Scotch®
video tape
playback
VOLUME 2, NUMBER 1

TECHNICAL INFORMATION

NEWS and DEVELOPMENTS

NEW PRODUCTS and PROCEDURES

PLEASE ROUTE

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A STANDARD TAPE FOR EVALUATING MAGNETIC VIDEO RECORDER DROPOUT AND NOISE IMMUNITY FACTORS

BACKGROUND: The Quality Control Processes used in the manufacture of magnetic video tape include a liberal amount of practical testing on user type recording equipment.

Inasmuch as an exact analysis of the complex asymmetrical FM signal which is actually recorded in such systems is extremely difficult, a majority of the techniques used for standardizing machine performance are empirically derived. While considerable work is being done to reduce standardization to a science rather than an art, instrumented verification of performance is as yet by no means developed to the degree possible in audio recording and certain phases of instrumentation recording.

One aspect of video tape performance which is of vital concern to the tape manufacturer, the machine manufacturer and the user alike, is the manner that recording apparatus responds to small tape imperfections or acquired debris which may cause various degrees of carrier signal loss. Traditionally, these are referred to as "dropouts" and their appearance on the reproduced picture can be grossly affected by a particular recording machine's circuit design and operating adjustments.

(Continued on Page 2)

Test Tape

(Continued from Page 1)

Attempts to check and maintain machine performance by means of tapes containing known numbers of natural dropout defects result in a wide margin of error, inasmuch as the defects themselves undergo physical change with continued use. Accordingly, they lose their authenticity as standards for repeated recording tests.

It had been recognized that if a tape surface is smooth, intact and not subsequently erased, the recorded magnetic image of a given defect is essentially permanent throughout the useful life of a tape, even though the surface defect may have been removed. Borrowing upon this principle, it was predicted that a useful and stable standard tape for dropout performance testing might be obtained by deliberately introducing abrupt amplitude variations in the normally constant FM record current of a video recorder system. When played back, such a tape would have the distinct advantage of checking dropout immunity for the entire playback system including the head assembly of the recorder, contrasting other calibrating systems which merely introduce such test signals into various points in the amplifying portions of the reproduce circuits.

Procedures, signal format and general methodology in this effort are undergoing change as more information is obtained through daily use of the test tapes produced to date. Therefore, the ensuing study merely outlines a recent status of the activity and makes no final recommendations as to the ultimate nature of this approach toward the measurement of machine performance.

Furthermore, the study in no way attempts to recommend or specify numerical values as to what constitutes minimum acceptable recorder performance levels. This is a matter which we feel must be determined through industry-wide analysis of data which a test tape of this type can in a substantial part provide.

Preliminary work in applying the test tape toward the standardization of test recorders that are used in tape manufacturing indicate that it quite adequately fulfills its purpose as a uniform yardstick of machine playback performance.

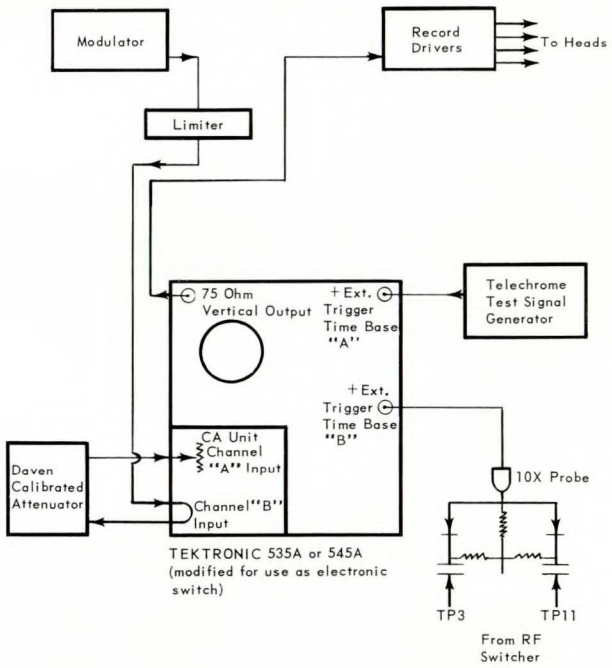
The dropout test tape provides an opportunity to express certain heretofore indeterminate and subjective aspects of recorder performance in the form of meaningful numbers. It is felt that this will permit an industry-wide opportunity for greater machine to machine standardization, as well as illuminate some of the pathways toward improvement of general system performance.

