

Stereo Review's

# TAPE RECORDER GUIDE 1972

SPRING EDITION • \$1.50

**SPECIAL FEATURE—  
COMPLETE BUYING GUIDE  
ON ALL TAPE PRODUCTS**

Status Report on

**4-CHANNEL STEREO**

Test Reports on

**CASSETTE TAPES**

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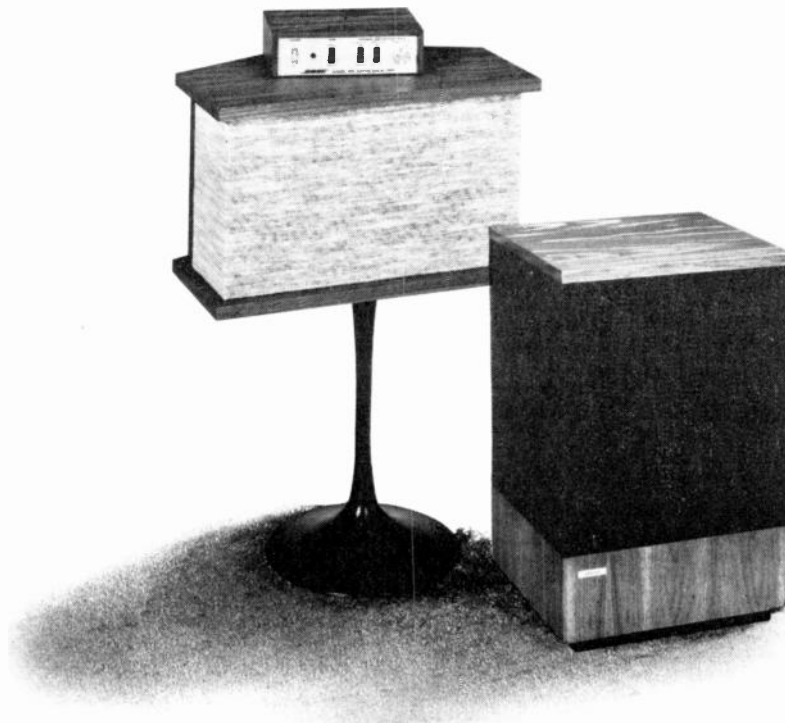
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## COVER STORY

Our cover shows a representative selection of equipment that can be used for tape recording and/or playback. Also included are some of the newest units designed to provide 4-channel reproduction—whether from tape or disc—in your own home. See Directory Section on 4-Channel Components for a complete rundown on available equipment.

- (A) Electro-Voice's EVX-4 Decoder
- (B) Dynaco's Passive QD-1A 4-Channel Adapter
- (C) Sansui's QS-1 Quadphonic Synthesizer
- (D) Teac's 1230 Stereo Tape Deck
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- (G) Koss' PRO-4AA Stereo Headphones
- (H) Wollensak's 4760 Dolby-ized Cassette Deck
- (I) Ampex's 8200 Cartridge/AM-FM Stereo Receiver Unit
- (J) Panasonic's RS-275US Play/Record Cassette Deck
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# USEFUL Hi-Fi TERMS

**Acoustic Feedback**—The echo, howling, or reverberation caused by a system's microphone (s) picking up the sound output from its own speaker (s).

**Air Suspension**—A type of speaker design which damps unwanted vibrations, resulting in better sound reproduction.

**AM**—or amplitude modulation. One of the two ways in which radio signals are transmitted. While AM signals travel greater distances than FM, they usually contain more noise and are not as high fidelity.

**Amplifier**—A component in a hi-fi sound system that boosts the signal from a preamplifier to a level which a speaker can reproduce.

**Antenna**—or aerial. A metal device that detects radio waves in the atmosphere and passes them on to the preamplifier. Also, a large tower-mounted apparatus that transmits radio waves from the broadcast station.

**Anti-Skate**—A device for balancing a tonearm so that the stylus rides in the record groove without any tendency to slide laterally across the record.

**Arm**—See Tonearm

**Automatic Frequency Control**—or a.f.c. A means of electronically keeping a receiver in tune. Used in conjunction with FM receivers/tuners.

**Automatic Gain Control**—or a.g.c. A circuit that keeps volume up to a listenable level irrespective of signal strength. It is especially useful in tuning weak FM stations.

**Binaural**—Two-channel reproduction. Literally, two-eared response to sound.

**Changer**—A record player with a mechanism that changes discs automatically. (See *Turntable*)

**Compact**—A high-fidelity sound system, almost always stereo,

in which the components are designed to fit together conveniently. Usually all components except the speakers are housed in a single cabinet.

**Components**—The various devices that make up a sound system; for example, microphone, tuner, record player, tape player or deck, preamplifier, amplifier, and speakers.

**Component System**—A high-fidelity system assembled from individual components. (Contrast with *Compact*)

**cps**—Abbreviation for cycles per second. The term "cps" is now obsolete and has been replaced by "hertz." (See *Frequency* and *Hz*)

**Decibel**—or dB. A relative measure of sound intensity or volume. It expresses the ratio of one sound intensity to another. One dB is about the smallest change in sound volume that the human ear can detect. (Also used to express voltage and power ratios logarithmically.)

**Distortion**—Any difference between the original audio signal and that reproduced. Distortion takes many forms and although it can never be completely eliminated, it can be reduced to a very low level in a good recording and reproducing system.

**Dynamic Range**—The voltage ratio (expressed in dB) 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.

**EIA**—A standard for rating amplifier power output, established by the Electronic Industries Association. (See *rms*)

**FET**—field-effect transistor. A special transistor used in receiver/tuner front-ends to pick up and detect weak signals.

**Flutter**—A form of distortion in which the higher frequencies oscillate rapidly in pitch. Often caused by faulty turntable, changer, or tape-transport mechanism, but sometimes due to faulty recording.

**FM**—or frequency modulation. One of the two ways in which radio signals are transmitted. FM is relatively noise-free compared to AM and is usually higher in fidelity. Signals do not travel as far as those transmitted by amplitude modulation. Stereo signals are transmitted only on FM.

This handy guide to audio terminology has been adapted from the "Layman's Lexicon of Stereo Terms," compiled by Theodore A. Strongin for J.C. Penney. Complete copies are available on request from Betsy Brooks, Public Relations, J.C. Penney Co., 1301 Avenue of the Americas, New York, N.Y. 10019.



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**Frequency**—The repetition rate of cyclic energy, such as sound or alternating electrical current, expressed in hertz or Hz (cycles per second) or kilohertz or kHz (thousands of cycles per second). 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 50-15,000 Hz; but in order to be meaningful must be further defined in terms of decibel variation from absolute flatness over a specified frequency range (e.g.,  $\pm 3$  dB from 50-15,000 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 End**—The section of a tuner or radio that receives signals detected by the antenna or inputs from tape or record players and then passes the desired signal along the sound-system chain.

**Gram**—or g. A measure of weight, applied to stylus pressures in phono equipment.

**Headphones**—In effect, miniature speakers, which fit snugly to an individual's ears for private listening.

**High Fidelity**—The reproduction of sound from a broadcast, disc, or tape with a minimum of distortion. Commonly called “hi-fi.”

**High-Fidelity Sound System**—The necessary components (i.e., amplifier, tuner, phono, tape equipment, etc.) hooked up so as to provide high-fidelity sound reproduction.

**Hum**—A droning noise that interferes with listening. Hum is usually the result of badly or incorrectly connected wires, or other internal troubles.

**Hz**—or hertz. The standard abbreviation (of hertz) which has replaced cps (cycles per second) as the term for the unit of frequency.

**IHF**—A standard for rating amplifier power output established by the Institute of High Fidelity. (See *rms*)

**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 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.

**Intermodulation Distortion**—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.

**kHz**—or kilohertz. One thousand cycles per second (Hz). For example, 19 kHz equals 19,000 Hz.

**Microphone**—A component that changes sound into electrical signals for transmission through a sound system, to a speaker, where the signals are converted back into sound again.

**Microphonics**—A condition resulting from the mechanical vibration of some part (other than the microphone) within the electrical circuit of an amplifier, tuner, etc. that causes corresponding electrical disturbances in its output signal. Usually appears as a “bonging” sound.

**Monaural**—One-channel reproduction. Literally, single-eared response to sound.

**Muting Circuit**—A device in an automatic tuning circuit which quiets the tuner or radio while it tunes into a new channel or changes channels. Also, a device which makes the desired channel come in more clearly by silencing unwanted background noise.

**mV**—millivolt. One-thousandth of a volt.

**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.

**Octave**—The interval between two frequencies of sound or electrical energy having a ratio of 2:1.

**Pickup**—The device that converts the vibrations of the stylus in the record grooves from the original sound on a moving disc into a signal in the form of electrical energy, which is then passed along the sound system for eventual transformation back to sound in the speakers.

**Player**—A component that plays back recorded sound from discs or tapes.

**Power Amplifier**—A component designed to produce sufficient output power to operate a loudspeaker. (See also *Pre-amplifier*)

**Power Cord**—A cord for connecting a tape recorder or other component to an external power source, such as a 120-volt a.c. line.

**Power Output**—The amount of power, expressed in watts, which an amplifier delivers to a speaker. Power output should be related to speaker efficiency to insure that a specific amplifier is capable of driving a particular loudspeaker(s).

**Preamplifier**—or preamp. An amplifier that raises extremely weak signal levels (such as those from a microphone, magnetic playback head, or phono pickup) to a level sufficient to drive a power amplifier. Some tape recorders combine a preamp and power amplifier. Others, especially tape recorders and tuners designed for use as a part of a hi-fi music system, may include a preamplifier but no power amp. The tape recorder's preamp usually includes the record and playback circuits.

**Quadriphonic**—One of the many variations of a term being used to describe four-channel stereo reproduction involving the division of the spectrum into four discrete channels which are fed through four separate speakers.

**Radio**—A component that detects radio signals in space, amplifies them, and then turns them back into their original sounds.



**Receiver**—An integrated unit comprising a tuner, preamplifier, and amplifier housed on a single chassis.

**RIAA**—A standard for long-playing records agreed upon by the Recording Industry Association of America and adopted internationally.

**rms**—root-mean-square. A standard for rating amplifier power output which accurately expresses power produced over the full frequency range. The two other standards in common use, EIA and IHF, result in numerically higher output figures but they represent true power output only under certain peak conditions.

**Rumble**—A pervasive sound caused by an inferior or faulty turntable or changer.

**Servo Drive**—A device that supplies power to move a control or controls.

**Signal**—The form in which original music, speech, or other intelligible sound is transmitted through the atmosphere or sound system for eventual reproduction in a speaker.

**Signal-to-Noise Ratio**—or S/N. The voltage ratio, usually expressed in decibels, between the loudest undistorted tone recorded and reproduced by a component and the noise reproduced when the audio signal is reduced to zero.

**Speaker**—The last component in the sound-system chain that converts the signal to sound.

**Speaker Sensitivity**—The amount of power a speaker must receive from an amplifier in order to reproduce sound properly. (See *Power Output*)

**Speaker System**—A combination of speakers usually mounted in a single enclosure, designed to cover a wider frequency range more efficiently than a single speaker can. (See *Tweeter and Woofer*)

**Stereophonic**—More than one channel of reproduced sound, each different.

**Stylus**—The "needle," usually diamond tipped, that rides the disc grooves. It is coupled to the pickup.

**Tonearm**—A pivoted arm that holds the cartridge at one end. When playing, the stylus is suspended from the cartridge on the disc grooves by means of the arm.

**Tracking**—The ability of a stylus to follow the grooves of a disc faithfully.

**Transistor**—A solid-state device that can control the flow of current without the use of moving parts, heated filaments, or vacuum gaps. Most hi-fi equipment today incorporate solid-state components.

**Tuner**—A component that selects the desired station from radio signals in the atmosphere as detected by the antenna. To convert such signals into usable form, a tuner must be connected into a sound system.

**Tweeter**—The section or component in a speaker system that reproduces the higher frequencies.

**Turntable**—A manually operated, non-automatic disc player.

**Woofer**—The section or component in a speaker system that reproduces the lower frequencies. ☐

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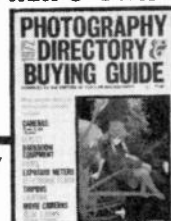
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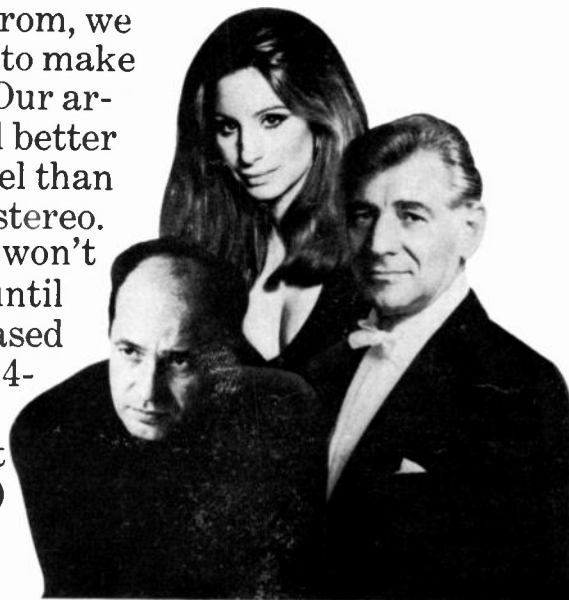
Add an extra stereo amp, an extra pair of speakers and a decoder to your current stereo system, and you're set up to play the SQ record in 4-channel.

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# 4-CHANNEL SOUND— WHAT, HOW, and WHEN?

A status report on quadraphonic sound—telling what it is, how it is produced, and when you can hear it.

By **WILLIAM CAWLFIELD**

**I**N order to understand 4-channel sound, we must first understand what “high fidelity” means. According to Webster, it means “the reproduction of sound with a high degree of faithfulness to the original.” For decades, this re-creation of a live concert performance in your home has been the goal of the audio industry. The whole chain of hardware—from the microphones which recorded the sound to the speakers that reproduced this sound in your living room—has been improved to the point where there is practically no difference in the live and recorded sound. But, do we now have true “high fidelity?” Not yet. The audio industry had actually arrived at this point, using a single channel of sound (monophonic), back in the late 1950’s.

Fig. 1 is a simplified illustration of how an orchestra was recorded. Sometimes multiple microphones were used in a session, but they were mixed down to a single signal which eventually made its way into the listening environment of your home.

But, there was still something missing from the concert-hall environment. Stereo was developed in the late fifties and increased the “concert-hall” feeling considerably. As Fig. 2 shows, an orchestra was no longer beamed to the listener from a single point but was dispersed across a line stretching between two speakers in a virtual curtain of sound. The orchestra now had breadth. The violins seemed to come from the left side, the percussion from the middle, and the brass from the right—or

however the conductor actually arranged his musicians. The recorded orchestra was now beginning to sound like its live counterpart.

However, one still did not have the illusion of “being there.” The problem lay in the strange world of psycho-acoustics. This pertains to how our ears and brain interpret sound. In a concert hall, we are immersed in the sound coming from all directions: the direct sound from the orchestra on stage; the reflected sound bouncing off the side walls, the ceiling, and the rear wall; and the sounds of the audience clapping, talking, coughing, or moving in their seats. All of these sounds are present in the hall during a live concert.

Acoustic engineers have always been concerned with the “liveness” or “ambience” of a particular hall. You may not be aware of this ambience until it is no longer present and you are sitting in the acoustically different environment of your living room.

Four-channel sound was conceived as a means of fooling your brain into thinking you are at a live performance. It is an illusion of being there and not the real thing—but still a very good illusion indeed. See Fig. 3.

There has been some grumbling that the audio industry has just “created another gimmick.” That all it is concerned with is to obsolete your present equipment and sell more speakers. This is simply not true.

Some people say, “Give me an excellent stereo rather than a good 4-channel system any day.” The

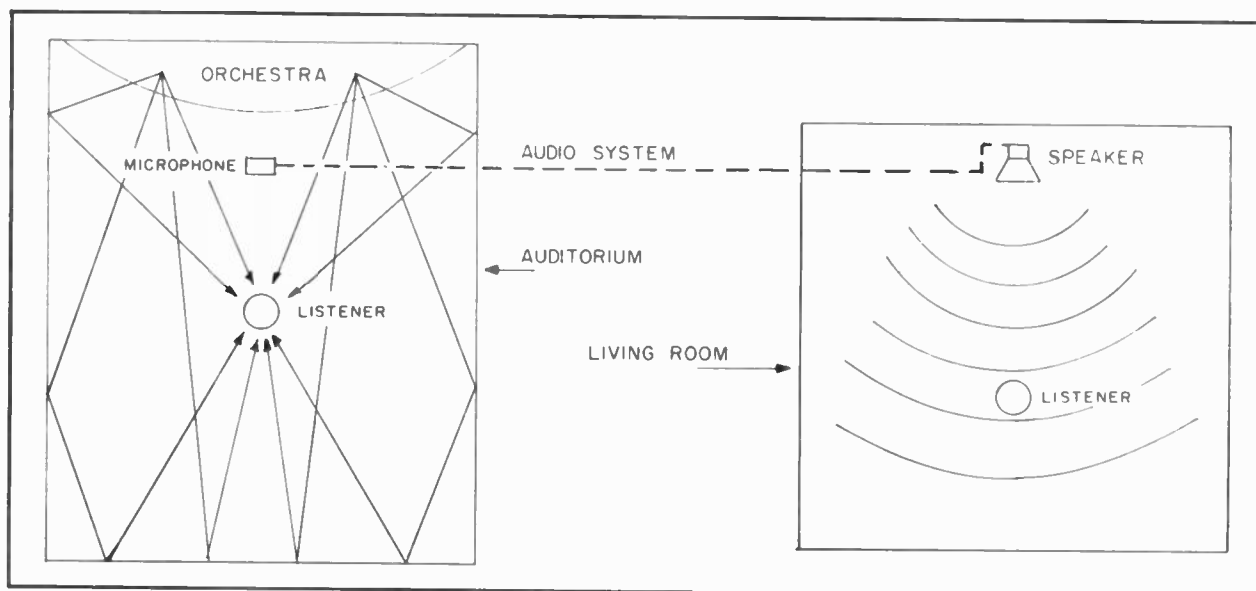


Fig. 1. Single-channel pickup and playback (monophonic) is illustrated here.

same thing was being said about stereo a decade ago, "Give me excellent mono rather than good stereo." These statements can sometimes be traced to an individual's concern over the "nuts and bolts" of his equipment rather than the total sound field generated by his system. They can also be traced to a reluctance to change.

The entire electronics industry is a dynamic one because of change. And each change has improved the overall enjoyment for the consumer. From radio to television, from black-and-white television to color TV, from tubes to transistors, from wire to magnetic tape—each step has caused some problems, but they were easily overcome. The advent of 4-channel does not mean that 2-channel stereo is obsolete any more than color killed black-and-white television. Price and convenience will still make 2-channel stereo an important part of the audio scene for the foreseeable future.

#### ACHIEVING 4-CHANNEL SOUND

Let us now look at the various ways of achieving 4-channel sound. The most straightforward method is called "discrete." This is a copy of the master tape which consists of the two tracks of music that was fed to the microphones near the orchestra and two tracks picked up by microphones placed out in the hall itself—generally toward the rear. These four channels of music are recorded onto a tape and reproduced in your home by means of a tape player that is equipped to pick up the four channels of music and send them through four amplifiers to four speakers (Fig. 4).

In this way, the orchestra comes to you from the front speakers while the rear speakers recreate the

sound of the hall or the "ambience." You are literally there. You are immersed in the hall and, depending on your seating preference, you can adjust the front and rear balance and put yourself in the front row, a middle row, or way in the back.

The use of four channels has spun-off another interesting byproduct. This is in the field of pop music which was never performed in a concert hall, but rather in a studio. Thus, the four channels can be used to surround the listener with singers or instrumentalists in the group.

Is this true high fidelity, as defined by Webster? Well, probably not, but increasing your enjoyment of the music is what it's all about. What one person enjoys may not be the same as what you like. One person likes jazz while another likes classical music. It is all a matter of personal preference. If someone likes to feel immersed in the orchestra, is it better or worse than sitting in front of the orchestra? Musical enjoyment, like art, is a very personal thing.

It is interesting to speculate whether some "purists" who look with disdain at this surround concept of 4-channel sound really know how most recordings are made today. One finds that most stereo discs are, in reality, two mono channels. The music, like a film, is "created" in the editing room where segments are blended, cut, overdubbed, slowed down, or speeded up to create a complete product. The whole orchestra may not even record in the same room or on the same day. Echo or reverberation is added during the mixing.

It is the author's feeling that it does not make any difference whether the complete product is sent into your home out of two channels or four. Nei-



ther concept is "purer" than the other. If the effect is more pleasing with four channels, then you should receive four channels. At times, 4-channel sound with the rear channels containing the ambience material is pleasing, while at other times the surround-sound effect of being immersed in the music is preferable.

The most popular tape format for discrete 4-channel sound is the 8-track cartridge system. Its advantages are many, including the fact that, being a continuous loop, you never have to rewind after hearing the program and, because of the immense popularity of the 8-track format, prerecorded material will be more readily available. It is too soon to know what the reel-to-reel market will do, but it is assumed that the only demand for the reel-to-reel format, until discrete records or FM broadcasts become available, will be from the live-recording hobbyist. The cassette, because of track-width restrictions, will probably go the way of records and FM broadcasts by achieving 4-channel sound through the use of a "matrix" system—for the next few years at least.

#### THE MATRIX SYSTEM

The matrix method of achieving 4-channel sound consists of encoding four channels of information into two channels by mixing them together in a complex phase and amplitude relationship. See Fig. 5. These two channels of information can then be pressed into a normal stereo record, broadcast over an FM-stereo station, or recorded onto a 2-channel stereo tape. When you play these two channels of music through the proper equipment, in-

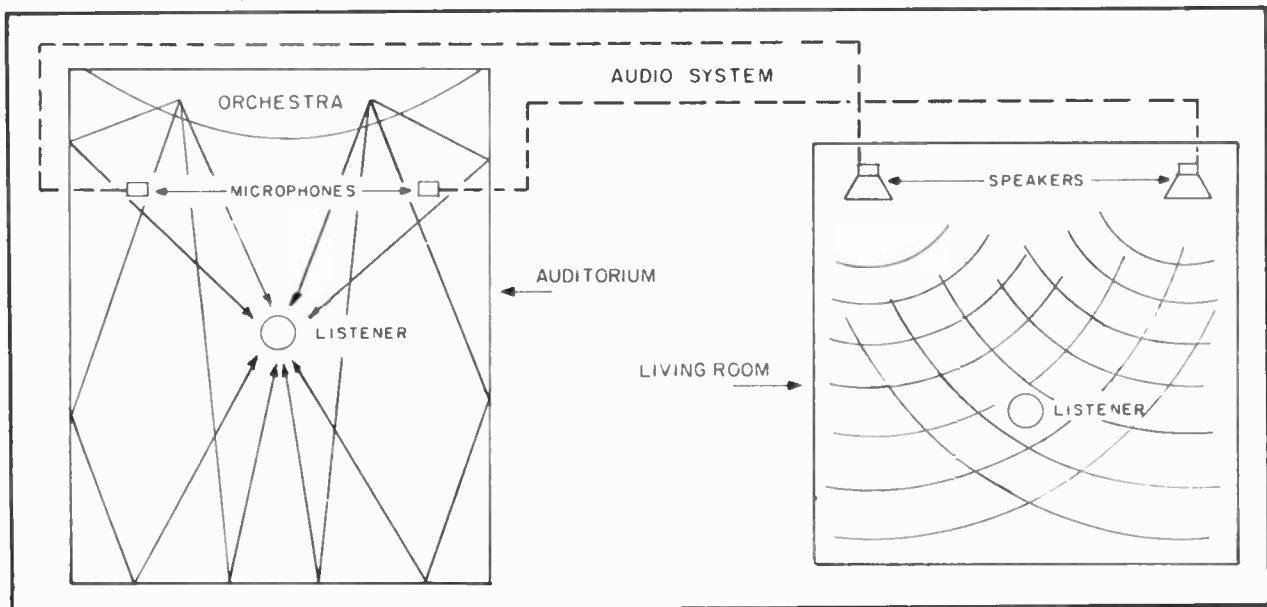
cluding a "matrix decoder," the two channels will be restored somewhat to the original four channels. The degree of restoration and at what cost to the customer is the battle that is now going on in the industry.

Various companies have introduced matrix decoders. When all the marketing superlatives have been stripped away, the various systems have only two ingredients to work with—one is the coefficients and the other is phasing. The coefficients are the terms in the formulas that clarify how much of each channel is mixed or separated from another. The phasing is an attempt to gain more distinctness between the channels. A commonly used phase shift is 180 degrees. The more complicated matrix circuits use 90-degree phase shifts.

One of the first major matrix systems was introduced by Electro-Voice. The heart of the unit is an IC chip that contains all the resistors, capacitors, and transistors that will decode by the proper coefficients and detect signals 180 degrees out-of-phase. It is the most popular matrix decoder because E-V made the IC available to all manufacturers at small cost to encourage the adoption of its system. There is an encoder available to record companies and FM stations who wish to encode 4-channel music into two channels.

This system looked as if it would capture the market until CBS announced that it had introduced another matrix system that was claimed to be better. The problem was that it utilized different coefficients than E-V and 90-degree phase shifts. This 90-degree phase shifting is sometimes described by CBS as the mechanical movement of the record

Fig. 2. Two-channel pickup and playback (stereophonic) is demonstrated in illustration.



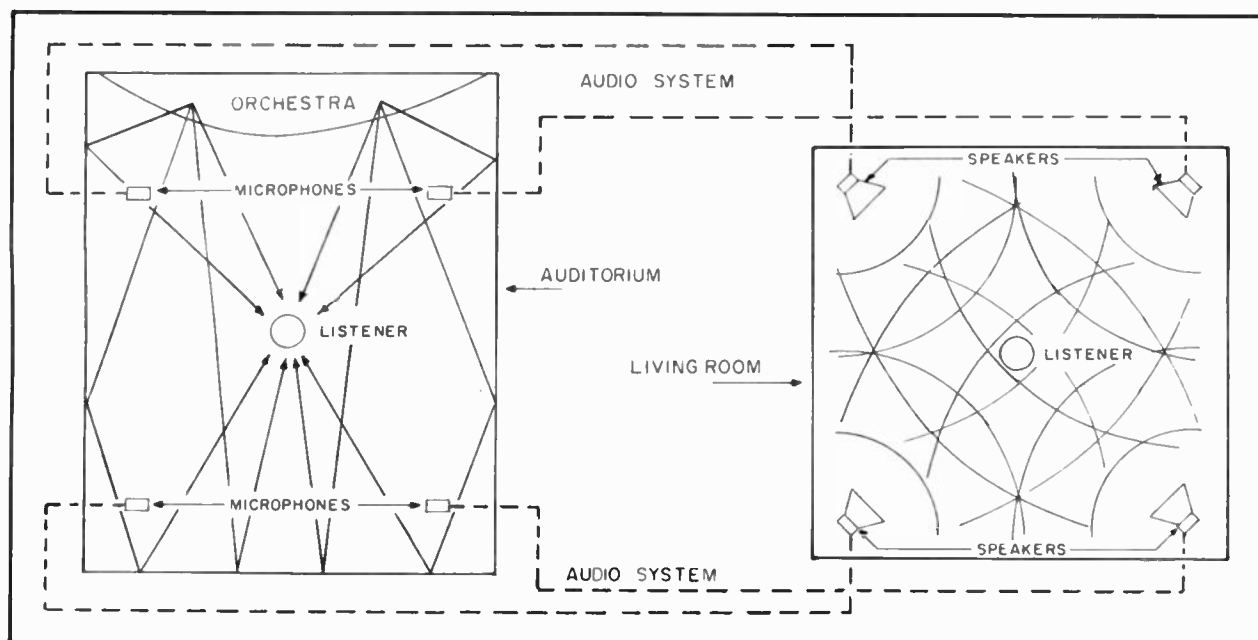


Fig. 3. Four-channel sound reproduction produces an illusion of concert-hall ambience.

stylus tracing these signals. The stylus will create a clockwise or counterclockwise helix as it moves along the groove. The Columbia system, called "SQ," is licensed to Sony, Sherwood, and Lafayette at the present time—and probably to others by the time you read this. Columbia, Ampex, Capitol, and Vanguard have all announced record releases under this system.

Sensing a battle of non-compatible systems and acknowledging the strength of Columbia's record library, E-V has announced a new chip will soon be available containing coefficients compatible with the CBS SQ system and that the circuit will have additional components to detect 90-degree phase shifting. This latter development now provides two systems that are compatible.

Sansui offers another matrix decoder that features 90-degree phase-shift circuits. Sansui's main push so far is the use of its decoder as an enhancer of stereo recordings. This circuit, like Electro-Voice's, detects signals that are at various phase relationships with each other, and directs these signals into appropriate channels where they eventually emanate from four speakers to create a total sound field in the listening room. Originally, the missing link was an encoder. This encoder is now available, but may be changed—as various record companies, especially Columbia, begin pouring out discs encoded in the SQ format—so as to have similar coefficients in order to be compatible.

Everyone claims his idea is the best and this is actually good for any dynamic industry. However, sometimes the difference between two systems is

so minute that there are no practical differences. This, then, brings us to the word "compatible." The author feels that if a recording is made with a solo trumpeter placed in the right-front channel, the drummer in the left-rear channel, any decoder that places them in the proper locations is compatible with the encoder used at the studio. And this is true regardless of whether the coefficients and phase angles used are identical or slightly different.

Again, psycho-acoustics come into play as to what we perceive as being a good reproduction of live performance. The degree of separation between channels from a matrix system is much less than with a discrete system. There is more blending of the channels in matrixing which some people actually prefer to the distinctness of the discrete tape system.

However, if more apparent separation is desired, a circuit can be added after the matrix decoder to enhance the 4-channel effect. This generally consists of a logic circuit that controls the gain of the four channels. When it detects an instrument that is louder in one channel than the rest, it will boost its level somewhat and reduce the levels of the other channels a bit. This gives the illusion that the instrument is located closer to that particular corner of the room than it was before the logic circuit took over.

These elaborate matrixing systems, some featuring this gain-riding logic circuit, will be more expensive and only appeal to the sophisticated music lover.

The matrix system has advantages over the dis-



crete other than the fact that it can be used for 2-channel records, tape, and FM-stereo. This feature is that you can convert many existing stereo systems to 4-channel quite easily. The only requirement is that you can place this matrix decoder into your amplifier circuit before the final stage. This hookup requires having either separate amplifier, tuner, and phono components, or a tape-monitor jack on the amplifier. Some companies have placed special jacks on the backs of their music-playing systems which will accept matrix decoders.

The matrix decoder can sometimes be used to enhance normal 2-channel stereo music. The decoder will attempt to split it into four parts by analyzing phase and amplitude relationships and a "synthesized" 4-channel sound is created. This

they will be supplying records and equipment for this system.

The method is not true discrete nor a matrix, as previously described, but a system in between. The four channels of a master tape are combined in a special formula and a coding signal is generated. This method is similar to the multiplex system used today in FM-stereo. The coded signal is pressed onto the record as well as the multiplex and when played back the two signals combine to create four individual channels of information. Because of the better separation this system provides over the matrix method, it has been called a discrete system.

One drawback at present is that the record system must be able to handle frequencies as high as

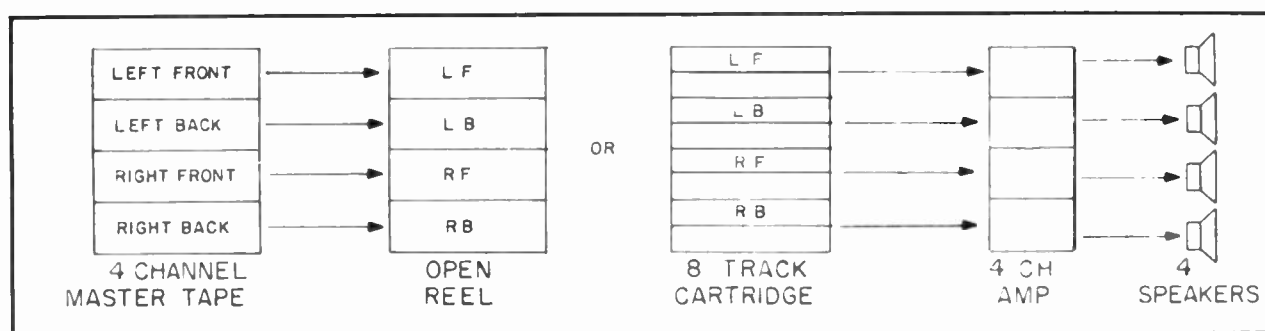


Fig. 4. Discrete 4-channel system keeps the individual channels separate.

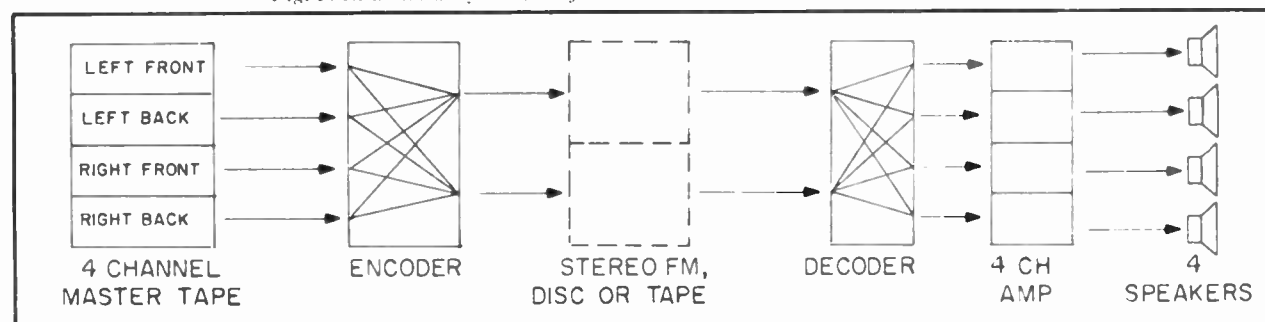
has led some people to confuse the main purpose of matrixing, which is to encode from four channels down to two and back to four. With this spin-off use of creating four out of two channels, the effect is quite pleasing. Because of the limited library of 4-channel music at present, you will find that most of the time the decoder is being used as a synthesizer.

Another method of bringing 4-channel sound into your home has been introduced by JVC of Japan. RCA and Panasonic have announced that

45,000 Hz. This is not a major problem for a sophisticated phono cartridge to handle. The magnetic cartridge has this capability within sight. The problem will arise when this response is needed in an inexpensive ceramic cartridge.

You may ask why this is important when you own a sophisticated system? Well, the music industry must produce records that will be purchased in the hundreds of thousands. In order to have a large selection of records from which to choose, this mass market must exist. A large

Fig. 5. In a matrix system, the four channels are combined into two as shown.



choice of selections simply cannot be provided for a small, specialized market. If the RCA-JVC system is to survive, some improvements—which, incidentally, RCA and JVC have said will be made—must occur. First, the need to produce an inexpensive ceramic cartridge for the mass market must be met; second, the problem of not being able to play this 4-channel record on a normal stereo machine without destroying the high-frequency coded signal must be overcome; and finally, the durability of the disc must be improved.

The catch is that even if all these things are done, the system may not be practical. To use this system on FM will require years of testing before the FCC will sanction it. This would then make the RCA-JVC system work only for discs, not FM or tape. So, at the present time the E-V or CBS matrix systems, which can be used today on any format without FCC approval, would seem to give the matrix a favorable edge.

#### FOUR-CHANNEL CONVERTERS

Many consumers today want to try 4-channel sound in their homes, but are not quite sure if they will like the effect or what system to go into. They are taking a “building block” approach. This involves the purchase of a small “black box” converter sold by many companies now, but originally conceived by Dynaco. See Fig. 6.

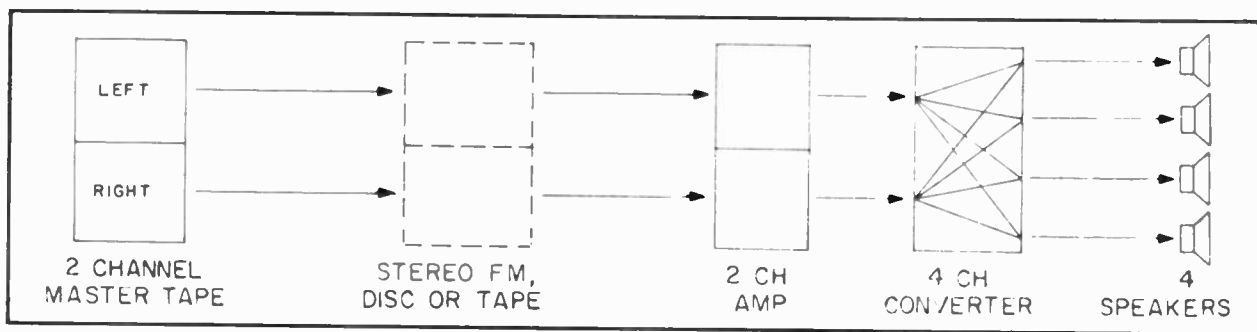


Fig. 6. A derived or ambience recovery system using a 4-channel converter.

All that is required as an investment is the converter and two more speakers. If, at a later date, you decided to go further by investing in a matrix decoder and/or discrete tape player, the speakers have already been purchased and the matrix decoder or tape player will then require just another stereo amplifier. The only casualty in this build-up approach was the original inexpensive “black box.”

The converter takes advantage of a very simple concept. Many times during a recording session, sounds that are 180 degrees out-of-phase with the

rest of the music will be recorded on the tape. This is generally not a problem when listening through a normal stereo system and, therefore, no efforts are made to eliminate these signals. Many records or tapes out in the field have this “hidden music” on them. Through the use of a simple resistive network across the two positive terminals of the stereo amplifier, the out-of-phase sound is recovered and fed to the rear speakers. Some of the ambience of the live recording appears at the forward microphones out-of-phase and so, in this hookup, the recorded ambience will be accented in the rear speakers. A solo instrument or singer that appears equally in the left- and right-front speakers will be canceled out of the rear speakers. In this way you will be surrounded by music and yet instruments, at times, will seem to come from various parts of the room.

This system does not have the accuracy of the true matrix system but it is a simple way to get started if you are not quite sure if you will like the effect. Also, because it does not require any hookups before the amplifier but is merely connected to the existing speaker terminals, this conversion can be done by anyone.

So, in the months to come, you will see many different methods of obtaining 4-channel reproduction. If you know what the various methods involve, you will find it less confusing. You will see

systems that have discrete 8-track tape players for 4-channel and a matrix decoder for records, FM, and stereo enhancement—all packaged together.

The industry is not trying to obsolete your equipment, but striving to improve it by way of adapters of many types and prices. If you know how far you want to go, how much existing equipment you want to keep, and how much distinctness in the separation of channels you want, you will find equipment for your purpose now—and in the very near future—available on your retail dealer’s shelves. □



# Which Tape Machine— CASSETTE or REEL-TO-REEL?

A Dolby-ized cassette machine will almost match performance of the best reel-to-reel unit. Your final decision will depend entirely on your specific requirements.



**A**LTHOUGH cassette and reel-to-reel tape recorders operate on the same principles, the cassette system is sufficiently unique to warrant separate consideration by a prospective user. A clear understanding of the differences between the two systems, and their limitations, will be helpful in making the choice between reel-to-reel and cassette formats, to say nothing of picking out the most suitable machine from the many models available in each category.

A typical cassette deck, except for its size, resembles a basic two-head, single-motor, open-reel tape recorder. Instead of placing a reel of tape on a supply hub, threading it across the heads (and sometimes around one or more tension rollers), and wrapping it around a take-up reel hub, the cassette user merely snaps a tiny cassette into a recess on the deck, and it is ready for playing (or recording). Removing it is just as simple (and can be done at any time), since merely pressing an EJECT button or lever pops the cassette out of the machine.

The cassette itself is a miniature tape-handling system, with supply and take-up hubs, the tape, and the necessary guide rollers and pressure pads housed in a molded plastic case about  $4 \times 2\frac{1}{2} \times \frac{3}{8}$ " thick. The tape is only 0.15" wide compared to the 0.25" width of open-reel tape, and moves at  $1\frac{7}{8}$  ips. Four parallel recording tracks, each about 0.020" wide, occupy the width of the tape.

Holes and cutouts in the cassette case are pro-

vided for locating pins, the two tape hub drive shafts, the capstan and pressure roller, and the erase and combined record/playback heads. Like open-reel tape, the four-track cassette is played two tracks at a time. It is turned over after one passage and the other two tracks are played in the opposite direction. Unlike open-reel tape, however, the cassette can be turned around in only two or three seconds.

A unique feature of the cassette is its ability to safeguard against accidental erasure of a recording. Knocking out a small tab in the back of the cassette keeps the deck's recording function from operating. If one wants to record on the cassette at a later date, a piece of tape may be placed over the hole in the cassette to restore the recording function.

Cassettes are identified by their total playing time. The most widely used size, the C-60, plays for 30 minutes in each direction, or a total of 60 minutes. For shorter recordings, there are C-30 cassettes which play for a total of 30 minutes; longer playing times are provided by C-90 (90 minute) and C-120 (120 minute) cassettes. The very thin tape used in the longer playing tapes (particularly the C-120) may cause difficulty with some recorder mechanisms. When in doubt, follow recommendations of the recorder manufacturer.

## ADVANTAGES & LIMITATIONS

It is apparent that the cassette offers *unparalleled ease of handling, storage, and loading*—sur-

passing even disc records in these respects. This convenience is not without its price, of course. Let us consider the limitations of the cassette medium and see how they are being overcome.

1. The low tape speed —  $1\frac{7}{8}$  ips — limits the high-frequency response. Early cassette machines (and some of the lower-priced current models) cannot reproduce frequencies above 8000 Hz. However, a 12,000-Hz frequency response is now common in medium-priced models while the best units go to 15,000 Hz or higher. In this respect they are comparable to most good reel-to-reel tape recorders operating at  $7\frac{1}{2}$  ips.

2. The narrow track width, combined with the low tape speed, results in a relatively high noise (hiss) level. With the latest tape formulations and low-noise electronics, a signal-to-noise ratio of 45 to 50 dB can be achieved (compared to the 55 to 60 dB of good reel-to-reel recorders). However, with the aid of a Dolby noise-reduction circuit, offered on a few top-priced cassette recorders, a signal-to-noise ratio of 55 to 60 dB is possible.

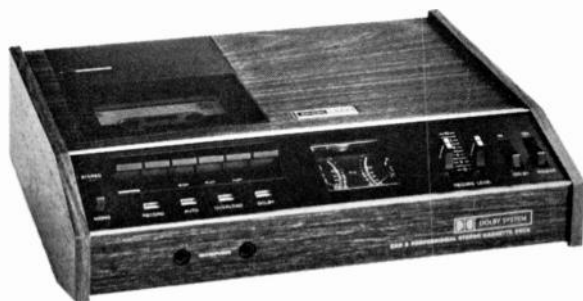
3. Flutter is inherently higher in cassette recorders since the tape tension is not completely under the control of the deck manufacturer. Although most cassette machines are rated at 0.2 % or higher flutter (a medium-priced open-reel deck may have

0.1 % to 0.15 % flutter), some of the best cassette mechanisms have reduced flutter to less than 0.15 %. Such techniques as heavy flywheels and dual-capstan tape drives are largely responsible for this improvement.

4. Tape editing and splicing are very difficult with a cassette. With considerable patience and skill, it can be done, but in this respect the reel-to-reel system is far superior. Furthermore, a tape breakage or jam within the cassette usually cannot be repaired since both ends of the tape must be accessible for splicing and many cassettes are ultrasonically welded and cannot be opened without destroying the cassette.

5. Off-the-tape monitoring, quarter-track mono recording, and special effects such as sound-on-sound and echo are not practical with cassettes since there is no room for a separate head. All audio cassette systems are licensed by the originator, Phillips of Holland, and they do not permit special head configurations which would be incompatible with stereo or mono cassette players.

6. Although tape quality is important with any type of recorder, it becomes paramount in the case of a cassette. Momentary drop-outs, due to uneven tape coating or head contact, which may be acceptable with the wider track open-reel format, can



*Three of the more sophisticated cassette machines now on the market. Directly above is Harman-Kardon's CAD5 professional deck which includes Dolby-B circuitry. Housed in a compact wood cabinet, it is designed to be used with your own hi-fi system. Top right is the Teac 350 which also includes Dolby circuitry and features special high-density ferrite heads.*

*Shown on the right is the Pioneer T-3300 stereo deck which offers a variety of operating modes — all actuated by piano-key switches.*





give cassette recordings an unpleasant roughness. The remarkable frequency response and signal-to-noise ratio of some modern cassette recorders is based on the use of premium-grade, low-noise tapes. Even more important, perhaps, is the mechanical quality of the cassette. Uneven tape winding, erratic friction in guide rollers or hubs, and similar mechanical flaws can ruin a recording or, in some cases, cause a cassette to jam or break. Since it is possible for a spilling cassette tape to jam a transport mechanism, requiring disassembly to clear the obstruction, this makes "bargain" cassettes a poor economy indeed.

#### APPLICATIONS OF CASSETTE SYSTEMS

Many serious tape-recording hobbyists will find the limitations of the cassette medium intolerable. The lack of editing convenience is the most damaging weakness of cassettes, but the flutter and drop-out problems may be equally annoying. Certainly no one would expect to produce professional-quality cassette tapes with a "live" recording situation, yet this is not uncommon with moderately good reel-to-reel recorders.

On the other hand, a good cassette machine is capable of copying disc records and FM broadcasts with such fidelity that no difference (in fre-

quency response, distortion, or noise) can be detected between the original program and the tape playback. Many home-recording hobbyists use their reel-to-reel machines principally for dubbing records or broadcasts, and a good cassette recorder can usually match the performance of an open-reel machine in this application. Some of them, in fact, are superior to comparably priced open-reel recorders. Fortunately, when recording from discs it is easy to do one's editing as the recording is being made so that the editing limitation of cassettes becomes less important.

The small size and light weight of cassette recorders simplifies their installation in systems with limited space. Battery-operated cassette transports are common in the lower price brackets. They vary widely in quality and cannot be expected to have the low flutter and accurate speed of a good a.c.-line-operated machine. If battery operation is important to you, be sure to listen to the recorder playing cassettes with piano music or similar material having sustained notes to determine whether its flutter is acceptably low. Unless independence from commercial power sources is a necessity, it is best to buy an a.c.-operated recorder. The better machines have constant-speed synchronous motors, and some have separate motors for the cap-



Three representative reel-to-reel tape machines. At top left is Tandberg's Series 3000X, a stereo unit with separate erase, record, and playback heads. It permits sound-on-sound, sound-with-sound, and echo effects. Top right is Pioneer's automatic-reversing stereo deck, T-6100, which operates at  $7\frac{1}{2}$  and  $3\frac{3}{4}$  ips. It, too, has three separate heads. Left is Viking Model 433 by Telex which has three heads, solid-state record/playback electronics and operates at  $7\frac{1}{2}$ ,  $3\frac{3}{4}$ , and  $1\frac{7}{8}$  ips. Its 8-position function selector illuminates color-coded indicator windows to eliminate recording errors.

stan and hub drives, with adequate torque to pull through the tape from a balky cassette.

A few cassette recorders offer such features as automatic tape reversal (sometimes even when recording), or automatic cassette changing for long periods of unattended operation. For many users, these conveniences are well worth their extra cost, although they are unrelated to the intrinsic quality of the recorder.

#### NOISE-REDUCTION CIRCUITS

Since noise (mainly tape hiss) is one of the major weaknesses of the cassette medium, much engineering effort has gone into noise-reduction systems. The most widely accepted technique is the Dolby "B" system, incorporated in a number of the better machines. Accessory Dolby units are also available from several manufacturers for use with recorders lacking this circuitry.

The Dolby system must be used both when making a recording and when playing it back. During recording, the higher frequencies are boosted at low program levels. In playback, they are reduced, in an exactly complementary fashion. The net frequency response of the system is unaffected, but any noise introduced by the recorder is reduced by 6 to 10 dB. With the Dolby system, a good cassette recorder will have less noise than almost any program source one might use, and the hiss problem can be forgotten.

Many manufacturers of recorded cassettes use the Dolby process in their releases. When played back on a Dolby-equipped machine, their noise level is generally insignificant—a marked contrast to the usually very audible hiss on ordinary commercially recorded cassettes. Even if the playback machine lacks the Dolby circuits, the Dolby-ized cassettes can be played with excellent results. They may sound a trifle bright, but amplifier tone controls can usually take care of this, and give a measure of hiss reduction at the same time.

Several other noise-reduction systems have been developed, both in Europe and Japan. Although differing in specific details, they are all "dynamic low-pass filters," whose cut-off action is controlled by the level and frequency content of the program. Unlike the Dolby systems, they do not require specially processed program material, but under certain conditions their action can sometimes be heard as a "swish" of the background noise. In general, however, they work very effectively and imperceptibly.

#### CHROMIUM-DIOXIDE TAPE

One of the significant factors in cassette sound

improvement has been the development of chromium-dioxide ( $\text{CrO}_2$ ) tape. Properly used, it can slightly extend the high-frequency response and significantly reduce noise levels. However, it requires somewhat different bias, equalization, and operating level for fully effective results. Many recorders now provide for its use with a switch marked " $\text{CrO}_2$ " and "Normal." With a suitable recorder, the somewhat higher price of  $\text{CrO}_2$  (available from several manufacturers) is justified for anyone wishing to get the most from his cassette machine.

Users of recorders not equipped for  $\text{CrO}_2$  tape need not feel limited in their recording activities, however. There are a number of ferric-oxide cassette tapes whose performance is almost equal to  $\text{CrO}_2$  formulations. Some, like  $\text{CrO}_2$ , are relatively expensive, but others can be purchased for little more than an ordinary tape of less distinguished performance.

#### AUTOMATIC LEVEL CONTROL

Several cassette recorders have automatic level recording control. These circuits adjust the recording gain to prevent distortion from sudden peaks. During periods of low average level, they increase the recording gain so that a wide volume range can be recorded without fear of distortion during loud passages and without attention from the operator.

Since an ALC circuit alters the program dynamics, it is usually used only for voice and non-critical music recordings. Lectures and classroom activities are typical situations where ALC is a desirable feature. Most ALC-equipped machines also have a defeat switch so that their recording levels can also be adjusted manually.

#### SUMMARY

Once you are aware of what a cassette recorder can do—and what it *cannot* do—and review your own planned usage of the recorder, you can compare manufacturers' specifications, features, and prices, and make an intelligent selection.

As with most audio components, the higher priced models have better quality and more flexibility. Decks selling for less than \$100 may be quite good, but should be listened to carefully before purchase. Lower-priced machines which include playback amplifiers and speakers should be viewed with suspicion unless top quality is not one of your requirements.

There are many recorders with first-rate performance selling between \$100 and \$200. Those over \$200 usually have Dolby circuits and/or other refinements. ☐

# Lab Report on CASSETTE RECORDING TAPES

The "correct" cassette tape depends on the record bias current. If it is fixed, then use the tape suggested by the manufacturer. If it can be varied, then you have a wide choice of tapes.

By JULIAN D. HIRSCH, Hirsch-Houck Laboratories



**I**F you want to obtain the best performance from magnetic tapes with respect to frequency response, distortion, and noise, you must have a careful balance among recording bias, recording and playback equalization, and recording level. Although the design of the tape recorder's heads and electronic systems is a vital factor, for any given recorder and tape formulation the key parameters are the bias and equalization characteristics.

The frequency response of any magnetic tape is far from "flat" and considerable equalization is required at both high and low frequencies to meet audio recording standards. The equalization is divided between the recording and playback amplifiers, but playback frequency response is standardized to permit tapes made on one machine to be played on another. This still leaves the recorder designer considerable latitude in setting bias levels and recording equalization for best results with his heads and available tapes.

The bias is an ultrasonic a.c. signal (often as high as 100 kHz) superimposed on the audio signal being recorded. It is used to minimize the distortion caused by the inherent nonlinearity of the magnetic tape coating. Bias also affects the recorded level and frequency response, particularly at high frequencies. The bias, recording equalization, and tape properties are inextricably linked and in every

case require some compromise among level, frequency response, and distortion.

Except in the higher price brackets, most home tape recorders have no adjustments, accessible to the user, for optimizing performance with any particular tape. Such recorders are generally designed to operate satisfactorily with a variety of tapes, although the manufacturer's specifications may be realized only with a certain recommended tape formulation.

Cassette recorders, which must extract the last bit of performance from the tape in order to meet reasonable high-fidelity standards at their 1 $\frac{7}{8}$ -ips operating speed, are especially critical in their adjustment for the specific tape used. In particular, the bias level is extremely important if a reasonably uniform response in the 8000 to 16,000-Hz band is to be obtained. Although the user normally has no means of optimizing bias for his tape, the recorder manufacturer often recommends specific tape brands and types which will enable his specifications to be met, and qualified service technicians can adjust almost any machine for use with any tape.

We recently made an extensive study of cassette tapes—some 40 different types—to determine the range of performance one might expect from them with a single recorder whose operating conditions



were held constant throughout. Our data suggested that optimizing the machine for each tape could greatly extend the performance. Now we have evaluated a smaller group of cassette tapes, adjusting the recording bias for flattest overall frequency response with each tape.

The Advent 201 cassette recorder was used in this test since it is not only representative of the current state-of-the art in cassette recorders, but is also the only one we know of which provides external access to the recording bias adjustments. We made test frequency-response measurements with each tape type, adjusting the bias until the flattest response was obtained over the full frequency range of the machine. A calibrated scale allowed us to return to any bias setting at will, and to compare the optimum bias levels for the various tapes. All bias-level indications were arbitrary and relative, since any absolute readings would have no significance for any other type of recorder. Whenever possible, a C-60 cassette was evaluated; exceptions are noted in our tabulated data.

#### TEST PROCEDURES

All frequency-response measurements were made at a recorded level of -30 dB, relative to the "0 dB" reading of the recorder's meter. This was necessary to avoid tape saturation at high frequencies, which could give erroneous frequency response indications if a higher level were used.

Recordings were made over the full-frequency range with each tape. If the playback response in the 10,000-15,000-Hz range deviated more than about 2 dB from the mid-range level, the bias was adjusted slightly and the measurement was repeated. Increasing the bias reduced the high-frequency response, while less-than-optimum bias resulted in a peaked, or accentuated, high-frequency response.

Using the optimum bias setting, we made 1000-Hz recordings at several levels around the 0-dB point, observing the playback distortion for signs

of overload. We determined the level (relative to 0 dB) which resulted in 3% distortion (predominantly third harmonic) in playback. The 1000-Hz output from this "3% distortion" level was considered to be the maximum usable output of the recorder with each tape.

We operated the recorder in the "Record" mode, with no input signal, and during playback measured the noise level (so-called "bias noise"). This is expressed in decibels below the maximum recording level. The noise measurement was unweighted, but was limited to a 22-kHz bandwidth to eliminate undue influence from inaudible wide-band noise.

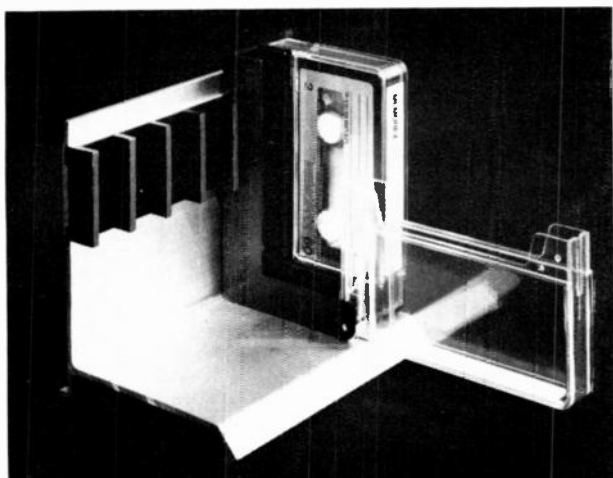
One of the major weaknesses of cassette tapes is the output fluctuation due to tape coating inhomogeneity ("dropouts") and erratic tape-head contact. The latter is a function of the mechanical design and assembly of the cassette. Unevenness of tape hub friction and tape winding can cause an irregular output amplitude similar to that resulting from actual tape-coating defects.

We evaluated each cassette for output uniformity by recording a 10,000-Hz tone for 3 minutes, using the middle of the tape where best performance can be expected. Many cassettes are somewhat erratic near the ends of the tape. We then recorded the playback output on our graphic-level recorder for the full 3 minutes. The degree to which the trace departed from a narrow straight line was an indication of tape-output non-uniformity. Mechanical problems within the cassette could be distinguished from tape dropouts by their periodic occurrence.

Finally, the method of cassette assembly was noted. Some cassettes use screw-assembled (S) cases. If the tape breaks, it is usually possible to open the cassette and retrieve both ends for splicing. On the other hand, the welded (W) case used on most cassettes cannot be opened non-destructively, so that a tape breakage means the loss of the cassette.

Two of the cassettes employed unique mechanical features, not found in any of the others. The BASF C-120 "Chromdioxid" was packaged in the new BASF "SM" design. This refers to an internal construction which places the tape windings under controlled tension to prevent uneven winding. Also, an additional pair of slots is included in the back of the cassette, adjacent to the tabs which can be removed to prevent recording over a previously recorded program. These slots will allow automatic selection of special bias and equalization for CrO<sub>2</sub> tape in future recorder designs, although none of these is yet available. The Auricord "PRO" cas-





*Memorex offers "library" storage for six tapes.*

settes are made of cast metal, instead of the usual plastic. This is claimed to provide superior dimensional stability with temperature variations, and to eliminate problems from build-up of static charges during operation.

#### TEST LIMITATIONS & QUALIFICATIONS

As we have stated, several interrelated operating parameters determine the ultimate performance of any cassette tape. By appropriate adjustment of bias *and* recording equalization it is possible to optimize any cassette in any recorder. However, recording equalization is rarely user-adjustable, and recorder manufacturers are reluctant to encourage any tampering with the internal factory settings.

The only firm conclusions one can draw from our tests relate to the degree of optimized performance obtainable on an Advent 201 recorder, with bias as the variable parameter. In a broad sense, our findings should apply to most other cassette recorders. It is always possible, however, that with a different recording equalization characteristic, a different bias level would be required and one might obtain a different signal-to-noise or distortion measurement on any given tape.

We have also found some variation between cassettes of the same make and type, with respect to optimum bias and output uniformity. Since our tests, in most cases, were limited to a single sample, no guarantee can be offered that all samples of the same type will be identical. Doubtless some manufacturers produce a more uniform product than others, but a meaningful evaluation of this factor is beyond our capabilities.

#### TEST RESULTS

We tested 20 different cassettes, from 13 manu-

facturers. The overall frequency response was largely a function of the recorder design, and differences between tapes were insignificant once the bias had been optimized. The major differences were in the 14,000- to 16,000-Hz range. The output of some tapes fell off rapidly above 14,000 Hz, while others showed a useful output between 15,000 and 16,000 Hz. In practical, audible terms, these distinctions are of little importance.

From the standpoint of optimum bias, most of the cassettes fell into two categories, which we called "low-bias" and "medium-bias" tapes (purely arbitrary classifications, of course). Within each category, all the tapes gave their best frequency response with the same bias. The so-called "standard" tapes require a "low" bias while most "extended-range" tapes fall into the "medium-bias" category. The only "high-bias" tapes in the group were the Hitachi and Maxell "Ultra-Dynamic" cassettes. The Sony tapes required a bias intermediate between the "medium" and "high" settings, while the Soundcraft and 3M "High Energy" tape operated between the "low-" and "medium"-bias ranges.

The three chromium-dioxide tapes were tested with the special bias and equalization settings provided by the CrO<sub>2</sub> switch on the Advent 201. No attempt was made to change the CrO<sub>2</sub> bias, which



was already the optimum for these particular tapes.

The effect of bias on output and frequency response, for three representative tapes in the "low-", "medium-", and "high-" bias categories, is shown in Fig. 1. Note that a bias setting giving flat response with a "low-bias" tape results in a rising high end with "high-" and "medium-bias" tapes. On the other hand, a recorder biased for a "high-bias" tape will suffer a loss of highs with "medium-" or "low-bias" tapes.

The output uniformity was graded as A, B, or C. The fluctuation in the A and B outputs is periodic, indicating a slightly uneven hub friction or mechanical tape-to-head contact. In the C examples, the trace is slightly thickened and shows a little more random variation.

The other data is presented in tabular form. Most of the column headings are self-explanatory. The Relative Output referred to 3% THD is the

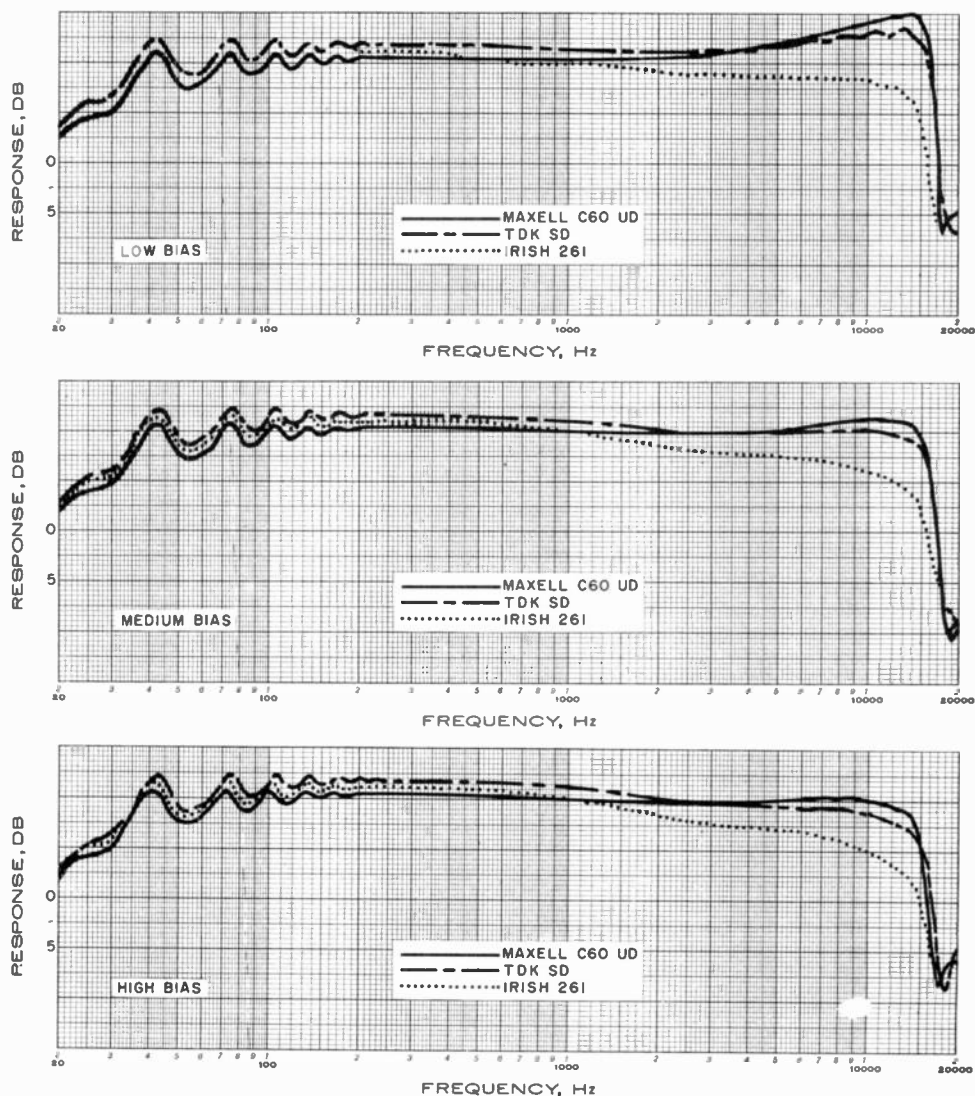
algebraic sum of the recording level giving 3% distortion and the relative playback levels from a 0 dB recording level. Since a tape delivering a very high output from a 0-dB input might distort at a lower level, compared to some tape with less output but the ability to be recorded at a higher level without distortion, this column indicates the actual useful relative outputs of the various tapes, as operated in the Advent 201 recorder.

The prices shown are manufacturers' list or recommended retail prices. In most cases this means a C-60 cassette, but where C-90 and C-12 units were tested, their prices are listed instead.

#### SUMMARY AND COMMENTS

As the data shows, unless one uses the type of tape for which the recorder is biased, there is little chance of realizing the potentially wide range, low noise, and low distortion designed into the record-

*Fig. 1. Frequency response of three representative tapes in the "low," "medium," and "high" bias categories when (top) the recorder is supplying low bias, (center) when it is supplying medium bias, and finally, (bottom) when supplying high bias.*





Tape Type	Case Type (S or W)	% THD at			Recording Level for 3% THD (dB)	Bias Noise	Output Uniformity	Relative Output (re 3% THD)	Price
		−3 dB	0 dB	+3 dB					
Low Bias									
Capitol	W	2.2	3.3	6.3	−0.5	−50 dB	B	+0.5 dB	\$1.19
Irish 261	W	—	3.0	—	0	−49.5	B	+1.0	1.85
Memorex	W	2.3	2.9	5.8	0	−51	C	+1.7	2.75
TDK LN	S	1.8	2.1	4.0	+2.5	−52	B	+2.0	1.29
Low/Medium Bias									
Soundcraft	W	2.0	2.5	4.3	+1.5	−51.5	B	+3.2	2.65
3 M "High-Energy"	W	2.7	4.0	7.2	−2.0	−51	B	+2.0	3.70
Medium Bias									
Ampex 362	W	1.9	2.7	4.4	+1.0	−51.5	B	+1.0	2.95
Audiopak (Audiotape)	W	2.1	2.8	4.3	+1.5	−50.5	B	+3.2	2.65
Auricord "PRO"	S*	1.9	2.5	4.2	+2.0	−50	B	+2.5	3.95
BASF C60LH	S	1.6	1.9	2.6	+4.0	−54.5	B	+4.0	2.65
Irish 262	W	1.9	2.7	4.2	+1.0	−50	C	+1.0	2.55
TDK SD	S	1.6	1.9	2.4	+4.0	−55	B	+5.3	1.99
Medium/High Bias									
Sony C-90†	S	1.7	2.2	3.0	+3.0	−53.5	A	+3.7	1.69
Sony UHF C-60	S	1.6	2.0	3.0	+3.0	−54	B+	+4.5	2.29
High Bias									
Hitachi UDC-90†	S	1.9	2.0	3.0	+3.0	−53.5	A	+2.5	4.50
Maxell UDC	S	2.0	2.0	3.0	+3.0	−53.5	B+	+3.2	3.75
Chromium-Dioxide									
Ampex 363	W	2.1	2.2	2.7	+3.5	−54	B	+2.0	3.95
BASF C-120†	S	1.8	2.3	3.2	+2.5	−52.5	B	+0.9	8.29
Irish 363	W	2.1	2.3	2.9	+3.5	−54.5	B	+1.0	3.75

\*Metal cassette

†All C-60 cassettes except as noted.

