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SMPTE STANDARD

SMPTE 32M-1998

Revision of
ANSI/SMPTE 32M-1993

for Video Recording — 1/2-in Type H — Cassette, Tape and Records



Page 1 of 44 pages

Table of contents

- 1 Scope
- 2 Normative references
- 3 Basic type H parameters and characteristics
- 4 LP and EP modes
- 5 FM audio recording characteristics
- 6 Compact video tape and cassette
- 7 High-performance type H cassette, records and system
- Annex A High-quality mode technology
- Annex B Compact video cassette adaptor

1 Scope

This standard specifies the characteristics and parameters for type H, helical-scan, 1/2-in video tape recorders operating with video signals as defined by ITU-R BT.470 and ANSI/SMPTE 170M, and having a typical scanning structure of 525 lines, 59.94 fields per second, and 2:1 interlace.

This standard also specifies the double record time mode (long play, LP) and the triple record time mode (extended play, EP), and optional frequency modulation (FM) audio recording.

This standard further specifies the dimensions of the video tape and compact video cassette for use in a type H, helical-scan, 1/2-in video tape recording cassette system with the aid of a cassette adaptor.

Finally, this standard specifies the characteristics and parameters for high-performance type H, helical-

scan, 1/2-in video tape recorders operating with video signals as defined by ITU-R BT.470 and ANSI/SMPTE 170M, and having a typical scanning structure of 525 lines, 59.94 fields per second, and 2:1 interlace.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below.

ANSI/SMPTE 170M-1994, Television — Composite Analog Video Signal — NTSC for Studio Applications

ITU-R BT.470-4, Television Systems

3 Basic type H parameters and characteristics

3.1 General specifications

3.1.1 Measurement conditions

The dimensions shall be measured with no transverse or longitudinal tension applied to the tape.

3.1.2 Measurement environment

The temperature shall be $20^{\circ}\text{C} \pm 1^{\circ}\text{C}$, with a relative humidity of $(50 \pm 2)\%$.

The user's attention is called to the possibility that compliance with this standard may require use of an invention covered by patent rights.

By publication of this standard, no position is taken with respect to the validity of this claim or of any patent rights in connection therewith. The patent holder has, however, filed a statement of willingness to grant a

license under these rights on reasonable and nondiscriminatory terms and conditions to applicants desiring to obtain such a license. Details may be obtained from the publisher.

No representation or warranty is made or implied that this is the only license that may be required to avoid infringement in the use of this standard.

3.1.3 Tape speed

The tape speed shall be $33.35 \text{ mm/s} \pm 0.5\%$.

3.1.4 Video writing speed

The nominal video writing speed shall be 5.80 m/s .

3.1.5 Video head drum diameter

The video head drum diameter shall be $62.00 \text{ mm} \pm 0.01 \text{ mm}$.

3.2 Video tape and video cassette

3.2.1 Tape characteristics

3.2.1.1 Length and thickness dimensions

The length and thickness dimensions of the video tape shall be as given in table 1.

3.2.1.2 Tape width

The average tape width shall be $12.65 \text{ mm} \pm 0.01 \text{ mm}$. Width fluctuation shall not exceed $6 \mu\text{m}$. The average tape width is the average of measured values of the width of the video tape, made at many points along a length of the video tape.

3.2.1.3 Tape type

The type of video tape to be used shall be high resolution video tape (for example, cobalt iron-oxide tape).

3.2.1.4 Coercivity

The coercivity shall be approximately $50 \times 10^3 \text{ A/m}$.

3.2.2 Leader and trailer tape

3.2.2.1 Length

The length of the leader and trailer tape shall be as follows:

- T-160, T-120 and T-90 $170 \text{ mm} \pm 20 \text{ mm}$;
- T-60 and T-30 $150 \text{ mm} \pm 20 \text{ mm}$.

The length of the leader and trailer tape is defined to be the distance between the point where they attach to the reel hub and the point where they attach (splice) to the magnetic tape.

3.2.2.2 Thickness and width

The thickness of the leader and trailer tape shall be $40 \mu\text{m} +5 \mu\text{m} -25 \mu\text{m}$. The width shall be $12.65 \text{ mm} \pm 0.03 \text{ mm}$.

3.2.2.3 Material

The material shall be polyester film or its equivalent with a light transmission greater than 50% (measured over the range of wavelengths 800 nm to 950 nm).