FORMAT:

To record a video test tape with "recorded-in" RF carrier dropouts of calibrated depth and with stationary screen positions, dropouts have to be so synchronized with the recording head position and the recorded TV signal scanning frequencies that one dropout per field will appear in the approximate center of each head pass and at the center of a scan line. Thereby the dropout sensitivity of each head channel may be evaluated separately, either by visual or instrumented means.

The above results can be produced by routing the normal RF carrier through an electronic switch which provides two signal paths, one which has zero insertion loss and another which attenuates the recording head drive voltage by a given amount for a short programmed period of time. A basic block diagram of the dropout simulator circuitry is shown in Figure 1.

Figure 1



The 960 cycle vertical timing signals are derived from the R. F. Switcher. Since this 960 cycle timing signal is not readily available in the Ampex recorder, two 480 cycle square waves 180° apart and readily available are differentiated and combined in a diode adder to generate 960 cycle pulses. The RCA recorder has the 960 pulse readily available from the switcher. The horizontal timing signals are derived from the station sync generator.

The following equipment or equivalent is required to produce the test tape:

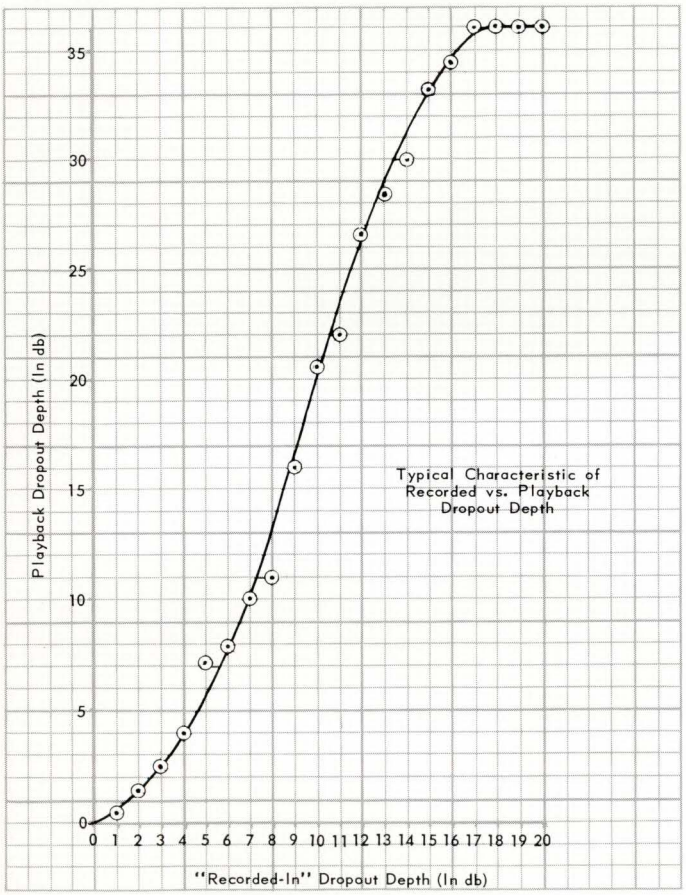
Ampex VR 1000C Television Recorder
Federal Flying Spot 2" x 2" Scanner (Picture Source)
Telechrome Test Signal Generator–Model 1005-AL
Tektronix Oscilloscope Model 535A and Type CA Dual Trace Plug In (to be modified for use as an electronic switch)

Daven RF Attenuator Type 760-73
RCA TG-2 TV Sync Generator
Television Magnetic Tape–"SCOTCH" Brand No. 379

In recording the test tape, a specially photographed four-step gray scale slide reproduced by a Federal Flying Spot Scanner was used as a video signal source. The slide is arranged with the white step at the top of the screen with progressively darker steps toward the bottom. This arrangement permits the simulated dropouts from each set of four head passes to be viewed against different gray scale values in order to study the relationship between dropout visibility and the accompanying intensity of the recording during playback.