*Characteristics of cassette tapes, by bias categories, along with relative outputs and prices of the various brands tested.*

er and the tape. At present, Advent is the only manufacturer we know of offering this bias adjustment capability for the technically competent consumer, but qualified service agencies should be able to do the same for most other machines.

Most tapes are very similar in their noise characteristics, with a signal-to-noise ratio of 49 dB to 52 dB in this machine. The premium tapes (BASF LH, TDK SD, Sony, Hitachi UD, and Maxell UD) average 3 to 5 dB better, as do the chromium-dioxide tapes. The chief measurable advantage of the latter is their flatter response at the extreme high-frequency end, with generally 3 to 5 dB more output at 15,000 Hz than the best ferric-oxide tapes. On the other hand, although they were slightly "flatter" above 10,000 Hz, there was no significant difference between them and the ferric-oxide tapes below 13,000 or 14,000 Hz. Many of the tape brands we tested are also available in C-90 and C-120 cassettes, providing longer playing time. One cannot assume that the performance of a longer playing cassette will equal that of a C-60 of the same brand. The longer playing versions use thinner tapes and have thinner magnetic coatings,

as well as potentially greater mechanical problems. However, judging from the few C-90 and C-120 cassettes included in this test, a good brand of tape can deliver excellent performance in any length.

The majority of the tapes had good output uniformity characteristics. We listened carefully to music recordings to judge the audibility of each grade of performance in our uniformity classification. With a B or C tape, an occasional roughness could be heard, but its offensiveness depended strongly on the nature of the program, as well as the sensibilities of the listener. Pop music is relatively tolerant of minor fluctuations, while most classical music is not. The B+ and A tapes were essentially free from audible roughness and certainly came very close to open-reel tape in this respect.

It is noteworthy that one manufacturer's "standard" tape may be better than another's "low-noise" tape, and sometimes there is little difference between the "premium" and standard tapes (often called "low noise") of the same manufacturer. A greater difference might be apparent under different test conditions. □

# Tips for Buyers of 8-TRACK CARTRIDGE MACHINES

All 8-track cartridge machines are basically the same in regards to the transport mechanism. There is, however, a wide difference in price depending on what features you want. Decide first on your particular needs before buying.

By **FRED PETRAS**



**I**F you were considering a cartridge tape player a few years back, you most likely thought of it for use in your car—for stereo music on the move, free from the fading, noise, and commercial interruptions of radio broadcasts. Two-channel stereo in the car is commonplace now. You need merely head for the nearest automotive parts store or car-tape specialty shop, state your budget and possibly a favorite brand name, and have a unit installed all within an hour or two.

Most basic eight-track stereo players for cars are of similar quality and generally have the same power and output and features at any given price level. Prices range from \$45 to \$80, exclusive of speakers and installation charges. Deluxe models offer such options as higher power, the convenience of a fast-forward mode, fine tuning for accurate alignment of the playback head, and special mountings to foil theft. The range is \$80 to \$100. And then there are sets with built-in radio sections—AM, AM/FM stereo or FM stereo alone. They range in price from \$110 to \$160 in nationally distributed major brands. A key reason for the similarity of product is that only a handful of companies makes the basic mechanisms used in the various lines and competition is fierce. Thus, prices of any given type of equipment are very close and one machine looks and performs much like the next.

Today there's a new attraction in mobile and at-home eight-track sound. It is four-channel stereo, or quadrasonic sound. In eight-track form, it goes under the designation "Q8." A Q8 cartridge holds two four-channel programs instead of the four two-channel programs in a traditional Stereo-8 cartridge and since it requires twice as much tape, costs a dollar or more per cartridge. A Q8 can be played only on equipment designed specifically for it, if all four recorded tracks are to be heard. However, you can play the existing two-channel cartridges on a Q8 machine, with the sound emanating from all four speakers, if you prefer.

Quadrasonic sound is reproduced through four speakers that surround the listener. Depending on the intentions of the recording engineer, the result can be instruments and voices coming from all directions, or an augmented sense of concert-hall space and acoustics. Right now there are at least a dozen companies offering Q8 players for automobiles. They range in price from \$100 to \$120 in lesser-known brands, and from \$130 to \$160 in major brands. These prices are exclusive of speakers and installation. The sets offer adequate power output for enjoyable listening in an auto environment, often with wattage to spare for those who want to be aurally overwhelmed.

Q8 players operate much like regular two-channel models, but usually have extra volume controls for the two additional speakers. Otherwise, you merely slip the cartridge in to start the machine and sit back and listen as it plays through to the end, at which point the cartridge is removed, or it will continue to play over again, just as a Stereo-8 would.

Recently there has been an upsurge of interest in eight-track equipment for the home. Many people who bought auto players over the past two or three years are buying home players now so that they can take their cartridges indoors and listen to them in the house. If you'd like to join them, you can do so in any number of ways. If you already have a stereo system in compact or component form, you can add a cartridge deck for under \$50. You just connect the audio cables to the tape jacks of your existing equipment and plug in the a.c. power cord of the deck. (If you own a modern stereo console you may find that it also has jacks for attaching a cartridge deck.) Most models in this group—priced up to around \$90—have only a single control: a program-selector button with related track indicator lights. There's no need for additional controls because you use the volume, balance, and tone controls of your component system or console.

A second category of decks consists of rec-

ord/playback models, which enable you to make your own tapes from the tuner, record player, or open-reel or cassette deck that may be part of your stereo system. You can also record your own "live" stereo programs via microphones. Such decks start at \$99.95 and touch the \$189.95 level. You'll find at least twenty different brand names represented in the marketplace.

In addition to looking for a deck that provides good sound quality from prerecorded tapes, pay attention to the quality of sound from the tapes the deck itself records. I suggest that you take along a disc record or open-reel tape with which you are familiar to see how closely the sound you record on the cartridge matches the original. Expect to hear some background tape hiss in the cartridge

you record, but make sure it is not of disturbing proportions. Another *caveat*: seriously study the way a recorder deck operates, with a view to selecting one that will be the easiest to handle. Some models are tricky to use. Careful timing is required for arranging programs so that they proceed properly from track to track without interruptions or overlapping of the musical selections. Insist on demonstrations of models you are considering. And watch the demonstrator; if he has trouble making a sample recording, you'll have trouble too. Reject machines that are unwieldy to operate.

Included in the deck group are double-duty models meant for home and car use. If you do not have a car unit but might want to own one some day, this type might well be worth investigating.



*The Panasonic RS-803US is a deck combining a tape transport and stereo preamp and is designed to be used with separate power amplifiers and speakers. It can also be connected directly into your own hi-fi system.*

*Telex's Model 48-D is a sophisticated automatic tape cartridge changer which can be plugged into any standard stereo power amplifier. It switches and selects up to 12 cartridges in four operating modes and can be operated in either a vertical or horizontal position.*



*The Hitachi TPQ-124A is another deck which is designed to be plugged into your hi-fi system. Performance is tied directly to the quality of your audio equipment.*



*Lear Jet's A-250 tape player will operate from 12-volt negative-ground automotive batteries. Units for cars vary considerably in quality, ranging from \$45 on up.*



For example, \$147 will buy a 10-watt automobile player plus a home adapter with speaker that will, in effect, be two sets. Play the unit in the car while traveling and then draw it out of its mounting, take it into the house, and slip it into the adapter for a home ensemble that is ready to play. Other conversion models of this type will accommodate any automobile stereo player.

You'll find at least fifty brands of cartridge-player ensembles in modular form. Models for home use are generally three-piece outfits, consisting of the tape player and amplifiers in one cabinet, plus two speaker systems in matching enclosures. These have volume, tone, balance, and track-selector controls with indicator lights. Some also have a stereo headphone jack and most have input connections to accommodate a record player with ceramic or magnetic phono cartridge, or a tuner. Power outputs are generally adequate for the speakers provided, but permit little leeway should you want to use bigger or better speakers. Prices start at around \$80 and go up to about \$150. My advice is to select ensembles priced over \$100 to obtain decent sound quality.

Another group of three-piece ensembles have the cartridge player built into an AM/FM stereo receiver in one housing plus two separate speaker systems. These can also accommodate auxiliary equipment such as a turntable or other tape player. Prices start at about \$90 in nationally distributed brands and go up to around \$200. Count on spending at least \$125 for reasonably good radio and tape sound quality.

The so-called "home entertainment centers" combine an AM/FM stereo radio with an eight-track cartridge deck and phono disc player in one unit and come with matching speaker systems. Again, the selection is broad and starting prices are relatively low—about \$160. Since these are, to all intents and purposes, "final" systems, I advise you to buy the best you can afford, with \$200 as a minimum outlay.

For carry-around stereo you'll find all kinds of portable equipment which will operate from batteries at the beach or picnic area, on a.c. on the patio, in your summer cottage, or at a trailer camp, or even from the 12-volt battery in your boat or car. Most of the stereo portables come in two piece form. One unit houses the player mechanism and electronics, plus one speaker while the other part houses the second speaker. For travel, the two sections clip together to form a single handy package weighing as little as 10 pounds. The sound from most of these sets is surprisingly good, even in the inexpensive models starting at around \$50.

You'll find two-piecers with built-in AM/FM stereo tuners from \$80 up.

A few companies sell equipment for stereo cartridge recording on the go. One such unit is a two-piece portable that operates from a.c., internal dry cells, or from an external power pack and will record from microphones as well as from the built-in AM/FM stereo radio. Such equipment ranges in price from \$159.95 to around \$200.

Portable mono eight-track players are considerably smaller than their stereo counterparts and therefore much easier to carry around. During playback they mix the two stereo channels on the tape into a single mono channel which is then reproduced by a single speaker. Such units start at about \$40 but with an AM radio added they cost at least \$52.50.

While quadrasonic sound is big news in car stereo, it is even bigger in equipment designed for the home. Some thirty companies have rushed in to meet the needs of those who will be looking into the new dimensions Q8 has added to tape listening. The equipment comes in various formats. These range from a playback deck that connects to a four-channel amplifier and speakers to a deck with the extra two channels of amplification needed to provide existing two-channel stereo equipment with four-channel capability.

Compact playback ensembles offer a package consisting of a deck with amplifiers in one enclosure plus four separate bookshelf-size speaker systems. There are quadrasonic receivers which include built-in Q8 players (but without the necessary four separate speaker systems), as well as "audio centers" which include a four-channel cartridge player, four-speed automatic turntable, an AM/FM stereo tuner, and four 25-watt amplifiers—all in a single table-top unit. These are all available now. In the near future, you will see other types, including a.c. and battery-powered portables for Q8 on the go in any surroundings.

The final category of cartridge equipment involves stereo consoles. This equipment takes two forms—already built in or as an option. For example, if your budget is limited, you can buy a two-channel stereo console without cartridge player and later add a cartridge deck made specifically for that console. Or, if your budget is healthy, you can buy the console with the cartridge mechanism integrated in the design. Prices of consoles with built-in cartridge decks start at about \$230 and range up to about \$600.

Consoles with Q8 capability start at about \$470. At present, such consoles come with the Q8 players already installed or as an optional accessory. □

# THE DOLBY Noise-Reduction System

While there are several different types of noise-reduction systems, the Dolby design is the most popular and the most effective.

By MANNIE HOROWITZ

**N**OISE can be defined as any undesired transmission which accompanies a desired signal. Should the amount of noise be minute when compared with the signal, it is unobtrusive and considered negligible. When it is comparable in magnitude to the intelligence to be reproduced, it will interfere with or completely obscure the program material. Hence, noise must be reduced to the smallest possible levels.

Noise may be due to various factors. Radio and tape recordings suffer from noise generated by radiation or induction from electrical equipment. Added to this, the coating on the tape used for recording consists of closely packed tiny particles. Although they appear identical in size and magnetic characteristics, there are variations from one particle to another. These variations are reproduced as high-frequency noise or "tape hiss."

Theoretically uniform noise is known as "white noise." Interference of this type appears as a hiss and identical power is delivered at all frequencies. Tune your FM receiver between channels and the sound you hear, if your receiver does not have a quieting circuit, is similar to white noise.

In addition to noise due to the tape, the semiconductors in the recorder are the source of two types of noise. One, *partition noise*, is caused by the irregular division of the total transistor emitter current between the elements (base and collector) in the device. The second important source of noise in the transistor is *shot noise*. This is due to the discrete particle nature of electricity and the variations in the motion of these electrical particles through the semiconductor device.

Noise interference is a wide-band phenomenon. The ear responds to noise at all audible frequencies but the most annoying is high-frequency hiss, above about 5000 Hz. Elimination or reduction of noise present in the top octave of the audio range is a desirable goal and various circuits have been designed to accomplish this.

## SCHEMES TO MINIMIZE NOISE

Before any method is applied to reduce noise, the amplifier must be designed so that it will be as noise-free as possible. Once circuit noise is minimized, the next step is to reduce noise originating from tapes or from any other medium used to reproduce program material.

One of the most widely used methods to minimize the reproduction of high-frequency noise employs a low-pass passive filter. Low frequencies are passed freely to the output of the amplifier while the upper portion of the audio band is attenuated. A common arrangement consists of one resistor and one capacitor in a circuit designed to reduce high frequencies, letting them roll off at the eventual rate of 6-dB-per-octave. That is to say, every time the frequency doubles, the gain of the circuit is reduced by an additional 6 dB. If, for example, you wish to reduce noise by 10 dB at 5000 Hz, noise will be reduced by about another 6 dB at 10,000 Hz when the filter is used.

However, not only is the interfering noise reduced at these frequencies, but the desirable music or program content is reduced as well and high-fidelity qualities are lost. In fact, some attenuation begins to become quite evident at the frequency where the gain is reduced by 3 dB, or at 1600 Hz in this case.

The situation is improved by using two resistor-capacitor networks so that the eventual rolloff is at the rate of 12-dB-per-octave (twice the 6-dB-per-octave rolloff rate of one network). If the gain at 5000 Hz is reduced by 10 dB with such a circuit, the frequency at which the attenuation becomes evident (the gain of the circuit is reduced by 3 dB) is now about 2100 Hz. This is an improvement over the previous case, but the output from the amplifier is still badly limited in bandwidth.

One method used to improve the signal-to-noise ratio when recording on tape is to "ride the gain."

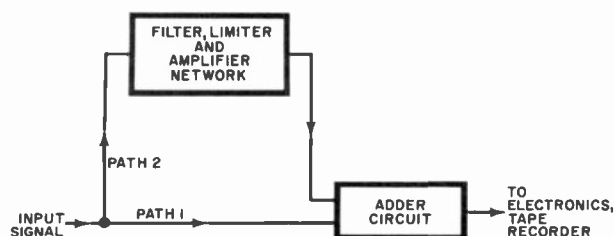


Fig. 1. The adder circuit which is used when recording.

A maximum limit on the size of the signal that can be fed to the record preamplifier is set by the distortion or saturation characteristics of the tape. Weak signals within the tape noise can be increased manually before being fed to the record amplifier. These signals can be boosted sufficiently before being recorded so that they can later override the noise during playback. Average and high-level signals can be manually limited in amplitude when fed to the recorder so that they will not saturate the tape. These signals are usually sufficient to mask any tape or record/playback amplifier noise similar to them in frequency.

A variation of this procedure uses an electronic compressor to limit the output as the gain increases. The relative output-level difference between the loud and soft passages of music is reduced. Extremely loud passages of music are subdued so as not to overload the tape or tape amplifiers, while relatively low intensities of sound are recorded at comparatively higher levels. The opposite of the compressor—the expander—is placed at the output of the tape recorder to restore normal amplitude relationships.

One big drawback to this system is the time it takes for the compressor and expander to go into action. Another defect is “breathing.” Background noise is alternately increased and decreased, producing very annoying listening conditions.

Another very successful means of improving the signal-to-noise ratio uses pre-emphasis and de-emphasis in the recording and playback processes, respectively. Standard curves specify that the high frequencies be emphasized a fixed amount while recording on tape. This band is reduced an equal amount during the playback process so that the overall frequency response is level. Noise is overridden by the large high-frequency signals placed on the tape in the record process and is reduced during playback due to the attenuation of the high end of the band. This system is used on all tapes and playback equipment currently on the market.

#### THE DOLBY SYSTEM

Perfecting the procedure just described, and adding some additional brilliant features, Dr. Ray

Dolby evolved an excellent method of reducing noise and hiss, along with any other type of undesirable low-level material found on tapes.

First, let us state the one thing this method of noise reduction *cannot* do. It cannot eliminate noise already recorded on the tape. Similar to the compressor/expander and preemphasis/de-emphasis methods, the program material must be processed before it enters the recorder electronics and after it emerges. Here is how the Dolby B-type system used in home recording equipment works.

However annoying, noise on tape is usually at a much lower level than the music or other program material. On loud passages, noise is masked by the program material. You do not hear the noise which may be 40 or 50 dB below the level of the desired sound.

During quiet passages, however, the level of noise is comparable to the level of the music. It is quite objectionable. The Dolby noise-reduction system discriminates between loud and soft passages and attenuates noise only when it can be annoying, as is the case when low levels of material are being reproduced.

Tape hiss, being a high-frequency phenomenon, is poorly masked by the low frequencies in the program material, even when the amplitude of the signal is high. Therefore, the Dolby system separates the high-frequency band from the low frequencies. Large signals at low frequencies will not keep the high-frequency noise from being attenuated. Only high-frequency amplitudes determine when noise will or will not be reduced.

Should fixed-filter circuits be used to determine or separate the high-frequency band from the low frequencies, breathing can become evident. Instead of a fixed filter, a variable type is used. The frequency characteristic automatically adjusts itself,



Advent's Model 100A with Dolby circuitry (top) and Teac's AN-80 outboard Dolby system. It operates on record or playback, but not both simultaneously.





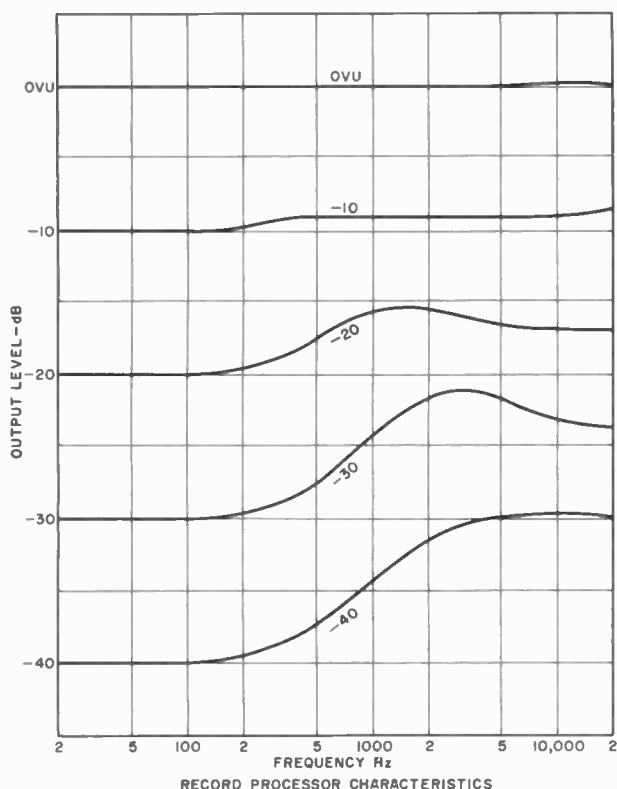


Fig. 2. Characteristics of the Dolby record processor.

by use of a feedback circuit, for the best performance.

Briefly, the input to the tape recorder takes the form shown in Fig. 1. The input signal follows two paths in the Dolby circuit before being fed to a summing or adder network. One path is directly to the adder. The second path is through a network which separates the high-frequency, but low-level input signals from the rest of the material to be recorded. The output from the network is significant above 1 kHz, rising to a maximum level at 5 kHz and above. The selected signals are amplified and fed to the adder. The sum of the direct signal and the amplified low-level, high-frequency signals are then fed to the input of the tape recorder.

Let us say that the high-frequency band, those frequencies above 5000 Hz, and the level-selective network are actuated when any signal over 5000 Hz falls to 1% or less of the maximum input signal. This low-amplitude signal will then actuate the level-selective network and all frequencies of 5000 Hz and above are then amplified 2.16 times. The low-amplitude portion of the signal, instead of being 1% or less of the maximum input signal, is now 1% + 2.16% or 3.16% which is equivalent to increasing the low-amplitude signals by 10 dB. A compressor-type action is accomplished here as the low and high levels of the signal feeding the

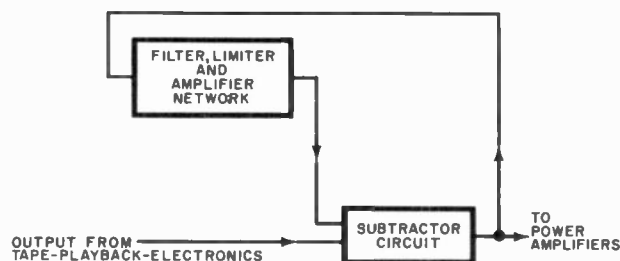


Fig. 3. A subtractor circuit is used during playback.

tape recorder approach each other in amplitude. Even though a wide gap exists between maximum and minimum amplitudes, the difference is narrowed by a factor of 3.16 or 10 dB. (See Fig. 2.)

It should now be obvious that any signal 1% or less over 5000 Hz will be increased 10 dB while those signals over 1% will be allowed to pass through without any Dolby action. The direct opposite will be true on playback. Any signal that is of 10-dB level or below will again actuate the level-selective network and, in this case, attenuate all high frequencies to their previous normal level.

The simple description above implied that the circuit has a sharp threshold at the 10% level. In practice, as the high-frequency signals rise above the 10% level, so the amount of boost introduced falls progressively from the 2.16 times. At levels of -20 dB and above, the boost is negligible, thus avoiding any possible over-modulation produced by higher peak signal levels than normally used.

The output from the preamplifier stages of the tape recorder feeds a network with frequency characteristics similar to the one at the input (Fig. 3). However, this time the path is through a subtractor. All the factors added to the signal by the network in Fig. 1 are now reduced by an equal amount. The original program material is restored in proper amplitude proportion, expanding the difference between the high- and low-amplitude portions of the signal. However, noise introduced by the tape and electronics is reduced by about 10 dB over what it would have been without the intervening Dolby circuits. The amplified high-frequency signals introduced at the input of the recorder are capable of overriding much of the noise normally generated while recording. Reducing gain of these frequencies at the output also diminishes the audible noise.

Although the system is complex, it can be made as a relatively simple and inexpensive circuit. The 10 dB reduction in hiss and noise makes it quite worthwhile. When playing back a Dolbyized tape through conventional equipment, it is only necessary to reduce the treble response somewhat, using the tone control. □

# How to Develop SOUND-ON-SOUND, SOUND-WITH-SOUND & ECHO

Use your reel-to-reel tape recorder  
to produce unusual creative effects.

By WILLIAM CAWLFIELD



THE tape recorder has always been used as a “re-creative” device. In other words, it has been used to recreate the sounds made by musicians and other performers. In this application it has done its work so well that today virtually all recordings originate on tape. The home recorder functions the same way—recording live music, FM broadcasts, phono records, or from another tape recorder.

The tape recorder is now making its appearance in the world of music as a *creative* instrument. It is being used to make music expressly for home listening—music which was never intended to be performed “live.” This is because the music was created in a studio by means of multiple recordings, overdubs, echo chambers, electronic synthesizers, and the tape recorder. One singer can become a chorus and one musician can become an entire orchestra, if he is talented enough.

The Moog synthesizer uses a tape recorder in order to achieve its utmost flexibility. Sounds have been speeded up, slowed down, or even reversed in order to achieve the results the composer wants.

This “creation” of music by tape recorder probably will be remembered by most as starting with

Les Paul and Mary Ford. The multiple recording technique did not go beyond this point until the Beatle era. This generation of musicians was not hindered by old ideas of what constituted music. They felt at home with the tape recorder and everything electronic and were therefore free to utilize every possible tool to create music.

Some of these techniques can be tried out in the home and many times they will give the owner a whole new set of possible uses for his audio system. Many reel-to-reel tape decks sold today are of the three-head type. In other words, there are separate heads for erase, record, and play. The techniques to be described will require this type of recorder.

## PRODUCING ECHO EFFECT

The simplest effect is echo. At a fast speed (15 or 7½ ips), it can make a singer’s voice more resonant while at the slower speeds (3¾ or 1⅞ ips), an eerie delay can be created. Try this first by recording with a microphone and the tape recorder set to Tape Monitor. If you have a deck plugged into a receiver, make sure the receiver is set to Tape Monitor as well. Now start recording. You

will notice a delay of your voice before it comes out of the speaker. By bringing the microphone close to the speaker and riding the gain of the amplifier and the recording level of the tape recorder, you can achieve a reasonably good echo effect with the echo occurring 6 to 10 times before it dies away or gets lost in noise. This method is not very convenient, though, and the best way is to feed part of the signal off the output of the deck back into the input. See Fig. 1.

This signal feedback is handled internally on many modern decks by means of an Echo switch. This switch is usually accompanied by a control that varies the amount of signal sent back. Remember this control adjusts only the amount of echo, not the time delay. The exact delay is a function of the speed and the distance between the record and

play head gaps. You will only be able to vary the tape speed. Some echo recorders used in studios actually have the play head on a slide that allows the operator a choice of time delays from thousandths of a second to many seconds.

If your deck is not equipped with an echo switch but does have separate mike and line-input controls, then you can patch in an echo. Connect a "Y" adapter to the output of the deck, one lead then goes to the receiver or amplifier and the other to the deck's line input. Now increase the mike-level control until a normal voice recording is obtained and then slowly advance the line-input control until an echo is heard. Juggle the two input controls until the desired balance between the original and delayed voices is achieved. Headphones are recommended for monitoring in order to eliminate

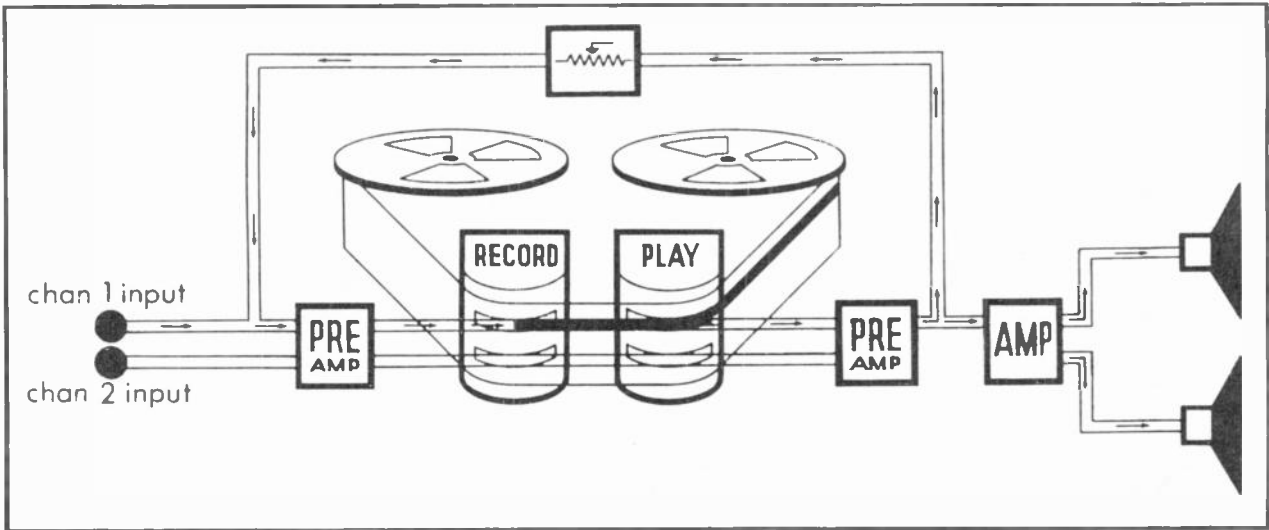
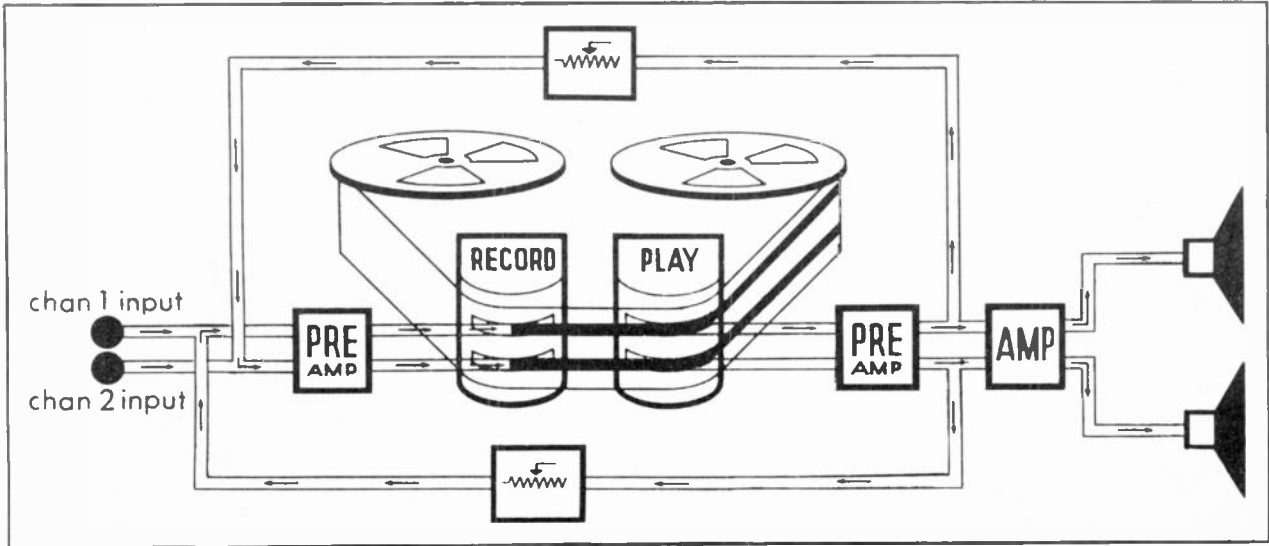


Fig. 1. Setup used to produce an echo effect on a monophonic tape recording.

Fig. 2. Setup used to produce cross-echo effect on a stereophonic recording.





any feedback that might occur between the microphone and the speakers. If a headphone is not used, make sure the speaker level is low enough not to cause any feedback.

Another interesting effect is to try stereo cross echo, where the echo occurs in the opposite channel. At 15 or 7½ ips this adds much more depth to certain music. The music is no longer coming from a dead studio, but sounds as if it were recorded in a large auditorium. This is accomplished by using two “Y” adapters and feeding the outputs back into the inputs but in opposite channels. See Fig. 2.

There is no need for “Y” adapters if your recorder has two sets of outputs. Some recorders have one set controlled by the tape/source switch and another set which comes from the tape only. If you have one of these recorders, then use these latter outputs for your patching.

### SOUND-ON-SOUND

If one wishes to sing a duet, trio, or even a quar-

tet with himself, he must use the “sound-on sound” technique. Sound-on-sound is requested by many recordists, but salesmen and most users find it difficult to achieve this interesting effect. Let’s see what happens when a duet is desired. See Fig. 3.

First, a single voice is recorded on channel #1, then it is played back and, while listening to channel #1, a person then records a second voice on channel #2, singing harmony with channel #1. But when both these channels are played back simultaneously, the operator finds the two voices are out of sync. This is because when he heard a particular word from channel #1 it came off the playback head and when he sang harmony in time with that word it was recorded by the record head a short distance from the playback head—just far enough away so that when both channels are played back they are not in sync. This is called sound-with-sound, and it can be used when it is not necessary to have perfect synchronization between the two tracks.

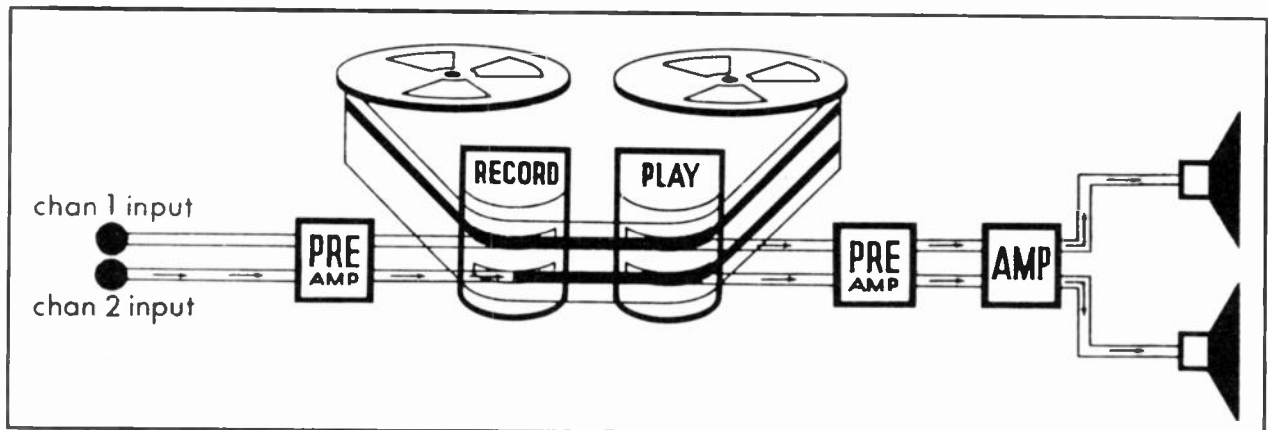
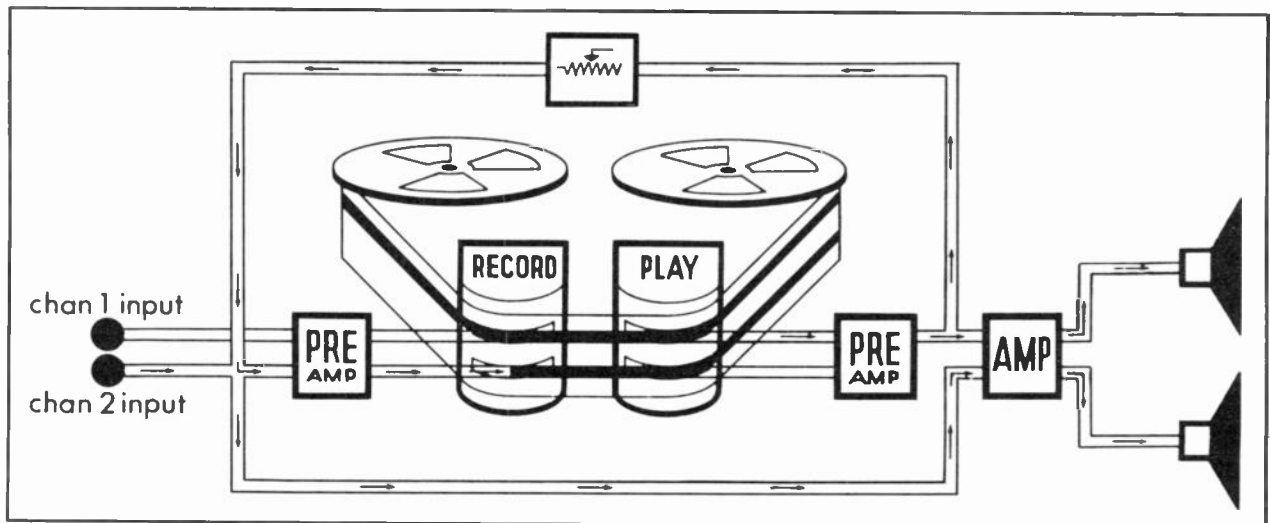


Fig. 3. With “sound-with-sound” arrangement, both channels are heard at once.

Fig. 4. The interconnection used to produce “sound-on-sound” on channel two.



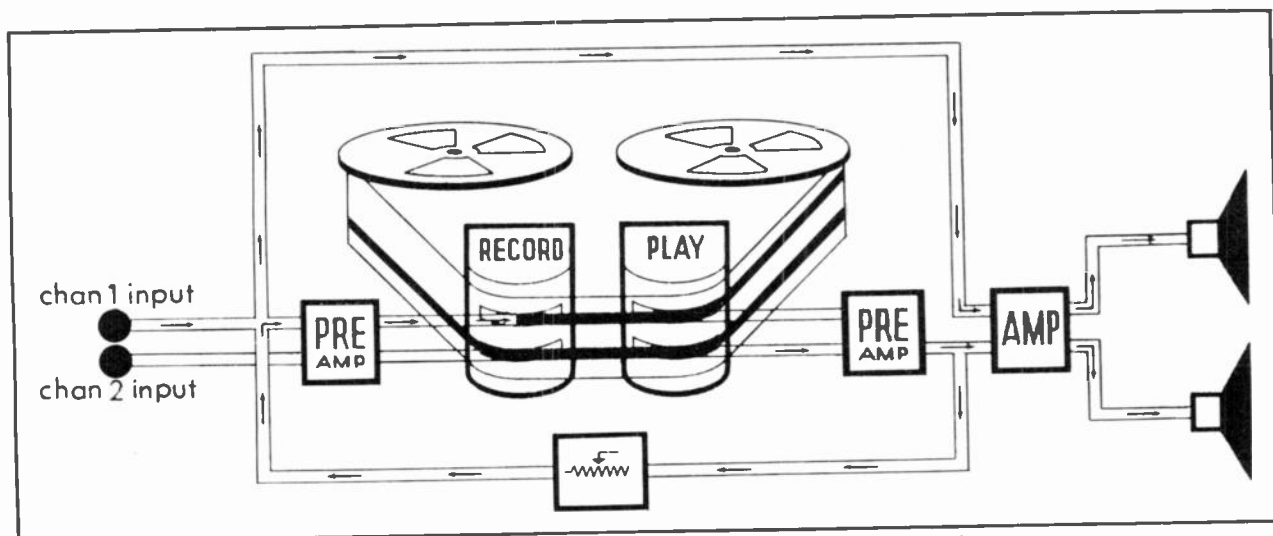


Fig. 5. Interconnection used to produce "sound-on-sound" on channel one.

"Sound-on-sound" was created to solve the above problem. It works like this. See Fig. 4.

When you hear the word on channel #1 that you want to sing with, you mix that word and your harmony together onto channel #2. The resultant duet is then on channel #2. Channel #1 still contains the original voice but, of course, out of sync. When listening to the duet, make sure to listen only to channel #2.

How this sound-on-sound is accomplished varies from recorder to recorder, but generally works as follows. As in the echo effect, a level control must be present in the feedback path from the output to the input. In this case the feedback is not to the same channel but to the opposite channel.

Record a single voice on channel #1, and then rewind. You will now want to monitor channel #1 in order to hear your previous recording. This is done automatically on some recorders and manually on others. At the same time, it is generally recommended that you "source" monitor the voice you will now record. It is very difficult to talk, much less sing, when you hear the words you say come out of the speaker or headphones a fraction of a second later. If you monitor in real time by way of a "source" monitor, then the problem is eliminated.

You now must blend the two signals to be recorded onto channel #2. Set your mike level as you normally would for your particular recorder. Set the level of the voice from channel #1 by actually making a trial run, and increase the level of the sound-on-sound control until an acceptable level is obtained. Now rewind and go for a "real take." You will find that it will take a few recordings to get the proper level and balance between the two voices.

When you are satisfied with the duet you might try a trio! This is nothing more than reversing the process. You mix the duet on channel #2 together with a new voice and record this trio on channel #1. See Fig. 5.

This movement back and forth from one channel to the next, with a new voice added each time, can be done quite a number of times. Depending on the quality of your recorder, you might expect anywhere from four to eight times before the recordings get noisy and blurred. Remember, in recording a "quartet" the original voice is actually a fourth generation copy. If your recorder has a hiss filter, use it. This will cut down the build-up of hiss without seriously affecting the voice frequencies.

If your recorder does not have a sound-on-sound control but does have separate mike and line-input controls, then a "Y" adapter must be used. One leg of the "Y" is between the output of the appropriate channel and into the line input of the opposite channel with the other leg of the "Y" going back to the receiver or amplifier.

One note of caution. When using "Y" connectors you can generally split outputs, but never combine outputs. This will cause an impedance mismatch and result in a poor recording. The only way you should combine two signals into one input is by way of a mixer. These mixers are sometimes built into recorders or can be purchased separately.

One final thought. Try recording one of the voices at half speed. While monitoring the other voice you will find the singing very slow and low, but sing in a normal voice keeping in time with the words, which are at half speed. When you go back and listen to this recording at normal speed, you will find that this latest addition to your vocal group sounds strangely like a chipmunk! □

# Directory of QUADRASONIC PHONO RECORDS

UNFORTUNATELY, the hi-fi industry and therefore the record industry are rather confused as to the particular direction that 4-channel discs will take. There are three different encoding processes being considered and actually being marketed. The Sansui and Electro-Voice designs are quite similar, differing only in the percentage of mixing and phase relationships and are, therefore, in a way compatible. Only the most critical ear could recognize a difference should an Electro-Voice decoder be used with a Sansui-encoded disc or vice versa. Each company, of course, claims that best reproduction is obtained using its encoder/decoder system. The CBS/Sony technique is somewhat different and does provide greater separation across the front and rear. Here, again, any decoding method will enhance the sound reproduction of these discs, but the use of their own decoder provides better response.

It is common knowledge within the industry that Electro-Voice has been working on a completely new decoder design that it claims will be compatible with all of the present systems of encoding 4-channel discs. Complete details obviously are not available, but we understand that a formal announcement will be made shortly.

One would be rather negligent not to include mention of Dynaco's system in any discussion of 4-channel discs. It is the simplest and least expensive of any of the systems. It is, basically, a resistive device that connects between your power amplifier and the speakers. It can be used with any 2-channel stereo disc or any of the three encoded 4-channel discs to convert to 4-channel sound reproduction. It enhances the response by simply picking off the out-of-phase component appearing on the records. Obviously, the degree of enhancement depends on the amount of out-of-phase component on the record.

Prices of 4-channel discs vary from one label to another. In some cases the 4-channel versions are priced the same as standard 2-channel stereo discs, while in others an additional charge of \$1.00 per record is made. In a few instances companies have "promotional prices" prevailing to encourage customers to try out this new way of listening to recorded sound.

Listed below is a complete directory of all the 4-channel records that have been announced as we go to press. The catalogue is large and more releases are being added daily. Don't miss the Directory of 4-channel tapes on page 40. □

## CBS "SQ" ENCODED

### AMPEX

"Purlie"—Original Cast Recording ..... SQ-40101

### BARNABY

Stevens, Ray—Greatest Hits ..... ZQ30770

### COLUMBIA (Classical)

Carlos, Walter—Switched-On Bach ..... MQ31018

Strauss, Richard—Also Sprach Zarathustra *Bernstein* ..... MQ30443

Stravinsky—Boulez Conducts Stravinsky *Pierre Boulez* ..... MQ31076

Subotnick, Morton—Touch ..... MQ31019

Tchaikovsky—Swan Lake Ballet *Bernstein* ..... MQ30056

Verdi—Requiem *Bernstein* ..... M2Q30060

Mathis, Johnny—In-Person at Caesar's Palace ... GQ30979

Mathis, Johnny—You've Got a Friend ..... CQ30740

Nero, Peter—Summer of '42 ..... CQ31105

—Abraxas ..... CQ30130

Price, Ray—For The Good Times ..... CQ30106

Joplin, Janis—Pearl ..... CQ30322

Streisand, Barbra—Stoney End ..... CQ30378

Anderson, Lynn—Rose Garden ..... CQ30411

Williams, Andy—Love Story ..... CQ30497

Conniff, Ray—Love Story ..... CQ30498

Raiders, The—Indian Reservation ..... CQ30768

Nabors, Jim—Help Me Make it Through the Night ... CQ30810

Faith, Percy—Romeo and Juliet Theme ..... CQ31004

Davis, Miles—Bitches Brew ..... GQ30997

Bloomfield, Kooper, Stills—Super Session ..... CQ30991

"Company"—Original Cast Recording ..... SQ30993

"No, No, Nannette"—Original Cast Recording ..... SQ30563

"Funny Girl"—Original Sound Track ..... SQ30992

Cash, Johnny—Johnny Cash at San Quentin ..... CQ30961

Parch, Harry—World of Harry Parch ..... MQ31227



Beck, Jeff Group—Rough and Ready . . . . .	EQ30973
Wynette, Tammy—We Sure Can Love . . . . .	EQ30658
Poco—Deliverin' . . . . .	EQ30209
Chase— . . . . .	EQ30472
Sly & The Family Stone—Greatest Hits . . . . .	EQ30325

## MONUMENT

Kristofferson, Kris—Silver Tongued Devil & I . . . . .	ZQ30679
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## VANGUARD (Classical)

Arensky/Prokofiev/Tchaikovsky—Var. on a Theme by Tchaikovsky, Classical Symphony, Serenade for Strings <i>Somary</i> . . . . .	VSQ-30011
Berlioz—Requiem <i>Abravanel</i> . . . . .	VSQ-30006/7
Handel—Messiah <i>Somary</i> . . . . .	VSQ-30003/4/5
Handel—Messiah (excerpts) <i>Somary</i> . . . . .	VSQ-30002
Mahler—Symphony No. 3 in D <i>Abravanel</i> . . . . .	VSQ-30008/9
Mozart—Divertimento in B Flat, Divertimento in F <i>Blum</i> . . . . .	VSQ-30010
Tchaikovsky—Symphony No. 4 in F <i>Stokowski</i> . . . . .	VSQ-30001
—Virtuoso Trumpet <i>Berinbaum</i> . . . . .	VSQ-30012

## VANGUARD (Popular)

Baez, Joan—Blessed Are . . . . .	VSQ-40001/2
Country Joe & the Fish—From Haight-Ashbury to Woodstock . . . . .	VSQ40004/5
St. Marie, Buffy—Moonshot . . . . .	VSQ-40003
Coryell, Larry—At the Village Gate . . . . .	VSQ-40006
Schickele—Wurst of P.D.Q. Bach . . . . .	VSQ-40007
Quadraphonic Demo Discs . . . . .	VSQ 1X/2X/3X/4X

## E-V "STEREO-4" ENCODED

### AUDIO SPECTRUM

101 Strings—Soul of Spain . . . . .	QS-1
101 Strings—Exciting Sounds . . . . .	QS-2
101 Strings—Today's Hits . . . . .	QS-4
Thatcher, Les—Multiple Guitars . . . . .	QS-3

### CREWE

Crewe, Bob Generation—Let Me Touch You . . . . .	1600
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### GOLDEN CREST

Levy, R & A. L.—Piano & Trumpet Music of Benson, Brown, Hartley, Kupferman, Mayer, Perchette, Wilder & Wolpe . . . . .	GC7045
Johannesen, Grant—Piano Music of Bergsma, Copland, Dello Joio & Harris . . . . .	GC CRS-4111
King, Karl—Music of Karl King <i>University of Illinois Symphonic Band</i> . . . . .	GC CRS-4096
Costanzo, Sonny—Sonny's Song . . . . .	GC CRS-31024
Mure, Billy & Gary—Quad Spectacular . . . . .	GC CRS-31025

### OVATION

Quadraphonic Sound Demo Disc . . . . .	QD-1
Christian, Bobby—Vibe-Rations . . . . .	QD/14-06
Hollins & Starr—Sidewalks Talking . . . . .	QD/14-07
Jones, Tommy—Tommy's Place . . . . .	QD/14-20
Koloc, Bonnie—After All This Time . . . . .	QD/14-21
Laura— . . . . .	OV/14-11
Morello, Joe—Another Step Forward . . . . .	OV/14-02
Rich Mountain Tower— . . . . .	OV/14-12
Schory, Dick—Carnegie Hall . . . . .	OV/14-10 (2)
Schory, Dick—Movin On . . . . .	OV/14-03
Steele, Ron—Chicago Guitar . . . . .	OV/14-08
Tweedy, Don Chorus & Orchestra . . . . .	OV/14-13
Horn, Paul—Concert Ensemble . . . . .	OV/14-05

## PROJECT 3

Light, Enoch—Spanish Strings . . . . .	PR5000QD
Light, Enoch—Brass Menagerie (Vol. 1) . . . . .	PR5036QD
Light, Enoch—Brass Menagerie (Vol. 2) . . . . .	PR5042QD
Light, Enoch—Spaced Out . . . . .	PR5043QD
Light, Enoch—Permissive Polyphonics . . . . .	PR5048QD
Light, Enoch—Hit Movie Themes . . . . .	PR5051QD
Mottola, Tony—Warm, Wild & Wonderful . . . . .	PR5025QD
—World's Greatest Jazzband (Vol. 2) . . . . .	PR5039QD
—Big Band Hits of the 30's . . . . .	PR5049QD
—4 Channel Stereo Demo Disc . . . . .	PR-D700

## SANSUI ENCODED

### ABC

Hooker, John Lee—Never Get Out of These Blues Alive . . . . .	ABCX 736
King, B. B.—L.A. Midnight . . . . .	ABCX 743
Coltrane, Alive—World Galaxy . . . . .	AS9218

### AUDIO TREASURY

Donizetti—Roberto Devereaux (excerpts) <i>Sills</i> . . . . .	ATQD-24001
—Welcome to Vienna <i>Sills</i> . . . . .	ATQD-24002

### COMMAND

Ray Charles Singers—Love Me With All Your Heart . . . . .	CDQ-40005
Light, Enoch—Great Cole Porter Songs . . . . .	CDQ-40002
Mattola, Tony—Guitar-Paris . . . . .	CDQ-40001
—Persuasive Percussion . . . . .	CDQ-40000
Count Basie—Broadway Basie's Way . . . . .	CDQ-40004
Doc Severinsen—Fever . . . . .	CDQ-40003

### PROJECT 3

Free Design—Kites Are Fun . . . . .	PR5019QD
Mattola, Tony—Best of the Movie Themes 1970 . . . . .	PR5046QD
Mattola, Tony—Superstar Guitar . . . . .	PR5062QD
Light, Enoch—Big Band Hits of the 30's & 40's . . . . .	PR5056QD
Light, Enoch—Big Hits of the 20's . . . . .	PR5059QD
Light, Enoch—The Brass Menagerie 1973 . . . . .	PR5060QD
Light, Enoch—Movie Hits . . . . .	PR5063QD

## DYNACO

### DYNAQUAD

Dynaco/Vanguard 4-Dimensional Stereo Demo Disc . SPV-7 (Available from Dynaco dealers or company for \$2.95)

Listed below are standard 2-channel stereo discs which Dyna recommends as being especially effective with the Dynaquad System.

Beach Boys—Surf's Up . . . . .	Reprise RS-6453
Beaver/Krause—Gandharva . . . . .	Warner WS-1909
Berio—Sinfonia . . . . .	Columbia MS-7268
Berlioz—Requiem . . . . .	Philips 6700-019
Blood, Sweat and Tears—Spinning Wheel Col. . . . .	CS-9720
Boston Pops—An Evening at the Pops . . . . .	RCA LSC-2827
Crosby, Stills and Nash—Judy Blue Eyes . . . . .	Atlantic SD-8229
—The Flame . . . . .	Brother 2500
—Last Night of the Proms . . . . .	Philips 6502-001
Michaels, Lee—Heighty Hi . . . . .	A&M 4199
Pink Floyd—Ummagumma . . . . .	Harvest STBB-388
Simon and Garfunkel—Bridge Over Troubled Water . . . . .	Columbia KCS-9914
Stockhausen—Electronic Music . . . . .	DGG SPLM-13811
Travers, Mary—Mary . . . . .	Warner WS-1907
Williams, Vaughn—A Sea Symphony . . . . .	Angel SB-3739
Los Chiriguano of Paraguay . . . . .	Nonesuch H-72021
Horowitz, Vladimir—At Carnegie Hall . . . . .	Columbia M2S-728

# Directory of 4-CHANNEL PRE-RECORDED TAPES

While four-channel material is being released on reel-to-reel tapes, the trend market-wise is decidedly toward the 8-track cartridge format.

## 4-CHANNEL, 8-TRACK CARTRIDGE RELEASES

### AMPEX

"Purlie"—Original Broadway Score . . . . . L70101  
Classic Film Themes . . . . . L71129

### APPLE

Lennon/Ono—Imagine . . . . . Q8W-3379

### ATLANTIC

Modern Jazz Quartet—Plastic Dream . . . . . L71589  
Franklin, Aretha—Aretha Live at the Fillmore T77205  
Santamaria, Mongo—Mongo at Montreux . . . L71593

### BARNABY

Stevens, Ray—Greatest Hits . . . . . ZAQ30770

### COLUMBIA

All releases available on 4-channel discs under this label are offered as 4-channel, 8-track cartridges as well. See page 38.

### EMBRYO

Mann, Herbie—Push Push . . . . . L7532

### EPIC

All releases available on 4-channel discs under this label are offered as 4-channel, 8-track cartridges as well. See page 38.

### EVOLUTION

Quad Music Sampler . . . . . L76502

### GRUNT

Jefferson Airplane—Bark . . . . . PQFT-1001

### LIBERTY

The Ventures—Hawaii Five-O . . . . . A-8948  
Rich, Buddy—Best of Buddy Rich . . . . . A-9025  
Canned Heat—Future Blues . . . . . A-9060  
Carr, Vikki—Nashville by Carr . . . . . A-9007

### OVATION

All releases available on 4-channel discs under this label are offered as 4-channel, 8-track cartridges as well. See page 38.

## PROJECT 3

All releases available on 4-channel discs under this label are offered as 4-channel, 8-track cartridges as well. See page 38.

### RCA (Red Seal Classical)

Tchaikovsky—Concerto No. 1 *Van Cliburn* . . . . . RQ8-1002  
Music from Million Dollar Movies *Fiedler/Boston Pops* . . . . . RQ8-1010  
Rodgers—Victory at Sea (Vol. 1) *Bennett* . . . . . RQ8-1027  
Best of Fiedler and Boston Pops . . . . . RQ8-1047  
Puccini—Madama Butterfly (excerpts) *Price/Elias/Tucker/Leinsdorf* . . . . . RQ8-1048  
Rodrigo/Vivaldi/Britten—Concierto de Aranjuez for Guitar & Orch., Concerto in D for Lute & Strings, Courtly Dances from "Gloriana" *Julian Bream* . . . . . RQ8-1052  
Puccini—La Boheme (highlights) *Moffo/Costa/Tucker/Merrill/Tozzi/Maero/Leinsdorf* . . . . . RQ8-1077  
Up Up and Away with Fiedler and Boston Pops . . . . . RQ8-1103  
Chopin—Concerto No. 2 in F Minor, Grand Fantasy on Polish Airs *Rubenstein/Ormandy* . . . . . RQ8-1110  
Tchaikovsky/Rachmaninoff—1812 Overture, Spring Cantata, Three Russian Folksongs *Buketoff* . . . . . RQ8-1115  
Liszt/Dvorak—Selections from Bartered Bride, Scherzo Capriccioso *Ormandy* . . . . . RQ8-1123  
The Moog Strikes Bach, Chopin, Mozart, Rachmaninoff, Paganini, Prokofiev *Wurman* . . . . . RQ8-1137  
Bizet-Shchedrin—Carmen Ballet *Fiedler/Boston Pops* . . . . . RQ8-1141  
Dvorak—Symphony No. 9 ("New World") *Fiedler/Boston Pops* . . . . . RQ8-1160  
Chopin a la Moog *Wurman* . . . . . RQ8-1162  
Stravinsky—Firebird Suite, Petrouchka *Ozawa/Boston* . . . . . RQ8-1164  
Saint-Saens/Falla—Concerto No. 2, Nights in the Gardens of Spain *Rubenstein/Ormandy* . . . . . RQ8-1165  
Strauss, Richard—Also Sprach Zarathustra *Reiner/Chicago* . . . . . RQ8-1168  
Copland—Billy the Kid Suite, Appalachian Spring *Ormandy* . . . . . RQ8-1170  
Handel—Messiah (excerpts), Water Music Suite *Ormandy* . . . . . RQ8-1198  
Love Story *Ormandy* . . . . . RQ8-1179  
**RCA (Popular)**  
Best of Al Hirt . . . . . PQ8-1011  
My World—Eddy Arnold . . . . . PQ8-1088  
Best of Mancini . . . . . PQ8-1128  
Best of Eddy Arnold . . . . . PQ8-1185  
The Youngbloods—Get Together . . . . . PQ8-1221  
Concert Sound of Henry Mancini . . . . . PQ8-1226  
Chet Atkins Picks the Best . . . . . PQ8-1261  
Montenegro, Hugo—Music from Fistful of Dollars, etc. . . . . PQ8-1301  
Best of Mancini (Vol. 2) . . . . . PQ8-1315  
Feliciano, Jose—Feliciano! . . . . . PQ8-1377

Mancini, Henry—Warm Shade of Ivory . . . PQ8-1441  
 The Guess Who—Wheatfield Soul . . . . . PQ8-1442  
 Friends of Distinction—Grazin' . . . . . PQ8-1443  
 Sensational Charley Pride . . . . . PQ8-1452  
 Presley, Elvis—From Elvis in Memphis . . . PQ8-1456  
 Nashville Brass—More Nashville Sounds . . PQ8-1470  
 Canned Wheat Packed by the Guess Who . . PQ8-1472  
 Best of Ed Ames . . . . . PQ8-1476  
 Feliciano, Jose—Feliciano/10 to 23 . . . . PQ8-1479  
 Friends of Distinction—Highly Distinct . . . PQ8-1489  
 Best of Charley Pride . . . . . PQ8-1505  
 Mancini, Henry—Six Hours Past Sunset . . . PQ8-1508  
 The Guess Who—American Woman . . . . . PQ8-1518  
 Feliciano, Jose—Alive Alive O! (Part 1) . . . PQ8-1537  
 Feliciano, Jose—(Part 2) . . . . . PQ8-1538  
 Mancini, Henry—Mancini Country . . . . . PQ8-1552  
 Friends of Distinction—Real Friends . . . . PQ8-1555  
 Nashville Brass/Davis—You Ain't Heard Nothin' Yet  
 . . . . . PQ8-1568  
 Mancini, Henry—Theme from "Z" and others . . . . . PQ8-1583  
 The Guess Who—Share the Land . . . . . PQ8-1590  
 Best of Hugo Montenegro . . . . . PQ8-1591  
 Floyd Cramer with The Music City Pops . . . PQ8-1592  
 Charley Pride's 10th Album . . . . . PQ8-1593  
 Presley, Elvis—On Stage (February 1970) . . PQ8-1594  
 Feliciano, Jose—Fireworks . . . . . PQ8-1595  
 Parton, Dolly—A Real Live Dolly . . . . . PQ8-1601  
 Como, Perry—In Person at the International, Las  
 Vegas . . . . . PQ8-1608  
 Hot Tuna . . . . . PQ8-1613  
 Best of the Youngbloods . . . . . PQ8-1617  
 Friends of Distinction or Whatever—Whatever . . . . . PQ8-1622  
 Nesmith & First National Band—Magnetic South . . . . . PQ8-1636  
 Cramer, Floyd—Class of '70 . . . . . PQ8-1640  
 Belafonte, Harry—Belafonte at Carnegie Hall . . . . . PQ8-1640  
 . . . . . OQ8-5002  
 The Archies—Sugar, Sugar . . . . . PQKO-1002  
 Best of Guess Who . . . . . PQ8-1710  
 Hot Tuna—Electric . . . . . PQ8-1762  
 Montenegro, Hugo—Mammy Blue . . . . . PQ8-1861  
 Nightlighters—Morning, Noon and . . . . . PQ8-1798



Rich, Buddy—Different Drummer . . . . . PQ8-1819  
 Best of Nina Simone . . . . . PQ8-1597  
 "Sound of Music" Original Sound Track . . . OQ8-1001  
 "Fiddler on the Roof" Original Broadway Cast . . . . . OQ8-1005  
 "Hello, Dolly!" Original Broadway Cast . . . OQ8-1006  
 "Hair" Original Broadway Cast . . . . . OQ8-1038

#### UNITED ARTISTS

Ferrante/Teicher—Greatest Hits . . . . . A-8168  
 Holmes, Leroy—Everybody's Talkin' . . . . . A-8173

#### VANGUARD

Country Joe & The Fish—Greatest Hits . . . . . L714  
 Surround Stereo Sound Demo Cartridge . . . . . L71

### 4-CHANNEL REEL-TO-REEL RELEASES

#### OVATION

All selections available on this label as "Stereo-4" encoded discs are available in the 4-channel, reel-to-reel format. See page 38.

#### PROJECT 3

Enoch Light—Spanish Strings . . . . . PR4C-5000  
 Enoch Light—Brass Menagerie (Vol. 1) . . . PR4C-5036  
 Enoch Light—Brass Menagerie (Vol. 2) . . . PR4C-5042  
 Enoch Light—Spaced Out . . . . . PR4C-5043  
 Enoch Light—Permissive Polyphonics . . . . PR4C-5048  
 Enoch Light—Big Band Hits of the 30's . . . PR4C-5049  
 Enoch Light—Hit Movie Themes . . . . . PR4C-5051  
 Enoch Light—Big Band Hits of the 30's & 40's . . . . . PR4C-5056  
 Enoch Light—Big Hits of the 20's . . . . . PR4C-5059  
 Enoch Light—The Brass Menagerie 1973 . . . . . PR4C-5060  
 Enoch Light—Movie Hits . . . . . PR4C-5063  
 Tony Mottola—Warm, Wild & Wonderful . . . . . PR4C-5025  
 Tony Mottola—Roma Oggi . . . . . PR4C-5032  
 Tony Mottola—Superstar Guitar . . . . . PR4C-5062  
 —Free Design/Kites are Fun . . . . . PR4C-5019  
 —World's Greatest Jazzband (Vol. 2) . . . . . PR4C-5039  
 —4-Channel Stereo Demo Tape . . . . . PR4C-D700  
 —Best of the Movie Themes 1970 . . . . . PR4C-5046

#### VANGUARD

Berlioz—Requiem *Abravanel* . . . . . VSS-2/3  
 Mahler—Symphony No. 3 *Abravanel* . . . . . VSS-4/5  
 Mahler—Symphony No. 9 *Abravanel* . . . . . VSS-6/7  
 Handel—Jephtha (highlights) *Somary* . . . . . VSS-11  
 Baez, Joan—David's Album . . . . . VSS-8  
 St.-Marie, Buffy—Illuminations . . . . . VSS-9  
 Perry Jean Jacques—Amazing Electronic Sound . . . . . VSS-10  
 Country Joe & The Fish—Greatest Hits . . . . . VSS-14  
 —Surround Stereo Sampler . . . . . VSS-1



# Hirsch-Houck Lab Tests DOLBY-IZED CASSETTE RECORDERS

A survey of six recorder/playback decks  
showing performance and other characteristics.

By **JULIAN D. HIRSCH**



**I**N the past few years we have reported on a number of cassette tape decks and recorders. Our initial experience with the better-quality cassette machines convinced us of the potential of this recording medium. Having encountered reel-to-reel machines capable of high quality at 3¾ ips, it was startling to find comparable frequency response in some of the new cassette recorders operating at half that speed.

Then, as now, the most objectionable characteristic (to a critical hi-fi ear) of cassette sound was the hiss level. This is principally due to two factors: (1) less treble roll-off in the playback equalization (as compared to reel-to-reel machines) which is necessary to extend the frequency response to 10 kHz or higher at 1⅞ ips; and (2) the extremely narrow track width of 24 mils (0.024") resulting from fitting four tracks on a 150-mil (0.150") wide tape. The playback amplifier input noise is essentially the same as that of other tape machines, but the output of the heads from the narrow cassette tracks is considerably lower. For these reasons, the signal-to-noise ratio of a cassette machine is inherently poorer than that of a reel-to-reel machine.

Since that time, head designs have been improved and there are special tape formulations, such as 3M High Energy, TDK SD, and DuPont Crolyn, which allow more energy to be stored in the tape, especially at the higher frequencies. The best tapes also have a fine grain structure which reduces "drop-outs", which is another common

characteristic deficiency of the cassette medium.

The noise problem remains, however. It can be minimized by maintaining a high average recording level, but this involves a compromise with distortion on high-level passages. Many critical listeners would find this objectionable. A logical solution is the application of the Dolby noise-reducing technique to the cassette deck, and a growing number of cassette machines are now "Dolby-ized."

The Dolby system has been used for several years in professional recording studios and is responsible for the lower noise level on many recent stereo discs. A comparison between a record made in the early 1960's and a recent release provides proof of this fact.

For details on how the Dolby circuit operates, see "The Dolby Noise-Reduction System" on page 31.

Several years ago, Dolby Laboratories began licensing consumer product manufacturers to use a simplified version, known as the "B-Type." At this time, at least 20 Japanese manufacturers (whose products are sold under more than 40 brand names), plus a number of others in Europe and the United States, are licensed to use the "B-Type" Dolby system. The "B-Type" circuits are relatively simple and can be economically incorporated in home tape recorders and cassette machines. However, practically all current usage is in the cassette field, where their advantage is greatest.

The first Dolby-ized cassette recorders to reach the American market were all basically similar,

since their transports and much of their electronic circuitry came from a single Japanese manufacturer. Today the situation is different, with several distinctly different design approaches evident in the transports and electronic circuits (although the Dolby circuits themselves are all essentially identical).

The impressive performance of the early Dolbyized decks, as well as their reliability, has been further improved and a number of today's cassette recorders are in many respects the equal of good quality reel-to-reel machines. Using a good-quality cassette tape, any of the decks we have tested is capable of true hi-fi performance. All the Dolbyized decks we know of are also designed to use chromium-dioxide ( $\text{CrO}_2$ ) tapes, which require special biasing (and sometimes, equalization) to realize their potential for extended high-frequency response and low noise. At the time the first cassette recorders with  $\text{CrO}_2$  provisions were released, the tape was available only under the Advocate brand name. Today several American tape manufacturers package DuPont Crolyn tape in cassettes, and the German-made BASF "Chrom-dioxid" tape is also being sold in this country.

To assess the present state of the Dolbyized cassette deck, we have tested a number of the newest models. One of the "first generation" machines—the Harman-Kardon CAD-5—is still available, and we have included our earlier test data on that unit in this survey. The other machines are the Advent 201, Concord Mk IX, Lafayette RK-D40, Teac 350, and Wollensak 4760.

#### GENERAL FEATURES

The operating convenience and simplified tape handling of a cassette recorder are two of its major attractions. Almost all cassette mechanisms use a row of "piano-key" levers for controlling tape motion and recording functions.

