STANDARDS AND RECOMMENDED PRACTICES

Approved SMPTE Recommended Practices

Two SMPTE Recommended Practices were approved by the Society's Executive Committee for Standards Approval on June 25, 1984: RP 11-1984, Tape Vacuum Guide Configuration and Position for Quadruplex Video Magnetic Tape Recording; and RP 89-1984, Dual-Program Audio for 2-in. Quadruplex Video Magnetic Tape Recording at 15 and 7.5 in./sec. These and other SMPTE Recommended Practices are available for $3.00 each from Society Headquarters.

Proposed American National Standards

Published here for a trial period and public review are two Proposed American National Standards: SMPTE 12M, Television — Time and Control Code — Video and Audio Tape for 525-Line/60-Field Systems; and SMPTE 220, Motion-Picture and Television Equipment — Camera Mounting Connections — 1/4-in. 20-Thread and 3/8-in. 16-Thread Tripod Screws. The proposals will be submitted to the Executive Committee for Standards Approval if no adverse comments are received by April 1, 1985. Comments should be addressed to Alex E. Alden.

Approved International Standard

The International Organization for Standardization (ISO) approved an International Standard, the technical content of which is published here for your information. ISO 1787-1984, Cinematography — Camera Usage of 8-mm Type S Motion-Picture Film — Specifications, is in agreement with American National Standard ANSI PH22.156M-1982, Specifications for Camera Usage of 8-mm Type S Motion-Picture Film. This material is reproduced with permission from the ISO and is copyrighted by the American National Standards Institute, 1430 Broadway, New York, NY 10018, from which copies are available.

Proposed Editorial Revision

Two Proposed American National Standards are subject to a trial period and public review. The technical content is unaffected, as the modifications are editorial in nature. The changes are being published for your information and comment.

SMPTE 179, Motion-Picture Film (8-mm Type S) — Printed Areas — 35-mm Film Perforated 2R and 5R (revision of ANSI PH22.179-1980 published in the November 1980 *Journal*) and SMPTE 181, Motion-Picture Film (8-mm Type S) — Printed Areas — 16-mm Film Perforated 8-mm Type S (1-3) (revision of PH22.181-1973 published in the April 1973 *Journal*): Dimension B, frame height, has been increased from 0.162 in. minimum to 0.163 in. minimum to reflect current international specifications.

Comments should be addressed to Alex E. Alden at Society Headquarters prior to April 1, 1985.

Reaffirmed SMPTE Recommended Practices

The Executive Committee for Standards Approval approved on August 28, 1984 the reaffirmation of two SMPTE Recommended Practices: RP 54-1974, Edge Numbering of 16-mm Release Prints; and RP 55-1974, 8-mm Type S (Super 8) Sprocket Design. — *Alex-E Alden, Manager of Engineering*

SMPTE RECOMMENDED PRACTICE — RP 11-1984

Tape Vacuum Guide Configuration and Position for Quadruplex Video Magnetic Tape Recording

1. *Scope*

This practice specifies the tape vacuum guide configuration and position for quadruplex video recordings on 2-in magnetic tape, and the test conditions for verifying these parameters.

2. *Mechanical Dimensions*

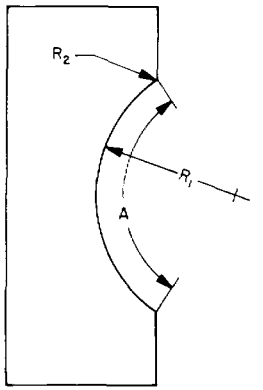
2.1 The radius of the tape vacuum guide (Dimension R_1) shall be 1.0334 + 0.0000 — 0.0004 in (26.248 + 0.000 — 0.010 mm).