3.2.2.4 Attachment

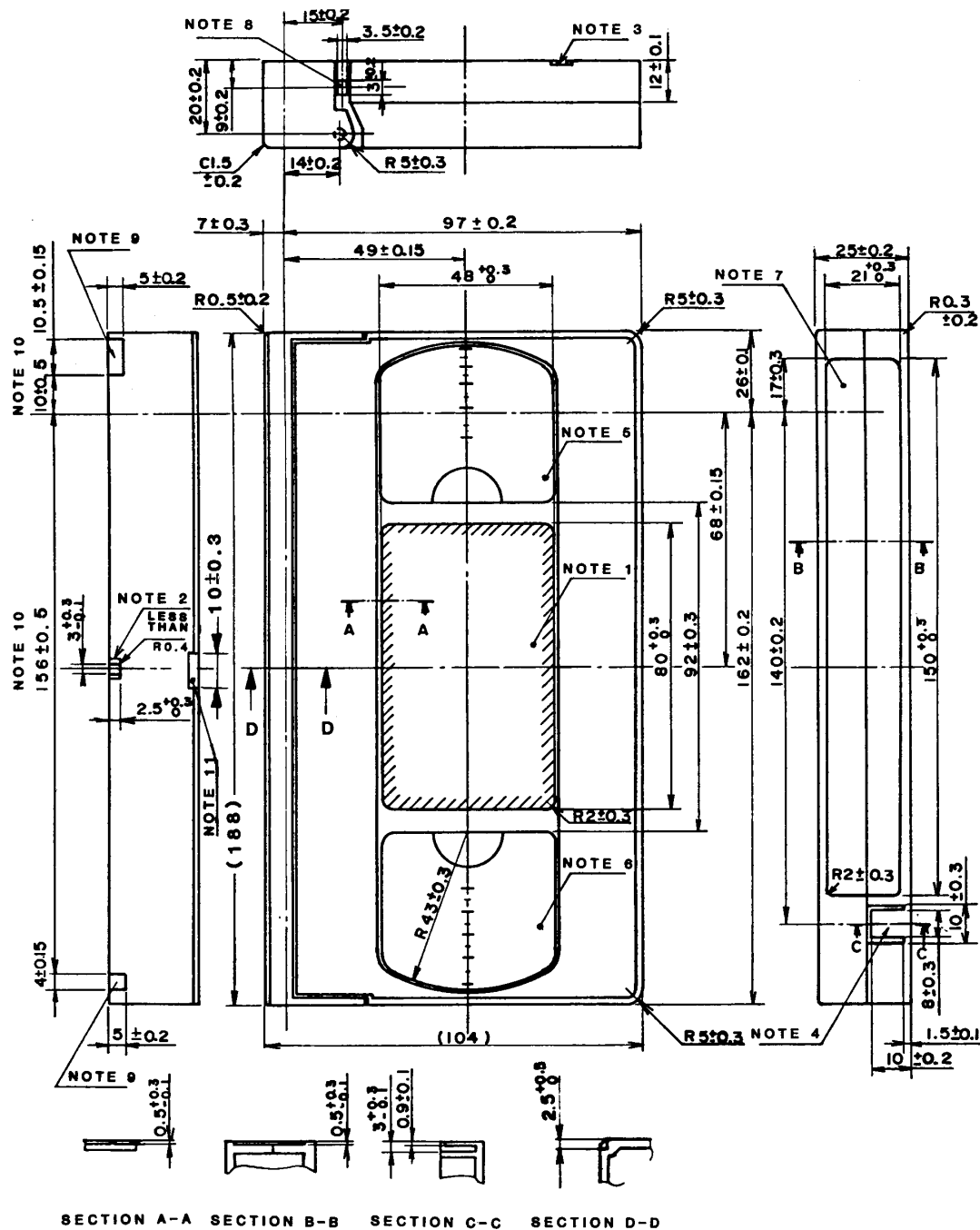
The attachment of the leader and the trailer to the video tape and to the reel hubs shall be capable of withstanding a pulling force of at least 30 N. The leader-to-video-tape and trailer-to-video-tape splicing gaps shall each be less than 0.07 mm.

3.2.3 Video cassette

Dimensions for the video cassette are shown in figures 1 to 5. The path of the video tape within the cassette is shown in figure 6.

Table 1 – Video tape dimensions

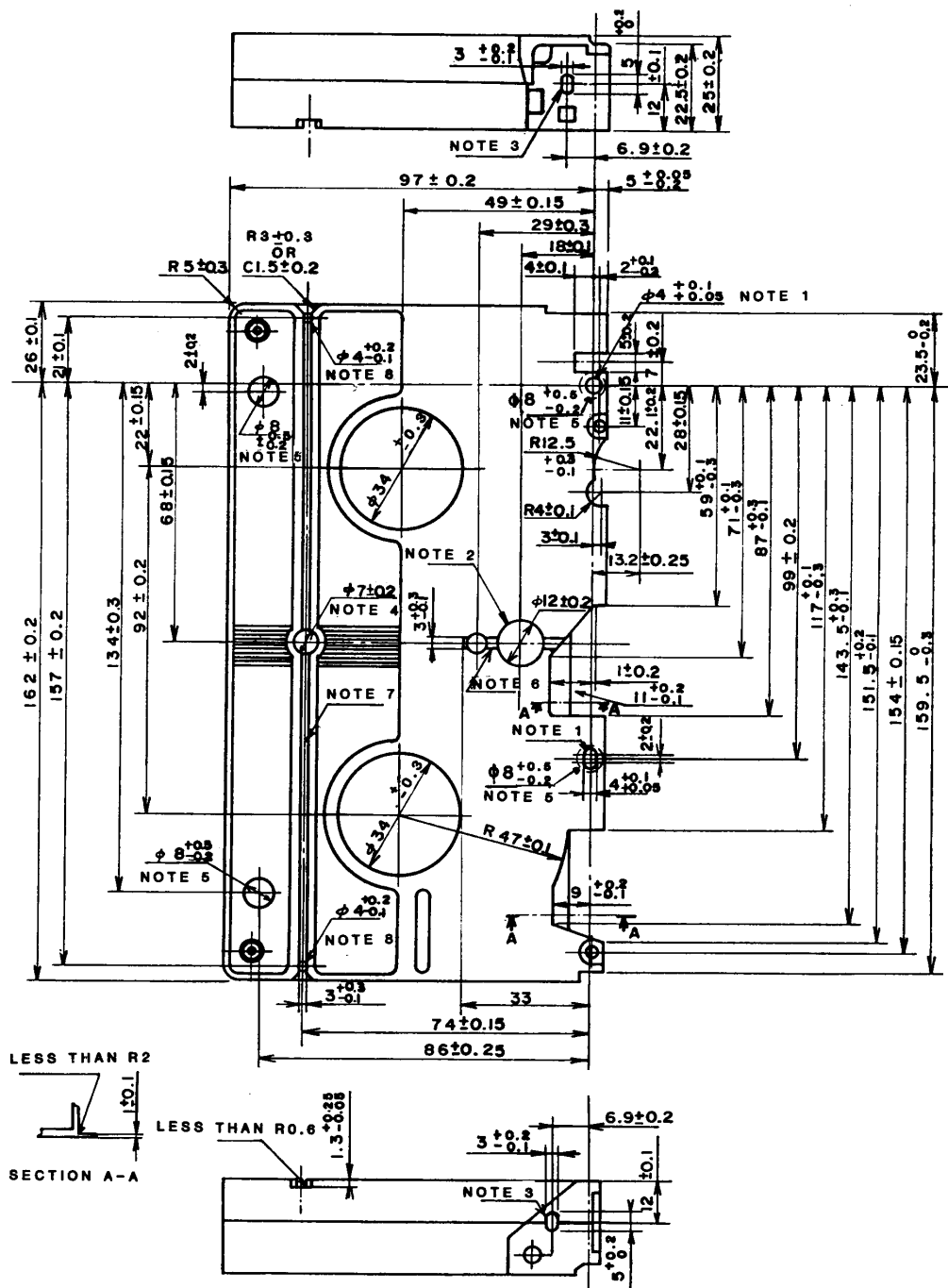
Name	Tape length m	Playing time min	Reel hub diameter mm	Tape thickness μm
T-160	$327 \begin{smallmatrix} +3 \\ 0 \end{smallmatrix}$	160	26	15.6 ± 0.5
T-120	$246 \begin{smallmatrix} +3 \\ 0 \end{smallmatrix}$	120	26	$19.0 \begin{smallmatrix} +1 \\ -2 \end{smallmatrix}$
T-90	$185 \begin{smallmatrix} +3 \\ 0 \end{smallmatrix}$	90	26	$19.0 \begin{smallmatrix} +1 \\ -2 \end{smallmatrix}$
T-60	$125 \begin{smallmatrix} +3 \\ 0 \end{smallmatrix}$	60	62	$19.0 \begin{smallmatrix} +1 \\ -2 \end{smallmatrix}$
T-30	$64 \begin{smallmatrix} +3 \\ 0 \end{smallmatrix}$	30	62 (or 70)	$19.0 \begin{smallmatrix} +1 \\ -2 \end{smallmatrix}$



