hours, and to check it thoroughly before restoring it to service.

Software diagnostics and system exercisers are being transferred to data cassettes, for use with small portable cassette readers. This eliminates the need for slow and noisy teleprinters, paper tape readers and the like, which are not well-suited to broadcast equipment room environments.

It may be noted that neither in radio nor television has it been necessary to increase the maintenance staff. Suitable training has, of course, been given. A central group of specialist instructors is also available at Engineering Headquarters in Montreal.

Conclusion

The restriction of computer controlled switching systems to a size not exceeding the capabilities of a human operator has been shown to be unnecessary, provided that there are facilities to permit fast replacement of defective units and a suitable apology system to cover radio and television program faults.

The author wishes to thank his colleagues both within and outside the CBC, especially those who have had the thankless tasks of maintaining services while converting the systems to the new, backed-up versions.

References

1. J. B. Dickson, "An Automated Network Control Center," *J. SMPTE, 84:*529-532, July 1975.
2. M. Barlow, "The Computer Control of Multiple-Bus Switchers," *SMPTE J., 85:*720-723, Sept. 1976.
3. P. Legare and E. Scott, "A Large Automated Radio Switching Centre," *CBC Engineering Review*, July 1977.
4. G. Young and M. Barlow, "Developments in Computer-Controlled Television Switchers," *J. SMPTE, 82:*658-662, August 1973.
5. M. Barlow, "The Assurance of Reliability in Television Automation Systems," *SMPTE J., 85:*73-75, Feb. 1976.
6. M. Barlow and M. Porteous, "A Universal Software for Automatic Switchers," *SMPTE J., 87:*682-683, Oct. 1978.

Standards & Recommended Practices

Proposed American National Standard

A proposed revision of an American National Standard is published here for a trial period and public review: C98.12, Time and Control Code for Video and Audio Tape for 525-Line/60-Field Television Systems. The proposal reflects the addition of recorder input waveform characteristics and a color frame flag. Specifications for the position of the address on the video tape have been deleted. They will be incorporated into individual recommended practices for each tape format.

Proposed SMPTE Recommended Practices

Two Proposed SMPTE Recommended Practices are also published for review: RP 92, Specifications for Audio Level and Multifrequency Test Films for 8-mm Type S Sound Reproducers, Magnetic Type; and RP 93, Requirements for Recording American National Standard Time and Control Code on 1-in Types A, B and C Helical-Scan Video Tape Recorders.

Proposed Withdrawal of American National Standard

On the recommendation of the Committee on Audio Recording and Reproduction Technology, the Standards Committee has approved the withdrawal of American National Standard Cross-Modulation Tests for 16-mm Variable-Area Photographic Sound Prints, PH22.52-1960 (R1975) because all test material and test method standards will be transformed into SMPTE Recommended Practices.

Comments should be addressed to Alex E. Alden, Manager of Engineering Services, at Society Headquarters prior to 1 September 1979. The revision of C98.12 and the withdrawal of PH22.52 have been submitted to their respective national standards committees. All comments from *Journal* publication will be reviewed before conclusion of committee action. If no adverse criticism is received on the proposed practices, they will be submitted to the Society's Board of Governors for final approval. —*Alex E. Alden, Manager of Engineering Services*

Proposed American National Standard

Time and Control Code for Video and Audio Tape for 525-Line/60-Field Television Systems

C98.12

Revision of C98.12-1975

1. Scope

This standard specifies a digital code format and modulation method for video and audio magnetic tape recorders to be used for timing and control purposes.

2. 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. 2.)

3. Code Format

3.1 Each television frame shall be identified by a unique and complete address. A frame consists of two television fields or 525 horizontal lines.

3.1.1 The frames shall be numbered successively 0 through 29.

3.2 Each address shall consist of 80 bits numbered 0 through 79.

3.3 The bits shall be assigned as shown in Fig. 1 and described below:

0-3	Units of frame
4-7	First binary group
8-9	Tens of frames
10	Drop frame flag (see Sec. 3.7)
11	Color frame flag (see Sec. 3.7)
12-15	Second binary group
16-19	Units of seconds
20-23	Third binary group
24-26	Tens of seconds
27	Unassigned address bit (0 until assigned by the SMPTE)
28-31	Fourth binary group
32-35	Units of minutes
36-39	Fifth binary group
40-42	Tens of minutes
43	Unassigned address bit (0 until assigned by the SMPTE)
44-47	Sixth binary group
48-51	Units of hours
52-55	Seventh binary group
56-57	Tens of hours
58-59	Unassigned address bits (0 until assigned by the SMPTE)
60-63	Eighth binary group
64-79	Synchronizing word
64-65	Fixed zero
66-77	Fixed one
78	Fixed zero
79	Fixed one

3.4 Boundaries of Address. The address shall start at the clock edge before the first address bit (bit zero). The bits shall be evenly spaced throughout the address period, and they 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 Sec. 3.1 for definition of a television frame.)