2.2 The radius of the entrance contour (Dimension R_2) shall be 0.156 + 0.000 — 0.005 in (3.96 + 0.00 — 0.13 mm).

2.3 The arc of the vacuum guide (Dimension A) shall be 1.940 ± 0.005 in (49.28 ± 0.13 mm).

3. *Guide Position for Recordings*

The center of curvature of the vacuum guide shall lie between the axis of rotation of the video pole tips and the vacuum guide. The extension of a line joining the center of curvature of the vacuum guide and the axis of rotation of the heads shall intersect the tape at the midpoint of its width. The distance (eccentricity) between the center of curvature of the vacuum guide and the axis of rotation of the heads shall be zero when the radius R_1 has its maximum permitted value (see 2.1) and shall increase by the same amount by which the radius R_1 decreases from its maximum permitted value. The table shows an example of such dimensional dependence. The dimensions are based on a nominal tape thickness of 0.0014 in (0.036 mm) and a radius of rotation of the magnetic head pole tips of 1.0329 in minimum to 1.0352 in maximum (26.236 mm minimum to 26.294 mm maximum).



Vacuum Guide Radius		Eccentricity	
Inches	Millimeters	Inches	Millimeters
1.0334	26.248	0.0000	0.000
1.0333	26.246	0.0001	0.003
1.0332	26.243	0.0002	0.005
1.0331	26.241	0.0003	0.008
1.0330	26.238	0.0004	0.010

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Revision of RP 11-1968
Approved 25 June 1984

4. *Test Conditions*

Tests and measurements made on the recorder to check the requirements of this practice shall be made under the following atmospheric conditions:

Temperature for drum diameter	23 ± 0.5°C (73 ± 1°F)
Temperature for other tests	23 ± 1°C (73 ± 2° F)
Relative humidity	50 ± 2 percent
Barometric pressure	86 to 106 kPa (860 to 1060 mbar)
Conditioning before testing	24 h

Appendix

(The Appendix is not a part of this SMPTE Recommended Practice, but is included for information purposes only.)

Achievement of tape reproducing interchangeability requires, among other things, that means be provided to accommodate variations of (a) the radius of rotation of the magnetic head pole tips, (b) the radius of the vacuum guide and (c) tape thickness. These effects are compensated by the stretching of the tape into a slot cavity in the vacuum guide by virtue of the radius of rotation of the magnetic head pole tips projecting beyond the unstretched oxide surface of the tape as held in the vacuum guide. Over the limits normally encountered, the stretching provides automatic compensation if the vacuum guide is positioned to give the minimum geometric distortion in the reproduced picture.

SMPTE RECOMMENDED PRACTICE

RP 89-1984

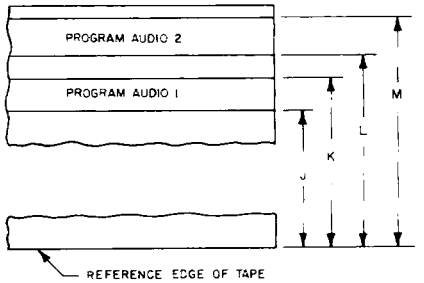
Dual-Program Audio for 2-in Quadruplex Video Magnetic Tape Recording at 15 and 7.5 in/s

1. *Scope*

This practice specifies the location, frequency response, operating level, and mechanical separation of the simultaneously-recorded information of the video and audio records, as recorded on 2-in quadruplex video magnetic tape operating at 15 and 7.5 in/s. (See Note.)

2. *Location of Program Audio Tracks*

The dimensions defining the transverse location of the dual-program audio tracks shall be as specified in the figure and table. The dual audio tracks are an alternative to the audio 1 (program audio) track defined in American National Standard Dimensions of Video, Audio and Tracking Control Records on 2-in Video Magnetic Tape Quadruplex Recorded at 15 and 7.5 in/s, ANSI V98.6-1981. All other track dimensions and the mechanical separation of the simultaneously-recorded information of the video and audio records are unchanged from the dimensions specified in ANSI V98.6-1981.



Dimensions	Inches Min	Inches Max	Millimeters Min	Millimeters Max
J	1.920	1.928	48.77	48.97
K	1.945	1.951	49.40	49.56
L	1.965	1.971	49.91	50.06
M	1.988	1.996	50.50	50.70

3. *Frequency Response and Operating Level*

The frequency response and operating level shall be as specified in American National Standard Frequency Response and Operating Level of Recorders and Reproducers for Audio 1 Record for 2-in Quadruplex Video Magnetic Tape Operating at 15 and 7.5 in/s, ANSI V98.3-1980.

