Proposed American National Standard

for video recording—

½-in type L electrical parameters—video, audio, time and control code and tracking control

SMPTE 230M

1. Scope

This standard specifies the electrical parameters of video, audio, time and control code, and tracking-control signals for ½-inch type L helical-scan video tape recorders operating on the 525/60 monochrome or NTSC color television system.

2. Referenced American National Standards

This standard is intended for use in conjunction with the following American National Standards:

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

ANSI/IEEE 152-1953 (R1976), Volume Measurements of Electrical Speech and Program Waves

3. Video Recording

The video recording system shall provide separate and distinct 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 C track shall record both R-Y and B-Y color difference signals in the form of a compressed time-division multiplexed signal. Monochrome signals, when recorded, shall be recorded on the Y channel only.

3.1 Luminance Channel

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

3.1.1.1 Means for modifying the sync portion of the luminance signal

3.1.1.2 A video detail enhancement process

3.1.1.3 A video pre-emphasis network

3.1.1.4 Means for clipping the video signal after pre-emphasis

3.1.1.5 A linear frequency modulator having constant deviation with respect to the modulating frequencies

3.1.1.6 An amplifier of the frequency modulated carrier signal to provide alternating current drives to the Y channel record heads

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

3.1.3 Luminance Detail Enhancement. The video signal shall receive detail enhancement. (See Fig. 2.) The characteristics shall be as shown in Table 1.

3.1.4 Luminance Pre-emphasis. Pre-emphasis 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.

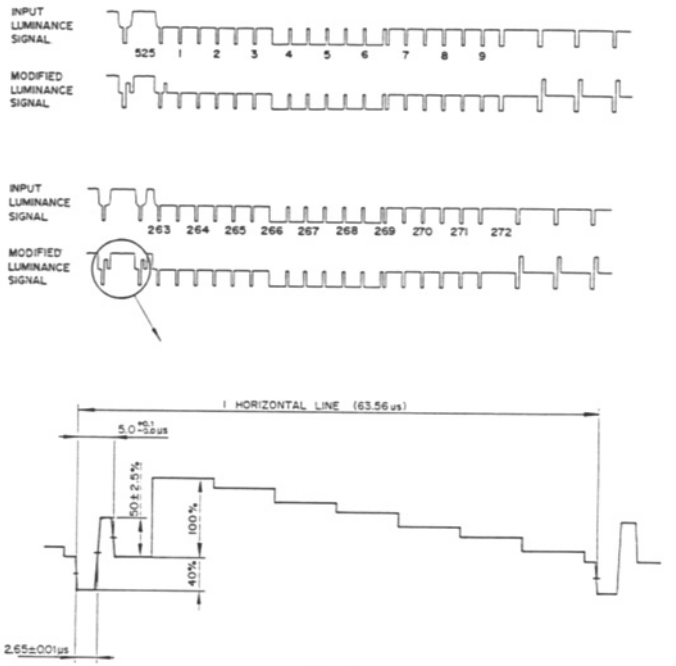

Fig. 1
Waveform of the Modified Luminance Signal

Note: The vertical sync and equalizing pulse portion remains unmodified.

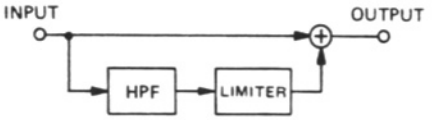

Fig. 2
Block Diagram of Detail Enhancement Circuit

Table 1
Detail Enhancement Output (dB) Characteristics

Frequency (Hz)	Input Video (dB) −27.5	−21.5	−17	−11	−1.5
500 K	1.6 dB ± 0.3	1.5 ± 0.3	1.5 ± 0.3	1.4 ± 0.3	0.9 ± 0.2
1 M	3.4 ± 0.5	3.2 ± 0.5	2.9 ± 0.5	2.7 ± 0.5	1.1 ± 0.2
2 M	6.4 ± 0.8	5.8 ± 0.8	4.7 ± 0.7	3.0 ± 0.5	1.1 ± 0.2
3 M	7.5 ± 0.8	6.5 ± 0.8	4.8 ± 0.7	3.0 ± 0.5	1.1 ± 0.2
4 M	7.8 ± 0.8	6.6 ± 0.8	4.8 ± 0.7	3.0 ± 0.5	1.1 ± 0.2