As in the case of automobile automatic transmission selectors, there is considerable standardization in the sequence of cassette transport controls. From left to right, they usually are Record (a safety interlock which must be pressed together with Play in order to record), Rewind, Play, Fast Forward, Stop (often combined with Eject), and Pause. Two exceptions among the recorders tested for this report are the Concord Mk IX and the Harman-Kardon CAD-5, which have Stop located between Rewind and Play.

Sometimes the levers are coded with symbols or colors to identify their functions at a glance. The adjacent markings on the control panel may be difficult to read from some angles, but the small tri-

angles, squares, and circles in common use are easily interpreted after a brief familiarization period.

All the recorders, except the CAD-5, shut off and mechanically disengage their pinch rollers automatically at the end of play. On the CAD-5, an Auto light goes out and the motor shuts off, but the mechanism must be turned off manually to avoid "flats" on the rubber pinch wheel.

As a rule, partially depressing the Stop lever disengages the transport drive without ejecting the cassette. A further pressure on the lever ejects the cassette. Some practice may be needed to avoid ejection when one wishes merely to stop the tape (Concord Mk IX and the Harman-Kardon CAD-5 are the only ones in the present group with this characteristic). The other decks have a separate tape-ejection button, physically apart from the other controls. All the recorders have three-digit index counters with pushbutton reset.

The Wollensak 4760 (and the Advent 201, which uses the same mechanism) is completely different from the other cassette recorders in its control layout. Two large rocker buttons handle the Start and Stop functions. A small Record button must be pressed before starting in order to record. Pause is a short upright lever which stops the tape instantly when pulled toward the user and locks in place when pushed to the right. Pushing it to the left releases it with a positive action and the tape starts instantly. To eject the cassette, a small lever near the tape well is pulled forward. A single lever, spring-loaded to return to its center Off position, controls fast tape motion in both directions.

All the recorders have separate switches for power, Dolby circuit operation, stereo/mono recording, and standard or  $\text{CrO}_2$  tape bias. In the Harman-Kardon CAD-5, the latter switch is in the rear; on all the others it is on the front panel. The stereo/mono switch operates during recording only, to connect both inputs together for mono recording. Except for the Harman-Kardon CAD-5 and the Lafayette RK-D40, all the recorders have adjustable playback levels.

There is considerable variety in respect to level controls, metering, signal lights, microphone inputs, and Dolby test facilities. These will be described individually for each recorder, together with other special or unique features.

#### ADVENT 201

Replacing the Advent 200—one of the first Dolbyized cassette machines—is the all-new Advent 201. The distinctive Wollensak transport mechanism used in this machine is rugged and (for many people) somewhat easier to operate than conven-

tional cassette transports with the "piano-key" configuration.

An open well on top of the recorder receives the cassette, which is completely visible during operation. The power switch, a sliding plate to the right of the tape well, turns On automatically when the Play button is pressed, and remains on until it is shut off manually. It can also be turned on manually, before the tape is put into motion. If the recorder is operating when the power switch is moved to Off, the transport Stop button is automatically actuated.

A unique feature of the Advent 201 is its single large "VU" meter. A three-position lever switch connects it to read either channel, or the higher of the two. Once recording levels have been balanced, the "Higher of A or B" setting simplifies monitoring levels, without having to follow two independently swinging meter pointers. The meter reads levels after the recording pre-emphasis, minimizing the likelihood of high-frequency overload with the meter reading safe values.

Individual knobs set the recording level for each channel; a single master-level control then operates on both channels. The line inputs and outputs are recessed in the left side of the wooden base, with a playback level control that affects both channels.

The Advent 201 has no microphone inputs. Instead, an accessory microphone preamplifier (Model MPR-1) is available, powered from a +18-volt jack on the side of the Model 201. The MPR-1 has switchable gains of 40 dB and 60 dB, and input for low-impedance balanced or unbalanced microphones.

Two lever switches, similar to the meter selector, activate the Dolby circuits and optimize the recorder for standard or CrO<sub>2</sub> tapes. Advent uses the same recording equalization for both types of tape, increasing the bias for CrO<sub>2</sub>. Unlike other manufacturers, they use more high-frequency roll-off in the CrO<sub>2</sub> playback equalization, improving the signal-to-noise ratio without incurring added high-frequency distortion.

Eight screwdriver adjustments, accessible through holes in the rear of the Advent 201, allow complete calibration of the recording Dolby circuits (a built-in test oscillator is provided for this purpose) and bias adjustment for CrO<sub>2</sub> or any ferric-oxide tape. The Advent 201 is factory adjusted for 3M High-Energy tape.

#### CONCORD MK IX

The Concord Mk IX has a conventional keyboard control setup. The cassette is inserted into a

tray that pops up when the Stop key is fully depressed. In operation, the entire cassette can be seen through the smoky plastic cover. The cassette compartment is dimly illuminated when the tape is in motion, as an indication of that fact.

The recording levels are set by two vertically oriented slider controls. To their right are two similar sliders for playback-level adjustment. Two microphone jacks (standard 1/4" phone jacks) below the recording-level controls accept dynamic microphones with an impedance between 500 and 5000 ohms. Inserting a microphone plug disconnects the corresponding line input. The Concord Mk IX also has a separate mixing input, with its own recording-level control and front-panel input jack. This can be used to mix a microphone or a high-level source, monophonically, with the two normal stereo inputs.

Two pairs of line inputs, with nominal sensitivities of 100 mV and 500 mV, are in the rear, together with the line outputs. A front-panel headphone jack carries the stereo outputs to low-impedance phones.

The two illuminated "VU" meters are on a hinged panel. They can be operated in the recessed position, flush with the top of the recorder, or, by pressing and releasing the meter panel, it tilts up to an angle of about 30 degrees for easier viewing.

Four pushbutton switches at the right of the sloping front panel control the power, the Dolby circuits, mono/stereo switching, and bias for standard or CrO<sub>2</sub> tape. Colored lights below the transport control levers show that the power and Dolby circuits are on, and that the unit is in the recording mode.

Screwdriver access holes in the rear of the Mk IX permit a qualified technician to adjust recording and playback calibration levels for the Dolby system. They are not intended to be used by the consumer.

#### HARMAN-KARDON CAD-5

The transport control levers of the Harman-Kardon CAD-5 are in the sequence Record, Rewind, Stop/Eject, Play/Rec, Fast Forward, Pause. Fully depressing the Stop/Eject lever raises the cassette tray for loading or unloading. The entire cassette can be seen in operation through the smoky plastic cover.

All the operating controls are on a sloped panel. Below the keys are four lights, indicating Record, Dolby-circuit operation, signal overload, and motor operation. The overload light flashes on brief peaks (higher than about +2 dB) that might not register on the slower moving meter pointers. The



recording-level controls are two vertical sliders. Two microphone jacks below the transport controls are designed for low-impedance dynamic microphones (500 to 1000 ohms).

In the rear are two pairs of line inputs, for low-level or high-level signals, and the playback outputs. The standard/CrO<sub>2</sub> bias switch and Dolby test-oscillator switch are also in the rear. Four holes provide access to the screwdriver-adjusted Dolby recording and playback calibration controls. For playback calibration (not ordinarily required) a special test cassette is available from Harman-Kardon. The recording calibration should be checked, and readjusted (if necessary), when changing to a different tape formulation. The procedure for this is fully described in the operating manual. The CAD-5 is factory adjusted for TDK SD tape.

#### LAFAYETTE RK-D40

The Lafayette RK-D40, the lowest priced Dolby-ized cassette deck we have tested, nevertheless has several features not found on more expensive machines.

The control levers are in the standard sequence. A separate Up button next to the cassette well raises the cover and loading platform. In operation, the center of the cassette can be seen through a window, and is backed by a mirror to show the portion of the tape in use. The transport controls, two meters, and the Rec and Dolby lights are on a sloping panel; the other controls are below them on a vertical panel section. There are two line-input level controls (concentric) and two more for the microphone inputs. The line and microphone signals can be mixed. The two 1/4" microphone jacks (10k ohms) are on the front panel.

Three pushbutton switches set the bias for standard or CrO<sub>2</sub> tapes, select stereo or mono recording, and activate the Dolby system. Another switch turns on the power, but can be left in its Off position for a unique automatic operating mode. Merely loading a cassette and placing it in motion turns on the power to the recorder's circuits, and energizes an a.c. outlet in the rear. An amplifier can be powered from this outlet, and at the end of the cassette the entire machine shuts off and simultaneously turns off the amplifier. There is a front-panel headphone jack, with a three-position level switch in the rear. The line inputs and outputs complete the facilities in the rear of the recorder.

#### TEAC 350

Teac's Model 350 has the standard sequence of control levers, with a separate Eject button. A

### DOLBY-IZED CASSETTE RECORDER PERFORMANCE

Make & Model	Frequency Response <sup>1</sup>	Playback Response <sup>1</sup>	Fletter (μV) <sup>1</sup>	S/N Ratio (dB) <sup>1</sup>	Revised & FF Time (sec) <sup>1</sup>	Input for 0 VU Mks	Output from 0 VU (volts)	1000-Hz THD at 0 VU (%)	Input for 3% THD (VU)	Dimensions (in)	Weight (lb-oz)	Price (\$)
	A: 30-15k (±2 dB) B: 30-16k (±3.2 dB) C: 30-15.8k (±2 dB)	+3.2, -0.7 dB	0.20	(a)na (b)na 57.50	43(RW) 46(FF)	0.031V na	0.52	na na 1.9	na na +3	13-4 W H D 13% 4% 9%	13-4	280 (MPPL1 Mike preamp, 20)
Concord Mk IX	A: 40-15.7k (±2 dB) B: 40-15k (±4 dB) C: 40-14k (±2 dB)	+0.5, -2.2 dB	0.17	(a)54 (b)60 57.58	87(RW) 79(FF)	0.08V 1.5mV 0.38V	1.0	2.2 3.1 2.5	+3 0 +1	16 4% 10%	14-0	299.95
Harman-Kardon CAD-5	A: 35-15.8k (±3 dB) B: 40-16k (±3 dB) C: 47-14.4k (±3 dB)	+0, -5.5 dB	0.24	(a)47 na (b)55	98(RW) 89(FF)	0.25V 0.22mV 0.60V	1.0	6.1 na na	-3 na na	na	na	195.95
Lafayette RK-D40	A: 25-17k (±4.5 dB) B: 28-17k (±5.5 dB) C: 25-16.8k (±3.5 dB)	+1, -4 dB	0.17	(a)55 na (b)63 61.5	87(RW) 87(FF)	0.097V 0.69mV	1.0	2.4 na 5.3	+2 na -3	11% 4% 11%	12-3	179.95
Teac 350	A: 25-14.5k (±2.5 dB) B: 25-15k (±3 dB) C: 25-14.5k (±1.5 dB)	+5.8, -5.3 dB	0.15	(a)na 52.55 (b)na 57.5 60	73(RW) 73(FF)	0.09V 0.23mV	1.0 (0.66uV CrO <sub>2</sub> )	na 4.2 2.2	na -1 +1	17 4% 9%	11-13	279.50
Wollensak 4760	A: 30-16k (±2.5 dB) B: 30-16k (±3.5 dB) C: 30-15.5k (±2.5 dB)	+4, -0.5 dB	0.20	(a)53.5 na (b)60.5 64.5	43(RW) 46(FF)	0.029V na	0.57	2.7 na 2.2	+1 na +3	13% 4% 9%	13-4	279.95 (Mike preamp, 29.95)

Record/playback frequency response averages out low-frequency response ripples.

na=not available or not applicable.

Dimensions supplied by manufacturer; weights our own measurement.

Editor's note: It should be noted that Fisher has a Dolby-ized cassette, the 80-B, but unfortunately it arrived too late to be tested. Details on the unit will be found in the directory section devoted to Cassettes.

Notes: (1) A=3M High-Energy tape (except 3M ER/BT for Advent 201, 3M #271 for CAD-5), B=TDK SD, C=Ampex CrO<sub>2</sub> (except Advent 201, Advocate Crolyn). Measured at -30 dB record level, no Dolby. (2) Variation 31.5-10k Hz, BASF standard tape, reference 333 Hz. (3) Unweighted, Philips TC-FL-3 tape. (4) Time for C-60 cassette.

S/N measurements in 250-20,000 Hz bandwidth, referred to level giving 3% THD at 1000 Hz: (a) no Dolby, (b) Dolby on.

window in the pop-up cassette cover allows the center portion of the cassette to be seen while in operation. A Tape Run indicator shows the speed and direction of tape motion by means of a traveling light spot in a small window.

The recording-level controls are two sliders with another pair for playback levels. The two "VU" meters, slightly tilted for better visibility, monitor recording and playback levels. The two 1/4" jacks for 600-ohm dynamic microphones and the jack for 8-ohm headphones are on the front edge of the panel. The line inputs and outputs, plus a DIN connector with microphone inputs and line outputs, are in the rear.

A novel and useful feature of the Teac 350 is the Peak Level light. This is a light-emitting diode (LED) which emits clearly visible red flashes when the peak levels in either channel approach the point where distortion might occur. This supplements the meters since it responds virtually instantly.

Power is applied by a rocker switch. Three toggle switches control bias for normal or CrO<sub>2</sub> tapes, turn on the Dolby circuits, and switch the inputs between the line jacks and the microphone or DIN connectors.

#### WOLLENSAK 4760

The transport mechanism of the Wollensak 4760 is identical to that of the Advent 201. The simplified two-button tape control and the exceptionally fast rewind and fast-forward speeds distinguish this transport from all the others. It is also the only American-made mechanism among the group tested.

The line inputs and outputs are recessed into the left side of the wooden base, together with the playback-level control, a +18-volt output jack, and the Dolby test-oscillator button. On the recorder's panel are individual recording-level controls and a master recording-level control. Two "VU" meters monitor recording and playback levels. There are no microphone inputs, but an accessory microphone preamplifier is available, powered from the +18-volt supply of the Model 4760.

The cassette is fully exposed in an open well on top of the deck. Pressing the Play button turns on the power (which can also be controlled manually). Sliding the power switch to Off disengages the transport drive system, preventing formation of flat spots on the rubber pressure roller. A separate Record button must be pressed with Play, in order to record, and a small red light goes on when recording. The Pause lever can be held in place or locked by pushing it to the right. A push to the left

then releases it instantly. The Eject lever pops the cassette from its well.

#### COMMENTS AND LISTENING COMPARISONS

Comparing the measured performance of these Dolby-ized cassette recorders, one finds more similarities than differences among them. All are capable of reasonably flat frequency response over the full audible range (few hi-fi systems extend significantly beyond the 35 to 15,000 Hz range of any top-quality cassette recorder). See Figs. 1 and 2. With a good grade of tape, either ferric-oxide or CrO<sub>2</sub>, most have a signal-to-noise ratio close to 60 dB—performance attained only by the best reel-to-reel recorders—and even this figure is exceeded by a couple of the cassette decks!

For many people, the differences in control features and flexibility will be major considerations in making a choice of a cassette machine. Even their prices fall into two general areas, about \$200 or \$280, give or take \$20.

Quite frankly, no one could decide, from the test data alone, whether one machine will sound better or worse than another. Even the flutter measurements, which range from 0.15% to 0.24%, must be discounted somewhat. We have found substantial variations from unit to unit of the same model and even in the same unit when measured at different times. None of these recorders has any audible flutter on 99% of the music that would ever be recorded or played on it. We *never* heard any flutter with them, but must allow for the possibility that it could be heard under some conditions.

Are there, then, any *real*, audible differences among these machines? The only way we know of to answer this is to listen, and this is what we did. By recording wide-range phonograph records on the cassette machines, and comparing the original to the playback of the recorded program, we were able to evaluate the recorders under controlled conditions.

It is possible for two machines with apparently identical frequency response to sound quite different. For example, a  $\pm 2$  dB response to 15,000 Hz would allow the output of one machine to increase by 2 dB, while the other could decrease by the same amount. A difference of 4 dB in any part of the audible frequency range can easily be heard (much smaller differences are detectable, in fact). Also, two machines with a 60-dB-signal-to-noise ratio can have distinctly different audible noise characteristics, due to the spectral distribution of their noise output.

Before we give specific comments on the machines, another caution is in order. The frequency

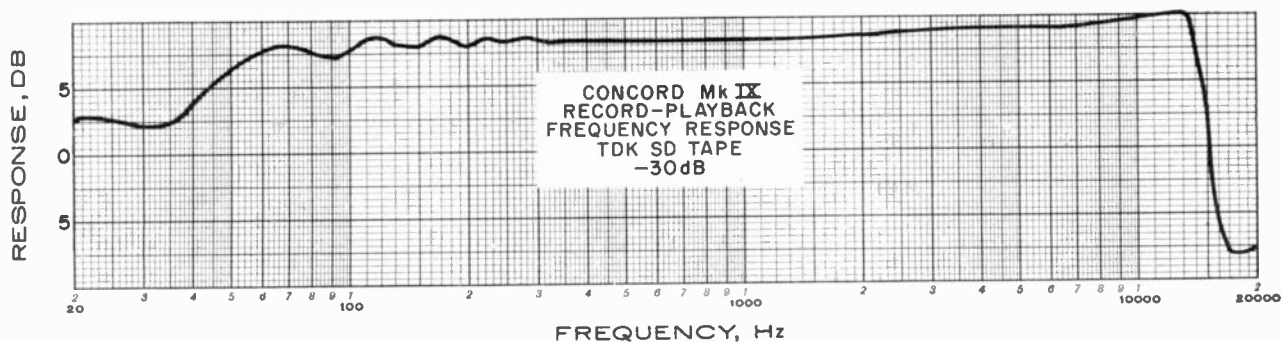


Fig. 1. Record-playback response for Concord Mk IX is also typical of other decks.

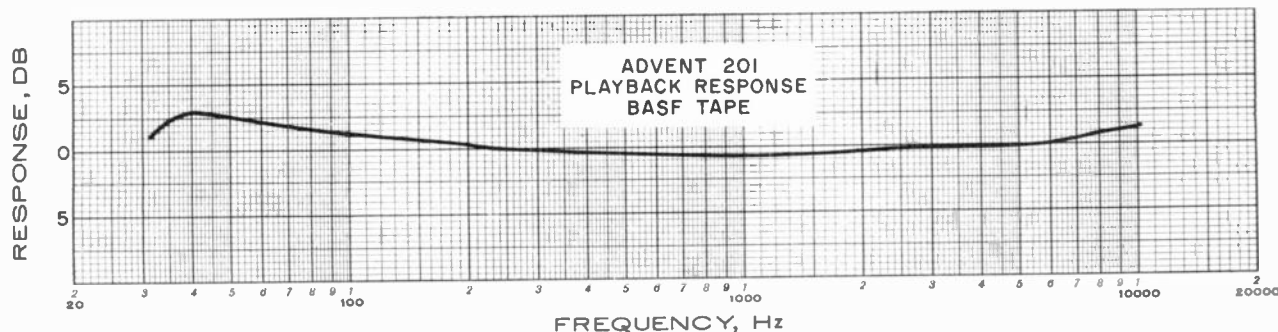


Fig. 2. This playback response curve for the Advent 201 is typical for other decks.

response of a cassette recorder is *critically* dependent on its bias adjustment, relative to the tape formulation used. We judged these units in "as received" condition, using 3M High Energy, TDK SD, and Ampex CrO<sub>2</sub> tapes. It is not only possible, but virtually certain, that normal production tolerances in recorder adjustments (and even in tape properties) could overshadow the differences we heard and measured. Fortunately, these were very minor in every case.

**Advent 201:** The sound quality (frequency response) was perfect with 3M High-Energy tape, slightly bright with TDK SD, and perfect with CrO<sub>2</sub> tape. By "perfect," we mean that there was absolutely no audible difference between the sound from the record and that from the tape copy. A minute increase in hiss level could be heard with the 3M and TDK tapes, but no increase at all with CrO<sub>2</sub>. These findings are completely consistent with the normal biasing of this recorder (for 3M High-Energy tape) and the fact that its playback equalization is changed to get additional signal-to-noise ratio with CrO<sub>2</sub> tapes.

**Concord Mk IX:** Quality was perfect with all three tapes. A slight increase in noise was noted with the 3M tape and TDK tape, but none at all with CrO<sub>2</sub> tape. The headphone volume was moderate.

**Harman-Kardon CAD-5:** This machine was tested some time earlier and a complete comparison is not possible. Our notes show a somewhat

bright sound with TDK SD tape, and some audible hiss.

**Lafayette RK-D40:** Using either the 3M High-Energy or the TDK SD tape, there was a slightly bright sound (more so with the TDK tape, since the machine's bias favored the 3M formulation). With the Ampex CrO<sub>2</sub>, the sound was perfect. Hiss was faintly audible with the 3M and TDK tapes, and inaudible with CrO<sub>2</sub> tape. This machine provided the greatest headphone volume of any we tested.

**Teac 350:** The Teac 350 gave perfect sound quality with all three tapes. This applied to noise as well as frequency response. This might seem surprising in view of its peak at 14,000 Hz, but it appears that the frequency of the peak was sufficiently high as to be inaudible. Headphone volume was good.

**Wollensak 4760:** The performance of this machine was identical to that of the Advent 201.

To place these comments in a proper perspective, it would be quite impossible to detect any change in frequency response or noise level introduced by *any* of these machines, with either phonograph records or FM broadcasts as source material, without a direct A-B comparison—and then only with the finest amplifiers and speakers.

It would appear, therefore, that the consumer in the market for a quality cassette deck is in an enviable position. One can hardly make a "wrong" choice! □



# MICROPHONES FOR TAPE RECORDING

Some suggestions on the selection, connection,  
and applications of mikes for your tape recorder.

By **ROBERT B. SCHULEIN**,  
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**I**F you recently purchased a tape recorder in the \$300 or over price range, you probably noticed that microphones were not included. There are several reasons for this exclusion. To begin with, the tape-recorder manufacturer realizes that the inclusion of a pair of microphones with his product adds to its selling cost and hinders his ability to remain competitive with other manufacturers. Tape-recorder manufacturers also realize that, depending upon the application, various types of microphones, cables, and accessories will be desired by the user. Consequently it makes little sense to include inexpensive microphones with an expensive recorder for their shortcomings will quickly be discovered and the microphones soon set aside. The purchaser of such a recorder is thus faced with the task of choosing microphones and accessories to meet his own particular needs.

To the amateur, this task can be quite difficult because of the specialized descriptive jargon as well as the often incomplete specifications in catalogues and advertising. In picking a microphone for a particular application, it is important to properly combine a knowledge of microphone characteristics, tape recorder characteristics, and the acoustical environment in which the microphone will be used. It is the purpose of this article to discuss these three areas and thus make the selection of a microphone a matter of logic rather than chance.

In order to understand and interpret microphone specifications, it is important to understand the terminology involved. Various terms are commonly used to describe microphone performance characteristics; some of the most important of which are: 1. operating principles, 2. frequency response, 3. directional characteristics, 4. output impedance, and 5. output level or sensitivity.

## OPERATING PRINCIPLES

The primary function of any microphone is to convert an acoustical signal into a corresponding electrical signal. There are many mechanisms by means of which such a conversion can take place; however, the most common are: 1. motion of a wire or conductor in a magnetic field, 2. motion of one electrode of a capacitor, and 3. distorting the shape of a piezoelectric material.

Dynamic and ribbon microphones are examples of the first transducing principle. Such microphones can be constructed to operate over a wide frequency range, require no external power source, and are compatible with a variety of inputs.

The capacitor or condenser microphone makes use of the second transducing principle. Unlike the dynamic or ribbon types, this form of microphone requires electronic circuitry to convert the acoustically generated capacitance variations into electrical signals. The circuitry needed for this conversion usually consists of a d.c. or radio-frequency bias signal plus an amplifier. Although more complex because of this requirement, capacitor microphones are generally noted for their wider frequency response. Within the past few years a new form of capacitor microphone has evolved. It makes use of the electret principle of charge storage. The fundamental advantage of this principle is to simplify the electronic circuit requirements. Whereas the conventional capacitor microphone requires both a high-voltage bias supply and a preamplifier, microphones using the electret principle require only a preamplifier. The electret can thus be thought of as a variable capacitor with a permanent bias voltage applied across it.

Ceramic and crystal microphones are examples of the third conversion principle. Ceramic types are perhaps more popular than crystals due to their

superior ability to withstand temperature and humidity extremes. Either form of microphone is capable of good low-frequency response, but is often inferior in high-frequency response. However, good low-frequency response is seldom achieved with crystal or ceramic mikes, due to the high mike preamp input impedance required.

### FREQUENCY RESPONSE

Perhaps the most publicized specification associated with microphones is frequency response. This specification in its most complete form is shown as a plot of output voltage in decibels vs frequency in hertz (cycles per second). The decibel (dB) as it applies to this form of specification is a means of expressing voltage ratios. For example, a 6 dB change corresponds to a 2 to 1 voltage ratio, and a 20 dB change to a 10 to 1 voltage ratio. Generally speaking,  $\pm 2$  dB variations in frequency response curves are not detectable subjectively. Often, however, frequency response is simply expressed as a frequency range such as 50 to 15,000 Hz with no mention of output variations, in decibels, within that range. Clearly, microphones specified in this manner cannot be compared meaningfully.

When considering frequency response specifications, it is important to bear in mind the conditions under which the microphone was measured. Measurements are usually made in anechoic (echo-free) chambers with the microphone pointed directly at the sound source two or more feet away. Since microphones are not always used on-axis at two feet or more, it is important to be aware of these two variables. For example, as the distance between the microphone and the sound source is decreased, all directional microphones exhibit, in varying degrees, a phenomenon known as proximity

effect. (See Fig. 1.) This effect results in an increase in the bass response of the microphone which may or may not be desired by the user. Secondly, many microphones tend to change their frequency response as the source of sound moves off-axis. This change in response is generally a loss of high frequencies and may be quite apparent for sounds as little as 45 degrees off-axis. Fig. 2 shows the uniformity in off-axis response that should be expected from a well-designed directional microphone.

### DIRECTIONAL CHARACTERISTICS

All microphones can be categorized as directional or nondirectional as a matter of design intent. Nondirectional microphones, which are also referred to as omnidirectional microphones, show little variation with output voltage as the speaker moves off the axis of the microphone (Fig. 3). On the other hand, directional microphones are designed to have large changes in output voltage as one moves off-axis. Of the many types of directional microphones available, the most common are the unidirectional and the bidirectional. Bidirectional microphones show two major directions of sensitivity (Fig. 3), whereas unidirectional microphones are primarily sensitive in one direction. A further subdivision can be made of unidirectional microphones into three major types: 1. cardioid, 2. super cardioid, and 3. hyper cardioid.

Examples of these various directional polar patterns are shown in Fig. 4. These polar characteristics show, in graphical form, the variation in output voltage of a microphone as the source of sound moves around the microphone. As an example, note that the output voltage from a cardioid unidirectional microphone is 6 dB down (a factor of  $\frac{1}{2}$ ) for a 90-degree orientation to a sound source. When considering the directional characteristics of a microphone, it is important to realize that this characteristic can vary with frequency and that uniform polar response vs frequency is quite desirable.

### OUTPUT IMPEDANCE

Microphone specifications generally include the terms "high-" or "low-impedance" when referring to electrical output characteristics. Impedance, as applied to microphones, can be considered as an opposition to current flow when the microphone is connected to an amplifier or tape recorder. From a circuitry standpoint, a microphone can be represented as a voltage generator with output proportional to its sensitivity combined in series with its output impedance. The nature of this impedance

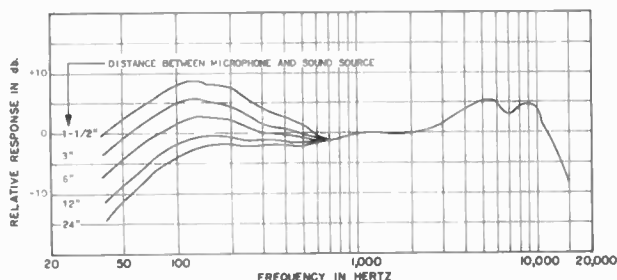
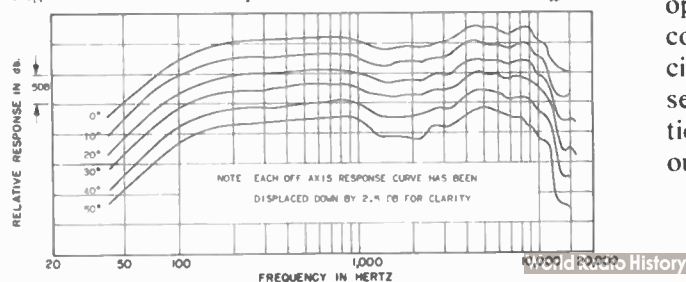


Fig. 1. Variations in frequency response due to proximity effect.

Fig. 2. Variations in response as sound source moves off-axis.



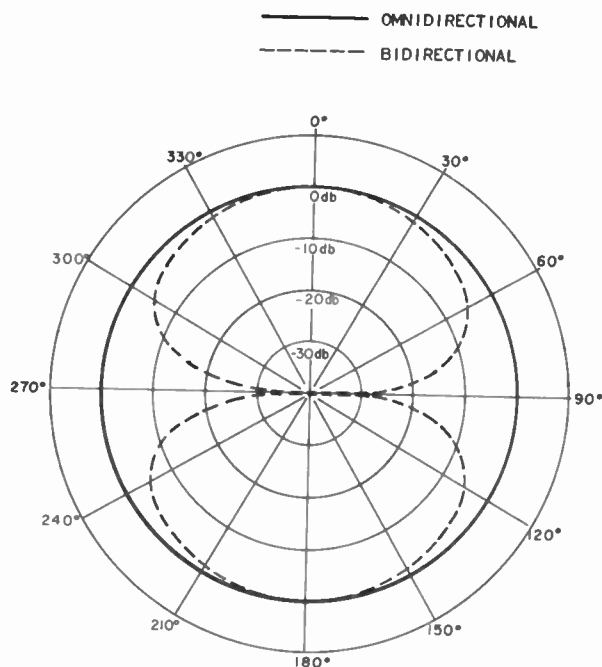


Fig. 3. Bi- and omnidirectional mike polar characteristics.

depends upon the microphone conversion principle and whether or not electronic circuitry is involved. The output impedance of dynamic, ribbon, or capacitor microphones (circuitry included) is almost purely resistive and varies anywhere from 50 to 50k ohms (Fig. 5). For ceramic and crystal microphones (Fig. 6), output impedance is represented by a capacitor whose value may vary from several hundred to several thousand picofarads (micro-microfarads).

#### OUTPUT LEVEL OR SENSITIVITY

Perhaps one of the most confusing specifications associated with microphones is output level or sensitivity. The reason for this confusion is that most sensitivity specifications found in advertising are incomplete and consequently cannot be used for comparison purposes. In order to properly specify the sensitivity of a microphone, three factors must be considered. First of all, the sound pressure used to excite the microphone must be stated. This pressure is generally 1 microbar ( $\mu\text{bar}$ ) or 10 microbars (1 microbar = 1 millionth of atmospheric pressure which is 14.7 lb/in<sup>2</sup>). Secondly, the resulting output voltage due to this sound pressure must be measured. Voltages ranging from .1 to 10 millivolts are common. Finally, the magnitude and type of the output impedance must be stated. (A statement of output impedance is necessary due to the fact that two microphones may have the same sensitivity but different output impedances. The microphone with the lower output impedance will in such case deliver a higher output level to the microphone input preamplifier. Such differences, however, are generally quite small.)

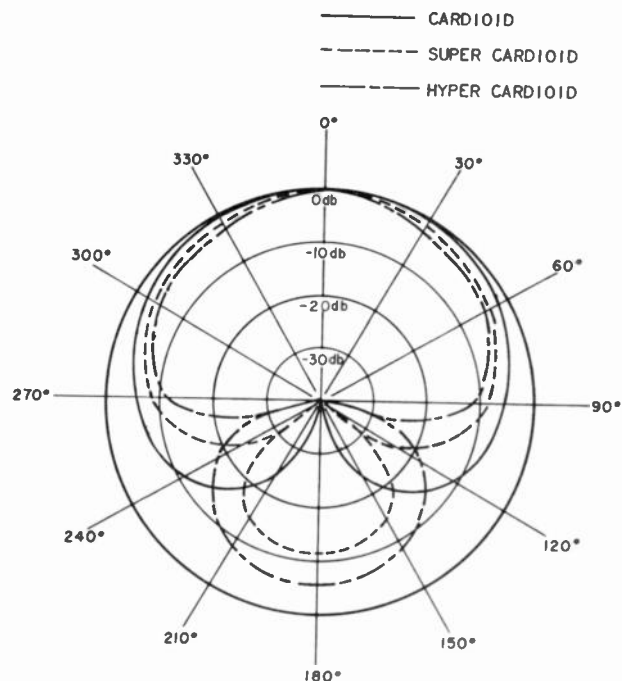


Fig. 4. Polar patterns for cardioid, super-, hyper cardioids.

These three factors may then be combined to form two commonly found sensitivity specifications: 1. open-circuit voltage sensitivity, and 2. maximum power sensitivity.

A properly stated open-circuit voltage specification might look as follows:

−58 dB re 1 volt/1  $\mu\text{bar}$

output impedance = 30k ohms resistive.

This means that for an output impedance of 30k ohms and 1  $\mu\text{bar}$  sound pressure, the output voltage of the microphone, as expressed in decibel form, is −58 dB with respect to 1 volt. An output of −58 dB re 1 volt/1  $\mu\text{bar}$  corresponds to .13 mV/1  $\mu\text{bar}$  which would be a typical output for conversational speech at about one foot. It is important to note that a less sensitive microphone would be represented by a larger negative dB number.

An example of a maximum power specification might be: −59 dB re 1 mW/10  $\mu\text{bar}$ . This means that the particular microphone in question can deliver a power, expressed in decibel form, of −59 dB with respect to 1 milliwatt for a 10-microbar sound pressure.

Although both of these specifications are complete and can be obtained from each other, the open-circuit voltage specification is the easiest to understand and relate to specific amplifier or tape-recorder matching considerations. As a rule of thumb, the open-circuit voltage sensitivity of high-impedance microphones is about 10 times (20 dB) greater than that of low-impedance microphones. Specifically, the average high-impedance microphone has an open-circuit voltage sensitivity of −60 dB re 1 V/1  $\mu\text{bar}$  (1 mV/ $\mu\text{bar}$ ) for a 20k ohm resis-



tive output impedance, whereas a low impedance microphone has a  $-80 \text{ dB re } 1 \text{ V/1 } \mu\text{bar}$  (.1 mV/ $\mu\text{bar}$ ) sensitivity for a 200-ohm resistive output impedance. This difference is due to the fact that most high-impedance microphones are actually low-impedance microphones connected to a voltage step-up transformer.

### MICROPHONE MATCHING

With this background in mind, consideration can now be given to the factors involved in connecting a microphone to a tape recorder. The term that is usually associated with this operation is "matching." One might ask the question, just what are we matching? Perhaps the best way to answer this question is to say that in matching we desire to achieve the following: 1. minimal loss of microphone output signal, 2. minimal degradation of frequency response, and 3. minimum pickup of unwanted signals, such as 60-Hz hum.

Just what factors influence these performance goals? Whenever a dynamic, ribbon, or capacitor microphone is connected to a tape recorder, a fraction of the signal generated by the microphone is not delivered to the recorder. This occurs due to the fact that the tape recorder has a certain input impedance (almost always purely resistive) and that when signal currents flow from the microphone, a small voltage is lost across the microphone's internal impedance. To minimize this loss, the input impedance of the tape recorder should be as high as possible and preferably three or more times greater than the output impedance of the microphone. (Typical tape-recorder input impedances for high-impedance microphones are 50k to 100k ohms.) When ceramic or crystal microphones are connected, however, the situation is somewhat

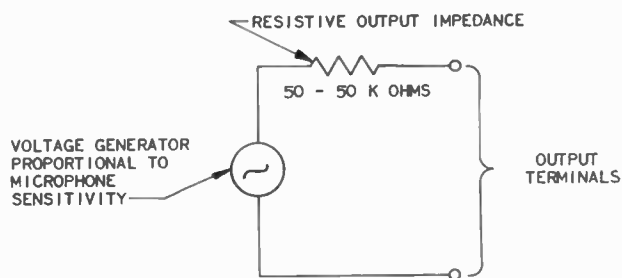


Fig. 5. Circuit equivalent of dynamic, ribbon, or capacitor mikes.

Fig. 6. Circuit representation of ceramic or crystal microphone.

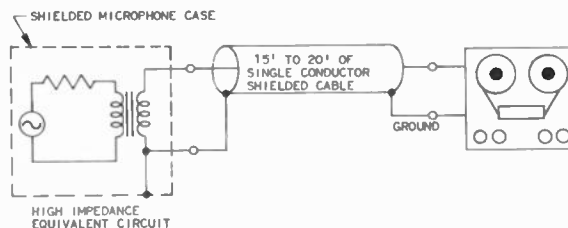
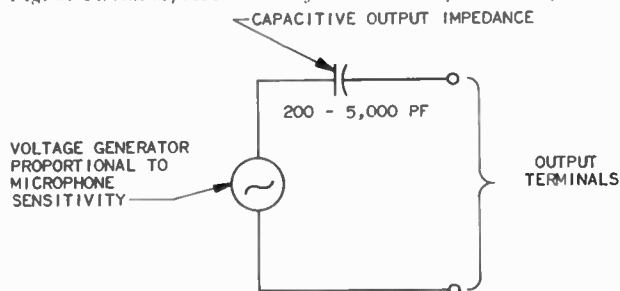


Fig. 7. Typical high-impedance microphone connection.

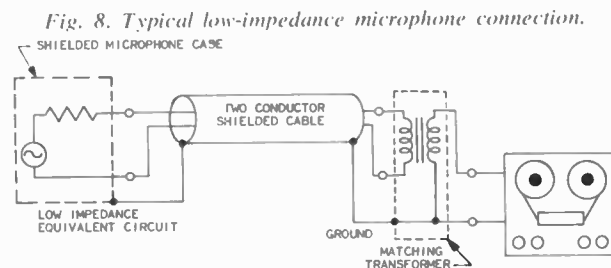


Fig. 8. Typical low-impedance microphone connection.

different. Due to the capacitive nature of their output impedance, resistive loads tend to roll off their low-frequency response. In order to achieve usable low-frequency response, an input impedance of 1 megohm or more is often needed.

In order to preserve good high-frequency response with dynamic, ribbon, or capacitor microphones, attention must be given to the length of the microphone cable used. Microphone cable acts as a shunting capacitor to the microphone and, depending upon the cable length and microphone output impedance, noticeable high-frequency loss may occur. Generally if the output impedance of the microphone is low (600 ohms or less), several hundred feet of cable can be used with negligible high-frequency loss. On the other hand, if the output impedance of the microphone is high (20k ohms or more), cables should be limited to 15 to 20 feet.

The undesired pickup of hum and buzzes can be avoided if proper attention is given to the microphone cable used. Electromagnetic hum is generally produced by such devices as power transformers or power lines, whereas various buzzes are electrostatic in nature and created by such things as fluorescent lamps or neon signs. A good grade of microphone cable with a braided mesh shield will effectively eliminate the pickup of electrostatic signals. The pickup of electromagnetic signals is generally not a problem with high-impedance microphones because the signal voltages are relatively high and cable lengths are short. However, when long cable runs are necessary, low-impedance microphones are used to avoid high-frequency losses and the amount of hum pickup compared to signal level increases.

To cope with this problem, balanced microphone lines are used in conjunction with an additional transformer located at the tape-recorder end of the

cable. A balanced microphone line requires a shielded cable with two conductors shielded as opposed to a single-conductor shielded cable which is used for high-impedance microphone connections. The transformer serves two purposes; the first is to balance out hum signals picked up on the microphone lines, and the second is to step up the output of the microphone. In general, one should use a short length of single-conductor shielded cable with high-impedance microphones, and a balanced line with low-impedance microphones as shown in Figs. 7 and 8. Some tape recorders or microphone mixers which were designed for use with balanced low-impedance microphone lines have a built-in transformer thus permitting a direct low-impedance microphone connection.

#### SELECTING THE MICROPHONE

At this point it is convenient to consider the factors that make one particular microphone type the best choice for a particular application. The first question that is generally asked is how much is it necessary to spend for a microphone? With microphones available from several dollars to several hundred dollars, this appears to be a difficult question to answer. Practically speaking, however, very excellent recordings can be made with microphones in the \$25 to \$75 price range and that as the price increases, quality improvements become smaller and smaller.

It is important to keep in mind that high-quality recordings depend on more than the price of the microphone. Factors such as frequency response, directional characteristics, placement techniques, appropriate accessories, and recording techniques play an equal, if not more important, role in obtaining high-quality recordings.

A second question that is often asked is what conversion principle is best to use. An accurate answer to this question is that microphones employing each of the transducing principles previously discussed are capable of producing excellent results, but that some are more expensive than others or are less practical to use. As previously mentioned, crystal and ceramic microphones are seldom used for wide-response recordings because of the high amplifier input impedance required. Ribbon microphones, on the other hand, must be protected from wind and explosive breath noises to prevent excessive stretching of the ribbon element. Capacitor microphones may be impractical because of their power-supply requirements or their comparatively high cost. The evolution of electret capacitor microphone technology is, however, greatly reducing the cost factor. All factors consid-

ered, however, the dynamic microphone still remains a very logical choice based on performance, reliability, convenience, and economy.

#### FREQUENCY RESPONSE CONSIDERATIONS

For making recordings of voice or music, a uniform frequency response from 100 to 10,000 Hz is generally desirable. The frequency response should not vary more than 2 dB above or below a flat response, and the response at 40 and 15,000 Hz should not be more than 10 dB down.

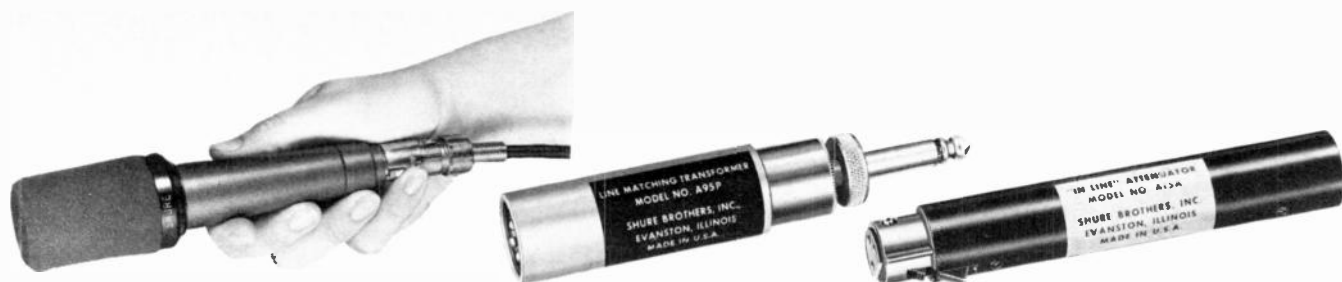
A falling response below 100 Hz is often desirable to minimize the pickup of low-frequency room noise produced by air-conditioning equipment or heavy truck traffic. Many microphones exhibit a response rise of 3 to 5 dB in the area of 7 kHz. This rise has the effect of adding more "presence" to voice and music as well as complementing the high-frequency roll-off of many high-fidelity speaker systems. To compensate for an increase in low-frequency response due to the proximity effect, a number of microphones employ a voice/music switch which introduces a low-frequency roll-off.

#### DIRECTIONAL CONSIDERATIONS

If, in a particular recording situation, the pickup of a specific background sound is undesirable, some form of directional microphone will be of value. Referring back to Figs. 3 and 4, four basic directional patterns are worthy of consideration.

For the case of the undesired sound being at 90° to the desired sound, a bidirectional microphone would be the logical choice. Such a microphone would also be desirable for the pickup of two sources facing each other. Examples of such situations would be two singers facing each other, or individuals on both sides of a conference table. To cope with a situation where the undesired sound is 180° with respect to the desired sound, some form of unidirectional microphone should be considered. Looking at the various types of cardioid responses in Fig. 4, it should be pointed out that the supercardioid and hypercardioid characteristics offer an advantage over the cardioid regarding rejection up to about 130 or 140 degrees off-axis. On the other hand, the basic cardioid provides superior discrimination to sounds arriving from the rear.

The cardioid polar characteristic also offers another advantage in that the output level does not drop off as rapidly as the source of sound moves off the most sensitive axis of the microphone. This characteristic is desirable when attempting to pick up a close-talking voice such as a singer who is holding the microphone in a variety of positions. Consequently, depending upon the direction of ar-



(Left) Shure A2WS add-on wind/pop screen; (Center) A95P line-matching transformer; (Right) A15A 15-dB attenuator pad.

rival of the unwanted sound, one particular directional characteristic is the best choice. If the unwanted sound is diffuse in nature, and therefore lacking any particular direction, all of the discussed directional patterns provide essentially the same advantage.

It should be pointed out that when using any directional microphone, large objects such as walls or furniture should be kept as far as possible from the microphone. The reason for this is to prevent the reflection of undesired sounds towards the most sensitive axis of the microphone. As an example, consider a singer with his back against a wall and facing an undesired source of sound. Reflections from the wall would consequently appear to the microphone to be coming from the same direction as the singer's voice.

#### MICROPHONE PLACEMENT

When recording voice, it is generally desirable to minimize the pickup of background noises as much as possible. It is thus desirable to place the microphone as close as possible to the speaker. However, if close placement is not possible, a directional microphone will aid in the reduction of background noise as compared to an omnidirectional microphone. The use of a directional microphone is not always desirable, however, for if the speaker tends to move far off axis of the microphone, his overall level will change due to the polar characteristic of the microphone. This is particularly true when attempting to record a two-man interview by pointing the microphone back and forth.

For musical recordings, a certain amount of reverberant room pickup is generally desirable. Using omnidirectional microphones, a closer microphone-to-source distance is required than for unidirectional microphones for the same reverberant pickup. This choice is consequently a matter of personal taste and the microphone distance restrictions of the particular recording situation.

#### MICROPHONE ACCESSORIES

There are three areas of microphone performance that are often overlooked and can lead to a poor recording. These areas are pop or "explosive breath sound" sensitivity, wind sensitivity, and mechanical vibration sensitivity. Although most

microphone manufacturers minimize these effects as much as possible in the basic microphone construction, it is often beneficial to make use of available accessories to provide additional protection. Pop and wind sensitivity can be significantly reduced through the use of add-on pop and wind screens. Vibrational problems can be minimized through the use of isolation microphone stands or isolation microphone-to-stand adapters. Very often simply supporting the microphone on a vibration-free surface with an appropriate microphone stand will eliminate a major problem. In addition to these accessories, several manufacturers offer low-frequency roll-off filters which can be inserted directly into the microphone line to further reduce these objectionable signals.

There is one additional area that is indirectly related to the microphone and can result in a highly distorted recording. This area is tape recorder overload which generally cannot be corrected by the input volume control. During the recording of high-level music, or close-talking vocal performances, relatively high voltages may be generated by the microphone which can easily overload the input microphone preamp of many tape recorders. In most recorders the only solution is to attenuate the output of the microphone. Various attenuators are available which provide from 10 dB to 15 dB signal reduction and may be connected directly in an existing microphone line.

In conclusion, a word or two should be said about the use of the tape recorder itself. The use of monitoring devices, such as VU meters and headphones, is very important and if the tape recorder provides a play head monitor, it should be checked periodically. While recording, it is not advisable to make rapid gain changes in recording level due to the subjectively poor results during playback. Finally, experiment so as to become familiar with your recording equipment and its limitations.

In selecting a microphone for tape recording, it should be clear that no particular microphone is always the best choice. On the other hand, after considering the type of recordings to be made, the characteristics of the tape recorder to be used, and the acoustical environment involved, a logical choice can be made as to microphone types, and excellent recordings can be obtained. □



# RECORDING TAPE—

## Materials & Characteristics

Here's a chance to "eavesdrop" on a discussion of recording tape by three highly qualified experts: **Harry Maynard**, the moderator, is host of the weekly program "Men of Hi-Fi\*," **Delos (Del) Eilers**, is a Technical Service Engineer for 3M Company; while **Jack Garner** is an Audio Engineer with the J. C. Penney Company.

*Garner:* What is the dynamic range of audio tape?

*Eilers:* The dynamic range of a piece of tape is as good as the machine coupled with it. You can get 65-75 dB dynamic range, but this depends on how you manipulate the system or how you define dynamic range.

*Garner:* Can we record the full dynamic range of a symphony orchestra with the best recording system available?

*Eilers:* No, we don't even get near the full dynamic range. The ear can detect sound-pressure levels of 110 dB down to 0 dB. The recorded sound's dynamic range, even with Dolby circuits and the most advanced tapes, is still on the order of 70-75 dB.

*Garner:* We have something to look forward to in recorded sounds in the future. As a matter of fact, several exotic oxides have been announced recently, one just introduced by a company in Texas.

*Eilers:* Yes, the Texas company announced a new oxide pigment, which they claim is a step beyond chromium-dioxide.

*Maynard:* You're referring to the Graham Electronics pigment called Cobaloy, right?

*Eilers:* Right.

*Maynard:* What makes that pigment so good?

*Eilers:* They claim it has a higher coercivity than chromium-dioxide. Tape manufacturers classify oxides as to coercivity.

*Maynard:* Coercivity is the resistance of any magnetic material to being magnetized or demagnetized.

*Eilers:* Yes, something that has a high coercivity makes a good permanent magnet. Magnetize it and it stays magnetized. If some material has very low coercivity, it makes a good recording head. The head accepts magnetization easily; however, if you take the field away from it, it loses its magnetism. Different oxides and different modifications of ox-

ides have different coercivity capabilities for magnetic recordings.

Chromium-dioxide cassette tape, for instance, has a coercivity of about 500 oersteds. Oersteds is the unit of measure for coercivity. This is a lot higher than standard cassette tape, which has always fallen in the range of 300 oersteds. Chromium-dioxide took this route to achieve increased output, but by doing so the tape became non-compatible with standard cassette machines.

Until we came up with "High Energy" tape, that was the story: if you wanted to increase output, you would wind up with a cassette tape that was non-compatible. But now everything is entirely different.

High Energy tape gives you the same increased output—or perhaps even a little more—than chromium-dioxide tapes and yet remains fully compatible with standard machines.

We did this by concentrating the high-coercive-force oxide on the surface of the tape. Since high frequencies don't penetrate deeply into the coating, you can see that this has considerable effect on them. This technology, coupled with improved surface smoothness, really extends the high-frequency output—a thing that has been lacking in previously used cassette tapes.

In addition to concentrating the high-coercive-force oxide on the tape surface, we control the average coercive force and coating thickness of the tape very precisely. As a result of all this, the average coercivity of our High Energy cassette tape is 320 oersteds. This makes it compatible with standard cassette recorders and still gives you 3 to 5 dB more output across the spectrum.

*Maynard:* What is Cobaloy's oersted range?

*Eilers:* The Cobaloy pigment is said to be in the 900 to 1000 oersted range. It is more than three

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\*This program is heard in the New York area over WNYC-FM (93.9 MHz) every Sunday from 10:00 to 10:55 p.m.

times as resistant to recording and erasing as the standard ferric-oxides now on the market. It's a material that might work very well in a new system designed to use it. It's not going to work with any of the recorders on the market today.

*Maynard:* In hi-fi circles there's talk about digital recordings using up to 16 channels. Do you have a comment?

*Eilers:* In digital recording we take an audio waveform and sample it every so often. We find it has a certain polarity—it's either positive or negative—and has a certain strength. If we sample a pure tone and do this enough times, we can put these little pulses on the tape and play them back. These pulses can be positive or negative and, depending on how strong they are, we can convert them to something that sounds just like the tone.

*Garner:* Do we miss the holes?

*Eilers:* Your ear doesn't hear the holes, nor does the speaker respond to the holes. This is called time-sharing in computerland. With five or six inputs you might see one input for one millisecond. After a gap of five milliseconds, you're back to the first input. In the sound business they do this by converting normal speech and music signals into a digital code and then transmitting this information digitally.

When you transmit this digital code, whether you put it on a piece of tape or on a telephone line, you're concerned about the rate of the pulses going by and whether they're positive or negative. You must reconstruct the waveform. You don't need a signal-to-noise ratio of 70 dB; 20 dB is enough.

*Maynard:* I've heard that we can sample these bits of information at 180 thousand times or more a second.

*Garner:* Yes.

*Maynard:* With four-channel playback and multiple-channel recording the wave of the future, digital recording will certainly be used.

*Eilers:* Digital recording has another advantage other than in multi-track recording. It has an im-

proved signal-to-noise ratio. Your signal-to-noise ratio is only limited by the electronics that it takes to convert information to digital pulses and then back from digital pulses to analog music and speech signals. Today's electronic circuitry is capable of some fantastic signal-to-noise ratios.

*Maynard:* There are many different kinds of magnetic tapes, even from the same manufacturer. Is this correct?

*Eilers:* Sure is. Each tape has an optimum application. We can record on almost any piece of magnetic tape. But to get the best performance, we need the right kind of tape for the job. Cassette tapes, for example, operating at  $1\frac{7}{8}$  ips have different properties than reel-to-reel tapes that travel at  $7\frac{1}{2}$  or 15 ips.

*Maynard:* What are the common characteristics of all good tapes?

*Eilers:* The tape backing has to be flexible, strong, and smooth. The tape should have a uniform thickness from the first to the last inch.

*Maynard:* There have been some changes in tape backing, right?

*Eilers:* We have evolved from the paper tapes first used by the Germans during World War II to the polyester used in the better tapes today. The first successful plastic tape was acetate. It was thin enough, yet strong enough to pass through the tape equipment.

*Maynard:* Why did you discard paper tape?

*Eilers:* Paper dries out, gets stiffer, is very combustible, and when the weather is damp, paper tape absorbs moisture and gets thicker.

*Maynard:* Why did you go from the acetate to the polyester tape?

*Eilers:* We found better properties in the polyester. Acetate was a sixfold improvement over paper, but it also got very dry and was sensitive to humidity changes.

*Maynard:* Where is the acetate tape being used most?

*Eilers:* It's being used for magnetic and photo-

(Left) Harry Maynard, Host/Moderator; (Center) J. C. Penney's Jack W. Garner; and (Right) Delos (Del) Eilers of 3M.



graphic film. The tape will accept sprocket holes, just as with photographic film. Acetate is also used for pre-recorded tapes, when price is a factor. However, some pre-recorded tapes are being made on polyester. This is especially true of high-volume recordings. Blank acetate tape is considered a general-purpose recording tape.

*Maynard:* What is polyester's biggest competitor?

*Eilers:* Polyester competes with a backing called polyvinyl chloride or PVC. PVC is more humidity stable than acetate, but it's more sensitive to temperature variations.

*Maynard:* In summary, Del, there are three basic backings used for tape today: acetate, polyester, and PVC.

*Eilers:* Yes. But in addition to the basic plastic backing, 3M adds a backing to the backing. This is done to make the tape line up and handle better.

*Maynard:* How does your special backing work?

*Eilers:* We add this texture to the tape to produce a cushion of air between each layer of tape on the reel. This gives the tape some "grab" with the pinch roller and capstan and makes for a truer pull by the capstan.

*Maynard:* What are some of the things people do to abuse tapes?

*Eilers:* Generally speaking, the professional tape user is very careful when handling tape. However, the consumer manhandles the tape by stopping, starting, and rewinding the tape too fast or too often. Manufacturers know this and so they build safeguards into the tape and the equipment. Home-recording machines have pressure pads that push the tape against the head. Professional equipment does not have this feature.

*Maynard:* But the main problem is manhandling?

*Eilers:* Yes. There are others. For example, brakes on the machine may fail if the user goes from high-speed wind to a quick stop too often. Another failing—this one easy to correct—is using warped reels. When this is done, the tape is scraped by the reel slant every time it comes around. Discard a warped reel and wind the tape on a good reel. Another thing the home user can do is to check his machine periodically. Make sure the tape motion is even from the supply reel through the heads and over to the take-up reel.

*Garner:* You're suggesting things that the professional does as a matter of course.

*Eilers:* Yes. I'm also suggesting something that even pros neglect—that is keeping debris and dirt away from the tape and equipment. Debris that's the thickness of a human hair will cause problems. A speck one-thousandth of an inch will drop the

signal on a machine. At 7500 Hz and 7½ ips, the signal will drop 55 dB because of a speck of dirt.

*Garner:* Cassette users are usually the people least knowledgeable about the technical aspects of tape and are not aware of the importance of cleanliness.

*Eilers:* True. Many are just as careless with their records. In both cases, with tapes and records, cleanliness is next to godliness.

*Garner:* Will the development of special tapes for the cassette be reflected in reel-to-reel tapes?

*Eilers:* The development of any tape for any recording use is important because we apply the technologies we have developed to other areas. For example, surface polishing was one of the things developed for videotape. Later it was used for tapes in the audio range.

*Garner:* Can you use your High Energy tape for reel-to-reel?

*Eilers:* The purpose of High Energy tape in cassettes is to allow you to pack more and closer pulses on the tape.

*Garner:* You are, in effect, saying that High Energy tape is basically designed for slow-speed operations?

*Eilers:* Exactly. The cobalt-energized High Energy tape was designed for slow-speed recording. So, changing the coercivity of the oxide from 300 to 500 oersteds, even up to 1000, doesn't make that much difference in the performance of reel-to-reel tape.

*Maynard:* Does this hold true for chromium-dioxide tape?

*Eilers:* Yes, chromium-dioxide tapes, even with some equipment modifications, do not have any advantage at the higher speeds.

*Maynard:* What are the virtues of chromium-dioxide? What are its deficiencies?

*Eilers:* Chromium-dioxide has some very interesting properties for high bit density, very crowded recording, and at high frequencies at low speeds. One of its disadvantages is that at low frequencies it's less sensitive than other oxides. It takes 25% more signal and 2½ more drive than standard ferric-oxide tapes to achieve the same result. Nevertheless, it's a quality product, a very interesting material, and there's no question that it is worthy of consideration by tape and machine manufacturers.

*Maynard:* It takes expensive engineering to compensate for its deficiencies and also take advantage of its virtues at the machine end.

*Eilers:* I would think so but at present it's not compatible with most machines on the market today. □



# Tips for Buyers of CASSETTE MACHINES

Because prices vary widely and features are often eliminated to meet a price, be sure you know just what features you must have before you shop. Then take time to track down just the right cassette machine for you.

By **FRED PETRAS**



**N**OT too long ago, buying a cassette recorder was a snap. There were only a few models on the market; they were all portable, all mono, and all quite expensive by today's standards. And none was what you could really call hi-fi. Basically, you determined how much you wanted to spend, walked into a store, and had a clerk wrap up the model whose price was right.

If you're in the market for a cassette recorder today, the vast number available in retail stores of all types is a bit "off-putting." Drugstores, tobacco shops, neighborhood candy stores, bookshops, and variety stores all offer cassette machines.

The prices are tempting, too, starting at \$14.95 for portable mono recorders similar to those that sold for \$100 not too long ago. There are stereo models, too: for instance, three-piece systems with a chrome-trimmed deck and matching speakers for as little as \$100.

This vast assortment of equipment could easily confuse a person, making him uncertain about what to buy. You may have heard of someone who bought a \$14.95 recorder only to find that it would not play or record in a car because vibrations caused poor tape-to-head contact. Or you may have listened to one of those \$100 systems whose brand name was unfamiliar and decided that the sound of your five-tube AM table model radio (circa 1955) was infinitely cleaner and easier on the ears.

What kind of cassette machine should you buy? Are there any hard and fast rules to observe? Or should you decide that no matter what, it will be a sticky situation?

There are several ways you can answer these questions. You could say, "I have \$50 to spend on a cassette tape recorder," and go look for one in that price range. You could say, "I want every feature I can get in a set priced at \$125," and make comparisons in a dozen stores to find the right model. You could say, "I'm going to experiment. I'll buy something that looks good and use it, then

buy something better later after I've gained some experience with cassettes." Or as so many people do, you might say, "I'm going down to Blank's and buy. Their salesmen know all about tape recorders and will steer me right."

Using one of these approaches might lead you to the right product, but then again it might not. I'd like to suggest a more foolproof method. This one involves determining what you want (or need) the equipment to do—basically, what you expect from it. Once you decide that, set your budget limit—stretching it as far as possible to get the best equipment of the type you want.

The "need" approach will be effective in the vast majority of cases for determining what cassette equipment you should buy. But you may be an unusual case; you may conclude that you need two or three cassette machines—one for each set of needs. If this describes your situation, accept it, and up your budget accordingly. After all, you probably have two or three radios around your home as well as a couple of TV sets.

Right off, I'll say you can't ordinarily buy a decent basic major-brand cassette recorder for less than \$29.95, convincing as the ads touting the "professional quality" of lower-priced sets may sound. Such a model would provide mono recording via a remote-control microphone or from a radio, phonograph, or perhaps a second tape recorder. It would have a combination battery-condition/record-level meter to check the set's batteries and to act as a volume-level indicator in the record mode. It would have a volume control (but probably no tone control), a 2- or 3-inch speaker, and an earphone jack for private listening. If you wanted to use the machine on house current to save batteries, you'd have to buy an a.c. adapter, priced from \$3.98 to around \$10.

A machine of this type would provide the basics. Its playback of music would be limited by the narrow frequency response of the small speaker and its overall sound quality would be similar to that of

an 8-transistor pocket radio. The machine's basic application would be in voice recording.

A step up would be models in the \$39.95 to \$49.95 range. These would operate from a.c. power lines as well as batteries, perhaps include automatic level control (ALC) for sure-fire recording under difficult conditions, a larger speaker, better frequency response and signal-to-noise ratio, and maybe larger and/or longer-life batteries. Machines in this price bracket would offer reasonably good mono reproduction and musical recordings made on them might yield satisfactory results when played through a component hi-fi system.

Starting at \$59.95, you can buy combination AM-radio/cassette recorders that permit you to tape a radio broadcast as you are listening to it. Starting at around \$69.95, you'll find AM-FM radio/cassette recorders. Sets in this price range offer good quality mono sound because they have more powerful amplifiers and, generally, larger speakers. But you won't really approach high-quality reproduction until you lay out around \$100 for a radio/cassette recorder system.

To record and play in stereo "on the go" you'll need a self-contained a.c.-d.c. recorder. These start at around \$125 and go up to about \$190 for quality name brands. Some in this group are two-piece models, containing the recorder and electronics plus a speaker in one housing and the second speaker system (and perhaps its amplifier) in a matching housing. Others contain the recorder/electronics in one enclosure, with two detachable speaker systems. Specifications for models in this group, priced at \$150 and up, are quite good but the sound quality could best be described as "medium-fi."

If you just want to record and play stereo at home, you have a wide choice in several equipment categories. The first is decks, meaning tape mechanisms with preamps but without power amplifiers and speakers. If you already own a component stereo system, you can easily and inexpensively add a stereo cassette playback or record/playback deck to increase your system's capabilities. A deck can be hooked in by means of two or four patchcords in just a few minutes. You can buy a stereo playback-only deck for around \$65.00.

Record/playback decks are available in the \$90 to \$100 range in the Allied Radio Shack, Bell & Howell, Craig, Hitachi, Lafayette, Norelco, Sharp, and Sony/Superscope lines, among others. Units in this price range are basic models. Machines with more features, better specifications, and generally better overall quality will run about \$150. Such machines offer excellent playback sound through

your component system and also provide top-quality sound as recorded from a tuner, phonograph, or open-reel recorder. Some offer bias/equalization switches to take maximum advantage of regular low-noise and/or chromium-dioxide tapes.

For true hi-fi in cassette form there is the *ne plus ultra* category which includes Dolby-ized decks in the \$179.95 to \$279.95 range. These units—using the proper tapes—can provide sound quality comparable to that of virtually any open-reel recorder in a similar price range and, in some cases, surpass the sound of open-reel decks with price tags over \$300. You'll find Dolby-ized record/playback decks in the Advent, Concord, Fisher, Harman-Kardon, Wollensak, Teac, and Lafayette lines, with more models being introduced all the time.

Other noise-suppression systems are beginning to appear, some of which are capable of approaching the effectiveness of the Dolby circuitry. These systems are showing up in equipment made by Norelco and a number of Japanese firms.

Another category of cassette stereo equipment for the home is the "ensemble," consisting of a deck with power amplifiers and two matching speaker systems housed in separate cabinets. They are available under a dozen labels—known and unknown. Prices range from around \$125 to well over \$200. The speaker systems supplied with such ensembles are adequate for noncritical applications and the amplifiers in such units will drive them properly. In some cases, the amplifiers will be capable of driving larger or better speakers. A compact ensemble of good quality has potential as a "building block" toward a complete component system. The ensemble alone provides the full range of record/playback amenities initially. Later, the deck portion can be incorporated into the larger component system you have been gradually building and then the ensemble speakers can be relegated to auxiliary or remote use in another part of the house. If you are thinking in such long-range terms, I heartily recommend that you buy the best ensemble you can afford so that the deck will be of the high caliber you'll want in your "ultimate" component system.

A third category of home cassette equipment is the multi-function compact system. There are two types. One consists of an AM/FM stereo receiver with built-in cassette and matching speaker systems. The other is a receiver/cassette-deck/record-player combination installed in one housing and with two matching speaker systems. Both groups are offered in a wide range of prices. The former run from \$189.95 up to \$495 for an elaborate system. The

compacts may cost anywhere from \$299.95 up to \$569.50. Some compacts offer a choice of speaker systems. These multi-function ensembles were intended as be-all, end-all systems, complete unto themselves. Since they represent a rather large outlay, I urge you to choose carefully, comparing several models. In your hunt, use a completely

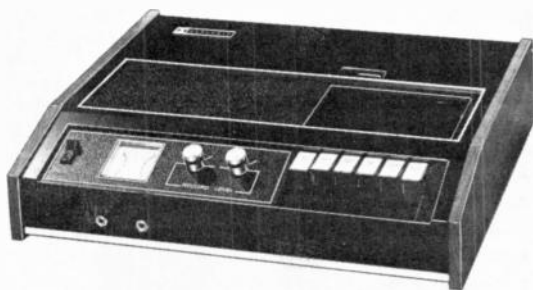
*The Norelco 3170 stereo cassette recorder includes an AM-FM stereo receiver and two matching speakers for a complete system. There are many units of this type available.*



*Kenwood's KX-700 stereo cassette deck comes with a Dolby noise-reduction circuit incorporated. There is also a selector switch for correct biasing of regular or chromium-dioxide tapes.*



*Heath's AD-110 deck will play and record. It has all of the features of most assembled units but is offered in kit form.*



familiar cassette as your test tape in order to improve your chances of finding a unit that sounds right to your ears. If the models include record players, take along a familiar disc to use for comparison purposes. And remember to check out the radio section so that you get the best in sensitivity, selectivity, ease of tuning, and clean sound.