The recorder is set up in the conventional manner except that the individual head record currents are so adjusted that the carrier dropouts produced by the switcher simulator are equal in all channels when measured in playback. Specifically, the simulator is first adjusted to produce a 10 db reduction in record drive voltage during dropout generation; then each record channel is adjusted to the point where the resulting recording produces a 20 db carrier dropout as measured at the pre-amplifier output during play-

Figure 2



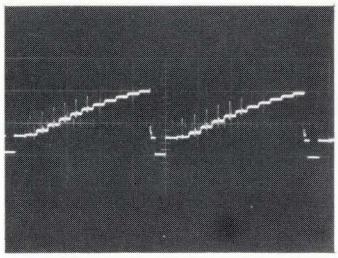
back. This represents a condition of adjustment wherein appreciable tape saturation is avoided in order to provide a reasonably linear operating curve as depicted in Figure 2.

(Continued on Page 6)

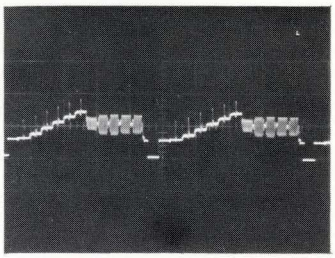
SMPTE RECOMMENDED PRACTICE RP10

EDITORIAL: As television magnetic tape recording progressed, the television broadcast industry recognized that interchangeability performance had to be developed to the point where under ideal conditions no operating adjustments would be required in order to playback tapes recorded on different machines or head assemblies. With this objective in mind SMPTE Recommended Practice RP10 was written to specify the recorded signals for use as a magnetic video recording test tape. This, then, could be used as a daily set-up operating procedure, and if followed with careful adjustments good interchangeability performance could be realized.

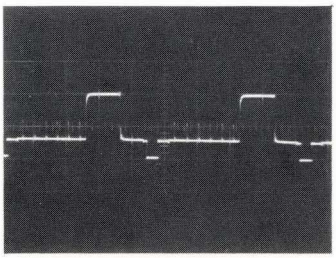
Section 1.2 of RP10 lists the numerous operating adjustments that can be checked with this alignment tape. Besides making the usual skewing and scalloping adjustments, the alignment tape offers a daily routine observation of overall machine performance. Figures 4, 5, 6, and 7 correspond to the bands as described on Page 5. The photos were taken from the Video Output test point at the Processor of an Ampex VR 1000B as viewed on a Model 545A Tektronix Scope which was synced from the System Sync jack in the Processor. Malperformance of amplitude linearity and high and low frequency response can easily be observed.



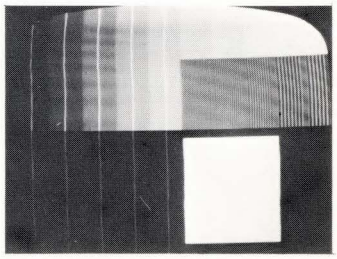
Bands 1 through 4 (Fig. 4)



Bands 5 through 8 (Fig. 5)



Bands 9 through 15 (Fig. 6)



Playback picture of monitor displaying all test signals (Fig. 7)

NOTE: A tape recorded in accordance with this Recommended Practice is currently available from RCA, Building 15-5, Camden 2, New Jersey. Specify Part No. MI-40793.

SMPTE Recommended Practice RP10

Signal Specifications for a Monochrome Video Alignment Tape for 2-In. Video Magnetic Tape Recording

1. *Scope*

1.1 This recommended practice specifies the signals to be recorded on a magnetic video tape for use in evaluating and adjusting the performance of monochrome video tape recording and playback equipment on a routine operational basis. The characteristics which can be checked primarily are related to the video performance although a cursory check of the audio channel is included for operating convenience.