4. *Use of Tracks for Stereo*

If the two tracks are used for stereo recording, the left channel shall be recorded on the track closest to the reference edge of the tape.

5. *Program Audio Head Position*

In addition to the required dimensions for the mechanical separation of the simultaneously-recorded information of the video and audio records, the record/reproduce gaps of the two program audio heads shall lie on a common straight line.

6. *Program Audio Head Phasing*

When the same signal is recorded on the two tracks, the two recorded tracks shall be so phased that when the two tracks are reproduced with a full-track head they will be additive.

7. *Monaural Recording*

If there is to be only one program recorded, both program tracks shall be utilized.

NOTE: Current technology restricts this practice to applications such as stereo where cross-talk is not a limitation.

Revision of RP 89-1978
Approved 25 June 1984

Proposed American National Standard

for television — time and control code — video and audio tape for 525-line/60-field systems

SMPTE 12M

Revision and Redesignation of ANSI V98.12M-1981

1. Scope

1.1 The first part of this standard specifies a format and modulation method for a digital code to be recorded on a longitudinal track of video and audio magnetic tape recorders. The code is to be used for timing and control purposes.

1.2 The second part specifies the digital format to be inserted into the television signal vertical interval to be used for timing and control purposes in video magnetic tape recorders. This part also specifies the location of the code within the television baseband signal and its relationship to other components of the television signal and to the longitudinal track code described in the first part of this standard.

2. Reference Standards

The following standards are intended to be used in conjunction with this standard:

EIA Industrial Electronics Tentative Standard No. 1, Color Television Studio Picture Line Amplifier Output Drawing

International Standard ISO 646-1983, Information Processing — ISO 7-Bit Coded Character Set for Information Interchange

International Standard ISO 2022-1982, Information Processing — ISO 7-Bit and 8-Bit Coded Character Sets — Code Extension Techniques

3. Longitudinal Track Application

3.1 Modulation Method. The modulation method shall be such that a transition occurs at the beginning of every bit period. "One" is represented by a second transition one half a bit period from the start of the bit. "Zero" is represented when there is no transition within the bit period. (See Fig. 1.)

3.2 Code Format

3.2.1 Frame Make-up. Each television frame shall be identified by a unique and complete address. A frame consists of two television fields or 525 horizontal lines. The frames shall be numbered successively 0 through 29, except as noted in 5.2.2 (Drop Frame). If color frame identification in the code is required, the even units of frame numbers shall identify Frame A and odd units of frame numbers shall identify Frame B, as defined by EIA Tentative Standard No. 1.

3.2.2 Frame Address. Each address shall consist of 80 bits numbered 0 through 79.

3.2.2.1 Boundaries of Address. The address shall start at the clock edge before the first address bit (bit 0). The bits shall be evenly spaced throughout the address period, and shall occupy fully the address period which is one frame. Consequently, the bit rate shall be 80 times the frame rate in frames per second. (See 3.2.1 for definition of a television frame.)

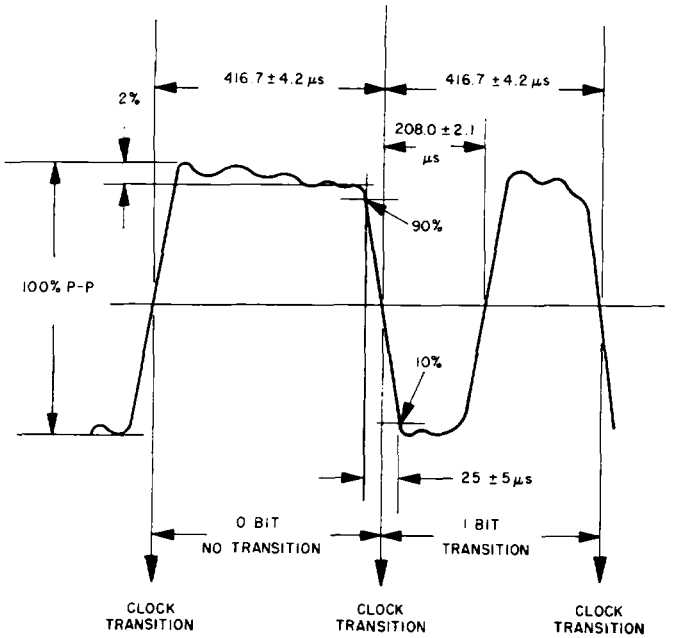


Fig. 1
Longitudinal Recorder Waveform

3.2.2.2 Start of Address. The start of the address shall occur at the beginning of line 5 in fields I and III, as defined in EIA Tentative Standard No. 1. The tolerance shall be ±1 line.

