Standards and Recommended Practices

Approved SMPTE Recommended Practices

Two SMPTE Recommended Practices were approved by the Society's Executive Committee for Standards Approval: RP 93-1989, Requirements for Recording American National Standard Time and Control Code on 1-in Type B Helical-Scan Video Tape Recorders; and RP 117-1989, Dimensions of Magnetic Control and Data Record on 8-mm Type S Motion-Picture Film. These and other SMPTE Recommended Practices may be obtained from Society Headquarters for $3.00 each.

Proposed American National Standards

Published here for a trial period and public review are Proposed American National Standards SMPTE 229M, Television Analog Recording — ½-in Type L — Records; and SMPTE 230M, Television Analog Recording — ½-in Type L — Electrical Parameters, Control Code and Tracking Control. The proposals will be submitted to the Society's Executive Committee for Standards Approval if no adverse comments are received from publication. Comments should be addressed to Sherwin H. Becker, prior to June 1, 1990.

Proposed SMPTE Recommended Practice

A Proposed SMPTE Recommended Practice is published here for a trial period and public review: RP 144, Basic System and Transport Geometry Parameters for ½-in Type L Format. If no adverse comments are received prior to June 1, 1990, the proposal will be submitted to the Society's Executive Committee for Standards Approval. Copies of the above proposals are available from Society Headquarters for $3.00 each.

—Sherwin H. Becker, Director of Engineering

SMPTE RECOMMENDED PRACTICE

RP 93–1989

Requirements for Recording American National Standard Time and Control Code on 1-in Type B Helical-Scan Video Tape Recorders

1. *Scope*

This practice specifies the recorded signal and the conditions for recording the time and control code on 1-in type B helical-scan video tape recorders as specified in American National Standard for Television—Time and Control Code—Video and Audio Tape for 525-Line/60-Field Systems, ANSI/SMPTE 12M-1986.

2. *Format Standards and Practices*

American National Standards referred to in this practice are given in Table 1.

Table 1

Basic System Parameters (lists associated documents)	ANSI/SMPTE 15M-1987
Dimensions and Locations of Records	ANSI/SMPTE 16M-1987
Frequency Response and Audio Recording Levels	ANSI/SMPTE 17M-1987

3. *Position of Code on Video Tape*

3.1 The code, if used, shall be recorded on the audio 3 track.

3.2 The start of the address for original recording shall be as specified in ANSI/SMPTE 12M-1986.

3.3 The position of the address start point along the tape is determined by the position of the appropriate audio head gap.

4. *Recorded Signal*

4.1 The input waveform of the recorder for original time and control code recording shall be as specified in ANSI/SMPTE 12M-1986.

4.2 Response of the recording channel shall be as specified in ANSI/SMPTE 17M-1987.

4.3 The amplitude of the recorded signal shall be such as to produce a peak-to-peak short circuit recorded flux level on the tape of at least 185 nWb/m of track width.

Revision of RP 93-1987
Approved September 27, 1989

Appendix

(This Appendix is not part of the SMPTE Recommended Practice, but is included for information only.)

A1. Flux Level Measurements

Means for measuring the short circuit flux level on magnetic recordings usually are not available to users of audio and video tape recorders. The values recommended in this document may be established by use of reference tapes. Such tapes usually contain a sine-wave reference level recording on each audio track whose rms short circuit flux level is as specified for the format being used. Usually the recorder is adjusted to record the same level that exists on the reference tape when its volume meter reads 0 vu. If the recording level of the code then is adjusted so that the volume indicator reads 0 vu, the recorded code will have the required peak-to-peak flux level specified in Sec. 4.3 above. Measurements should be made with a standard volume indicator (vu meter), as specified in IEEE Std 152-1953, Volume Measurements of Electrical Speech and Program Waves. Although the ballistics of the meter are of little importance with respect to the code, the use of a full-wave rectifier and the approximate average reading characteristic of the volume indicator are essential to the accuracy of the procedure.

A2. Dub Recordings

A2.1 The preferred method of producing time and control code dubs is by insertion of a slaved time code generator in the video and time code signal paths between reproducer and recorder to ensure compliance with all sections of ANSI/SMPTE 12M-1986 and the section of this practice for original recordings. When using this method, the user bit information, if any, may be delayed by two or more frames due to the length of a complete code group and the mechanical tolerance of audio head-gap location specified.

A2.2 Other acceptable methods of producing time and control code dubs are:

A2.2.1 Reclock and reshape the time code waveform to meet ANSI/SMPTE 12M-1986. The resulting waveform will not comply with ANSI/SMPTE 12M-1986, thereby allowing buildup of video-to-address timing errors on multiple-generation dubs.

A2.2.2 Reshape the time code waveform to meet ANSI/SMPTE 12M-1986. Video-to-address timing errors and waveform transition jitter will build up on multi-generation dubs.

A2.2.3 Provide no special time code signal processing. The usefulness of dubs will be limited.

SMPTE RECOMMENDED PRACTICE — RP 117–1989

Dimensions of Magnetic Control and Data Record on 8-mm Type S Motion-Picture Film

1. *Scope*

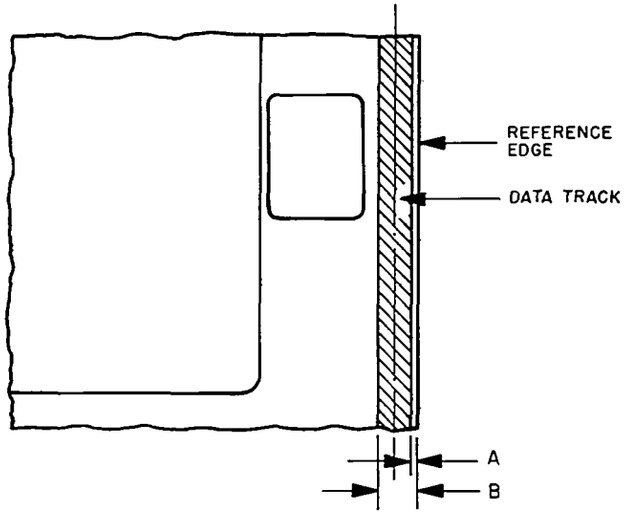
This practice specifies the lateral location and dimensions of a magnetic control and data record on 8-mm type S motion-picture film.

2. *Data Record*

2.1 The dimensions and lateral location of the control and data record shall be as specified in the figure and table.

2.2 The recording shall be made so that the azimuth of the record is at an angle of 90° ± 1° to the reference edge of the film.

2.3 The recording is on the balance stripe of the film.



Dimensions	Inches	Millimeters
A	0.006 max	0.15 max
B	0.012 min	0.30 min

595 West Hartsdale Avenue, White Plains, NY 10607, (914) 761-1100

Revision of RP 117-1983
Approved September 1, 1989

Appendix

(This Appendix is not part of the SMPTE Recommended Practice, but is included for information only.)

A1. Balance Stripe Composition

The data track recording specified in this practice is on the balance stripe of magnetically striped 8-mm type S motion-picture film. Such film is striped in accordance with American National Standard for Motion-Picture Film (8-mm Type S)—Magnetic Striping, ANSI/SMPTE 161-1986. That standard states that the balance stripe may be made of either magnetic or non-magnetic material. Thus, the user of this practice should be aware that film may exist which has a balance stripe which is suitable to fulfill its intended purpose of facilitating winding, but which is not suitable for magnetic data recording.