For those who demand the utmost in convenience, cassette changes are the answer. These, in both deck and "ensemble" form, can provide from 6 to 12 hours of continuous music at one loading. The units are priced from about \$140 for the six-cassette Norelco Model 2401A play/record deck, on up to around \$350 for the Ampex Micro 335, which plays twelve cassettes on both sides, in sequence. The Norelco 2401A also comes as a three-piece "ensemble" at \$169.95. There are also other brands worth looking into.

If you want to play cassettes in your car, the choices are relatively simple. There are two basic types of equipment: straight stereo players and models that provide stereo playback plus mono recording capability. Both types mount under the dashboard. In playback models the choice is easy since the units have only the basic transport controls, plus volume, balance, and tone controls.

A major consideration in deciding on a player for your car is safe operation. Pick one that can be used with a minimum amount of fuss and distraction. Your best bet is an automatic-reversing model that plays a cassette straight through on both sides without interruption. Prices start at around \$100. If you can't find one you like, settle for a model that partially ejects the cassette when one side has been played to make the flip-over operation easier and faster. Another consideration is adequate power so that the program is audible over motor and road noises. Car recording machines should also be selected with safety in mind. For safety's sake, make sure the recording controls can be operated without taking your eyes from the road.

If you were thinking of an automobile cassette player a year or so ago, you would have found the prices substantially higher. Car cassette recorder/players are now available in top-name brands for around \$80, compared to \$110 last year.

If you are thinking of four-channel sound in cassette form, you'll have to wait awhile. The technology has quite a way to go and universal standards such as those established by Philips for the two-channel cassette have not evolved as yet. And it is quite possible that, in the final analysis, cassettes will have to bow to cartridge machines when it comes to quadrasonic sound! □



# HOME VIDEO TAPE MACHINES

While still not a "hot" consumer item, steady improvement in performance, simplification of operation, and a reduction in price may lure prospective buyers in near future.

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**I**N the past few years, seven or eight different systems of home video players have been successfully demonstrated and several are available for those who want to purchase right now. There are several factors, however, which seem to be holding back the acceptance of video players domestically. One is the cost; many of the systems when first introduced were to be sold for around \$700—\$800. Now that some hardware is actually being marketed, many prices have crept up to the \$1000 plus mark.

Another big problem is the complete lack of interchangeability between systems. Some use film, some tape, one uses a phonograph-like disc, another utilizes a plastic film into which has been impressed a holographic image. Even among those using videotape, there are many different tape speeds and four different tape widths.

This means that the user who buys one type of player can only play recordings made for that particular system—you would not be able to play a recording made for some other design of player.

All of the videoplayer units are designed to show their pictures on regular television sets by making a connection from the player to the antenna terminals of the TV receiver. (The units using the Avco Cartrivision and JVC systems include a television receiver as part of the package.) The players include an r.f. modulator (like a miniature TV transmitter) which is tuned to a channel not in use in the area where it is being operated. The selector knob on the TV is turned to this channel to show the picture. This kind of connection only needs one cable to carry both picture and sound to the receiver.

In 1971, a problem became apparent—the mod-

ulators were found to be radiating too much r.f. power and were exceeding the allowable limits. Excessive power could interfere with a neighbor's TV set and, if this became widespread, could play havoc with TV reception through the air. For a time the FCC stopped the sale of equipment likely to cause such interference while a solution was worked out.

It now seems that the regulations will be changed somewhat and manufacturers will attempt to reduce spurious emissions from the modulators.

Home video machines can be classified in two groups. First, those which can only *play* pre-recorded programming, and second, those which have the ability to *record* original material and *play* this as well as pre-recorded programming. This second class of equipment needs, additionally, some other device (such as a TV camera or TV receiver) to provide an input picture for the machine to record. A TV camera used in conjunction with the recorder is able to operate as an "instant-home-movie" unit.

The "play-only" systems are, as is to be expected, somewhat less expensive than the "record-play" units.

## ELECTRONIC VIDEO RECORDING (EVR)

The EVR partnership, consisting of CBS, Imperial Chemical Industries, Ltd (U.K.), and Ciba (Switzerland), was among the earliest of entries in the field with its Electronic Video Recording system. Although EVR players have been advertised for the educational and industrial markets, it is generally assumed that once these areas are well-established, EVR will be promoted for domestic use.

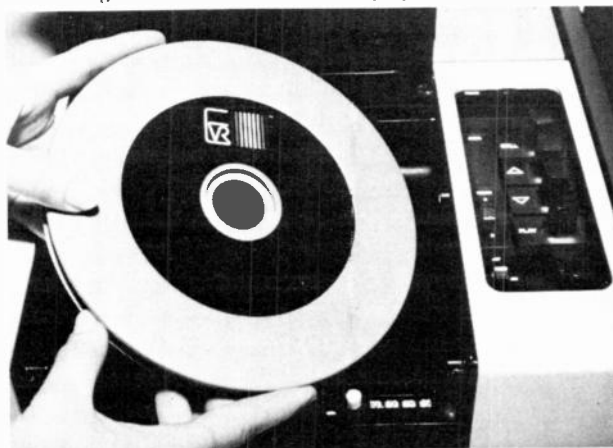
In the EVR system the recording medium is an optical film with magnetic sound tracks on a common base. It is contained in a circular cartridge, seven inches in diameter and two-thirds of an inch thick (Fig. 1). The film is 8.75 mm wide and is 750 feet long, giving a maximum playing time per track of 25 minutes. A cartridge can accommodate two 25-minute black-and-white programs or one 25-minute color program. Enlarged views of both the color and black-and-white films are shown in Fig. 2.

There are two separate picture tracks on the black-and-white film: magnetic stripe sound tracks are laid down at the edges of the film, one adjacent to each picture track. There is an optical sync mark, one per frame in the center of the film. Although the film is printed in black-and-white only, color programs can be reproduced by utilizing two side-by-side frames for each color picture. One frame contains the luminance (brightness and detail) information, the other frame contains the color information in the form of a pilot-carrier and two chroma signals corresponding to the R-Y and B-Y components of the picture. With the color cartridge, the two sound tracks may be used for stereo sound or, alternatively, each track could carry recordings in a different language.

Each picture frame on the film is very small, about 0.31 cm wide by 0.25 cm, and there are 90,000 of these frames for each 25-minute black-and-white program (double this number for color). The film runs at a rate of six inches-per-second, sixty frames-per-second.

EVR films can be copied from 35 mm or 16 mm film originals or from videotapes, and the cost of a 25-minute color cartridge in mass production quantities (2000 and up) is about \$18.50 per cartridge. For the equivalent black-and-white program time, the cost is \$12.30. At present, the films are

Fig. 1. EVR color cassette. It plays 25 minutes.

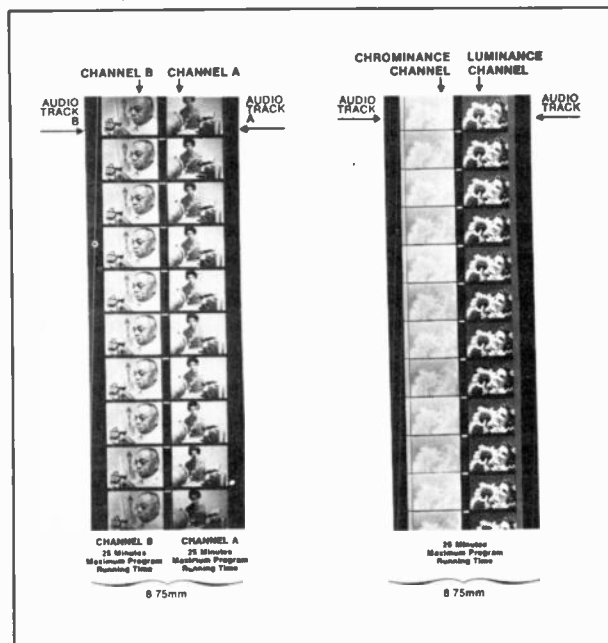


printed on silver-halide material (like photographic film) but experimental work is being done on Diazo-type film. This is virtually grainless and is less expensive than silver-halide, an important feature which should stimulate large-scale distribution.

A player is shown in Fig. 3. To operate, the cartridge is placed on a hub under the hinged cover. When the cover is closed and the play button is pressed, the film leader from the cartridge is automatically threaded through the deck, and in a few seconds the picture appears. The film may be stopped, started, or still-framed anywhere throughout its length.

Inside the player, the film is scanned by a flying-spot cathode-ray tube, the resulting modulated light is picked up and is processed by photo-multiplier tubes for viewing. Unlike a movie projector which uses intermittent motion of the film (stopping the film in the gate while light is projected through it), the EVR film moves continuously and smoothly, while the image of the cathode-ray tube raster also moves in the same direction as

Fig. 2. Enlarged view of EVR film. See text.



the film, producing the effect of a smooth vertical scan.

The modulator in the EVR player produces a v.h.f. output of 50 mV (+34 dBmV) which is sufficient to feed twenty or more television receivers simultaneously without any further amplification. The player is less suited to connection to existing MATV cable systems because the modulator is double-sideband—this means that if, for example, it were tuned to channel 4, then it would also pro-

duce interference to the audio of channel 3.

Until the end of 1971, Motorola had the exclusive manufacturing and distribution rights for the EVR player in the U.S. Beginning in 1972, several other companies were licensed by CBS to manufacture the players and distribute them internationally. These companies are Thomsen CSF in France; Hitachi, Matsushita, Mitsubishi, and Toshiba in Japan; and Rank-Bush-Murphy in Britain.

The cost of the Motorola player is set at present at \$795; there are indications from the manufacturers and the EVR partnership that price reductions could be made when the mass-production home market opens up.

#### **SUPER 8mm VIDEO PLAYER**

It is appropriate to mention here another player using film as the recording medium. This is the Kodak super-8mm video player, which, as its name implies, uses super-8mm film. This is a great advantage because the film can be recorded in color using a standard super-8mm motion picture camera (which can be obtained for around \$30).

The player can be used to play back via its modulator to a TV set any super-8mm film with or without a magnetic sound track. Like the EVR system, the player uses a flying-spot cathode-ray tube scanning the film which is in continuous motion. The light passing through the film is picked up by three photo-multipliers, each corresponding to one of the red, blue, and green primaries. The phototube outputs are passed to an encoder to produce an NTSC-type color signal.

This system has certain advantages over many other video systems, one being the ease with which the film may be edited and spliced. Also, there is complete interchangeability between the video player and all super-8mm projectors and films.

There are, however, some less desirable features; one is that compared to the "instant-replay" available with videotape machines there is a delay of several days, required for processing, between exposing your film and being able to see it. Also, at present, the cost of film and processing for one hour of super-8mm film is around \$100 or so which is three to five times the cost of the same length of recording on video tape.

#### **SELECTAVISION**

RCA has demonstrated a cartridge system known as SelectaVision (SV). At one time this was expected to be available in 1972, but there has been no recent word confirming this. In order to produce the SV cartridges, the original program

material on movie film, videotape, or from a TV camera is first recorded on conventional film by an electron-beam recorder. This film is developed and converted by a laser process to a hologram master. The master is plated with nickel and this nickel form is used to press the holographic pattern onto a vinyl strip, which is then wound into the cartridge ready for reproduction. This simple means of pressing the recorded hologram onto the vinyl is a very inexpensive process, enabling mass reproduction of programs at very low cost.

The reproduction process, in the home player, uses a very low power (2 milliwatts) laser which reconstructs a real image from the hologram. This image is picked up by a simple, built-in TV camera and produces a TV waveform of the image which is processed and modulated for viewing on a regular TV receiver.

The use of a holographic recording medium has an important advantage over film, disc, or tape media; in these types of recording, dust, scratches, or other imperfections produce very definite picture impairment. However, the hologram does not contain a pictorial recording of the image as such, but only a representation of the object's optical phase relationship to the recording laser-light source, distributed over the whole image frame. Thus, it is possible to tolerate a far greater amount of film-transport instability and scratches, dust, etc., before picture impairment is objectionable.

The SelectaVision system is expected to be marketed at about \$400. A pre-recorded 30-minute color cartridge will sell for \$10. RCA is planning to distribute the system and programs through outlets already selling phonograph records and audio tapes.

#### **THE TELDEC DISC**

An entirely different sort of video player is the Teldec disc device. Teldec represents the combined efforts of AEG-Telefunken in Germany and Decca Records in England. The Teldec system uses a 9-inch diameter PVC disc 1 mm thick, which looks very much like a long-playing stereo-audio disc. The Teldec disc has a very fine recorded groove spacing, about 3500 grooves per inch, compared to 250-350 per inch on the regular audio disc, and the stylus moves in a hill-and-dale fashion instead of laterally (side-to-side). The disc rotates at 1800 rpm (once per TV frame) on a cushion of air and, due to the fact that the pick up operates in a pressure (sensitive) mode, the player is insensitive to mechanical shocks and will even play satisfactorily upside down.

Both picture and sound are recorded in the same



groove, the sound track is modulated into the horizontal blanking portion of the video waveform. This is a distinct departure from all the other video players which provide a separate track for audio—together with the inherent disadvantage of an additional audio transducer plus its added cost.

The groove depth is so shallow (20 to 40 microinches), that a positive mechanical drive is necessary to track the pickup across the radius of the disc. A traverse drive is used which moves the pickup one groove-space for every revolution of the disc.

So far only a black-and-white version of the player has been demonstrated (Fig 4), but a color player has been promised for 1972. A 9-inch disc has a playing time of five minutes and a 12-inch version with finer groove spacing will play for 12 minutes.

The discs are manufactured by simply hot-pressing a metal master disc into plastic sheet, a very quick and inexpensive process, much as present-day stereo-audio discs are pressed. It is this simple low-cost replication (about \$2.50 per disc) that could make Teldec the major contender in the home video player stakes.

The Teldec player is estimated to cost only about \$150 for a singles player and \$250 for an auto changer, by far the least expensive of the home players.

#### VIDEO TAPE RECORDERS

The "record and play" video devices all use magnetic tape as their recording medium, and can be further broken down into reel-to-reel machines and cassette-cartridge types.

The reel-to-reel machines have gradually evolved from the relatively high cost helical-scan (slant track) semi-professional video tape recorders (VTR's). There are well over 50 models available, some differing from others in only minor details.

In 1969, the Electronic Industries Association

of Japan formulated a standard for 1/2-inch VTR's (known as the E.I.A.J. Type I standard) and there are now 8 or more manufacturers producing machines on this standard. A tape made on any E.I.A.J. Type I standard machine should play satisfactorily on any other machine of the same standard.

There are a number of firms making reel-type portable-VTR-camera combinations to these standards; for example, Sony AV3400 (Portapack), JVC4500, Panasonic NV/WV3080, Ampex Instavideo, to mention a few. These VTR's weigh about 15-18 lbs and measure about 12" × 11" × 5".

The Ampex Instavideo uses the E.I.A.J. Type I standard, but the tape is enclosed in a 4.6-inch-diameter plastic cartridge; the tape may be rewound and played on an E.I.A.J. Type I reel-to-reel machine.

(There is one portable not using E.I.A.J. Type I standards; the Akai VT-100 uses 1/4-inch videotape. It is somewhat lighter than the others—10 pounds—and measures 10" × 10" × 4")

These combinations are priced at about \$1200 to \$1500 and include black-and-white camera, microphone, portable VTR with shoulder strap, plus batteries. They have a somewhat limited recording time, about 20-30 minutes, but do permit operation as instant-home-movie devices.

There are also various non-battery record/players utilizing the E.I.A.J. Type I standard (Sony AV3600, Panasonic 3020, Concord VTR800). These sell for around \$700 and can record and play tapes up to one-hour in length as well as play tapes from the 1/2-inch portable VTR's. Other models are available providing higher playback stability, editing, and other features in the region of \$1000.

In the "record and play" cassette-cartridge market are Avco Cartrivision, Norelco (Philips) V.C.R., Sony "Videocassette" as well as the Ampex Instavideo mentioned before.

Fig. 3. EVR player operates through TV receiver.

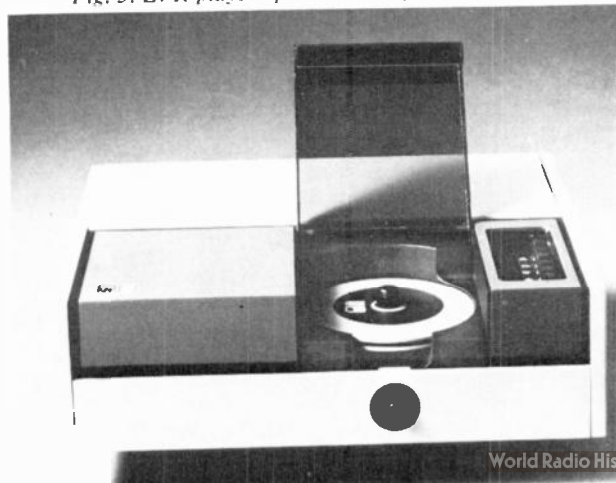
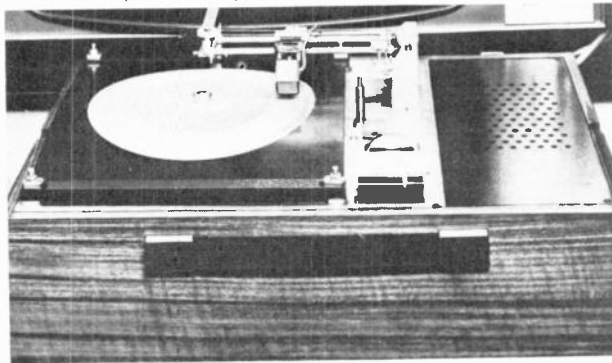


Fig. 4. Prototype Teldec video disc player.



### CARTRIVISION

Cartridge TV Inc. has designed and developed a cartridge video tape recorder, using half-inch tape, specifically for the consumer market. The company will build the recorders and sell them to manufacturers of television receivers who will combine receiver and recorder into a self-contained unit.

A number of firms have indicated they will produce these combination units, among them are some big names in the industry: Sears Roebuck (Warwick TV), Admiral, Emerson, Du Mont, Montgomery-Ward, and Teledyne-Packard-Bell.

The first model on the market will be produced by Warwick TV and sold under the Sears label. It will be introduced in the Sears Chicago stores in June 1972 at a price of about \$1600 (Fig. 5). The unit will include a Cartrivision record-player, a 25-inch color-TV receiver, and a black-and-white TV camera with microphone. Later in the year it will be introduced to other markets in the U.S.

In 1973, Sears will introduce a Cartrivision "player-only", at \$750 which can be connected to any TV receiver to play pre-recorded tapes. Other options will be a color-TV recorder-player without camera for \$1350, a recorder attachment for the player-only at \$150, and a color camera in late 1973 for \$400.

With the complete equipment you can record on a cartridge from a TV broadcast or from the TV camera and microphone and also play either these cartridges or pre-recorded ones which have been purchased or rented. Cartridges are made in two sizes, both are  $6\frac{5}{8}$  inches wide and  $1\frac{1}{2}$  inches thick; the 114-minute cartridge is  $7\frac{1}{8}$  inches long while the 15-30 minute cartridge is  $5\frac{1}{8}$  inches.

The VTR in the equipment will play either type; the cartridge has a built-in head cleaner, a time indicator, and uses  $\frac{1}{2}$ -inch  $\times$  .001-inch iron-oxide tape. The tape runs at a speed of 3.8 inches-per-second for play or record, and about 20 times that speed for fast-forward or rewind. There are two audio tracks and three video heads—only one video field in three is recorded; on replay each field is played by each of the three video heads successively.

A built-in 8-hour time clock allows you to turn the recorder on even when there is no one home so that you can record your favorite TV program while you are away and view it when you return.

For rented cartridges, there is a slight mechanical modification: the tape cannot be rewound in the home machine, only by the rental organization. So the fee you pay for rental is for *one* play only.

Cartridge cost will be about \$32 for a 114-minute unrecorded tape.

A full-length motion-picture classic (without commercials) will rent for \$6 for a single showing. Titles which are already announced include feature films "Exodus," "High Sierra," and "Marriage Italian Style," as well as other programming such as "The Bolshoi Ballet," Mozart's 40th Symphony, the "Ali-Frazier Fight," together with educational and religious material.

Pre-recorded purchased cartridges will cost from \$5-\$30 each, depending on length of program.

### NORELCO VIDEO CASSETTE

The Philips company in Eindhoven, Holland, has produced a cassette recorder system which will be marketed in the U.S. by its associated company, North American Philips (Norelco). See Fig. 6.

The VCR operates with any domestic TV receiver and allows the following functions to be carried out: play pre-recorded cassettes and view on the receiver, record a TV program off-the-air onto a blank cassette, record from an appropriate camera onto a blank cassette.

A special feature in the VCR not found in other devices is a built-in TV tuner; this lets you record a program off-the-air while watching a *different* program on your receiver. The VCR unit also includes other useful features such as a built-in timer for automatic switching on and off, built-in digital tape counter, provision against accidental erasure of pre-recorded programs, and automatic audio and video gain and color controls.

The manufacturer has gone to great lengths to simplify insertion of a cassette, all you do is to drop it into a recessed slot on the player. The built-in threading mechanism does the rest. The cassette contains a tape supply spool and a take-up spool, mounted concentrically, and two guide rollers. On the player itself there are two smaller guide pins fixed to a drum under the video head wheel. A

Fig. 5. Sears' video tape cartridge plays through TV.





Fig. 6 (top). Norelco's video cassette recorder.  
Fig. 7 (above). Norelco cassette is  $5" \times 5\frac{1}{2}" \times 1\frac{3}{4}"$

Fig. 8 (below). JVC's ensemble, Model CE-7000.  
Fig. 9 (bottom). JVC's player, Model CP-5000.



small motor rotates the drum pulling the tape out of the cassette and tensions it against the video head wheel. The motion stops and the drum stays in that position for the duration of the tape play. The process is reversed for unthreading.

The  $\frac{1}{2}$ -inch chromium-dioxide tape runs at 5.6 inches-per-second; a 60-minute tape is contained in a cassette about 5-inches by  $5\frac{1}{2}$  inches by  $1\frac{3}{4}$ -inch thick (Fig 7). A blank tape will cost around \$20-\$25; the VCR recorder-player will cost about \$1000 and \$200 more with a black-and-white camera.

A bright spot for European users is that it appears that the VCR might become the home-recording standard there as a number of manufacturers (AEG-Telefunken, Blaupunkt, Grundig, Loewe-Opta) as well as some Japanese manufacturers (headed by Sony) have agreed to use this system.

A somewhat strange situation exists because of this standard being adopted by Sony and other Japanese manufacturers in Europe, while they are actively promoting another standard for the U.S. market. This is the Sony "Videocassette," also to be manufactured by the 3M Company in the U.S. and Matsushita (Panasonic) and Victor (JVC) in Japan, using  $\frac{3}{4}$ -inch chromium-dioxide tape—a tape width not hitherto used, running at a speed of 3.75 inches-per-second.

The Videocassette will play up to 90 minutes of black-and-white or color programming with two audio tracks; the cost of a prerecorded program will be between \$80 and \$140—a blank tape will cost \$22-\$28. The Sony color player unit will be available the first half of 1972 at a cost of \$995, recording capability will cost a further \$400. Sony is also reportedly working on a low-cost color camera, which it is hoped will sell for under \$1000.

The Victor Company of Japan (JVC) has recently introduced three models, using  $\frac{3}{4}$ -inch cassettes. One is the Victor VCR Model CE-7000 ensemble which includes a cassette record and play unit plus a 20-inch color-TV receiver (Fig 8). The price of this is \$1750. Another model is the Victor CR-6000, a record and play unit which can be attached to a TV receiver with an r.f. modulator. This sells for \$995. There is also the Victor VCR player, Model CP-5000 priced about \$750 (Fig 9). The Victor company is using the name "Video Cassette Recorder System" and the initials "VCR" to identify its products; the same terms being used by Norelco (Philips) for its equipment—although the systems are not compatible since they use different tape widths and cassettes. □



# The Quietest Revox

One of the most compelling reasons for buying a Revox is the sounds it doesn't make.

No spurious pops or clicks. No wavering, fluttering tones. No distracting hum. And best of all, virtually noise-free electronics.

Take our new A77 Mk III for example. We manufacture it to such close tolerances and with such exacting attention to detail, that it is generally regarded as one of the quietest tape recorders ever made.

Unfortunately, no matter how quiet our electronics are, there is still the inherent problem of tape hiss.

And that's where our new Revox A77/ Dolby B recorder comes in.

By now, the virtues of the Dolby Noise Reduction system are too well known to require any elaboration on our part.

Suffice it to say, for all practical

purposes the last major stumbling block to quality, noise-free recording has finally been eliminated.

Listening to tapes on the new Revox/Dolby B is a revelatory experience. Tape hiss is virtually non-existent. The music seems to emerge from a background of velvety silence. And at 3-3/4 i.p.s. the absence of extraneous noise is truly startling.

But no mere description of the

Revox/Dolby B can adequately convey the experience awaiting you the first time you listen to a tape made on this remarkable machine.

Your nearest Revox dealer will be delighted to audition the Quietest Revox

for you. Once you've heard it, you'll understand why we say...

Revox delivers what all the rest only promise.

The Revox/Dolby B



## SECTION

# Reel-to-Reel Tape Machines

### AIWA

#### TP-1012 Tape Recorder

Two-speed (7½, 3¾ ips, 1⅞ ips with capstan change), 4-track stereo unit. 7" maximum reel.



Response 50-16,000 Hz. 1¼ W/ch dynamic output. Operates from 117 V a.c., 8 "D" cells, or 12 V battery. Features two VU meters, tape counter, pause control. Has two 6" x 4" oval speakers and two dynamic microphones. 13½" x 12⅞" x 7¼" D ..... \$189.95

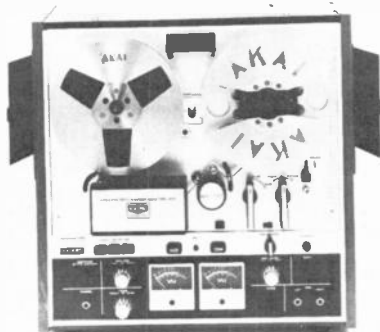
### AKAI

#### GX-220D Stereo Tape Deck

Three-speed (7½, 3¾, 1⅞ ips), 4-track, 3-motor, 3-ferrite head design. Will handle up to 7" reels. Response 30-24,000 Hz ±3 dB, wow & flutter 0.08%, S/N 50 dB, all at 7½ ips. Has VU meters, and counter. Features automatic reverse and shutoff, pause control, and sound-on-sound facilities. 17¼" x 17" W x 9¼" D ..... \$399.95

#### GX-220 Stereo Tape Recorder

Same as GX-220D except has stereo power amplifiers (10W/ch continuous sine wave at 8



ohms, 15 W/ch dynamic power). Has two built-in 4-inch speakers ..... \$469.95

#### GX-280D Stereo Tape Deck

Two-speed (7½, 3¾ ips), 4-track, 3-motor, 3-ferrite head design. Will handle up to 7" reels. Response 30-24,000 Hz ±3 dB, wow & flutter 0.08%, S/N 50 dB, all at 7½ ips. Has VU meters, counter, and remote control (optional extra). Features automatic reverse and shutoff, pause control, and sound-on-sound facilities.



17" x 18" W x 10" D ..... \$499.95

#### GX-365D Stereo Tape Deck

Four-speed (15, 7½, 3¾, 1⅞ ips), 4-track, 3-motor, 3-ferrite head design. Will handle up to



7" reels. Response 30-28,000 Hz ±3 dB, wow & flutter 0.04%, S/N 55 dB, all at 7½ ips. Features instant stop, braking, automatic reverse and shutoff, pause control, sound-on-sound facilities, sound-with-sound, and monitor facilities. Has VU meters, counter, and remote control (optional extra). 18½" x 16¼" x 11½" D ..... \$559.95

#### 1720W Stereo Tape Recorder

Three-speed (7½, 3¾, 1⅞ ips), 4-track, 2-head, single-motor design. Will handle up to 7"



reels. Response 40-15,000 Hz ±3 dB, wow & flutter 0.18%, S/N 50 dB, all at 7½ ips. Features built-in electronics with 4 W/ch output and built-in speakers. Has VU meters and counter. Includes automatic shutoff, pause and tone controls. 14½" x 14½" W x 9½" D

World Radio History

..... \$239.95

#### X165D Stereo Tape Deck

Three-speed (7½, 3¾, 1⅞ ips), 4-track, 3-head (Crossfield) design. Features instant stop/pause control, automatic shutoff. Response 30-20,000 Hz ±3 dB, wow & flutter 0.12% rms, S/N 50 dB, all at 7½ ips. Supplied with dust cover. 13½" x 13½" x 9" D ..... \$229.95

#### M-11D Stereo Tape Deck

Two-speed (7½, 3¾ ips), 4-track, 2-channel stereo/mono design. Features automatic reverse and stop/shutoff switch, pause control, VU meters. Has super-range tape switch which changes equalization according to tape used. Can be used as a p.a. system. Response 30-25,000 Hz ±3 dB, dist. 2%, S/N 50 dB, all at 7½ ips. Has mike (0.3 mV) and line (100 mV) inputs plus line (1.23 V) and phone outputs. 16¼" x 16" x 9⅞" D ..... \$299.95

#### M-11 Stereo Tape Recorder

Same as M-11D except has stereo power amp (7 W/ch continuous sine wave into 8 ohms, 10 W/ch dynamic power). Has two built-in 4" speakers. 16⅞" x 16" x 9⅞" D ..... \$369.95

### ALLIED RADIO SHACK

#### TD-1099 Stereo Tape Deck

Three speeds (7½, 3¾, 1⅞ ips); 4 tracks; one motor. Will take up to 7" reel. Has three heads.



Response 30-22,000 Hz ±3 dB; wow & flutter 0.1% at 7½ ips; S/N 48 dB. Features VU meters, automatic shutoff, pause control, sound on sound, sound-with-sound, counter, and monitoring facilities. 12¾" H x 16" W x 6⅞" D 20 lbs ..... \$179.95

#### 909A Stereo Tape Recorder

Three speeds (7½, 3¾, 1⅞ ips); 4 tracks. Will take up to 7" reel. Response 50-18,000 Hz wow & flutter 0.25% at 7½ ips. Has built-in



## 1 Reel-to-Reel Tape Machines

electronics with 3½ W/ch output. Supplied with speakers, microphones, VU meters, and counter. Permits sound-with-sound recording. Overall dimensions 14" H x 24¼" W x 7½" D. Weight 26 lbs ..... \$169.95

### ASTROCOM/MARLUX

#### 407 Stereo Tape Deck

Two-speed (7½, 3¾ ips), 4-track, 3-motor, 4-head deck. Will handle up to 7" reel. Response



30-20,000 Hz, wow & flutter 0.07% at 7½ ips, S/N 50 dB. Has VU meters, automatic reverse and shutoff, pause control, echo effects, sound-on-sound, sound-with-sound, counter, solenoid control, and monitoring facilities. 14½" H x 21" W x 10½" D ..... \$459.95

### CONCORD

#### Mark II Tape Deck

Three-speed (7½, 3¾, 1⅞ ips), 4-track, one-motor, 3-head (ferrite erase) stereo deck. Will handle up to 7" reels. Response 20-20,000 Hz ±3 dB, wow & flutter 0.09%, S/N 52 dB, all at 7½ ips. Has VU meters, automatic shutoff, pause control, echo effects, sound-on-sound, counter, monitoring facilities, and dynamic muting. With dust cover. 13" H x 18½" W x 6" D ..... \$179.95

#### Mark IV Tape Deck

Similar to Mark II, but with 4 heads and automatic reverse. Wow & flutter 0.08% at 7½ ips. Overall dimensions 17" H x 17" W x 8½" D. .... \$279.95

#### Mark 8 Tape/Cartridge Recorder

Three-speed (7½, 3¾, 1⅞ ips), 4-track stereo recorder which includes 8-track cartridge



play/record facilities. Will handle up to 7" reels. Response 50-19,000 Hz, wow & flutter 0.1%, S/N 45 dB, all at 7½ ips. Built-in electronics with 10 W/ch output. Supplied with speakers. Has VU meters, automatic shutoff, pause control, counter, monitoring facilities, tone controls, and dust cover. Sound-with-sound. 17½" H x 16¾" W x 8¼" D. Has carrying handle ..... \$319.95

## FERROGRAPH

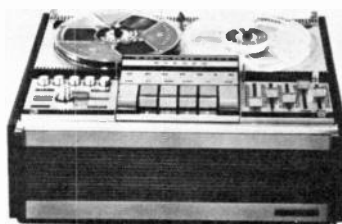
### Series 7 Tape Recorders

Three speeds (7½, 3¾, 1⅞ ips), 4 tracks. Has three heads and three motors, braking, VU meters, automatic shutoff, pause, sound-on-sound capability, bias adjust, and counter. Available in half-track and mono versions, with or without power amplifiers and portable cases. Cabinet available extra ..... \$599.00 to \$699.00

## GRUNDIG

### TK-600 Tape Recorder Deck

4-track, 2-speed (7½, 3¾ ips), play/record stereo deck. Has VU meters, end-of-tape stop.



Features sound-on-sound, tape monitoring. Response 30-18,000 Hz ±2 dB, wow & flutter 0.15%, S/N ratio 50 dB, all at 7½ ips. Inputs for microphone, radio & ceramic cartridge. Preamp output 0.5 to 1.5 V adjustable. Overall dimensions 16½" H x 14¼" W x 7¼" D. .... \$429.95

### TS-600 Tape Recorder Deck

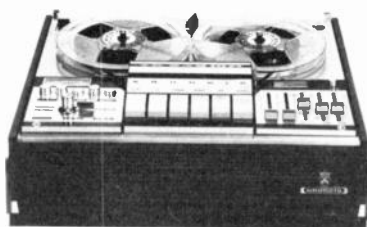
Basically the same as Model TK-600 except does not have bass and treble tone controls ..... \$349.95

### TK-246 Tape Recorder Deck

Two speed (7½, 3¾ ips), 4-track stereo deck. Will handle up to 7" reels. Features VU meters, automatic shutoff, pause control, counter, and monitoring facilities. 13¾" H x 17" W x 8" D ..... \$249.95

### TK-248 Tape Recorder Deck

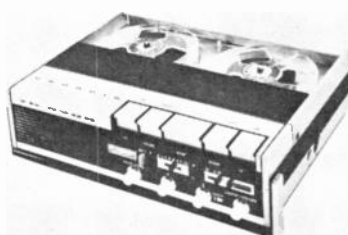
Two speed (7½, 3¾ ips), 4-track stereo deck. Will handle up to 7" reels. Features VU meters,



automatic shutoff, echo effects, sound-on-sound and sound-with-sound capability, counter, and tape monitoring facilities. 13¾" H x 17" W x 8" D ..... \$299.95

### TK-3200 Mono Portable Recorder

Three speed (7½, 3¾, 1⅞ ips), battery-powered mono recorder for portable applications. Features built-in speaker, automatic and manual level controls, pause control, automatic



shutoff, bass/treble/volume control, VU meter, and remote operation from microphone. 3½" Overall dimensions 3½" H x 12" W x 9¾" D. Comes with carrying handle ..... \$269.95

## HITACHI

### TRQ-730D Tape Recorder

Three-speed (7½, 3¾, 1⅞ ips), 4-track, 3-head, one-motor unit. Will handle up to 7" reels. Response 20-23,000 Hz, wow & flutter 0.12%, S/N 52 dB. Has automatic shutoff, counter, monitoring facilities, and a dust cover. 16⅞" H x 13¼" W x 7½" D ..... \$189.95

### TRQ-770D Tape Recorder

Three-speed (7½, 3¾, 1⅞ ips), 4-track, one-motor stereo unit. Will handle up to 7" reels. Response 20-23,000 Hz, wow & flutter less than 0.12%, S/N greater than 53 dB. Has VU meters, automatic reverse and shutoff, pause control, sound-with-sound, counter, and monitoring facilities. 17⅞" H x 16⅞" W x 8⅞" D ..... \$259.95

## JVC

### 1224 Stereo Recorder

Three-speed (7½, 3¾, 1⅞ ips), 4-track design. Will handle up to 7" reels. Response 30-20,000



Hz, wow & flutter 0.15% at 7½ ips, S/N 45 dB. Features built-in electronics with 4½ W/ch output. Has VU meters, automatic reverse and shutoff, pause control, counter, and dust cover. Provides sound-on-sound and sound-with-sound facilities. Comes with speakers and microphones. 12¾" H x 38¼" W x 7½" D ..... \$299.95

## KENWOOD

### KW4066A Stereo Tape Deck

3-head, 3-speed (7½, 3¾, 1⅞ ips) design. Features bias adjust for regular or low-noise tape,



slide-type controls, sound-with-sound, separate left/right record capabilities, and tape monitor. Has dual VU meters. Response 25-20,000 Hz at 7½ ips, wow & flutter 0.15% rms at 7½ ips, S/N 50 dB. Sensitivity: mike 0.6 mV, line 100 mV. Outputs 0.775 V. 16" x 7⅞" x 12¾" D ..... \$199.95

### KW-5066 Stereo Tape Deck

4-head (with extra full-track erase), 3-speed (7½, 3¾, 1⅞ ips) design. Features record-bias adjust with built-in test signal oscillator, tape monitor, sound-on-sound and echo, VU meters. Response 25-20,000 Hz at 7½ ips, wow & flutter 0.15% at 7½ ips, S/N 50 dB. Has two mike inputs (0.6 mV) and 2 line inputs (100 mV). Output 0.775 V/ch. 16" x 7" x 15½" D ..... \$299.95

## TAPE RECORDER GUIDE



## KLH

### Forty-One Stereo Deck

Three-speed (7½, 3¼, 1⅞ ips), 4-track, 3-head stereo design. Will handle up to 7" reels. Re-



sponse 50-15,000 Hz  $\pm 3$  dB, wow & flutter 0.1% at 7½ ips, S/N 68 dB. Has VU meters, automatic shutoff, pause control, and counter. Features Dolby noise-reduction system. There are two line inputs and one microphone input. Individual level controls for each channel. 11¾"  $\times$  14¼"  $\times$  5⅝" D ..... \$249.95

## MAGNAVOX

### 1K8875 Tape Recorder Deck

Three-speed (7½, 3¼, 1⅞ ips) stereo design. Response 50-15,000 Hz  $\pm 4$  dB at 7½ ips, wow & flutter 0.15% at 7½ ips. Has automatic shut-off record-level meters. Features sound-with-sound, mike & aux. inputs. Supplied with two dynamic mikes with stand. Wood cabinet. 13¾"  $\times$  11¼" D  $\times$  7" H ..... \$119.95  
1K0884. Same except features sound-on-sound ..... \$159.95  
1K8877. Same as 1K0884 except has 3 heads, monitor control, headphone volume switch and features echo effects ..... \$229.95  
1K8879. Same as 1K0884 except 2 speeds (7½ & 3¼ ips) and features bi-directional record/play, continuous automatic reverse, dual capstan drive, and includes a dust cover ..... \$229.95

## MOTOROLA

### RA20GW Tape Recorder

Three speeds (7½, 3¼, 1⅞ ips), 4 track stereo design. Will handle up to 7" reels. Features VU meters, automatic shutoff, and counter. Supplied with microphones. Walnut enclosure ..... \$129.95

## NAGRA

### 4.2 Synchronous Recorder

Battery-powered mono design with 7-inch reel capacity (5-inch reel capacity with cover



closed) Synchronizes with motion-picture camera. Response 30-20,000 Hz  $\pm 2$  dB at 15 ips, S/N 70 dB. Has two mike inputs and one line input, meter for recording level and battery and internal circuit tests, tape-monitor switch. Features built-in speaker powered by 1.6-watt amplifier ..... \$1674.00

### S Tape Recorder

Stereo version of the Model 4.2. Two-track as delivered has switching, metering, and sockets for future conversion to a synchronous stereo recorder. Is equipped for mono synchronous recordings. Has single modulator with over-laying green and red needles for more accurate mixing ..... \$2042.00

## PANASONIC

### RS-736 Tape Deck

## FACTS ON REEL-TO-REEL TAPE RECORDERS

ALTHOUGH the quarter-track reel-to-reel tape recorder may never replace the phonograph record as a stereo program source, it is now and will continue to be a key component in a well-equipped music system. Tape recording allows anyone to assemble musical or vocal entertainment to his own taste, either from live or recorded sources—something which no other recording medium can do. The ease with which a reel-to-reel recording can be edited gives it a powerful advantage over the cartridge and cassette format.

Many recorders are available in a choice of portable or fixed packaging, using the same tape transport and electronics. Sometimes low-powered playback amplifiers and small speakers are included, particularly in portable versions. These are convenient for monitoring or casual listening, but the true quality of any tape recorder can only be realized when it is played through a good external amplifier and speakers.

Tape transports are often classified according to the number of heads and motors they contain. At a minimum, two heads (erase and combined record/playback) and one motor are required. By using separate recording and playback heads, each can be optimized for its own function. Most three-head machines also have separate recording and playback electronics, allowing monitoring off the tape while recording. Sometimes a fourth head is added for playback in the reverse direction. In combination with an automatic tape travel reversing system, the listener has uninterrupted playback of a tape in both directions (4 tracks). A few tape recorders have complete duplication of heads—six in all—and can record as well as play back in either direction.

Most low-to-moderate priced transports (and a few expensive, high-quality models) have a single motor which drives the tape capstan and turns the reels through a system of belts and clutches. Higher priced machines generally use three motors—one for constant-speed capstan drive and two torque motors for the reels. Most three-motor machines have solenoid-operated controls, actu-

ated by light-touch push-buttons, instead of the purely mechanical controls of a single-motor machine. Remote control is offered as an option on many three-motor machines. Three-motor transports tend to have less flutter and faster rewind action than single-motor designs. As with phonographs, excessive flutter in a tape recorder imparts a rough or "gargly" sound to the program. Flutter levels as high as 0.25% may be tolerable for many situations, but the better tape machines have flutter as low as 0.1% or less.

Most tape recorders accept inputs from high-level sources (such as amplifier or receiver tape outputs) or from medium-impedance dynamic microphones. Higher priced models usually have mixing inputs for combining two program sources when recording. Recorders with separate playback heads often have provision for transferring one recorded track to the other (sound-on-sound or sound-with-sound), or re-recording each track on itself to produce an echo effect.

The recorder's bias and equalization are optimized for a particular type of tape. The full benefits of improved tape formulations—extended frequency response and lower noise—can only be realized through correct bias adjustment. Complete adjustment facilities have long been provided on professional and semi-professional recorders, but only recently has this feature been available on many of the moderate priced machines.

A signal-to-noise ratio of 55 to 60 dB can be achieved on a good quality reel-to-reel recorder. Since this is acceptable performance, even for critical listening, auxiliary noise-reducing circuits (such as the Dolby "B" system) are rarely incorporated in these machines. If desired, however, Dolby can be added through "outboard" electronics.

Frequency response, at 7½ ips, often extends beyond 20 kHz, and many recorders have flat response to beyond 15 kHz at 3¼ ips. At 1⅞ ips, offered on some machines, high-frequency response is usually limited to 8 kHz or less, restricting its usefulness in high-quality recording. □

## 1 Reel-to-Reel Tape Machines



4-track, 3-speed (15, 7½, 3¾ ips), 3-head stereo design. Wow & flutter 0.09% at 7½ ips. Frequency response 20-28,000 Hz at 7½ ips. Inputs: mike 20,000 ohms, max. sensitivity 0.3 mV; Phono #1 xtal 1 megohm, max. sensitivity 100 mV; Phono #2 mag 47,000 ohm, max sensitivity 2 mV; Aux. #1 250,000 ohms, max. sensitivity 30 mV (3 V max. input); Aux. #2 50,000 ohms, max. sensitivity 100 mV (10 V max. input). Dual outputs both 1 V & 50,000 ohms (1 fixed, 1 variable). Features equalization switch for normal or low-noise tape. Separate record & playback amplifiers for echo effects, cueing and pause controls, sound-on-sound. With dust cover and adapter for 15 ips operation ..... \$329.95

### RS-714US Tape Deck

Two-speed (7½, 3¾ ips), 4-track, 3-motor stereo design. Will handle up to 7" reels. Has 3 fer-



rite heads. Response 30-22,000 Hz at 7½ ips, wow & flutter less than 0.1% at 7½ ips, S/N better than 50 dB. Has VU meters, automatic shutoff, pause control, sound-on-sound, counter, remote control (optional extra), solenoid operation, and monitoring. 20" H x 17" W x 7⅞" D ..... \$449.95

**Model RS-715US.** Similar to RS-714US except this model includes an automatic reverse feature ..... \$499.95

## PIONEER

### T-6600 Tape Deck

Two-speed (7½, 3¾ ips), 4-track, 4 head, single-motor stereo unit. Will handle up to 7" reels. Response 50-15,000 Hz ±2 dB, wow & flutter less than 0.12% at 7½ ips, S/N 55 dB. Has VU meters, automatic reverse and shutoff, pause control, and counter. 17" H x 17¾" W x 7¼" D ..... \$299.95

### T-6100 Tape Deck

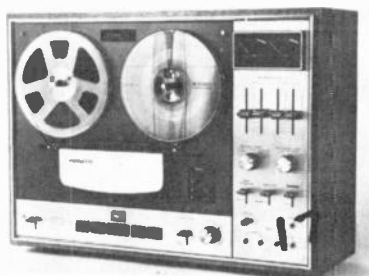
Two-speed (7½, 3¾ ips), 4-track, 3-head, single-motor stereo unit. Will handle up to 7"



reels. Response 50-15,000 Hz ±2 dB, wow & flutter 0.12% at 7½ ips, S/N 55 dB. Has VU meters, automatic reverse and shutoff, pause control, and counter. 14⅞" x 15⅞" W x 6¾" D ..... \$249.95

### T-8800 Tape Deck

Two-speed (7½, 3¾ ips), 4-track, 4-head, two-motor stereo unit. Will handle up to 7" reels.

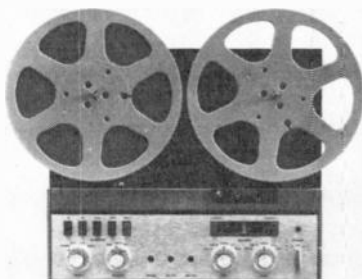


Response 40-15,000 Hz ±2 dB, wow & flutter less than 0.08% at 7½ ips, S/N 55 dB. Has VU meters, automatic reverse and shutoff, pause control, echo effects, sound-on-sound, bias adjustment possible, counter, remote-control, monitoring facilities. Dust cover included. 9½" H x 21¾" W x 16¾" D ..... \$549.95

## REVOX

### A77-1102 Stereo Deck

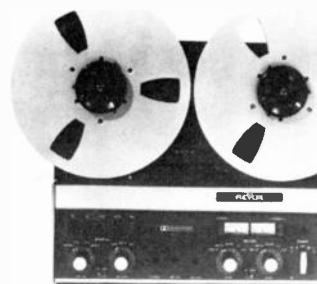
Two-speed (3¾-7½ ips and 7½-15 ips), 2-



track, 3-motor, 3-head deck. Will handle up to 10½" reels. Response 20-20,000 Hz ±2.5 dB, wow & flutter 0.08% at 7½ ips, S/N 58 dB. Has braking, VU meters, automatic shutoff, sound-on-sound, counter, remote control, solenoid operation, monitoring facilities. Numerous options available including 4 track, plug-in 10 W/ch rms continuous power amplifiers, portable version, etc. at up to \$669.00 16½" H x 16¼" W x 8½" D ..... \$649.00

### A77 "Dolby B" Tape Deck

Same as the A77-1102 but a Dolby B noise-reduction system has been added. Has compressors and expanders for both stereo chan-



nels. THD is 1.5% instead of 2.5% at 7½ ips, S/N ratio is 5 dB better ..... \$859.00

## RHEEM CALIFONE

### 70-TC Tape Recorder

Two-speed (7½, 3¾ ips), 2-track, single-motor mono design. 2 heads. Handles up to 7" reels. Response 50-15,000 Hz ±2 dB, wow & flutter 0.18%. Built-in electronics with 5 W rms output. Features VU meter, automatic shutoff, pause control, counter, monitoring facilities. May be used as p.a. system. Supplied with speaker and microphone. 13¼" H x 13¼" W x 9" D ..... \$235.00

### 3205 Tape Recorder

Two-speed (7½, 3¾ ips), 4-track, single-motor, two head stereo design. Handles up to 7" reels.



Response 50-15,000 Hz ±3 dB, wow & flutter 0.18% at 7½ ips. Built-in electronics with 4 W/ch rms output. Features VU meters, automatic shutoff, pause control, counter, monitoring facilities, and tone controls. Comes with speakers and handle for carrying. 15¼" H x 15½" W x 8½" D ..... \$365.00

### 70-TF Tape Recorder

Similar to Model 70-TC, but with lever-action



speed change and built-in storage compartment ..... \$245.00



## SANSUI

### SD-7000 Stereo Tape Deck

Two-speed (7 1/2, 3 3/4 ips), 4-track, 3-motor, 4-head deck. Will handle up to 7" reels. Response 20-20,000 Hz  $\pm 2$  dB, wow & flutter 0.06% at 7 1/2 ips, S/N 60 dB. Has VU meters, automatic reverse and shutoff, pause control, sound-on-sound, sound-with-sound, counter, monitoring facilities, and solenoid operation. Remote control optional extra. Comes with dust cover. 21 1/8" H  $\times$  17 1/8" W  $\times$  10 1/2" D .. \$679.95

## SHARP

### RD-709 Stereo Tape Recorder

Three-speed (7 1/2, 3 3/4, 1 7/8 ips), 4-track, 3-motor unit. Will handle up to 7" reels. Features



automatic reverse with continuous-play function, VU meters, sound-on-sound, sound-with-sound, counter, solenoid operation, and built-in electronics. Response 25-18,000 Hz, wow & flutter 0.07%, both at 7 1/2 ips. S/N 50 dB. 4 W/ch dynamic (EIA) power at 5% THD. Has swing-out speaker enclosures (16 1/8"  $\times$  18 1/2"  $\times$  6") each with 8" woofer & 2 1/2" tweeter. Control center 16 1/8"  $\times$  18 1/2"  $\times$  7 3/4". Comes with two microphones ..... \$299.50

### RD-708 Stereo Tape Recorder

Three-speed (7 1/2, 3 3/4, 1 7/8 ips) design. Features sound-with-sound, automatic shutoff, sound monitoring, VU meter, 2 heads. Has swing-out speaker cabinets (each with 6 1/4" woofer & 2 3/8" tweeter). 2 1/2 W/ch dynamic (EIA) power at 5% THD. Response 40-16,000 Hz, S/N 45 dB. Supplied with two dynamic microphones. 15 3/8"  $\times$  15 3/4" H  $\times$  10 1/2" D ... \$179.95

## SONY/SUPERSCOPE

### 252D Tape Deck

Two-speed (7 1/2, 3 3/4 ips), 4-track, one-motor, 2-head stereo tape deck. Will handle up to 7" reel. Response 30-18,000 Hz; wow & flutter 0.12% at 7 1/2 ips; S/N 52 dB. Features VU meters, automatic shutoff, pause control, and counter. 15 1/4" H  $\times$  13 1/8" W  $\times$  7 1/2" D ..... \$149.95  
Model 252. Same as Model 252D except three speeds and with built-in 6 W/ch power amplifiers ..... \$299.95

### 330 Tape Recorder

Three-speed (7 1/2, 3 3/4, 1 7/8 ips), 4-track stereo unit. Will handle up to 7" reels. Response 30-18,000 Hz; wow & flutter 0.12% at 7 1/2 ips. Built-in electronics with 7 1/2 W/ch output. Supplied with speakers and microphones. Has VU meters, automatic shutoff, counter, monitoring facilities, tone controls. Includes a cas-



ette record/play facility. Carrying handle. 11 3/16" H  $\times$  21 3/16" W  $\times$  13 7/8" D ..... \$349.95

### 366 Tape Deck

Three-speed (7 1/2, 3 3/4, 1 7/8 ips), 4-track, 3-head, one-motor stereo unit. Will handle up to



7" reels. Response 30-25,000 Hz  $\pm 3$  dB, wow & flutter 0.09% at 7 1/2 ips; S/N 55 dB. Has VU meters, automatic shutoff, pause control, counter, monitoring facilities. Slanted upright base. 16 7/16" H  $\times$  14 13/16"  $\times$  8 7/16" D .. \$259.95

### 440 Tape Deck

Three-speed (7 1/2, 3 3/4, 1 7/8 ips), 4-track, 3-head, one-motor stereo unit. Will handle up to 7" reels. Response 30-25,000 Hz  $\pm 3$  dB; wow & flutter 0.06% at 7 1/2 ips; S/N 56 dB. Has VU meters, automatic shutoff and reverse, six-head function, pause control, echo effects, sound on-sound, counter, solenoid operation, and monitoring facilities. 16 7/16" H  $\times$  16 7/16" W  $\times$  8 1/2" D ..... \$369.95

### 580 Tape Deck

Three speed (7 1/2, 3 3/4, 1 7/8 ips), 4-track, 3-head, 3-motor stereo unit. Will handle up to 7"



reels. Response 30-25,000 Hz  $\pm 3$  dB; wow & flutter 0.06% at 7 1/2 ips; S/N 56 dB. Has VU meters, automatic reverse and shutoff, counter, monitoring facilities, solenoid operation. 18 1/16" H  $\times$  17 1/2" W  $\times$  8 7/8" D ..... \$479.95

### 630 Tape Recorder

Three-speed (7 1/2, 3 3/4, 1 7/8 ips), 4-track, 3-head, one-motor stereo unit. Will handle up to 7" reels. Response 30-22,000 Hz; wow & flutter 0.09% at 7 1/2 ips; Built-in electronics with 20 W/ch output. Supplied with speakers and microphones. Has VU meters, automatic shutoff, pause control, echo effects, sound-on-sound, counter, phono input, tone controls, monitoring facilities. Carrying handle included. 20" H  $\times$  17 7/8" W  $\times$  11 5/8" D ..... \$449.50

### 640 Tape Deck

Two-speed (7 1/2, 3 3/4 ips), 4-track, 3-head stereo unit. Will handle up to 7" reels. Response 30-20,000 Hz  $\pm 3$  dB; wow & flutter 0.07% at 7 1/2 ips; S/N 55 dB. Features VU meters, brak-



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## 1 Reel-to-Reel Tape Machines

ing, automatic shutoff, pause control, echo effects, sound-on-sound, counter, monitoring facilities, and solenoid operation. 15½" H x 14½" W x 9½" D ..... \$349.95

### 650-4 Tape Deck

Two-speed (7½, 3¾ ips), 4-track, 3-head, 3-motor stereo unit. Will handle up to 7" reels.



Response 30-22,000 Hz  $\pm 2$  dB; wow & flutter 0.04% at 7½ ips; S/N 57 dB. Has VU meters, automatic shutoff, pause control, echo, sound-on-sound, bias adjustment, monitoring facilities, and counter. Remote control optional extra. 17½" H x 16½" W x 9½" D ..... \$475.00  
**Model 650-2.** Same as Model 650-4 except 2-track ..... \$499.95

### 770-4 Tape Deck

Three-speed (7½, 3¾, 1½ ips), 4-track, 4-head, one-motor stereo unit. Will handle up to 7" reels. Response 20-22,000 Hz; wow & flutter 0.09% at 7½ ips; S/N 56 dB. Has VU meters, automatic shutoff, pause control, counter, solenoid operation, and monitoring facilities. A.c./d.c. operation. 16½" H x 15½" W x 5½" D ..... \$595.00

### 850-4 Tape Deck

Three-speed (15, 7½, 3¾ ips), 4-track, 4-head, 3-motor stereo unit. Will handle up to 10½" reels.



Response 30-22,000 Hz  $\pm 2$  dB; wow & flutter 0.03% at 7½ ips; S/N 57 dB. Has VU meters, automatic shutoff, pause control, echo effects, sound-on-sound, bias adjust, counter, solenoid operation, monitoring facilities. Remote control optional extra. 19¾" H x 17½" W x 10" D ..... \$895.00  
**Model 850-2.** Same as Model 850-4 except two-track ..... \$895.00

### TC-353 Stereo Tape Recorder/Speakers

Three-speed (7½, 3¾, 1½ ips), 3-head stereo tape recorder with integrated speakers. 7 W/ch rms dynamic power. Features separate record/playback preamps, sound-on-sound and echo, tape/source monitoring facilities, and a tape-select switch for use of high-output low noise tape or standard tape. Has VU meters, retractable pinch roller for easy tape threading,

automatic tape lifters to protect heads during fast-forward and rewind, non-magnetizing record head. Full complement of controls. Has p.a. capabilities, pause control with lock, built-in reel locks, four-digit tape counter, stereo headphone monitor jack. Can be operated vertically or horizontally ..... \$329.95

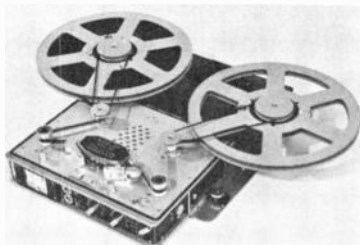
### TC-353-D Stereo Tape Deck

Features three speeds (7½, 3¾, 1½ ips) and three heads. Has line & mike mixing; pause control, automatic shutoff, VU meters. Sound-on-sound with optional Sony MX-6S mixer ..... \$199.95

## STELLAVOX

### Sp 7 Portable Recorder

Professional 4-speed (3¾, 7½, 15, 30 ips) battery-operated portable recorder with numer-



ous options. 3 heads plus fourth synchronizing head. 5" max. reel size (up to 10½" reels with ABR adapter as shown). Numerous mono and stereo head assemblies available, equalized for various tape speeds. Has modulometers, built-in speaker, and 1 W amp. A.c.-d.c. operation. Response 30-16,000 Hz  $\pm 2$  dB (at 7½ ips, stereo), wow & flutter 0.1%, S/N 60 dB stereo, 65 dB mono. Weight with tape and batteries 8 pounds. 8½" H x 10½" W x 3" D ..... \$1603.00 and up

## TANDBERG

### Series 11 Tape Recorder

Portable (15 V, ten 1½-V cells), mono design. Three speeds (7½, 3¾, 1½ ips), two tracks,



and three heads. Will handle up to 7" reels. Has automatic level-input controls, mike & line mixing, and built-in speaker. Response 40-16,000 Hz  $\pm 2$  dB at 7½ ips, wow 0.1% at 7½ ips, S/N 58 dB unweighted. 13" W x 10" D x 4".

**Model 11-1.** Full-track ..... \$449.95

**Model 11-2.** Two-track ..... \$449.95

**Model 11-1-P.** Full-track with "Pilotone" head for film camera sync. Connects cable to camera, providing starting signal tone. Can also be used with Jensen 205S Synchronizer ..... \$699.00

A.c. power supply ..... \$44.95

Tandberg Synchronizer ..... \$350.00

### Series 15 Tape Recorder

Mono design with built-in 4" x 7" speaker. Three speeds (7½, 3¾, 1½ ips). Response 40-16,000 Hz  $\pm 2$  dB at 7½ ips, wow 0.1% at 7½ ips, S/N at max. record level 55 dB. 5 W/ch continuous output with both channels driven. Has 0.75 V preamp outputs, low-Z mike & high- and low-level inputs. 13½" W x 11½" D x 6¾" H. Has 0.75 V preamp outputs, low-Z mike & high- and low-level inputs. 13½" W x 11½" D x 6¾".



**Model 1541.** Four-track ..... \$313.50

**Model 1541F.** With foot remote control ..... \$401.50

**Model 1521.** Two-track ..... \$287.00

**Model 1521F.** With foot remote control ..... \$399.00

### Series 14 Tape Recorder

Same as Series 15 except 2-speed (3¾ & 1½ ips) design.

**Model 1441.** Four-track without case ..... \$270.00

**Model 1442.** With case ..... \$294.00

**Model 1422.** Two-track with case ..... \$275.00

**Model 1421.** Two-track without case ..... \$250.00

### Series 3000X Tape Deck

Stereo design with crossfield bias head, separate erase, record, and playback heads. Fea-



tures VU meters, add-a-track, sound-on-sound, A-B testing, echo & mono mixing. Has mike and low- and high-level line inputs and line (0.75 V) outputs. Three speeds (7½, 3¾, 1½ ips). Flutter & wow 0.07% at 7½ ips. Response 40-20,000 Hz  $\pm 2$  dB, S/N 60 dB, ¼-track weighted, all at 7½ ips.

**Model 3041X.** Four-track ..... \$349.95

**Model 3021X.** Two-track ..... \$349.95

### Series 4000X Tape Recorder

Stereo design with two built-in 7" x 4" speakers. Three speeds (7½, 3¾, 1½ ips). Has 4



heads including crossfield bias head. Features source/tape monitoring, sound-on-sound, add-a-track, full mono mixing, end-of-tape stop, mag. or ceramic phono inputs. Response 40-20,000 Hz  $\pm 2$  dB, wow & flutter 0.07%, S/N 62 dB, ½-track weighted, all at 7½ ips and 5% distortion. 10 W/ch rms continuous power output with both channels driven. 15½" W x 12½" D x 6½". Walnut cabinet.

**Model 4041X.** Four-track ..... \$459.00

**Model 4021X.** Two-track ..... \$459.00

### Series 6000X Tape Deck

Stereo record/play design with four heads, including crossfield bias head. Features VU me-



ters, automatic start/stop/pause, remote control, record/playback monitoring, cueing, stereo/mono mixing, A-B testing, sound-on-sound, add-a-track, echo. Has automatic overload input protection, line, tuner, mike, and mag. or ceramic phono inputs, and line (1.5 V) outputs. Three speeds (7 1/2, 3 3/4, 1 7/8 ips). Response 40-22,000 Hz  $\pm 2.5$  dB, flutter & wow 0.1%, S/N 62 dB, 1/4-track weighted, all at 7 1/2 ips. 15 1/2" W x 12 3/8" D x 6 1/2" H. Walnut cabinet.

Model 6041. Four-track ..... \$499.00  
Model 6021X. Two-track ..... \$499.00

### TAPESONIC

#### 70A Tape Recorder

Three-speed (15, 7 1/2, 3 3/4 ips), 4-track, 3-head, 3-motor stereo design. Will handle up to 10 1/2"



reels. Response 30-20,000 Hz  $\pm 2$  dB, wow & flutter 0.008% at 7 1/2 ips. Features VU meters, braking, automatic shutoff, bias check, solenoid operation, and monitoring facilities. Cabinet optional extra ..... \$675.00

### TEAC

#### 3300-10 Tape Recorder Deck

4-track, 2-channel, 2-speed (7 1/2 & 3 3/4 ips) stereo design. Response 30-20,000 Hz  $\pm 3$  dB at



7 1/2 ips, wow & flutter 0.06% at 7 1/2 ips, S/N 58 dB. Has mike (0.25 mV) and two line inputs (0.1 V & 0.3 V), 3 heads (erase, record & play). Will handle up to 10 1/2" reels. Features three motors (1 dual-speed hysteresis sync capstan motor and 2 eddy-current induction reel motors); VU meters; automatic shutoff; bias adjust; and monitoring facilities. 15 3/8" x 15 3/8" x 9 1/4" ..... \$549.50  
Model 3300-11. Same except 2-track, 2-channel, 2-speed (15 & 7 1/2 ips) ..... \$599.50  
Model 3300-12. Same as Model 3300-11 except 2-speed (7 1/2 & 3 3/4 ips) ..... \$549.50

#### A-1200U Stereo Tape Deck

Two-speed (7 1/2 & 3 3/4 ips), 4-track, 3-motor, 3-head stereo design. Response 50-15,000 Hz  $\pm 3$  dB, wow & flutter 0.12% at 7 1/2 ips, S/N 50 dB. Will handle up to 7" reels. Has VU meters, automatic shutoff, echo effects, sound-on-sound, and counter. Remote control available optional extra. 17" H x 15 1/2" W x 9 3/4" D ..... \$299.50

#### 1230 Stereo Tape Deck

Two-speed (7 1/2 & 3 3/4 ips), 4-track, 3-motor, 3-head stereo design. Response 40-18,000 Hz  $\pm 3$



dB, wow & flutter 0.08% at 7 1/2 ips, S/N 50 dB. Will handle up to 7" reels. Has VU meters, automatic shutoff, pause control, bias adjustment, counter, solenoid operation, and monitoring facilities. 14 1/4" H x 17 1/8" W x 8" D ..... \$399.50  
Model 1250. Same as Model 1230 except includes automatic reverse ..... \$499.50

#### 4070 Stereo Tape Deck

Two-speed (7 1/2 & 3 3/4 ips), 4-track, 3-motor stereo design. Has four high-density ferrite



heads (6 head functions). Will handle up to 7" reel. Response 30-20,000 Hz  $\pm 3$  dB, wow & flutter 0.05% at 7 1/2 ips, S/N 58 dB. Has braking, VU meters, automatic reverse and shutoff, pause control, bias adjustment, counter, and monitoring facilities. Remote control available optional extra. 17 1/8" H x 18" W x 9 1/8" D ..... \$699.50

#### 4010SL Stereo Tape Deck

Two-speed (7 1/2 & 3 3/4 ips), 4-track, 3-motor stereo design. Has four hyperbolic heads. Will handle up to 7" reel. Response 40-18,000 Hz  $\pm 3$  dB, wow & flutter 0.08%, at 7 1/2 ips, S/N 55 dB. Has VU meters, automatic reverse and shutoff, echo effects, sound-on-sound, bias

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## 1 Reel-to-Reel Tape Machines



adjustment, counter, and monitoring facilities. Remote control available optional extra. 17 1/4" H x 17 1/2" W x 9 3/4" D ..... \$549.50

### 6010SL Stereo Tape Deck

Two-speed (7 1/2 & 3 3/4 ips), 4-track, 3-motor stereo design. Has four ferrite heads. 7" reel.