3.3 Longitudinal Recorder Input Waveform Characteristics (See Fig. 1)

3.3.1 Rise Time. The rise and fall times of the clock and "one" transitions of the code pulse train shall be 25 ± 5 microseconds, measured between the 10 and 90 percent amplitude points on the waveform.

3.3.2 Amplitude Distortion. Amplitude distortion, such as overshoot, undershoot, and tilt, shall be limited to 2 percent of the peak-to-peak amplitude of the code waveform.

3.3.3 Time of Transitions. The time between clock transitions shall not vary more than 1 percent of the average clock period measured over at least one frame. The "one" transition shall occur halfway between two clock transitions within 0.5 percent of one clock period. Measurements of these timings shall be made at half-amplitude points on the waveform.

3.4 Use of Binary Groups. The binary groups are intended for storage of data by the users, and the 32 bits within the 8 groups may be assigned in any manner without restriction if the character set used for the data insertion is not specified and the binary group flag bits 43 and 59 are both zero.

If an 8-bit character set is used, the binary group flag bits 43 and 59 shall be set according to the following truth table:

	Bit 43	Bit 59
Character set not specified	0	0
Eight-bit character set	1	0
Unassigned	0	1
Unassigned	1	1

Unassigned states of the truth table cannot be used and their assignment is reserved to the SMPTE.

3.4.1 If an 8-bit character set conforming to ISO 646-1983 and ISO 2022-1982 is signalled by the binary group flag bits 43 and 59, the characters should be inserted in accordance with Fig. 2. Information carried by the user-bits is not specified.

3.5 Assigned and Unassigned Address Bits. Six bits are reserved within the address groups, 4 for identifying operational modes, 1 for bi-phase correction, and 1 unassigned bit reserved for future assignment and defined as zero until further specified by the SMPTE.

Bit 10 — Drop Frame Flag. If certain numbers are being dropped to resolve the difference between real time and color time, as defined in 5.2.2, a "1" shall be recorded.

Bit 11 — Color Frame Flag. If color frame identification has been intentionally applied, as defined in 3.2.1, a "1" shall be recorded.

Bit 27 — "Bi-phase Mark" Phase Correction. This bit shall be put in a state so that every 80-bit word will contain an even number of logical zeros. This requirement results in the following truth table for Bit 27:

Number of Logical Zeros in Bits 0 to 63 (27 exclusive):	Bit 27
Odd	1
Even	0

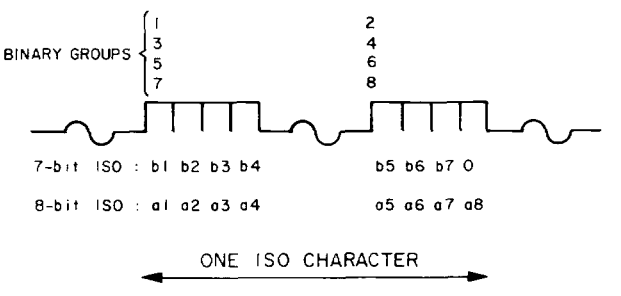


Fig. 2
Use of Binary Groups to Describe ISO Characters Coded with 7 or 8 Bits

Bits 43 and 59 — Binary Group Flag Bits. These two bits shall be set in accordance with the truth table as specified in 3.4.

Bit 58 — Unassigned Address. "0" until assigned by the SMPTE.