A2. Reproducing Head Gap Width

It will normally be good practice to make the reproducing head as wide as possible in order to be tolerant to film weave and misplacement of the recorded track. A restriction to this is the possibility of grooving of a reproducing head wider than the balance stripe, which grooving damages the head and eventually the film.

Proposed American National Standard

television analog recording— ½-in type L— records

SMPTE 229M

Revision of
ANSI/SMPTE 229M-1987

1. Scope

This standard specifies the dimensions and location of the video, audio, time code, and tracking-control records, as recorded by ½-in type L helical-scan video tape recorders operating with video signals having a typical scanning structure of 525 lines, 59.94 fields per second, and 2:1 interlace. Use is made of the video cassette and tape specified in ANSI V98.35M-1984 for type G format or SMPTE 238M for type L format.

2. Referenced Documents

This standard is intended for use in conjunction with the following documents:

ANSI V98.35M-1984, Video Recording — ½-in Type G — Cassette and Tape

SMPTE 230M, Television Analog Recording — ½-in Type L — Electrical Parameters, Control Code and Tracking Control

SMPTE 238M, Television Analog Recording — ½-in Type L — Tape and Cassettes

SMPTE RP 144, Basic System and Transport Geometry Parameters for ½-in Type L Format

3. General Specifications

3.1 Dimensions are in the metric system.

3.2 Tests and measurements made on the tape record to check the requirements of this standard shall be made under the following conditions unless otherwise stated:

Temperature	20°C ± 1°C
Relative humidity	50% ± 2%
Barometric pressure	86 to 106 kPa
Tape tension	0.46 N ± 0.05 N

3.3 Conditioning of the tape stock before recording and testing shall be as follows:

Environmental	Stablized to the conditions specified in 3.2
Tape tension	Wound on a reel at a tension of 0.56 N ± 0.20 N
Conditioning time	24 hours

3.4 The reference edge of the tape for dimensions specified in this standard shall be the lower edge as shown in Fig. 1. The magnetic coating, with the direction of tape travel as shown in Figs. 1 and 2, is on the side facing the observer.

4. Tape Speed

The tape speed shall be 118.582 mm/s, basic, and shall result in Dimension "O" as shown.

5. Record Locations and Dimensions

5.1 Record locations and dimensions shall be as specified in Figs. 1 and 2 and the table.

5.2 Dimensions P, Q, R, and W are shown for reference purposes only. The actual value of these dimensions is determined by the transport parameters, the tape speed, and their tolerances. A tape

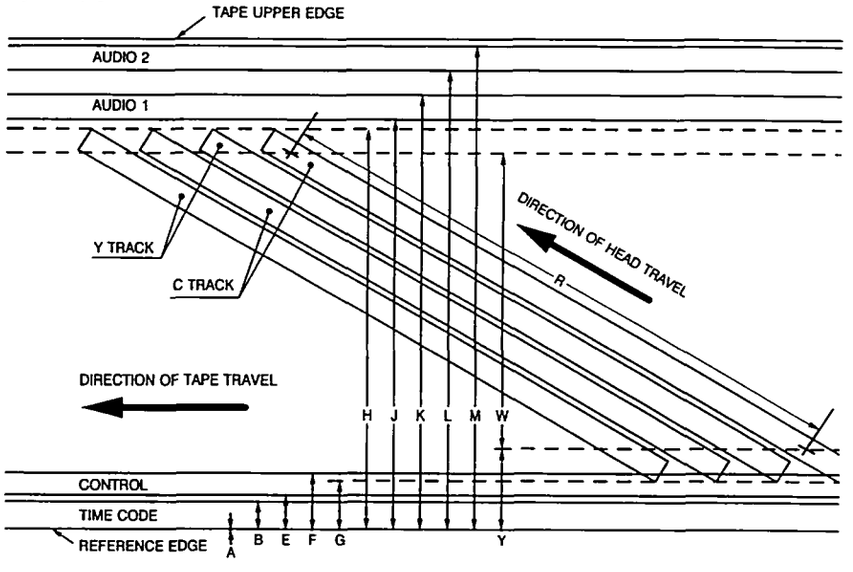


Fig. 1
Record Locations and Dimensions

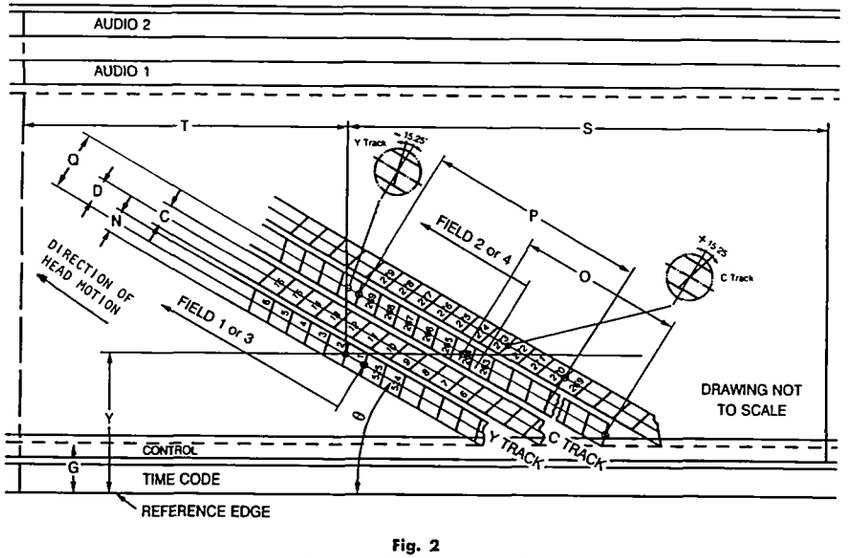


Fig. 2
Video Record Location (525/60)

speed at 118.582 mm/s basic shall result in Dimension "O" as shown. The nominal values given are based on tensioned tape; therefore, direct measurements without tension must take into account tape elasticity.

6. Video Record Curvature

The edge of any video record contained within an area defined by dimension W shall lay within two parallel straight lines 0.010 mm apart. (See Appendix for preferred measurement technique.)

7. Relative Positions of Recorded Signals

7.1 Video luminance, color difference, tracking control, audio, and time code signals, with information intended to be time coincident, shall be positioned as shown in Fig. 2.

7.2 Luminance and color-difference records for fields 2 and 4 are offset by one-half line with respect to fields 1 and 3. (See Fig. 2.)

8. Gap Azimuth

8.1 The azimuth of the audio, tracking control, and time code head gaps used to produce longitudinal track records shall be perpendicular to the direction of relative head-to-tape motion. (See Fig. 2.)

8.2 The azimuth of the video head gaps for the luminance signal shall be — 15.25° and for the color-difference signals + 15.25° to the perpendicular of the direction of head motion.