NOTES

- 1 Top label area.
- 2 Guide groove A to prevent improper insertion.
- 3 Guide groove B to prevent improper insertion.
- 4 Break-out lug to prevent accidental erasure.
- 5 Window for take-up reel.
- 6 Window for supply reel.
- 7 Side label area.
- 8 Unlocking pin for the front cover. The unlocking force is less than 0.15 N.
- 9 Groove for positioning of cassette.
- 10 Allowances include slight play of the front cover.
- 11 Recess to prevent improper insertion.

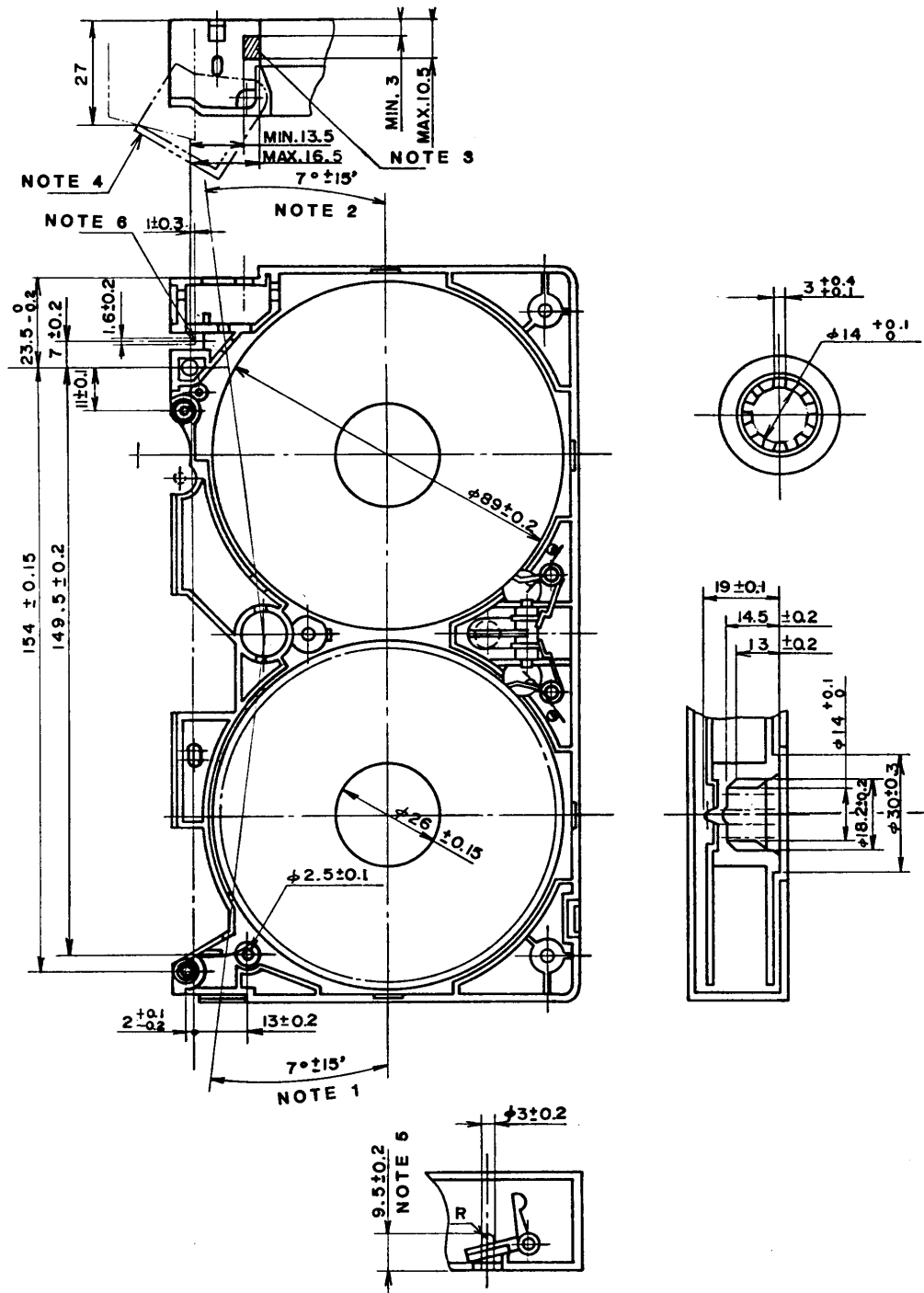
Figure 1 – Top and side views of video cassette



NOTES

- 1 Reference hole.
- 2 Hole for the sensor lamp.
- 3 Hole for the sensor light pass.
- 4 Unlocking hole for the reel brake. The unlocking force is less than 0.69 N.
- 5 Datum plane. The flatness of the four datum planes shall be less than 0.2 mm.
- 6 Guide groove A to prevent improper insertion.
- 7 Guide groove B to prevent improper insertion.
- 8 Auxiliary hole position.