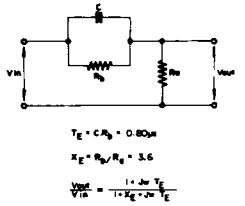

Fig. 3
Pre-emphasis Network

3.1.5 Amplitude Clipping. For a signal with sync tip at — 40 IRE units and normal peak white at + 100 IRE units, any positive amplitude excursions above + 310 ± 5 IRE or negative amplitude excursions below — 125 ± 5 IRE shall be clipped.

3.1.6 Recorded Carrier Frequency. Carrier frequencies corresponding to reference video levels shall be as follows:

Peak white	6.4 MHz ± 0.05 MHz
50% level	5.7 MHz
Blanking	4.97 MHz ± 0.05 MHz
Sync tip	4.4 MHz

3.1.7 Y Track Record Head Current

3.1.7.1 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 a 50% average picture level.

3.1.7.2 The amplitude of the Y track record current shall decrease with increasing frequency according to a curve defined by the following discrete points:

Frequency (MHz)	Level (dB)
2.0	+ 4.0 ± 1.0
3.0	+ 3.0 ± 1.0
5.7	0.0
8.0	— 2.0 ± 2.0

3.2 C Channel

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

3.2.1.1 A means for 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

3.2.1.2 Means for adding a horizontal timing pulse

3.2.1.3 A video detail enhancement process

3.2.1.4 A video pre-emphasis network

3.2.1.5 Means for clipping the video signal after pre-emphasis

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

3.2.1.7 An amplifier of the frequency modulated carrier signal to provide alternating current drive to the C channel record heads

3.2.2 Time Compression and Multiplexing

3.2.2.1 The R-Y and B-Y signals shall each be compressed into a half time scale. The starting point of compression shall be as shown in Fig. 4.

3.2.2.2 The compressed R-Y and B-Y signals shall be multiplexed alternately as shown in Fig. 5.

3.2.2.3 The compressed and multiplexed R-Y and B-Y signals shall be delayed by one horizontal line with respect to the luminance signal.

3.2.3 Addition of Horizontal Timing Pulse. The horizontal timing pulse shall be added to the compressed and multiplexed R-Y and B-Y signals as shown in Fig. 4.

3.2.4 R-Y and B-Y Detail Enhancement. The video signal shall receive detail enhancement which has the characteristics as shown in Table 1.

3.2.5 R-Y and B-Y Pre-emphasis. Pre-emphasis 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.

3.2.6 Amplitude Clipping. For a signal with sync tip at — 90% level and normal positive peak + 50% level, any positive amplitude excursions above + 175 ± 5% level or negative amplitude excursions below — 300 ± 5% level shall be clipped.

3.2.7 Recorded Carrier Frequency. Carrier frequencies corresponding to reference video levels shall be as follows:

Peak positive video excursion	4.0 MHz
Peak negative video excursion	5.0 MHz
Blanking	4.5 MHz ± 0.05 MHz
Sync tip	5.4 MHz nom
Deviation	1.4 MHz ± 0.05 MHz

3.2.8 C Track Record Head Current

3.2.8.1 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.

3.2.8.2 The amplitude of the C track record current shall decrease with increasing frequency according to a curve defined by the following discrete points:

Frequency (MHz)	Level (dB)
2.0	+ 3.0 ± 1.0
3.0	+ 1.5 ± 1.0
4.5	0.0
8.0	— 3.0 ± 2.0

