Hz; 47V₄" H × 247/₈" W × 285/₁₆" D \$12,500.00

25-2 Recorder/Reproducer

Two-track, two-channel open-reel recorder/reproducer; 15 and 71/2 ips tape speeds; direct-



drive d.c. servo-controlled capstan motor and two eddy current induction reel motors; integral dbx noise-reduction system; independent three-position bias and equalization switches; built-in 4-in/2-out mixer for remote recording applications; switchable 20-dB attenuation pad for each pair of mic inputs; tape-only outputs; cue and edit controls; ±5% variable speed operation; wow and flutter 0.05% at 71/2 ips; frequency response 25-30,000 Hz and 30-28,000 Hz ±3 dB at 15 ips, 25-28,000 Hz and 30-24,000 Hz ±3 dB at 71/2 ips; overall S/N 100 dB with dbx, 65 dB without dbx; overall harmonic dist. 0.4% with dbx, 0.8% without dbx (1 kHz); stereo channel separation 80 dB with dbx, 50 dB without dbx (1 kHz); fast-winding time 150 sec (1800 ft); inputs four line 100 mV/50,000 ohms, four mic 0.1 mV (-58 dB)/600 ohms or more; outputs two line 0.3V/10,000 ohms, one 8-ohm stereo headphone jack; 117-V a.c., 60 Hz, 83 W; transport size 1715/16" H × 181/2" W ×

11'3/16" D, amp size 81/16" H \times 181/2" W \times 121/4" D

Model 10B Audio Mixer

Incorporates 101B Input Module (×8) and 102A Submaster Module (x4); 101B has peakreading LED indicator, accessory send/receive, and aux. echo send/receive; 200-ohm imp. XLR-type, balanced, transformer isolated mic input; Model 116 8-Channel Monitor Mixdown Module available for direct interface for buss/ tape monitoring, individual pan and gain control, split mono cue send (1 and 2), and outboard automatic switching matrix; Model 120 Input Cue/Solo Module will mult accessory send signals from 12 inputs max. for mix of tape cue and input cue on split mono cue buss, provides facilities to solo any of 12 active input channels; complete line of optional input modules available; Model 10B \$2600.00

Model 5 Mixing Console

8-in/4-out mixing console; input module: 0, 20, or 40 dB of mic padding; 0-20 dB mic, tape, or



line trim; foldback pre EQ and fader cue; foldback post EQ and fader echo; 15 dB boost or cut at 3 or 10 and 75 or 200 Hz; pan automatically engages for multi-output assignment; LED overload indicator; straight-line fader; submaster module: buss tape monitor; tape cue; monitor gain and pan; echo receive; submaster fader; master module: 400-Hz test tone; fourchannel monitor; studio monitoring; control room monitoring; solo level control; master fader; VU-type level-averaging meters and peak-indicating LEDs; optional talkback module available; frequency response 30-20,000 Hz ±2 dB; S/N 75 dB weighted (one input, mic or line), 65 dB weighted (8 inputs, mic or line); crosstalk -60 dB at 1 kHz; 0.3% THD max.; 117-V a.c., 60 Hz, 40 W; 71/2" H x 231/8" W x 241/2" D \$1500.00

TELEX

Telex/Magnecord 1400 Series

Three-speed (15, 71/2, 33/4 ips) open-reel tape recorder; available with a variety of head configurations allowing one-, two-, or four-track mono or stereo operation; brushless d.c. servo ball bearing drive system; wow and flutter 0.35% at 3¼ ips, 0.24% at 71/2 ips, 0.17% at 15 ips (all DIN weighted), 0.25% at 3³/₄ ips, 0.17% at 71/2 ips, 0.12% at 15 ips (all rms unweighted); S/N 60 dB (NAB weighted); frequen-



World Radio History

cy response 30-10,000 Hz ±3 dB (3³/₄ ips), 30-18,000 Hz ±3 dB (71/2 ips), 35-22,000 Hz ±3 dB (15 ips, half-track); crosstalk ratio 50 dB at 1 kHz (half-track head); fast-winding time 80 sec (1200 ft, 7-in reel, 1.5 mil tape); reel sizes 5, 7, or 81/4 in EIA; inputs: 150-ohm microphone, balanced bridge, unbalanced bridge, mixing bridge, and aux. bridge; outputs: 150/ 60C ohm balanced, +4 dBm, aux. A and B unbalanced; VU meters for each channel; mike and line input separate gain controls plus master gain control; catenary head block design and hyperbolic contour heads insure intimate tape/head contact; 110/130-V a.c., 50/60 Hz, 180 W prices start at \$1535.00