1.2 Specifically, the recorded signals on the tape provide means for check of the following characteristics or adjustments:

(a) video-head quadrature
(b) tape vacuum guide position
(c) video levels
(d) video amplitude-frequency response
(e) video transient response
(f) video low-frequency tilt
(g) video amplitude linearity
(h) video-head playback sensitivity
(i) relative noise banding
(j) r-f carrier deviation frequencies
(k) program and cue track audio levels
(l) control track levels and phase

2. *Recorded Signal Characteristics*

2.1 The video signals recorded by the video heads shall occupy sequential bands from top to bottom in the reproduced picture, each of which corresponds to a single traverse of a video head across the tape. For the purpose of identification, these bands are designated as one through sixteen. The first band after that containing the vertical synchronizing pulse interval shall be designated as band one. (Band one will contain fewer active lines than the other bands because it contains a portion of vertical blanking.) The active picture portion of the horizontal scan shall be divided into eleven equal sections. For the purpose of identification, these sections are designated as zero through ten. Information shall be recorded as follows:

	Information	*Bands*
2.1.1	A stairstep signal consisting of a ten-step linear gray scale extending from blanking level to 100 IRE units respectively, as shown in Fig. 1.	1 through 4
2.1.2	A stairstep signal consisting of a five-step linear gray scale extending from black level to 50 IRE units respectively, as shown in Fig. 2.	5 through 8
2.1.3	A series of five sine-wave bursts, as shown in Fig. 2, and described as follows: The time sequence of the burst frequencies shall be 4.2, 3.6, 3.0, 2.0 and 1.5 mc. The axis of the multiburst shall be at 30 IRE units, and the peak-to-peak amplitude shall be 40 IRE units. Each burst duration will be at least 75% of the section width.	5 through 8
2.1.4	A window signal at reference white level (100 IRE units) three sections wide and six bands high to be positioned horizontally in sections six, seven and eight, as shown in Fig. 3, and vertically between the centers of the ninth and fifteenth bands. The remaining section shall be at blanking level (0 IRE units).	9 through 15

Information	*Bands*
2.1.5 Vertical synchronizing pulse interval and a portion of vertical blanking.	Band 16 Only
2.1.6 Sine-squared pulses of $\frac{1}{8}$-microsecond width (measured at half level) and 50 IRE units in height at horizontal positions corresponding to the center of each of the first six sections. The base level of each sine-squared pulse shall be as follows:	1 through 15
(a) Bands 1 through 8, the same as the accompanying stairstep section level, as shown in Figs. 1 and 2.	
(b) Bands 9 through 15, at blanking level, as shown in Fig. 3.	

2.2 The waveform of the composite signal shall appear as shown in Fig. 4.

2.3 All synchronizing waveforms and signal amplitudes shall conform with EIA Standard RS-170 or the latest revision thereof.

2.4 All video signals shall be within ±1 IRE unit of specified amplitudes.

2.5 Rise and decay time of window and stairstep signals shall not exceed 0.003 H (0.3% of the horizontal scanning period)

2.6 Overshoot of window and stairstep signals shall not exceed 5% of the amplitude of transition. An exception is the trailing edge of stairstep (leading edge of horizontal blanking) which is limited to 2% in accordance with EIA Standard RS-170 or the latest revision thereof.

2.7 Multiburst frequencies shall conform with specified values within 1%. Total harmonic distortion content of the multiburst frequencies shall not exceed 2%.

2.8 The audio tone and cue records shall consist of an audio tone interrupted periodically with voice announcements.

2.9 (a) The audio tone shall be 400 cps ±2% recorded at a level 10 db below that corresponding to a 3% total harmonic distortion at 400 cps.

(b) The audio response-frequency characteristics shall be as specified in Proposed American Standard Characteristics of the Audio Records for 2-In. Video Magnetic Tape Recordings, VTR 16.5, or the latest revision thereof.

2.10 The voice announcements shall be made at one-minute intervals and shall not exceed 20 seconds in duration. The announcement shall provide identification of the tape as regards the applicable SMPTE Recommended Practice, the tape issue number, and the manufacturer of the standard tape. Additional identification (such as serial number) may be included at the discretion of the manufacturer.