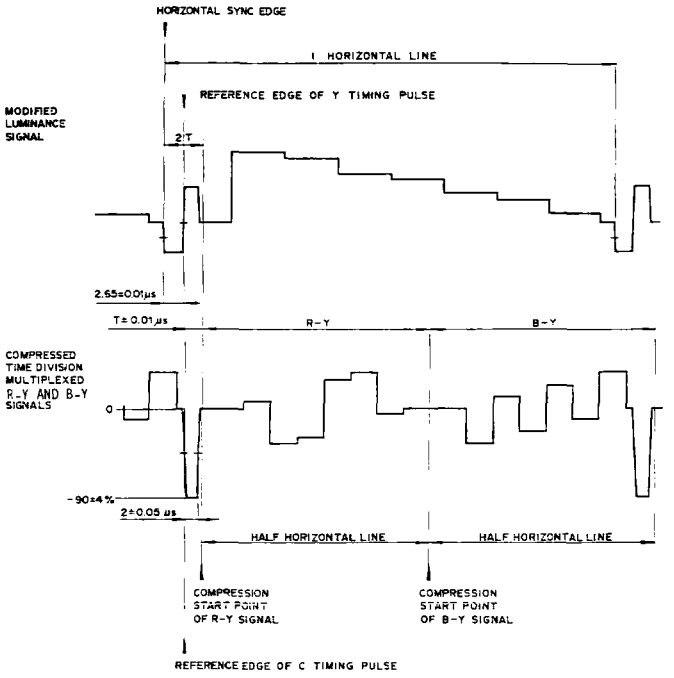

Fig. 4
Compressed R-Y, B-Y Signals (525/60) Waveform

Note: T = 2.65 ± 0.2 µs.

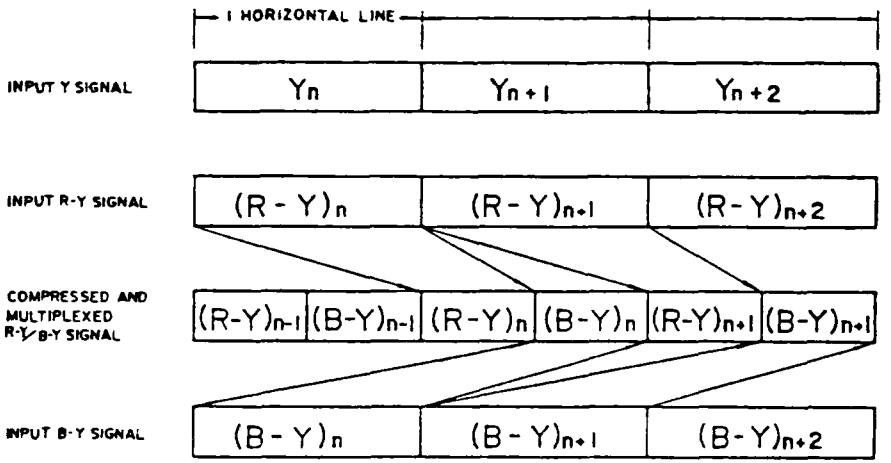

Fig. 5
Time Compression and Multiplexing System

3.3 Y and C Timing

3.3.1 The Y/C timing pulses shall be inserted into the horizontal blanking period as shown in Fig. 4. These pulses shall be utilized to correct the timing difference between the luminance signal and color difference signals during playback.

3.3.2 The reference edge of the C timing pulse shall be inserted as shown in Fig. 4. The inserted C timing pulse shall be positioned midway between the horizontal sync edge and the compression start point. A tolerance of + 0.01 μsec shall exist between the C timing pulse reference edge and the compression start point.

3.4 Y, R-Y, B-Y Amplitudes. The Y, R-Y, and B-Y component signal amplitudes shall be as shown in Table 2.

3.5 Field Identification. A color field identification signal may be inserted into the chrominance signal, as shown in Fig. 6, when the recorded luminance signal and R-Y and B-Y signals are the result of the decoding of a composite NTSC video signal.

4. Audio Signal

4.1 Reference Levels

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

Table 2
NTSC 75% Color Bar Amplitude

	Luminance with 7.5% Set up (%)	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
Sync	40%	—	—