Lab Series 2001 Tape Deck

Two-speed (71/2, 33/4 ips), four-track, threehead, two-motor stereo design; will handle up to 81/4-in reels; response 45-18,000 Hz ±2 dB; wow and flutter 0.18% at 71/2 ips; (S+N)/N 52 dB; has VU meters, automatic shutoff, pause control, counter, solenoid operation, and monitoring facilities; 141/2" × 191/8" × 8" ... \$725.00 2002W. Similar to 2001 except half-track, three-motor design; solid-state preamps; walnut base \$725.00

TAPE RECORDING & **BUYING GUIDE 1978 ADVERTISERS INDEX**

-

SE	RVICE NO. ADVERTISER PAGE NO	
	Advent Corporation	3
	Audio Technica U.S. Inc	9
	BASF Systems, Inc 44	4
1	Discount Music Club	1
2	Discwasher 101	Į
3	Fuji 69)
4	Hammon Industries	1
	Harmon/Kardon SECOND COVER, 1	
5	Illinois Audio 89)
19	J&R Music World 89)
6	J.V.C FOURTH COVER	
7	Maxell Corp. of America 14	
8	Memorex Corporation 4	
9	Minnesota Mining & Mfg. Company 9	
10	Mura Corporation 107	
11	MXR Innovations	
12	Sankyo Seiki 81	
	Sennheiser 109	
13	Shure Brothers Inc	
14	Studer/Revox	
15	Tandberg of America, Inc 70	
16	TDK Electronics Corp 110	
17	TEAC Corporation THIRD COVER	
18	Toshiba	

BE SURE YOU CHOOSE THE ONE YOU LIKE.



A TEAC LASTS A LONG, LONG TIME.

One of the reasons is that we've been making them for a long, long time. In 1955, TEAC came on the scene with the first in a long line of fine open reel tape recorders.

Since then, of course, we have developed a sister line of cassette decks. But our first love remains open reel tape recording equipment: the truest method of sound reproduction available today. Consider the alternatives. If you want top-of-the-line quality, but only need bottom-of-the-line features, the A-2300SX is the buy of the year. From there, you can add DOLBY,* larger 10½" reels, four heads, auto reverse, four-in/ two-out mixer, memory stop, 15 ips, four channel Simul-Sync, and variations thereof.

*Dolby is a trademark of Dolby Laboratories, Inc. CIRCLE NO. 17 ON READER SERVICE CARD In short, as long as you're getting a tape deck, can you conjure up a single reason it shouldn't be a TEAC?

TEAC.

The leader. Always has been.

TEAC Corporation of America 7733 Telegraph Road Montebello, California 90640 In Canada TEAC is distributed by White Electronic Development Corporation (1966) Ltd.

c)TEAC 1977



5 LED peak level indicators help eliminate distortion.

A.

Long life Sen-Alloy head

reduces distortion





IR TAPE SELECT EQ BIAS Cr 07 Fo-Cr 1 NORM/SF

Dolby reduces tape hiss.

Bias and EQ switches for all types of tape.

No cassette deck can give you better performance without all these recording ingredients.



Most quality cassette decks look pretty much alike on the outside. So at first glance you might take the new JVC KD-35 for granted.

But take a second look. You'll see something no other make of cassette deck has—five peak-reading LED indicators. With a faster response than VU meters, or even peak-indicating meters, they help you avoid under-recording and they eliminate tape saturation and distortion. It's as close as you can come to goof-proof recording.

Then there's JVC's exclusive Sen-Alloy head for record and playback. Designed to give you the best of two worlds, it combines the truly sensitive performance of permalloy with the ultra long life of ferrite.

Of course, the KD-35 has many other features like Dolby, bias and equalization switches, and automatic tape-end stop in all modes. It's also possible to go from one operating mode to another without going through Stop. What's more, you'll never have to miss taping a favorite broadcast because you're not



there; just connect the KD-35 to a timer and switch to automatic record.

And yet, with all this built-in capability, at \$260,* the KD-35 is priced just above the least expensive model in JVC's new cassette deck lineup. Just imagine what our top model is like.

JVC America Company, Division of US JVC Corp., 58-75 Queens Midtown Expressway, Maspeth, New York 11378 (212) 476-8300. For nearest JVC dealer call toll-free (outside N.Y.) 800-221-7502. Canada: JVC Electronics of Canada, Ltd., Scarborough, Ont.

Approximate retail value Dolby is a trademark of Dolby Labs Inc. IEAVE OUT CIRCLE NO. 6 ON READER SERVICE CARD