The bits shall be assigned as shown in Fig. 3 and described below:

0-3	Units of frames
4-7	First binary group
8-9	Tens of frames
10	Drop frame flag (see 3.5)
11	Color frame flag (see 3.5)
12-15	Second binary group
16-19	Units of seconds
20-23	Third binary group
24-26	Tens of seconds
27	Bi-phase mark phase correction bit (see 3.5)
28-31	Fourth binary group
32-35	Units of minutes
36-39	Fifth binary group
40-42	Tens of minutes
43	Binary group flag bit (see 3.4)
44-47	Sixth binary group
48-51	Units of hours
52-55	Seventh binary group
56-57	Tens of hours
58	Unassigned address bit (0 until assigned by the SMPTE)
59	Binary group flag bit (see 3.4)
60-63	Eighth binary group
64-79	Synchronizing word
64-65	Fixed zero
66-77	Fixed one
78	Fixed zero
79	Fixed one

80 BITS PER FRAME

32 USER BINARY SPARE BITS
16 SYNC
31 ASSIGNED ADDRESS
1 UNASSIGNED ADDRESS
THE UNASSIGNED BIT IS LOGICAL ZERO UNTIL ASSIGNED

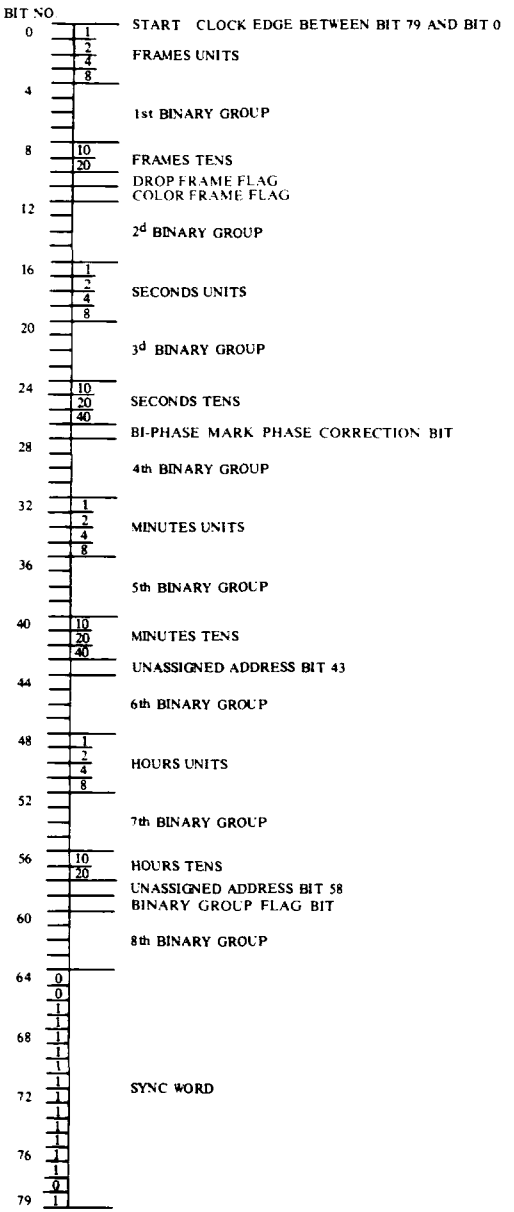


Fig. 3
Longitudinal Bit Assignment

4. Vertical Interval Application

4.1 Modulation Method. The modulation method shall be such that each state of the signal corresponds to a binary state and a transition occurs only when there is a change in the data contained in adjacent bit cells from a "1" to "0" or "0" to "1." No transitions shall occur when adjacent bits contain the same data. Synchronization bit pairs shall be inserted as required in 4.2.3 (modified NRZ).

4.2 Format

4.2.1 Make-up. The frames shall be numbered successively 0 through 29, except as noted in 5.2.2 (Drop Frame), with field identification as specified in 4.4.

The address recorded in each field shall relate directly to the field/frame identification as set forth in EIA Tentative Standard No. 1, and shall be related to the longitudinal code as shown in Fig. 4.

Bit Rate. The bit rate, F_e, at which the address is generated shall be as follows:

$$F_e = F_h \times \frac{455}{4} \pm 200\,\text{Hz}$$

where F_h is the horizontal line rate.

Recorder Input Waveform Characteristics. The baseband video signal after address insertion shall be specified as shown in Fig. 5.

4.2.2 Address. Each address shall consist of 90 bits numbered 0 through 89.

4.2.2.1 Boundaries of Address. The address shall start at the leading edge of the first synchronizing bit (bit 0). The bits shall be evenly spaced throughout the address period, and shall occupy fully the address period which is 50.286 μsec nominal in duration.