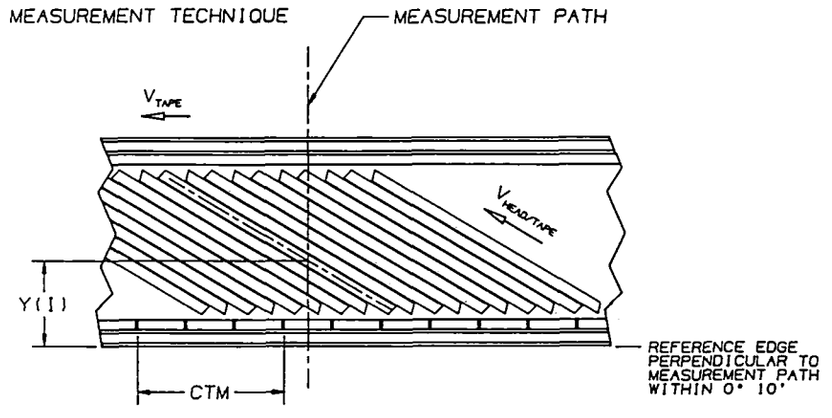
Table
Record Locations and Dimensions

	Dimensions	Micrometers Minimum	Nominal	Maximum
A	Time code track lower edge	0	0	0
B	Time code track upper edge	330	400	470
C	Color track width	68	73	78
D	Y-C track pitch	77.5	80.5	83.5
E	Control track lower edge	635	700	765
F	Control track upper edge	1035	1100	1165
G	Video track lower edge	880	950	1020
H	Video track upper edge	10720	10720	10805
J	Audio 1 track lower edge	10805	10850	10895
K	Audio 1 track upper edge	11390	11450	11510
L	Audio 2 track lower edge	11790	11850	11910
M	Audio 2 track upper edge	12405	12450	12495
N	Y track width	83	86	89
O	Lead signal overlap			8.3H ref
P	Y-C track offset		4399 (= 10H) ref	
Q	Video track pitch	161.0	161.4	161.8
R	Video track length		115032	(262.5H) basic
S	Control track record offset	36600	36700	36800
T	Audio and time code record offset	180681	180918	181155
W	Video area effective width		9384 ref	
Y	Lower limit of W	1238	1248	1258
Ø	Track angle (degrees)		4.6790 (basic)	

Note: Ref indicates those measurements which are fixed by other parameters and are given for reference purposes only.

Appendix

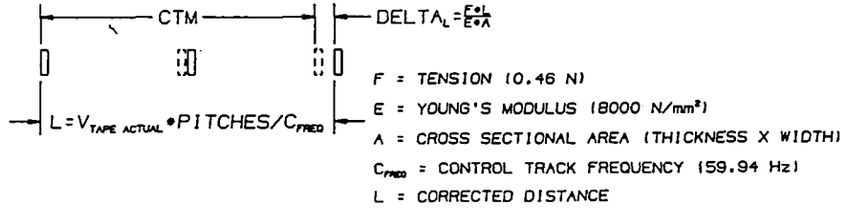
(This Appendix is not part of the American National Standard, but is included for information only.)



Y(1) MUST USE SAME HEAD FOR EACH MEASUREMENT (i.e. EVERY 2nd TRACK)

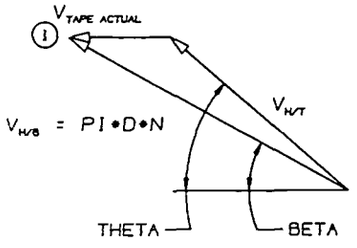
CTM = CONTROL TRACK PULSES (UNTENSIONED TAPE)

CORRECTION FACTORS ACTUAL TAPE SPEED, TENSION



$$V_{TAPE\ ACTUAL} = CTM \bullet C_{FREQ} / ((1 - F/(E \bullet A)) \bullet PITCHES)$$

MODEL



$V_{H/B}$ = VELOCITY OF HEAD wrt BAND

$V_{TAPE\ ACTUAL}$ = ACTUAL VELOCITY of TAPE

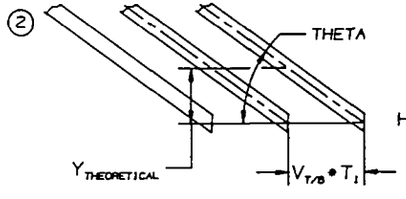
$V_{H/T}$ = VELOCITY of HEAD wrt TAPE

D = EFFECTIVE SCANNER DIAMETER

N = SCANNER SPEED ($\frac{REV}{S}$)

THETA = TRACK ANGLE

BETA = SCANNER HELIX ANGLE



T_1 = TIME BETWEEN HEAD PASSES

$$= \frac{1}{N * HPPR}$$

HPPR = HEAD PASSES per REVOLUTION

FROM (1)

$$TAN\ (THETA) = \frac{PI \bullet D \bullet N \bullet SIN(BETA)}{PI \bullet D \bullet N \bullet COS(BETA) - V_{TAPE\ ACTUAL}}$$

FROM (2)

$$TAN\ (THETA) = \frac{Y_{THEORETICAL}}{V_{TAPE\ ACTUAL} \bullet T_1}$$

THEREFORE:

$$Y_{THEORETICAL} = \frac{PI \bullet D \bullet N \bullet SIN(BETA)}{PI \bullet D \bullet N \bullet COS(BETA) - V_{TAPE\ ACTUAL}} \bullet V_{TAPE\ ACTUAL} \bullet T_1$$

$$TRACK\ LOCATION\ ERROR = Y(I) - Y(I)_{THEORETICAL}$$

Proposed American National Standard

television analog recording— ½-in type L— electrical parameters, control code and tracking control

SMPTE 230M

Revision of ANSI/SMPTE 230M-1987

1. Scope

1.1 This standard specifies the electrical parameters of video, audio, time and control code, and tracking-control signals for ½-in type L helical-scan video tape recorders operating with video signals having a typical scanning structure of 525 lines, 59.94 fields per second, and 2:1 interlace. This standard specifies two recording modes: Mode 1 uses oxide-particle tape, and mode 2 uses metal-particle tape and permits audio frequency modulation (AFM) signals to be recorded.

1.2 Where nominal values are given without tolerances, interchange performance will be limited by implementation accuracy.

2. Referenced Documents

This standard is intended for use in conjunction with the following documents:

ANSI/SMPTE 12M-1986, Television — Time and Control Code — Video and Audio Tape for 525-Line/60-Field Systems

ANSI V98.35M-1984, Video Recording —½-in Type G — Cassette and Tape

SMPTE 229M, Television Analog Recording — ½-in Type L — Records

SMPTE 238M, Television Analog Recording — ½-in Type L — Tape and Cassettes

IEEE Std 152-1953, Volume Measurements of Electrical Speech and Program Waves

IEC Publication 268-12 (1975), Circular Connectors for Broadcast and Similar Uses

CCIR Report 624-3, Characteristics of Systems for Monochrome and Colour Television

3. Video Recording

This component video recording system is intended to operate compatibly in an NTSC environment. To achieve this, the levels and ratios used in the format are derived from the monochrome or composite input signal as defined in 3.4.

The video recording system shall provide separate signal paths for the luminance and color-difference signals. These component signals shall be recorded on two separate tracks designated respectively as the Y track for the luminance signal and the C track for the color-difference signals. The R-Y and B-Y color-difference signals shall be recorded in the form of a compressed time-division multiplexed signal on the C track. When operating in mode 2, two AFM signals may be recorded in addition to the compressed color-difference signals.

3.1 Mode Selection

3.1.1 Two modes of operation are defined for the following tape types:

Oxide-particle tape	Mode 1
Metal-particle tape	Mode 2

3.1.2 Sensing of tape type shall be automatic by way of a sensing hole in the cassette as described in SMPTE 238M.

3.2 Luminance Channel

3.2.1 Signal Processing. A signal processing system, as specified in this standard, shall contain the following elements in the order of the signal flow.