Figure 2 – Bottom view of video cassette

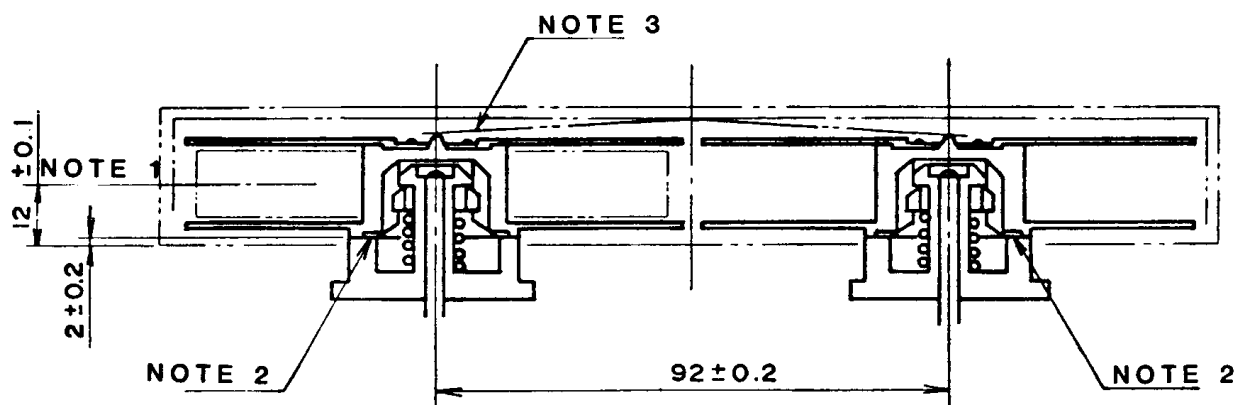


NOTES

- 1 Sensor light angle of supply side.
- 2 Sensor light angle of take-up side.
- 3 Pushing position of the cover unlocking device of the recorder.

- 4 The cover opens more than 27 mm. The opening force is less than 1 N.
- 5 Position of the brake unlocking pin of the recorder.
- 6 Position of the lever in the recorder for opening the cassette cover.

Figure 3 – Inner structure and reels



NOTES

- 1 Center of tape.
- 2 Height of the reel base from the cassette datum plane. The cassette shall operate smoothly at a height of 2.0 mm + 0.8 mm – 0.5 mm.
- 3 Reel spring.