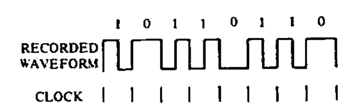
3.5 Start of Address. The start of the address shall occur at the beginning of Line 5 in Fields I and III, as defined in EIA Standard RS-170-A, Electrical Performance Standards—Monochrome Television Studio Facilities. The tolerance shall be plus or minus one line.

3.5.1 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 Standard RS-170-A.

THIS PROPOSAL IS PUBLISHED FOR COMMENT ONLY

80 BITS PER FRAME

32 USER BINARY SPARE BITS
16 SYNC
28 ASSIGNED ADDRESS
4 UNASSIGNED ADDRESS
ALL UNASSIGNED BITS ARE ZEROS.
(Assignment of these bits is reserved to the SMPTE.)



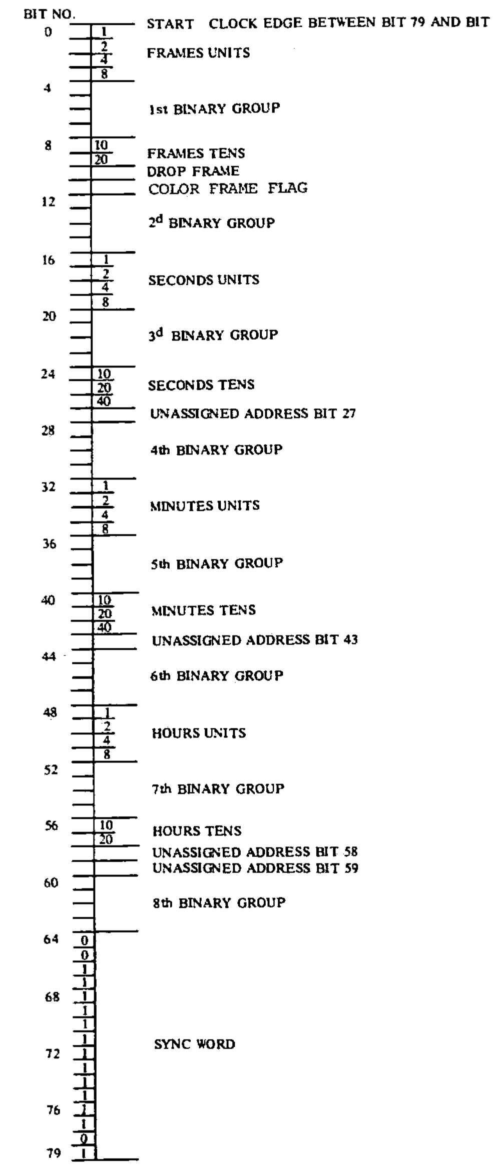


Fig. 1

3.6 Use of Binary Groups. The binary groups are intended for storage of supplementary data by the users, and the 32 bits within the eight groups may be assigned in any fashion without restrictions. It is anticipated that the use of these bits will be standardized in the future.

3.7 Assigned and Unassigned Address Bits. Six bits are reserved within the address groups, two for identifying operational modes, and four unassigned but reserved for future assignment and defined as zeros until further specified by the SMPTE.

Bit No. 10—Drop Frame Flag. If certain numbers are being dropped to resolve the difference between real time and color time, as defined in Sec. 4.2.2, a "1" shall be recorded.

Bit No. 11—Color Frame Flag. If color frame identification has been intentionally applied, as defined in Sec. 3.5.1, a "1" shall be recorded.

Bits No. 27, 43, 58, 59—Unassigned Address Bits. "0" until assigned by the SMPTE.

4. Time Discrepancies

4.1 Definitions of Real Time and Color Time:

4.1.1 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.

4.1.2 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.

4.2 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), 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:

4.2.1 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, bit No. 10 of each address shall be a "0" as specified in Sec. 3.7.