3. *Recording Conditions*

3.1 The video alignment tape shall conform with applicable American Standards and SMPTE Recommended Practices.

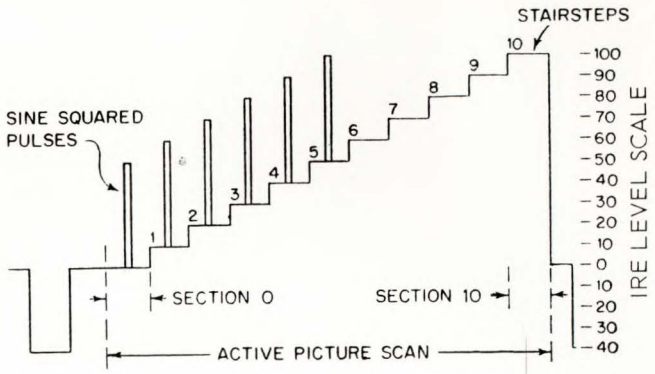


Fig. 1. Bands 1 through 4.

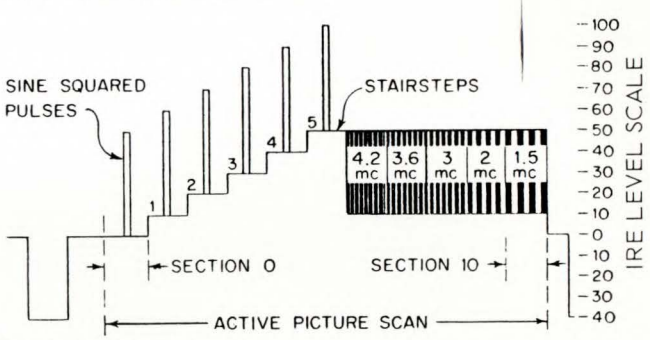


Fig. 2. Bands 5 through 8.

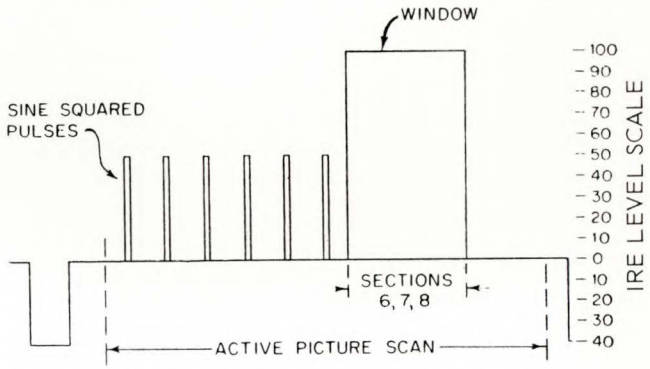


Fig. 3. Bands 9 through 15.

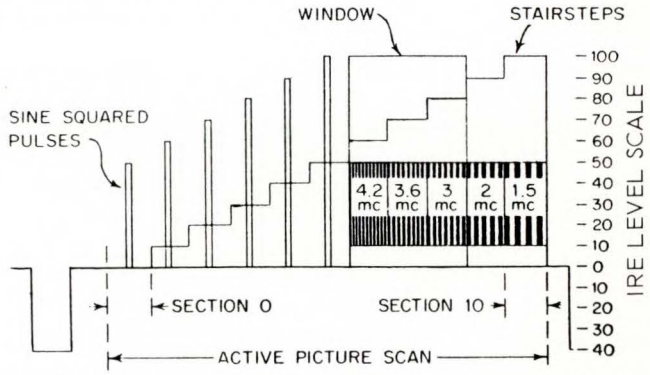


Fig. 4. Composite waveform. Waveforms shown at line rate sweeps.

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(Continued from Page 3)

Various "recorded-in" dropout depths ranging from 0 db to 20 db in one db increments can be obtained by utilizing the Daven RF attenuator.

RESULTS: A considerable variety of information concerning playback performance is obtainable by examining various playback system signals while the simulated dropout test tape is being produced.