3.2.1.1 A means for modifying the sync portion of the luminance signal

3.2.1.2 A means for insertion of a vertical interval subcarrier is required in mode 2 when the signal to be recorded has been decoded from a composite source as defined in CCIR Report 624-3. The vertical interval subcarrier (VISC) is optional in mode 1.

3.2.1.3 A video nonlinear preemphasis process

3.2.1.4 A video preemphasis network

3.2.1.5 A means for clipping the video signal after preemphasis

3.2.1.6 A linear frequency modulator having constant deviation with respect to the amplitude of the modulating frequencies

3.2.1.7 An amplifier to provide current drive to the Y channel record heads

3.2.2 Modification of Sync Portion. Means shall be used to modify the pulse width and amplitude of the sync portion as shown in Fig. 1.

3.2.3 Luminance Nonlinear Preemphasis. The luminance signal shall receive nonlinear preemphasis. (See Fig. 2.) The characteristics shall be as shown in Table 1.

Table 1
Video Nonlinear Preemphasis Characteristics

	Input (dB)					
(MHz)	—30	—20	—15	—10	—5	0
0.2	0.4	0.4	0.4	0.4	0.3	0.2
0.5	1.9	1.7	1.7	1.4	0.8	0.4
1.0	4.6	4.0	3.5	2.4	1.3	0.7
1.5	6.7	5.6	4.6	3.0	1.6	0.9
2.0	8.0	6.6	4.9	3.3	1.8	1.1
3.0	9.5	7.5	5.3	3.6	2.2	1.3
4.0	9.9	7.6	5.3	3.6	2.2	1.4
5.0	9.9	7.3	5.1	3.3	2.0	1.2

Values are in decibels.

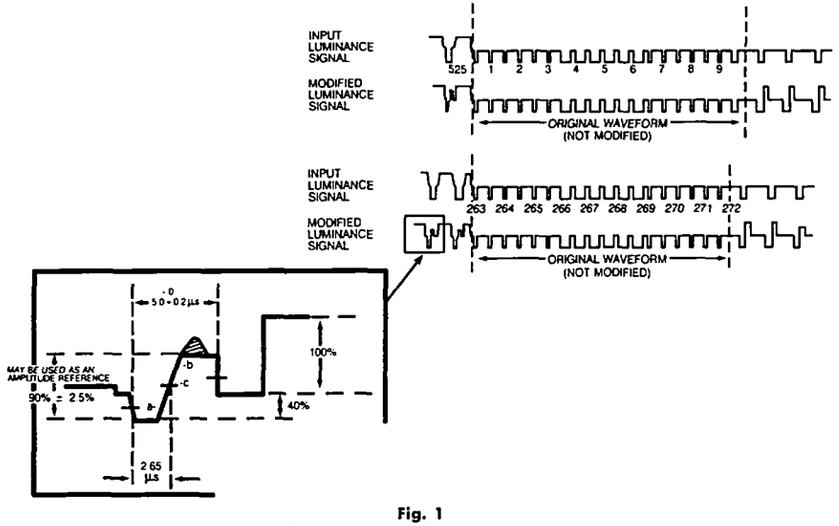


Fig. 1
Waveform of the Modified Luminance Sync
(Vertical Sync and Equalizing Pulse Portion Remains Unmodified)

Notes: 1. The shaded area of this signal may or may not be present. It is not part of the format.
2. Rise time a-b should be 180 ns with an approximate Gaussian shape at the 10% and 90% points.
3. Dimension c is the midpoint of the a-b transition.
4. See Appendix A1.

3.2.4 Luminance Preemphasis. Preemphasis is defined by the frequency and phase characteristics of the network shown in Fig. 3 when fed from a zero impedance source and feeding an infinite impedance load.

3.2.5 Amplitude Clipping. For an input signal where blanking is at 0% and peak white at 100%, any positive or negative amplitude excursion exceeding the levels shown in Table 2 shall be clipped.

Table 2
Luminance Amplitude Clipping Characteristics

	Mode 1	Mode 2
Positive excursion limit	+ 310% nom + 315% max	+ 324% nom + 329% max
Negative excursion limit	— 125% nom — 130% max	— 214% nom — 219% max

3.2.6 Recorded Carrier Frequency. Carrier frequencies corresponding to reference video levels shall be as shown in Table 3 when recording a flat-field signal.

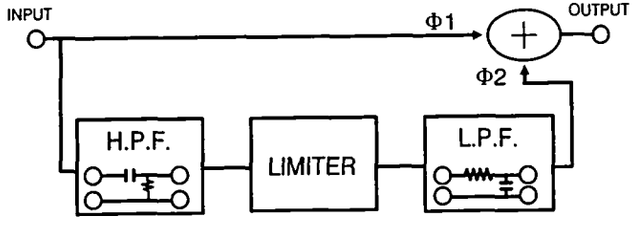


Fig. 2
Block Diagram of Video Nonlinear Preemphasis

Note: The phase of the side chain (Φ2) shall be equal to the phase of the input signal (Φ1) at 3.58 MHz prior to the mixing.

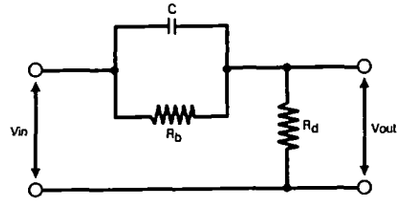


Fig. 3
Preemphasis Network

Table 3
Carrier Frequencies Corresponding to Reference Video Levels

	Mode 1	Mode 2
100% white	6.4 MHz nom	7.7 MHz nom
50% level	5.7 MHz nom	7.0 MHz nom
Blanking	4.97 ± 0.05 MHz	6.27 ± 0.05 MHz
Sync Tip	4.4 MHz nom	5.7 MHz nom
Deviation (blanking to peak white)	1.43 ± 0.05 MHz	1.43 ± 0.05 MHz

3.2.7 Y Track Record Head Current

3.2.7.1 The amplitude of the record current for the Y track shall be such that the maximum level of remanent flux on the tape is produced when recording a Y signal with 50% amplitude flat field.

3.2.7.2 The amplitude of the Y track record current shall decrease with increasing frequency in the range 2 to 10 MHz, according to a straight line contained within limit lines as shown in Fig. 4.

3.3 C Channel

3.3.1 Signal Processing. A signal processing system, as specified by this standard, shall contain the following elements in the order of the signal flow:

3.3.1.1 A means of compressing the time scale of the R-Y and B-Y signals over a period of one horizontal line such that they may be time multiplexed into one horizontal line

3.3.1.2 A means of adding a horizontal timing pulse

3.3.1.3 A video nonlinear preemphasis process

3.3.1.4 A video preemphasis network

3.3.1.5 A means for clipping the video signal after preemphasis

3.3.1.6 A linear frequency modulator having contsant deviation with respect to the amplitude of the modulating frequencies

3.3.1.7 A high-pass filter to reduce the low-frequency component amplitude of the FM chrominance signal

3.3.1.8 A means of combining the frequency modulated audio signal and the frequency modulated chrominance signal in mode 2 when the AFM signals are present

3.3.1.9 An amplifier to provide amplitude current drive to the C channel record heads

3.3.2 Time Compression and Multiplexing

3.3.2.1 The R-Y and B-Y signals shall each be compressed into a half-time scale as shown in Fig. 5.

3.3.2.2 The compressed R-Y and B-Y signals shall be multiplexed alternately and delayed by one horizontal line with respect to the luminance signal as shown in Fig. 6.

