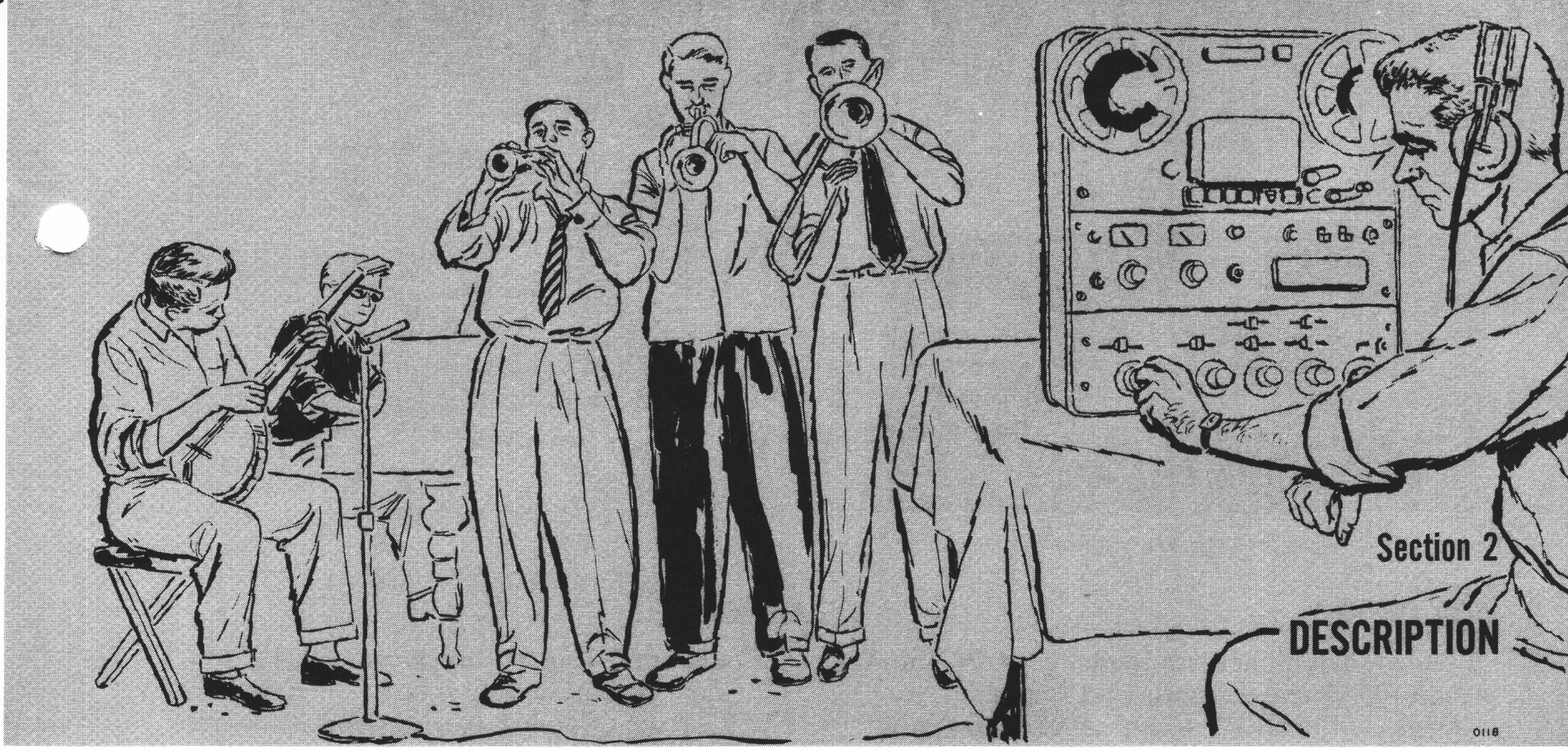
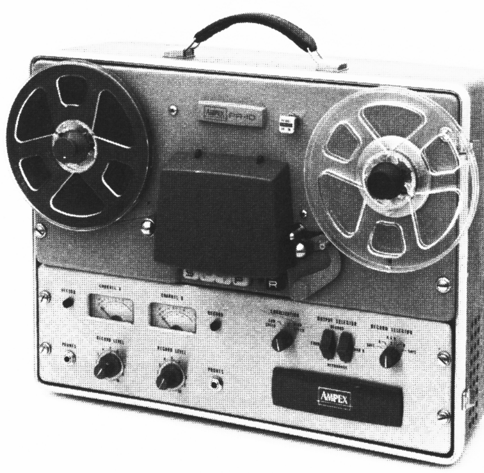