The use of fairly large amounts of high frequency pre and post emphasis applied to the video signal in magnetic recording improves the signal to noise ratio of the system. Since the playback video signal generated during a carrier dropout contains a substantial amount of high frequency noise, the use of these emphasis techniques also improves a recorder's dropout immunity.

In playback tests on a typical Ampex VR 1000C recorder, utilizing Monochrome playback equalization and deviation standards, simulated dropouts consisting of 20 db reductions in playback carrier level (10 db reduction in recorded signal) produced corresponding video bursts wherein signal to noise ratio measured 23.2 db (p. p. Video to rms noise voltage-ratio). When recording with Monochrome deviation and with the highly de-emphasized Ampex color playback equalization in use, the signal to noise ratio during the dropout measured 27 db below reference video level, indicating an improvement of 3.8 db. During a dropout comprising a 26 db reduction in carrier level (12 db reduction in record signal), the signal to noise ratio changed from a value of 17.5 db to 21 db when using Ampex color equalization, representing an improvement of 3.5 db.

CONCLUSION: It appears that the noise level in the first stage of the playback pre-amplifier generally sets the limit on the depth of dropout which may be recovered by action of the limiters. Therefore, within limits, any reduction in the inherent equivalent noise level of the first stage, or an increase in head signal output, should improve dropout immunity.

Since natural dropouts on tape may occur in such a way as to cause carrier signal losses in all degrees, large and small, the use of more pre and post emphasis than represented by the Standard Ampex Monochrome Equalization should statistically reduce the size and number of dropouts that are visible in the picture by supressing their noise content.

Inherent residual noise due to the tape itself appears as intermodulation products in the recorded signal. Therefore, this component of noise decreases in amplitude at somewhat the same rate as the useful modulation products of video information signal decrease, when a dropout area is transversed by the playback head. Accordingly, the instantaneous degradation in video signal to noise ratio accompanying a carrier dropout should not be influenced by inherent tape noise, and appears to be almost solely determined by the system's ability to overcome first stage pre-amp noise, assuming all other playback system parameters are normal.

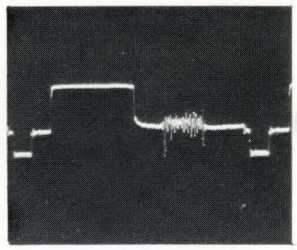
The relationship between "Recorded-in Dropout Depth" and "Playback Dropout Depth" will vary with different head and tape combinations. Therefore, the highest potential uniformity in producing test tapes of this type can be achieved by matching their performance at only one level of playback dropout depth.

Performance tests made on a variety of recorders suggest that a recording with simulated carrier interruptions that produce 20 db dropouts in each head channel during playback may be the most practical form of test tape to provide for quantity usage. Measurement of instantaneous video noise during reproduction of the dropout provides a convenient figure of merit for checking relative machine performance.

It should be noted here that the data is independent of the recorder and head used for recording provided that the playback dropout noise is compared to the playback video signal amplitude as shown by Figure 3.

Figure 3

Photo of playback of Dropout Test Tape from monitor



Waveform of horizontal line with "recorded in" dropout corresponding to black area of gray scale

3M does not intend to produce any of these tapes. Consequently, the company does not have any for sale and is publishing this study merely as an informative technical article which can be used as another means for checking recorder performance and increased standardized performance from machine to machine.

For more complete information on procedural steps involved in actual preparation of a dropout test tape write to 3M Company, St. Paul 19, Minnesota.

playback
published by
Magnetic Products Division 3M COMPANY

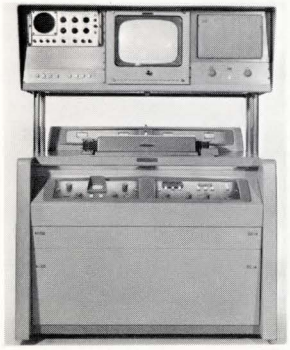
NEW TAPE PLANT

Construction of a third domestic magnetic tape manufacturing plant has been undertaken by the 3M Company at Camarillo, California, about 45 miles northwest of Los Angeles. The West Coast location of this 125,000 square foot plant (shown at left in an artist's drawing) will enable 3M to give the best possible service to its western customers and will increase production capacity by 35%. Mr. James L. Bergstrom has been appointed Manager of the Camarillo facility, scheduled for completion in 1963.

playback

"Tape Recorder Roundup"

The following is a brief resume' of machines currently being offered, available on order from manufacturers listed:



AMPEX VR-1000C (Broadcast)-- Provides the television broadcaster with a fast, versatile and economical facility for recording and immediate reproduction from a variety of sources.