Figure 4 – Relationship between reels and spindles

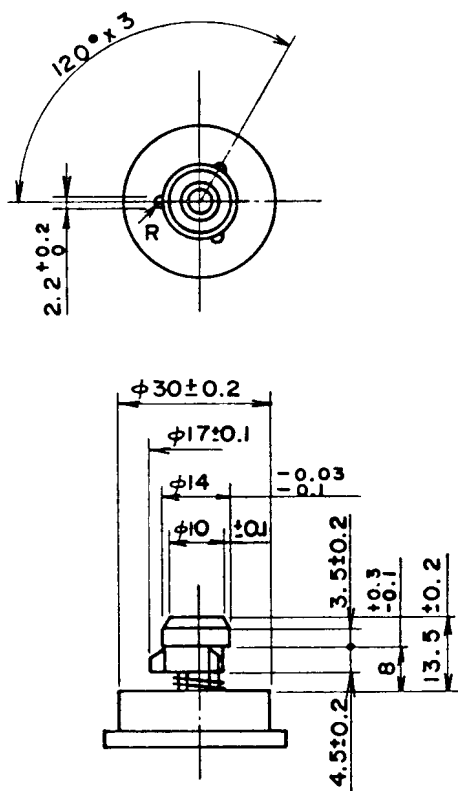


Figure 5 – Reel spindle

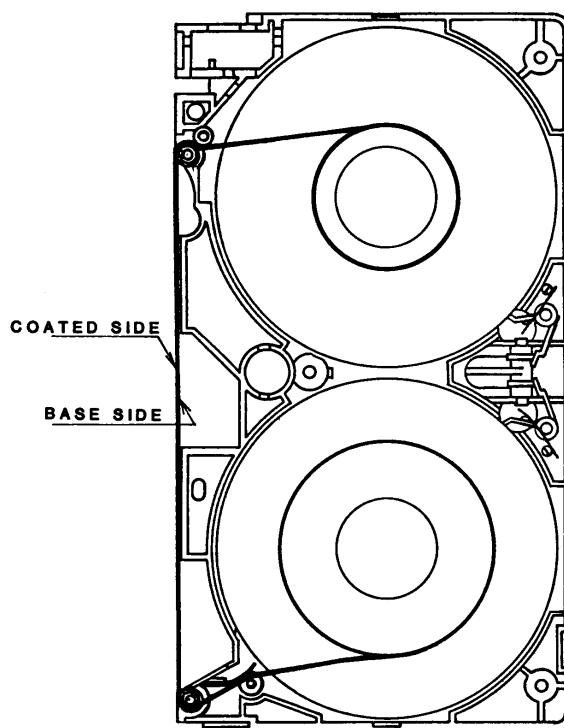


Figure 6 – Tape winding

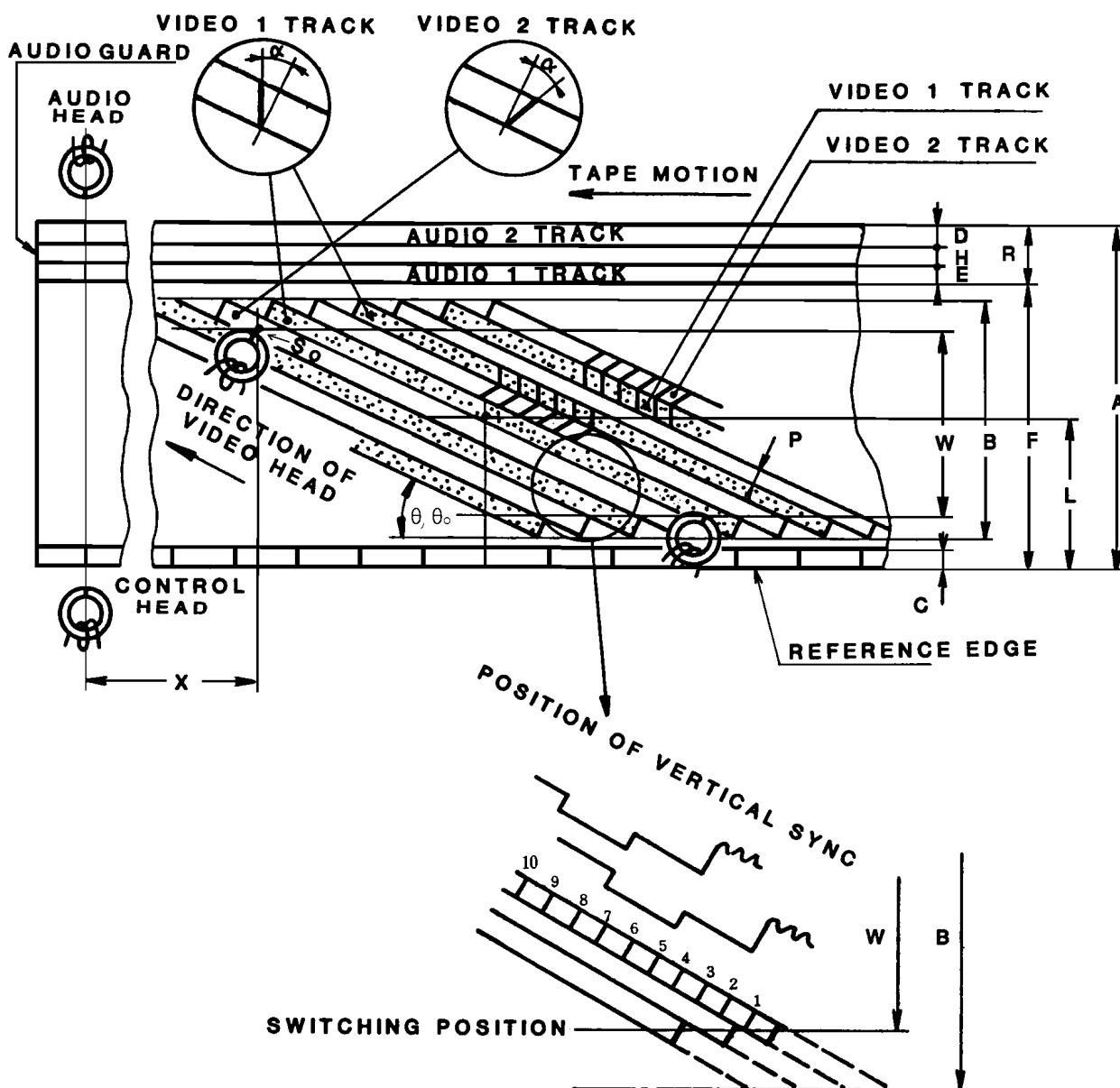


Figure 7 – Track configuration from magnetic coating side

Table 2 – Track configuration (refer to figure 7)

Dimensions	Description	SP mode mm
A	Tape width	12.65 ± 0.01
B	Video recording area width	10.6
C	Control track width	0.75 ± 0.10
D	Audio 2 track width (stereophonic)	0.35 ± 0.05
E	Audio 1 track width (stereophonic)	0.35 ± 0.05
F	Audio track reference line	11.65 ± 0.05
H	Audio-to-audio track guard band	0.3
L	Video track center from reference edge of tape	6.2
P	Video track pitch	0.058
R	Audio track width (monophonic)	1.0 ± 0.1
T	Video track width	0.058
W	Video recording effective area	10.07
X	Position of audio and control track head	79.244
α	Video head azimuth angle	$+6^\circ$ and -6°
θ	Video track angle	$5^\circ 58' 9.9''$
θ_0	Video track angle (tape stationary)	$5^\circ 56' 7.4''$
	Track shift error (from logical value)	0.014
	Track bend (peak-to-peak value)	0.014

NOTES

1 Values are nominal where there are no tolerances specified.

2 Dimension θ_0 represents the video track angle without linear motion of the video tape, such as might result from repetitive reading of a single track (one field) of the video record on the tape.

3.3 Video tape records; SP mode track configuration and dimensions

The track configuration and the transverse and longitudinal dimensions in the SP mode shall be as specified in figure 7 and table 2.

3.4 Audio and control track head position

The distance X on the tape pattern, from the end of the 180° scan of a video head to the audio and control track head position, shall be 79.244 mm, as shown in figure 7.

3.5 Audio record displacement

Program audio or other information which is time coincident with video information recorded at a point S_0 of the video 2 track shall be recorded on either audio track at a distance X downstream from that point (S_0). (See figure 7.) S_0 is the center of the video track at the switching position of the video heads.

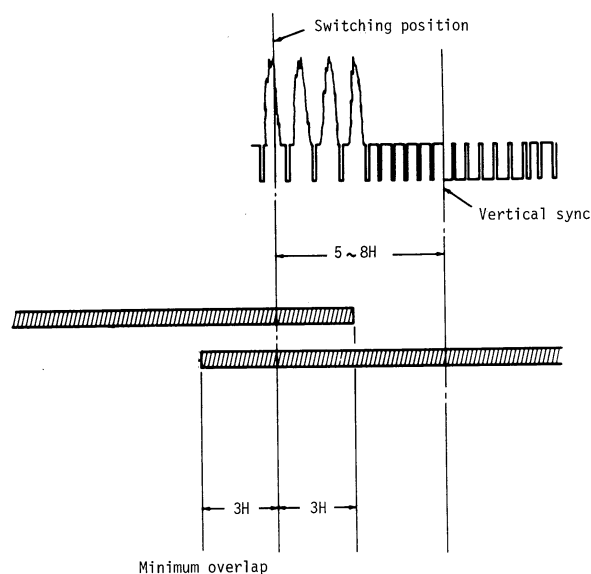


Figure 8 – Switching position and overlap of two video heads

3.6 Video head switching

The switching position between the two heads during playback shall lie between 5 and 8 horizontal lines ahead of the leading edge of the vertical sync signal, as shown in figure 8.