Response 30-20,000 Hz  $\pm 3$  dB, wow & flutter 0.06% at 7 1/2 ips, S/N 58 dB. Has VU meters, automatic reverse and shutoff, pause control, echo effects and sound-on-sound (optional extras), counter, solenoid operation, and monitoring facilities. Remote control available optional extra. 20 7/8" H x 17 1/2" W x 6 7/8" D ..... \$799.50

**Model 7010SL.** Same as Model 6010SL except will handle up to 10 1/2" reels ..... \$1049.50

**Model 7030SL.** Same as Model 7010SL except 15 & 7 1/2 ips, S/N 60 dB, response 30-22,000 Hz  $\pm 3$  dB ..... \$949.50

## TELEX

### Lab Series 2001 Tape Deck

Two-speed (7 1/2, 3 3/4 ips), 4-track, 3-head, 2-motor stereo design. Will handle up to 8 1/4" reels. Response 45-18,000 Hz  $\pm 2$  dB, wow & flutter 0.18% at 7 1/2 ips, S/N 52 dB. Has VU meters, automatic shutoff, pause control,



counter, solenoid operation, and monitoring facilities. 14 1/2" H x 19 1/8" W x 8" D .. \$799.95

### 433 Tape Recorder

Quarter-track stereo design featuring sound-on-sound, reverb (echo), 2-channel input mixing, tape monitoring, and pause control. Three-speed (7 1/2, 3 3/4, 1 7/8 ips), 3-head, 3-motor design. Has automatic shutoff. Response 40-18,000 Hz  $\pm 3$  dB at 7 1/2 ips, S/N 54 dB, flutter & wow 0.2% at 7 1/2 ips. 15 3/4" W x 14 3/8" H x 8 3/4" ..... \$379.95

### 423 Tape Deck

Basically same design as Model 433 except without power amps. Response 50-15,000 Hz



$\pm 3$  dB, S/N 50 dB, wow & flutter 0.2%, all at 7 1/2 ips. THD 1.5%. 12 7/8" H ..... \$274.95

## UHER

### 724 Tape Recorder

Two-speed (7 1/2, 3 3/4 ips), 4-track stereo unit. Will handle up to 7" reels. Response 50-20,000 Hz at 7 1/2 ips, wow & flutter  $\pm 0.2\%$  at 7 1/2 ips, S/N 51 dB. Built-in electronics with 2 W/ch output, built-in speakers. Has VU meter, sound-with-sound, tone control, counter, and cover. 12 1/2" H x 15 1/4" W x 6" D ..... \$193.50

### 4000L Tape Recorder

Four-speed (7 1/2, 3 3/4, 7 1/8, 1 9/16 ips), 2-track portable. Mono design. Powered by 5 NiCad cells or rechargeable battery, 6-12 V car battery, or separate 120-V a.c. power supply. Has electromagnetic start/stop remote control actuated by microphone or remote switch, digital counter, VU meter, and power supply indicator. Acoustic switch available for sound control to start or stop tape. Response 40-20,000 Hz  $\pm 2.5$  dB, S/N 52 dB, wow & flutter 0.1%, all at 7 1/2 ips. Speaker output 1 W. Inputs: microphone 0.1 mV at 2000 ohms, radio 1 mV at 47,000 ohms, phono 4 mV at 1 megohm. Ten hours playing time with NiCad cells. Weight without batteries 7 pounds. Comes complete with dynamic microphone, leather case, shoulder strap, a.c. power unit, battery charger, and "Dryfit" storage battery. 11" x 9" x 3 1/2" ..... \$379.50

### 4400 Tape Recorder

Four-track version of Model 4000L. Has additional stereo amplifiers & one speaker. Mark IV package ..... \$523.70  
**Model 4200.** Two-track version of Model 4400 ..... \$523.70

### Universal 5000 Tape Recorder

Three-speed (3 3/4, 1 7/8, 1 9/16 ips), 2-track mono unit. Will handle up to 6" reels. Response 40-16,000 Hz, S/N 48 dB, wow & flutter 0.2%, all at 3 3/4 ips. Output 2 W at 4 ohms. Has digital counter, automatic record-level control, solenoid controls, VU meter, plus inputs for low-impedance microphone, radio, and phono. Outputs: 2.5 V at 4 ohms and 0.9 V at 47,000 ohms. 6" x 10" x 13" ..... \$335.50

### 1000 Portable Mono Recorder

Will operate from 117-250 V a.c., five "D" cells, or 6-12 V car battery. Solid-state porta-

ble design. Response 20-20,000 Hz  $\pm 2.5$  dB at 7 1/2 ips. Single speed (7 1/2 ips), full-track. Will handle up to 5" reels. Features automatic photoelectric level control, overload filter, "Neo-Pilot" level adjust, battery-condition checker, Can monitor off the tape. Stroboscopic speed control, built-in speaker, pause control. Designed especially for sound synchronization of motion picture films. 11" x 9" x 3 1/2" ..... \$1195.00

### 10,000 Stereo Recorder

4-speed, record/play stereo design with 10 W/ch continuous sine-wave output and two built-in speakers. Features built-in "Dia-Pilot" for sound/slide synchronization, sound-on-sound, sound-with-sound, single-channel echo, and stereo mixing. Amplifiers can be used independent of tape recorder. Response 20-20,000 Hz  $\pm 2$  dB, wow & flutter 0.25%, both at 7 1/2 ips. With walnut case and Plexiglas lid. 17 3/4" x 13 3/4" x 7 3/4" ..... \$560.00  
**Model 9500.** Same as Model 10,000 except without amplifiers & speakers ..... \$482.75

### Variocord 63 Tape Recorder

Three-speed (7 1/2, 3 3/4, 1 7/8 ips), mono design. Interchangeable 2- and 4-track heads for flexibility. With both heads assembled sound-with-sound is possible. Automatic level control can be added. Response 30-20,000 Hz, wow & flutter 0.05%, both at 7 1/2 ips. 6 W continuous power output. Sensitivity: mike 0.2 mV, radio 1.2 mV, ceramic phono 100 mV. Output 1.4 volts. 17 1/2" x 13 1/4" x 7" ..... \$262.00

### Variocord 263 Tape Recorder

Three-speed (7 1/2, 3 3/4, 1 7/8 ips), stereo design. 2- or 4-track using plug-in head assembly. 6 W/ch continuous rms power. Response 30-20,000 Hz, wow & flutter 0.05%, S/N 53 dB (4-track), all at 7 1/2 ips. Sensitivity: mike 0.12 mV, radio 1.2 mV, phono 100 mV. Has one control and one dB-calibrated VU meter for both channels. Has input mixing capabilities. 17 1/2" x 13 1/4" x 7" with lid ..... \$313.95

## V-M

### 734 Tape Deck

Three-speed (7 1/2, 3 3/4, 1 7/8 ips), 4-track, 3-head, single-motor stereo unit. Will handle up



to 7" reels. Supplied with microphones, VU meters, automatic shutoff, pause control, and counter. Will record sound-on-sound and sound-with-sound. Has handle for carrying. 14" H x 16" W x 8" D ..... \$189.95

## WOLLENSAK

### 6250 Tape Recorder

Three-speed (7 1/2, 3 3/4, 1 7/8 ips), 4-track, 3-head, 2-motor stereo unit. Response 35-20,000 Hz  $\pm 2$  dB, wow & flutter 0.12% at 7 1/2 ips, S/N 54 dB. Will handle up to 7" reels. Has built-in electronics with 18 W/ch output, self-contained speakers, VU meters, automatic shutoff, pause control, echo effects, sound-on-sound, sound-with-sound, bias adjust, counter, monitoring facilities, and phono input jack. 20 1/2" H x 13 1/2" W x 7 1/2" D ..... \$379.95

**Model 6150.** Similar to Model 6250, except preamp deck (less power amp) ..... \$199.95

## TAPE RECORDER GUIDE



## SECTION

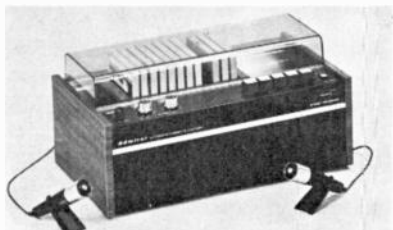


# Cassette Tape Machines

### ADMIRAL

#### CSTR851 Cassette Changer

Automatic stereo cassette record/play deck. Will play 12 cassettes automatically, up to 12

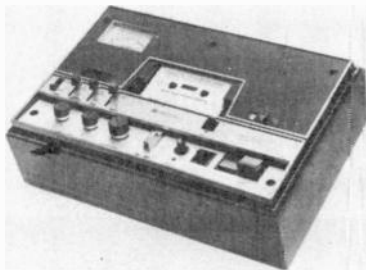


hours play. Has dual record-level meters and is supplied with two microphones with stands. Tinted dust cover. Walnut-grained vinyl housing ..... \$169.95

### ADVENT

#### 201 Dolbyized Cassette Deck

Play/record stereo design. Response 35-14,500 Hz at  $\pm 2$  dB. THD less than 1 1/2% with chro-



mium-dioxide tape; wow & flutter less than 0.15%; S/N 54 dB. Has VU meter, counter, automatic shutoff, pause control, and line inputs. 4 7/8" H x 13 3/4" W x 9 1/4" D. Oiled-walnut cabinet ..... \$280.00

### AIWA

#### TP-1100 Cassette Deck

Play/record stereo design. Response 30-15,000 Hz at 1.5% distortion, wow & flutter 0.02%. Hysteresis motor. S/N 50 dB. Has VU meters, counter, eject button, automatic shutoff, pause control, and mike & line inputs. 3 3/16" x 12" x 10 3/16" D ..... \$139.95

#### TPR-2001 Cassette Recorder/Receiver

Combines an AM/FM stereo receiver and Starr system cassette recorder. 40 W dynamic power at 8 ohms, 15 W/ch rms at 8 ohms. HD 0.3%. Features pause control, VU meters, and "wide-range micron" head. Metal extruded front with blackout dial. Walnut finished cabinet. .... \$219.95

### AKAI

#### GXC-40D Play/Record Deck

Features special switch for chromium-dioxide tape, fast forward, pause control, VU meters. Wow & flutter 0.2% rms. Response 30-16,000 Hz  $\pm 3$  dB with standard tape (30-18,000 Hz



with chromium-dioxide tape). Dist. 2%, S/N 45 dB. Has mike (0.2 mV) and line (50 mV) inputs plus line (1.23 V) and phono outputs. 16 1/2" x 5" x 9" D ..... \$199.95

#### GXC-40 Cassette Recorder

Same as GXC-40D except has stereo power amplifier (5 W/ch continuous sine wave into 8 ohms, 6 W/ch dynamic power) ..... \$239.95

### ALLIED RADIO SHACK

#### SCT-3B Cassette Deck

Stereo record/play design. Has individual channel record-level controls, VU meters, mike



and auxiliary inputs, and preamp outputs. Response 50-10,000 Hz  $\pm 3$  dB (playback-only response 40-12,000 Hz  $\pm 2$  dB). Wow & flutter 0.25% rms. Oiled-walnut case. 10 5/8" x 7 1/4" x 4" ..... \$99.95

#### SCT-5 Cassette Recorder

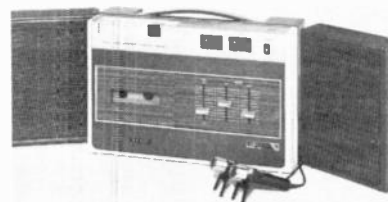
Stereo record/play design. Has dual VU meters. Response 50-12,000 Hz  $\pm 2$  dB (playback-



only response 40-14,000 Hz  $\pm 2$  dB). Wow & flutter 0.2%. 13 3/8" x 9 3/4" x 3 7/8" ..... \$129.95

#### SCT-2B Cassette Recorder

Portable stereo design. Has dual VU meters, monitor switch, slide controls. Operates from



117-volt power source or six "D" cells. Supplied with two mikes (one with remote-control switch) Has two removable wing speaker systems. 11" x 8 1/2" x 6 1/2" ..... \$119.95

#### Cassanova Cassette Music Center

Combines an AM/FM stereo receiver, a cassette tape recorder/player, and two separately



housed speaker systems. Has input for mikes and magnetic phono cartridge, VU meters and monitor switch. Speaker cabinets 9 7/8" x 7 3/8" x 12 1/8". Walnut cabinets. Supplied with two dynamic microphones. .... \$199.95

### ALTEC-LANSING

#### 912A Cassette/Phono/Tuner

Combines 3-speed Garrard SL95B automatic turntable with Shure M93E magnetic car-



tridge. 0.4 x .7 mil elliptical diamond stylus; an AM/FM stereo receiver (the Model 714A); and a Starr cassette recorder. Power amp 44 W/ch continuous sine wave with both channels driven into an 8-ohm load (180 watts total dynamic, IHF, power). Recorder response 50-10,000 Hz. Has mike input. Control center 21 1/2" x 6 7/8" x 19 1/2" D overall. Unit is housed in a walnut cabinet ..... \$650.00

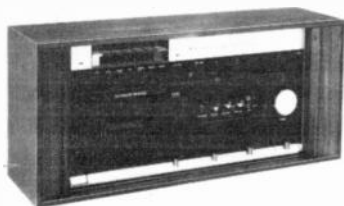
**Model 911.** Same as Model 912A but does not include the cassette recorder. Performance specifications are the same ..... \$499.00

## 2 Cassette Tape Machines

### BELL & HOWELL

#### 3410 Cassette Recorder

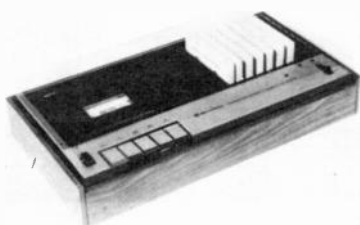
Deck with power amplifier and AM/FM stereo tuner. Will play and record. Response 60-8000



Hz; wow & flutter 0.3%; S/N 45 dB. 12 W/ch. Comes with microphone and speakers. Includes VU meters, counter, eject button, tone controls, automatic reverse and shutoff, mike & line inputs, and phono input. 10 1/2" x 23 1/2" W x 7" D. .... \$259.95

#### 3100 Cassette Deck

Play/record stereo design. Response 40-10,000 Hz; wow & flutter 0.25%; S/N 45 dB. Fea-



tures synchronous motor, record indicator, counter, eject button, mike & line inputs. Comes with dust cover and walnut enclosure. 8 1/8" x 15 1/4" W x 4" D. .... \$89.95

### BENJAMIN

#### 2036 Cassette/Phono/AM-FM

Combines a 4-speed BSR C117-4 automatic turntable with Shure M71MC magnetic car-



tridge (0.6-mil diamond stylus), a slot-loading cassette tape recorder, a 16 W/ch dynamic power amplifier, an AM-FM stereo tuner with 1.6  $\mu$ V FM sensitivity for 20 dB quieting, with a pair of 2-way speaker systems. Power bandwidth 25-30,000 Hz, response 10-100,000 Hz. Speaker cabinets (16 1/4" x 11 1/8" x 8 3/8"), each with 8" woofer & 3 3/8" tweeter. Control center 9 7/8" x 20 3/8" x 16 7/8" D. Dust cover (DCP-6) optional extra. .... \$449.50

#### RAC-10 Cassette Changer

Stereo record/playback deck designed around the "Starr transport. Will change ten cassettes automatically. Has dual record-level meters, automatic shutoff, pause control. Response 40-10,000 Hz  $\pm$  1 1/2 dB, S/N 48 dB, wow & flutter 0.3% weighted. Inputs: mike (0.2 mV) and aux. (80 mV). Output 750 mV. Walnut cabi-

net. 14 1/2" W x 8" D x 9 1/2" H. .... \$299.95

### BOGEN

#### CRP Cassette Deck

Play/record stereo design. Wow & flutter 0.25%. Includes VU meters, eject button,



counter, automatic shutoff, pause control, and mike inputs. .... \$149.95

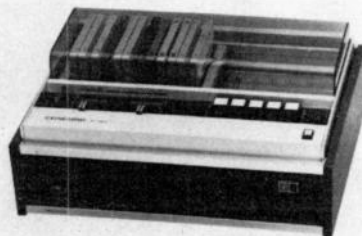
### CONCORD

#### F-107 Cassette Deck

Plays and records. Response 30-13,000 Hz, wow & flutter 0.2%, S/N 47 dB. Has hysteresis motor, VU meters, counter, eject button, automatic shutoff, pause control, monitoring facilities, and mike & line inputs. 3 1/2" x 15 1/8" x 10 1/4" D. .... \$179.95

#### F-120 Cassette Changer Deck

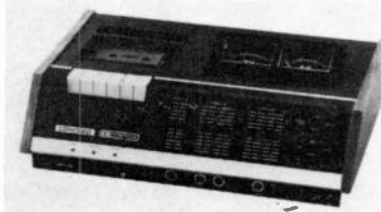
Plays and records. Response 50-10,000 Hz, wow & flutter 0.3%, S/N 43 dB. Features VU



meters, counter, eject button, changer mechanism to handle 12 cassettes, automatic shutoff, pause control, mike & line inputs. Comes with dust cover. 6 3/4" H x 14" W x 11 1/8" D. .... \$229.95

#### Mk IX Dolbyized Cassette Deck

Plays and records. Response 30-15,000 Hz, 1.5% THD, wow & flutter 0.2%, S/N 50 dB.



Has VU meters, counter, eject button, automatic shutoff, pause control, monitoring facilities, mike and high- and low-level line inputs. For use with either chromium-dioxide or conventional tapes. Comes with dust cover. 4 1/2" H x 10 3/8" W x 10 3/8" D. .... \$299.95

#### F-106E Stereo Cassette Deck

Features dual bias selection for standard or super-dynamic tapes, pause control, remote-control switch, automatic shutoff, automatic end-of-reel indicator, and dual record-level controls. Response 40-12,000 Hz, wow & flutter 0.2%, S/N 46 dB. Has mike & aux. inputs and line output. 10 1/2" x 10 1/4" x 3 1/2" H. Comes with microphone. .... \$149.95

**Model F-106EB.** Same as Model F-106E except without microphone and remote control. .... \$129.95

### F-140 Stereo Cassette Recorder

Portable design (117 V a.c., six "D" cells, or 12 V car battery). Response 50-10,000 Hz, wow & flutter 0.25% rms, S/N 45 dB. 2 1/2 W/ch dynamic (EIA) power at 5% THD. Features two built-in speaker systems, automatic stop. Supplied with remote-control microphone. 12 1/2" W x 9 3/4" x 4" D. .... \$129.95

### F-150 Recorder/AM-FM Receiver

Portable stereo design combining an AM-FM stereo receiver and a cassette recorder. 5 W/ch dynamic (EIA) power at 5% THD. Features built-in swing-type stereo speaker enclosures, dual VU meters. Operates from 117 V a.c. line or six "D" cells. Response 50-10,000 Hz  $\pm$  3 dB, wow & flutter 0.25% rms, S/N 42 dB. FM sensitivity 1.9  $\mu$ V for 30 dB quieting. Supplied with remote-control mike. 10 1/2" x 13 3/4" x 7" D. .... \$189.95

### DENON

#### TRC-798 Cassette Deck/Changer

Deck with automatic changer mechanism. Will play and record up to 12 cassettes continuous-

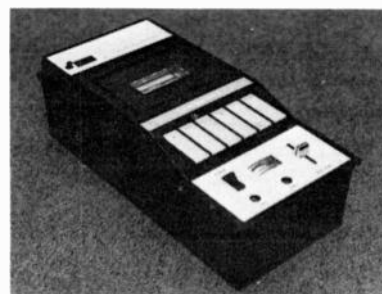


ly, side 1 and side 2. Response 50-10,000 Hz, wow & flutter 0.2%, S/N 43 dB. Has reject button, VU meters, switch for continuous play or stop after one cycle. Comes with mikes and dust cover. 8 3/8" H x 13 3/4" W x 6 1/2" D. .... \$199.95

### ELECTROHOME

#### STD-3 Cassette Tape Deck

Plays and records in stereo. Response 40-12,000 Hz, wow & flutter 0.3% rms, S/N 40 dB.



HD less than 3%. Features VU meter, automatic shutoff, pause control, two mike inputs, and one line input. .... \$129.50

### EMERSON

#### 31M30 Cassette Play/Record/AM-FM

Modular stereo center combining a cassette player/recorder with AM-FM stereo receiver and two matching speaker systems (each with 6 1/2" woofer & 2" tweeter, 9 7/8" x 11 3/4" H x 7" D). 4 1/2 W/ch dynamic (EIA) power at 5% THD. Features two record-level meters, eject button, illuminated stereo indicator. Supplied with two microphones. Walnut-grain vinyl on wood. 16 7/8" W x 4 1/2" H x 10 1/8" D. .... \$219.95

### FISHER

#### RC-80B Cassette Deck

Dolby-ized record/play stereo design. Has sep-

### TAPE RECORDER GUIDE

# Hiss

The Concord Mark IX cassette deck starts with an extremely low signal to noise ratio—better than 50 dB down. The Dolby Noise Reduction system reduces hiss by another 10 dB—and that's just the beginning. The deluxe Concord Mark IX has switch selected bias for standard and chromium dioxide tape cassettes. The narrow head gap—and better than 100 kHz bias frequency provide extended frequency response from 30 to 15,000 Hz.

The Mark IX looks like a studio console and performs like one too. With pop-up VU meters, studio type linear sliders for individual control of input and output levels, third mike input for mixing in a center channel microphone, a 3-digit tape counter and a stereo/mono switch for more effective mono record and playback. And this brilliant panel lights up for power on, record and for Dolby.

And when the cassette is finished, Endmatic, a Concord exclusive, disengages tape and transport and returns the pushbuttons to off. And best of all, it's now available at your Concord dealer at a fair price for all of this quality, \$249.79.

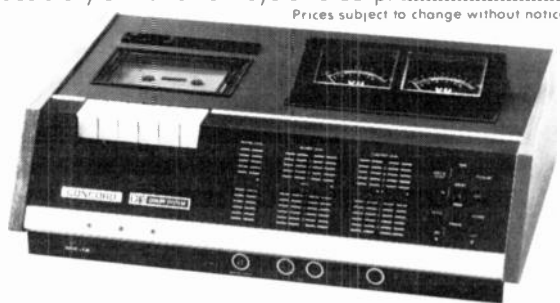
If you already have a cassette, open-reel or 8-track deck, the Concord DBA-10 Dolby tape adaptor can

reduce hiss and improve performance. It will also improve your receiver's performance in playing back Dolbyized FM programs, \$99.79.

Your Concord dealer also has a complete line of 8-track and open-reel decks, stereo receivers and cassette portables. Concord Division, Benjamin Electronic Sound Corp., Farmingdale, N.Y. 11735/

**BENJAMIN  
CONCORD**

Prices subject to change without notice.



## Concord Mark IX Dolby Cassette Deck

CIRCLE NO. 18 ON READER SERVICE CARD



## 2 Cassette Tape Machines



arate control for chromium-dioxide tapes, VU meters. Response (standard tapes) 30-12,000 Hz. 7 $\frac{1}{8}$ " W x 3 $\frac{1}{2}$ " H x 11 $\frac{1}{8}$ " D ..... \$299.95  
M-5 Dynamic mikes (pair) ..... \$9.95  
15-W Walnut base ..... \$9.95

### 5055 Cassette/Phono/Tuner

Combines an AM/FM stereo tuner, a 4-speed automatic turntable with Pickering magnetic



cartridge, a cassette stereo recorder, and a pair of separately housed speaker systems (10" x 20" x 7 $\frac{1}{2}$ ") each with 8" woofer & 3" tweeter. 45 W/ch dynamic power. Supplied with two dynamic microphones. 23 $\frac{3}{8}$ " W x 16" x 8" ..... \$499.95  
PC4 Dust cover ..... \$19.95

### GENERAL ELECTRIC

#### M8550 Cassette Recorder

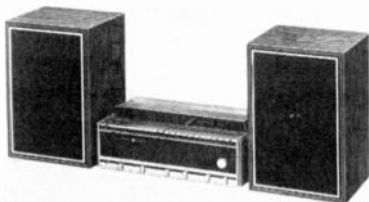
Deck with power amplifier and AM/FM stereo tuner. Plays and records. Supplied with mikes



and speakers. Has record indicator, eject button, tone controls, pause control, mike & line inputs. 8 $\frac{3}{8}$ " H x 12 $\frac{3}{8}$ " W x 5 $\frac{3}{4}$ " D .... \$99.95

#### M9000 Cassette Changer/Recorder

Twelve hours (12 tape cassettes) of automatic



play. Has AM/FM stereo receiver, 20 W/ch dynamic (EIA) power at 5% HD. Supplied with pair of separately housed speaker systems each with 8" woofer & 3" tweeter. Has dual VU meters and mike inputs ..... \$499.95

#### TA755 Cassette Deck

Tape deck supplied with two dynamic micro-



phones. Has record-level meter. Walnut vinyl cabinet. 8 $\frac{1}{4}$ " W x 3 $\frac{3}{8}$ " H x 13 $\frac{3}{8}$ " .... \$109.95

### GRUNDIG

#### CN-222 Cassette Recorder Deck

Stereo design featuring automatic record level, pause control. Response 40-11,000 Hz, wow &



flutter 0.4%, S/N ratio 40 dB. Has inputs for microphone, ceramic phono cartridge, and line. Line output 0.150 to 1. V. 11 $\frac{3}{4}$ " x 10" x 3 $\frac{1}{2}$ ". Walnut cabinet ..... \$129.95

### HARMAN-KARDON

#### CAD5 Dolbyized Cassette Deck

Play/record stereo design. Response 30-12,500 Hz with standard tape and 30-15,000 Hz with

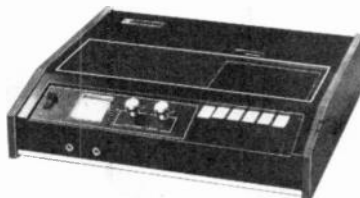


chromium-dioxide tape. 1% THD, wow & flutter 0.15%. Has two VU meters, microphone and line inputs, Dolby set controls, and a bias switch ..... \$199.95

### HEATH

#### AD-110 Cassette Deck

Play/record stereo design. Response 30-12,000 Hz  $\pm$ 3 dB, 0.25% distortion, wow & flutter



less than 0.25%, S/N 45 dB. Has VU meters, eject button, pause control, mike & line inputs, and adjustable bias. 11" H x 13 $\frac{3}{8}$ " W x 3 $\frac{1}{8}$ " D. Walnut cabinet. Kit ..... \$129.95

### HITACHI

#### KST-3410 Stereo Deck/Tuner

Deck with amplifier and AM/FM stereo tuner. Will play and record. Comes with speakers, VU meters, eject button, tone and pause controls, monitoring facilities, and mike & line inputs. 18 W/ch output ..... \$259.95

#### TRQ-242 Stereo Cassette Deck

Plays and records. Response 40-12,000 Hz, S/N 45 dB. Has VU meters, counter, eject button, mike inputs. 3 $\frac{3}{8}$ " H x 7 $\frac{3}{8}$ " W x 10 $\frac{1}{8}$ " D ..... \$109.95

#### TRQ-262 Stereo Cassette Deck

Plays and records. 20-18,000 Hz response, wow & flutter 0.15%, S/N 50 dB. Has VU me-



ters, counter, eject button, automatic shutoff, pause control, monitoring facilities. Has provision for mike & line inputs. 3 $\frac{3}{8}$ " H x 13 $\frac{1}{8}$ " W x 9 $\frac{3}{8}$ " D ..... \$149.95

#### TRQ-282 Stereo Cassette Deck

Plays and records. Response 40-12,000 Hz, wow & flutter 0.3%, S/N 46 dB. Has VU me-



ters, counter, eject button, pause control, monitoring facilities, mike & line inputs. 3 $\frac{3}{8}$ " H x 8 $\frac{1}{8}$ " W x 10 $\frac{3}{4}$ " D ..... \$119.95

### JVC

#### 1660-2 Cassette Deck

Plays and records. Response 30-18,000 Hz, wow & flutter 0.2%, S/N 45 dB. Has VU meters, counter, eject button, pause control, monitoring facilities, mike & line inputs. 3 $\frac{3}{8}$ " H x 11 $\frac{1}{8}$ " W x 9" D ..... \$119.95

#### 9450 Cassette Recorder/Tuner

Combines a cassette recorder with an AM/FM stereo tuner. Will play and record. Supplied with microphones and speakers. 20 W/ch output. Has VU meters, counter, eject button, tone controls, pause control, and mike inputs. 5 $\frac{1}{2}$ " H x 16 $\frac{1}{4}$ " W x 13" D ..... \$199.95

### KENWOOD

#### KX-700 Dolby-ized Cassette Deck

Record/play stereo design with Dolby circuitry (improving S/N 10 dB). Features bias selector



switch for regular, low-noise, or chromium-dioxide type tapes, two VU meters, slide-type controls, pause control, and automatic shutoff. Response 25-13,000 Hz, wow & flutter 0.15%, S/N 55 dB without Dolby. Has two microphone (0.11 mV) and two line (24.5 mV) inputs. Outputs 0.775 V, 4 $\frac{1}{8}$ "  $\times$  15 $\frac{1}{2}$ "  $\times$  11 $\frac{3}{4}$ " D. \$299.95

## LAFAYETTE

### RK-D40 Cassette Deck

Dolbyized stereo deck which plays and records. Response 40-13,000 Hz at 2.5% THD, wow & flutter 0.25%. Hysteresis motor. S/N 49 dB. Has VU meters, counter, eject button, automatic shutoff, pause control, monitoring facilities, mike & line inputs, bias adjust, and sound-with-sound capability. 4 $\frac{3}{4}$ " H  $\times$  11 $\frac{3}{4}$ " W  $\times$  11 $\frac{3}{4}$ " D. \$179.95

### RK-520 Cassette Recorder System

Stereo deck with power amplifier plays and records. Response 50-11,000 Hz at 2.5% THD, wow & flutter less than 0.25%, S/N 48 dB. Supplied with mikes and speakers. 10 W/ch output. Has VU meters, counter, eject button, tone controls, automatic shutoff, pause control, monitoring facilities, mike & line inputs, bias adjust, sound-with-sound capability, and two matched acoustic-suspension speaker systems. 4 $\frac{3}{8}$ " H  $\times$  15 $\frac{1}{2}$ " W  $\times$  11" D. \$179.95

### RK-760A Cassette Deck

Stereo deck which plays and records. Response 30-12,000 Hz, 2.5% THD, wow & flutter 0.3%, S/N 48 dB. Hysteresis motor. Has VU meters, counter, eject button, automatic shutoff, pause control, monitoring facilities, mike & line inputs, bias adjust, and sound-with-sound capability. 4 $\frac{1}{8}$ "  $\times$  9" W  $\times$  12 $\frac{3}{4}$ " D. \$99.95



ter 0.3%, S/N 48 dB. Hysteresis motor. Has VU meters, counter, eject button, automatic shutoff, pause control, monitoring facilities, mike & line inputs, bias adjust, and sound-with-sound capability. 4 $\frac{1}{8}$ "  $\times$  9" W  $\times$  12 $\frac{3}{4}$ " D. \$99.95

## MAGNAVOX

### 1K8867 Cassette Deck

Play-only stereo design. Response 63-9000 Hz  $\pm$ 3 dB, wow & flutter 0.25%. Has push-button eject. 7 $\frac{3}{4}$ "  $\times$  9 $\frac{1}{2}$ "  $\times$  3 $\frac{1}{2}$ " H. \$49.95

### 1K8871 Cassette Deck

Play/record stereo design. Response 63-10,000 Hz  $\pm$ 5 dB, wow & flutter 0.2%. Has automatic reject, mike & aux. inputs, record-level meters, digital counter. 11 $\frac{1}{4}$ "  $\times$  9"  $\times$  3 $\frac{1}{2}$ " D. \$119.95

## MICOTRON

### 12-154 Cassette Deck

Play/record stereo design. Response 40-12,000 Hz, wow & flutter 0.1%. Has synchronous motor.



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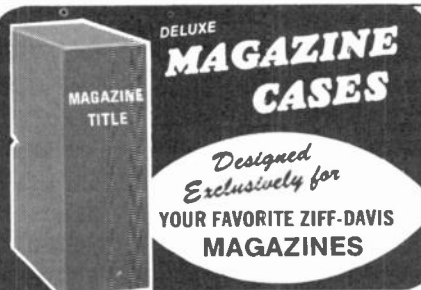
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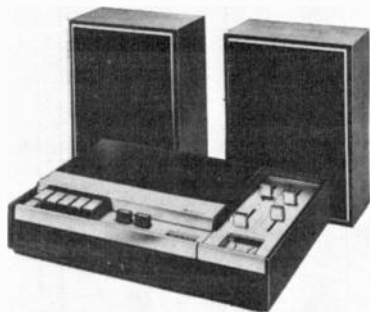


## 2 Cassette Tape Machines

tor. Comes with mikes, VU meters, eject button, mike & line inputs, and phono input. 27/8" H x 13 1/2" W x 9 1/2" D. Walnut enclosure ..... \$114.95

### 12-157 Cassette Recorder

Plays and records. Has built-in 2 W/ch stereo amplifier. Response 40-12,000 Hz, wow & flut-



ter 0.1%. Synchronous motor. Comes with mikes, speakers. Has VU meters, eject button, mike & line inputs. 27/8" H x 13 1/2" W x 9 1/2" D. Walnut enclosures ..... \$149.95

### 12-153 Cassette Deck

Stereo play only. Response 40-12,000 Hz, wow & flutter 0.15%. Four-pole synchronous motor.



Line output 0.5 V/ch. Comes with dust cover. 10 1/2" W x 27/8" H x 9 1/2" D. Walnut wood enclosure ..... \$49.95

## MOTOROLA

### GA16GW Cassette Recorder Deck

Play/record stereo design. Comes with mikes, VU meters, counter, eject button. Features



automatic shutoff, pause control, microphone and line input ..... \$129.95

### GP12G Cassette Recorder Deck

Portable stereo deck design. Will record and play back. Designed to be used with any conventional hi-fi system ..... \$119.95

### FH230HW AM/FM/Cassette Player

Combines a conventional stereo cassette player and an AM/FM stereo receiver with a pair of



separately housed speaker systems, each with 8" and 3 1/2" speakers (cabinets measure 10" x 13 1/4" x 8 3/8" D). Power output 15 W/ch dynamic (EIA) power at 5% THD. Walnut veneer cabinets. 22 7/8" x 5 1/8" x 11 1/2" D. .... \$259.95

### SK107GW AM-FM/Cassette Player

Combines conventional stereo cassette player and an AM/FM stereo receiver with a pair of



separately housed speaker systems, each with 6 1/2" and 2" speakers (cabinet measures 8 1/4" x 13" x 7 1/2" D). Power output 7 1/2 W/ch dynamic (EIA) power at 5% THD. Walnut veneer cabinets. 22 1/4" x 4 1/2" x 8 3/4" D. .... \$239.95

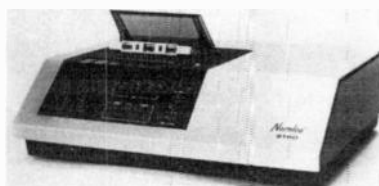
## NORELCO

### 2000 Stereo Cassette Deck

Deck only. Plays and records. Has VU meters, counter, eject button, automatic shutoff, pause control, mike & line inputs. Response 100-8000 Hz, wow & flutter 0.3% rms, S/N 43 dB. Input sensitivity: mike 0.2 mV, phono 160 mV. Supplied with microphone. Walnut. 10 1/4" W x 8 3/4" D x 3 1/8" H ..... \$99.95

### 2100 Stereo Cassette Deck

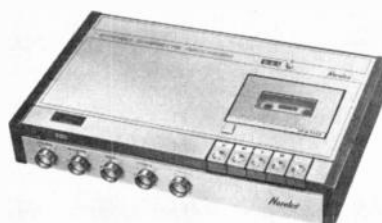
Deck only. Plays and records. Has VU meters, counter, eject button, pause control, monitor-



ing facilities, mike & line inputs. Features Philips dynamic noise limiter. Provides for bias adjust. 3 7/8" H x 12 3/4" W x 10 1/2" D ... \$219.95

### 2400 Stereo Cassette System

Plays and records. Response 60-10,000 Hz  $\pm 3$  dB, S/N 45 dB. Has VU meter, counter, eject



button, tone controls, automatic end-of-tape stop, pause control, monitoring facilities, mike & line inputs, phono input. 4 W/ch rms power output. Supplied with mike and two satellite speakers in walnut enclosures (10" W x 13 3/4" H x 7 3/8" D). Control center 3" H x 14" W x 8 1/2" D ..... \$149.95

### 3170 Stereo Cassette System

Combines a cassette play/record tape system with an AM-FM stereo receiver. Will operate



from 117-volt a.c. or 8 "D" cells. Response 70-10,000 Hz, wow & flutter 0.25% rms, S/N 40 dB. FM max. sensitivity 100  $\mu$ V. Has counter, eject button, tone controls, pause button. Supplied with two detachable speakers, each 8 3/8" W x 9 1/4" H x 4" D. Has automatic record level control and inputs for mike, phono, and line. Control center 16 3/8" W x 3 1/4" H x 1/2" D ... \$199.95

## OLSON

### RA-389 Cassette Deck

Record/play stereo design. Has VU meters, slide-type level controls, and mike inputs. With walnut base. 7 1/2" x 12 1/4" x 3 1/2" H ... \$89.00

### RA-314 Cassette/AM-FM System

Combines a stereo cassette recorder, an AM-FM stereo receiver with a 15 W/ch dynamic (EIA) power amp at 5% HD. Has automatic record level control, slide-type controls, dual



VU meters. Has mike, ceramic phono cartridge, and auxiliary inputs. Recorder response 100-8000 Hz. 8 ohm outputs. 18 1/2" x 5 1/8" x 10 5/8" D ..... \$159.99

## PACKARD BELL

### TRA-17 Cassette Deck

Record/play stereo design with dual level controls and two mikes with stands. Input sensitivity: mike 0.1 mV, aux. 80 mV; output 0.25 V. Black leatherette case ..... \$99.95

## PANASONIC

### RS-256 Cassette Deck

Play/record stereo design. Response 30-12,000 Hz. Has VU meters, counter, eject button,



automatic shutoff, pause control, mike & line inputs, and hiss suppression circuitry. 3 3/4" H x 10 7/16" W x 10" D ..... \$89.95  
RS-272 Hartsdale. Similar to Model RS-270 but with automatic reverse feature ..... \$149.95

## TAPE RECORDER GUIDE



### RS-270 Middlebury Cassette Deck

Play/record stereo design. Has VU meters, counter, eject button, automatic shutoff,



pause control, monitoring facilities, mike & line inputs, bias adjust, and memory rewind. Walnut enclosure ..... \$139.95

### RS-275 Cassette Deck

Play/record stereo design. Response 30-15,000 Hz, wow & flutter less than 0.1%, S/N greater than 45 dB. Has two motors, VU meters, counter, eject button, automatic shutoff, pause control, monitoring facilities, mike & line inputs, remote control (optional extra), bias adjust, and memory rewind. 5 1/8" H x 16 1/2" W x 12" D ..... \$249.95

### SC-777 Cassette/Phono/Tuner

Combines a 4-speed Garrard automatic turntable with Pickering V-15 mag. cartridge with diamond stylus, a 15 W/ch dynamic power amp

into 8 ohms at 1% THD, and AM/FM stereo tuner section with 2.8  $\mu$ V FM sensitivity for 30 dB quieting with a pair of two-way air-suspension speaker systems and cassette record/playback unit. The speaker cabinets measure 15 3/8" x 9 3/4" x 8 1/4" D, each with 6 1/2" woofer & 2 1/2" tweeter. Control center measures 9 3/4" x 18 7/8" x 19" D. Oiled walnut cabinet with dust cover ..... \$429.95

### RS-257S Essex Cassette/Phono/Tuner

Features 4-speed automatic record player, magnetic cartridge with diamond stylus, and



AM/FM stereo receiver, cassette tape recorder, and a pair of separate speaker systems, 10 W/ch dynamic (EIA) power. Response 30-12,000 Hz. Has mike & aux. inputs, line outputs, 8-ohm speaker terminals, VU meters, speaker

monitoring, and slide controls. Speakers are 6 1/2" woofer and 2 1/4" tweeter in cabinet measuring 10 3/8" W x 14 3/8" H x 5 1/2" D. Control center 21 1/8" W x 10 3/8" H x 14" D. Walnut-grain housing with dust cover and microphone ..... \$329.95

### PENNEY, J.C.

### 6661 Phono/Cassette Recorder

Combines an AM/FM stereo tuner, a 4-speed



## THE CASSETTE TAPE RECORDER

THE cassette is a miniature tape-handling system, with the supply and takeup hubs and tape sealed in a compact plastic case. It is more compact and physically durable than phono discs and much easier to handle than records or tape reels.

Since cassettes operate at only 1 7/8 ips and have four narrow tracks on a tape only 0.020" wide, you would not expect them to compete in sound quality with discs or reel-to-reel tape systems. Early cassette recorders made no pretensions of "hi-fi" performance, and were characterized by limited high-frequency response, a high hiss level, frequent tape dropouts, and often audible flutter.

Progress in this field has been rapid and by 1970 there were a number of cassette recorders whose frequency response extended up to 10-12,000 Hz, with flutter reduced to acceptable levels. The hiss problem was attacked on two fronts. Tape manufacturers developed better tape, with fine grain structure and improved magnetic properties. These tapes made a substantial improvement in signal-to-noise ratio, as well as extending the high-frequency response and reducing the number of dropouts. At about the same time, the Dolby noise-reducing system (long used in professional recording studios) was adapted to consumer products. The combination of the Dolby "B" system and the new tape resulted in a "giant step" forward for the cassette medium.

The Dolby "B" system (as distinguished from the much more complex Dolby "A" system used professionally) boosts the high frequencies, principally above several kHz, in recording and reduces them in an exactly complementary fashion during playback. This action takes place only at low signal levels; at high levels the Dolby has no effect. The amount of boost and cut varies with recording level and the action is instantaneous and inaudible. The net result is an improvement of 8 to 10 dB in signal-to-noise ratio, apparent to the listener as a dramatic reduction in background hiss. Frequency response and distortion are completely unaffected by the Dolby action.

Since the Dolby system must be used in recording as well as playback, it cannot improve the noise level in existing tapes. However, several manufacturers of prerecord-

ed cassettes now apply Dolby processing to their releases, so that anyone with a Dolby-equipped cassette deck can enjoy the reduction in noise. These tapes sound a trifle "bright" when played back without the Dolby system, but can easily be compensated by using the amplifier tone controls.

During the past year, tape manufacturers have been very active and a number of improved tapes are now packaged in cassettes. The problems of jamming, slipping, or breaking tape which have plagued the cassette industry have been greatly reduced by improving mechanical design of the cassette package (but one should beware of un-branded, bargain-priced cassettes, which are usually of poor quality). Chromium-dioxide (CrO<sub>2</sub>) tape, available in limited quantities in 1970, is now used in cassettes packaged by several manufacturers. The recorder must be designed to use this tape, since it requires different bias and equalization than iron-oxide tapes to fully realize its advantages. With a suitable recorder, CrO<sub>2</sub> tape offers extended high-frequency response and lower noise.

Many of the newest cassette recorders have improved transports with lower flutter and less tendency to jam with balky cassettes. Many of the better ones have a bias-adjust switch to optimize them for CrO<sub>2</sub> tapes. The Dolby system is more widely used but some manufacturers have developed their own noise-reducing circuits which they claim give similar benefits. A number of recorders feature automatic shut-off devices, which completely disengage the mechanical tape drive when the end of the cassette is reached.

No longer can the cassette medium be relegated to second-class status in the hi-fi world. The newest decks with CrO<sub>2</sub> tape and the Dolby system, have flat frequency response to beyond 15,000 Hz and a signal-to-noise ratio of 60 dB, matched by only a few semi-professional reel-to-reel recorders at 7 1/2 ips. The flutter of a high-quality cassette transport, although slightly higher than that of a good reel-to-reel machine, is well below 0.2% and can rarely be heard. Cassette tapes are still not amenable to editing, but from a listening standpoint have earned their place as a true hi-fi recording medium.

## 2 Cassette Tape Machines

BSR minichanger with 7" turntable and ceramic cartridge, a cassette record/playback unit, and two separately housed speaker systems, each with 6½" woofer & 2½" tweeter. Has record-level indicators and 6 W/ch rms continuous sine wave power at 5% HD. Vinyl-covered wood cabinets and dust cover ..... \$199.95

### 1981 Phono/Cassette Player

Combines an AM/FM stereo tuner, a cassette tape player, a BSR C-116-H-1 4-speed changer



with diamond stylus and two separately housed speaker systems, each with 6" woofer & 2" tweeter. Has dual VU meters, 10 W/ch rms continuous power output at 5% HD. Walnut wood cabinet and dust cover ..... \$299.95

### 1980 Phono/Cassette Recorder

Combines an AM/FM stereo tuner, a cassette recorder/player, a BSR MA-65 changer with diamond stylus, and two separately housed speaker systems, each with 8" woofer & 2½" tweeter. Has record-level indicators and 20 W/ch rms continuous sine wave output at 5% HD. Walnut wood cabinets ..... \$399.95

### 7525 Cassette Tape Deck

Stereo tape record/playback design with automatic shutoff, pause control, and dual mike & phono inputs ..... \$89.95

## PILOT

### PTD-100/100A Cassette Deck

Will play and record. Response 30-15,000 Hz, wow & flutter 0.2%, S/N 45 dB. 0.2% THD. Has synchronous motor, counter, eject button, automatic shutoff, pause control, monitoring facilities, mike and line inputs, and bias adjust. Supplied with mikes. Walnut. 3⅞" H × 12¼" W × 9" D ..... \$169.95

## PIONEER

### T-3300 Cassette Recorder

Stereo deck only. Plays and records. Response 40-12,000 Hz at 1.3% THD, wow & flutter less than 0.2%, S/N 52 dB. Has hysteresis motor,



VU meters, counter, eject button, automatic shutoff, pause control, monitoring facilities, and mike & line inputs. 4⅞" H × 13" W × 8⅞" D ..... \$149.95

## RHEEM CALIFONE

### CR-5 Cassette Recorder

Mono play and record. Response 50-10,000 Hz ±3 dB, less than 5% THD, wow & flutter less

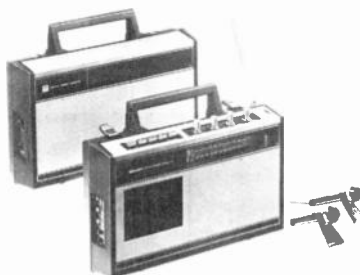


than 0.25%. Hysteresis motor. 5 W rms output, S/N 45 dB. Has VU meter, counter, eject button, tone control, and pause button. Metal case with carrying handle. 7¼" H × 15" W × 10" D ..... \$175.00

## SHARP

### RS-433U Cassette Recorder

Stereo play/record portable design for 117-volt a.c., 8 "D" cells, or 12-volt car battery opera-



tion. Features an AM-FM stereo receiver, record/battery meter, two 5" speakers, 0.8 W/ch dynamic (EIA) power at 5% THD. Supplied with remote-control microphone. 13¼" × 10⅞" × 3½" D ..... \$149.95

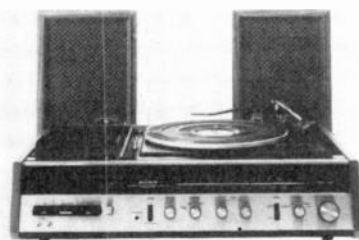
## SONY

### HST-119 AM-FM/Cassette Player

Combines an AM-FM stereo receiver with a cassette player. 5 W/ch dynamic (EIA) power at 5% THD. Input sensitivity: mag. phono 5 mV, ceramic phono 300 mV, Aux. 250 mV. 8 ohm output. FM sensitivity 2.2 μV for 30 dB quieting. Has automatic or manual tape-track switching. Walnut cabinet. 5¼" H × 21⅞" × 12¼" D. Also available with 8-track tape player as Model HST-118 ..... \$185.00

### HP-219 AM-FM/Phono/Cassette System

Combines an AM-FM stereo receiver, a cassette player, and a pair of SS-210 speaker sys-



tems (each with a 6½" woofer & 2" tweeter, 15" × 9¼" × 8⅞" D) with a BSR automatic turntable and Sony VX-18P stereo phono cartridge. 18 W/ch dynamic power at 5% THD at 8 ohms. Response 40-40,000 Hz ±3 dB at 1 W. FM sensitivity 2.5 μV for 30 dB quieting. Features automatic and manual tape program selection. Walnut cabinet. 15" H × 9¼" × 8⅞" D. Also available with 8-track tape player as HP-218 ..... \$329.95

### HP-149 AM-FM/Phono/Cassette System

Combines an AM-FM stereo receiver, a cassette player, a BSR 4-speed micro-minichanger with ceramic stereo cartridge, with a pair of separately housed speaker systems (each with 6½" woofer & 2" tweeter, 11⅞" × 11⅞" × 5⅞" D). 5 W/ch dynamic (EIA) power at 5% THD at 8 ohms. Response 40-20,000 Hz ±3 dB at 1 W. 8" × 22¼" × 12" D. Also available with 8-track tape player as HP-148 ..... \$235.95  
Prices as of December 1, 1971

## SONY/SUPERSCOPE

### CF-620 Cassette Recorder/Radio

Cassette recorder combined with AM/FM stereo tuner. Plays and records. Response 30-



12,000 Hz, wow & flutter 0.22%, S/N 46 dB. Supplied with mikes and speakers. 6 W/ch dynamic (EIA) power at 5% HD. Features VU meters, counter, eject button, pause control, monitoring facilities, mike & line inputs, bias adjust. 5⅞" H × 16½" W × 12¼" D ... \$317.95  
Model CF-610. Same except portable version ..... \$289.95

### 127 Stereo Cassette Deck

Plays and records. Response 30-12,000 Hz, wow & flutter 0.2%, S/N 48 dB. Features VU meters, counter, eject button, pause control, headphone monitoring, mike & line inputs, bias adjust, and peak limiter. 3⅞" H × 15¼" W × 18⅞" D ..... \$159.95

### 160 Stereo Cassette Deck

Plays and records. Response 20-16,000 Hz, wow & flutter 0.1% S/N 49 dB. Features VU



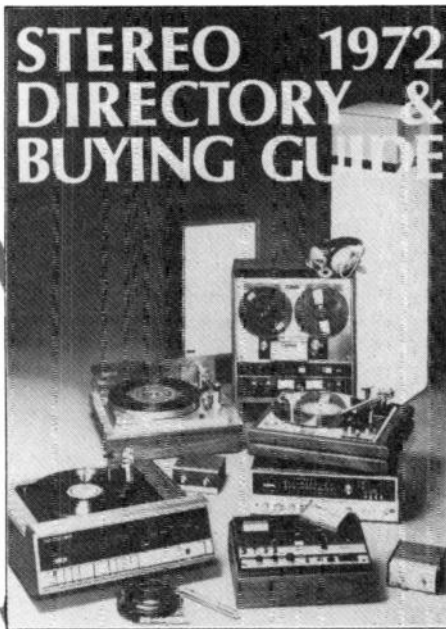
meters, counter, eject button, pause control, headphone monitoring, mike & line inputs, peak limiting, and bias adjust. 5" H × 15¼" W × 10⅞" D ..... \$199.95  
Model 165. Same except includes automatic shutoff and reverse ..... \$269.95

### CF-550 Cassette Recorder/Radio

Combines AM/FM stereo receiver with cassette recorder. Has two built-in condenser mikes



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## 2 Cassette Tape Machines



and four built-in speakers, built-in battery charger for optional NiCad battery (6 V). Will operate from a.c. power line. Response 50-10,000 Hz. Has two line (0.06 V) and two mike inputs. 1 1/2 W/ch dynamic (EIA) power output. Portable design. 13 1/4" x 9 3/8" H x 4 3/4" D ..... \$219.95

### 124 Cassette Recorder

117-V a.c. or 6 V d.c. (four "C" cells) stereo design. Response 50-10,000 Hz, S/N 45 dB,



wow & flutter 0.28%. Has battery-strength and record-level indicator, line (0.06 V) & mike inputs, built-in mono speaker (4" x 2 3/4"), and stereo speaker outputs. Supplied with F-99 microphone with remote control, earphone, and carrying case. 6 3/4" x 2 3/4" x 9 7/8" D ..... \$179.95

### SOUNDESIGN

#### 490 Cassette Tape Deck

Play-only stereo design. Response 30-15,000 Hz. Oiled wood cabinet. 2 3/4" x 8 3/4" x 6" ..... \$59.00

### STANDARD RADIO

#### T178DK Stereo Cassette Deck

Plays and records. Response 30-15,000 Hz, wow & flutter less than 0.2%, S/N 45 dB. Has hysteresis motor, VU meters, counter, eject button, automatic shutoff, pause control, mon-



itoring facilities, and mike & line inputs. 3 3/4" H x 12 3/4" W x 9" D. Walnut enclosure ..... \$169.95

#### T180DK Cassette Deck

Similar to Model 7178DK but includes a dynamic noise suppression system .... \$199.95

#### SR-T180DK Cassette Deck

Stereo record/play deck. Sensitivity 0.3 mV for mike input (600 ohms), 70 mV for aux. in-



put (270,000 ohms). Has hysteresis motor, VU meters, automatic shutoff, and automatic level controls. Output: 100,000 ohms 0.6 V (high), 0.2 V (medium), 0.07 V (low). Wow & flutter 0.2%, S/N ratio 45 dB (58 dB with noise suppression). Response 30-15,000 Hz (30-18,000 Hz with chromium-dioxide tape); THD 2%. Features dynamic noise suppression circuit and bias switch for standard tape and chromium-dioxide. 12 3/4" x 3 7/8" x 8 1/16" D .. \$189.95

### TEAC

#### 350 Dolby-ized Cassette Deck

Stereo design. Plays and records. Response 30-16,000 Hz, wow & flutter 0.13%, S/N 58



dB. Has hysteresis motor, VU meters, counter, eject button, automatic shutoff, pause control, monitoring facilities, and mike & line inputs. 4 3/8" H x 16 1/16" W x 9 7/8" D ..... \$299.50

#### A-23 Cassette Deck

Stereo design. Plays and records. Has hysteresis motor, VU meters, counter, eject button, pause control, and mike inputs ..... \$139.50

#### AC-7 Auto Cassette Player

Play only. Response 40-8000 Hz, wow & flutter 0.3%. 12-volt d.c. operation. 3 W/ch dynamic (EIA) output at 5% THD. Has eject button. 7 3/4" H x 9" W x 7 1/2" D ..... \$129.50

#### A-25 Cassette Recorder

Stereo play/record design. Response 40-12,000 Hz, wow & flutter 0.2%, S/N 45-dB. Has hysteresis motor, VU meters, counter, eject button, automatic shutoff, pause control, monitoring facilities, mike & line inputs. Has 10 W/ch dynamic (EIA) power amps at 5% THD. Supplied with two bass-reflex, 8-ohm speakers

**NOTE:** Almost all of the cartridge tape manufacturers (both cassette and 8-track) rate their products according to the EIA (Electronic Industries Association) standards of measurement. All power output figures are therefore based on 5% THD. Their music-power rating is basically the same as the IHF (Institute of High Fidelity) dynamic power rating. The results are about the same, the only difference being in the method of testing.

each with 4" full-range speaker. (14 3/16" H x 9 1/16" W x 7 3/8" D. Has phono input. Control center 4 3/4" H x 13 3/4" W x 9 3/4" D .... \$279.50

#### A-24 Cassette Deck

Stereo design. Plays and records. Response 40-12,000 Hz, wow & flutter 0.2%, S/N 45 dB.



Has hysteresis motor, VU meters, counter, eject button, automatic shutoff, pause control, monitoring facilities, and mike & line inputs 4 3/4" H x 13 3/8" W x 9 3/8" D ..... \$179.50

### WOLLENSAK

#### 4760 Cassette Deck

Dolby-ized deck. Plays and records. Response 35-15,000 Hz +2 dB, wow & flutter 0.15%, S/N



greater than 54 dB. Has VU meters, counter, eject button, automatic shutoff, pause control, monitoring facilities, mike & line inputs, bias adjust. Mike preamp \$29.95 extra .. \$279.95 Model 4755. Similar to Model 4760 but without Dolby circuit ..... \$199.95

### ZENITH

#### C682W "Latham" Cassette System

Combines an AM/FM stereo receiver, a cassette record/playback tape unit, with a pair



of separately housed speaker systems (12" x 12" x 5 3/8" D). 10 W/ch dynamic power at 5% HD. Has two record-level meters and tape storage space. Comes with 2 microphones. 4 7/8" H x 22" W x 12 7/8" D. Walnut-grained veneer cabinets ..... \$269.95

#### A636W Cassette Deck

Slot-loading stereo record/play deck with automatic end-of-tape shutoff and eject. Has re-



cord-level meters, preamp outputs, two microphones, and tape storage space. 4 1/2" x 14" x 9 1/4" D. Walnut-grained cabinet ..... \$119.95

### TAPE RECORDER GUIDE

# TAPE TERMINOLOGY

**Acetate Base**—The transparent cellulose-acetate plastic film that forms the backing for many magnetic recording tapes.

**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.

**Azimuth Adjustment**—The mechanical adjustment of a magnetic head whereby exact alignment of the head gap with a standard tape-recorder magnetic pattern is achieved. Of prime importance for optimum high-frequency performance and recorder-to-recorder playback compatibility. (See also *Head Alignment*)

**Azimuth Loss**—The signal loss caused by lack of alignment between the playback-head gap and the signal recorded on the tape.

**Backing or Base**—The flexible material, usually cellulose acetate or polyester, on which is deposited the magnetic-oxide coat that "records" the taped signal.

**Bias**—A constant signal or tone added to the audio signal during recording to circumvent the inherent non-linearity of magnetic systems. The best (and most commonly used) bias is a high-frequency (usually 50,000 to 100,000 Hz) alternating current fed to the recording head along with the audio signal to be recorded.

**Bulk Eraser or Degausser**—A hand-held (or larger) device used to erase magnetic tape without removing it from the reel. It generally produces a strong alternating magnetic field that neutralizes all previously recorded magnetic patterns on the tape.

**Cartridge**—A sealed plastic container that holds tape of 1/4-inch or narrower width. Designed to eliminate manual tape threading, cartridges operate on either the continuous-loop (single hub) principle or the reel-to-reel (double hub) system. Cartridge machines are usually smaller and simpler to use than ordinary open-reel units. (See also *Cassette*)

**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.

**Cassette**—A type of tape cartridge operating on the hub-to-hub principle and now coming into wide use in portable and home machines.

**Crosstalk**—The undesired pickup of a signal from an adjacent track recorded on a tape.

**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.

**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 tape recording are now available to the audiophile as accessories or built into tape machines.

**Dropout**—During playback, 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. However, these imperfections are most commonly high spots on the tape surface that push the tape away from the magnetic head, thereby increasing the area affected (the "umbrella" effect).

**Dual-Track Recorder**—Usually a monophonic recorder with a recording-head gap that covers somewhat less than half the width of a standard quarter-inch tape, making it possible to record one track on the tape in one direction and (by turning the reels over) a second track in the opposite direction. Also known as "two-track" or "half-track."

**Dub**—A copy of another recording.

**Dynamic Microphone**—An electromagnetic pressure microphone that employs a moving coil in a magnetic field to convert sound pressure to electrical energy in a manner similar to that of an electric generator. Impedance and output are generally lower than those of the ceramic or crystal microphone types. Low impedance permits the use of longer connecting cables without high-frequency loss or hum pickup.

**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.

**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.

**Erase**—The neutralization of the magnetic pattern on tape by use of a strong magnetic field, thereby removing 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*)

**Extra Play**—Also called "long play" or "extended play." Refers to tape that gives more than standard playing time on a standard reel because it employs a thinner base together with a thinner but usually more responsive oxide coating, and thus more tape can fit on a reel.

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This material has been adapted from "101 Terms: A Glossary of Tape Recording Terms," published by the Magnetic Products Division of the 3M Company. Our thanks for their permission to bring it to you.

**Fast Forward**—The provision on a tape recorder permitting tape to be run rapidly through it in the 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.

**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.

**Four-Channel Stereo**—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 Recording**—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 Stereo*.)

**Full-Track Recording**—Applies to quarter-inch-wide (or less) tape only. It defines track width as essentially equal to tape width.

**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.

**Harmonics**—Overtones that are integral multiples of the fundamental frequency. In properly balanced a.c.-biased tape recorders, only the odd-order harmonics (primarily the third) are generated by the recording process and these are very low in amplitude.

**Head**—In a magnetic-tape recorder, the generally ring-shaped electromagnet across which the tape is drawn. Depending on its func-

tion, it either erases a previous recording, converts an electrical signal to a corresponding magnetic pattern and impresses it on the tape (record function), or picks up a magnetic pattern already on the tape and converts it to an electrical signal (playback function). Most home recorders have a separate erase head, but combine the record and play functions in a single unit. Professional machines and those intended for the serious amateur have separate heads for erase, record, and playback.

**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. See Fig. 1.

**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.

**Hiss**—A high sibilant sound, most often found in tape recording or tape playback. The better the tape system, the lower the hiss.

**Index Counter**—An odometer type of counter that indicates revolutions (not feet of tape), usually of the supply reel, thereby making it possible to index selections within a reel of tape and readily locate them later on a given machine.

**Input Signal**—An electrical voltage embodying the audio information that is presented to the input of an amplifier, tape recorder, or other electronic component.

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

**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.

**Leader and Timing Tape**—Special tough non-magnetic tape that can be spliced to either end of a magnetic tape to prevent its damage and possible loss of recorded material. Either white or in colors, it usually has some type of marking that enables it to be used as a timing tape. It therefore can be spliced between musical selections to provide desired pauses in playback.

**Level Indicator**—A device on a tape recorder for indicating the level at which the recording is being made; it serves as a warning against under- or over-recording. It may be a neon bulb (now becoming obsolete), a "magic eye," or a meter. (See also *VU Meter*)

**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 low-noise tapes include extremely good high-frequency sensitivity and a heavy-duty binder system for reduced ruboff of magnetic oxide and an increase in wear life over ordinary tapes.

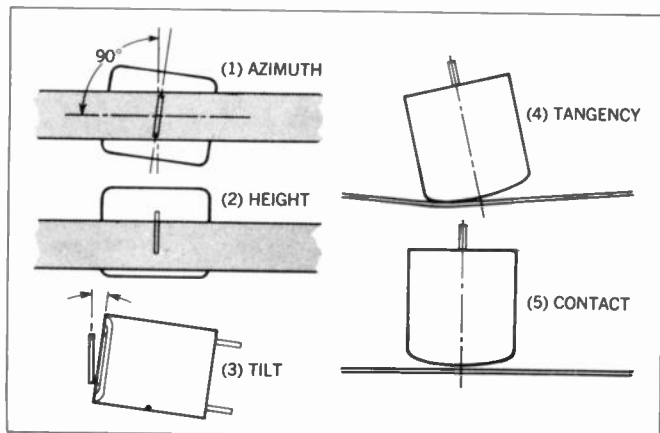
**Low-Print Tape**—Special magnetic recording tape significantly less susceptible to print-through (the transfer of signal from one layer of tape to another), which results when tape is stored for long periods of time. These tapes are especially useful for "master recording" (making an original recording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

**Mil**—One one-thousandth of an inch. Tape thickness is usually measured in mils.

**Mixer**—A device that allows two or more signal sources to be blended, balanced, and fed simultaneously into a tape recorder or amplifier.

**Monophonic (Monaural) Recorder**—Refers to single-channel recorders, as distinguished from stereophonic types. Current home

Fig. 1. (1) Azimuth, or skew, in which the width dimension (corresponds to track width) of the head gap is a precise 90-degree angle to the tape edge. (2) Height, in which the gap-width dimension is centered on the standard track location. (3) Tilt, in which the face of the head must be simultaneously tangent to the same degree with both edges of the tape and without distortion of either of the latter. (4) The adjustment to assure that the tape is tangent with, and contacting the specific portion of, the head face containing the head gap, and remains so during the playing of the tape. (5) The adjustment toward or away from the tape to assure proper contact pressure ("wrap") between the head and the tape.





recorders are almost all of the four-track stereo configuration.

**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 the recording is made and while the recording is still in progress.

**NAB Curves**—Standard tape-recorder playback equalization curves established by the National Association of Broadcasters. (See also *Equalization*)

**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*)

**Open Reel**—Tape systems that, for home applications, use up to 7-inch reels of tape. To start the tape, it must be threaded by hand from the full to the empty (or takeup) reel. Open-reel tape systems usually provide greater fidelity than cassette or tape cartridge systems, but that gap is closing rapidly. (See *Tape Speed*)

**Output (also Maximum Undistorted Output)**—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 (such as Scotch No. 111).

**Oxide**—The ferro-magnetic particles which, when properly dispersed in a plastic binder and coated on a backing or base, form the magnetic portion of magnetic tape. Conventional oxide particles are chemically known as gamma ferric oxide, are brown in color, acicular (needlelike) in shape, and of micron length. Less conventional oxides have been developed that exhibit significantly different magnetic properties (and size).

**Patch Cord**—Sometimes called "signal lead." A short shielded wire or cable with a plug on either end (or with a pair of clips on one end) for conveniently connecting together two pieces of sound equipment such as a phonograph and tape recorder, an amplifier and speaker, etc. Not to be used for 120-volt current.

**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."

**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.)

**Portable Recorder**—Originally, any tape recorder designed for easy mobility and requiring connection to a 120-volt a.c. supply for operation. Recently the term has been applied specifically to battery-powered units that do not require external power for operation.

**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.

**Pressure Roller**—Also called "pinch roller" or "capstan idler." A hard-rubber roller that holds the magnetic tape tightly against the capstan, permitting the latter to draw the tape off the supply reel and past the heads at a constant speed. (See also *Capstan*)

**Print-Through**—Undesired transfer of magnetic pattern from layer

to layer of tape on a reel. In most cases, will make recording unusable.

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

**Reel-to-Reel**—Designates those tape machines that do not use a cartridge or cassette. (See also *Open Reel*)

**Rewind Control**—A button or lever for rapidly rewinding tape from the takeup reel to the supply reel.

**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**—As used to describe the capabilities of raw tape, it indicates the relative output for a given input in the linear (low-distortion) portion of a tape's magnetic transfer characteristic. Sensitivity data plotted as a function of frequency (or wave length) gives frequency response, usually relative to a standard reference tape.

**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. Tape systems have separation capability superior to that of disc systems.

**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.

**Splicing Block**—A metal or plastic device incorporating a groove within which ends of the tape to be spliced are held. An additional diagonal groove provides a path for a razor blade to follow in cutting the tape. It makes splices very accurately using narrow-width ( $\frac{7}{32}$ " ) splicing tape. (See also *Tape Splicer*)

**Splicing Tape**—A special pressure-sensitive, 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.

**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 "message-repeater" 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-Transport Mechanism**—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.

**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  $7\frac{1}{2}$  ips or half that speed ( $3\frac{3}{4}$  ips). Speeds of  $1\frac{7}{8}$  and  $1\frac{5}{16}$  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.

**Tape Splicer**—A device, similar to a film splicer, for splicing magnetic tape automatically or semi-automatically. Different models vary in operation, most using splicing tape; some professional units employ heat. (See also *Splicing Block*)

**Telephone Pickup**—Any of several devices used to feed telephone conversations into a tape recorder, usually without direct connection to the telephone line and operating by magnetic coupling.