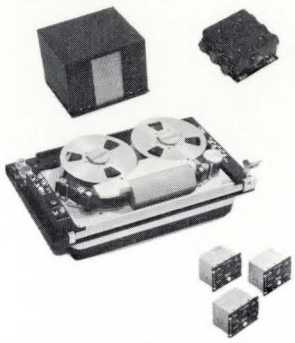
Features include: An AFC modulator / demodulator, which includes zero centering meter of any two pre-set carrier frequency and deviation standards; a new Mark III head assembly; monochrome and color requirements well within FCC standards of good engineering practice; automatic guide servo control, manual or automatic; provisions for Intersync, Amtec and Colortec accessories. Tape width 2" ; tape speed 15 ips and 7-1/2 ips; recording time 96 minutes on 14" reel; console 34-3/4" deep, 55" wide, with two additional standard racks.

AMPEX VR-1002 (Broadcast/Mobile)-- A compact, improved upright design with simplified operating procedures. This model is designed to include major innovations and refinements in operating controls and circuitry.

Features include: An AFC modulator / demodulator which incorporates automatic frequency control of the carrier, simplified arrangement of carrier frequency and deviation with built-in zero-center metering; a new Mark III head assembly to minimize geometric picture distortion and improve performance characteristics; fewer tubes and transistors to simplify maintenance and adjustment; high signal-to-noise ratio and accurately controlled noise banding over the entire gray scale; provision for Amtec and Colortec accessories. Tape width 2"; tape speed 15 ips and 7-1/2 ips; recording time 96 minutes on 14" reel; machine takes 11-1/2 square feet of floor space with additional two racks for associated equipment.

INSTRUMENTATION RECORDERS

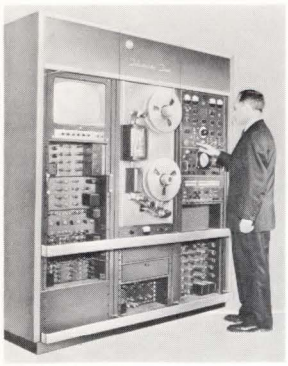
AMPEX AR-300 (Record Only Airborne or Mobile Unit)-- AMPEX FR-800 (Complete Laboratory Record/Reproduce System)-- Rotary head instrumentation recorders for radar, wideband communications monitoring, and other advanced applications. Both cover a wideband frequency spectrum from 10 cps to 4 megacycles. The AR-300 can be used in any of the FR-800 applications since both machines have identical recording characteristics. Tapes recorded on the AR-300 are reproduced on the compatible FR-800 with militarized components used to assure reliable, trouble-free operation. Available in military versions AN/ALH-4 (AR-300) and AN/GLH-3 (FR-800). Heads travel at 12,000 rpm over 2" width tape at speeds of 12-1/2 ips or 25 ips with standard 10-1/2" reels used. The two recorders also use the same basic transport which is 30-1/2" long, 10-1/2" high and 16-1/2" deep, and operate in any position. Transports have aluminum casting with precision milled mounting surfaces for guides, heads and other components.



AR-300 Features: For airborne, mobile, shipboard or submarine applications, designed to record data under extreme environmental conditions. Operates off standard aircraft power (115 volt, 3 phase, 400 cps AC, and 28 volt DC). For mobile use commercially available power converters can be used. Remote operation using either a supervisory or autonomic remote control unit is possible.