3.7 Tape tension

The tape tension for the record and playback modes, measured with a spring scale for a full supply reel, shall be normally from 0.30 N to 0.45 N at the entrance of the drum when the tape is pulled at the specified speed.

3.8 Relationship of video track and video field signal

Type H recording devices, whose applications require that each video signal field and video tape track be distinguished, shall record video field 1 on video tape track 1, and video field 2 on video tape track 2.

3.9 Video recording

The video recording system shall provide separate signal paths for the luminance and chrominance signals. The luminance signal shall be frequency modulated on a high-frequency rf carrier signal prior to recording. The chrominance signal shall be down-converted to a low frequency prior to recording. After this separate processing, the signals shall be combined and recorded together on a single video track.

3.9.1 Luminance channel

3.9.1.1 Signal processing

A luminance signal processing system, as specified in this standard, shall contain the following elements in the order of the signal flow:

3.9.1.1.1 Separation filter

The luminance signal component of the composite video signal shall be separated from the chrominance component by a filter that attenuates the luminance signal by no less than 40 dB at the chrominance subcarrier frequency.

3.9.1.1.2 Preemphasis

The luminance video signal shall be preemphasized prior to frequency modulation. The preemphasis network characteristic shall be as shown in figure 9.

3.9.1.1.3 Clipping

The preemphasized luminance video signal shall be clipped prior to frequency modulation. The clipping levels are as shown below. The level from sync tip to peak white is defined to be 100%.

- White clipping level measured from tip of sync: 160% nominal, 155% minimum, 200% maximum;
- Dark clipping level measured from tip of sync: 40% nominal, –50% minimum, –30% maximum.

3.9.1.1.4 Modulation characteristics

The preemphasized and clipped luminance video signal shall be frequency modulated (FM) by a linear frequency modulator, having constant deviation with respect to the amplitude of the modulating frequencies, on an rf carrier corresponding to the reference luminance video levels below:

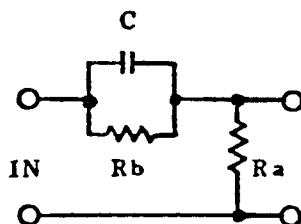
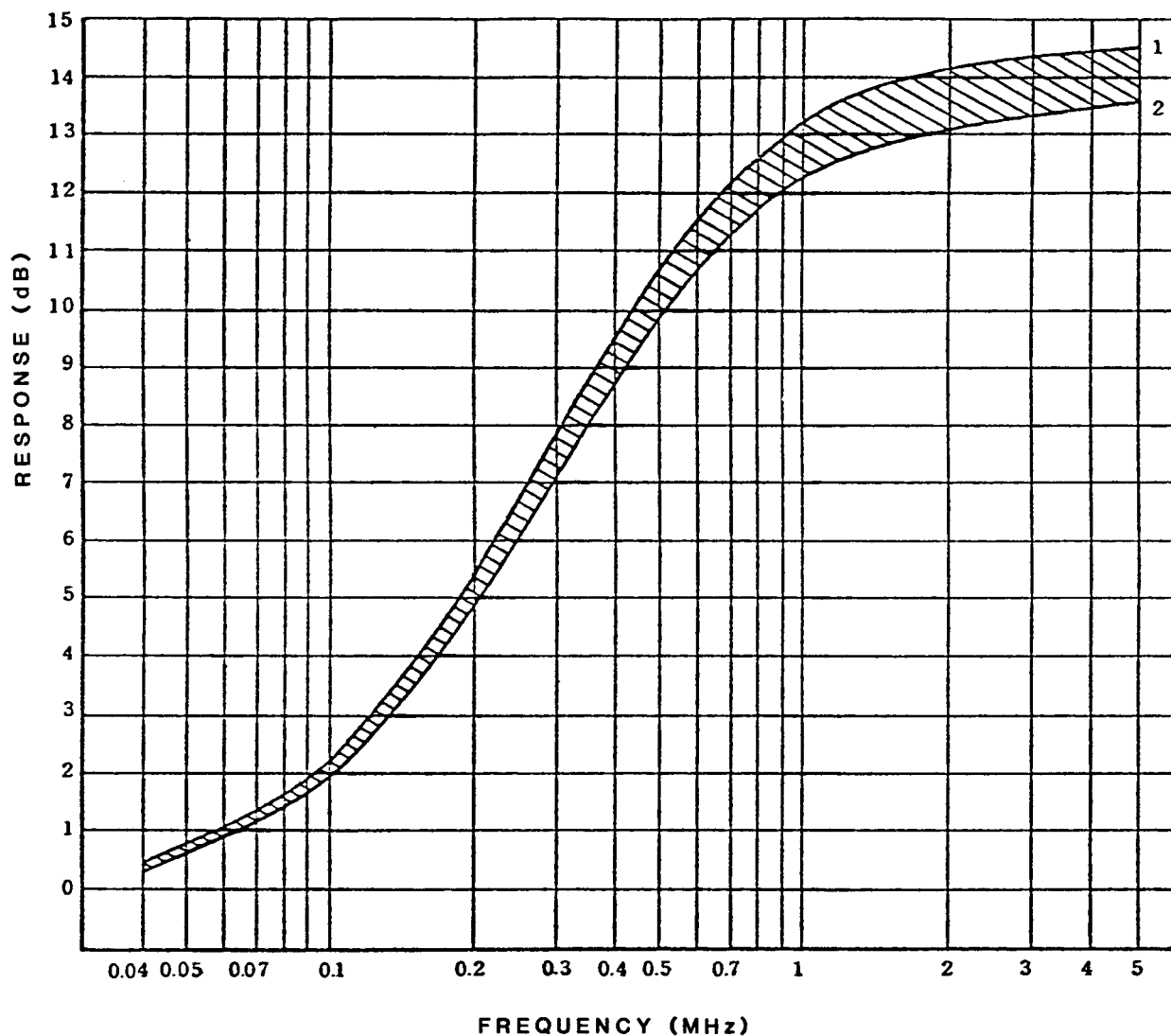
- Reference white level (100 IRE units) 4.4 MHz $\pm$ 0.1 MHz;
- Reference sync level (–40 IRE units) 3.4 MHz $\pm$ 0.1 MHz;
- Frequency deviation, ref white to ref sync (140 IRE units) 1.0 MHz $\pm$ 0.1 MHz.