GENERAL DESCRIPTION

AMPEX Model PR-10-2 Magnetic Tape Recorder/Reproducers are high quality precision instruments designed for the professional user who requires the finest, most faithful recording and reproduction in a small portable unit. Recorder/reproducer equipment in the Model PR-10-2 series consists of an unmounted tape transport, a head assembly, an electronic assembly, and optional extra-cost accessory items such as a mixer assembly, a speaker-amplifier assembly, and a portable carrying case (see "Accessory" paragraph in this section and "Accessory" section).



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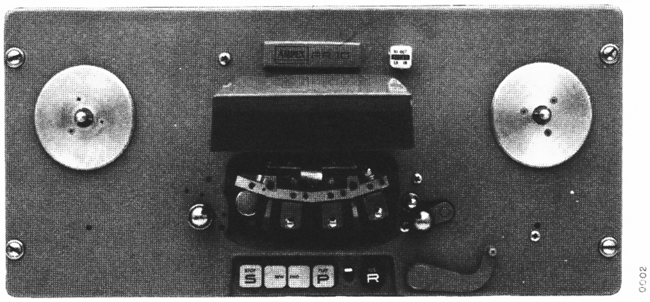
Ampex PR-10-2 Tape Recorder/Reproducer

Two mounting arrangements are possible — portable and rack mount. In the portable equipment, the tape transport and the electronic assembly are designed to be mounted together in a custom-designed, complementary carrying case. An accessory carrying case is offered that provides sufficient room to mount the tape transport, the electronic assembly, and either the mixer assembly or a second electronic assembly. A portable speaker-amplifier is available and has a matching carrying case. Unmounted equipment can be supplied for rack mounting by the user.

TAPE TRANSPORT ASSEMBLY

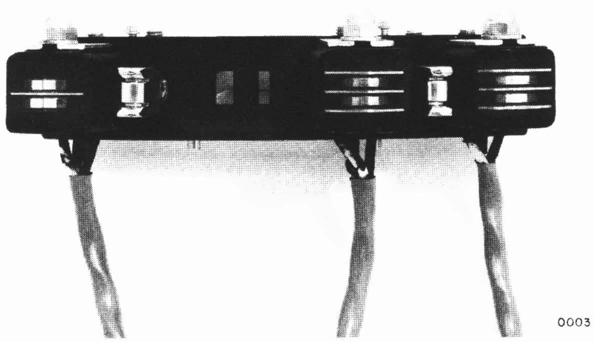
The tape transport mechanism is capable of handling up to 7-inch reels, and is available for operation in tape speed pairs of 3¾ and 7½ inches per seconds (ips) or 7½ and 15 ips, using ¼-inch magnetic recording tape. Manually-operated tape lifters are provided to minimize head wear during fast forward and rewind operations. A self-threading device is an accessory item available at extra cost. When rack mounted the tape transport occupies 8¾ inches of 19-inch rack space.



Tape Transport Assembly

HEAD ASSEMBLY

Head assemblies normally contain three head stacks (erase, record, and reproduce head stacks). A fourth head can be accommodated and can be the same as one of present heads or can be another configuration.



Typical Head Assembly

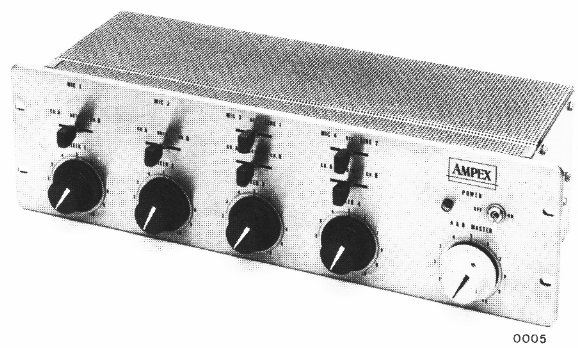
ELECTRONIC ASSEMBLY

The two channel record/reproduce assembly consists of two record amplifiers, two reproduce amplifiers, a bias and erase oscillator, and a power supply. Plug-in equalization is available for 3¾ ips (120/usec)—7½ ips NAB, 3¾ ips (200/usec)—7½ ips NAB, or 7½ ips NAB—15 ips NAB. Special equalization circuitry is available on special order at extra cost. The electronic assembly utilizes etched board construction wherever possible. When rack mounted, the assembly occupies 5¼ inches of standard 19-inch rack space.