**Tensitized Polyester**—A polyester tape backing that has been pre-stretched principally in the lengthwise direction to increase resistance to further stretching.

**Tone Controls**—Control knobs on a tape-recorder amplifier used to vary bass and treble response to achieve the most desirable balance of tone during playback.

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

**Two-Track Recording**—On quarter-inch-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).

**Uniformity**—In terms of magnetic tape properties, a figure of merit relating to the tape's ability to deliver a steady and consistent output level when being recorded with a constant input. Usually expressed in decibel variation from average at a mid-range frequency.

**VU Meter**—A "volume unit" meter that indicates audio-frequency levels in decibels relative to a fixed 0-dB reference level. The meter movement differs from those of ordinary voltmeters in that it has a specified ballistic response adapted to monitoring speech and music. Used in many home and most professional recorders to monitor recording levels and maintain them within the distortion limits of the tape.

**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 sound-reproducing systems caused by relatively slow periodic variation in the speed of the medium (such as tape) and characterized by its effect on pitch.

**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*) □

## THE "COMPACT" STEREO SYSTEM

THE "compact" stereo system represents a nearly complete integration of components, designed to be compatible electrically and physically. Instead of the inefficient use of space by a stereo tuner and amplifier receiver in its cabinet, with a record changer and/or a tape player on a separate base, the two (or more) are combined into a single unit only slightly larger than the record changer alone.

Stereo compacts were made possible by the development of solid-state circuits which could be modularized and mounted so as to fill unused spaces around the record changer or cassette deck mechanism. Since transistors generate little heat, the components can be placed close together, with a minimum of ventilation required. Operating controls are usually on the front of the base, although in some models they are located on top.

Just as a receiver is simpler to install than separate units with their many interconnecting cables, the compact goes one step further by having its record changer built-in, with the phono cartridge internally wired to the amplifier input. Setting up a record changer and mounting a cartridge can be difficult for a neophyte; compact systems come from the manufacturer in a "ready-to-play" condition.

Ordinarily, connecting speakers to amplifier output terminals requires care to avoid short circuits and observance of correct polarity to insure in-phase operation. The speakers supplied with compact systems are fitted with phono jacks, as are the amplifier outputs. Plugging in the cables supplied automatically provides a safe, correctly phased speaker hook-up.

Most compact systems are relatively low powered (from 8 to 20 watts per channel), but their power ratings are rarely included in manufacturers' specifications. There is no need for the user to be concerned with the selection of a suitable speaker, since the manufacturer has provided speakers whose efficiency and frequency response are matched to the amplifier.

Since compact systems were not intended to compete with elaborate, powerful stereo component sys-

tems, speaker units are usually quite small and of modest performance. However, some manufacturers offer the same basic receiver/record-changer unit with a choice of several types of speaker systems. With the larger and costlier speaker options, many of the better compacts are equivalent in performance to good component systems. A few compacts, using unusually small speaker systems, have a "contoured" frequency response in their amplifiers to compensate for the speaker's characteristics. Although these systems frequently produce amazingly good sound, they cannot be expected to match the quality of a more expensive unit with larger speakers. Furthermore, since the amplifier frequency response is tailored to its own speakers, other types of speaker systems cannot be used with this type of compact.

A few full-size stereo receivers are designed to be converted to "compacts" by replacing the cabinet top with a mounting board and record changer. These receivers, with the addition of a pair of suitable speakers, form the basis of a very powerful, high-quality compact system.

The record player and phono cartridge supplied with a compact system have been selected to complement the quality of the speakers. Most compacts use low-priced changers, with more rumble than higher-priced record players. Normally, the relatively small speakers used in such systems will not reproduce rumble frequencies. Higher-priced compacts with wider-range speakers, often have high-quality record changers suitable for use with almost any speaker system.

Phono cartridge characteristics are determined by the record-changer requirements. Low-priced models use a cartridge tracking at 3 to 4 grams; better record players use high-compliance cartridges operating at 1 to 2 grams.

As with components, performance of a compact system is roughly related to its price. However, the buyer is assured of a compatible design, installation problems are virtually non-existent, and cost is somewhat less than an equivalent component system. □

## SECTION



# 8-Track Tape Machines

### ADMIRAL

#### STPF841 8-Track Tape Player

Combines an AM/FM stereo receiver and an 8-track stereo cartridge tape player. Will operate from 8 "D" cells, car battery, or house current. Supplied in portable-type case with two built-in speaker systems ..... \$99.95

#### STC891 8-Track Tape Player

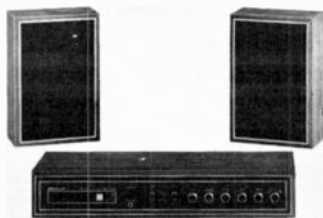
Combines an AM/FM stereo receiver with an 8-track stereo cartridge tape player. 5 W/ch dy-



amic (EIA) power at 5% THD. Supplied with separately housed speaker systems. Walnut-grained vinyl finish ..... \$159.95

#### STC 861 8-Track Tape Player

Similar in many ways to the Model STC891 but



apparently an "economy" version ... \$139.95

### AKAI

#### CR-80 8-Track Recorder

Will record/play. 12 W/ch dynamic power output at 5% THD. Features one-micron gap tape



head, two VU meters, automatic stop control, sliding tone and volume controls, microphone and line inputs. Response 50-16,000 Hz, wow & flutter 0.25% rms, S/N 47 dB .... \$209.95

#### CR-80T 8-Track Recorder/Tuner

Combines an AM-FM stereo tuner with a conventional 8-track cartridge machine. FM sensitivity 3 mV for 30 dB quieting. Response 50-16,000 Hz  $\pm$  3 dB, S/N 47 dB. 7 W/ch continu-



ous sine wave into 8 ohms (10 W/ch dynamic power). Has mike (0.5 mV), line (50 mV), and phono (3.5 mV) inputs. Can be used as a p.a. system. 19 $\frac{1}{8}$ "  $\times$  5 $\frac{1}{8}$ "  $\times$  10 $\frac{7}{8}$ " ..... \$249.95

#### CR-80D 8-Track Deck

Same as Model CR-80 except does not have



power amps. 13 $\frac{1}{2}$ "  $\times$  10"  $\times$  5 $\frac{1}{2}$ " D ... \$169.95

### ALLIED RADIO SHACK

#### TR-8 8-Track Stereo Record Deck

Has VU meters and independent record-level



controls. Response 30-15,000 Hz; wow & flutter 0.3%. Walnut cabinet. 15 $\frac{3}{4}$ "  $\times$  10 $\frac{1}{4}$ "  $\times$  4 $\frac{1}{4}$ " ..... \$159.95

#### TR-880 8-Track Stereo Record Deck

Has record-level meters and independent record-level controls. Response 50-12,000 Hz;



wow & flutter 0.3%. Walnut cabinet. 17 $\frac{1}{4}$ "  $\times$  5"  $\times$  9 $\frac{3}{8}$ " ..... \$99.95

#### 14-913 8-Track Stereo Player

Includes an 8-track tape player and two separately housed speaker systems (8"  $\times$  10 $\frac{1}{2}$ "  $\times$  8 $\frac{1}{2}$ " each). Has 2 $\frac{1}{2}$  W/ch dynamic (EIA) power; 5% HD. Walnut cabinet. 15 $\frac{1}{2}$ " W  $\times$  10 $\frac{1}{2}$ "  $\times$  3 $\frac{1}{4}$ " ..... \$89.95

### BELL & HOWELL

#### 3420 AM-FM/8-Track Player

Combines 8-track player with AM/FM stereo



receiver. Unit comes with two matching speaker systems. Features illuminated tuning meter, slide-rule dial, a.f.c. switch, a.c. convenience outlet, and a full array of input and output jacks. Response 60-16,000 Hz; wow & flutter 0.2% rms ..... \$149.95

### BOGEN

#### 8P 8-Track Deck

A playback stereo deck for use in audio systems. Features "Micro Balance" fine-tuning



control for better tracking and reduced noise and crosstalk. Has an Aux. input to play additional unit through deck. Walnut cabinet trimmed in gold ..... \$79.95

### BSR McDONALD

#### RD-8S 8-Track Recorder

Record/play stereo deck to be used with audio system. Has dual VU meters and microphone and auxiliary mixing. Response 30-15,000 Hz; wow & flutter 0.3% rms; S/N ratio 40 dB. 12 $\frac{7}{8}$ "  $\times$  10 $\frac{1}{4}$ "  $\times$  4 $\frac{1}{8}$ " ..... \$199.95

#### RS-28A Player/AM-FM Receiver

Cartridge player/AM-FM stereo receiver with 10 W/ch dynamic (IHF) power output. Comes complete with two matching speaker systems ..... \$199.95

#### TD-8S 8-Track Playback Deck

Deck includes a 3-stage preamp. Comes with cabinet and connecting cables ..... \$49.95

### CLARICON

#### 26-200 8-Track Player/Receiver

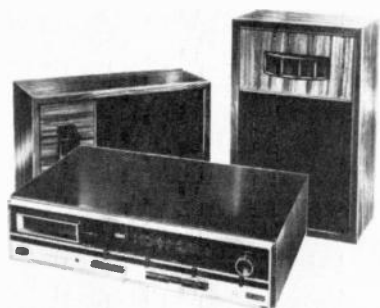
Combines an 8-track cartridge player with an AM-FM stereo receiver and two matched speaker systems. Features seven push-button controls; linear balance, tone, and volume controls; a.f.c.; stereo indicator light. Has a stereo headphone jack on front panel and a full complement of inputs and outputs ..... \$119.95

#### 26-545 8-Track Player/Receiver

Combines an 8-track cartridge player with an AM-FM stereo receiver and two matched speaker systems with exposed tweeters. Features nine push-button controls, four sliding controls, and full array of input/output connec-



### 3 8-Track Tape Machines



tions. Output 30 W/ch dynamic power. FM sensitivity 3  $\mu$ V. Response 30-25,000 Hz. Feed slot has dust cover ..... \$169.95

#### 34-200 Player/Phono/Receiver

Combines an automatic turntable with magnetic cartridge and diamond stylus with a 30 W/ch

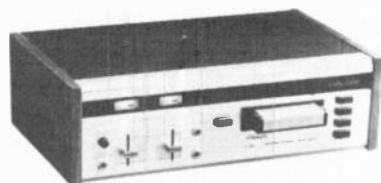


dynamic power amp, AM-FM stereo tuner, 8-track cartridge player, and a pair of two-way air-suspension speaker systems (each with 8" woofer & tweeter with horn dispersion system). Speaker cabinets 15" x 10" x 7" D. Control center 21" x 16" x 8 1/2" D. Oiled walnut finish. Dust cover ..... \$229.95

### CONCORD

#### F-128 8-Track Stereo Deck

Records and plays. Has two VU meters, a three-digit tape counter, slide record-level con-



trols, fast-forward control, and headphone jack. Response 50-10,000 Hz, wow & flutter 0.3% rms, S/N 45 dB ..... \$159.95

### DENON

#### TRC-315 8-Track Deck

A record/play deck for use with audio systems. Has dual VU meters, function switch for continuous play or repeat, automatic shutoff and eject, fast-forward. Response 40-15,000 Hz, wow & flutter 0.25%, S/N 45 dB. Comes with two mikes and a stereo headphone jack. 16 3/8" x 9 3/8" x 4 1/2" ..... \$179.95

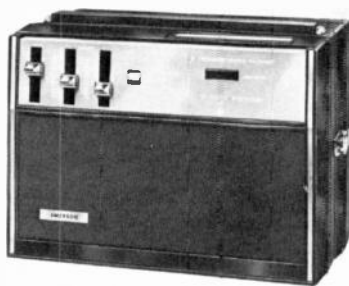
### ELECTROHOME

#### STP-1 8-Track Tape Deck

Response 30-12,000 Hz. 0 VU output level 200 mV min., wow & flutter 0.3% max. at 3 kHz. Features automatic and manual program switching ..... \$69.95

### EMERSON

#### ETP-110 8-Track Stereo Player



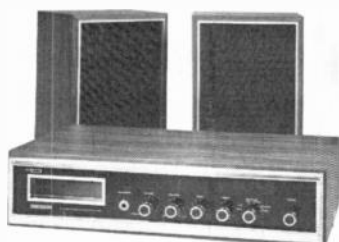
Portable 8-track stereo tape player. Will operate from 120-volt a.c., 8 "D" cells, or 12-volt car battery. Features continuous play or manual channel selection, channel indicator, channel selector switch. 1 1/2 W/ch dynamic (EIA) power at 5% THD, S/N 40 dB, wow & flutter 0.25%. Two 4" PM speakers, one in detachable section. 10 3/8" W x 7 1/2" H x 6" D ..... \$59.95

#### ETP-120 8-Track Stereo Player

Plays 8-track stereo cartridges. Features 4-pole synchronous motor, program indicator lights, channel selector switch. 2 1/2 W/ch dynamic (EIA) power at 5% THD, S/N 50 dB, wow & flutter 0.25%. Separate enclosures with 4" PM speaker in each (7 1/2" W x 9 7/8" H x 6 3/4" D). Walnut veneer enclosures. 13 7/8" W x 4 1/2" H x 7 1/4" D ..... \$69.95

#### 31M25 8-Track Player/AM-FM Receiver

Plays 8-track stereo cartridges and receives AM-FM stereo broadcasts. Power output 2 1/2



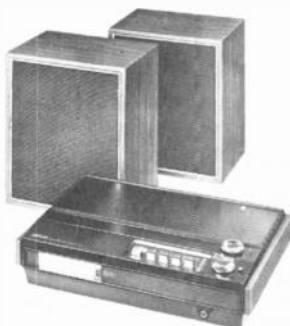
W/ch dynamic (EIA) power at 5% THD, wow & flutter 0.3%, crosstalk 38 dB. Features automatic and manual channel switching and lighted channel indicators. Includes two acoustic speaker enclosures each with a 4 1/2" speaker (12 3/8" H x 8 3/8" W x 5 3/4" D). Walnut finished hardboard. 18 1/2" W x 4 3/8" H x 10 3/4" D ..... \$119.95

#### 31M26 8-Track Player/AM-FM Receiver

8-track cartridge player with AM-FM stereo receiver. Power output 10 W/ch dynamic (EIA) power at 5% THD, 5 W/ch dynamic (IHF) power, wow & flutter 0.25%, S/N 42 dB. Has all standard controls, plus phono, auxiliary, headphone, and recording jacks. Comes with two speaker enclosures (each with 8" and 2" speakers, 9 1/2" W x 14" H x 6" D). Walnut-veneered wood cabinets. 18 3/16" W x 6 1/2" H x 16" D ..... \$159.95

#### 31M29 Player/Recorder/AM-FM

Plays and records 8-track cartridges. Includes



AM-FM stereo receiver. 4 1/2 W/ch dynamic (EIA) power at 5% THD. Has jacks for phono, tape recording, and headphones. Comes with two speaker enclosures (each with 6 1/2" woofer and 2" tweeter, 9 7/8" W x 11 3/4" H x 7" D). Walnut-grain vinyl cabinets. 15 3/4" x 3 3/4" H x 10 3/4" D ..... \$179.95

### GENERAL ELECTRIC

#### M8621 8-Track Player

Player system consisting of a stereo tape deck, 5 W/ch dynamic (EIA) power amplifiers, and two speaker systems. Has tone, volume, and balance controls. .... \$99.95

#### M8635 Player/AM-FM Receiver

Cartridge player combined with an AM/FM stereo receiver and two matching speaker systems. Has dust-guard cartridge door, front-panel stereo headphone jack, and switchable a.f.c. Features an array of inputs and outputs and 5 W/ch dynamic (EIA) power output ..... \$139.95

#### M8630 Player/AM-FM Receiver

Cartridge player combined with an AM/FM stereo receiver and two matching speaker sys-



tems. Has separate tone controls, switchable a.f.c., slide controls, stereo headphone jack, phono input, and tape output jacks. 9 W/ch dynamic (EIA) power output at 5% HD ..... \$179.95

#### M8640 Recorder/Player/Receiver

Combines a recorder/player with an AM/FM stereo receiver and two matching speaker sys-



tems. Records off tuner circuit or from external source. Has four slide controls, switchable a.f.c., automatic level control, phono input and tape output, stereo headphone jacks. 7 W/ch dynamic (EIA) power output at 5% HD ..... \$239.95

#### SC1080 8-Track Tape System

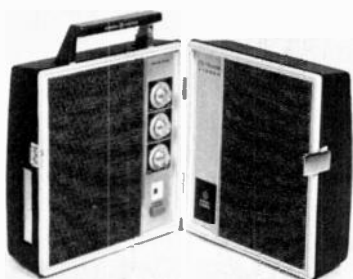
Combines an AM/FM stereo receiver, an 8-track tape player, and a pair of separately



housed speaker systems each with 6 1/2" dual-cone speaker. 3 1/2 W/ch dynamic (EIA) power at 5% HD ..... \$119.95

#### M8614 8-Track Portable Player

Has built-in 3-way power (117 V a.c., 8 "D"



cells, or car battery). 1.6 W/ch dynamic (EIA) power at 5% HD. Portable-type carrying case with removable lid & built-in stereo speakers ..... \$79.95  
**M8615.** Same but with AM/FM stereo tuner. 10 1/8" x 13" x 7" ..... \$129.95

#### TA600 8-Track Deck

Record/playback stereo design. Has all con-



ventional controls including dual VU meters. Supplied with two dynamic mikes. .... \$109.95

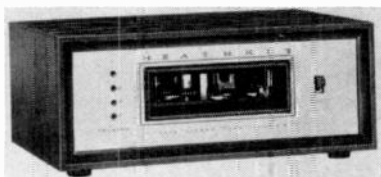
#### TA556 8-Track Stereo Player

Deck only. Supplied in walnut finished hard-board cabinet. Features automatic program sequencing. 4 1/8" H x 9" W x 9" ..... \$64.95

### HEATH

#### GD-28 8-Track Stereo Deck

Home playback deck for use in component

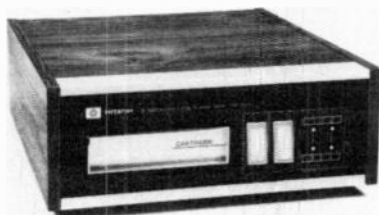


system. Response 50-10,000 Hz. Simulated walnut-finished cabinet measures 10 3/8" x 4 1/2" x 8 1/4" ..... \$59.95

### HITACHI

#### TPQ-124 Cartridge Player Deck

Home player deck for use in audio systems. Has select/eject controls, program indicator



lights, and dust cover on loading slot. 11 1/4" x 10" x 4" ..... \$79.95

#### KSP-2850 Player/Receiver

Cartridge player with AM/FM stereo receiver and matched speaker systems. Features black-out tuning dial, stereo beacon, automatic tape repeat button, individual tone controls, input for phono turntable, output for tape recorder. 10 W/ch dynamic power output ..... \$249.95

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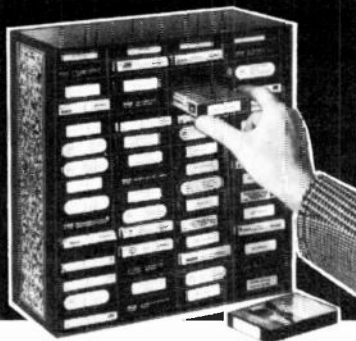
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- \_\_\_\_\_ 30-unit Cassette Storage Cases @ \$7.95 each; 2 for \$15.00
- \_\_\_\_\_ 12-unit Cartridge Storage Cases @ \$4.95 each; 3 for \$13; 6 for \$25

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PAYMENT MUST BE ENCLOSED WITH ORDER



## 3 8-Track Tape Machines

### KSP-2810 Player/Receiver

Cartridge player with AM/FM stereo receiver and matched speaker systems. Features slope-front enclosure, sliding tone and balance controls, a.f.c., tuning meter, stereo indicator, black-out-tuning dial. 18 W/ch dynamic power output ..... \$219.95

### LAFAYETTE

#### RK-800A 8-Track Deck

A home stereo playback deck designed to be



used with audio system. Response 30-12,000 Hz ..... \$54.95

#### LSC-8000B Cartridge/Phono/Tuner

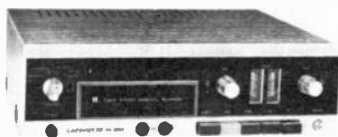
Combines 4-speed Garrard 2025 automatic turntable with ceramic turnover cartridge and diamond stylus with 50 W/ch dynamic power amp, AM/FM stereo tuner, a pair of 3-way air-suspension speaker systems, and an 8-track cartridge player. Speaker cabinets measures 14 7/8" x 11 1/4" x 6 3/4" D, each with 6 1/2" woofer and two 3 1/2" tweeters. Unit has slide-type controls for balance, volume, bass & treble. Mike input. Control center measures 23 1/2" x 9 1/4" x 15" D. Walnut vinyl cabinet includes a dust cover ..... \$229.95

#### SRS-828 Cartridge Player/Receiver

8-track cartridge player combined with an AM/FM stereo receiver and matching speaker systems. Has separate slide controls for tone and balance, a front-panel headphone jack, FM stereo light, plus a full complement of inputs and outputs. Output 1W/ch rms power ..... \$99.95

#### RK-890A 8-Track Deck

Stereo record/play design. Has stereo/mono mode switch, meter overload protection, sepa-



rate mike & aux. inputs and line-level outputs. Features sound-with-sound, dual VU meters. Sensitivity: mike 1 mV, aux. 100 mV. Response 30-12,000 Hz, wow & flutter 0.25%, output level 1 V max. With walnut metal case. 12" x 3 3/4" x 9 1/8" D ..... \$129.95

### LEAR JET

#### A-250 8-Track Tape Player

For 12-V negative-ground operation. Combines an 8-track stereo play-only unit with an AM-FM stereo receiver. Features automatic stereo signal-seeking receiver, fast-forward tape control. Wow & flutter 0.3%. 4 W/ch continuous power, 8 W/ch dynamic (EIA) power at 5% THD. FM sensitivity 5  $\mu$ V for 20 dB quieting. 8 1/2" x 8 1/8"

D x 3 1/4" H ..... \$149.95

#### A-55 8-Track Tape Player

Stereo playback-only design for home or car. 4 W/ch continuous power, 8 W/ch dynamic (EIA)



power at 5% THD. Has cartridge-deck dust door. 7 1/2" W x 6 3/4" D x 3" H ..... \$89.95

#### H-310 8-Track Deck

117-volt a.c. stereo playback design. Wow &



flutter 0.3%, 0.5 V preamp output. 7 1/8" x 9 7/8" D x 3 1/4" H ..... \$59.95

#### H-415 8-Track Tape Player

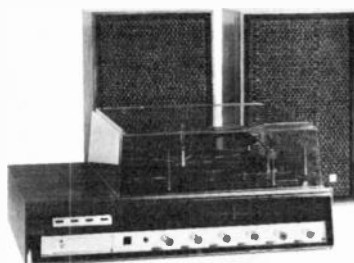
Combines an 8-track stereo tape player, an AM-FM stereo receiver, and a pair of separate-



ly housed (16" x 10" x 7" D) speaker systems (6" speakers). 3 1/2 W/ch dynamic (EIA) music power at 5% THD. 21 1/2" x 10" D x 4 1/2" ..... \$149.95

#### H-455 8-Track Compact

Combines an 8-track stereo tape player, an AM-FM stereo receiver, a 4-speed automatic



record changer, and a pair of separately housed (16" x 10" x 7" D) speaker systems, each with 6" speaker. 6 W/ch dynamic (EIA) power at 5% THD. 21 1/2" x 15 1/4" D x 9" H ..... \$189.95

### MAGNAVOX

#### 1K8869 8-Track Stereo Deck

Front-loading play-only design with automatic program changer and continuous play. Response 50-8000 +2, -8 dB, wow & flutter 0.25%. Wood cabinet. 9 7/8" x 6 3/4" x 3 3/4" ..... \$49.95  
1K0886. Same except press to open & close

and automatic shut-off for non-play position ..... \$69.95

#### 1K8870 8-Track Stereo Deck

Play/record design. Response 50-10,000 Hz  $\pm$  5 dB, wow & flutter 0.25%. Has record-level meters and mike & aux. inputs. Wood cabinet. 15 1/4" x 10" x 4" ..... \$159.95

### MICOTRON

#### 19-578 Recorder/AM-FM Receiver

Combines an 8-track cartridge recorder with an AM/FM stereo receiver and matching speak-



er systems. Slide controls for volume, tone, balance, and recording levels. Features fast-forward, pause, automatic stop, and power restart. Has hysteresis synchronous motor and stereo headphone jack. Response of recorder is 40-12,000 Hz, receiver 40-20,000 Hz. Output 5 W/ch rms at 2% THD into 8 ohms ..... \$249.95

#### 19-531 Player/AM-FM Receiver

Combines an 8-track cartridge player and AM-FM stereo receiver with two matching speaker systems. Has full complement of controls, inputs and outputs. Front-panel stereo headphone jack. Response 40-18,000 Hz. Output 2 1/2 W/ch rms at 10% THD ..... \$129.95

#### 12-623 Player Deck

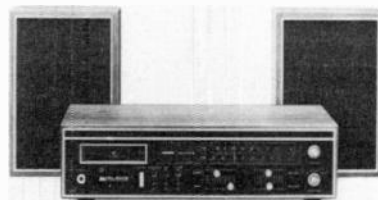
Home player deck for use in component system. Features automatic or manual program



selector, individual program indicator lights. Response 50-10,000 Hz. 9 3/4" x 4 1/8" x 9". Wood cabinet ..... \$46.90

#### 19-572 Player/AM-FM Receiver

Cartridge player with AM-FM stereo receiver and matching speaker systems. Slide controls



for volume, tone, and balance; rocker switches for other functions. Response 35-20,000 Hz. Output 5 W/ch rms into 8 ohms ..... \$169.95

#### 12-636 Record/Play Deck

For use in component systems. Has automatic stop to prevent recording over previous program material, pause control, fast-forward button, sliding volume controls, and hysteresis synchronous motor. Response 30-12,000 Hz. 15 1/2" x 5 1/2" x 10 1/4" ..... \$179.95

### TAPE RECORDER GUIDE



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## 3 8-Track Tape Machines

### 12-629 8-Track Player

Stereo play-only design with pair of full-range speaker systems. Power output is 2 W/ch con-



tinuous rms into 8 ohms. Response 50-10,000 Hz at 10% THD. Has tone controls and automatic program switching. Speakers are 4" dia., housed in cabinets 10" x 7 1/4" x 4". Control center 11" W x 8 1/2" D x 4 1/8". Walnut-grained wood cabinets ..... \$89.95

### MOTOROLA

### SK106GW AM-FM/8-Track Player

Same as their SK107GW but with an 8-track stereo cartridge player instead of a cassette player. 19 3/4" W x 4 7/8" x 10" ..... \$199.95

### GP80HW 8-Track Player

8-track stereo cartridge design with pair of separately housed speaker systems, each with



5" speaker (cabinet 6 3/4" x 9 7/8" x 5 1/2" D). Output 0.75 W/ch dynamic (EIA) power at 5% THD. Walnut veneer. 13 1/2" x 4 1/4" x 10 3/4" D. \$99.95

### FH210HW AM-FM/Cartridge Player

Combines stereo cartridge player with an AM-FM stereo receiver and two speaker systems. Includes a tuning meter, FM stereo light, record-changer jack, and six push-button controls. Output 5 W/ch dynamic (EIA) power ..... \$179.95

### FH225HW AM-FM/Cartridge Player

Same as Model FH210HW except 30 W/ch dynamic (EIA) output and includes a front-panel stereo headphone jack. .... \$229.95

### OLSON

### RA-308 8-Track Stereo Deck

Playback only. Features automatic start and



manual/automatic channel changer. Response 50-15,000 Hz. Walnut cabinet. 11 1/2" x 7 1/4" x 4 1/4" ..... \$49.95

### PACKARD BELL

### RTS-125WL 8-Track System

Combines an AM-FM stereo receiver, an 8-track stereo cartridge player, two separately housed speaker systems (11" x 17 1/4" x 8"),

each with 6" & 3 1/2" dual-cone speakers, and a 15 W/ch dynamic power amp at 5% HD. Response 40-12,000 Hz. Walnut cabinet. 19 3/4" x 4 3/4" x 9 7/8" D ..... \$179.95

### TPA-27 8-Track Deck

Stereo tape cartridge playback deck. Has conventional controls. Walnut cabinet. 8" x 4 1/2" x 9 1/2" D ..... \$69.95

### RTS-123WL 8-Track System

Combines an AM-FM stereo receiver, an 8-track cartridge tape player, 8 1/2 W/ch dynamic



power amp at 5% HD (response 50-10,000 Hz), and two separately housed speaker systems (9 7/8" x 12 1/4" x 7 1/2" D), each with 6 1/2" x 2" speaker. Walnut cabinet. 19 3/4" x 4 3/4" x 9 7/8" D ..... \$129.95

### PANASONIC

### RS-802US Collingswood Stereo Deck

Play only. Response 50-12,000 Hz. Has line



outputs and lighted channel indicators. 4 1/4" H x 8 1/4" W x 9 3/4" D. Walnut grain finish. . \$49.95

### RS-803US Wellesley Stereo Deck

Plays and records. Frequency response 50-12,000 Hz. Has VU meters and lighted channel



indicators. Features fast-forward, mike, line, and aux. inputs. 4 1/2" H x 16 7/8" W x 9 1/4" D ..... \$99.95

### PENNEY, J.C.

### 1701 8-Track System

Combines an AM-FM stereo tuner, an 8-track tape player, and two separately housed speaker systems, each with 5" speakers. 1.5 W/ch



continuous sine wave power at 5% HD. Vinyl walnut-finished cabinet ..... \$119.95

### 1702 8-Track System

Combines an AM-FM stereo tuner, an 8-track tape player, and two separately housed speaker systems, each with 6 1/2" speakers. 3.5 W/ch continuous sine wave power at 5% HD ..... \$159.95

### 1758 8-Track System

Combines an AM-FM stereo tuner, an 8-track record/playback system, and two separately housed speaker systems, each with 4 1/2" woofer & 2 1/2" tweeter. Has record-level indicators and 6 W/ch rms continuous power at 5% HD. Walnut wood cabinet ..... \$229.95

### 1900 Phono/8-Track Player

Combines an AM/FM stereo tuner, a BSR 4-speed minichanger, an 8-track tape player, and



two separately housed speaker systems, each with 6 1/2" woofer & 2" tweeter. With dust cover ..... \$159.95

### SONY

### HST-118 AM-FM/8-Track Player

Combines an AM-FM stereo receiver and an 8-track tape player. 5 W/ch dynamic (EIA) power at 5% THD. Input sensitivity: mag. phono 5 mV, ceramic phono 300 mV, Aux. 250 mV. 8 ohm output. FM sensitivity 2.2 μV for 30 dB quieting. Has automatic or manual tape-track switching. Walnut cabinet. 5 1/4" H x 21 3/8" x 12 3/4" D. Also available with cassette player as Model HST-119 ..... \$161.95

### HP-148 AM-FM/Phono/8-Track System

Combines an AM-FM stereo receiver, an 8-track cartridge player, a BSR 4-speed micro-minichanger with ceramic stereo cartridge, with a pair of separately housed speaker systems (each with 6 1/2" woofer & 2" tweeter, 11 1/8" x 11 5/8" x 5 5/8" D). 5 W/ch dynamic (EIA) power at 5% THD at 8 ohms. Response 40-20,000 Hz ±3 dB at 1 W. 8" x 22 1/4" x 12" D. Also available with cassette player as Model HP-149 ..... \$215.95

### HP-218 AM-FM/Phono/8-Track System

Combines an AM-FM stereo receiver, an 8-track tape player, and a pair of SS-210 speaker systems (each with a 6 1/2" woofer & 2" tweeter, 15" x 9 1/4" x 8 3/8" D) with a BSR automatic turntable and Sony VX-18 P stereo phono cartridge. 18 W/ch dynamic power at 5% THD at 8 ohms. Response 40-40,000 Hz ±3 dB at 1 W. FM sensitivity 2.5 μV for 30 dB quieting. Features automatic and manual tape program selection. Walnut cabinet. 15" H x 9 1/4" x 8 3/8" D. Also available with cassette player as Model HP-219 ..... \$309.95  
Prices as of December 1, 1971

### SOUNDESIGN

### 4777-622 AM-FM/8-Track/Changer

Combines an AM-FM stereo receiver, a BSR 4-speed changer with dust cover & ceramic cartridge, an 8-track tape player, and a pair of separately housed (8" x 17 3/4" x 11 3/4") speaker



systems, each with 8" woofer & 3" horn tweeter. 12½ W/ch dynamic (EIA) power at 5% THD. Control center 8¾" × 17½" × 14½". Walnut cabinet ..... \$249.00  
**4777-610.** Same except with 8" speaker systems (6" × 14¼" × 10") ..... \$225.00

#### 4479-622 AM-FM/8-Track System

Combines an AM-FM stereo receiver, an 8-track tape player, and two separately housed speaker systems (8" × 17¾" × 11¾"), each with 8" woofer & 3" horn tweeter. 6½ W/ch dynamic (EIA) power at 5% THD. Walnut grained cabinet. 4" × 18" × 11" ..... \$169.00  
**4479-608.** Same except with 8" speaker systems (6" × 13" × 9½") ..... \$149.00

#### 4491-622 AM-FM/8-Track System

Same as Model 4479-622 except 12½ W/ch dynamic (EIA) power at 5% THD ..... \$189.00  
**4491-610.** Same except with 8" speaker systems (6" × 14¼" × 10") ..... \$169.00

#### 483 8-Track Tape Deck

Play-only stereo design. Response 30-15,000 Hz. Walnut wood cabinet. 3½" × 8" × 9¾" ..... \$49.95

#### 484 8-Track Tape Deck

Play-only stereo design. Response 50-15,000 Hz. Walnut wood cabinet. 4" × 11" × 8½" ..... \$59.00

### STANDARD RADIO

#### SR-T391DK 8-Track Recorder Deck

Record/play stereo deck for use in audio systems. Features automatic record-level system,



fast-forward and pause controls, jacks for high, medium, or low output levels. Wow & flutter less than 0.25% rms. Response 100-10,000 Hz, S/N 40 dB. Walnut wood cabinet. 3½" × 13½" × 7¾" ..... \$129.95

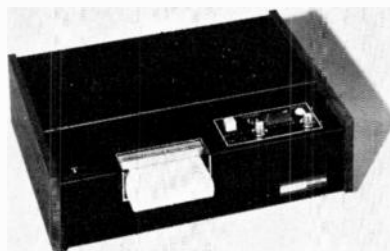
### TELEX

#### 811 Playback Deck

For use in audio systems. Same response, S/N, and wow & flutter specifications as 811R. Same dimensions ..... \$99.95

#### 811R 8-Track Recorder Deck

A record/play stereo deck for use in audio systems. Record mode features automatic stop at end of single program or end of tape. In playback mode, automatic stop at end of tape or continuous play. Response 40-15,000 Hz, S/N 50 dB, wow & flutter 0.3%. 15" × 11" × 4½"



..... \$169.95

#### 48H 8-Track Changer

Selects at random 16 hours of continuous, non-repetitive sound. Switches and selects 12



stereo 8-track cartridges. 7½ W/ch dynamic power at 1% HD. Supplied with dust cover. 18¼" × 9" H × 16¼" D ..... \$299.95  
**Model 48D.** Deck only with 1 V preamp output.



Response 50-15,000 Hz ±3 dB, S/N 50 dB, flutter 0.25% ..... \$249.95

### TOSHIBA

#### KT-87 8-Track Stereo Player

Cartridge player with two matched speaker systems. Has slider volume, balance, and tone controls; phono and line inputs; and track-selector button with indicator lights. Response 40-12,000 Hz, wow & flutter 0.3%, S/N 40 dB. Speakers 9¼" × 15½" × 8¾". Control center 16½" × 4¾" × 8" ..... \$129.95

### V-M

#### 569 Phono/8-Track System

Combines a V-M 4-speed "Stere-O-Matic" record changer with 10" turntable and flipover



sapphire/diamond ceramic cartridge, an 8-track stereo cartridge player, and a pair of separately housed speaker systems, each with 6" × 9" oval speaker. Amp. output 2 W/ch rms at 5% HD. Response 60-15,000 Hz ±3 dB. 10" H × 21" W × 14¾" D (closed) ..... \$149.95

### WEBCOR

#### 257 8-Track Stereo Compact

Combines an 8-track tape player, an AM-FM stereo receiver, a Garrard 4-speed automatic



record player with diamond stylus ceramic cartridge, and a pair of separately housed SP-33 air-suspension speaker systems (6½" woofer, 2¼" mid-range, 3" tweeter). Response 20-20,000 Hz, 10 W/ch continuous power, 50 W/ch dynamic (EIA) power at 5% THD. Speaker size 16" × 11" × 6". Control center 22" × 8¼" × 16¾". With dust cover. Walnut finish ..... \$229.95

#### 259 8-Track Stereo Compact

Same as Model 257 except has 5 W/ch continuous power (25 W/ch dynamic, EIA, power at 5% THD). Response 60-20,000 Hz. Has SP-33



## NOTICE TO OUR READERS

We consider it a valuable service to our readers to continue, as we have in previous editions of the TAPE RECORDER GUIDE, to print the prices submitted by the manufacturers for items described as available at press time. With few exceptions, prices submitted by manufacturers should be considered "audiophile net."

We are aware that prices vary across the country in different trading areas. It is obvious that we are not in a position to quote local prices for the various trading areas in the United States on each of the items listed. Accordingly, we are quoting the price furnished to us by the manufacturer or distributor, for each of the products, even though it may be possible to purchase some items in your trading area (depending on where you are) at a price lower than that listed in this Guide.

We would also like to point out that almost all manufacturers' and distributors' prices are subject to change without notice.



### 3 8-Track Tape Machines

omnidirectional air-suspension speaker systems (6 1/2" woofer, 2 1/4" mid/tweeter) \$199.95

#### 1521 8-Track Stereo Player

Response 60-10,000 Hz. 5 W/ch continuous power, 25 W/ch dynamic (EIA) power at 5%



THD. Has slide-type controls. Supplied with two separately housed SP-9 systems (6 1/2" woofer & 2 1/4" cone radiator). Walnut cabinet. 13 3/4" x 4 7/8" x 9 1/2" ..... \$89.95

#### WESTBURY

#### 808 Player/AM-FM Receiver

Portable 8-track cartridge player with AM/FM stereo receiver and two 4" pull-out speakers.



Designed for 117-volt a.c., 8 "D" cells, or car/boat operation. Has slide volume controls for each channel, slide tone controls, track selector button and indicator lights, and telescoping whip antenna. Response 200-10,000 Hz. 7 1/2 W/ch dynamic (EIA) output. 5% HD. 12" x 6" x 13" ..... \$129.95

#### 806 8-Track/AM-FM Player

Portable design. Operates from 117-volt a.c., self-contained batteries, or 12-volt car or boat



battery. Combines player with AM/FM stereo receiver and two 8-ohm speaker systems. Features push-button function control, automatic stereo switching with stereo indicator light, and slide controls for stereo balance and tone. Comes with car/boat power cord, 8 "D" cells, and a.c. power cord. Response 40-12,000 Hz. 13 1/2" x 9 1/2" x 6 1/2" D ..... \$89.95

#### 809 Tape Recorder/Player

Portable 8-track stereo recorder/player. Operates from 117-volt a.c., 8 "D" cells, or 12-volt car or boat battery. Has two 3" pull-out speakers plus two external speaker jacks, channel indicator lights, automatic or manual channel switching, battery-life meter, separate tone/balance controls, two microphone and two auxiliary jacks, fast-forward switch, and a monitoring control. Response 150-8000 Hz, 5



W/ch dynamic (EIA) power at 5% THD. 4 1/2" W x 9" D x 11 1/2" H ..... \$99.95

#### 804 8-Track Player/Receiver

Portable tape player with AM/FM stereo radio with two outboard dynamic speakers. Response 200-10,000 Hz. 7 1/2 W/ch dynamic (EIA) output at 5% HD. Will operate from 117-volt a.c., 8 "D" cells, or 12-volt car or boat battery. Features automatic stereo switching and stereo indicator light, channel lights, battery-life meter, and separate tone and balance controls. 4 1/2" W x 9" D x 11 1/2" H ..... \$99.95

#### 4100 Stereo Record/Play Deck

Records or plays 8-track stereo cartridges. Features a selector switch which permits



choice of repeat, continuous, automatic stop (1, 2, 3 & 4), and automatic stop (1 through 4) functions. Has individual volume controls for left and right channels, level meters, fast-forward, and a stereo headphone jack. Playback response 50-10,000 Hz +4 dB, overall response 60-8000 Hz +6 dB, wow & flutter 0.3% rms, S/N 40 dB. Output 0.775 V. Microphone and auxiliary inputs. 15 1/8" W x 10" D x 4 1/2" H ..... \$99.95

#### 6100 8-Track Player/Receiver

Combines 8-track stereo player with AM/FM stereo receiver. Response 80-10,000 Hz ±3 dB, wow & flutter 0.35%, S/N 35 dB. 2 1/2 W/ch dynamic (EIA) power at 5% HD. Has two separate speaker systems (12" H x 9" W x 5" D) each with 6 1/2" woofer and 2 1/2" tweeter. Has automatic FM stereo switching, record-changer input jacks, a.c. outlet. Control center 16" W x 9 1/2" D x 4 1/2" H ..... \$99.95

#### 7100 8-Track Player/Receiver

Combines an 8-track stereo tape playback unit with an AM/FM stereo receiver. Has tuning



controls, selector switch, slide-type volume, bass & treble controls, phono input jack. Includes stereo beacon lamp and channel indicator. 19 3/4" W x 9 3/4" D x 4 3/4" H. Two matched speaker systems each with 6 1/2" x 2" tweeter with 6" exponential horn housed in walnut wood cabinets (14" H x 9" W x 4" D) .. \$129.95

#### 8100 8-Track Player/Receiver

Combines an 8-track stereo player with an AM/FM stereo receiver, 10 W/ch rms output.



50 W/ch dynamic (EIA) power at 5% HD. Features graduated treble and bass controls and phono/tape input jacks. Has tuning meter, separate loudness control, a.f.c. switch. Comes with two separately housed speaker systems (18" H x 12" W x 8 1/4" D) each with air-suspension speaker with exponential horn. Control center 18" H x 4" W x 8" ..... \$179.95

#### 9000 8-Track Player/Receiver

Combines an 8-track stereo player with an AM/FM stereo receiver. 20 W/ch rms output at 1% distortion (100 W/ch dynamic (EIA) power at 5% HD). Features automatic stereo switching, speaker damping controls, contour controls, tuning meters, bass & treble controls. Has tape monitor switch, a.f.c. switch. Two separate air-suspension speaker systems with exponential horns and crossover network (17 1/2" H x 11 1/2" W x 7 1/2" D). Control center 20 1/8" W x 13 1/4" D x 5 1/2" H ..... \$269.95

#### WOLLENSAK

#### 8050 8-Track Stereo Tape Deck

Record/play deck for use in component systems. Has special cueing method which as-



ures that tape is always at the beginning when unit is placed in record mode, automatic eject to prevent accidental erasure of previously recorded material, pause lock, fast-forward, dual illuminated VU meters, switchable automatic-level control, stereo headphone jack. Response 30-15,000 Hz, S/N better than 50 dB ..... \$149.95

#### ZENITH

#### C635 8-Track Deck

Playback design with preamp outputs. Has



conventional controls. Walnut-grained veneer cabinet ..... \$69.95

#### TAPE RECORDER GUIDE

## SECTION

# 4

# 4-Channel Components

### ADMIRAL

#### STP921 4-Channel Tape Player

8-track tape cartridge, 4- or 2-channel system. Supplied with four separately housed speaker



systems. 5 W/ch EIA dynamic power; 5% THD. Walnut-grained vinyl enclosures . . . . \$219.95

### AKAI

#### 1730D-SS 4-Channel Tape Deck

Features surround stereo. Four-track, 4 & 2 channel play and record with two erase heads



(2-channel & full track) for compatibility with 2-channel stereo. Features automatic shutoff, pause control, universal voltage selector, and two speeds (7 1/2, 3 3/4 ips). Response 30-22,000 Hz  $\pm 3$  dB, wow & flutter 0.12% rms. dist. 1.5%, all at 7 1/2 ips. Has mike (0.4 mV) and line (40 mV) inputs plus line (1.23 V) output. 16 1/2" x 18" x 9 1/2" . . . . . \$309.95

#### 1730-SS 4-Channel Recorder

Same as Model 1730D-SS except includes two channels of power amp (10 W/ch dynamic power), designed to be used with your present stereo system for 4-channel response. \$379.95

#### CR-80-SS 8-Track/4-Channel Recorder

Records and plays back. Four or 2-channel design. Response 30-16,000 Hz  $\pm 3$  dB, wow & flutter 0.25% rms, dist. 2%. Power (4-ch) 7 W/ch at 8 ohms continuous sine wave (10 W/ch dynamic power). S/N 47 dB. Has mike (0.5 mV) and line (50 mV) inputs. 19 1/2" x 5 5/8" x 11 1/4" . . . . . \$329.95



#### CR-80D-SS 4-Channel Deck

Same as CR-80-SS 8-track tape recorder except does not have power amp . . . . \$289.95

#### 280D-SS 4-Channel Tape Deck

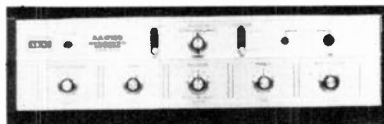
Play/record design for 2 and 4 channels. Fea-



tures 4 heads, 3 motors, automatic reverse, and sound-on-sound facilities . . . . \$649.95

#### AA-6100 4-Channel Amplifier

15 W/ch continuous sine wave into 8 ohms (20 W/ch dynamic power). HD 0.5%. Input: tape



monitor 500 mV & 150 mV, tuner 150 mV, aux. 150 mV, phono 3 mV. Response 20-22,000 Hz  $\pm 3$  dB, S/N 70 dB. Can be used for either 2- or 4-channel operation. 16 7/8" x 4" x 9 3/4" . . . . \$189.95

#### AS-8100 4-Channel Tuner

Features an AM-FM stereo receiver with 2- or 4-channel power amplification. Has single stick-shift type control for four-way balance. 18 W/ch (four channels) continuous sine wave power into 8 ohms (22 W/ch into 4 ohms) and 30 W/ch dynamic power into 4 ohms. HD 0.1%. Power bandwidth 20-30,000 Hz at 8 ohms. Input: phono 3 mV, aux. & tape monitor 150 mV. FM sensitivity 2  $\mu$ V for 30 dB quieting. 19 1/4" x 7" x 14 1/2" . . . . . \$434.95

### ALLIED RADIO SHACK

#### TR-284 Quadraphonic Player

8-track play only for 2- or 4-channel reproduction. Supplied with four separately housed speaker systems (7 7/8" x 5 1/2" x 9 7/8" each). Wal-



World Radio History

nut cabinets. 15" x 5" x 11 1/4" . . . . \$169.95

#### Auto Q8 4-Channel Car Player

Will play 4- or 2-channel 8 track tapes. Mounts under dash. 12-volt d.c. negative-ground operation. Supplied with mounting bracket but less speakers. 7" x 9" x 4" . . . . . \$99.95

### ASTROCOM/MARLUX

#### 307 4-Channel Cassette Deck

Deck with amp. Will play and record. Response 30-12,000 Hz, wow & flutter 0.14%, S/N 46



dB. Has hysteresis motor, four VU meters, counter, eject button, automatic reverse and shutoff, pause control, bias switch, mike & line inputs. Remote control optional extra . . . . . under \$500.00

#### 711 4-Channel Deck

Two-speed (7 1/2-3 3/4 or 15-7 1/2 ips), 4-head, 4-channel, 3-motor deck. Will handle up to 10 1/2" reels. Response 20-20,000 Hz at 7 1/2 ips, wow & flutter 0.07% at 7 1/2 ips, S/N 60 dB, 0.9% THD at 1 kHz & 0 VU. Has 4 low-impedance mike and 4 high-impedance line inputs; 4 low-impedance outputs with master gain control. Features synchronous recording on all 4 channels, built-in mixing facility. . . . under \$2000.00

### BELL & HOWELL

#### 3120 4-Channel Tape Player

An automatic 8-track, 2- or 4-channel stereo tape-cartridge player with two 10" H x 8 1/4"



W x 5 3/4" D speaker systems. Has four preamps and 2-channel power amp. outputs. Will play 2-channel stereo but for 4-channel reproduction a separate stereo power amplifier and two additional speakers are required. Your present stereo system could be used. Includes master volume control and stereo-headphone output jack on front panel . . . . . \$169.95

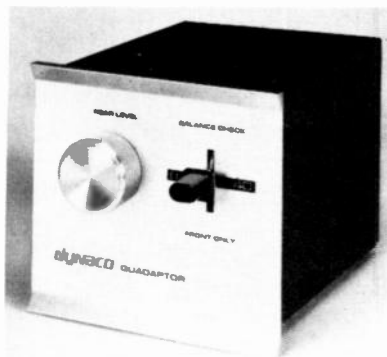
### DYNACO

#### Quadtator

The simplest type decoder for recovering 4-



## 4 4-Channel Components



channel information from 2 channels. Does not require two additional power amplifier channels. Unit connects between speakers and power-amp outputs. Is a passive device. 4 1/2" x 4 1/2" x 6 3/4" D. Kit ..... \$19.95  
Assembled ..... \$29.95

### SCA-80Q 4-Channel Amplifier

Combines a two-channel amplifier (their Model 80) and a Quadaptor for 4-channel reproduc-

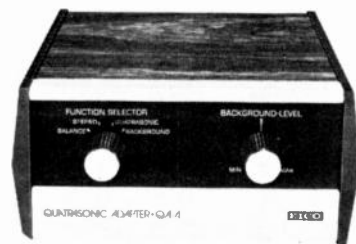


tion. Preamp has most features of the company's PAT-4. 40 W/ch continuous sine wave into 8 ohms from 20-20,000 Hz at 0.5% HD with both channels driven. IHF bandwidth 8-50,000 Hz. Sensitivity: phono 3 mV, aux. 0.13 V. 13 1/2" x 10" x 4 1/4". Kit ..... \$169.95  
Assembled ..... \$249.95  
West Coast prices \$5.00 additional.

## EICO

### QA-4 Quatrasonic Adapter

Designed to reproduce a concert-hall ambience response from conventional stereo discs



and tapes. Similar in design to the Dynaco system. It is a passive device and can also be used to separate out-of-phase response from matrixed 4-channel discs and tapes.

Kit ..... \$17.95  
Assembled ..... \$29.95

## ELECTRO-VOICE

### 1244X 4-Channel Amp/Decoder

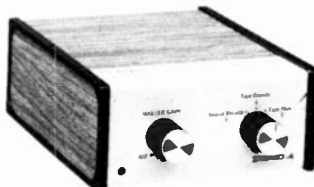
Combines the E-V four-channel decoder with two additional amplifiers. To be used with any conventional hi-fi system. 25 W/ch into 8 ohms dynamic (IHF) power (32 1/2 W/ch into 4 ohms, 18 W/ch continuous rms power). Response 20-20,000 Hz  $\pm 1.5$  dB at rated output. HD 1.0%. Input sensitivity: phono 3 mV, tuner, aux., tape 150 mV. 3 3/8" x 8 3/8" W x 10 1/4" D



..... \$149.95

### EVX-4 Four-Channel Decoder

Matrixing design used to convert the E-V matrixed phono records from two to four chan-



nels. Connects to any hi-fi system with "tape in" and "tape out." Will also enhance regular 2-channel stereo records and provide simulated 4-channel effects ..... \$59.95

### EVX-444 Four-Channel Decoder

A universal design for decoding all types of



matrixed tape, records, and FM broadcasts without switching. Less than ..... \$100.00

### EVR 4X4 4-Channel Receiver

Combines an AM-FM stereo receiver, four separate amplifier channels, and the E-V 4-chan-



nel decoder. 15 1/2 W/ch dynamic power. FM sensitivity 1.9  $\mu$ V for 30 dB quieting. Less than ..... \$250.00

## FISHER

### 40 4-Channel System

Combines an AM/FM stereo receiver, a 4-speed automatic turntable with magnetic cartridge, and a 4- and 2-channel 8-track tape cartridge player. Includes matrixing circuit to provide 4-channel reproduction from conventional 2-channel programs. 25 W/ch (100 W total) dynamic (EIA) power at 5% HD. FM sensitivity



2.4  $\mu$  V. 25" x 8 3/4" x 17 1/2" D ..... \$499.95  
PC4 Dust cover ..... \$19.95

### CP-100 4-Channel, 8-Track Deck

4- or 2-channel, 8-track playback. Response



50-12,000 Hz. 4 5/8" x 10 1/4" x 10 1/8" D ..... \$169.95

### TX-420 4-Channel Converter

Designed to be used with present stereo systems to provide 4-channel reproduction. Has



4-channel preamps and 2-channel stereo power amp. Includes a 4- or 2-channel 8-track cartridge player and decoding (matrixing) system for producing 4-channel material from 2-channel conventional or encoded sources. 18 W/ch (2 channels) dynamic power into 8 ohms (15 W/ch continuous) at 0.5% HD. Power bandwidth 30-20,000 Hz. Sensitivity: tuner & aux. inputs 200 mV. 16 1/8" x 4 3/4" x 11 3/4" D ..... \$299.95

### 601 4-Channel Receiver

AM/FM stereo tuner with four separate power amps. 37 1/2 W/ch dynamic power at 1000 Hz &



8 ohms (36 W/ch rms continuous power). Power bandwidth 25-22,000 Hz at 0.5% HD. Sensitivity: mag. phono 2.7 mV, aux. #1 & #2 200 mV, tape monitor 300 mV. Features a matrixing circuit to produce 4-channel sound from conventional 2-channel program material. FM usable sensitivity 1.8  $\mu$ V (IHF). 17" x 5 1/4" x 16 1/2" D ..... \$599.95  
110UW Walnut cabinet ..... \$24.95

### 801 4-Channel Receiver

Similar to the Model 601 with an AM/FM stereo tuner and four power amps. 50 W/ch dynamic (IHF) power at 1000 Hz and 4 ohms (44 W/ch rms continuous power). Power bandwidth 20-25,000 Hz at 4 ohms and 0.5% HD. Sensitivity: mag. phono 2.7 mV, aux. #1 & #2 200 mV, tape monitor 300 mV. Features a matrixing circuit to provide 4-channel sound from conventional 2-channel sources. FM usable sensitivity 1.7  $\mu$ V (IHF). 17" x 5 1/4" x 16 1/2" D ... \$749.95  
110UW Walnut cabinet ..... \$24.95

## GENERAL ELECTRIC

### M8660 4-Channel Player

8-track cartridge design. 10 W/ch dynamic (EIA) power at 5% HD. Supplied with 4 separately housed speaker systems. Can be used for either 2- or 4-channel playback. Has synthesizer circuit to convert 2-channel tape or





disc material into 4-channel output. Uses 6" speaker in each speaker system . . . . \$199.95

## HEATH

### AA-2004 Four-Channel Amplifier

Will operate in mono, stereo, discrete 4-channel, or matrixed 4-channel with its built-in

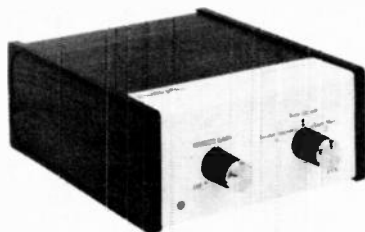


decoder. 50 W/ch (4 channels) dynamic power into 8 ohms (65 W/ch into 4 ohms, 30 W/ch into 16 ohms). Can be used to power two separate stereo speaker systems or two 4-channel systems. Back-lighted front panel contains four calibrated VU meters with a meter-range switch covering three ranges: 0 VU at 35 W, 3.5 W, or 350 mW. Meters are used to balance output.

Kit . . . . . \$349.95  
Walnut cabinet . . . . . \$24.95

### AD-2002 "Stereo-4" Decoder

Provides 4-channel E-V matrixed signals from encoded material. Will also enhance current

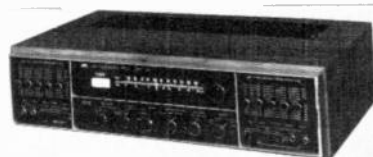


stereo records, tapes, and FM stereo broadcasts with a simulated 4-channel effect. Designed to be inserted between your stereo system's preamp and amplifier or by using the amplifier's or receiver's tape monitor inputs. 2 1/2" H x 5 3/16" W x 7" D. 110-120 V, 50-60 Hz. Kit . . . . . \$29.95

## JVC

### 5444 4-Channel Tape Deck

Two-speed (7 1/2, 3 3/4 ips), 4-track, 4- or 2-channel, 3-head stereo deck. Response 20-25,000



Hz, wow & flutter 0.07%, S/N 53 dB. Has four separate slice-type record/playback volume-level controls plus a master control, four independent VU meters, automatic stop, tape bias adjustment, and pause lever control . . . . . \$399.95

### 5444 4-Channel Amp/Receiver

Combines 4-channel amplifier with AM-FM stereo receiver. Amplifier is rated at 50 W/ch dynamic (IHF) power into 4 ohms at a power bandwidth of 20-30,000 Hz. HD at rated power output 0.5%. FM sensitivity 2.0  $\mu$ V, stereo separation 35 dB. Includes a graphic tone-control for front and rear speakers, phono input (2 mV), remote control, FM muting, headphone outputs, tape monitoring facilities. 5 7/8" x 22 7/8" W x 13 3/4" D . . . . . \$499.95

## KOSS

### K2 + 2 4-Channel Headphones

Dynamic type. Features four separate drive elements (2 in each phone) for 4-channel re-



production, arranged in conventional 4-channel format. Has switch for conventional stereo operation. Frequency response 10-20,000 Hz. Sensitivity -87 dB  $\pm$  3 dB SPL from each cup with 1 V rms signal at 1000 Hz. Impedance 300 ohms each driver. For use with 3.2 to 600 ohm source impedances. Power input 5 V rms maximum per phone. 10-ft. coiled cord. 26 ounces. Fluid-filled ear cushions. Comes with carrying case . . . . . \$85.00

## LAFAYETTE

### LRK-855 4-Channel System

Combines an AM/FM stereo receiver and 8-track record/playback unit with built-in 4-channel circuits. Has adapter circuits for deriving 4-channel sound from 2-channel sources. Basically is a 2-channel stereo recorder and playback unit. 7 1/2 W/ch dynamic (IHF) power at 0.2% HD at 1 W output. Response 20-20,000 Hz  $\pm$  1.5 dB. Input sensitivity: mag. phono 4 mV, ceramic 130 mV, aux. 275 mV. FM sensitivity 3.5  $\mu$  V. Design is quite similar to the Model LRK-480. 4 1/2" x 19 1/2" x 13 1/4" . . . . . \$219.95

### RK-48 4-Channel Tape Deck

Can be used as a 2- or 4-channel stereo, 8-track playback tape deck. Has 1 V output. Hum & noise -49 dB. 4 1/2" x 9 1/2" x 10 1/2" D . . . . . \$89.95

### LA-424 4-Channel Amplifier

A 2-channel stereo amplifier with the company's 4-channel matrixing circuit used to convert any 2-channel source material into 4 channels. Rated at 25 W/ch. Requires separate 2-channel amp & speakers for 4-channel reproduction . . . . . \$59.95

### LA-524 4-Channel Amplifier

Designed to convert regular 2-channel stereo systems into discrete and SQ matrix 4-channel stereo systems. Features built-in SQ decoding circuit for playback of Columbia and other SQ-decoded discs; firm's 4-channel matrixing circuit for regular 2-channel stereo program sources. Requires separate 2-channel amp & speakers. Features master front- and rear-volume control. Has fused speaker outputs . . . . . \$79.95

### 4-Channel Adapter for Cars

Derives 4-channel sound from present 2-chan-

nel car stereo tape system or FM radio. Front panel contains rear-level speaker control, 2- or 4-channel mode switch, and front (L & R) speaker-level controls. If present system has four speakers, only adapter is required; if two speakers, two more speakers must be added. For 12-V negative ground systems. Includes two 3-ft., two 6-ft., and two 15-ft. connecting cables. 5 1/2" W x 1 3/4" H x 2 1/2" D. #99 G 85128 . . . . . \$9.95  
99 G 62994. Pair of 3" x 5" matching rear deck speaker systems . . . . . \$7.10

### LRK-480 4-Channel Tape Player

Features an 8-track, 2- or 4-channel tape playback unit with an AM/FM stereo receiver. Also includes matrixing circuit for deriving 4 channels from 2-channel sources. Requires separate stereo amplifier and two additional speakers for 4-channel playback. Amp. 7 1/2 W/ch dynamic (IHF) power. FM sensitivity 3.5  $\mu$ V. Has mag. & ceramic phono inputs . . \$179.95

### LA-2525 4-Channel Amplifier

A full 4-channel amplifier with 7 1/2 W/ch dynamic (IHF) power. Response 20-20,000 Hz  $\pm$  1.5 dB. Includes matrixing circuit used to convert any 2-channel source material into 4-channel sound. Sensitivity: mag. phono 3.5 mV, ceramic phono 125 mV, tuner 500 mV, aux. 275 mV . . . . . \$119.95

### LA-44 4-Channel Amplifier

Upgraded version of the LA-2525. 24 W/ch continuous sine wave power into 8 ohms. Could be used as two separate stereo amplifiers . . . . . \$219.95

### LR-440 4-Channel System

Same as LA-44 except with AM/FM stereo receiver added. FM sensitivity 1.65  $\mu$ V (IHF),



S/N 70 dB, capture ratio 1.5 dB. Response 20-20,000 Hz  $\pm$  1.5 dB at rated output. Input sensitivity: mag. phono 4 mV, ceramic phono 140 mV, tape play 500 mV, aux. #1 & #2 250 mV. Also includes "SQ Decoder" circuits for Columbia 4-channel records. Has FM detector output jack for future FM 4-channel adapters. In simulated walnut metal case. 18 1/2" x 13 3/4" x 4 3/4" . . . . . \$369.95

### SQ-M 4-Channel Decoder

For reproducing 4-channel sound. Includes the company's "Composer Circuit" (similar to Dy-



naco system) to convert conventional 2-channel stereo sound sources into 4-channel reproduction. Also includes CBS matrixing circuits for playback of CBS 4-channel Quadraphonic records. Has simulated walnut-finished case. 6" x 2 7/8" x 7 1/4" D . . . . . \$44.95

### LRK Cassette/Tuner System

Deck with power amplifier and AM/FM stereo tuner. Plays and records. 10 W/ch output. Wow & flutter 0.25%, S/N 48 dB. Has VU meters, counter, eject button, tone controls, automatic shutoff, pause control, monitoring facilities, mike inputs, phono input, bias adjust, sound-with-sound. Has built-in 4-channel matrixing circuit for 4-channel reproduction from con-

## 4 4-Channel Components

ventional 2-channel sources. Requires additional, separate stereo amplifier and speakers for 4-channel use. 4" H x 10 1/4" W x 11 7/8" D ..... \$199.95

### MOTOROLA

#### FH275HW 8-Track, 4-Channel Player

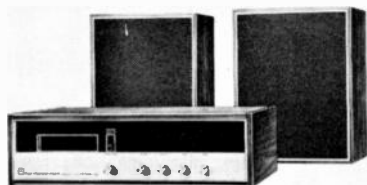
Will operate on 4-channel or conventional 2-channel stereo. 15 W/ch dynamic (EIA) power



at 5% THD. Supplied with four speaker systems, each with an 8" woofer & 3 1/2" tweeter (cabinets 10" x 13 1/4" x 8 3/8" D). System response 20-20,000 Hz. Has novel electronic balancing grid for use in balancing 4 channels for any particular listening position in the room. Walnut cabinets. 22 7/8" x 5 1/8" H x 12 1/8" D ..... \$399.95

#### GP111HW 8-Track, 4-Channel Deck

To be used with your own hi-fi stereo system to obtain 4-channel operation. Unit supplied has



4-channel output but only 2-channels of stereo amplification with pair of speakers, each with 8" x 3 1/2" reproducer (cabinet 10" x 13 1/4" x 8 3/8" D). Walnut cabinets. 16 1/8" x 5 1/8" x 10 1/4" D .... \$229.95

#### TM920S 4-Channel Auto Player

Will play 4-channel or conventional 2-channel stereo. 8-track cartridge design for automotive



use. 3 W/ch dynamic (EIA) power at 5% THD. Supplied with four 5 1/4" speaker grilles and hardware for in-the-door or underdash installation ..... \$159.95

### OLSON

#### HF-180 4-Channel Adapter

Passive device does not require a.c. power. Suitable for reproducing out-of-phase program material from any 2-channel stereo tape or disc. 6 1/4" x 2 1/2" H x 5 1/4" D ..... \$24.98

### PANASONIC

#### RS-740 4-Channel Tape Deck

Two speeds (7 1/2, 3 3/4 ips). Response 30-20,000 Hz  $\pm 3$  dB at 7 1/2 ips, wow & flutter less than 0.1%. Has four independent VU meters, spe-



cial front and rear separation controls, tape-bias adjustment switch, front or rear headphone monitoring and pause control, mike & line inputs, digital counter, and automatic shut-off ..... \$399.95

#### RS-847 8-Track, 4-Channel Deck

Compatible 8-track, 4- or 2-channel stereo cartridge deck. Frequency response 30-15,000



Hz, wow & flutter less than 0.2%. Easy loading and a protective mechanism to prevent tape snarls or damage when player is not in use. Single-button program selector controls all tracks. Lighted indicator shows whether cartridge is 2- or 4-channel ..... \$149.95  
Model RS-845US. Similar unit except does not include automatic eject feature ..... \$114.95

#### SU-3604 Quadruplex Amplifier

Solid-state integrated amplifier rated at 60 W/ch rms into 4 ohms. Preamplifier section



contains built-in dematrixing circuit for taking signals for the rear-channel speakers from conventional 2-channel program sources. System is not passive but requires a separate 2-channel amplifier. Switching arrangement is provided to permit discrete 4-channel amplification from 4-channel program sources. Frequency response 5-100,000 Hz, -1.0 dB; HD & IM 0.2% at rated output. Hum & noise -73 dB. Ceramic and magnetic phono input sensitivity 1.5 mV. Features a special tone-control system with three step turnover switches with settings for 125, 250, and 500 Hz for bass range and 2000, 4000, and 8000 Hz for treble range ..... \$349.95

#### SC-8700 4-Channel Stereo System

Four-piece stereo system with a 4-channel amplifier. Amplifier is rated at 15 W/ch dynamic power into 8 ohms. Frequency response 40-60,000 Hz  $\pm 3$  dB. HD is less than 1.0% at rated output. Has three built-in program sources and will accept inputs from 4- or 2-channel open reel tapes, 8-track cartridges, or cassettes. The AM/FM stereo tuner and amplifier are housed in a center unit measuring 5 1/4" H x 17 1/8" W x 14 1/8" D. The Garrard automatic turntable

with Pickering V-15 cartridge is housed on a separate base which "nests" on top of the center unit and measures 8 1/8" x 17 1/8" W x 15 1/2" D. Two sealed, three-way speaker systems include an 8" woofer, 5" mid-range, and 2" tweeter. Two additional speakers are required to play back 4-channel program material. Selector switch on front panel permits use of the amplifier through a built-in electronic crossover to feed 15 watts in each of two channels to the woofers and 15 watts in each of two channels to the mid-range and tweeters ..... \$479.95

### PENNEY, J.C.

#### 1760 4-Channel Player

Combines a 4-channel, 8-track tape player with 4 separately housed speaker systems, each with 6 1/2" woofer & 2 1/2" tweeter. 1.5 W/ch rms continuous sine wave output at 5% HD ..... \$249.95

### PILOT

#### PTD-400 4-Channel Tape Deck

Tape deck which is fully 4- or 2-channel compatible. Has four preamplifiers to give 0.5 V output per channel. Features a program indicator. 4 3/8" H x 12" W x 8 3/4" D ..... \$119.95

#### PMC-4000 "Quadrasonic" Center

Modular center. Amplifier section has 20 W/ch dynamic (IHF) power output at less than 0.5%



distortion. IHF power bandwidth 20-50,000 Hz. Damping factor 25, phono input sensitivity 2.0 mV. AM-FM stereo receiver has IHF FM sensitivity of 2.5  $\mu$ V, capture ratio of 3.5 dB, S/N 50 dB. Each amplifier has complete tone-control system while rear channels have individual loudness controls. Will accept either discrete, matrixed, or synthesized 4-channel program material ..... \$349.95

### PIONEER

#### QT-2100 4-Channel Tape Deck

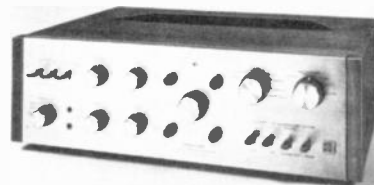
8-track, 2- or 4-channel stereo playback design. Response 30-12,000 Hz, S/N 48 dB, wow



& flutter 0.2%. Output 0.775 V at 50,000 ohms. 17" x 5 1/4" x 13" D ..... \$249.95

#### QC-800 4-Channel Preamp

Incorporates the company's "Quadralizer," a matrix circuit that converts any 2-channel stereo program source into 4-channel operation. Design is based on phase shifting. Response 10-70,000 Hz  $\pm 1$  dB at 0.05% HD. Sensitivity: phono #1 & #2 4 mV, tuner, aux. #1 & #2,





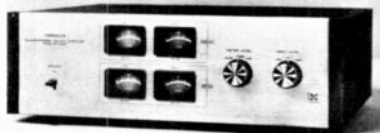
tape monitor #1 & #2, 250 mV. Power source 110, 120, 130, 220, 240 V, switchable. 17" W x 5 3/4" H x 13 1/4" D ..... \$249.95

#### QA-800 4-Channel Amplifier

Preamp section same as QC-800. Has 27 W/ch (4 channels) continuous power with two channels driven into 8 ohms (34 W/ch into 4 ohms), 20 W/ch into 8 ohms with four channels driven. Bandwidth 15-50,000 Hz into 8 ohms (4 channels driven) at 0.5% HD ..... \$349.95

#### QM-800 4-Channel Power Amp

35 W/ch (4 channels) continuous power into 8 ohms with two channels operating (42 W/ch



into 4 ohms), 25 W/ch into 8 ohms with four channels operating at 0.5% HD. Sensitivity 0.5 V. Response 5-80,000 Hz  $\pm 1$  dB. 17" x 5 3/4" x 13 1/4" D ..... \$299.95

#### QT-6600 4-Channel Tape Deck

Reel-to-reel design for record/playback 4- or 2-channel stereo. One-motor drive with automat-



ic reverse. Two speeds (7 1/2, 3 3/4 ips), wow & flutter 0.12% at 7 1/2 ips. Response 50-15,000 Hz  $\pm 2$  dB at 7 1/2 ips, S/N 55 dB. Has mike (0.3 mV) and line (30 mV) inputs. Output 0.775 V at 50,000 ohms. 17" W x 18 3/8" H x 8 3/8" D ..... \$599.95

#### QL-600 4-Channel Amplifier

Integrated design incorporating the company's "Quadralizer," similar to the one used in the Model QC-800. Design is a 2-channel stereo system to be used in conjunction with present stereo systems to produce 4-channel sound. Connects between tape record & tape monitor terminals of present stereo systems. 44 W total dynamic (IHF) power, 10 W/ch continuous power into 8 ohms (12 W/ch into 4 ohms) with both channels driven at 0.5% HD. Power bandwidth 20-20,000 Hz, response 20-20,000 Hz  $\pm 1$  dB. Sensitivity 200 mV. Power source 110, 120, 131, 221, 240 V, switchable. 17" x 5 3/4" x 12 1/4" D ..... \$199.95

#### QX-8000 4-Channel Receiver

An AM/FM stereo receiver with 4 channels of power amplification. Has "Quadralizer" circuits as described for the Model QC-800. FM usable sensitivity 2.2  $\mu$  V, capture ratio 3 dB.