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

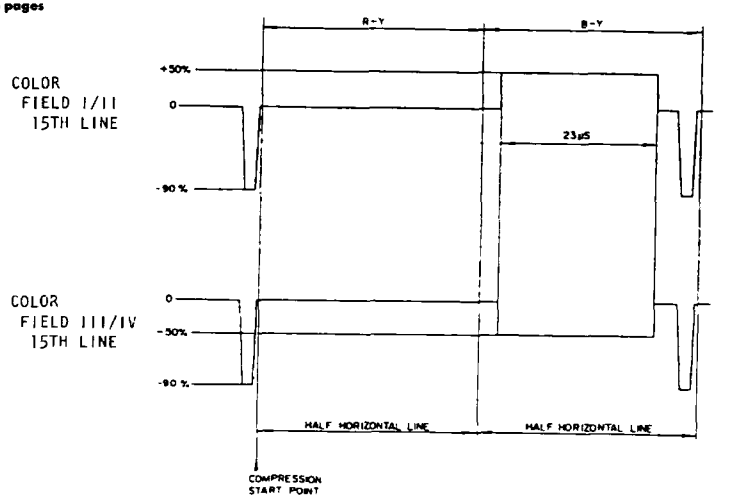

Fig. 6
Color Field Identification Signal

4.1.2 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 or equivalent, as specified in ANSI/IEEE 152-1953.

4.1.3 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 in the record is 100 ± 3 nWb/m of track width, the recording volume indicator shall be adjusted to deflect to its reference level (0 vu) scale mark. The reference level is intended to be nominally 8 dB below the recorded level that would produce 3% third-harmonic distortion.

4.1.4 Reproducer Reference Level. When a tape record having an rms short circuit tape flux per unit track width of 100 nWb/m and a frequency of 1000 Hz is reproduced, the reproducing volume indicator shall deflect to its reference level (0 vu) scale mark.

4.2 Frequency Response

4.2.1 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, $L_\Phi(f)$, in the record, shall be as given by the equation:

$$L_\Phi(f) = 10 \log_{10} \frac{1 + (F_1/f)^2}{1 + (f/F_h)^2} \text{ dB}$$

where L_Φ 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; and F_h is the high-frequency transition frequency, 4547 Hz.

4.2.2 Reproducer Flux/Frequency Response. When a tape record having a short-circuit tape flux versus frequency given in 4.2.1 is reproduced, the output voltage level versus frequency of the reproducer shall be constant.

4.2.3 Noise Reduction Characteristics. Noise reduction, if applied, shall have the static encoding characteristics shown in Table 3.

Table 3
Frequency Response (dB) of Noise Reduction Encoding Levels

Frequency	Input Level (dB)			Tolerance ± 1.5 dB			
	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. The input level of 0 dB is the reference audio input level at 1000 Hz.

2. The encode level of 0 dB is the recorded reference audio level specified in 4.1.3 and 4.1.4.

3. A block diagram of encoding is shown in Fig. 7.

4. The frequency response of the playback decoder shall be complementary to the record encoder.

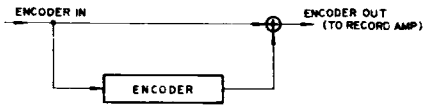

Fig. 7
Block Diagram of Encoding

4.3 Track Usage

4.3.1 Non-Stereo Audio. The primary program audio channel shall be recorded on the audio 1 track.

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

4.4 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. Time and Control Code

5.1 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.

5.2 Recording Method. A recording level sufficient for the full saturation of the magnetic domains, as defined by a 0.5 dB increase in output level for a 1 dB increase of input level, shall be employed.

6. Tracking Control

6.1 Tracking-Control Signal

6.1.1 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. 8.

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

6.2 Tracking Control and Video Timing. Recording current transitions representing video fields shall occur at 1.5 ± 1.0 lines after the negative-going transitions of the first broad pulse, as shown in Fig. 8. The south-to-north transition shall occur in field I, identified as the field which ends with a half line of video information.

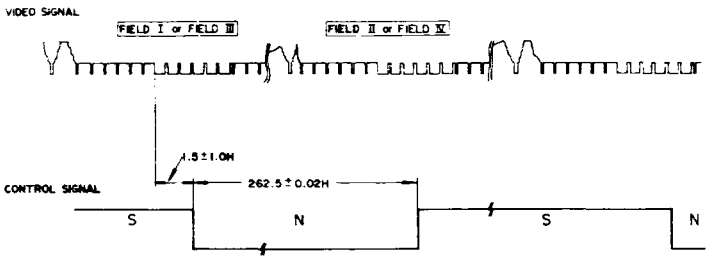

Fig. 8
Tracking-Control Waveform and Timing

Proposed American National Standard

for video recording—

½-in type L cassette—records

SMPTE 229M

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 on the 525/60 monochrome or NTSC color system, and utilizing the video cassette and tape specified in ANSI V98.35M-1984.