Electronic Assembly

ACCESSORIES

Companion equipments to the AMPEX PR-10-2 Tape Recorder/Reproducer include the MX-10 Mixer (Catalog No. 01-96900-01) and the SA-10 Speaker/Amplifier (Catalog No.



MX-10 Mixer Assembly

SA-10 Speaker-Amplifier Assembly

01-96975-01). The MX-10 Mixer is a professional, compact and extremely versatile four position, two channel mixer. The SA-10 speaker/amplifier is a complementing unit consisting of a powerful, low distortion amplifier (Catalog No. 01-96950-01) and a matched speaker enclosure (Catalog No. 01-96980-01) that provides quality and overload characteristics exceeding other similar combination units.

Accessories for the PR-10-2 recorder/reproducer include a plug-in balanced bridging line input transformer (Catalog No. 58-0116-01), a plug-in balanced matching line input transformer (Catalog No. 58-0116-02), a 40 db plug-in microphone preamplifier (Catalog No. 01-96440-01), a 60 db plug-in microphone preamplifier (Catalog No. 01-96440-04), a remote control unit (Catalog No. 01-96510-01), a remote control panel (Catalog No. 01-96520-01), a portable recorder carrying case (for the PR-10 tape transport and electronics – Catalog No. 15-0200), a portable multi-use carrying case (can accommodate the PR-10 tape transport and electronics and the MX-10 mixer – Catalog No. 01-96940-01), a portable carrying case for the speaker-amplifier (Catalog No. 15-0201), and a self-threading system for the PR-10 tape transport (Catalog No. 02-96030-01).

PERFORMANCE CHARACTERISTICS

The ratings given in the following specifications use the following gain and level ratings:

db — refers to gain or loss

dbm — single-frequency, sine wave power referred to 1 milliwatt

$$\left(\text{dbm} = 10 \log \frac{P}{.001}\right)$$

vu — program level as read on a standard vu meter. Since program material is of a complex and transient nature, the vu meter indicates a level considerably under the instantaneous peak program level. In practical usage the amplifier dbm rating should exceed the vu level to be transmitted by at least 10 db.

Tape Width	¼ inch	
Tape Speed Pairs	3¾ —7½ ips 7½ — 15 ips	
Frequency Response	Speed (ips)	Response (Cycles per second)
	3¾	± 2 db 40 to 8,000
	7½	± 2 db 40 to 12,000
		+ 2 —4 db 40 to 15,000
	15	± 2 db 30 to 18,000
Signal-to-Noise Ratio	Speed (ips)	Peak Record Level to Unweighted Noise (db)
	3¾	50
	7½	55
	15	55

Peak record level is that level at which the overall (input to output) total rms harmonic distortion does not exceed 3 per cent when measured on a 400 cycle tone. Noise is measured when erasing a signal of peak recording level in the absence of new signal. Bias, erase and reproduce amplifier noise are included in the measurement. All frequencies between 30 and 15,000 cycles are measured.

Flutter and Wow	*Speed (ips)*	*Flutter and Wow (percentage rms)*
	3¾	.18%
	7½	.13%
	15	.11%

Flutter and wow measurements include all components between 0.5 and 250 cycles. The figure quoted is for the reproduction of a relatively flutter-free tape and is measured in accordance with American Standards Association standard number Z57.1-1954.

Recording or Reproducing Time (7 inch Diameter EIA reels, 1200 feet of tape)

Speed (ips)	Half Track (hrs)	Half Track (min)	Two Track (hrs)	Two Track (min)
3¾	2	8	1	4
7½	1	4		32
15		32		16

Starting Time — The tape is accelerated to full speed in less than 1/10 of a second.

Stopping Time — When operating at 15 ips, the tape moves less than two inches after the STOP button is pressed.

Reproduce Timing Accuracy

Accuracy (percentage)	Accuracy (second)	Length of Recording (min)
± .25%	± 4.5	30

Rewind Time — Approximately 90 seconds for a full 7-inch 1200 foot EIA reel.