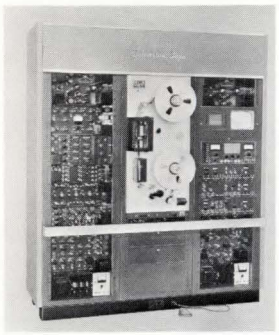
FR-800 Features: The entire FR-800 system mounts in a single rack cabinet, operates on standard input power sources (117 volts single phase, 50 or 60 cps AC). No external cooling air is required when the machine is in operation. A specially plated glass dust cover, head cover and extra screening prevent radio frequency interference, and complete monitoring facilities are provided for continuous check of recorded data and system alignment.

For additional information write: Ampex Corporation, Video Instrumentation Division, 934 Charter Street, Redwood City, California.



RCA TRT-1B (Broadcast) Includes features now standard with all RCA video tape recording equipment. Recent improvements include: Built-in transistorized Pixlock, freedom from dropouts thru better limiting, transistor processing amplifier for sharper pictures, air-bearing headwheel for improved performance and longer headwheel life.

Additional features include: Built-in control of picture quality to eliminate skewing, jogging and other disturbances; advanced signal processor for full fidelity color and monochrome pictures with long-term stability; semi-conductor power supplies for less heat and protection against overloads and shorts; longer headwheel life for longer pole tip life; many others. Tape width 2", tape speed 15 ips (7-1/2 ips modification available); recording time 96 minutes on 14" reel; 13.7 square feet floor space, monochrome; 16.5 square feet, color.



RCA TR-2 UNIVERSAL COMPACT (Broadcast/Mobile)--Combines high performance standards with compact design and is readily converted to color operation. Design makes liberal use of transistorized circuitry extended to the operation of "switchlock", a standard feature which prevents picture roll-over when signal is switched among local sources. While in the compact class, the TR-2 has the capability to perform functions inherent in standard size TV tape recorders.

Additional features include: Choice of two models, studio or short-rack model for mobile units; simplified control panel; precision transistorized headwheel servo; electronic quadrature alignment; etc. Studio model available (3-rack) 70" wide, 84" high, 24" deep; mobile (2 cabinets) 50" wide, 66" high, 24" deep. Tape width 2"; tape speed 15 ips (7-1/2 ips modification available); recording time 96 minutes on 14" reel.

RCA TR-22 SOLID STATE (Broadcast)--Deluxe, precision built, totally transistorized (750 transistors, 350 diodes) in all recording and playback circuits. All recording, monitoring, and testing facilities are in one console with provision for addition of color and automatic timing correction modules.

Features include: 5 second starting time to record or playback; air-bearing headwheel for minimum of jitter, improved signal-to-noise ratio, excellent frequency response; self-adjusting circuits for minimum operator control; carrier and deviation monitor for reference during record and playback; modularized construction for easy servicing; unique signaling system that indicates area of malfunction; 14" picture monitor; built-in Pixlock to eliminate picture break-up when switching video feeds and for special effects use; tone oscillator for marking cue channel; separate record and playback control panels to reduce chance of accidental erasure; adaptable as mobile unit. Tape width 2"; tape speed 15 ips (7-1/2 ips modification available); recording time 96 minutes on 14" reel; takes 10 square feet of space.

For additional information write: RCA, Building 15-5, Camden 2, New Jersey.

MACHTRONICS MVR-10 (Industrial/Educational)--A portable transistorized recording/reproducing unit. The recorder is self-contained, weighs 65 lbs., takes up only 2.0 cubic feet of space and operates wherever AC current is available.

Features include: Acceptance of composite video from any image orthicon or vidicon camera; sync may be blanking, industrial, or EIA; video signal is placed on tape by helical scan method, using 180° tape wrap and two long life, high output heads; a unique servo system and a high precision scanning assembly assures interchangeability; pushbutton control; electronic interlocking prevents accidental operation of more than one mode at a time. Tape speed 7-1/2 ips; tape width 1"; recording time 96 minutes on 10-1/2" reel. Video frequency characteristics ±3 db from 10 cycles to 3.0 megacycles with respect to 100 kilocycles. Video S/N 40 db rms noise to peak-to-peak video or more.

For additional information write: Machtronics, Inc., 185 Evelyn Avenue, Mountain View, California.

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