2. Referenced American National Standard

This standard is intended for use in conjunction with the following American National Standard:

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

3. General Specifications

3.1 Dimensions in the metric system are the primary measurements. The English equivalents are derived from them and may deviate from established conversion practices.

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 percent
Barometric pressure	86 to 106 kPa (860 to 1060 mbar)
Tape tension	0.46 ± 0.05 N

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

Environmental	Stabilized to the conditions specified in 3.2
Tape Tension	Wound on a reel at a tension of 0.56 ± 0.20 N

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 Fig. 1, is on the side facing the observer in Figs. 1 and 2.

4. Tape Speed

The nominal tape speed shall be 118.582 mm/s (4.6686 in/s).

5. Record Location and Dimensions

5.1 Record location 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. Measurement of some of these tolerances using present techniques is impractical. A reference tape speed of 118.582 mm/s should 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.

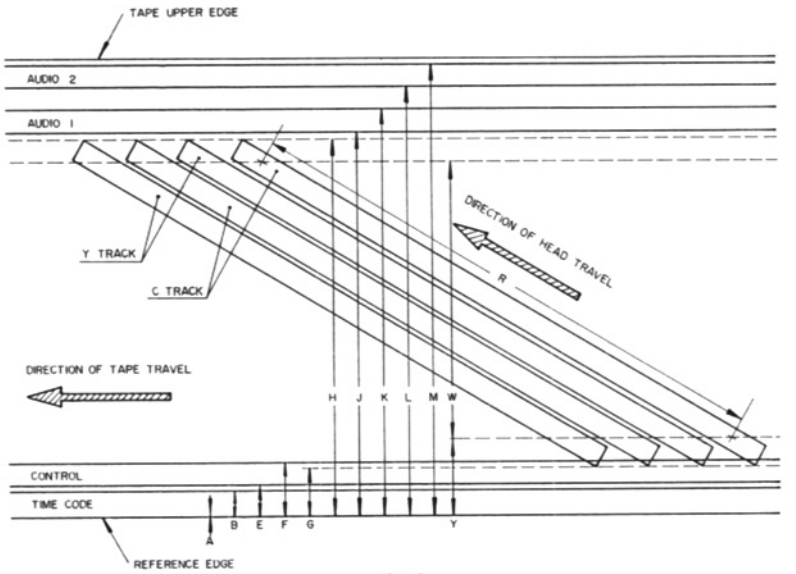

Fig. 1
Record Locations and Dimensions

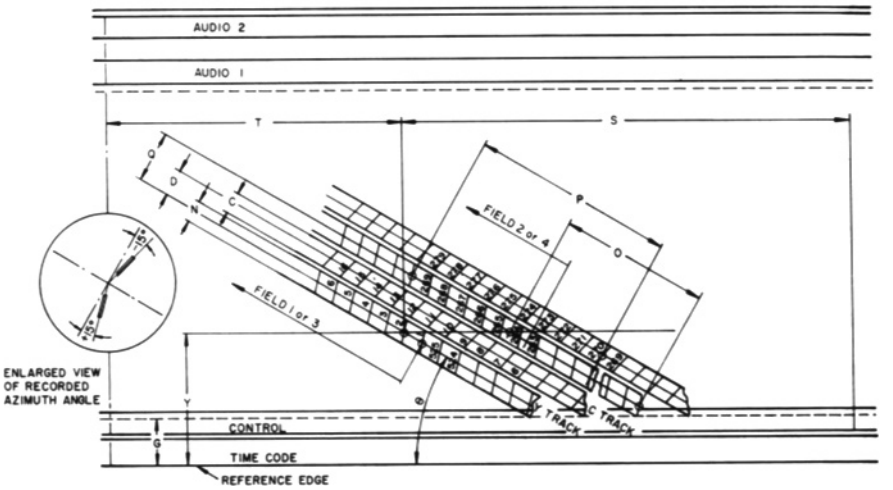

Fig. 2
Video Record Location (525/60)