Controls

Tape Motion — All tape motion is controlled by pushbuttons PLAY, STOP, FAST FORWARD and REWIND.

Record Control — A separate RECORD button on the tape transport, when pressed, energizes the record relay which drops out when the STOP button is pressed. Selection of record channel(s) desired, is accomplished by the RECORD SELECTOR switch on the electronic assembly.

Tape Speed — Tape speed can be changed by the TAPE SPEED control.

Equalization — An EQUALIZATION switch on the face of the electronic assembly provides a means for selecting LOW or HIGH speed equalization appropriate to the tape speed used.

Record Inputs — Two inputs are supplied; one for each channel. With plug-in preamplifiers, plug-in transformers or dummy plugs, the inputs will accommodate microphones, balanced lines or unbalanced lines respectively. A RECORD LEVEL control is supplied for each channel.

Input Impedance

Unbalanced Bridging: 100 K ohms

Balanced Bridging: unity ratio (0 db gain) — 100 K ohms (for use with 600 ohm source impedance and using optional plug-in balanced bridging input transformer).

Balanced Matching: step up ratio (14 db gain) — 600 ohms (for use with 600 ohm source impedance and using optional plug-in balanced matching input transformer).

Microphones: — Unloaded transformer (for use with 30 to 250 ohms source impedance) using either plug-in microphone preamplifier.

Input Level (nominal)

Unbalanced Bridging:	−4 to +8 vu lines or cathode follower output of 0.5 volt or more.
Balanced Bridging:	−4 to +8 vu lines using optional plug-in balanced bridging line input transformer.
Balanced Matching:	−20 to −4 vu lines using optional plug-in balanced matching line input transformer.
Microphone:	−45 to −35 vu microphones using optional plug-in 40 db microphone preamplifier. −60 to −50 vu microphones using optional plug-in 60 db microphone preamplifier.

NOTE

For more detailed information, see the accessory section of this manual.

Reproduce Outputs	+4 vu ±.5 db (Zero indication on the vu meter corresponds to +4 dbm into 600 ohms balanced or unbalanced.)
Head Housing	The erase, record and reproduce heads are contained in a single head housing. (See HEAD ASSEMBLY section.)
Monitoring (aural and visual)	The signal on the tape can be monitored while the equipment is recording. Two phone jacks are available to allow monitoring the record input signal, or the output signal from the reproduce head. A switch provides a means for making direct comparison between the original program and the recorded program. Two 2½-inch vu meters are provided for level comparison and visual monitoring of each channel.
Power Requirements	Two track equipment requires 1.84 amperes at 117 volts ac, 50 or 60 cycles.

Dimensions (in.) Item	Height	Depth	Width
Tape Transport	8¾ (rack space)	6 (behind rack)	19
Electronic Assembly	5¼ (rack space)	5⅞ (behind rack)	19

Weight

Unmounted	44 pounds
Portable	53 pounds

EQUIPMENT APPLICATIONS

The Stereophonic Technique

In stereophonic recording, two or more microphones, each transmitting its signal independently, sample the complex wave-fronts of sound at separated points in an imaginary curtain between the performers and the intended audience. A microphone at the left of an orchestra picks up first and most strongly the instruments on the left. The right-hand microphone, then, picks up first and most strongly the instruments on the right.

In the reproduction, the listener is faced with two or more loudspeakers, each connected through time and space with the microphone corresponding. Each is located in about the same angular relation to him as the microphones were during recording. The speaker on the left reproduces first and most strongly the sounds which were nearest its microphone, while the speaker on the right does the converse.

Mixture occurs only at the time of reproduction, and performs a sort of minor miracle of re-creation. Not only are the instruments on the left stronger from the left loudspeaker, but they are reproduced there momentarily earlier than they are heard, at a distance, in the right speaker. Since the reverse is going on between sounds at the right and their speaker, there results a melting of sound between them. With a strong sense of direction, the whole orchestra seems to be spread out before the audience, when the mixture is correct. There is no hole in the middle; indeed, in a perfectly microphoned and balanced presentation, a soloist can be made to appear exactly front and center, where there is no loudspeaker at all in a two-channel presentation.