3.9.1.1.5 High-pass filter

The FM rf carrier, frequency modulated by the luminance video signal, shall be processed by a high-pass filter prior to recording. The high-pass filter network characteristic shall be as shown in figure 10.

3.9.1.1.6 Recording level

The record current shall be set to the optimum value over the entire bandwidth of the FM carrier. Optimum record current shall be that which returns the maximum output signal level during playback.



$$T = C \times R_b = 1.3 \mu s \pm 0.05 \mu s$$

$$X = R_b/R_a = 4 \pm 0.3$$

$$T = 1.35 \mu s$$

$$X = 4.3$$

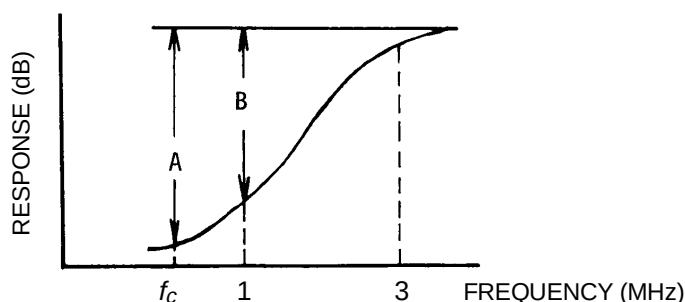
} (1)

$$T = 1.25 \mu s$$

$$X = 3.7$$

} (2)

Figure 9 – Preemphasis characteristic of luminance signal



A = Greater than 17 dB.

B = Greater than 10 dB.

f_c = Converted chrominance carrier frequency (629.371 kHz).

Figure 10 – FM high-pass filter

3.9.2 Chrominance channel

3.9.2.1 Signal processing

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

3.9.2.1.1 Separation filter

The chrominance signal component of the composite video signal shall be separated from the luminance component by a band-pass filter. Characteristics of the band-pass filter shall be as follows:

- Center frequency: 3.58 MHz;
- Response: –3 dB at 4.08 MHz; –3 dB at 3.08 MHz.

3.9.2.1.2 Recording level

The chrominance signal is recorded directly on the video tape as an amplitude modulated (AM) rf carrier. Record level shall be such that the amplitude of the played back chrominance signal is 7 dB to 10 dB below the saturation level of the recording chrominance signal.

3.9.2.1.3 Color burst amplitude doubler

The amplitude of the color burst part of the chrominance signal shall be increased by $6.0 \text{ dB} \pm 0.5 \text{ dB}$ prior to recording.

3.9.2.1.4 Chrominance frequency conversion

The chrominance signal shall be (down) converted such that the new carrier frequency to be recorded equals the horizontal scanning rate, multiplied by 40 (629.371 kHz). (See figure 11.)

3.9.2.1.5 Chrominance carrier phase rotation

The chrominance carrier shall be shifted in phase at every horizontal sync pulse as follows:

- video track 1: Advance $+90^\circ$ from the carrier phase of the previous horizontal line period;
- video track 2: Retard -90° from the carrier phase of the previous horizontal line period.

Shift of phase shall be completed before color burst occurs in each horizontal blanking interval.

3.9.3 Recording signal

3.9.3.1 Luminance and chrominance combination

The FM luminance carrier and AM chrominance carrier shall be combined before recording.

3.9.3.2 Record amplifier

An amplifier shall be provided to supply recording signal current drive to the record heads.