4.2.2.2 Timing of the Start of Address. The half-amplitude point of bit 0 shall occur not earlier than 10.0 μsec following the half-amplitude point of the leading edge of the line synchronizing pulse. The half-amplitude point of the trailing edge of bit 89 logical 1 shall occur not later than 2.1 μsec before the half-amplitude point of the leading edge of the following line synchronizing pulse. (See Fig. 6.)

4.2.2.3 Location of the Address Code Signal in the Vertical Interval. The address code signal, generated at the bit rate F_e, shall be inserted on two non-adjacent lines of the vertical interval in both fields. Insertion of the address code shall not be earlier than line 10 or later than line 20, as defined in EIA Tentative Standard No. 1. The address code shall be on the same lines in all fields for a given recording.

User bits shall be the same in both fields of a frame to avoid confusion when transferring from the vertical interval to the longitudinal code.

4.2.3 The bits shall be assigned as shown in Fig. 6.

4.3 Use of Binary Groups The binary groups are intended for storage of data by the users, and the 32 bits within the 8 groups may be assigned in any manner without restriction if the character set used for the data insertion is not specified and the binary group flag bits 55 and 75 are both zero.

If an 8-bit character set is used, the binary group flag bits 55 and 75 shall be set according to the following truth table:

	Bit 55	Bit 75
Character set not specified	0	0
Eight-bit character set	1	0
Unassigned	0	1
Unassigned	1	1

Unassigned states of the truth table cannot be used and their assignment is reserved to the SMPTE.

4.3.1 If an 8-bit character set conforming to ISO 646-1983 and ISO 2022-1982 is signalled by the binary group flag bits 55 and 75, the characters should be inserted in accordance with Fig. 2. Information carried by the user-bits is not subject to any regulation.

4.4 Assigned and Unassigned Address Bits. Six bits are reserved within the address groups, 5 for identifying operational modes and 1 unassigned bit reserved for future assignment and defined as zero until further specified by the SMPTE.

Bit 14 — Drop Frame Flag. If certain numbers are being dropped to resolve the difference between real time and color time, as defined in 5.2.2; a "1" shall be recorded.