It is curious that a certain amount of left-hand sound must be present in the right-hand speaker, subdued a little and delayed by distance, of course, if the effects of spread and realism are to be heard. When there is little or none of this mixing, we hear a kind of musical ping-pong, which certainly may be used synthetically by the director for good novelty effect, but is unsuitable for most musical reproduction.

The balance of sound which places the soloist in the middle must be established at the time of the recording. It might be thought, at first, that errors in microphone placement might be compensated later in the dubbing studio by raising or lowering the strength of one signal in relation to the other. Within limits, where the error was only one of gain setting during the recording, it is true that this can be done. But after the recording is made it is not possible to vary individually the multitude of small variations in the delay of sound from each of many sound sources to each of the microphones, so good microphone placement at the time of recording is greatly to be desired.

Some Applications Outside of Stereo

Many examples may be given. Music and dialogue for an elaborate puppet-show have been recorded on one channel of a two-channel recorder, while advance cues, and signals for entrances and effects have been recorded on the other channel. Since there is no possibility for one channel to get off synchronism from the other, every performance is letter perfect, every cue and every line on time.

Such an arrangement is also used for a well-known ice-skating show. On one channel is the music for the performance, played into the auditorium's sound system. Synchronized, on the other channel, are the backstage signals. Not only are the performer calls recorded here, but metronome ticks, in perfect synchronism with the music which will follow, permit all the performers to make their entrances, in perfect time with music which begins only when they are on stage.

Reconstructing Historical Events

The ability to record several different sound sources on tape, all simultaneous but unmixed, offers many other possibilities. Often tape recorders are used to record sounds which cannot be repeated, either because of cost or because of their unique character. An important occasion, perhaps an inauguration or conference, cannot be rehearsed or repeated. Yet a commentary on it, made simultaneously with the event, may be needed later to present a meaningful record. This, of course, may be recorded on a separate channel on the same tape as the recording of the event itself, when a multi-channel recorder is used.

Often on such occasions it is not possible to make a perfect "mix" of the several microphones which may be used. Yet a perfect recording can be obtained later if each of several microphones or groups of microphones are fed to individual channels for separation and mixing later at leisure in the studio, then to be dubbed to one-channel tape or disc.

Scientific Uses

In science and industry it is useful sometimes to record simultaneously one or more sounds under study, or to present previously recorded sounds to separate locations repeatedly, always in synchronism, in exact time sequence. An effect may be recorded in one channel, while the operations producing that effect are described on another channel. Or, in a psychological experiment, entirely different stimuli may need to be presented simultaneously to different subjects.

Educational Uses

Both single-channel standard recorders and multi-channel machines have been used to improve the efficiency of language instruction. In one language department, for example, each student is provided with a standard tape recorder into which he plugs an earphone. All the recorders receive the output of a master tape in the control room, on which is a series of phrases or sentences spoken by an instructor, for students to imitate.

Because the instructor is on tape, his voice quality is the same throughout, and he never makes an error. Each student hears this example in his headphone as it is simultaneously recorded on his tape. With his own microphone the student then records his imitation after each of the instructor's examples. After the session, each student rewinds his tape and plays back the entire sequence of the instructor's voice followed by his own, in direct comparison. The tape can now be rewound and the lesson repeated, the master tape once again being fed to all students. While they record a new version the previous recording is automatically erased. Each successive attempt of the student is made more nearly correct by the experience of hearing himself as others do.

Binaural vs. Stereo

Stereophonic recording has received so much attention that the binaural technique seems to be somewhat neglected lately, and most multi-channel recorders are called "stereophonic" recorders. Fortunately, any good quality stereo machine of two or more channels will also serve well as a binaural recorder or reproducer.

The binaural technique implies the use of headphones or separate earpieces, which is usually impractical for commercial systems. Yet for special purposes this technique has its advantages. It might be said that stereophonic reproduction brings the scene of the sound to the listener, while binaural transmission takes the listener to the scene of the sound.

The binaural method takes into account the fact that a substantial part of our human ability to sense the direction of sound results from small differences in its character at one ear, compared with its character at the other. A whistle at our left not only strikes our left ear first, but is much weaker at the right than the left because our head deflects and absorbs it. Lower pitched sounds on the left will reach the left ear first, but be about the same level, only later, at the right ear. In either case, experience has taught us how to interpret the result and to know where the sound is coming from. It is interesting to find that very low pitched hum, without harmonic overtones, is almost impossible to locate.