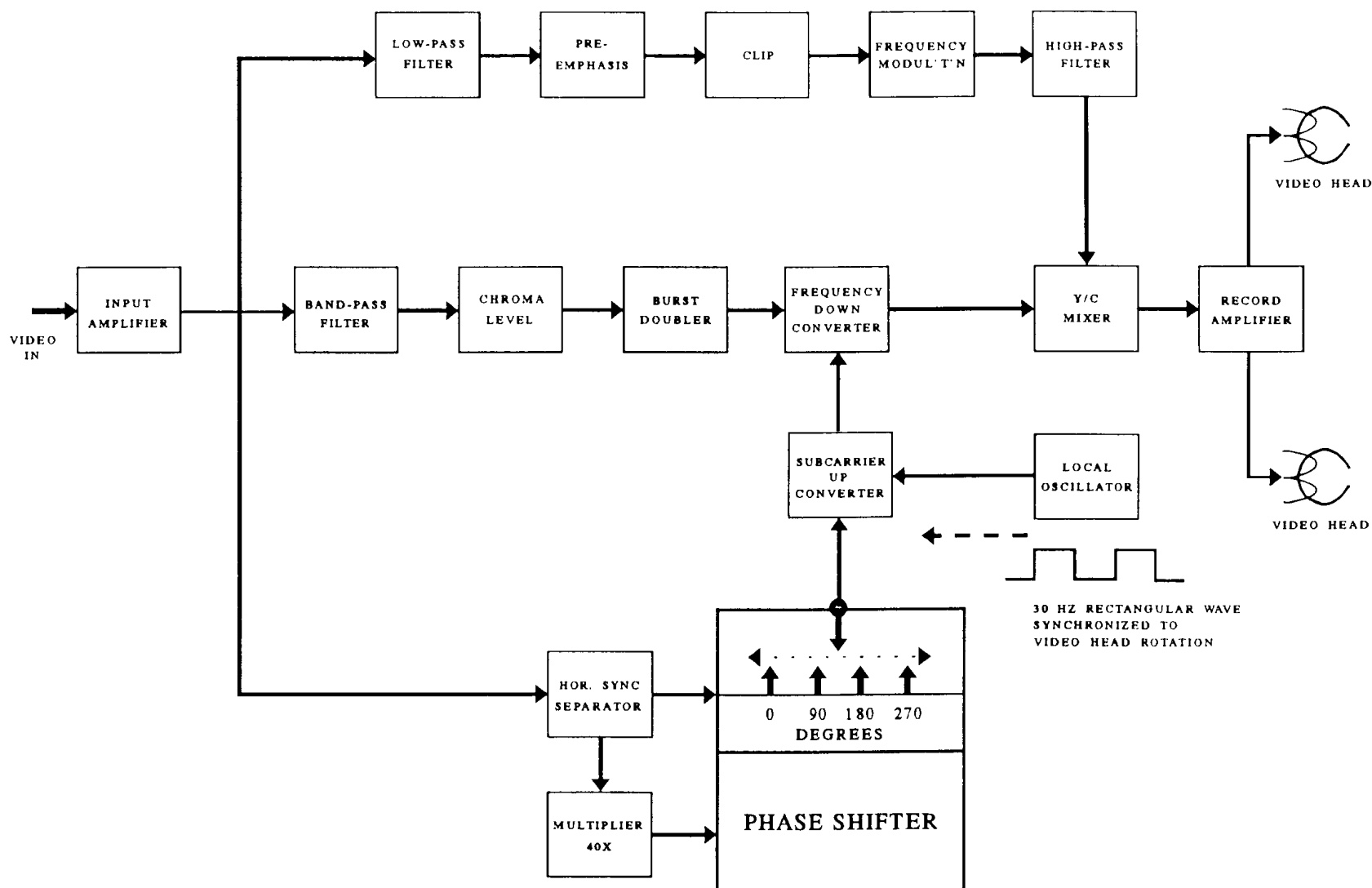


Figure 11 - Record process block diagram

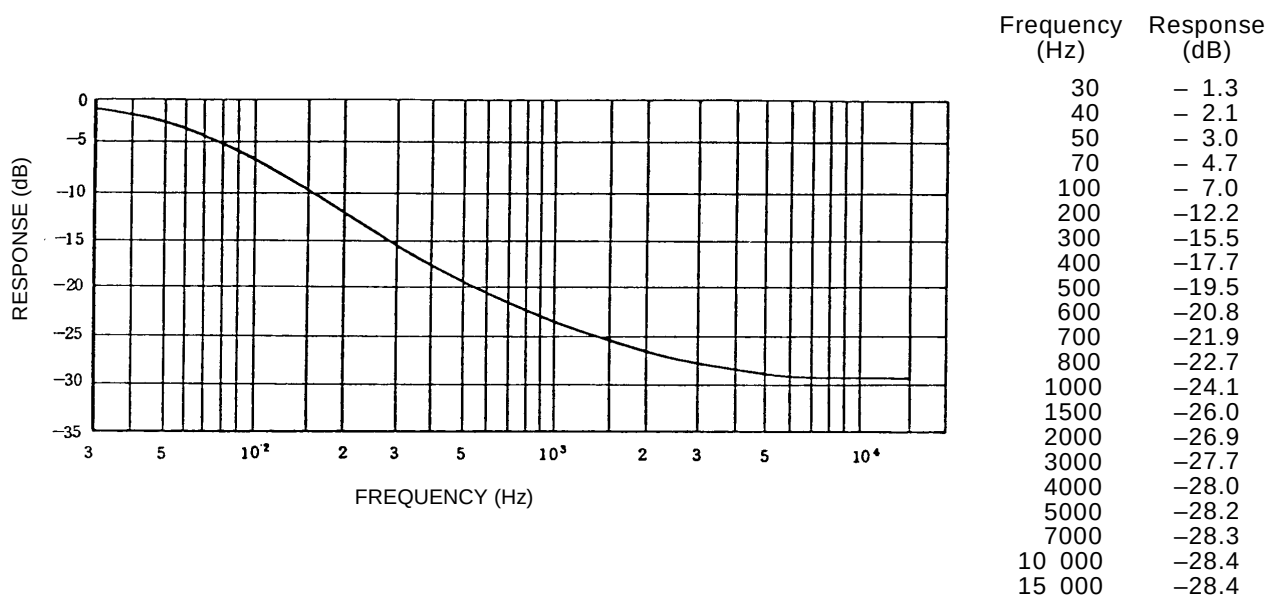


Figure 12 – Reproducing deemphasis of audio signal

3.10 Longitudinal audio signal recording

Two longitudinal tape tracks shall be provided for the recording of audio signals. These shall be as specified in figure 7 and table 2.

3.10.1 Recording level

The recording reference audio level shall be 100 nWb/m.

3.10.2 Audio signal recording current characteristics

Recording current shall have a characteristic such that the reproduced output shall be of essentially flat frequency response after application of the deemphasis characteristic shown in figure 12. The time constants shall be 120 μ s and 3180 μ s.

3.10.3 Relative polarity

For stereo program material, the relative polarity of the audio signals at the inputs to a stereo television video tape recorder shall be such that any monophonic component of the program shall have the same polarity in the magnetic records of both channels.

3.10.4 Audio track allocation

For stereo audio associated with television program material, audio track 1 shall carry the discrete left (L)

signal and audio track 2 shall carry the discrete right (R) signal. The terms left and right shall relate to the viewer's perspective.

3.11 Control signal

3.11.1 Recording signal

The positive-going edge of the recorded control pulse signal shall be in coincidence with the start of video 1 track scan as shown in figure 13.

3.11.2 Polarity

The control signal shall be recorded so that the rotating drum side of the control head poles shall be north polarized when the pulse signal is positive.

3.11.3 Recording current waveform

The rise time shall be less than 200 μ s.

4 LP and EP modes

4.1 Tape speed

The tape speed shall be 16.67 mm/s $\pm$ 0.5% in the LP mode and 11.12 mm/s $\pm$ 0.5% in the EP mode.