130 W total dynamic (IHF) power into 8 ohms, 20 W/ch continuous power into 8 ohms (25 W/ch into 4 ohms) at 1% HD. Bandwidth 15-80,000 Hz at 8 ohms, response 5-100,000 Hz  $\pm 3$  dB. 20" W x 6 3/4" x 15 1/8" ..... \$499.95

#### SANSUI

The company has a series of four different AM-FM 2- and 4-channel receivers, decoder, synthesizer, amplifier, control centers. Each can decode all compatible matrixed 4-channel recordings and broadcasts, synthesize 2 rear channels of ambient signals from conventional 2-channel recording to 4 channels. Will also play discrete 4-channel tapes.

#### QR-6500 4-Channel System

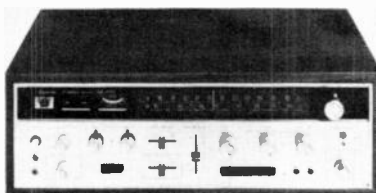
37 W/ch continuous power output at 8 ohms with 0.5% THD. Response 20-30,000 Hz  $\pm 1$  dB



(50 W/ch at 4 ohms); 70 W/ch dynamic (IHF) power at 4 ohms. FM sensitivity 1.8  $\mu$  V for 30 dB quieting. Has multi-system 4-channel speaker selectors ..... \$679.95

#### QR-4500 4-Channel System

27 W/ch continuous power output at 8 ohms (38 W/ch at 4 ohms) with 0.5% THD. 60 W/ch



dynamic (IHF) power at 4 ohms. Power bandwidth 20-30,000 Hz. FM sensitivity 2  $\mu$  V for 30 dB quieting. Controls are similar to QR-6500 ..... \$579.95

#### QR-1500 4-Channel System

15 W/ch continuous power output at 8 ohms



#### IF YOU NEED. . .

. . . additional information on any of the products listed in this directory, don't hesitate to write directly to the manufacturers themselves. They will be more than pleased to help with your questions. See list of company addresses beginning on page 5.

# BIG SAVINGS ON THE GREAT NAMES IN TAPE

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• CERTRON • BASF

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46-35 54th Road, Maspeth, N.Y. 11372

CIRCLE NO. 9 ON READER SERVICE CARD

## DELUXE RECORD AND TAPE CASES

With  
Gold  
Embossed  
EXCLUSIVE  
STEREO  
REVIEW  
DESIGN



Decorative and sturdy cases constructed of reinforced fiberboard and covered in rich leatherette to keep your records and tapes from getting tossed about and damaged. Available in your choice of five decorator colors. Stereo Review Record and Tape Cases lend themselves handsomely to the decor of any room. Padded back (in your color choice) is gold tooled in an exclusive design available only on Stereo Review Record and Tape Cases. Sides are in standard black leatherette to keep them looking new after constant use.

Record cases are available in three sizes for 7", 10" and 12" records. Center divider separates records for easy accessibility, holds an average of 20 records in their original jackets. Tape case holds 6 tapes in their original boxes.

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My remittance in the amount of \$  
Quantity is enclosed for the Cases indicated below.

Tape Cases at \$4.50 ea., 3 for \$12.6 for \$23  
7" Record Case at \$4.50 ea., 3 for \$12.6 for \$23  
10" Record Case at \$4.15 ea., 3 for \$13.6 for \$25  
12" Record Case at \$4.15 ea., 3 for \$13.6 for \$25

Add \$1.00 PER ORDER for POSTAGE and HANDLING. Outside U.S.A. add \$1.00 PER CASE ORDERED.

Check color choice for back of case (sides in black only):

☐ Midnight Blue ☐ Red ☐ Spice Brown  
☐ Pine Green ☐ Black

Name

Address

TRG-S72

City

State

Zip

PAYMENT MUST BE ENCLOSED WITH ORDER



## 4 4-Channel Components

(20 W/ch at 4 ohms) with 0.8% THD. 25 W/ch dynamic (IHF) power at 4 ohms. Power bandwidth 20-30,000 Hz. FM sensitivity  $3 \mu\text{V}$  for 30 dB quieting ..... \$289.95

### QR-500 4-Channel System

Economy version. 8 W/ch dynamic (IHF) power at 8 ohms (15 W/ch at 4 ohms). Power band-



width 30-30,000 Hz. FM sensitivity  $5 \mu\text{V}$  for 30 dB quieting ..... \$239.95

### MQ-2000 4-Channel Compact

Combines a Perpetuum-Ebner 2032 automatic turntable with Shure M75-6 magnetic car-



tridge, and an AM-FM 2- or 4-channel stereo receiver with integrated amplifier. 14 W/ch continuous (IHF) power at 8 ohms (15 W/ch at 4 ohms) at 1% THD. 18 W/ch dynamic (IHF) power at 4 ohms. Power bandwidth 30-30,000 Hz. FM sensitivity  $5 \mu\text{V}$  for 30 dB quieting ..... \$549.95

### QS-500 4-Channel Converter

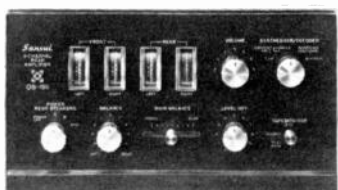
Basic principle of decoding/synthesizing 2-channel program material or reproducing 4-



channel discrete programs is the same as previous 4-channel design. Difference is that only 2 channels of power amplification are included. Designed to be used with present stereo systems for 4-channel reproduction. Has four VU meters for channel balancing, 2- and 4-channel tape monitoring, and provision for rotating channel outputs. 33 W/ch continuous (IHF) power at 8 ohms (40 W/ch at 4 ohms) at 0.5% THD. 60 W/ch dynamic (IHF) power at 4 ohms. Power bandwidth 20-40,000 Hz ..... \$289.95

### QS-100 4-Channel Converter

Same as QS-500 except 15 W/ch continuous



power at 8 ohms (18 W/ch at 4 ohms) at 0.8% THD. 25 W/ch dynamic power at 4 ohms. Power bandwidth 25-40,000 Hz. .... \$209.95

### QS-1 Decoder/Synthesizer

Offers full facilities for 2- or 4-channel operation and system control, including four VU

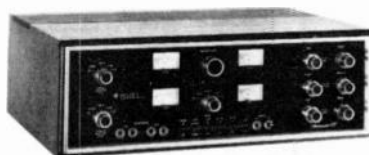


meters but without any power amplifiers ..... \$159.95

## SCOTT, H.H.

### 499 4-Channel Stereo Amp

Frequency response 15-30,000 Hz  $\pm 1$  dB. Continuous power output (rms) per channel with



all channels driven 35 W at 8 ohms, HD 0.5% at rated output, hum & noise (phono) -65 dB. Input sensitivity: high level (extra) 0.50 V, phono high 3.0 mV, phono low 6.0 mV, tape 1.0 mV, mike 10 mV. Designed to drive four speakers from a true 4-channel source such as a four-channel tape recorder but can be used to drive a pair of speakers from tape recorder or record player while the second pair of channels drives a pair of extension speakers. Features four independent VU meters, tape monitoring facilities, loudness compensation, high and low filtering, four front-panel microphone jacks, and independent tone and volume controls for each of the four channels.  $18\frac{1}{2}"$  W  $\times$   $11\frac{1}{8}"$  D  $\times$   $6\frac{1}{4}"$  H ..... \$459.90

## SONY

### SQD-1000 4-Channel Decoder

A 4-channel (CBS type) decoder for use with Columbia 4-channel (2-channel matrixed) rec-



ords. Will also enhance regular 2-channel (stereo) records or tapes or any other matrixed material.  $3\frac{1}{4}"$   $\times$   $9"$   $\times$   $9\frac{7}{8}"$  D ..... \$96.50

### SQA-200 4-Channel Decoder/Amp

Combines the circuitry of the SQD-1000 4-channel decoder and two channels of power amplification. Designed to be used with your present hi-fi system (system must have tape monitor facilities) to produce 4 channels. 15



W/ch (2 channels) dynamic (EIA) power at 5% THD. Input sensitivity: 250 mV, 2- and 4-channel tape 440 mV. Output sensitivity: Rec. 250 mV, line 400 mV.  $2\frac{7}{8}"$   $\times$   $12\frac{3}{8}"$   $\times$   $11\frac{1}{8}"$  D ..... \$127.50  
Prices as of December 1, 1971

## SONY/SUPERSCOPE

### 366-4 Quadradial Tape Deck

Similar in design to the Model 366 stereo (2-channel) reel-to-reel tape deck except has provision for discrete 4-channel sound reproduction ..... \$499.95

### 654-4 Quadradial Tape Deck

Designed for 4-channel sound reproduction. Has 3 motors, 4 heads (two  $\frac{1}{4}$ -track erase,



four-channel record, and separate playback), 2 speeds ( $7\frac{1}{2}$ ,  $3\frac{3}{4}$  ips). Can record/play  $\frac{1}{4}$ -track, 4-channel stereo or mono. Response 30-18,000 Hz  $\pm 2$  dB at  $7\frac{1}{2}$  ips; S/N 54 dB; wow & flutter 0.04% at  $7\frac{1}{2}$  ips. Sensitivity: 0.06 V. Has four aux. inputs & four line outputs.  $16\frac{3}{4}"$   $\times$   $20"$  H  $\times$   $9\frac{5}{8}"$  D ..... \$875.00

### 248-D Quadradial 4-Channel Deck

8-track playback design. Response 30-13,000 Hz; S/N 45 dB; wow & flutter 0.17%. Has four



line outputs (1/ch), 0.650 V at 0 VU. Can also be used for 2-channel play. Has automatic shutoff and is supplied with walnut cabinet.  $13"$   $\times$   $5\frac{7}{8}"$  H  $\times$   $8\frac{3}{8}"$  D ..... \$169.95

### 277-4 Quadradial Tape Deck

Reel-to-reel, 3-speed ( $7\frac{1}{2}$ ,  $3\frac{3}{4}$ ,  $1\frac{1}{8}$  ips), 4-channel, in-line design. Response 50-16, 000



Hz  $\pm 3$  dB at  $7\frac{1}{2}$  ips; S/N 52 dB; wow & flutter 0.12% at  $7\frac{1}{2}$  ips. Has two heads (4-channel erase & record/play), one induction motor, four inputs, and four line outputs (1/ch). Input sensitivity 0.06 V.  $15\frac{3}{4}"$   $\times$   $7\frac{3}{4}"$   $\times$   $15\frac{1}{2}"$  H ... \$329.95

## SUPEREX

### QT-4 "Quad-Tette" Headphones

Has four identical reproducers (two to an ear-piece) with frequency response of 20-18,000 Hz. 15-ft. cord ..... \$50.00

## TEAC

### TCA-42 4-Channel Tape Deck

Designed for 4-channel play and record or 1/4-track, 2-channel stereo. Has automatic reverse



for 2-channel operation. Has 4 VU meters, 3 motors, and off-the-tape monitoring on all 4 tracks. Has four heads, 8 separate record & play preamps, line/mike mixing. Two speeds (7 1/2 & 3 3/4 ips), will handle up to 7" reels. Response 50-15,000 Hz  $\pm 3$  dB at 7 1/2 ips, wow & flutter 0.12% rms at 7 1/2 ips, S/N 50 dB at 7 1/2 ips. Inputs: 4 mike (0.25 mV min.) and 4 line (0.14 V min.), and 4 outputs (1 V rms). Preamp comes in two separate walnut cabinets each 4 3/4" x 17 1/4" x 7 1/4". Optional mounting cradle available. 12" x 17 1/2" x 7" ..... \$695.00  
TCA-43. Same as TCA-42 only with "Simul-Sync" feature which makes possible the inde-



pendent recording of each of four channels yet provides synchronized 4-channel output ..... \$749.50

## TELEX

### Quad/Sonic 2 + 2 Tape Deck

Four- or two-channel reel-to-reel design. Can provide discrete 4-channel playback only. Has



3 motors, 3 speeds (7 1/2, 3 3/4, 1 7/8 ips), automatic shutoff/tape-break switch. Response 40-18,000 Hz  $\pm 3$  dB, S/N 48 dB, wow & flutter 0.2% at 7 1/2 ips. 16 1/2" W x 11" x 6 1/4". \$249.95

## TOSHIBA

### QM SC-410 4-Channel Adapter

Designed as a 2-channel stereo system with 15 W/ch rms continuous power for use with any



conventional 2-channel stereo system to provide 4-channel sound reproduction. Can be used with both discrete or matrix inputs. Has matrix decoding circuits similar to Dynaco system. Will extract out-of-phase material from a 2-channel program source or any 4-channel encoded material. Features four choices of multi-channel listening: "Concert Hall," "Studio," "Surround," and "Stage," apparently derived from variations in mixing and high-frequency roll-off ..... \$169.95

## TOYO

### 730 2/4 Channel 8-Track Player

Combines an 8-track, 2- or 4-channel tape player with an AM-FM stereo receiver. Has 4



channels of amplification and level meters for all four channels ..... \$279.95  
Model 580. Cassette adapter that permits cassettes to be played through the Model 730 8-track player ..... \$29.95

### 740 2/4 Channel 8-Track Player

Combines an 8-track, 2- or 4-channel tape player, an AM-FM stereo receiver, and a 4-



channel matrix-type decoder. Features a joystick-type balance control (4 channels) with a lighted listener's position scope. 10 W/ch (4 channels) dynamic (EIA) power. 23 1/4" x 5" x 12" ..... \$349.95

### 751 2/4 Channel 8-Track Deck

Features four built-in preamps for playing 2- or 4-channel discrete tapes. 250 mV output at



2% THD. Response 50-10,000 Hz  $\pm 0$ ,  $-1 1/2$  dB, S/N 50 dB, wow & flutter 0.25% .6" x 3/4" x 12" ..... \$119.95

### QC-002 4-Channel Decoder

Designed to recover the "hidden ambience" of  
World Radio History



standard 2-channel stereo records, tapes, or FM and the 4 channels from matrixed program material. 6 7/8" x 5 3/4" x 11" ..... \$69.95

## WOLLENSAK

### 6364 4-Channel Recorder

Three-speed (7 1/2, 3 3/4, 1 7/8 ips), 4-channel play back, 4-track stereo record/playback, 3-head



2-motor unit. Will handle up to 7" reels. Response 35-20,000 Hz  $\pm 2$  dB, wow & flutter 0.12% at 7 1/2 ips, S/N 54 dB. Has built-in electronics with 18 W/ch output, braking, VU meters, automatic shutoff, pause control, echo effects, sound-on-sound, sound-with-sound and phono input ..... \$399.95  
Model 6154. Similar to Model 6364 but preamp deck only ..... \$319.95

### 8054 4-Channel Player

Plays 8-track, 2- and 4-channel quadrasonic cartridges. Has a channel-selector key, auto-



matic programming facilities for 2- or 4-channel, fast-forward. Response 30-15,000 Hz, wow & flutter 0.25%, S/N 52 dB ..... \$119.95

## ZENITH

### C-9029W 4-Channel Modular Adapter

A two-channel stereo system with matrixing circuits that will provide 4-channel sound from any 2-channel program material. Connects into tape output of conventional stereo system. The two front speakers are then played through stereo system while two rear speakers are played through adapter unit. Could work with encoded or discrete 4-channel program material. Supplied with two air suspension speaker systems (10 7/8" x 12" x 7 1/2" D), each with 6" woofer and separate exponential-horn tweeter. 15 W/ch dynamic power at 5% HD. Response 40-17,000 Hz ..... \$169.95



# *YOU CAN'T HEAR OUR TAPE FOR THE MUSIC*



When you listen to a TDK tape, all you can hear is the living sound, just the way it reached the tape. No background hiss. No distortion. No dropouts or fluctuations in output level. Nothing added, nothing left out.

Whether your thing is cassette or open-reel recording, TDK has *the* tape that will give you the best results with your deck or recorder. The only sounds you will hear are the sounds you put on the tape.

**Super Dynamic Reels.** Gamma ferric (SD) oxide for response beyond 30,000 Hz. 1200' and 1800' lengths on 7" reels; 3600' lengths on 10½" NAB reels.

**Deluxe Low-Noise Reels.** "Standard" tape superior to most other premiums. Extended range. 1200', 1800' and 2400' lengths on 7" reels.

**Super Dynamic Cassettes.** Gamma ferric (SD) oxide for response to 20,000 Hz. "The tape that turned the cassette into a high-fidelity medium." 30 minute, 60 minute, 90 minute and 120 minute lengths.

**Deluxe Low-Noise Cassettes.** High-output, extended-range tape in the TDK ultra-reliable cassette. 30 minute, 60 minute, 90 minute and 120 minute lengths.

**Maverick Cassettes.** Economy plus TDK's ultra-reliable cassette. 30 minute, 60 minute and 90 minute lengths.

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# TDK





# SECTION



# Miscellaneous

Raw Tape • Microphones  
Headphones • Accessories

## AMPEX

<b>311 1.5-Mil Acetate Base Tape</b>	
150 ft., 3" reel	\$0.90
600 ft., 5" reel	\$2.25
1200 ft., 7" reel	\$3.50

<b>321 1.0-Mil Acetate Base Tape</b>	
1800 ft., 7" reel	\$5.50

<b>331 1.5-Mil Polyester Base Tape</b>	
600 ft., 5" reel	\$2.65
1200 ft., 7" reel	\$4.25

<b>341 1.0-Mil Polyester Base Tape</b>	
900 ft., 5" reel	\$3.60
1800 ft., 7" reel	\$6.20

<b>351 0.5-Mil Tensitized Polyester Tape</b>	
300 ft., 3" reel	\$1.85
2400 ft., 7" reel	\$9.50
3600 ft., 7" reel	\$11.95

<b>344 Low-Noise 1.0-Mil Polyester Tape</b>	
1800 ft., 7" reel	\$7.35

<b>334 Low-Noise 1.5-Mil Polyester Tape</b>	
1200 ft., 7" reel	\$6.25

<b>8-Track Cartridges</b>	
381-40, 40 min	\$2.25
381-64, 64 min	\$2.50
381-80, 80 min	\$2.95

<b>362 Extended-Range Cassettes</b>	
40 min	\$2.25
60 min	\$2.95
90 min	\$3.95
120 min	\$4.50

<b>363 Chromium-Dioxide Cassettes</b>	
363-C-60, 60 min	\$3.95
363-C-90, 90 min	\$5.25

## AUDIOTAPE

### Cassettes

AC-30, 30-min cassette	\$2.25
AC-60, 60 min cassette	\$2.65



AC-90, 90-min cassette	\$3.95
AC-120, 120 min cassette	\$5.50

### Cartridges

A-8, 8-track, 80-min cartridge	\$2.56
A-8A, 8-track, 40-min cartridge	\$2.23
A-8-150, 32-min cartridge	\$2.23
A-8-190, 64-min cartridge	\$2.56

### Double Recording

Of 0.5-mil tempered Mylar. Allows twice as much recording per reel. Is stronger than double-length tape.

Type 331T, 300 ft., 3" reel	\$1.72
Type 1231T, 1200 ft., 5" reel	\$5.85
Type 2431T, 2400 ft., 7" reel	\$10.05

### Triple Recording

Tempered Mylar. Three times as much recording time per reel as standard plastic-base tape, plus the same extra strength as other tempered Mylar tapes.

Type 633T, 600 ft., 3 1/4" reel	\$2.95
Type 1833T, 1800 ft., 5" reel	\$7.05
Type 3633T, 3600 ft., 7" reel	\$11.99

### Master Tape

Made on 1.5-mil Mylar base. Durable over wide temperature range.

Type 1251M, 1200 ft., 7" reel	\$4.40
Type 1271M, 1200 ft., 7" reel	\$5.10

### Long Recording

Made on 1-mil Mylar polyester film. Provides 50% more recording time per reel. Offers exceptional strength and durability plus longer storage life.

Type 261, 225 ft., 3" mailer	\$1.15
Type 961, 900 ft., 5" reel	\$3.60
Type 1861, 1800 ft., 7" reel	\$6.20
Type 3661R, 3600 ft., 10 1/2" reel	\$14.80

### Standard Recording

High-strength super-durable 1.5-mil Mylar tape that meets all professional performance standards. Will withstand extreme temperatures and is virtually immune to humidity. Maximum tape life under any conditions of use or storage.

Type 671, 600 ft., 5" reel	\$2.80
Type 1271, 1200 ft., 7" reel	\$4.40
Type 2571R, 2500 ft., 10 1/2" reel	\$11.20

### Standard Recording

Plastic-base, professional-quality recording tape. Provides maximum fidelity, uniformity, frequency response, and freedom from noise and distortion. 1.5-mil acetate.

Type 151MB, 150 ft., 3" reel	\$0.80
Type 351, 300 ft., 4" reel	\$2.05
Type 651, 600 ft., 5" reel	\$2.55
Type 1251, 1200 ft., 7" reel	\$3.90
Type 2551R, 2500 ft., 10 1/2" reel	\$10.80

### Low-Noise Tape

Provides high signal-to-noise ratio and reduced hiss level. On 1.5-mil plastic base.

Type 1257, 1200 ft., 7" reel	\$4.00
Type 2557R, 2500 ft., 10 1/2" reel	\$12.20

### 1.5-Mil Polyester

Type 677, 600 ft., 5" reel	\$3.10
Type 1277, 1200 ft., 7" reel	\$4.60
Type 2577R, 2500 ft., 10 1/2" reel	\$12.20

### 1-Mil Polyester

Type 967, 900 ft., 5" reel	\$4.50
Type 1867, 1800 ft., 7" reel	\$6.65
Type 3667, 3600 ft., 10 1/2" reel	\$17.15

## AURICORD

### X-R Series Cassettes

Metal-housed cassettes which act as a ground, draining off static charges. Company claims metal housing insures precise dimensional stability. Contains two machined bearing tape guides for exact tape location and low internal friction. Immune to temperature and humidity effects. Will fit any standard cassette machine. Five-screw design permits user to edit tapes.

Pro 60, 60 min	\$3.95
Pro 90, 90 min	\$4.95

Pro 120, 120 min	\$5.75
------------------	--------

## BASF

### SP-52 Recording Tape

Polyvinyl chloride, tensitized, 1.5-mil. Recommended for standard play.

600 ft., 5" reel	\$2.48
1200 ft., 7" reel	\$3.75
1200 ft., 7" reel (3 pack)	\$11.25

### LP-35 Recording Tape

Polyester base, tensitized 1-mil. Recommended for long-play applications.

900 ft., 5" reel	\$3.33
1800 ft., 7" reel	\$5.42
1800 ft., 7" reel (3 pack)	\$16.26

### DP-26 Recording Tape

Polyester base, tensitized 3/4-mil. Recommended where double play is desired.

300 ft., 3" reel (plastic mailer)	\$1.85
1200 ft., 5" reel	\$4.90
2400 ft., 7" reel	\$7.80
2400 ft., 7" reel (3 pack)	\$23.40

### TP-18 Recording Tape

Polyester base, tensitized, 1/2-mil., triple play.

450 ft., 3" reel (plastic mailer)	\$2.90
1800 ft., 5" reel	\$7.65
3600 ft., 7" reel	\$11.76

### LP-35LH Long-Play Tape

1-mil polyester base. Low-noise, high-output.

900 ft., 5" reel	\$3.93
1800 ft., 7" reel	\$6.85

### DP-26LH Double-Play Tape

3/4-mil polyester base. Low-noise, high-output.

1200 ft., 5" reel	\$5.60
2400 ft., 7" reel	\$9.15

### TP-18LH Triple-Play Tape

1/2-mil polyester base. Low-noise, high-output.

1800 ft., 5" reel	\$8.73
3600 ft., 7" reel	\$13.10

### SM "Chromdioxid" Cassettes

Plastic swivel box (suitable for mailing).

2110-141, 30 min/side	\$3.89
2120-191, 45 min/side	\$5.99
2130-231, 60 min/side	\$8.29

### Cassette Cartridges

Plastic swivel box (suitable for mailing).

C-30	\$2.23
C-60	\$2.65
C-90	\$3.98
C-120	\$5.22

### SK Standard plastic box

C-30	\$1.48
C-60	\$1.75
C-90	\$2.65
C-120	\$3.48

### "Sound Loop 8" Cartridges

32 minutes	\$2.39
64 minutes	\$3.05
84 minutes	\$3.72

## CAPITOL

### Mod Line Cassettes

C-30, 15 min/side	\$0.99
C-60, 30 min/side	\$1.19
C-90, 45 min/side	\$1.79
C-120, 60 min/side	\$2.49

## 5 Raw Tape

C30, Three pack	\$2.79
C-60, Three pack	\$3.39
Cassette head cleaner	\$0.99
Cassette saver	\$2.29

### Mod Line 8-Track Cartridges

27-432-102, 32 min/150 ft	\$1.69
27-440-102, 40 min/190 ft	\$1.99



27-464-102, 64 min/300 ft	\$2.29
27-480-102, 80 min/380 ft	\$2.39
Cartridge head cleaner	\$1.19

### Mod Line Open-Reel Tape

1.5-mil polyester	
21-706-102, 600 ft., 5" reel	\$1.89
21-712-102, 1200 ft., 7" reel	\$2.49
1.0-mil polyester	
21-609-102, 900 ft., 5" reel	\$2.39
21-618-102, 1800 ft., 7" reel	\$3.19
0.5-mil polyester	
21-312-102, 1200 ft., 5" reel	\$2.69
21-318-102, 1800 ft., 5" reel	\$3.69
21-324-102, 2400 ft., 7" reel	\$3.99
21-336-102, 3600 ft., 7" reel	\$5.99

## HITACHI

### "Ultra-Dynamic" Cassettes

UDC-60, 60 min	\$3.70
UDC-90, 90 min	\$4.80

### Low-Noise Cassettes

C-60, 60 min	\$2.25
C-90, 90 min	\$3.20
C-120, 120 min	\$4.30

All "suggested list" prices.

## IRISH

### 190 Series Home-Professional Tape

Standard 1 1/2-mil, acetate base, 1/4"	
195-111, 150 ft., 3" reel	\$0.65
195-121, 300 ft., 4" reel	\$1.75
195-131, 600 ft., 5" reel	\$1.95
195-151, 1200 ft., 7" reel	\$3.15
Extra-length, 1-mil, acetate base, 1/4"	
196-111, 225 ft., 3" reel	\$0.80
196-121, 450 ft., 4" reel	\$2.10
196-131, 900 ft., 5" reel	\$2.50
196-151, 1800 ft., 7" reel	\$4.95
Extra-length, 1-mil, polyester base, 1/4"	
197-111, 225 ft., 3" reel	\$0.95
197-121, 450 ft., 4" reel	\$2.55
197-131, 900 ft., 5" reel	\$2.85
197-151, 1800 ft., 7" reel	\$4.95
Double-length, 1/4-mil, polyester tensilized base, 1/4"	
198-111, 300 ft., 3" reel	\$1.40
198-121, 600 ft., 4" reel	\$3.75
198-131, 1200 ft., 5" reel	\$4.50
198-151, 2400 ft., 7" reel	\$7.95

### 200 Series Professional Tape

Standard 1 1/2-mil, acetate base, 1/4"	
211-111, 150 ft., 3" reel	\$0.80
211-131, 600 ft., 5" reel	\$2.55
211-151, 1200 ft., 7" reel	\$3.90
Extra-length, 1-mil, acetate base, 1/4"	
221-111, 225 ft., 3" reel	\$0.90
221-131, 900 ft., 5" reel	\$3.35
221-151, 1800 ft., 7" reel	\$5.95
Standard, 1 1/2-mil, polyester base, 1/4"	
231-131, 600 ft., 5" reel	\$2.75

231-151, 1200 ft., 7" reel	\$4.25
Extra-length, 1-mil, polyester base, 1/4"	
241-111, 225 ft., 3" reel	\$1.10
241-131, 900 ft., 5" reel	\$3.40
241-151, 1800 ft., 7" reel	\$5.90
Double-length, 1/2-mil polyester tensilized base, 1/4"	
251-111, 300 ft., 3" reel	\$1.75
251-131, 1200 ft., 5" reel	\$5.45
251-151, 2400 ft., 7" reel	\$9.50
0.5-mil, polyester tensilized base, 1/4"	
261-131, 1800 ft., 5" reel	\$6.95
261-151, 3600 ft., 7" reel	\$11.95

### 270 Series Low-Noise, Wide-Range Tape

1 1/2-mil, acetate base, 1/4"	
271-131, 600 ft., 5" reel	\$2.65
271-151, 1200 ft., 7" reel	\$4.00
1 1/2-mil, polyester base, 1/4"	
273-131, 600 ft., 5" reel	\$2.70
273-151, 1200 ft., 7" reel	\$4.60
1-mil, polyester base, 1/4"	
274-131, 900 ft., 5" reel	\$3.85
274-151, 1800 ft., 7" reel	\$6.65

### Hi-Fi Series Cassettes

Soft plastic boxes	
199-C30, 15 min/side	\$1.20
199-C60, 30 min/side	\$1.45

### Professional-Series Cassettes

In album/mailer	
261-C30, 15 min/side	\$1.75
261-C60, 30 min/side	\$1.85
261-C90, 45 min/side	\$2.90
261-C120 60 min/side	\$3.45

### Low-Noise, Extended-Range Cassettes

Flip-top plastic box	
262-C60, 30 min/side	\$2.55
262-C90, 45 min/side	\$3.35

### Chromium-Dioxide Cassettes

Flip-top plastic box	
263-C60, 30 min/side	\$3.75
263-C90, 45 min/side	\$4.75

## MALLORY

### "Professional Duratape" Cassettes

Cobalt-energized, extended-frequency cassettes. Tape has built-in head cleaner that automatically cleans recorder before recording or playback.

EFR 30, 30 min	\$1.95
EFR60, 60 min	\$2.95
EFR90, 90 min	\$3.95

### "Duratape" Cassettes

Cassettes with special head-cleaning leader.	
LNF30, 30 min	\$1.45
LNF60, 60 min	\$1.95
LNF90, 90 min	\$2.95
LNF120, 120 min	\$3.45

### "Flitape" Cassettes

FL60, 60 min, 3 per package	\$2.89
FL90, 90 min, 3 per package	\$3.99

## MAXELL

### Low-Noise Cassettes (Normal Bias)

C-30, 15 min/side	\$1.65
C-60, 30 min/side	\$2.25



C-90, 45 min/side	\$2.95
C-120, 60 min/side	\$3.95

### Ultra-Dynamic Cassettes (High Bias)

UDC-60, 30 min/side	\$3.75
UDC-90, 45 min/side	\$4.50
UDC-120, 60 min/side	\$5.60

### Standard Tape (Normal Bias)

1.5-mil acetate	
A-50-7, 1200 ft., 7" reel	\$4.00
A-50-10R, 2500 ft., 10 1/2" reel	\$10.80
1-mil polyester	
E-35-7, 1800 ft., 7" reel	\$6.20
E-35-10R, 3600 ft., 10 1/2" reel	\$14.35

### Low-Noise Tape (Normal Bias)

1.5-mil acetate	
LNA-50-7, 1200 ft., 7" reel	\$4.10
LNA-50-10R, 2500 ft., 10 1/2" reel	\$12.00
1.5-mil polyester	
LNE-50-7, 1200 ft., 7" reel	\$4.75
LNE-50-10R, 2500 ft., 10 1/2" reel	\$12.20
1-mil polyester	
LNE-35-7, 1800 ft., 7" reel	\$6.80
LNE-35-10R, 3600 ft., 10 1/2" reel	\$17.15
0.75-mil polyester	
LNE-25-7, 2400 ft., 7" reel	\$10.00
0.5-mil polyester	
LNE-18-7, 3600 ft., 7" reel	\$11.85

### Extended-Range Tape

Ultra-dynamic, high-energy type, high bias.

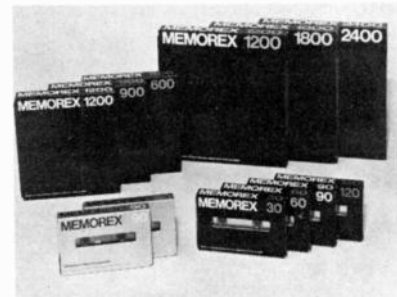
1.5-mil polyester	
*UD50-7, 1200 ft., 7" reel	\$6.75
*UD50-10R, 2500 ft., 10 1/2" reel	\$16.00
1-mil polyester	
UD35-7, 1800 ft., 7" reel	\$8.55
UD35-10R, 3600 ft., 10 1/2" reel	\$19.55
8-Track Cartridges (Normal Bias)	
8T-200, 40 minutes	\$2.90
8T-300, 64 minutes	\$3.05
8T-400, 80 minutes	\$3.25

\*Available in June, 1972

## MEMOREX

### Low-Noise, High-Output Tape

Standard play, 1.5-mil polyester, 1/4"	
600 ft., 5" reel	\$3.09



1200 ft., 7" reel	\$5.75
Long play, 1-mil polyester, 1/4"	
900 ft., 5" reel	\$4.45
1800 ft., 7" reel	\$7.49
Double play, 0.5-mil tensilized polyester, 1/4"	
1200 ft., 5" reel	\$5.75
2400 ft., 7" reel	\$9.99

### Low-Noise, High-Output Cassettes

C-30, 15 min/side	\$2.30
C-60, 30 min/side	\$2.75
C-90, 45 min/side	\$4.05
C-120, 60 min/side	\$5.49

### Chromium-Dioxide Cassettes

C-60, 30 min/side	\$3.95
C-90, 45 min/side	\$5.85

### 8-Track Cartridges

40 minutes	\$2.99
64 minutes	\$3.29
80 minutes	\$3.49

### Cassette Storage Case

Holds 6 Memorex cassettes. Special interlock connects units together

\$2.59



## NORELCO

### 400 Cassette Tape

Chromium-dioxide. Has "Perma-Guides"—guiding arms on each spindle that move with diameter of tape to produce flat "tape pancake."

60 min	\$3.49
90 min	\$4.49

## RCA

### RCA Red Seal

#### Acetate Base

15A1, 150 ft., 3" reel, 1.5-mil, all-purpose, in cardboard mailer	\$0.80
15A6, 600 ft., 5" reel, 1.5-mil, all-purpose, standard play	\$2.55
15A12, 1200 ft., 7" reel, 1.5-mil, all-purpose, standard play	\$3.90

#### Polyester Base

15M6, 600 ft., 5" reel, 1.5-mil, all-purpose, standard play	\$2.65
15M12, 1200 ft., 7" reel, 1.5-mil, all-purpose, standard play	\$4.25
10M2, 225 ft., 3" reel, 1.0-mil, long-play in cardboard mailer	\$1.05
10M9, 900 ft., 5" reel, 1.0-mil, all-purpose, long-play	\$3.45
10M18, 1800 ft., 7" reel, 1.0-mil, all-purpose, long play	\$6.00
5TM3, 300 ft., 3" reel, 0.5-mil, all-purpose, double-play	\$1.63
5TM12, 1200 ft., 5" reel, 0.5-mil, all-purpose, double-play	\$5.55
5TM24, 2400 ft., 7" reel, 0.5-mil, all-purpose, double-play	\$9.75

#### Tapes in Plastic Mailers

15A1PM, 150 ft., 3" reel, 1.5-mil acetate	\$0.90
10M2PM, 225 ft., 3" reel, 1.0-mil polyester	\$1.35
5TM3PM, 300 ft., 3" reel, 0.5-mil tensilized polyester	\$1.85

#### Red Seal

5TM18TP, 1800 ft., 5" reel, 0.5-mil all-purpose, triple-play	\$7.40
5TM36TP, 3600 ft., 7" reel, all-purpose, triple-play	\$11.90

#### Low-Noise, Low-Print

15MLN12LT, 1200 ft., 7" reel, 1.5-mil polyester	\$6.45
10MN18LT, 1200 ft., 7" reel, 1.0-mil, extra-strength	\$7.90

#### Vibrant Cassettes

CV30, 15 min/side	\$1.39
CV60, 30 min/side	\$1.69
CV90, 45 min/side	\$2.49

#### 8-Track Cartridges

8TR32, 150 ft. lubricated tape in 32-min cartridge	\$2.45
8TR64, 300 ft. lubricated tape in 64-min cartridge	\$2.95
8TR94, 440 ft. lubricated tape in 94-min cartridge	\$3.70

#### Cassette Head Cleaner Tape

10R121, Non-abrasive cassette head cleaner in plastic box	\$2.00
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## SCOTCH

### Cassettes

Features Scotch "High Energy" cassettes, fully compatible, with nearly twice the signal output of leading high-density cassettes and Scotch "Extended-Range" cassettes, and up-graded replacement of the "Dynarange" series. Both feature "Posi-Trak" back treatment.

#### "High Energy" Cassettes

30 minute (album package)	\$3.20
60 minute (album package)	\$3.70
90 minute (album package)	\$5.35

#### "Extended-Range" Cassettes

30 min. (album & mailer package)	\$2.25
60 min. (album & mailer package)	\$2.65
90 min. (album & mailer package)	\$4.00
120 min. (album package)	\$5.35

### No. 102 "All-Purpose" Tape

For all general recording; suitable for long-term storage. On super-tough, weather-balanced 1 1/2-mil polyester backing.

102-1/4-600, 600 ft., 3" reel	\$2.80
102-1/4-1200, 1200 ft., 7" reel	\$4.40

### No. 111 "All-Purpose" Tape

For all general recording, 1 1/2-mil plastic backing.

111-1/4-150, 150 ft., 3" reel	\$0.85
111-1/4-600, 600 ft., 5" reel	\$2.70
111-1/4-1200, 1200 ft., 7" reel	\$4.00

### No. 131 "Low-Print" Tape

Reduces print-through to a point below noise level of most professional machines. Allows long-time storage. 1 1/2-mil plastic backing.

131-1/4-600, 600 ft., 5" reel	\$2.95
131-1/4-1200, 1200 ft., 7" reel	\$4.55

### No. 138 "Low-Print, Extra-Strength" Tape

Same as No. 131, except on strong 1 1/2-mil polyester backing.

138-1/4-1200, 1200 ft., 7" reel	\$5.25
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### No. 150 "Extra-Length, Extra-Strength" Tape

Designed to withstand temperature and humidity extremes. High-potency oxide on 1-mil polyester backing.

150-1/4-900, 900 ft., 5" reel	\$3.60
150-1/4-1800, 1800 ft., 7" reel	\$6.20

### No. 175 "Heavy-Duty Tenzar" Tape

Long-wearing tape for applications involving hard use and rough handling. Runs 15 minutes longer than ordinary tapes. Made with wear-resistant, high-potency oxide coating. Available on red, blue, green, yellow, or clear reels.

175-1/4-600, 600 ft., 5" reel	\$2.50
175-1/4-1200, 1200 ft., 7" reel	\$3.85

### No. 200 "Double-Length, Double-Strength" Tape

As much playing time as two reels of standard tape. For recording opera, concerts, or conferences. High-potency oxide on tensilized polyester backing.

200-1/4-1200, 1200 ft., 5" reel	\$5.85
200-1/4-2400, 2400 ft., 7" reel	\$10.05

### "Dynarange Tapes"

Although originally engineered for professional use, these tapes are now available for home recording. Provides high-fidelity recording even at 3 3/4 ips.

201 1 1/2-mil plastic	
201-1/4-600, 600 ft., 5" reel	\$2.80
201-1/4-1200, 1200 ft., 7" reel	\$4.10
202 1 1/2-mil polyester	
202-1/4-600, 600 ft., 5" reel	\$2.85
202-1/4-1200, 1200 ft., 7" reel	\$4.75
203 1-mil polyester	
203-1/4-900, 900 ft., 5" reel	\$4.05
203-1/4-1800, 1800 ft., 7" reel	\$6.85



### "High-Output, Low-Noise" Tapes

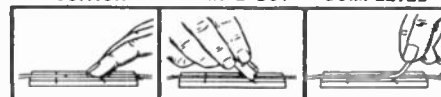
Provides a 50 percent increase in signal output and an additional 3 dB in dynamic range over



**This splice  
took 12 seconds.  
It is now  
stronger than  
the original  
tape.**

Tape splicing used to be a painstaking nuisance. Now it can be accomplished in a matter of seconds with EDITall, the only true splicing method for reel, cartridge, cassette and video tape. Perfect for professional and amateur alike. It's virtually the only method used by broadcast, recording studios and manufacturers of 4 and 8 track tape cartridges and cassettes. The reason: it's precise... rapid... simple to use — every time you use it. EDITall precisely trimmed tape splices, make splicing even easier. They are available in 1/4" and 150 mil sizes. Tape spliced in an EDITall block may be erased and used over and over again for top quality recordings. EDITall splices are guaranteed to be stronger than the original tape. Perfectly smooth, they retain the original quality of sound reproduction. And they never damage tape heads or tape.

#### POSITION MARK & CUT COMPLETED



Regardless of the size tape you're using, there's an EDITall kit to meet your requirements. Visit your EDITall dealer today or write: ELPA MARKETING INDUSTRIES, INC., New Hyde Park, N.Y. 11040

**EDITall®**  
**Tape Splicing System**



## 5 Raw Tape

conventional low-noise tape. Gives the audiophile and critical music lover the same magnetic and physical properties of the studio music mastering tape introduced to professional users in 1970. Features "Posi-Trak" backing.

206-1/4-1.5-mil-7", 60 minutes recording time in both directions at 7 1/2 ips ... \$6.75  
207-1/4-1-mil-7", 90 minutes recording time in both directions at 7 1/2 ips ... \$8.55

### No. 290 "Triple-Length" Tape

1/2-mil tensilized polyester backing.  
290-1/4-1800, 1800 ft., 5" reel ... \$7.40  
290-1/4-3600, 3600 ft., 7" reel ... \$11.99

### "Living Letters" Tape

111-1/4-150-LL, 150 ft., 3" reel ... \$1.05  
200-1/4-300-LL, 300 ft., 3" reel ... \$2.05  
290-1/4-600-LL, 600 ft., 3" reel ... \$2.95

### 8-Track Cartridges

S-8TR-40, 40 minutes ... \$2.95  
S-8TR-80, 80 minutes ... \$3.40

## SONY/SUPERSCOPE

### Professional Recording Tape

Extra-heavy-formula Oxi-coat homogenized oxide coating; polyester back, "lubri-cushion" impregnated lubricant.

PR-150-3, 300 ft., 3 1/4" reel ... \$1.29  
PR-300-6, 600 ft., 3 1/4" reel ... \$1.95  
PR-150-9, 900 ft., 5" reel ... \$2.49  
PR-200-12, 1250 ft., 5" reel ... \$3.79  
PR-150-18, 1800 ft., 7" reel ... \$3.89  
SLH-180-18, 1800 ft., 7" reel ... \$6.49  
PR-200-24, 2400 ft., 7" reel ... \$7.19  
PR-150-36, 3600 ft., 10 1/2" reel ... \$10.95  
SLH-180-25, 2500 ft., 10 1/2" reel ... \$14.50  
SLH-180-36, 3600 ft., 10 1/2" reel ... \$19.95

### Tape Cassettes

C-60, 60 min ... \$1.19  
C-90, 90 min ... \$1.69  
C-120, 120 min ... \$3.29  
UHF C-60, 60 min ... \$2.29  
UHF C-90, 90 min ... \$2.53  
UHF C-120, 120 min ... \$4.89

### 8-Track Cartridge

8T-60 60 min ... \$3.29

### Empty Tape Reels

Computer-styled tape reels, with box.  
7" ... \$0.99  
5" ... \$0.79  
3 1/4" ... \$0.69

## SOUNDCRAFT

### "Standard" Tape

1.5-mil, acetate base, professional quality, economy priced.

S-6, 600 ft., 5" reel ... \$2.55  
S-12, 1200 ft., 7" reel ... \$3.90

### "Standard-50" Tape

Long-play version of "Standard" tape on 1-mil acetate base.

S5-9, 900 ft., 5" reel ... \$3.45  
S5-18, 1800 ft., 7" reel ... \$6.00

### "Lifetime" Tape

For use where utmost strength and quality are necessary. 1.5-mil polyester base.

L-6, 600 ft., 5" reel ... \$2.40  
L-12, 1200 ft., 7" reel ... \$3.75

### "Plus-50" Tape

Made on 1-mil polyester for 50% more playing time than standard 1.5-mil tapes. Combines long play-type tape with great tape strength.

PL-9, 900 ft., 5" reel ... \$3.45  
PL-18, 1800 ft., 7" reel ... \$6.00

### "Triple-Play" Tape

0.5-mil polyester base.  
TP-18, 1800 ft., 5" reel ... \$7.05

TP-36, 3600 ft., 7" reel ... \$11.99

### "Golden Tone" Tape

High-quality special tape, 25% more high-frequency output and 7 dB better signal-to-noise ratio. 7" reel.

..... \$4.00  
GTM-18, 1800 ft., 1-mil polyester base  
..... \$6.65

### Cassette Tapes

C-30 ... \$2.25  
C-60 ... \$2.65  
C-90 ... \$3.95

## TDK

### "Super Dynamic" Cassettes

Employs new type of ferric oxide for wide dynamic range, low noise, distortion-free output. Response 30-20,000 Hz. Polyester base, packaged in plastic boxes.

C-30SD, 30 min ... \$1.69  
C-60SD, 60 min ... \$1.99  
C-90SD, 90 min ... \$2.99  
C-120SD, 120 min ... \$3.99

### Deluxe Low-Noise Cassettes

For all general recording. Packaged in plastic boxes.

C-30LN, 30 min ... \$1.09  
C-60LN, 60 min ... \$1.29  
C-90LN, 90 min ... \$1.99  
C-120LN, 120 min ... \$2.99

### Maverick Cassettes

For all general recording. Packaged in mailing cartons.

C-30F, 30 min ... \$0.85  
C-60F, 60 min ... \$0.99



C-90F, 90 min ... \$1.49

### "Super Dynamic" Tape

Employs new type of ferric oxide for wide dynamic range, low noise, and distortion-free output.

1200 SD, 1200 ft., 7" reel ... \$3.59  
1800 SD, 1800 ft., 7" reel ... \$4.99  
3600 SD, 3600 ft., 10 1/2" NAB reel ... \$12.49

### Deluxe Low-Noise Tape

100-7, 1200 ft., 2 mil. 7" reel ... \$2.50  
150H-7, 1200 ft., 1.5 mil, 7" reel ... \$2.75  
150-7, 1800 ft., 1.5 mil, 7" reel ... \$3.50  
200-7, 2400 ft., 1 mil, 7" reel ... \$5.00

## WABASH

### Primus Low-Noise, High-Output Tape

1.5-mil polyester  
600, 600 ft., 5" reel ... \$2.95  
1200, 1200 ft., 7" reel ... \$4.95  
1-mil polyester  
900, 900 ft., 5" reel ... \$4.25  
1800, 1800 ft., 7" reel ... \$6.95  
0.75-mil polyester  
1200/5, 1200 ft., 5" reel ... \$5.95  
2400, 2400 ft., 7" reel ... \$9.95

### Primus Professional Cassettes

In plastic album box.  
C-60, 30 min/side ... \$2.79  
C-90, 45 min/side ... \$3.99

## 5 Microphones

### AGC

#### D-109 Dynamic Microphone

Sensitivity -56 dB ASA. Response 50-15,000 Hz  $\pm 3.5$  dB. 200 ohms impedance. Omnidirectional pattern. Use for speech. Has lavalier, dust filter or windscreen, 30-ft cable, and chrome finish. Connector not included ... \$49.00

#### D-160E Dynamic Microphone

Sensitivity -55 dB ASA. Response 50-15,000 Hz  $\pm 3$  dB. 200 ohms impedance. Omnidirectional pattern. Use for tape recording. Has slip-in stand attachment, dust filter or windscreen, with detachable windscreen. With windscreen presence rise, without windscreen linear response. Comes with 15-ft. cable, XLR connector, and chrome finish ... \$60.00

#### D-190E Dynamic Microphone

Sensitivity -53 dB ASA. Response 40-15,000 Hz  $\pm 3$  dB. 200 ohms impedance. Cardioid pattern. Use for music. Has slip-in stand attachment, dust filter or windscreen, XLR connector. Comes with 15-ft. cable ... \$50.00  
Model D-190TS. Same as D-190E except high impedance operation with "on-off" switch. Has 24-ft. cable and phone plug ... \$50.00

#### D-200E Dynamic Microphone

Sensitivity -55 dB ASA. Response 30-15,000 Hz  $\pm 3$  dB. 200 ohms impedance. Cardioid pat-



tern. Use for music and tape recording. Has slip-in stand attachment, dust filter or windscreen. Comes with 15-ft. cable, XLR connector, matte grey finish ... \$69.00  
Model D-200TS. Same as D-200E except for high impedance operation with "on-off" switch, 24-ft. cable, and phone plug ... \$69.00

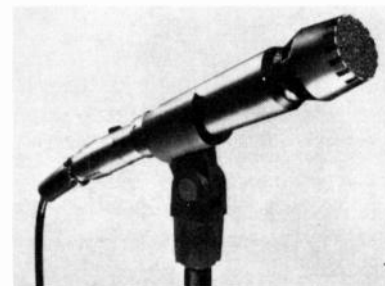
#### D-707E Dynamic Microphone

Sensitivity -52 dB ASA. Response 50-15,000 Hz  $\pm 3.5$  dB. 200 ohms impedance. Cardioid pattern. Use for tape recording. Comes with slip-in stand attachment, pop or blast filter, chrome finish, 15-ft. cable, and XLR connector ... \$40.00

Model D-707TS. Same as D-707E but for high impedance operation with "on-off" switch, 24-ft. cable, phone jack ... \$40.00

#### D-1000E Dynamic Microphone

Sensitivity -53 dB ASA. Response 40-16,000 Hz  $\pm 3$  dB. 200 ohms impedance. Cardioid pat-



tern. Use for rock vocals. Has slip-in stand attachment, pop or blast filter, chrome finish, 15-ft cable, and XLR connector ... \$60.00  
Model D-1000TS. Same as D-1000E but for high impedance operation with "on-off" switch, 24-ft. cable, and phone plug ... \$60.00

## ALLIED RADIO SHACK

### Pro-100 Microphone Kit

Supplied as a pair with miscellaneous accessories, including wind screens, table stands, floor stand adapters, lavalier cords, and cables. Response 10-10,000 Hz. Switchable 250 and 10,000 ohm impedance ..... \$29.95

### Highball Dynamic Microphone

Cardioid design. Response 50-15,000 Hz. Features "on-off" switch and internal push-on impedance change 50/250 ohms or 50,000 ohms. Has pop filter and 15-ft. cable . \$39.95

### Highball 5 Dynamic Microphone

Cardioid design. Response 70-13,000 Hz. Has change plug for 600 to 20,000 ohm impedance. Includes stand adapter and 15-ft cable ..... \$26.95

## AUDIOTEX

### 30-2314 Cardioid Microphone

Frequency response 50-13,000 Hz. Unidirectional pattern minimizes pickup from rear and sides and reduces feedback. Comes with built-in windscreen, 20-ft. cable with standard phone plug and adapter for floor or desk stand. Has built-in "on-off" switch. Dual impedance. Output -58 dB (on high impedance) .. \$39.95

### 30-2312 Omnidirectional Microphone

Dynamic type designed for recording groups. Frequency response 55-13,000 Hz. Dual impedance. Output -62 dB (on high impedance). Comes with 15-ft. cable, standard phone plug, swivel holder, "on-off" slide switch, and windscreen ..... \$34.95

### 30-2310 Cardioid Microphone

Response 80-13,000 Hz  $\pm 3$  dB; high-impedance type. Has hinge mount to desk stand, "on-off" switch. Use for speech and tape recording. 10-ft. cable. Chrome finish .. \$29.95

### 30-2312 Omnidirectional Microphone

Response 55-13,000 Hz. Selectable high or low impedance. Hand-held type with "slip-in" stand attachment. Has dust filter or wind screen, "on-off" switch, 15-ft. cable. Use for speech or rock vocals. Chrome finish . \$34.95

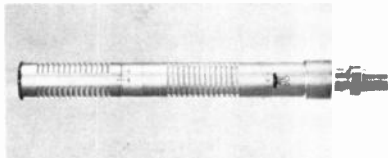
### 30-2314 Cardioid Microphone

Response 50-17,000 Hz  $\pm 3$  dB. Selectable high or low impedance. Hand-held with hinge mount to stand. Has "on-off" switch, 20-ft. cable, volume control on mike barrel. Chrome finish ..... \$39.95

## BANG & OLUFSEN

### Beomic BM-5 Ribbon Microphones

Two stacked ribbon microphones (top one detachable). Sensitivity -85 dB (1 V/ $\mu$ bar). Re-



sponse 30-13,000 Hz  $\pm 2$  dB. Figure-8 pattern. Use for speech and music. Comes with desk stand and 20-ft. cable. Connector not included ..... \$99.95

### Beomic 1000 Dynamic Microphone

Sensitivity -80 dB (1 V/ $\mu$ bar). Response 50-17,000 Hz  $\pm 5$  dB. Omnidirectional pattern. Use for speech and music. Comes with lavalier or desk stand and 10-ft. cable. Connector not included ..... \$40.00

### Beomic 2000 Dynamic Microphone

Sensitivity -80 dB (1 V/ $\mu$ bar). Response 50-15,000 Hz. Low impedance. Cardioid pattern. Use for speech and music. Comes with desk stand. Connector not included ..... \$80.00

1972 SPRING EDITION

## BEYER

### M69 Dynamic Microphone

Cardioid design with 16 dB front-to-back discrimination at 180 degrees. Sensitivity 0.24



mV/ $\mu$ bar (0 dB = 1 mV/1  $\mu$ bar, 0.72 dBV) ASA. Response 50-16,000 Hz  $\pm 3$  dB. 200 ohms impedance. Use for speech and music. Supplied with XLR connector ..... \$75.00

### M260 Dynamic Ribbon Microphone

Hyper-cardioid design. Response 50-18,000 Hz  $\pm 3$  dB. Sensitivity 0.09 mV/ $\mu$ bar (0 dBm = 1



mV/10  $\mu$ bar) (-58 dBV) at 1 kHz. 200 ohms impedance. 1 1/4" diameter mesh head  $\times$  6" long ..... \$90.00

### M67 Dynamic Microphone

For tape recording outdoors & inside. Cardioid pattern. Response 40-18,000 Hz  $\pm 2.5$  dB;



front-to-back discrimination 18 dB at 180 degrees. Sensitivity 0.25 mV/ $\mu$ bar (0 dB = 1 mV/1  $\mu$ bar) (-72 dBm) at 1 kHz. Impedance 200 or 500 ohms. Cartridge is rubber suspended. Has built-in "speech-off-music" switch. 7 3/4"  $\times$  1.5" ..... \$95.00

### "Soundstar X1" Microphone

Cardioid design with front-to-back attenuation greater than 20 dB. Response 30-18,000 Hz.



Sensitivity 0.2 mV/ $\mu$ bar (-74 dBV); 200 ohms impedance. Has built-in pop screen & hum compensation coil ..... \$65.00  
Model X1HLM. Same as "Soundstar X1" but has unbalanced 200, 500 & 25,000 ohm impedance ..... \$75.00

### M81HL Dynamic Microphone

Cardioid pattern with 18 dB front-to-back attenuation at 180 degrees. Response 50-16,000 Hz  $\pm 3$  dB. Sensitivity 0.23 mV/ $\mu$ bar (0 dB = 1V/1  $\mu$ bar at 1 kHz) (-73 dB). Supplied with

table stand, cable, and plug adapter. Company claims suitable for all impedances. 32  $\times$  32  $\times$  131 mm ..... \$35.00  
M818HL. Matched pair with stereo mounting rail, table stand, and carrying case ... \$70.00

## ELECTRO-VOICE

### 621 Dynamic Microphone

Response 150-12,000 Hz  $\pm 2$  dB. Specify high or low impedance when ordering. Cardioid pat-



tern. Supplied with slip-in stand attachment, desk stand, mike stand adapter. Use for music and tape recording. Comes in a matte satin finish ..... \$19.95

### 635A Dynamic Microphone

Sensitivity -149 dB EIA. Response 80-13,000 Hz  $\pm 3$  dB. 150 ohms impedance. Omnidirectional pattern. Hand-held with slip-in stand attachment and lavalier neckcord assembly. Use for tape recording and broadcasting. Has a four-stage pop or blast filter, 18-ft. cable, Switchcraft A3F connector. Fawn beige matte finish ..... \$56.70

### 670 Dynamic Microphone

Sensitivity -152 dB EIA. Response 60-14,000 Hz. User selects high or low impedance. Single-D cardioid. Hand-held with slip-in stand attachment. Use for speech, rock vocals, music, and tape recording. Has built-in "Acousti-foam" pop or blast filter, "on-off" switch, 15-ft. cable, and Switchcraft A3F connector. Frequency response varies with distance from microphone (maximum bass response is 1/4" from source). Features an anodized brass finish ..... \$45.90

### 670V Dynamic Microphone

Sensitivity -152 dB EIA. Response 60-14,000 Hz. User selects high or low impedance. Sin-



gle-D cardioid. Hand-held with slip-in stand attachment. Use for speech, rock vocals, music, and tape recording. Has built-in "Acousti-foam" pop or blast filter, "on-off" switch, 15-ft. connector, and Switchcraft A3F connector. Features a special thumb-actuated volume control for user convenience. Bass response varies with distance from sound source. Anodized finish ..... \$50.10

### 674 Dynamic Microphone

Sensitivity -152 dB EIA. Response 60-15,000 Hz  $\pm 6$  dB. User selects high or low impedance. Cardioid pattern. Use for speech, music, and tape recording. Comes with "on-off" switch, a 3/8"-27 thread for stand mounting, 15-ft. cable, built-in three-position bass tilt-off control, and E-V QC-4M "quick change" connector. Satin chrome finish ..... \$61.35

## 5 Microphones



**Model 674G.** Same as Model 674 but with gold finish ..... \$64.20

### 676 Dynamic Microphone

Sensitivity -151 dB EIA. Response 60-15,000 Hz  $\pm 5$  dB. User selects high or low impedance. Cardioid pattern. Has a slip-in stand attachment, 15-ft. cable, built-in three-position bass tilt-off control, and QC-4M connector. Wind-screen available as an optional extra. Satin chrome or non-reflecting gray finish .. \$61.35

**Model 676G.** Same as Model 676 except gold finish ..... \$64.20

### 1710 Condenser Microphone

Sensitivity -142 dB EIA. Response 80-13,000 Hz. 150 ohms unbalanced; omnidirectional pattern. Hand-held with slip-in stand attachment. Use for speech, rock vocals, music, and tape recording. Has a built-in "Acoustifoam" pop or blast filter, "on-off" switch, 18-ft. cable with permanent strain relief. Connector not included. Beige anodized with gray enamel trim ..... \$39.75

### 1711 Condenser Microphone

Sensitivity -142 dB EIA. Response 60-15,000 Hz. 150 ohms balanced. Omnidirectional pattern. Hand-held with slip-in stand attachment. Use for speech, rock vocals, music, and tape recording. Has built-in pop or blast filter, "on-off" switch, 18-ft. cable with Switchcraft A3F connector. Impervious to extremes of humidity or temperature. Beige anodized with gray enamel trim ..... \$59.70

### 1750 Condenser Microphone

Sensitivity -137 dB EIA. Response 80-13,000 Hz. 150 ohms unbalanced. Cardioid pattern. Hand-held with slip-in stand attachment. Use for speech, rock vocals, music, and tape recording. Has built-in pop or blast filter, "on-off" switch, 18-ft. cable with permanent strain relief. Beige anodized with gray enamel trim. Connector not included ..... \$45.00

### 1751 Condenser Microphone

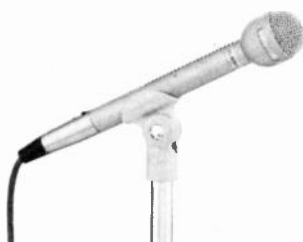
Sensitivity -137 dB EIA. Single-D cardioid. Response 60-15,000 Hz. 150 ohms balanced.



Hand-held with slip-in stand attachment. Use for tape recording, p.a., and sound reinforcement. Has built-in pop or blast filter, "on-off" switch, 18-ft. cable, and Switchcraft A3F connector. Beige anodized with gray enamel trim ..... \$75.00

### RE10 Dynamic Microphone

Response 90-13,000 Hz. Super-cardioid polar



pattern. 150 ohms impedance. Output -56 dB (0 dB = 1 mW/10 dynes/cm<sup>2</sup>). Sensitivity -150 dB EIA. Has 18-ft. cable. 6 $\frac{3}{4}$ "  $\times$  1 $\frac{1}{8}$ " with carrying case ..... \$99.60

### RE55 Dynamic Microphone

Response 40-20,000 Hz. Omnidirectional pattern. 150 ohms impedance. Output -55 dB (0

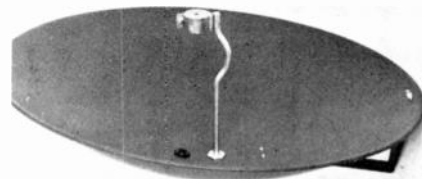


dB = 1 mV/10 dynes/cm<sup>2</sup>). Sensitivity -149 dB EIA. 18-ft. cable. 10 $\frac{1}{2}$ "  $\times$  1 $\frac{1}{32}$ " with carrying case ..... \$141.30  
All of the above prices are "Net."