A binaural recorder uses two separate channels, one for each ear. Two microphones are used, each of which has as nearly as possible the same pickup characteristics as one ear. They are separated approximately the distance between our ears by an artificial head of much the same size and sound-absorption as a human head. This apparatus is then placed wherever we wish our eventual headphoned listener to seem to be when he plays back the binaural tape.

In actual practice a matched pair of almost any professional quality cardioid or one-direction microphones serve well, separated by a small pillow, their diaphragms about six inches apart, facing opposite from one another and slightly forward. Each microphone then feeds its own channel on one track of the recorder. In playback, that track which carries the left ear impression is fed individually through amplifiers to the left headphone alone, the right track to the right headphone. The effect is as if the listener has been transported to the location of the microphones, so far as sound is concerned. Of course, if he turns, the sound scene will turn with him.

This arrangement has special usefulness in the recording of conferences, courtroom proceedings, debates or other gatherings where a verbatim written transcription will be needed later. If a simple single-channel recorder were used, only the voice quality would identify the speaker, while with the binaural recording his location as well would be apparent. In a single-channel recording it is almost impossible to extract one voice from another when two or more speak at once, yet with the binaural playback we are able to exercise our normal power to select one at a time, then replay for each of the others.

Sound-On-Sound

The phenomenal success of Les Paul and Mary Ford in their unique multi-voice records focused attention on the technique which they pioneered, and which has great usefulness for other purposes as well.

In the earliest days, "sound on sound" was accomplished with a single recorder, and a single-channel recorder at that, to produce those remarkable masters on which Les is heard accompanying himself, many times over, while Mary becomes a vocal soloist and all the members of the chorus behind her.

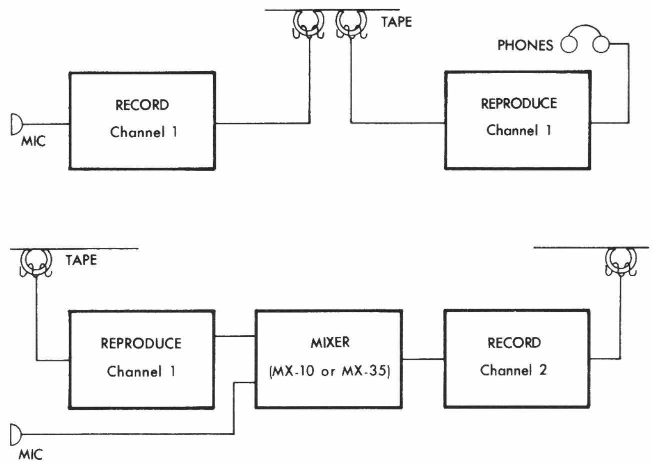
The machine was unusual in one way only: its heads were arranged in an unusual manner. In a normal machine the tape passes first an erase head, which removes all previous recording, then a recording head, which impresses a new recording, and then a playback head, which independently reproduces the newly recorded program. Les and Mary had a machine custom-built with the heads arranged Playback, Erase, and Record.

Using this machine,Les would record first a solo version of his music. This would go on the tape through the recording head. He would then rewind the tape. The playback amplifier was then connected into the recording amplifier, while simultaneously being mixed with the output of Les' microphone preamplifier. He wore a pair of headphones which monitored the mixture going into the recording circuit. And then he would record an accompaniment to his own previously recorded solo, which he would hear in his headphones. The original solo would be copied along with the new part. Thus, the playback head would feed out the original solo line which would simultaneously be recorded with the new part a little further along the tape.

The solo passage would then move past the erase head, leaving a clean tape for the record head to continue operation. The process would then be repeated, again and again, until all of Les' guitar parts and all of Mary's vocals had been collected. The difficulty with this arrangement was that a fluff anywhere along the line would make all of the previous work useless, and it would be necessary to start over again. Nevertheless, for many successful releases, this is how it was done.

A better solution was to use two normal recorders. In this case, the solo would start on one recorder. This would be rewound, the playback fed to the recording circuit of the second recorder, mixed with the output of the microphone. On the second recorder solo and first accompaniment would be recorded together, but the first tape wás not erased, and errors in stage two would not affect it. The third part was added by playing the second tape back into the first machine, while adding part three, and so on.