3.3.3 Addition of Horizintal Timing Pulses. The horizontal timing pulses which are continuous through the vertical interval shall be added to the compressed and multiplexed R-Y and B-Y signals as shown in Fig. 6. The sync shall have an approximate Gaussian shape with a fall time of 220 ns between the 10% and 90% points.

3.3.4 R-Y and B-Y Nonlinear Preemphasis. The video signal shall receive nonlinear preemphasis which has the characteristics shown in Table 1 and Fig. 2.

3.3.5 R-Y and B-Y Preemphasis. Preemphasis is defined by the frequency and phase characteristics of the network as shown in Fig. 3, when fed from a zero impedance source and feeding an infinite impedance load.

3.3.6 Amplitude Clipping. For an input signal of (100, 7.5, 77, 7.5) color bars which produces a color-difference signal defined as 100% for clipping reference, any positive or negative amplitude excursions shall be clipped according to limits defined in Table 4.

Table 4
Chrominance Amplitude Clipping Characteristics

	Mode 1	Mode 2
Positive excursion limit	∓ 175% nom	— 230% nom
	+ 180% max	— 235% max
Negative excursion limit	— 305% nom	— 305% nom
	— 310% max	— 310% max

3.3.7 Recorded Carrier Frequency. The carrier frequencies obtained using a flat field input test signal with appropriate levels corresponding to reference video (100, 7.5, 77, 7.5) color bar levels shall be as shown in Table 5.

3.3.8 C Track Record Head Current

3.3.8.1 The amplitude of the record current for the C track shall be such that the maximum level of remanent flux on the tape is produced when recording the chrominance blanking level.

3.3.8.2 The amplitude of the C track record current shall decrease with increasing frequency in the range 2 to 10 MHz according to a straight line contained within limit lines as shown in Fig. 4.

3.3.9 Low-Frequency Amplitude of Chrominance FM Signal. If the AFM signals are recorded in mode 2, the chrominance signal shall be subject to high-pass filtering prior to combining with the AFM signals. The filter response is shown in Fig. 7.

3.4 Reference Y, R-Y, B-Y Amplitudes. The reference Y, R-Y, and B-Y component signal amplitudes shall be as shown in Table 6.

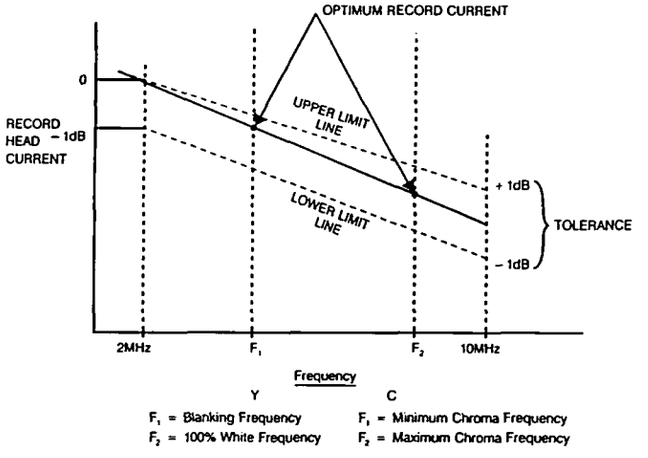


Fig. 4
Record Equalization

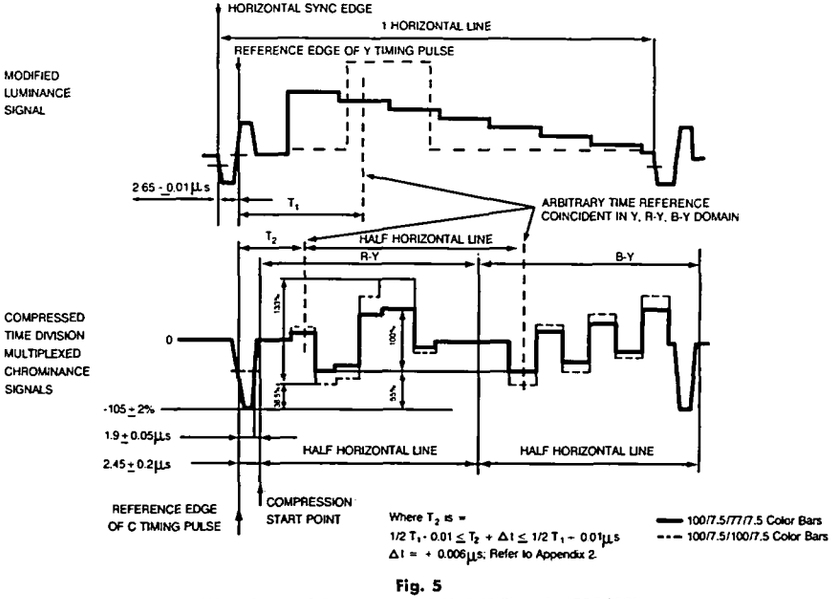


Fig. 5
Waveform of Compressed R-Y, B-Y Signals (525/60)

Table 5
Recorded Carrier Frequency

	Mode 1	Mode 2
Positive video excursion	4 MHz nom	4.8 MHz nom
Negative video excursion	5 MHz nom	5.8 MHz nom
Blanking	4.5 ± 0.05 MHz	5.3 ± 0.05 MHz
Sync tip	5.55 MHz nom	6.35 MHz nom
Deviation peak to peak	1.0 ± 0.05 MHz	1.0 ± 0.05 MHz

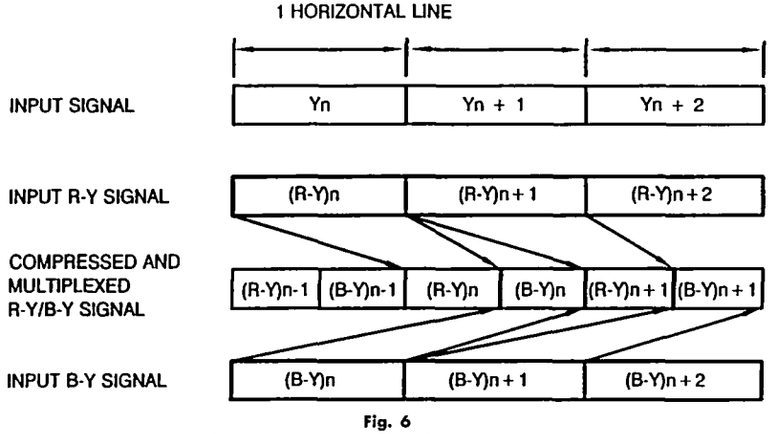


Fig. 6
Time Compression and Multiplexing System

Table 6
NTSC 75% Color Bar Amplitude
(100/7.5/77/7.5)

	Luminance % with 7.5% Setup (%)	Color Difference (%) R-Y	B-Y
Gray	76.9	0	0
Yellow	69.0	+ 8.1	— 50.0
Cyan	56.1	— 50.0	+ 16.9
Green	48.2	— 41.9	— 33.1
Magenta	36.2	+ 41.9	+ 33.1
Red	28.2	+ 50.0	— 16.9
Blue	15.4	— 8.1	+ 50.0
White	100.0	0	0
Sync	— 40.0	—	—

Note: The ratio of 100% amplitude of luminance and chrominance shall be 714:700.

