DESCRIPTION AND PERFORMANCE CHARACTERISTICS

GENERAL

The AMPEX Series 351 Magnetic Tape Recorder/Reproducers are high quality precision instruments designed for the professional user who requires the finest and most faithful recording and reproduction.

A basic recorder/reproducer in the 351 series consists of a tape transport for operation at tape speed pairs of 3¾ inches per second (ips) and 7½ ips or 7½ and 15 ips; a head assembly for use with the ¼-inch magnetic tape; and an electronic assembly which contains the record amplifier, reproduce amplifier, bias and erase oscillator, and power supply — all featuring etched board construction.

NOTE

This manual is primarily intended for recorders using Ampex Catalog Number 02-30960 electronics. In instances where there are significant differences between this electronics assembly and earlier models using Catalog Number 30750 or 30950 electronics, an appropriate notation will be found.

Head assemblies for either full (single) track, half track or two track stereophonic (351-2) operation are available.

CCIR equalization can be obtained on request

when ordering equipment.

Several mounting arrangements are offered —console, two case portable, and rack mount. In the portable equipment, one case contains the tape transport and the other houses the electronic assembly.

PERFORMANCE CHARACTERISTICS

Tape Width — ¼-inch

Tape Speed Pairs — 3¾-7½ ips
7½-15 ips

Frequency Response

Speed (ips)	*Response (Cycles per second)*
3¾	±2 db 50 to 7,500
7½	±2 db 40 to 10,000
	±4 db 30 to 15,000
15	±2 db 30 to 15,000

Signal-to-Noise Ratio

Speed (ips)	*Peak Record Level to Unweighted Noise (db)*
3¾	50
7½	60 full track
	55 half track or two track
15	Same as 7½ ips

Peak record level is that level at which the overall (input to output) total rms harmonic distortion does not exceed 3 percent 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 50 and 15,000 cycles are measured.

Flutter and Wow

Speed (ips)	*Flutter and Wow (percentage rms)*
3¾	.18%
7½	.14%
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 test tape and is measured in accordance with American Standards Association standard number Z57.1-1954. (The alternate non-standard method of measuring flutter as described in Appendix II of the ASA standard was previously used by Ampex in determining flutter specifications.)

Recording or Reproducing Time (NAB 10½ Inch Diameter Reels, 2400 feet of tape)

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

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)*
±.2%	±3.6	30

Rewind Time — Approximately 1 minute for a full 2,400 foot NAB reel.

Controls

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

Record Control — A separate RECORD button on the face of the electronic assembly, when pressed, energizes the record relay which drops out when the STOP button is pressed. The stereophonic function (two track) is controlled by pressing the RECORD buttons on both electronic assemblies simultaneously. In two track operation, for consistency, the master electronic assembly is usually connected to the upper track in the head assembly so that, when the RECORD button on the master (only) is pressed, recording takes place on the upper track.

Tape Speed — Tape speed can be changed by the TAPE SPEED switch. LOW or HIGH positions are used to select drive motor windings.

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.

Reel Size — A REEL SIZE toggle switch on the tape transport makes possible selection of the proper tape tensioning for the NAB 10½ inch diameter reel or the EIA 5 inch and 7 inch reels.

Record Inputs — The INPUT TRANSFER SWITCH provides a means for selecting three different types of inputs:

Input	*Input Impedance*	*Minimum Input Signal that will produce Operating Level (1% tape characteristic distortion)*
MICROPHONE	150 and 250 ohms nominal (transformer can be strapped for 30-50 ohms nominal.)	200 microvolts
BAL BRIDGE	200K ohms	−10 dbm
UNBAL BRIDGE	100K ohms	−10 dbm

Reproduce Output — Zero indication on the v-u meter corresponds to +8 dbm (±1 db). Sufficient gain and power handling capabilities exist to feed a +14 vu line output into 600 ohms balanced or unbalanced. The center tap of the output transformer can be strapped to ground for balanced output. Plus 4 vu also can be obtained by strapping. (See INSTALLATION).

Head Housing — The erase, record, and reproduce heads are contained in a single head housing (See SECTION 6 on HEAD ASSEMBLIES).

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. The same switch transfers a 4 inch vu meter for level comparison and visual monitoring. The vu meter also is used to indicate bias and erase current.

Power Requirements

The half track and single track equipment requires 2.0 amperes at 117 volts ac and is available for 50 or 60 cycle line frequency. Two track equipment requires 2.5 amperes at 117 volts ac, 50 or 60 cycles.

When the Ampex Model 375 Precision Frequency 60 cycle amplifier is used with the equipment, power requirements are greater by 2.5 amperes: single track equipment 4.5 amperes; dual track 5.0 amperes.

EQUIPMENT AVAILABLE

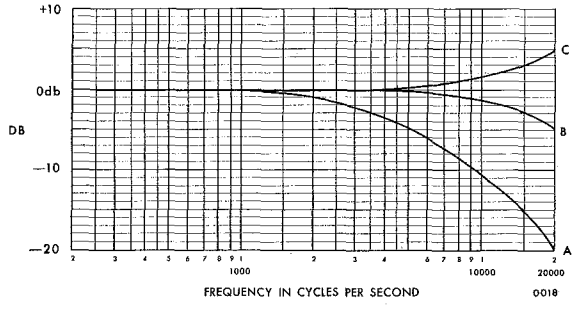
Dimensions and Weight (in.) (lb.)	*Item*	*Height*	*Depth*	*Width*	*Weight*
Rack Mount	Tape Transport	15¾ (rack space)	8 (behind rack)	19	50
	Electronic Assembly	7 (rack space)	8½ (behind rack)	19	18
Console	Console	48 (max)	28½ (max)	24½	155
Two Case Portable	Tape Transport Case (Equipment in Case)	15½	17	20¼	69
	Electronic Ass'y. Case (Equipment in Case)	9	13	21	38
	Two Track Stereophonic Electronic Ass'y. Case (Equipment in Case)	16½	13	21	80

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



Head output and compensating equalization

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 prerecorded 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.)