With the advent of two-track recorders, the recording of sound-on-sound became even easier because it no longer required two recorders. In this case, the solo would start on the upper track. This would be rewound, the playback fed to the recording circuit of the second track, mixed with the output of the microphone. On the second track, solo and first accompaniment would be recorded together, but the first track was not erased, and errors in stage two would not affect it. The third part was added by playing the second track into the first track, while adding part three, and so on.



Sound-on-sound with a stereo recorder

But even this arrangement has its disadvantages. Fine as they are, magnetic recordings can be subjected only to a certain number of successive dubbings before audible degradation sets in. By the time the first voice on one of these tapes gets mixed onto the second tape it is a copy; when it gets to the third tape, it is a copy of a copy, until, if eighteen parts are added it is a long chain descendant of its original self.

Several things happen to the sound. If, for example, the original recordings were to deviate in frequency response only $\pm 1/2$ db from 30 to 15,000 cycles, thus, perhaps down ½ db at 30 and 15,000 cycles, then its copy on an equally flat recorder would be —1 at 30 and 15,000, —1½ in the third generation, and so on, until at eighteen generations the response would be —9 db at 30 and at 15,000 cycles. Any little bumps or hollows in the frequency response curve would similarly be exaggerated.

In well-designed recorders, whose noise depends solely on tape, noise also accumulates when generation after generation of copies are made. The noise increase, over the master recording, follows the "square root of the sum of the squares" law. This means that the S/N ratio decrease is 3 db in the first copy, and that it will total 6 db at the 4th generation, 9 db at the eighth generation, and 12 db at the 16th generation. Thus it is desirable to begin with great S/N ratio in the original, if the final release is to be several generations removed.

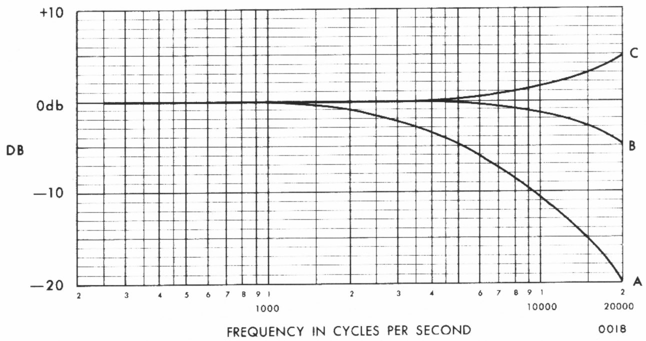
Distortion collects, too, although luckily it is not the arithmetic sum of the distortions occurring with each successive generation, either. There is a limit to the dodges which can be employed to make each recording ten or more times better than it need be for single generation copies. It would be much better if most parts could be kept separate on their own original magnetic tracks, undiminished by multiple-generation copying, the ultimate number of generations being held to two or three.

EQUALIZATION CHARACTERISTICS

General

The following paragraphs briefly describe the various equalization characteristics available so that the user may choose the equalization best suited to his application. Proper equalization requires the use of a reproduce equalizer which follows a standardized reproduce curve and a complementary record equalizer which is used to achieve flat over-all response.

Up to a certain frequency (in the neighborhood of 1000 to 2000 cps depending on tape speed), the output of the reproduce head of a tape recorder will increase directly with frequency. Above this frequency, the output of the reproduce head decreases. The reproduce equalizer produces a decaying slope that compensates for the increasing output of the reproduce head below the frequency at which peak output is obtained. The record equalizer is used to compensate for the decreasing output above this frequency. The equalizers have been designed to obtain an optimum in the overall record/reproduce system between signal-to-noise ratio on



Head output and compensating equalization

one hand and tape overload characteristics on the other and are related to considerations of the relative spectrum energy distribution of speech and music.

Reproduce equalizers may be either fixed or variable. Fixed equalizers will follow the equalization curve within the tolerances allowed and for most practical purposes are adequate. However, under certain circumstances such as critical master recordings which may have many generations of copies, a variable equalizer would be more desirable since it can be adjusted to follow the equalization curve exactly, overcoming the effects of small variables introduced by reproduce head differences and the like. There is, of course, a disadvantage to variable equalization in that it can also be misadjusted whereas fixed equalizers can not.

Record equalizers are always variable since the amount of equalization necessary to achieve flat response will vary from machine to machine and will vary when tapes from different sources are used on the same machine. In all cases, there is a corresponding record equalizer for each reproduce equalizer.