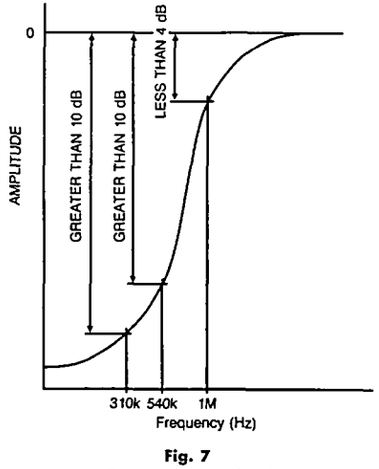


Fig. 7
Low-Frequency Amplitude of Chrominance FM Signal (In Mode 2 When AFM Signal is Present)

4. Decoding and Color Field Identification

4.1 Vertical Interval Subcarrier (VISC) Reference

4.1.1 When operating in mode 2, a VISC signal shall be inserted on line 11 and 274 of the Y signal prior to any signal preemphasis. This signal shall only be present when the signal to be recorded is the result of decoding a composite NTSC signal with a coherent subcarrier. The VISC signal is optional in mode 1.

4.1.2 The format of the VISC signal is shown in Fig. 8.

4.1.3 The frequency of the VISC signal shall be equal to the frequency of the subcarrier of the NTSC video signal.

4.1.4 The phase of the VISC signal shall be within = 5° of the burst phase of the NTSC signal prior to decoding.

4.2 Field Identification

4.2.1 When operating in mode 1 and mode 2, a color field identification signal shall be inserted into the chrominance as shown in Fig. 9, when the signal to be recorded is the result of decoding a composite NTSC signal meeting CCIR Report 624-3.

4.2.2 When operating in mode 2 and recording signals that originated directly from color components, the identification signal shall identify a four-field sequence as shown in Fig. 9. When there is an associated time code signal, it is preferred that the flag indicating field 1 correspond to an even-numbered time code frame.

4.2.3 When there is no way to detect the beginning of a four-field color sequence, the sequence may start arbitrarily.

4.2.4 When operating in mode 1, the color field identification signal referred to in 4.2.2 and 4.2.3 is optional.

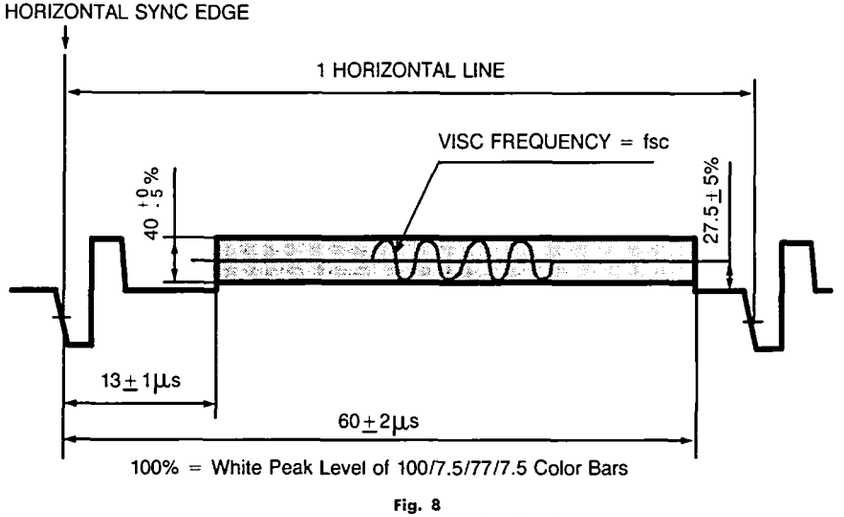


Fig. 8
Vertical Interval Subcarrier Signal

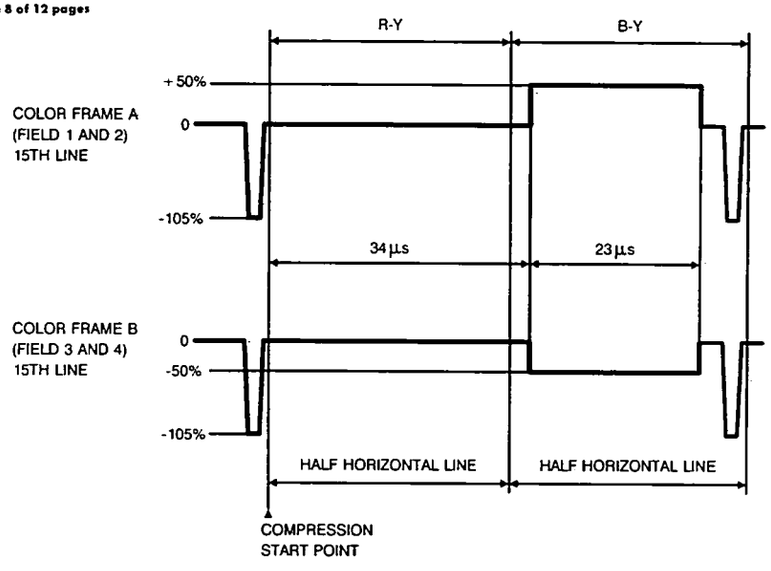


Fig. 9
Color Field Identification Signal (525/60)

5. Longitudinal Audio Signal Recording

5.1 Reference Levels

5.1.1 Recording Method. All recordings shall be made using the anhysteretic (bias) method.

5.1.2 Recording and Reproducing Level Indicator. The audio recording and reproducing levels of the video tape recorder shall be adjusted with reference to a standard volume indicator, as specified in IEEE Std 152-1953, or equivalent.

5.1.3 Recorder Reference Level. When a recording is made from a sinusoidal signal having a frequency of 1000 Hz such that the rms short circuit tape flux per unit track width on the record is 85 ≐ 3 nWb/m, the recording volume indicator shall be adjusted to deflect to its reference level scale mark.

5.2 Frequency Response

5.2.1 Recorder Flux/Frequency Response. When a tape is recorded from a constant voltage level applied to the input terminals of the recording system, the short circuit tape flux level versus frequency, L(f), on the record, shall be as given by the equation:

$$L(f) = 10 \log_{10} \frac{1 + \left(\frac{F_1}{f}\right)^2}{1 + \left(\frac{f}{F_h}\right)^2} \text{ [dB]}$$

where

L is the relative tape flux level
f is the frequency at which the response is being computed
F_1 is the low-frequency transition frequency (50 Hz)
F_h is the high-frequency transition frequency (4547 Hz).

5.2.2 Reproducer Flux/Frequency Response. When a tape record having a short circuit tape flux versus frequency given in 5.2.1 is reproduced, the output voltage level versus frequency of the reproducer shall be constant.

5.2.3 Noise Reduction Characteristics. Noise reduction, if applied, shall have the static encoding characteristics shown in Table 7.