## ERCONA

### Parabolic Reflector

24" in diameter, 5" deep, weight 4 $\frac{3}{4}$  pounds. Increases mike sensitivity 14 dB when record-



ing the band 500 to 5000 Hz from distances up to 100 feet. Matte green finish. Microphone not included ..... \$55.00

## FARGO

### Fargram Parabolic Reflector

Dynamic, low-impedance, directional parabolic microphone. Mounted on a tripod. For use in sound hunting or long-range pickup. Approximately 15 dB gain in the range 500-5000 Hz. Spun aluminum 24" parabolic reflector with gunsight. 6-ft. cable. Supplied with mini-plug connector. Green finish ..... \$98.50

## HITACHI

### NDM-32 Dynamic Microphone

Sensitivity -73 dB. Response 70-12,000 Hz  $\pm 4$  dB. Balanced 600 ohms. Omnidirectional with desk stand. Use for speech and recording applications. Supplied with plug connector and wind screen. 16-ft. cable. Black ..... \$40.00

## OLSON

### M-237 Dynamic Microphone

Cardioid design. Dual impedance (600 & 50,000 ohms) with selector switch. Response 50-15,000 Hz. Output -54 dB (high imp.), -72 dB (low imp.). Has built-in filter for anti-feedback & close-to-mouth use. With stand adapter and 20-ft. cord ..... \$19.98

## PML

### DC-21 Condenser Microphone

Response 30-20,000 Hz  $\pm 3$  dB; sensitivity -30 dB (10 dyne/cm<sup>2</sup>). 200 ohms balanced. Car-



dioid type. Has lavalier or hinge-mount to stand. For use in recording speech and music. Powered and uses FET's for high signal-to-noise ratio ..... \$149.50

**Model DC-20.** Same as DC-21 except has omnidirectional pattern ..... \$139.50

### F-67BS Dynamic Microphone

Response 40-16,000 Hz; sensitivity -54 dB ASA. 200 ohms balanced. Cardioid pattern. Has "slip-in" stand attachment. For recording speech and music. Chrome finish and 20-ft. cable ..... \$59.50  
Wind pop screen (optional) ..... \$19.95

### RD-34WS Dynamic Microphone

Response 30-20,000 Hz  $\pm 3$  dB; sensitivity -54 dB ASA. 200 ohms balanced. Cardioid pattern.



May be hand-held or used as lavalier, has "slip-in" stand attachment. For recording speech and music. Comes with windscreen and 18-ft. cable. Silver gray finish ..... \$75.00

### D-44BS Dynamic Microphone

Cardioid design for hand-held, stand-mounting, or lavalier use. Response 60-16,000 Hz  $\pm 5$  dB. Has windscreen, "on-off" switch, 30-ft. shielded cable, and stand adapter. 5-inches long, weight 4.7 ounces. 200 ohms or hi-Z. Sensitivity -51 dB (10 dyne/cm<sup>2</sup>) and 200 ohms ..... \$39.95

### EC-71 Condenser Microphone

Cardioid design. Response 40-18,000 Hz  $\pm 3$  dB. Sensitivity -60 dB/dyne/cm<sup>2</sup> at 200 ohms. Impedances 50, 200, 600 ohms balanced or hi-





Z unbalanced. Must have power supply. 1 1/4 ounces. 2 1/16" x 1 1/16" ..... \$109.50  
**EK-71** Same except omnidirectional pattern ..... \$109.50  
**7130.** A.c. power supply ..... \$69.50  
**7130S.** A.c. power supply for 2 mikes ..... \$89.50  
**7140.** Battery supply ..... \$39.50  
**7140S.** Battery supply for 2 mikes ..... \$49.50

## SENNHEISER

### MD21N Dynamic Microphone

Omnidirectional, 200-ohm impedance design. Response 50-15,000 Hz  $\pm 3$  dB. Sensitivity 0.2 mV/ $\mu$ bar at 1000 Hz. EIA rating -145.8 dB. Output level -53 dBm (1 mW/10 dynes/cm<sup>2</sup>). Fitted with small Tuchel connector. Has balanced output. 10 ounces. 120 x 46 x 46 mm ..... \$90.20



**MD21-HL.** Same as MD21N except dual impedance (200 & 30,000 ohms) ..... \$94.60

### MD421U Dynamic Microphone

Cardioid, 200-ohm impedance design. Response 30-17,000 Hz  $\pm 5$  dB. Sensitivity 0.2 mV/



$\mu$ bar  $\pm 3$  dB at 1 kHz. EIA rating -145.8 dB. Output level -53 dBm (1 mW/10 dynes/cm<sup>2</sup>). Has front-to-back ratio 18 dB -2 dB and a variable bass attenuator. Fitted with small Tuchel connector. 14 ounces. 177 x 48 x 46 mm

..... \$129.00  
**MD421-U2.** Same except has large Tuchel connector ..... \$125.00

### MD411HLM Dynamic Microphone

Super-cardioid. Features a built-in triple-impedance transformer to permit mike to be connected directly to any tape recorder. High



impedance is 25,000 ohms for tube units; 800 ohms medium impedance for transistor recorders; 200 ohms low impedance for recorders of either type fitted with low-impedance input transformers. Response 50-12,000 Hz. Side

## MICROPHONES—COST VS PERFORMANCE

THE role of the microphone is analogous to that of the loudspeaker, but at the opposite end of the hi-fi reproduction chain. It is a transducer, converting minute pressure variations in the air (sound) to electrical voltage waveforms. Since the microphone diaphragm moves only microscopically, compared to the large excursions of a speaker cone, it has fewer inherent deficiencies and, in its most refined form, can be a nearly perfect device.

In a home music system, microphones are used almost exclusively for recording "live" programs on a tape recorder. Low-to-medium priced recorders sometimes come with a pair of inexpensive microphones, but better quality machines leave the selection of the microphone to the user. If the recorder is to be used for preserving baby's first words, any inexpensive microphone will be satisfactory. The quality of a musical recording, on the other hand, will usually depend on the response of the microphone, rather than the recorder.

Microphones may be classified in several ways, according to: 1. operating principle, 2. sensitivity, 3. frequency response, 4. impedance, 5. directional pattern, and 6. styling. The most widely used type of microphone is the dynamic—actually a miniature loudspeaker in reverse. Low-priced dynamic microphones supplied with some tape recorders vary in quality from poor to quite good, but few have the frequency response and smoothness to take full advantage of the capabilities of the recorder. Dynamic microphones in the \$30-\$60 price class are intended for public-address and non-critical recording applications, and are generally adequate for home recording. Above \$100, dynamic microphones approach professional quality standards. Many dynamic microphones can be wired for low-impedance (50 to 250 ohms) or high-impedance (about 10k ohms) operation, to match the requirements of the recorder.

Capacitor microphones (sometimes referred to as condenser microphones) use a tiny two-plate capacitor, whose spacing is varied as one plate (the diaphragm) flexes under the sound pressure. It has a very high impedance and requires an impedance transforming circuit, usually built into the microphone case. The capacitor microphone requires a power supply, both to power the amplifier and to supply a polarizing voltage to the capaci-

tor element. Its high price (from about \$100 to well over \$300) often removes it from consideration in home recording, but the very smooth, wide-range frequency response of the capacitor microphone makes professional-quality tape recordings possible on any reasonably good home machine.

A variation on the capacitor microphone is the so-called "electret" which requires no polarizing voltage or separate power supply, and is considerably cheaper.

Most home-recording microphones are omnidirectional, a satisfactory characteristic for the majority of applications. Sometimes it is necessary to exclude sounds from certain directions and then a directional microphone is required. Most directional microphones have a cardioid (heart-shaped) pattern, rejecting sounds from the rear, but some have bidirectional "figure-8" patterns, with side rejection.

The frequency response rating of an expensive microphone is usually accurate, but in the under-\$100 class do not take these figures too literally. Home tape recorders usually have a low-to-medium impedance input, capable of working with any microphone designed to work into an impedance of less than a few thousand ohms. This includes all dynamic microphones and capacitor microphones, whose FET amplifiers provide an output impedance of a few hundred ohms.

Sensitivity refers to the output voltage from a microphone with a given sound input level. Since the sensitivity is expressed in "—dB," smaller numbers indicate higher output. Microphones carrying an EIA sensitivity rating can be compared in this range, but it is often difficult to determine from a tape-recorder specification how much input level it requires from the microphone (in terms of the EIA rating).

In styling, microphones vary widely, from simple hand-held units to tiny lavalier types. Capacitor microphones are among the smallest, while dynamic microphones range from lavalier size to bulky directional units.

Obviously, individual microphone needs vary considerably. In all cases, one should consider the intended application and what investment can be justified. Good "live" recordings must start with good microphones and there are no short-cuts.

## 5 Microphones

attenuation 20 dB at 120 degrees. Sensitivity 1.25 mV/ $\mu$ bar at 1 kHz; EIA rating -154 dB; output level -58.1 dBm (1 mW/10 dynes/cm<sup>2</sup>) all at high-imp. setting. Comes with table stand, floor stand adapter, and zippered case. 8 ounces ..... \$54.00

### SHURE

#### 300 Ribbon Microphone

Sensitivity -153 dB (EIA). Response 40-15,000 Hz. User selects high or low impedance. Bidirectional. Hinge mount to stand. Use for speech and music. Has 20-ft. cable and connector. Gray ..... \$171.00

#### 515SA "Unidyne B" Microphone

Dynamic type. Sensitivity -154 dB (EIA). Response 80-13,000 Hz. High impedance. Cardioid pattern. Hand-held with slip-in stand attachment. Use for speech, rock vocals, and music. Has "on-off" switch and 15-ft. cable. Chrome finish ..... \$45.00  
**Model 515SM.** Same as Model 515SA except low impedance ..... \$45.00

#### 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 ..... \$96.00  
**Model 545S.** Similar to Model 545 but has cable connection through hinge and "on-off" switch in upright ..... \$102.00  
**Model 545SD.** Same as Model 545 but has "on-off" switch on microphone barrel ..... \$102.00  
**Model 545L.** Similar to Model 545 but has lavalier cord and clip ..... \$80.00

#### 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. .... \$155.00

#### 548SD "Unidyne IV" Microphone

Dynamic type. Sensitivity -141 dB (EIA). Response 40-15,000 Hz. User selects high or low impedance. Cardioid pattern. Hand-held with slip-in stand attachment. Use for speech and music. Has "on-off" switch, 15-ft. cable, and connector. Chrome finish ..... \$120.00

#### 55S Dynamic Microphone

Sensitivity -148 dB (EIA). Response 50-15,000 Hz. User selects high or low impedance. Cardioid pattern. Hinge mount to stand. Use for speech and music. Supplied with Amphenol-type MC3M connector and 15-ft. cable. Chrome finish ..... \$95.00  
**Model 55SW.** Same as Model 55S except has built-in "on-off" switch ..... \$98.00

#### 565 "Unisphere 1" Microphone

Dynamic type. Sensitivity -148.5 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. Has pop or blast filter, 15-ft. cable, and connector. Chrome finish ..... \$108.00  
**Model 565SD.** Same as Model 565 except has "on-off" switch ..... \$113.00  
**Model 566.** Similar to Model 565 except with shock mount ..... \$165.00

#### 578 Dynamic 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, 15-ft. cable, and connector. Chrome finish ..... \$90.00  
**Model 578S.** Similar to Model 578 except has swivel assembly ..... \$100.00

#### 580SA(B) Dynamic Microphone

Sensitivity -151 dB (EIA). Response 50-13,000 Hz. User specifies high or low impedance. Cardioid pattern. Hand-held with slip-in stand attachment. Use for speech and music. Comes with "on-off" switch, 15-ft. cable, and connector. Chrome finish ..... \$70.00

#### 585SA(B) Dynamic Microphone

Sensitivity -151 dB (EIA). Response 50-13,000 Hz. User specifies high or low impedance. Cardioid pattern. Hand-held with slip-in stand attachment. Use for speech, rock vocals, and music. Has pop or blast filter, "on-off" switch. Supplied with 15-ft. cable and connector. Chrome finish ..... \$75.00  
**Model 585SAV.** Similar to Model 585SA(B) but has volume control on microphone barrel ..... \$83.00

#### 5885SA(B) Dynamic Microphone

Sensitivity -155 dB (EIA). Response 80-13,000 Hz. User specifies high or low impedance. Car-



dioid pattern. Hand-held with slip-in stand attachment. Use for speech, rock vocals, and music. Has pop or blast filter, "on-off" switch. Comes with 15-ft. cable and connector. Chrome finish ..... \$65.00

#### 579SB Dynamic Microphone

Sensitivity -151 dB (EIA). Response 50-15,000 Hz. Low impedance, omnidirectional pattern. Has slip-in stand attachment, "on-off" switch, pop or blast filter. Use for speech, rock vocals, and music. Supplied with 20-ft. cable and connector. Chrome finish. .... \$75.00

## SONOTRONICS

#### FM Wireless Microphone

FCC-approved cardioid design to be used with any standard FM receiver. Has 60-14,000 Hz



response. Battery operated (7 V pack), 300 battery hours. Typical range 100 to 200 feet; fail-safe range 70 ft. when used with company's receiver. 8 ounces with battery. 1" diameter x 8 1/4" ..... \$130.00  
 Available with firm's FM receiver with built-in antennas, tuning meter. Combination microphone & receiver ..... \$330.00

## SONY/SUPERSCOPE

#### ECM-16 Condenser Microphone

Sensitivity -57.8 dB (0 dB = 1 V/10  $\mu$  bar). Response 50-13,000 Hz. Low impedance, om-

nidirectional pattern. Lavalier-type for speech and tape recording. Supplied with mini connector. Internal battery operation. 6-ft. cable. 9/16" dia. x 1 1/16" long. Silver .... \$34.95

#### ECM-18 Condenser Microphone

Sensitivity -56.8 dB (0 dB = 1 V/10  $\mu$  bar). Response 50-12,000 Hz. Low impedance, cardioid pattern. Hand-held type for speech, music, and tape recording. Supplied with mini connector, dust filter or windscreens. 6.5-ft. cable. Internal battery operation. Silver gray and black ..... \$19.95

#### ECM-19B Condenser Microphone

Sensitivity -54 dB (0 dB = 1 V/10  $\mu$  bar). Response 50-12,000 Hz. Cardioid pattern. Hand-held type with "slip-in" stand attachment. Use for speech, music, and tape recording. Supplied with mini connector, dust filter or windscreens. Internal battery operation. 9-ft. cable. Silver and black ..... \$29.95

#### ECM-21 Condenser Microphone

Sensitivity -54 dB (0 dB = 1 V/10  $\mu$  bar). Response 50-12,000 Hz. Low impedance, balanced 50, 250, 600 ohms. Cardioid pattern. Hand-held with "slip-in" stand attachment. Use for music and tape recording. Comes with dust filter or windscreens and 19-ft. cable. Connector not included. Internal battery operation. Chrome ..... \$54.50

#### ECM-22P Condenser Microphone

Sensitivity -54.8 dB (0 dB = 1 V/10  $\mu$  bar). Response 40-15,000 Hz; Low impedance, balanced 250/600 ohms. Cardioid pattern. Hand-held with "slip-in" stand attachment. Use for speech, rock, vocals, music, and tape recording. Comes with dust filter or windscreens and 20-ft. cable. Connector not included. Internal battery/phantom powering ..... \$99.95

#### ECM-95S Condenser Microphone

Sensitivity -50 dB (0 dB = 1 V/10  $\mu$  bar). Response 70-10,000 Hz. Low impedance. Cardioid pattern. Hand-held. Use for speech and tape recording. Supplied with 2-prong mini connector, stop/go switch, and 4.5-ft. cable. Internal battery operation. Silver .... \$17.95

#### ECM-99 Condenser Microphone

Sensitivity -53 dB (0 dB = 1 V/10  $\mu$  bar). Response 50-12,000 Hz. Low impedance. Cardioid (dual) pattern. Hand-held with "slip-in" stand attachment. Use for music and tape recording. Comes with dust filter or windscreens, 10-ft. cable, mini (2) connector, one-point stereo pickup. Internal battery operation. Nickel satin finish ..... \$39.95

#### F-98 Dynamic Microphone

Sensitivity -58 dB (0 dB = 1 V/10  $\mu$  bar). Low impedance. Cardioid pattern. Hand-held. Use for speech and tape recording. Supplied with mini connector and 6.5-ft. cable ..... \$10.50

## STANFORD

#### MB 207 Dynamic Microphone

Response 80-16,000 Hz  $\pm$ 2.5 dB. Balanced 200 ohms. Cardioid pattern. Hand-held type for recording, speech, and music applications. Has pop or blast filter ..... \$35.00

#### MB 270 Dynamic Microphone

Response 70-15,000 Hz  $\pm$ 2.5 dB. Balanced 200 ohms. Cardioid pattern. Hand-held type for recording, speech, and music. Has pop or blast filter. .... \$60.00  
**Model MB270S.** Same as MB 270 except has slide shorting switch ..... \$65.00

## TEAC

#### MC-201 Microphone

Electret. Response 50-15,000 Hz. Balanced 600 ohms. Has slip-in stand attachment, windscreens, and 10-ft. cable. .... \$50.00

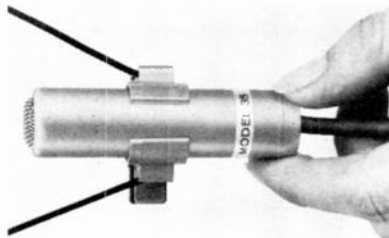
## TAPE RECORDER GUIDE



## TURNER

### 35 Microphone

Dynamic type. Sensitivity -151 dB (EIA), response 40-15,000 Hz. User selects high or low



impedance. Cardioid pattern. Hand-held with for use in speech applications. 25-ft. cable. Non-reflecting desert gold finish ..... \$70.00

### 500 Microphone

Dynamic type. Sensitivity -151 dB (EIA), response 40-15,000 Hz. User selects high or low impedance. Cardioid pattern. Hand-held with "slip-in" stand attachment. For use in recording speech, rock vocals, and music. Pop or blast filter. Detachable 20-ft. cable. Supplied with XLR connector. Satin chrome finish ..... \$100.00

Model S-500. Same except with rotary "on-off" switch ..... \$100.00

### 600 Microphone

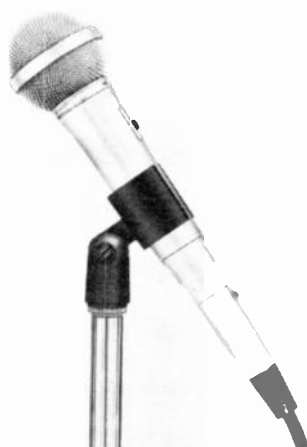
Dynamic type. Sensitivity -151 dB (EIA), response 50-15,000 Hz. High impedance. Car-



dioid pattern. Hand-held with "slip-in" stand attachment. For speech, rock vocals, and music. Pop or blast filter, "on-off" switch. Detachable 20-ft. cable. Satin chrome finish . \$70.00  
Model 602. Same except low-impedance version ..... \$70.00

### 700 Microphone

Dynamic type. Sensitivity -151 dB (EIA), response 40-15,000 Hz. User selects high or low



impedance. Cardioid pattern. Hand-held with "slip-in" stand attachment. For speech, rock vocals, and music. Pop or blast filter, "on-off" switch. Detachable 20-ft. cable. Comes with Switchcraft A4F connector. Satin chrome finish ..... \$95.00

### 2300 Microphone

Dynamic type. Sensitivity -151 dB (EIA), response 50-15,000 Hz. High-impedance, omnidirectional. Hand-held with "slip-in" stand attachment. For speech, rock vocals, music, and tape recording. Has 20-ft cable, "on-off" switch, and phone plug. Satin chrome finish ..... \$80.00

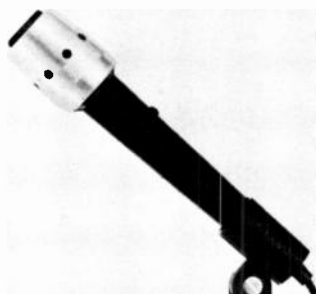
Model 2302. Same except low-impedance version ..... \$80.00

### 2850 Microphone

Dynamic type. Sensitivity -161 dB (EIA), response 70-10,000 Hz. User selects high or low impedance. Cardioid pattern. Hand-held with "slip-in" stand attachment, lavalier clip. Use for speech and tape recording. Does not include connector but does have "on-off" switch and 12-ft. cable. Black ..... \$50.00

### 45 Cardioid Microphone

Dynamic design. Sensitivity -155 dB (EIA), response 100-13,000 Hz. High impedance. Use



for speech, group singing, and music. Supplied with 20-ft. cable, phone plug, stand adapter, and "on-off" switch ..... \$45.00

Model 45A. Same except low-impedance version ..... \$45.00

### 2250 Cardioid Microphone

Dynamic design. Sensitivity -155 dB (EIA), response 70-13,000 Hz. High impedance. Use



for speech, rock vocal groups, and music. Supplied with 20-ft. detachable cable, phone plug, stand adapter, and "on-off" switch. Comes with Cryovac carrying case ... \$65.00  
Model 2255. Same except low-impedance version ..... \$65.00

### SRR2811 Omnidirectional Microphone

Dynamic design. Sensitivity -159 dB (EIA), response 80-12,000 Hz. High impedance. Supplied with 12-ft. cable terminated in a variable-spaced, split 2-prong mini plug for cassette recorders. Has "on-off" switch. Black with desk stand ..... \$20.00  
SRR2812. Same except low impedance ..... \$20.00

## 5 Headphones

### AKAI

#### ASE-22 Dynamic Headphones

Moving-coil type. Response 20-20,000 Hz. Sensitivity 1.0 mW, distortion 1% at 1.0 mW. 8 ohms impedance. 1/2 W maximum input per phone. Has individual earphone volume controls. 6-ft. coiled cord. Weight 20 ounces ..... \$19.95

### AKG

#### K-60 Dynamic Headphones

Moving-coil type. Response 20-20,000 Hz. Sensitivity 1.0 mW at 1000 Hz produces 112 dB



SPL. Distortion less than 1% at 125 dB SPL. 600 ohms impedance. 11 ounces .... \$49.50

#### K-180 Dynamic Headphones

Moving-coil type. Response 16-20,000 Hz. Sensitivity 1.0mW at 1000 Hz produces 112 dB SPL. Distortion less than 1% at 125 dB SPL. 600 ohms impedance. 85-inch coiled cord. Control moves headphone driver back and forth with headphone cup. 21 ounces ..... \$69.00

### ALLIED RADIO SHACK

#### Custom Pro Headphones

Dynamic type. Response 20-20,000 Hz. Imped-



ance 4 to 16 ohms; bass port ..... \$23.95

#### Pro-1 Headphones

Dynamic type. Response 10-24,000 Hz; 8 ohms impedance; 10-ft. coiled cord; fluid-filled ear cushions. Has individual earphone volume controls ..... \$49.95

#### Nova Pro Headphones

Stereo dynamic design with volume controls on each earcup. Response 20-20,000 Hz; 8 ohms impedance. 10-ft. coiled cord ..... \$29.95

### ASTROCOM/MARLUX

#### Stereo Headphones

Dynamic type. Response 30-18,000 Hz, 8 ohms impedance. Sensitivity 1 mW, maximum input 500 mW. Distortion 1%. Features replaceable headpad, ear cushions, and cord. 6-ft. coiled cord, 15 ounces ..... \$39.95



## 5 Headphones

### AUDIOTEX

#### 30-5204 Dynamic Headphones

Response 20-20,000 Hz. Impedance 4 to 16 ohms. Maximum input per phone 0.8 W. Has 6-



ft. coiled cord and individual earpiece slider volume controls ..... \$29.95

#### 30-5206 Dynamic Headphones

Response 10-20,000 Hz. Impedance 4 to 16 ohms. Has 6-ft. coiled cord ..... \$59.95

### BEYER

#### DT96A Dynamic Headphones

Moving coil type. Response 30-17,000 Hz. Sensitivity 1.0 mW at 400 Hz produces 110 dB (re  $2 \times 10^{-4}$   $\mu$ bar). 50-200 ohms impedance. 100 mW maximum input per phone. 5-ft. cord. 8 ounces ..... \$37.50

#### DT100 Dynamic Headphones

Moving coil type. Response 30-18,000 Hz. Sensitivity 1 mW at 400 Hz produces 110 dB



(re  $2 \times 10^{-4}$   $\mu$ bar). 5-100-400-2000 ohms impedance. 1 W maximum input per phone ..... \$57.50

#### DT900 Dynamic Headphones

Moving coil type. Response 30-18,000 Hz. 5-



2000 ohms impedance. 200 mW maximum input per phone. 6-ft. cord ..... \$29.95

#### DT480 Dynamic Headphones

Moving coil type. Response 20-18,000 Hz. Sensitivity 1 mW at 400 Hz produces 115 dB (re  $2 \times 10^{-4}$   $\mu$ bar). 25-200 ohms impedance. 1 W maximum input per phone. .... \$75.00

### CLARK, DAVID

#### 100A Headphones

Dynamic type with frequency response 20-10,000 Hz  $\pm 3$  dB. Sensitivity 1.0 mW at 1000



Hz produces 100 dB (reference 0.0002  $\mu$ bar). Distortion less than 0.2% at 100 phon. 17 ohms impedance and 1.0 W maximum input per phone. 8-ft. coiled cord. 16 ounces. Also available in impedances of 300, 600, and 1200 ohms ..... \$50.00

#### 200 Headphones

Permanent-magnet type with frequency response 20-17,000 Hz. Sensitivity 1.0 mW at 1000 Hz produces 105 dB (reference 0.0002  $\mu$ bar). 8 ohms impedance. 1.0 W input. 17 ounces ..... \$29.00

#### 250 Headphones

Similar to 200, but with individual earphone volume control ..... \$34.00

#### 300 Headphones

Permanent-magnet type with frequency response 20-17,000 Hz. Sensitivity 1.0 mW at



1000 Hz produces 105 dB (reference 0.0002  $\mu$ bar). 8 ohms impedance. 1.0 W maximum input per phone. 10-ft. coiled cord .... \$21.00

### ERCONA

#### RDF-224 Headphones

Stereo/mono dynamic design. Response 20-



18,000 Hz. Output impedance 8 ohms  $\pm 20\%$  at 1 kHz. Output 100 dB at 1 kHz. Maximum power 100 mW. Weight 20 ounces ... \$24.95

### FISHER

#### HP-70 Dynamic Headphones

Response 30-18,000 Hz. Sensitivity 2.5 mW for



average listening. Max. power 0.5 W. 16 ohms. 10-ft. coiled cord. 12 ounces ..... \$29.95

#### HP-100 Dynamic Headphones

Response 18-22,000 Hz. Sensitivity 2 mW for average listening. Max. power 0.7 W. 50 ohms. 10 ounces ..... \$49.95

### HITACHI

#### HD-66 Dynamic Headphones

Response 20-18,000 Hz. Distortion less than 1.0% at 1 mW. 8 ohms impedance. 0.5 W maximum input per phone. 12 ounces .... \$24.95

### KENWOOD

#### KH-71 Stereo Headphones

Open-back dynamic design. Has 3" speakers. Response 20-20,000 Hz. Max. input 0.5 W, 8



ohms. With 12-ft. coiled cord ..... \$49.95  
KH-51. Economy version ..... \$29.95

### KLH

#### Eighty Dynamic Headphones

Response 20-20,000 Hz  $\pm 4$  dB; sensitivity 1 mW at 1000 Hz produces 112 dB (80  $\mu$ bar).

### TAPE RECORDER GUIDE

Distortion 0.5% at 112 dB SPL. 600 ohms impedance, 1.66 mW maximum input per phone. Has special headband webbing which conforms exactly to shape of wearer's head. Phones may be driven from 0-600 ohm source. Has 10-ft. cord. Weight 11¼ ounces. Black and gray ..... \$49.95

## KOSS

### ESP-9 Electrostatic Headphones

Frequency response 15-15,000 Hz  $\pm 2$  dB. Sensitivity 80 dB SPL (reference 0.0002



dyne/cm<sup>2</sup>). Distortion less than 0.2% at 110 dB SPL. 4 to 16 ohms impedance. 6-ft. coiled cord. 19 ounces. Black, fluid-filled earcups for ambient noise isolation. Designed for critical studio monitoring ..... \$150.00

### ESP-6 Electrostatic Headphones

Frequency response 30-19,000 Hz  $\pm 5$  dB. Sensitivity 80 dB SPL (reference 0.0002 dyne/cm<sup>2</sup>). Distortion less than 0.2% at 110 dB SPL. 4 to 16 ohms impedance. 10-ft. coiled cord. 27 ounces. Black, fluid-filled earcups for ambient noise isolation. Self-contained polarizer ..... \$95.00

### PRO-4AA Dynamic Headphones

Frequency response 10-20,000 Hz. Distortion is negligible at 95 dB SPL. 4 to 16 ohms im-



pedance. 10-ft. coiled cord. 19 ounces. Fluid-filled earcups for ambient noise isolation ..... \$60.00

### PRO-600AA Dynamic Headphones

Same as PRO-4AA except nominally 600 ohms voice-coil impedance for matching audio transmission lines. 600 ohms characteristic impedance. Available on special order ..... \$65.00

### KO-727B Dynamic Headphones

Frequency response 10-16,000 Hz. Distortion unmeasurable at 95 dB SPL. 4 to 16 ohms impedance. 10-ft. coiled cord. 19 ounces. Dark green finish ..... \$34.95

## KO-747 Stereo/Mono Headphones

Compatible with both stereo and mono music sources. Features a volume control on each



earcup for fine adjustments in level and balance. Incorporates the firm's new driver element. Has extendible, stainless-steel headband with self-adjusting, pivoting yoke to permit the phones to fit any head size. Frequency response 30-20,000 Hz. Two-tone brown. Fluid-filled washable ear cushions ... \$45.00

### KRD-711 "Red Devil" Headphones

Dynamic type. Frequency response 10-17,000 Hz. THD less than 1/2% at 110 dB SPL. 3.2 to 600 ohms impedance. 5 V maximum input per phone. 10-ft. coiled cord. 12 ounces. Red solid plastic ..... \$29.95  
K-711 Same as above, but in jet black... \$29.95

### K-6LC Dynamic Headphones

Frequency response 10-16,000 Hz. Distortion unmeasurable at 95 dB SPL. 4 to 16 ohms impedance. 10-ft. coiled cord. Individual earphone volume controls. Brown/beige . \$29.95  
Model K-6. Same except without volume controls ..... \$26.50

### SP-5SM Headphones

Similar to SP-3XC below but with lavalier switch to change from stereo to monaural ..... \$24.95

### SP-3XC Headphones

Frequency response 10-14,000 Hz. 4 to 16 ohms impedance. 10-ft. coiled cord. Brown ..... \$19.95

### T-10A Chairside Listening Station

Offers remote control for two sets of stereophones. Features separate volume controls for each stereophone and a speaker "on-off" switch. Wires directly to amplifier or receiver. Unit measures 6" diameter and has a walnut-like base combined with black trim and aluminum control panel ..... \$19.95

### T-5 Remote Control Station

Similar to T-10A. Has jacks for two sets of stereophones. Left- and right-channel volume controls and speaker "on-off" switch. Metal cabinet ..... \$9.95

### T-4A Connector Box

Accepts up to five sets of stereophones. 14-ft. cord with 3-conductor phone plug fits standard headphone jack. Private listening for five persons at one time. Unit measures 6" diameter and has walnut-like base combined with black trim and aluminum plug-in panel . . . . . \$12.95

## T-4 Connector Box

Accepts up to five sets of stereophones. 10-ft. cord with 3-conductor phone plug fits standard headphone jack. Provides private stereo listening for up to five persons at one time. Suitable for use in schools and libraries as well as in the home ..... \$7.95

## T-3 Speaker/Headphone Transfer Switch

Provides a speaker "on-off" switch and stereo-phone jack. Connects to speaker terminals of amplifier or receiver. Adds low-impedance jack to system for wide-range performance of stereophones ..... \$7.95

## T-1 Monitoring Adapter

For use with dynamic phones in monitoring tapes from high-impedance sources such as tape recorders with preamps only. Adapter contains matching transformers to match 600 to 10,000 ohm outputs down to 4 ohms. Equipped with two output jacks for stereophones and two pin-type jacks for inputs ..... \$7.95

## MICOTRON

### 17-007 Dynamic Headphones

Frequency response 20-18,000 Hz. 8 ohms impedance. 10-ft. coiled cord. Has individual



channel volume controls. Shipping weight 13¼ pounds. Beige ..... \$14.95

## MIDLAND

### 21-328B Headphones

Dynamic type. Frequency response 20-20,000 Hz, 8 ohms impedance. Has coiled cord and separate earphone level controls. 16 ounces. Gray ..... \$25.00

## OLSON

### PH-192 Dynamic Headphones

Stereo design with volume controls. 7-ft. cord.



## ALWAYS . . . . .

take along your copy of this Directory when shopping for hi-fi components. It is a comprehensive reference to complete technical details and prices . . . and when writing to manufacturers, tell them you saw it in the Tape Recorder Guide.



## 5 Headphones

Response 15-30,000 Hz. Impedance 8 ohms  
..... \$30.00

### PIONEER

#### SE-20A Headphones

Dynamic type. Response 20-18,000 Hz, 4-16



ohms impedance. 0.5 W max. input per phone.  
8-ft. coiled cord with a 3-conductor stereo  
plug. 13 ounces ..... \$24.95

#### SE-30A Headphones

Dynamic design, 4-16 ohms. Response 20-  
20,000 Hz. Sensitivity 115 dB/0.3 V (400 Hz,  
artificial ear). Max. input 2 V per phone. 2 3/4"  
driver unit. Supplied with 16-ft. coiled cord  
with 3-conductor phone plug. 13.4 ounces ....  
..... \$34.95

#### SE-50 Headphones

Dynamic design. Response 20-20,000 Hz, 4-16  
ohms impedance. 0.5 W max. input per phone.



Tweeter and volume controls on each earpiece.  
16-ft. coiled cord with 3-conductor phone  
plug. 24 ounces ..... \$49.95

#### SE-L20 Headphones

Dynamic type. Response 20-20,000 Hz, 4-16  
ohms impedance. 0.3 W max. input per phone.  
Features specially designed high-molecular-  
film diaphragm 1 1/2" speaker in each earpiece.  
..... \$29.95

Note: Models SE-30A, SE-50, and SE-20A are  
similar in appearance.

### SANSUI

#### SS-2 Dynamic Headphones

Moving-coil type. Response 20-18,000 Hz, dis-  
tortion 1% at 1 mW. 8 ohms impedance. 500  
mW max. input per phone. 6-ft. cord. 12 1/2  
ounces. Black and white ..... \$14.95

#### SS-10 Dynamic Headphones

Moving-coil type. Response 20-20,000 Hz. 8  
ohms impedance. 500 mW max. input per  
phone. 10-ft. coiled cord. Has individual head-

phone volume controls and "Y" connector for  
simultaneous use of extra headset. 22 ounces.  
Cream ..... \$29.95

### SENNHEISER

#### HD414 Headphones

Dynamic stereo design. 2000 ohms/ch. Re-  
sponse 20-20,000 Hz. Sensitivity 17.7  $\mu$ bar/V.  
Normal power 1 mW/ch (1.41V) for sound pres-  
sure of 102 dB. HD 1% at 22 V & 1000 Hz. Can  
be connected to any preamp output. 5 ounces  
without cord. 10-ft. cable ..... \$29.95

### SHARPE

#### 7 Dynamic Headphones

Response 15-20,000 Hz. Sensitivity 0.34 V at  
100 dB SPL; distortion 0.9% at 1000 Hz. 4 to  
16 ohms impedance. 1.0 W maximum input per  
phone. 14-ft. coiled cord. 9 ounces. Bronze  
..... \$19.95

#### 9B Dynamic Headphones

Response 15-20,000 Hz. Sensitivity 0.1 V at  
100 dB SPL; distortion 0.25% at 1000 Hz. 4 to  
16 ohms impedance. 1.0 W maximum input per  
phone. 14-ft. coiled cord. 16 ounces. Gray  
..... \$29.95

#### 10B Dynamic Headphones

Response 30-15,000 Hz  $\pm$ 3 dB. Sensitivity  
0.23 V at 100 dB SPL; distortion 0.3% at 1000  
Hz. 4 to 16 ohms impedance. 2.0 W maximum  
input per phone. 14-ft. coiled cord. 18 ounces.  
Green ..... \$39.95

#### 10A Dynamic Headphones

Same as Model 10B but with 10-ft. straight  
cord ..... \$36.95

#### 660/PRO Dynamic Headphones

Response 20-20,000 Hz  $\pm$ 3 dB. Sensitivity  
0.82 V at 100 dB SPL; distortion 0.6% at 1000  
Hz. 4 to 16 ohms impedance. 1.0 W maximum  
input per phone. 14-ft. coiled cord. 18 ounces.  
3/10 A fuse protects against overloads. Bronze  
..... \$60.00

#### 770 Dynamic Headphones

Response 20-20,000 Hz  $\pm$ 3 dB. Sensitivity  
0.82 V at 100 dB SPL; distortion 0.6% at 1000



Hz. 4 to 16 ohms impedance. 1.0 W maximum  
input per phone. 14-ft. coiled cord. 19 ounces.  
3/10 A fuse protects against overloads. Walnut  
..... \$100.00

### STANFORD

#### MB K61 Dynamic Headphones

Moving-coil type. Response 20-16,000 Hz.  
Sensitivity 0.2 mW produces 100 phn. 16  
ohms impedance. 7 1/2-ft. cord (uncoiled).  
Weight 12 ounces ..... \$14.95

#### MB K600 Dynamic Headphones

Moving-coil type. Response 16-20,000 Hz.

Sensitivity 0.2 mW produces 100 phn. Distor-  
tion 0.3% at 120 phn. 400 ohms impedance.  
Maximum input per phone 0.4 W. 7 1/2-ft. cord  
(uncoiled). Weight 14 ounces ..... \$69.95

### STANTON

#### Isophase Electrostatic Headphones

Electrostatic design. Response 30-15,000 Hz  
 $\pm$ 3 dB. Sensitivity 2 V for 100 dB (SPL) sound



pressure level at 1000 Hz. Distortion 1% at  
115 SPL. Impedance 4-16 ohms. Has automat-  
ic cut-out circuit at 110 dB SPL. Supplied with  
Mark III electrostatic polarizer unit (also  
switches from headset to main speaker opera-  
tion). Power requirements 120 V a.c., 4 W. For  
use with power amplifiers of 10 W or over. 11-  
ft. cord. 15 ounces. 4 3/4" W  $\times$  7 3/8" D  $\times$  2 3/4" H.  
Beige and cream ..... \$159.95  
Second headset ..... \$75.00  
2-headset "Y" adapter ..... \$9.95  
10-ft. extension cord ..... \$15.95

#### Dynaphase Sixty Headphones

Dynamic design; two-way system—woofer &  
tweeter with individual LC crossover. Response



40-11,000 Hz  $\pm$ 3 dB. Sensitivity 95 dB for 1  
mW at 1000 Hz (100 dB sound pressure level).  
Distortion 1% at 115 dB SPL. Impedance 12  
ohms. Power input 0.5 W rms max. per phone.  
10-ft. coiled cord. 28 ounces. Can use same  
accessories as the Dynaphase Forty. Blue and  
black ..... \$59.95

#### Dynaphase Forty Headphones

Dynamic design. Response 60-10,000 Hz  $\pm$ 3  
dB. Distortion 1% at 115 dB SPL. 12 ohms



impedance at 1000 Hz; Power input 0.5 W rms  
max. per phone. 10-ft cord. 21 ounces. Blue-  
black/chrome ..... \$39.95  
Model 5741. Separate volume & tone controls  
for each channel, stereo/mono switch & 17-ft.  
extension coiled cord ..... \$19.95  
Model 5742. 25-ft. extension coiled cord \$7.95



## SUPEREX

### PEP-77C Electrostatic Headphones

Frequency response 10-22,000 Hz  $\pm 5$  dB. 4 to 16 ohms impedance. 5 W minimum input to



energizer. Uses "console" energizer (included). Provides two-phone accommodation and separate channel grounds. 15-ft. coiled cord. 12 ounces ..... \$99.00

### PROB-V Headphones

Has moving-coil dynamic woofer and ceramic tweeter. Response 16-25,000 Hz. 4 to 16 ohms impedance. 2 W maximum input per phone. 10-ft. coiled cord ..... \$59.95

### SST Headphones

Has moving-coil dynamic woofer and ceramic tweeter. Response 20-20,000 Hz. Sensitivity 15 mW. 4 to 16 ohms impedance. 2 W maximum input per phone. Includes individual volume and tweeter-level controls on earphone. 15-ft. coiled cord. Green ..... \$39.95

### EA500 Stereo-Headphone Amp

Compact, solid-state design. Response 100-20,000 Hz  $\pm 2$  dB at maximum volume setting, tuner input, and with both channels driven. THD: speakers less than 2%; phones less than 0.5%. Maximum sine-wave output: speakers & phones 500 mW into 8 ohms both channels driven. Hum level 75 dB below full output on mag. phono inputs. Unit has front-panel input (tuner-phonos) selector, left & right volume controls, two parallel stereo headphone jacks, illuminated power switch, rear-panel mag. phono



input, tuner input, speaker output, and speaker-phones switch. 3" x 10 3/4" x 8 1/3" D . \$79.95

### ST-M Stereo Master Headphones

Has moving-coil dynamic woofer and ceramic tweeter. Response 20-20,000 Hz. 8 to 16 ohms impedance. 2 W maximum input per phone. Tweeter level control on each earphone. Has 7-ft. coiled cord ..... \$29.95

### ST-PRO-B Headphones

Moving-coil dynamic woofer and ceramic tweeter. Response 18-22,000 Hz. 4 to 16 ohms impedance. 2 W maximum input per phone. 7-ft. coiled cord ..... \$50.00

### ST-S-U Headphones

Moving-coil dynamic type. Response 30-15,000 Hz. Switch-selected 4 to 8 ohms or 2000 ohms impedance. 2 W maximum input per phone. 7-ft. coiled cord ..... \$31.95

### ST-VC Headphones

Moving-coil dynamic type. Response 30-15,000 Hz. 4 to 16 ohms impedance. 2 W maximum input per phone. Designed for the hard-of-hearing, with individual earphone volume controls. 7-ft. coiled cord ..... \$27.95

### SW-2 Swinger Headphones

Moving-coil dynamic type. Response 30-16,000 Hz. 4 to 16 ohms impedance. 2 W maximum input per phone. 10-ft coiled cord. White ..... \$24.95

## TEAC

### HP-101 Dynamic Headphones

Stereo design. Frequency response 18-20,000 Hz. 8 ohms. Input sensitivity 1 mW, maximum power 500 mW. 6-ft. cable ..... \$25.00  
**HP-102.** Same as HP-101 except 10,000 ohms impedance ..... \$25.00

## TELEX

### Serenata SER-1 Headphones



Dynamic design. Response 20-20,000 Hz. 3 to 16 ohms impedance. Distortion 0.5%. Has 8-ft. coiled cord, tone control, and comfort control to adjust earcups for optimum comfort. Liquid-filled ear cushions. With carrying caddy ..... \$59.95  
**SER-11.** Same but without comfort control and with fixed 8-ft. cord ..... \$44.95  
**SER-6.** Same as SER-11 but 600 ohms ..... \$44.95

### Studio 1 Headphones

Dynamic design. Response 20-22,000 Hz. Sensitivity 105 dB SPL/mW. Distortion 1.0% at



122 dB SPL. 3 to 16 ohms impedance. 1.0 W maximum input per phone. Has tone & volume controls on each earphone. 25-ft. coiled cord. 24 ounces ..... \$69.95  
**Studio 2.** Same except without controls ..... \$59.95

## WHY HEADPHONES?

**T**HE most obvious reason for using stereo headphones is the ability to listen at high volume levels without disturbing other members of the family or the neighbors. While many high-fidelity enthusiasts would not consider their music systems to be part of the "noise pollution" scene, other people sometimes take a different view. Most stereo headphones provide this benefit in reverse, isolating the wearer from outside noises which might interfere with his listening enjoyment.

Another unique characteristic of headphone listening is the removal of the wearer—acoustically speaking—from his environment. Room characteristics, which have so much to do with loudspeaker performance, have no effect on headphone sound. The listener hears only what the microphones in the concert hall or recording studio picked up. The effect, especially to one experiencing it for the first time, can be very impressive.

Most stereo headphones are miniature dynamic loudspeakers, with cones from 2 1/2" to 3 1/2" in diameter, designed to couple to the ear cavity instead of to a large room volume. Their bass response, if the air seal around

the ears is tight, can match that of the finest speaker systems. Headphones share most of the sonic aberrations of speakers, and differ as widely in their sound as do speakers. For this reason, listening is the best way to make a selection. Fortunately, listening can be done in a dealer's showroom with as much validity as they can be tested in the home.

A few low-priced headphones use magnetic transducers similar in principle to telephone headsets. These are audibly inferior to most dynamic headsets. Some headphones have miniature two-way speakers in each earpiece, with a separate high-frequency speaker or "tweeter." Often these have individual tweeter-level controls and individual volume controls on each earpiece.

The best—and most expensive—headphones use electrostatic generating elements. They may not be adaptable to low-powered, inexpensive amplifiers and are quite heavy and bulky as compared to most dynamic headphones. However, it is helpful to listen to a good electrostatic headphone before making a choice, if only to provide a frame of reference.

## 5 Accessories

### ADVENT

#### 100A Dolby System

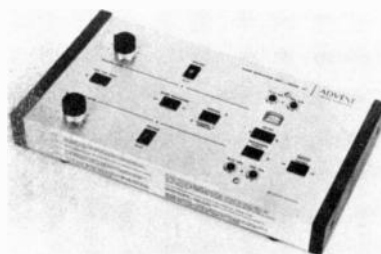
Noise-reduction unit with Dolby system for home tape recording/playback. Also plays Dol-



by-encoded pre-recorded commercial tapes and FM broadcasts. Provides four-input mixing (two on each channel), headphone monitoring, and sound-on-sound recording. Harmonic and IM distortion 0.1%. 5" x 12 7/8" x 8 3/4" D. Cabinet extra ..... \$275.00

#### 101 Dolby System

Similar in principle to Model 100A, but can only be used in record or playback mode (uses



same circuitry), but not simultaneously for two operational modes ..... \$125.00

### AUDIOTEX

#### Kleentape Kit

Restores performance by removing deposit on reel-to-reel recorder heads. Works automatically—impregnated cloth tape is "played" through machine. Cleans guides and rollers as well. Kit includes 5" reel with cleaning tape plus bottle of impregnating fluid. #30-126 ..... \$2.25

#### Tape-Head Cleaner

Aerosol spray for use on all tape recorders and players. Loosens oxide and dust on tape heads. Comes with 5" extension tube to reach recessed heads in auto stereos and other hard-to-reach places.

#30-630 3 oz. aerosol can ..... \$1.75  
#30-128 6 oz. economy size ..... \$2.25

#### Head Cleaner/Lubricant

Removes dirt and grease. Lubricant with silicone, applied liberally to recorder head, leaves



light protective film to reduce friction. Cuts wow, flutter, and tape squeals. Cotton swab applicators included. #30-124-3 ..... \$1.95

#### Recorder Care Kit

Kit includes professional tape slicer, splicing

tape, tape-head cleaner and lubricant, tape reel holders, tape end clips, cleaning brush and cotton swabs, cleaning cloth, tape cueing and indexing labels. #30-125 ..... \$9.95

#### Cassette Head Cleaners

To "dry clean" heads in cassette recorders. Will remove all deposits on heads, guides, etc. and restore original sound quality. Uses special cloth belt impregnated with solvent. Non-abrasive and guaranteed safe. Cleaning cassette comes in storage box with fluid and dropper applicator. #30-618 ..... \$4.95

#### 8-Track Stereo Head Cleaner

Consists of an endless cloth belt impregnated with special fluid that dissolves accumulated dust and magnetic particle deposits. Works on "dry cleaning" principle. Non-abrasive and safe. Comes with fluid, dropper applicator and 5 replacement belts. #30-620 ..... \$5.95

#### Cassette Tape Splicers

Semi-automatic. Has "cut" position to provide a diagonal cut on tape ends. After applying



splicing tape, handle is set to "trim" position which trims sides and leaves edges free from adhesive.

#30-104 For reel-to-reel 1/4" tape ..... \$4.95  
#30-650 For 1/8" wide cassette tape ... \$4.95

#### Test Tapes

For checking recorders and players for performance and proper alignment. Precision tapes contain recordings to check or measure frequency response and equalization, flutter, wow, distortion, stereo balance, separation and channel identification, and tape-head alignment.

#30-212 Cassette type ..... \$5.60  
#30-213 4- and 8-track cartridge type . \$7.95  
#30-214 4-track reel-to-reel, 7 1/2 ips stereo type, 5" reel ..... \$6.80  
#30-2610 2-track mono reel-to-reel, 3 3/4 & 1 1/8 ips. Designed specifically for portable recorders ..... \$4.95

#### Magnetic Tape Eraser

Universal bulk eraser for reels, cassettes, cartridges, and video tape. May be used as table



or hand-held model. Erases all recordings and background noise. UL and CSA approved. #30-140 ..... \$17.95

#### Head Demagnetizer

Demagnetizes player heads. Extra long tip will reach into tape cartridge players. Tip is coated with soft plastic to prevent head damage. Comes with momentary push-button switch and 6-ft. cord. #30-112-2 ..... \$11.95

#### Tape Strobe

Designed to check accuracy of tape recorder speed. 7 1/2 and 3 3/4 ips test speeds.

#30-234 Strobe ..... \$7.50

#30-238 Strobe light ..... \$1.75

#### Strobe/Tape Kit

Monitors speeds of either 3 3/4 or 7 1/2 ips for proper adjustment. Precisely calibrated mark-



ings on tape will appear motionless when viewed under strobe light at proper speed. Complete kit with instructions.

#30-2600 ..... \$6.95

### CHEMTRONICS

#### Tape Head Cleaner

Aerosol cleaner formulated for cassette, reel-to-reel, and 8-track recorders and players. Removes dirt, film, and oxides from heads, tape guides, capstan rollers, and other critical parts. Furnished with spray extender for pinpoint application. #THC-6 ..... \$2.49  
504-3. Same except 2-oz. bottle with special felt applicator ..... \$1.49

#### Drive/Belt Restorer

Restores hardened and glazed rubber drives and belts. Fast drying. Prevents slippage and insures uniform speed. Comes with felt applicator. 2 ounces. #507-7 ..... \$1.50

#### Cassette Head Cleaner

Non-abrasive buffing tape. Cleans graphite deposits from tape head. To be used the same as regular cartridge. #CHC ..... \$1.98

#### Cassette Maintenance Kit

Performs double cleaning function of tape head and capstan shaft cleaner. Uses special cleaning liquid applied directly to non-abrasive buffing tape. #CHC-Kit ..... \$2.98

#### 8-Track Head Cleaner

Cleans graphite deposits from tape heads with gentle wiping action. In use it is inserted in tape player and run for 30 seconds for every 50 hours of operation. #TR-8 ..... \$1.98

#### 8-Track Maintenance Kit

Cleans player head and capstan shaft with special cleaning liquid applied to tape. Prepared cartridge is inserted in player and job is done in seconds. Designed to be used weekly. #TR-8 Kit ..... \$2.98

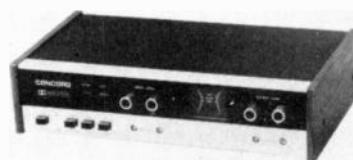
#### Double-Head Cleaner

Requires no liquids or solvents. Works automatically in seconds. Has click timer. Removes graphite deposits from magnetic head and capstan shaft and prevents build-ups which often cause tape pull-out and breakage. Use after every 40 hours of play. #DH-8 ... \$3.49

### CONCORD

#### DBA-10 Dolby System

Record/playback noise-reduction system using Dolby B-type circuitry. Has individual input/output channel-level controls with calibration adjustments available from front panel. Includes a built-in calibration tone signal and twin DIN/Dolby NAB meters. Response 20-20,000 Hz  $\pm 0.5$  dB, HD 0.4%. Input sensitivity





30 mV, output 0.58 V adjustable. Noise reduction 8 dB at 2000 Hz, 10 dB at 5000 Hz. 13 1/2" x 3 1/2" x 7 1/4" D ..... \$129.95

## EDITALL

### KP-2 Editing Kit

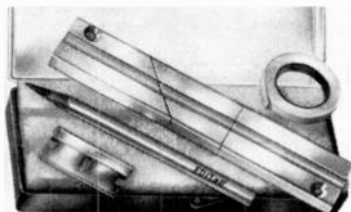
Complete kit includes splicing block, 30 splicing tapes, demagnetized razor blade, and grease pencil ..... \$3.50

### P-2 Splicing Block

Plastic splicing block for 1/4" tapes .... \$1.50

### KS-2 Editing Kit

For 1/4" tape, includes a 4" x 3/4" x 1 1/4" block,



marking pencil, roll of splicing tape, and cutting blade ..... \$8.50

### KS-3 Editing Kit

Same as KS-2 except includes larger block (5 3/4" x 1" x 3/8") ..... \$10.00

### Metal Splicing Blocks

- S-1, For 150" cassette-type tape ... \$9.00
- S-2, For 1/4" tape compact machines \$7.50
- S-3, For 1/4" tape console machines . \$9.00
- S-3.5, For 1/2" tape ..... \$25.00
- S-3.75, For 3/4" tape ..... \$30.00

## ERCONA

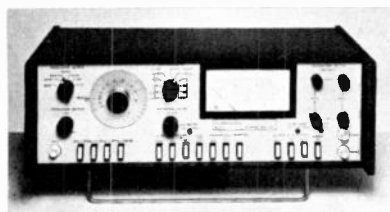
### Microphone Mixer

3-channel design for two low-level microphones (200 ohms balanced) and an auxiliary high-level input. Output 200 ohms, 1 V. Response 50-15,000 Hz  $\pm 1$  dB. Has tone controls. 8 1/4" x 5 1/4" x 3 1/2" ..... \$99.50

## FERROGRAPH

### RTS-1 Recorder Test Set

Will test wow & flutter, frequency response, S/N ratio, gain, distortion, crosstalk, erasure,



input sensitivity, output power, and drift. Input required 35 mV to 5 V. Has output for oscilloscope. 17 3/8" x 10" x 5 5/8" H. .... \$1050.00

## KENWOOD

### KF-8011 Audio "De-Noiser"

Will reduce undesirable background noise in the audio high frequencies of any program source by 6 to 15 dB. It can be used with Dolby systems to further reduce noise. Has four individually controlled, narrow, sharp filters which divide the frequencies between 3 and 15 kHz into four frequency ranges. Connects into tape record and play terminals. Response 10-80,000 Hz  $\pm 0.5$  dB, amplification factor 0 dB  $\pm 1$  dB. HD 0.09% at 5.5 kHz, 1 V input . \$199.95

## MICOTRON

### 17-014 8-Track Head Cleaner

1972 SPRING EDITION

An abrasive tape that cleans as it passes over heads ..... \$1.49

### 17-013 Cassette Head Cleaner

An abrasive tape that cleans as it passes over heads ..... \$1.09

## MIDLAND

### 14-580 8-Track Head Demagnetizer

Operates from 117-volt a.c. line. Will also re-



move dust and oxide deposits. .... \$4.95

### 14-579 8-Track Head Demagnetizer

Same as the Model 14-580 except designed for 12-volt d.c. operation ..... \$7.79

## 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  $\mu$ in gap spacer. For use with vacuum-tube or transistor circuits. No-mount type ..... \$94.50
- #5602. Low imp., 90 mH, 100  $\mu$ in gap spacer. For use with vacuum-tube or transistor circuits. No-mount type ..... \$94.50
- #5603. Medium imp., 370 mH, 100  $\mu$ in gap spacer. For use with vacuum-tube or transistor circuits. No-mount type ..... \$94.50

### Professional Tape/Head Cleaner

A fluorocarbon solvent formulated to clean without leaving any residue. There is no silicone lubricant, allowing use on capstans and pressure rollers. Safe for plastics, rubber, metals, painted surfaces, and elastomer parts. Meets all standards of MSFC No. 237A. Chemicals used in this cleaner have low surface tension and high density to penetrate into small crevices. Its high dielectric strength and quick-drying qualities allow use during equipment operations. Is relatively non-toxic and non-flammable.

- #HC-100-8, 8 oz. liquid (can) ..... \$2.25
- #HC-100-32, 32 oz. liquid (can) . . . \$7.50
- #HC-200-16, 16 oz. spray (can) . . . \$2.75

### QM-102 Liquid Head Cleaner

Will remove impacted dirt and oxide deposits. Can be used on plastics, rubber, metals, painted surfaces, epoxies, elastomer parts. High dielectric strength and quick drying. Leaves no residue. Contains no silicone lubricant. 1 1/4 oz ..... \$1.50

QM-103. Same as QM-102 except in 3-oz. spray can with 5" extension tube ..... \$2.40

### QM-140 Cassette Head Cleaner

Features special non-abrasive belt to remove accumulated oxide and dirt from cassette heads ..... \$2.90

QM-141. Same as QM-140 but supplied with a liquid cleaner for removing heavier accumulations of oxide and dirt ..... \$3.90

### QM-180 8-Track Cassette Head Cleaner

Special non-abrasive endless belt of woven Dacron and cotton which removes accumulated oxide and other contaminants. Sensing tab for proper indexing to clean entire head face

..... \$3.50  
QM-181. Same as QM-180 except supplied with liquid cleaner ..... \$4.50

### QM-182 8-Track Head/Capstan-Cleaner

Accessory unit which has a special non-abrasive endless belt on one end for removing oxide and other contaminants and on the other end a capstan cleaner made from Microlon ..... \$4.50

### QM-201 Wand Head Demagnetizer

Professional unit that removes residual magnetism from heads, tape guides, and capstans. Flat tip reaches most heads without removing cover plate. Tip is specially coated with soft plastic material that will not scratch head surfaces. Comes with momentary switch and 6-ft. cord. 110-120 V a.c., 50-60 Hz ..... \$12.90

### QM-210 Bulk Tape Eraser

Hand-held unit which bulk erases an entire reel, cassette, or cartridge in seconds. Reduces background noise levels to below that of virgin tape. Built-in momentary switch. Supplied with a.c. cord ..... \$21.50

### QM-240 Cassette Head Demagnetizer

Removes residual magnetism from cassette heads. Operates on 110-120 V a.c., 50-60 Hz. Comes with a.c. cord ..... \$11.50

### QM-280 8-Track Cleaner/Demagnetizer

Dual-purpose accessory which demagnetizes heads in 8-track machines and provides endless cleaning belt for removing dirt and oxide from the head. Supplied with a.c. cord for operation on 110-120 V a.c., 50-60 Hz .. \$13.90

QM-281. Same as QM-280 but designed for operation on 12-V d.c. automotive battery. Supplied with cigarette lighter plug .. \$14.90

### QM-301 Splicer

For rapid tape editing and repair of all 1/4" tapes. Provides both diagonal and waist-type cuts. Tape guides and hold-down fingers secure tape firmly ..... \$5.00  
QM-340. Same as QM-301 except designed for use with 0.150" cassette tapes ..... \$5.00

### QM-401 Alignment Tape

7 1/2 ips full-track tape for checking 1/4" record/play heads of all types. 40-10,000 Hz. Recorded for checking azimuth, equalization, and head wear ..... \$9.90

### QM-440 Cassette Alignment Tape

3 3/4 ips full-track tape for checking cassette record/play heads of all types. 31.5-10,000 Hz. Original recorded tones for zero reference, azimuth, and frequency-response tests .. \$21.00

### QM-501 Splicing Tape

A 1/2" x 150" roll of Mylar splicing tape that will not bleed or creep ..... \$1.20  
The company has prepared a 14-page "Maintenance Guide" which is available without charge from local Nortronics distributors. It covers the problems that degrade performance and sound quality. It describes a preventive maintenance program which allows the user to obtain maximum performance from his tape recorder at all times.

## OLSON

### M-335 Stereo Mike Mixer

Has six inputs: 4 mike with additional switches for high & low impedance and 2 magnetic phono. 9-V battery operation. 9 3/4" x 7" x 1 3/4" ..... \$49.98

## ROTRON

### "Whisper Venturi" Fan

Specially designed cooling fan for preventing overheating of component hi-fi equipment. Can be placed or mounted within cabinet. Will move 80 cubic feet of air per minute. Draws 7 watts. Comes in kit form with all necessary



## TAPE RECORDER GUIDE SPRING 1972 ADVERTISERS' INDEX

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hardware and controls.  $5\frac{3}{16}'' \times 5\frac{3}{16}'' \times 1\frac{1}{8}''$  D  
..... \$15.95

### SHURE

#### SA-1 "Solo Phone"

Stereo amplifier for headphones. Permits two sets of phones to be used simultaneously. Has balance control, dual input for tape/tuner or phono. Inputs: phono 47,000 ohms equalized for magnetic cartridge, tuner 250,000 ohms. Output 8 ohms, 100 mV.  $10\frac{1}{4}'' \times 3\frac{1}{2}'' \times 3\frac{7}{8}''$  D  
..... \$48.00  
Model SA-1F. Same as SA-1 except panel-mounting version ..... \$57.00

#### M68 Microphone Mixer

Five channels. A transistorized portable mixer for p.a. and tape recorders. Has four mike inputs for high- or low-impedance microphones, one high-level auxiliary input for tape, tuner & accessories, individual volume control to balance each of five inputs, and a master volume control to simultaneously control level of all inputs. Has high-impedance mike and auxiliary outputs. 105-130 V, 50/60 Hz ..... \$140.00

#### M67 Microphone Mixer

Four low-impedance balanced mike inputs & one line input. Has built-in tone oscillator for calibration. Response 20-20,000 Hz  $\pm 2$  dB. Has automatic switchover to battery if power fails. Gain 90 dB max. (150-ohm mike into 600-ohm line). Battery power supply \$25.00 extra.  $11\frac{3}{8}'' \times 7\frac{1}{2}'' \times 2\frac{1}{2}''$  ..... \$270.00

#### M688 Stereo Microphone Mixer

For use with stereo tape recorders which do not have built-in mixing. Accepts four high- or low-impedance mikes through four inputs plus a stereo auxiliary high-level input, each with its own volume control. Three of the mike inputs have front-panel switches for left- or right-channel output, fourth microphone input has pan control. A stereo master volume control adjusts level of all inputs. (list) ..... \$190.00

#### M63 Audio Control

For use with mike mixers. Provides volume, bass, treble & high- and low-frequency rolloff. Has VU meter, two high-level inputs for mike mixer, tape recorder, tuner. Five different outputs: 600 ohms balanced line, high-impedance high-level, high-impedance mike level, low-impedance mike level (balanced), and headphone ..... \$160.00

#### M62V Audio Level Control

Automatic microphone volume control. Prevents blasting. Output adjustable to predetermined level. Response 20-20,000  $\pm 2$  dB. Compression 40 dB input change, 6 dB output. For single mike. Has "on-off" bypass switch. Can be battery operated or from M68 mixer.  $11\frac{3}{8}'' \times 5\frac{1}{4}'' \times 2\frac{1}{2}''$  D ..... \$100.00

#### M64 Stereo Preamp

Provides gain and equalization to operate magnetic phono cartridges and tape playback heads with amplifiers without equalization. Response flat 20-20,000 Hz  $\pm 2$  dB, phono RIAA curve 40-15,000 Hz  $\pm 2$  dB, tape for  $7\frac{1}{2}$  ips NAB curve 50-15,000 Hz  $\pm 2$  dB. Max. input phono & tape 100 mV, flat 250 mV ... \$34.00

#### SFG-2 Stylus Force Gauge

For all modern tonearms & manual or automatic turntables. Accurate within one-tenth gram in primary operating range of  $\frac{1}{2}$  to  $1\frac{1}{2}$  grams, extended measurement range to 3 grams. Stainless steel pivots ..... \$4.95

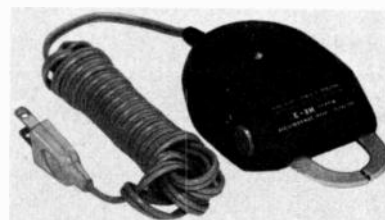
#### A97A Matching Transformer

Designed to permit transistorized tape recorders to be used with high-quality, low-impedance microphones. Designed to improve the overall audio input signal as well as permit the use of long cables without loss of high frequencies and without hum and noise pickup.  $2\frac{1}{2}''$  long  $\times \frac{3}{4}''$  diameter ..... \$21.00  
Printed in U.S.A.

### SONY/SUPERSCOPE

#### HE-2 Head Demagnetizer

Designed with high flux density to provide



maximum reduction of residual magnetism  
..... \$13.95

#### BE-7 Cassette Bulk Eraser

Erases all cassettes without a.c. power or batteries ..... \$19.95

### TEAC

#### AN-180 Outboard Dolby System

Record/playback control center with Dolby noise-reduction system. Recording section



contains microphone & line preamps plus Dolby recording circuitry. Playback section has playback line preamps & Dolby playback circuitry. Can be used with any good tape deck. Has separate input level controls for mike and line inputs for each stereo channel, two VU meters, internal test-tone oscillator, Dolby level standard tapes, source/tape monitor switch. A multiplex filter prevents recording interference from pilot tone frequencies or unsuppressed multiplex carrier by tuner .. \$319.50

#### AN-80 Outboard Dolby System

Less elaborate version of AN-180. Input mixing feature omitted and only one Dolby circuit per



channel. Circuit operates for recording, then playback, but not together. Provides 10 dB noise reduction ..... \$149.50

#### AN-50 Outboard Dolby System

Compact, less elaborate version of the AN-80. Designed for use with cassette equipment



such as the Teac A-23, A-24, and A-25 or other conventional stereo cassette equipment  
..... \$64.50

the silent touch of DOLBY  
to enhance the  
"Super Sound" of KENWOOD



## NEW KENWOOD KX-700 Stereo Cassette Deck

...with Dolby Noise Reduction System ■ Super-Ferrite Head ■ 3-Way Tape Selection

Luxurious in every respect, the KX-700 combines reel-to-reel quality with cassette convenience. Its patented Dolby Noise Reduction System virtually eliminates high frequency background noise without affecting high frequency signals. The super-ferrite record-and-play head, with its precision micro-gap, utilizes bias frequencies to optimum advantage for top quality reproduction; and a three-way Tape Selector permits a choice of the correct bias for Regular, Low Noise or Chromium Dioxide tapes. A measure of the unit's fine performance is indicated by a few of its excellent specs: Frequency Response, 25-15k Hz (CrO<sub>2</sub>). Wow and Flutter, less than 0.15%. Signal-to-Noise, with Dolby, 58 dB (CrO<sub>2</sub>); without Dolby, 48 dB.

For complete specifications, visit your nearest  
KENWOOD Dealer, or write ...



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72-02 Fifty-first Ave., Woodside, N.Y. 11377  
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