15 ips NAB Reproduce Equalization

The 15 ips NAB (National Association of Broadcasters) reproduce equalization curve is the American broadcast and recording industry standard. The equalization curve consists of a 6 db per octave decaying slope with a 3180 microsecond low end time constant and a 50 microsecond high end time constant. This curve is used for most of the master recordings made by the recording studios.

7½ ips NAB Reproduce Equalization

The National Association of Broadcasters has not set up a standard for 7½ ips. However, industry practice has been to use the 15 ips NAB reproduce curve for 7½ ips hence it is called the 7½ ips NAB curve. This curve is used for all of the 7½ ips pre-recorded tapes (both two track and four track) made in the United States.

3¾ ips Reproduce Equalization

Prior to the introduction of the 3¾ ips pre-recorded tape cartridge, industry practice was to use the 3¾ ips 200 microsecond reproduce curve. This curve, which consisted of a 6 db per octave decaying slope with a 3180 microsecond low end time constant and a 200 microsecond high end time constant, provided good quality speech recordings but, because of limited signal-to-noise ratio, it was not adequate for good quality music recordings. When the tape cartridge was introduced, the high end time constant was changed to 120 microseconds. This change improved the signal-to-noise ratio considerably (with some sacrifice in overload characteristics) and allowed music recordings of passable quality to be made. The 120 microsecond curve is now used for all 3¾ ips recordings, both cartridge type and reel-to-reel type.

The choice between the 120 microsecond and the 200 microsecond time constant will depend on the number of recordings of each type in the user's tape library. If there are no 3¾ ips recordings in the library, the 120 microsecond time constant is preferred.

15 ips AME Equalization

Tape noise, or "hiss" is perhaps the greatest limiting factor in the quality of present-day tape recordings. The noise generated by the tape cannot actually be reduced by any means outside of improving the tape itself. However, an increase in the signal-to-noise ratio can be obtained by increasing the signal level. As the input signal amplitude increases to a high level, however, the amount of signal actually recorded on the tape reaches a limit called saturation. At this point, the signal on the tape is much less than the input signal, or is *compressed* to about one-half the amplitude or less of the input signal. Since this saturation level varies with frequency, a very uneven response is obtained when recording at too high a level. If the high-frequency input level is increased still more beyond the saturation point, the signal on the tape decreases. This phenomenon is known as self-erasure. A high-level, high-frequency signal not only erases itself as it is being recorded, but partially erases any other tone which is also being recorded.

The 15 ips Ampex Master Equalization (AME) curve is designed to obtain a somewhat better apparent signal-to-noise ratio than is obtainable with the standard NAB equalization (see note). It was found that a greater signal amplitude could be recorded in the 2000 to 6000 cps region than is presently allowed by NAB equalization — without significant increase in overall distortion. This region is the band to which the ear is most sensitive.

NOTE

The apparent signal-to-noise ratio is increased by approximately 8 db although the actual measured signal-to-noise ratio remains unchanged. Note also that the recorded signal amplitude is increased ONLY in the 2000 to 6000 cps band, thus avoiding self-erasure at high frequencies.

The 15 ips AME curve is intended for internal use in companies specializing in producing "master" recordings and is not to be considered as supplanting the NAB standard for commercially released tapes.

7½ and 15 ips CCIR Reproduce Equalization

The 7½ and 15 ips CCIR equalization curves are the European counter parts of the 7½ and 15 ips NAB curves. The CCIR curves and the NAB curves are *not* the same. The 7½ ips CCIR curve consists of a 6 db per octave decaying slope with a 100 microsecond high end time constant and no low end equalization. The 15 ips CCIR curve consists of a 6 db per octave decaying slope with a 35 microsecond high end time constant and no low end equalization. When 7½ ips CCIR tape is played back on a machine with 7½ ips NAB equalization, it has the affect of decreasing high frequency response by approximately 6 db. When a 15 ips CCIR tape is played back using 15 ips NAB equalization, it has the affect of increasing high frequency response by approximately 4 db. When NAB tapes are played back using CCIR equalization, the opposite affects occur.

NOTE

The CCIR specifications do not include a low end time constant. However, the frequency response tolerances at the low end are broad enough that most machines that do have a low end time constant are still within CCIR specifications. (Most manufacturer's include the low end time constant.)