Table 7
Longitudinal Audio Frequency Response of Noise Reduction Encoding Level

	Input Level (dB)						
Frequency (Hz)	0	— 10	— 20	— 30	— 40	— 50	— 60
100	0.2	0.9	2.7	2.9	2.9	2.9	2.9
200	0.1	1.5	5.3	8.0	8.1	8.1	8.1
300	0	1.6	6.1	10.7	12.0	12.0	12.0
500	0	1.7	6.3	11.8	15.6	16.2	16.2
1k	— 0.3	1.5	5.9	11.4	16.2	19.4	19.6
3k	— 1.6	— 0.1	3.7	9.2	13.9	19.2	20.7
5k	— 2.3	— 0.6	2.9	8.4	13.5	18.7	20.4
10k	— 3.5	— 1.4	2.6	8.2	13.6	18.1	19.2
15k	— 6.3	— 3.3	1.5	7.3	12.2	15.0	15.0

Notes: 1. Values are in decibels.
2. The input level of 0 dB is the reference audio input level at 1000 Hz.
3. The encode level of 0 dB is the recorded reference audio level specified in 5.1.3.

5.3 Track Usage

5.3.1 Nonstereo Audio. The primary program audio channel shall be recorded on the audio 1 track.

5.3.2 Stereo Audio. When separate channels are used for stereo audio, the left channel shall be recorded on the audio 1 track, and the right channel on the audio 2 track.

5.4 Program Audio Head Phasing. When the same signal is recorded on audio 1 and audio 2 tracks, the tracks shall be so phased that, when reproduced with a head wide enough to sense the recorded flux on both records, the result will be additive.

5.5 Recording Polarity. When a positive-going waveform is present on pin 2 of the input connector, as defined in IEC Publication 268-12 (1975), the audio head shall generate a magnetic flux such that the direction of remanent flux on the tape is from north to south.

6. AFM Signal Recording

FM audio signals can only be recorded in mode 2. Audio signals for the two channels shall be used to individually frequency modulate two carriers. The carriers shall be located in the low-frequency range and added to the frequency modulated chrominance signal.

6.1 Signal Processing. A signal processing system as specified by this standard shall contain the following elements:

6.1.1 An audio noise-reduction scheme incorporating compression

6.1.2 A linear frequency modulator having constant deviation with respect to the amplitude of the modulating frequencies

6.1.3 A means of adding the two AFM signals to the chrominance signal in the ratio specified

6.2 Reference Levels

6.2.1 Recording and Reproducing Level Indicator. The audio recording and reproducing levels of the video tape recorder shall be adjusted with reference to a standard volume indicator or equivalent, as specified in IEEE Std 152-1953.

6.2.2 Recorder Reference Level. When a recording is made from a sinusoidal signal having a frequency of 400 Hz with the reference deviation, the recording volume indicator shall be adjusted to deflect to its reference level scale mark.

6.3 Noise Reduction. A noise-reduction scheme shall be employed having the following characteristics:

6.3.1 Compression Ratio. The compression ratio shall be a 2:1 logarithmic scale.

6.3.2 Frequency Response. The frequency response of the compressor at a reference input level shall be in accordance with Table 8. (Fig. 10 represents a possible implementation.)

Table 8.
Frequency Response of Compressor

Frequency (Hz)	50	100	200	400	700	1K	2K	4K	7K	10K	14K
Response (dB)	0	0	0	0	−0.1	−0.3	−1.2	−2.7	−4.1	−4.8	−5.3

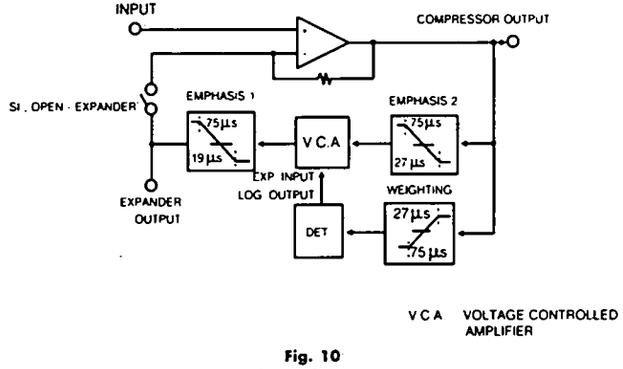


Fig. 10
AFM Noise-Reduction System

6.3.3 Transient Response. The transient response shall be:

Attack time	18 ms ± 0.4 ms
Recovery time	40 ms ± 8 ms
Hold time	15 ms ± 3 ms

The dynamic characteristics of the compression are shown in Fig. 11.

6.4 Frequency Modulation

6.4.1 Carrier Frequencies. The carrier frequencies shall be as shown below.

Left channel	(CH3)	310 ± 5 kHz
Right channel	(CH4)	540 ± 5 kHz

6.4.2 Frequency Deviation

6.4.2.1 Reference Deviation. The recording reference deviation shall be ± 25 kHz nom 0.75 kHz at a reference audio frequency of 400 Hz..

6.4.2.2 Maximum Deviation. The maximum deviation shall not exceed ± 75 kHz.

6.5 The recording current for the two AFM carriers relative to the chrominance recording current specified in 3.3.8.1 shall be — 24 dB ± 2 dB for channel 3, and — 26 dB ± 2 dB for channel 4.

7. Time and Control Code

7.1 Designated Track for Time and Control Code. The longitudinal track identified as the time and control code track shall be used for recording the code specified in ANSI/SMPTE 12M-1986.

7.2 Recording Level. The recording level shall be at saturation of the magnetic domains which is defined as that point above which a 0.5 dB increase in output level results from a 1 dB increase of input level as indicated on an rms reading meter.

8. Tracking Control

8.1 Tracking-Control Signal

8.1.1 The tracking-control record shall be a series of constant flux levels alternating in polarity at a field rate and completing one cycle per frame as shown in Fig. 12.

8.1.2 The polarity of the tracking control record flux shall be such that the transition from the south pole of the magnetic domains to the north pole of the magnetic domains point in the direction of tape travel during the vertical intervals identifying field I and the transition of the north pole of the magnetic domains to the south pole of the magnetic domains point in the direction of tape travel during the vertical intervals identifying field II.

8.2 Tracking Control and Video Timing. Recording current transition representing video fields shall occur at 1.5 ± 1.0 lines after the negative-going transition of the first broad pulse, as shown in Fig. 12. The south-to-north transition shall occur in field I, identified as the field which ends with a half line of video information.

8.3 Recording Level. The recording level shall be at saturation of the magnetic domains which is defined as that point above which a 0.5 dB increase in output level results from a 1 dB increase of input level as indicated on an rms reading meter.