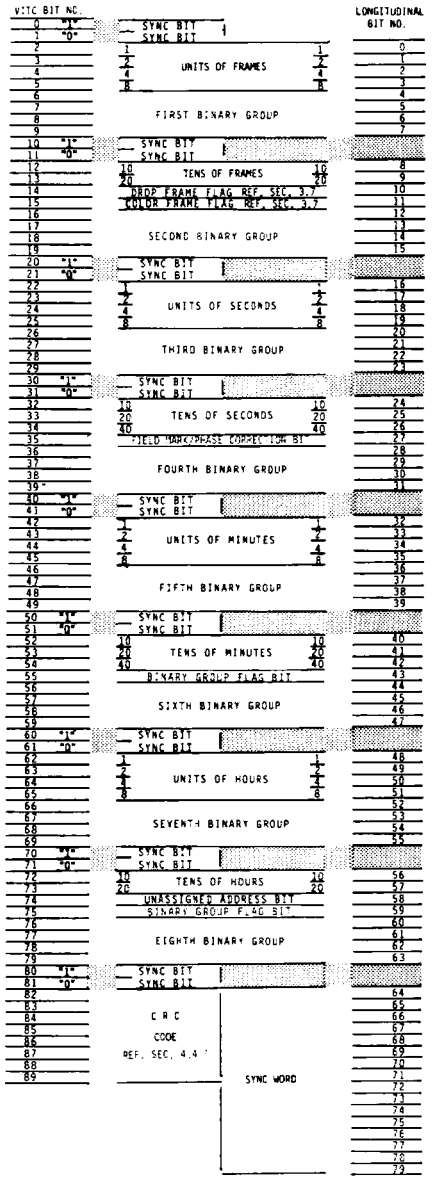


Fig. 4
Relationship of Vertical Interval Code to Longitudinal Code

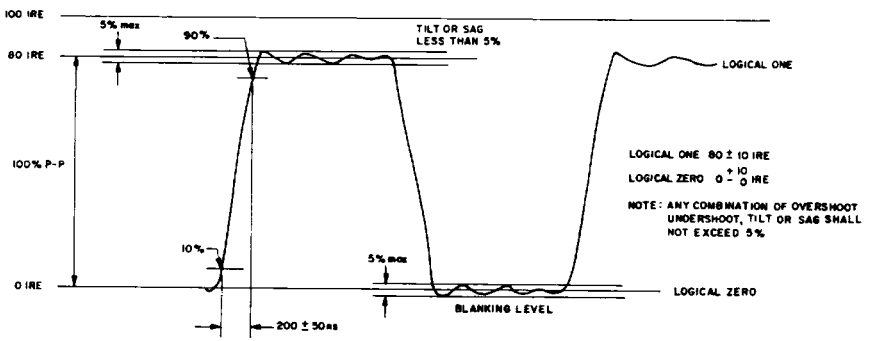


Fig. 5
Vertical Interval Recorder Waveform

Bit 15 — Color Frame Flag. If color frame identification has been applied intentionally, a "1" shall be recorded. Color frame identification of the code is defined as the even units of frame numbers identifying frame A and the odd units of frame numbers identifying frame B. Frames A and B correspond to color frames A and B as defined by EIA Tentative Standard No. 1.

Bit 35 — Field Mark. Field identification shall be recorded as follows: A "0" shall represent the field in which the first pre-equalizing pulse follows the preceding horizontal sync pulse by a whole line. This corresponds to monochrome field I and color field I or III. A "1" shall represent the field in which the first pre-equalizing pulse follows the preceding horizontal sync pulse by a half line. This corresponds to monochrome field II and color field II or IV. Color fields I and III and II and IV are defined in EIA Tentative Standard No. 1.

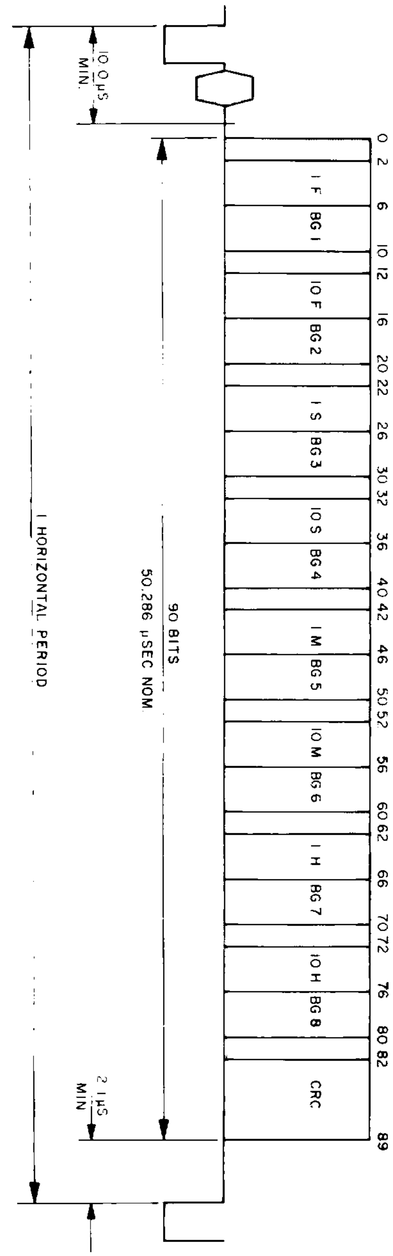
Bits 55 and 75 — Binary Group Flag Bits. These two bits shall be set in accordance with the truth table specified in 4.3.

Bit 74 — Unassigned Address. "0" until assigned by SMPTE.

4.4.1 Cyclic Redundance Check Code. Eight bits, 82 to 89, are set aside at the end of the code to provide for error detection by checking for cyclic redundance. The generating polynomial of the cyclic redunance check, G(X), will be applied to all bits from 0 to 81 inclusive and shall be as follows:

$$G(X) = X^8 + 1$$

The received data divided by the generating polynomial shall result in a remainder of "all zeros" when no error exists in the received data.



0-1	Synchronizing bits	0 Fixed one 1 Fixed zero
2-5	Units of Frames	
6-9	First Binary Group	(BG 1)
10-11	Synchronizing bits	10 Fixed one 11 Fixed zero
12-13	Tens of Frames	
14	Drop Frame Flag	
15	Color Frame Flag	
16-19	Second Binary Group	(BG 2)
20-21	Synchronizing bits	20 Fixed one 21 Fixed zero
22-25	Units of Seconds	
26-29	Third Binary Group	(BG 3)

30-31	Synchronizing bits	30 Fixed one 31 Fixed zero
32-34	Tens of Seconds	
35	Field Mark	
36-39	Fourth Binary Group	(BG 4)
40-41	Synchronizing bits	40 Fixed one 41 Fixed zero
42-45	Units of Minutes	
46-49	Fifth Binary Group	(BG 5)
50-51	Synchronizing bits	50 Fixed one 51 Fixed zero
52-54	Tens of minutes	
55	Binary Group Flag	
56-59	Sixth Binary Group	(BG 6)

60-61	Synchronizing bits	60 Fixed one 61 Fixed zero
62-65	Units of Hours	
66-69	Seventh Binary Group	(BG 7)
70-71	Synchronizing bits	70 Fixed one 71 Fixed zero
72-73	Tens of Hours	
74	Unassigned bit	(Zero until specified)
75	Binary Group Flag	
76-79	Eighth Binary Group	(BG 8)
80-81	Synchronizing bits	80 Fixed one
82-89	CRC Code (Cyclic Redundance Check Code. See 4.4.1)	81 Fixed zero

Fig. 6
Address Bit Assignment

5. Time Discrepancies

5.1 Definitions of Real Time and Color Time

5.1.1 One-second real time is defined as the time elapsed during the scanning of 60 fields (or any multiple thereof) in an ideal television system at a vertical field rate of exactly 60 fields per second.

5.1.2 One-second color time is defined as the time elapsed during the scanning of 60 fields (or any multiple thereof) in a color television system at a vertical field rate of approximately 59.94 fields per second.

5.2 Because the vertical field rate of a color signal is approximately 59.94 fields per second, straightforward counting at 30 frames per second (60 fields per second) will yield an error of + 108 frames (+ 216 fields), approximately equivalent to + 3.6 seconds timing error, in one hour of running time. For correction of this time discrepancy, two methods of operation are allowed:

5.2.1 Nondrop Frame — Uncompensated Mode. During a continuous recording, no numbers shall be omitted from the chain of addresses. Each address shall be increased by 1 frame over the frame number immediately preceding it. When this mode is used, the drop-frame flag of each address shall be a "0" as specified in 3.5 and 4.4.

5.2.2 Drop Frame — Compensated Mode. To resolve the color time error, the first two frame numbers (0, 1) at the start of each minute, except minutes 0, 10, 20, 30, 40, and 50, shall be omitted from the count. When this mode is used, the drop-frame flag of each address shall be a "1" as specified in 3.5 and 4.4.

6. Structure of the Address Bits

6.1 The basic structure of the address is based upon the Binary Coded Decimal (BCD) system. Because the count in some cases does not rise to 9, conservation of bits is achieved because 4 bits are not needed as in an ordinary BCD code. (The 24-hour clock system is used; 2:00 p.m. is 1400 hours.)

6.2 Longitudinal Track and Vertical Interval Applications. Assignment of bits and binary coded decimal arrangements for both applications are shown in the following table:

Longitudinal Track and Vertical Interval Structure

Structural Member	Assignments of Bits		Binary Coded Decimal (BCD)		
	Longitudinal	VIT	No. of Bits	Arrangement	Count
Units Frames	0-3	2-5	4	1 2 4 8	0-9
Tens Frames	8-9	12-13	2	1 2	0-2
Units Seconds	16-19	22-25	4	1 2 4 8	0-9
Tens Seconds	24-26	32-34	3	1 2 4	0-5
Units Minutes	32-35	42-45	4	1 2 4 8	0-9
Tens Minutes	40-42	52-54	3	1 2 4	0-5
Units Hours	48-51	62-65	4	1 2 4 8	0-9
Tens Hours	56-57	72-73	2	1 2	0-2