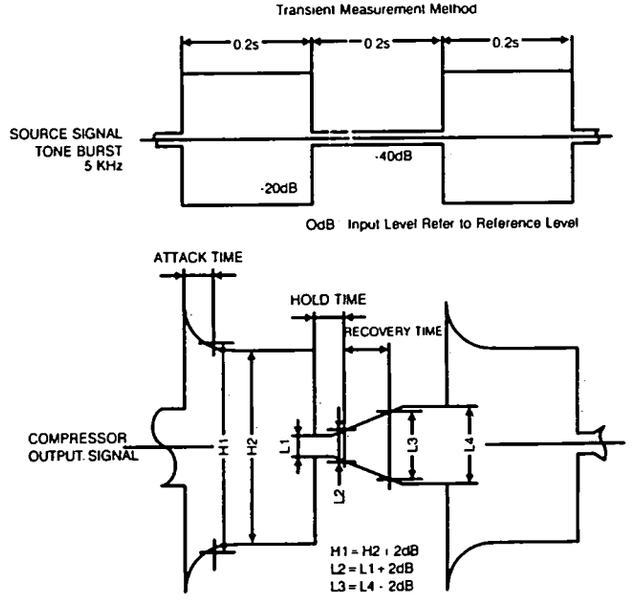


Fig. 11
AFM Noise-Reduction Transient Response Characteristics

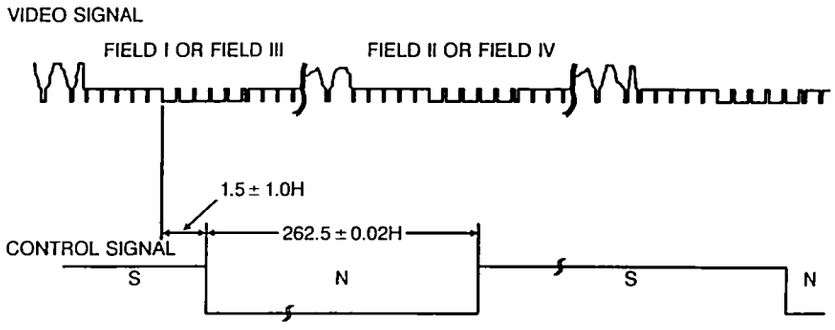


Fig. 12
Tracking-Control Waveform and Timing

Appendix

(This Appendix is not part of the American National Standard, but is included for information only.)

A1. Manufacturers of format L compatible equipment should be aware that some equipment may produce an additional machine generated pulse on line 1.

A2. The offset timing, $\triangle t$, shown in Fig. 4 ensures signal timing interchange between early format L machines and later models.

PROPOSED

SMPTE RECOMMENDED PRACTICE

RP 144

Revision of RP 144-1987

Basic System and Transport Geometry Parameters for ½-in Type L Format

Page 1 of 2 pages

1. *Scope*

This practice specifies the tape speed, scanner parameters, tape tension, and test conditions for achieving the record dimensions specified in SMPTE 229M. The parameters are for reference purposes only and should not be interpreted as the only method available to attain the specifications in SMPTE 230M.

2. *Referenced American National Standards*

This practice is intended to be used in conjunction with the following American National Standards:

SMPTE 229M, Television Analog Recording—½-in Type L—Records

SMPTE 230M, Television Analog Recording—½-in Type L—Electrical Parameters, Control Code and Tracking Control

SMPTE 238M, Television Analog Recording—½-in Type L—Tape and Cassettes

3. *Definitions*

Scanner: A mechanical assembly containing a drum, rotating pole tips, and tape-guiding elements used to record and reproduce video tape recordings. (See Fig. 1a.)

Drum: A cylindical column around which the tape is at least partially wrapped in order to form the head-to-tape interface of a video tape recording system.

Upper Drum: That part of the drum which does not contact the reference edge of the tape. (See Fig. 1b.)

Lower Drum: The part of the drum which contacts the reference edge of the tape and usually provides tape guiding.

Effective Drum Diameter: A value of drum diameter which, when used in theoretical calculations, will correspond to the actual video recording produced. The effective value is equal to or greater than the actual drum diameter.

Helix Angle: The angle formed between the path of the rotating pole tips and the tape reference edge-guiding system.

Basic Dimension: A fundamental dimension to which no tolerence is applicable.

Track Angle: The angle of the video record with respect to the reference edge of the tape.

Center Span Tension: A calculated value of the tape tension at a point midway between the tape entrance and exit guides of the scanner in a video tape recording system.

Wrap Angle: The angle at the center of the drum rotation subtended by the lines of contact between the drum and the reference edge of the tape.

Lead Signal Overlap: That portion of the helical record which is required to provide a duplicate (overlap) recording.

4. *General Specifications*

4.1 Dimensions in this practice are given in the metric system.

4.2 Tests and measurements conducted on the recorder to measure the parameters specified in this practice should be conducted under the following conditions:

Temperature for drum diameter	20°C ± 0.5°C
Temperature for all other tests	20°C ± 1.0°C
Relative humidity	50% ± 2%
Barometric pressure	86 to 106 kPa
Conditioning time before testing	24 hours

5. *Tape Speed*

The tape speed shall be 118.582 mm/s, basic.

6. *Representative Scanner Parameters*

6.1 Drum Diameter and Structure. The effective drum diameter, tape tension, helix angle, and tape speed taken together completely determine the track angle. Different methods of design and/or minor variations in drum diameter and tape tension will produce equivalent recordings for interchange purposes.

6.1.1 Actual Upper Drum Diameter. The actual upper drum diameter shall be 74.487 mm + 0.008 mm — 0.000 mm.

6.1.2 Actual Lower Drum Diameter. The actual lower drum diameter shall be 74.487 mm + 0.000 mm — 0.008 mm.

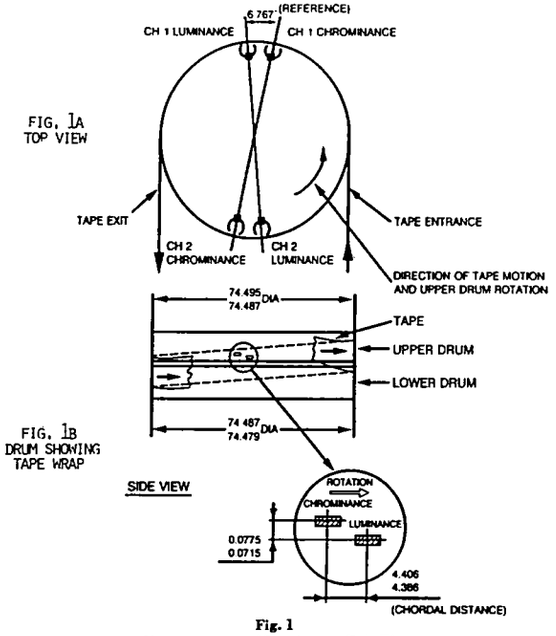


FIG. 1A
TOP VIEW

FIG. 1B
DRUM SHOWING
TAPE WRAP

Fig. 1
Chrominance and Luminance Pole Tips

6.1.3 Upper Drum Section. The upper drum section shall rotate together with the video head tips.

6.1.4 Center Span Tension. The center span tension shall be 0.46 N ± 0.05 N.

6.1.5 Helix Angle. The helix angle formed by the scanner and all associated tape guides shall be 1.6° ± 0.003°.

6.2 Scanner Pole Tips. Four circumferential pole tips shall be located as shown in Fig. 1.

6.2.1 Pole Tip Projection. Each pole tip shall project radially 0.040 mm + 0.010 mm — 0.025 mm above the outer surface of the upper drum.

6.2.2 Luminance Pole Tips. Two pole tips circumferentially spaced at 180° ± 0.003° shall be produced for recording the luminance signal.

6.2.3 Chrominance Pole Tips. Each luminance pole tip shall have an associated pole tip for recording the time-associated chrominance signal, and when applicable, the AFM audio signals. Chrominance pole tips shall be located at a chordal distance of 4.396 mm ± 0.010 mm in a counter-rotational direction from the associated luminance pole tips, and are axially displaced from the associated luminance pole tips by 0.0745 ± 0.0030 mm in a direction away from the reference edge of the tape. (See Fig. 1b.)

6.2.4 Channel Identification. Suitable means, such as a pulse generator producing one pulse per drum revolution, shall be provided to permit identification of the luminance/chrominance-recording pole-tip pair which records field 1. This pair is identified as channel 1 and the remaining pair as channel 2.