4.2.2 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, bit No. 10 of each address shall be a "1" as specified in Sec. 3.7.

5. Structure of the Address Bits

5.1 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.)

5.1.1 Units Frames. Bits 0-3—4 bit BCD arranged 1, 2, 4, 8. Count 0-9.

5.1.2 Tens Frames. Bits 8-9—2 bit BCD arranged 1, 2. Count 0-2.

5.1.3 Units Seconds. Bits 16-19—4 bit BCD arranged 1, 2, 4, 8. Count 0-9.

5.1.4 Tens Seconds. Bits 24-26—3 bit BCD arranged 1, 2, 4. Count 0-5.

5.1.5 Units Minutes. Bits 32-35—4 bit BCD arranged 1, 2, 4, 8. Count 0-9.

5.1.6 Tens Minutes. Bits 40-42—3 bit BCD arranged 1, 2, 4. Count 0-5.

5.1.7 Units Hours. Bits 48-51—4 bit BCD arranged 1, 2, 4, 8. Count 0-9.

5.1.8 Tens Hours. Bits 56-57—2 bit BCD arranged 1, 2. Count 0-2.

6. Recorder Input Waveform Characteristics (See Fig. 2)

6.1 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.

6.2 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.

6.3 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 .5 percent of one clock period. Measurements of these timings shall be made at half-amplitude points on the waveform.

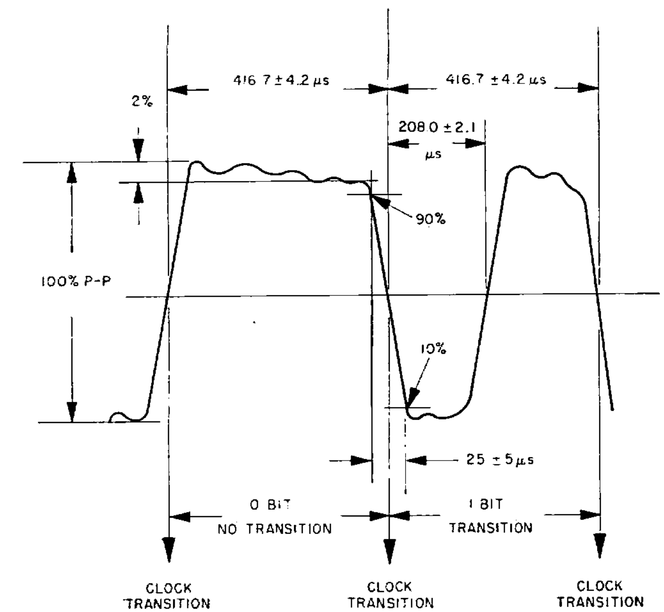


Fig. 2

PROPOSED

SMPTE RECOMMENDED PRACTICE — RP 92

Specifications for Audio Level and Multifrequency Test Films for 8-mm Type S Sound Reproducers, Magnetic Type

1. *Scope*

This practice specifies two audio frequency test films to be used for adjusting the sensitivity and frequency response of 8-mm Type S motion-picture magnetic sound reproducers; one operating at 24 and the other at 18 frames per second.

2. *Test Film Signal*

2.1 Frequencies

2.1.1 Type 24 Film. The sound record on the Type 24 film shall be an original recording which will reproduce at the frequencies specified in Sec. 3 when the linear velocity of the film is 24 frames per second or approximately 20 ft (6.1 m) per minute (4 in or 10.2 cm per second).

2.1.2 Type 18 Film. The sound record on the Type 18 film shall be an original recording which will reproduce at the frequencies specified in Sec. 3 when the linear velocity of the film is 18 frames per second or approximately 15 ft (4.6 m) per minute (3 in or 7.6 cm per second).

2.2 Distortion. The total harmonic distortion of the recorded signals shall not exceed 1 percent.

2.3 Sound Record. The location and dimensions of the recorded sound record shall be in accordance with American National Standard Position, Dimensions and Reproducing Speed of Magnetic Sound Record on 8-mm Type S (Super 8) Motion-Picture Film, PH22.164-1975.

2.4 Signal Fluctuation. The signal levels shall not fluctuate more than ± 0.5 dB within the test section lengths.

2.5 Flutter. The weighted peak flutter of the sound record shall not exceed ± 0.10 percent when measured in accordance with American National Standard Method of Measurement of Weighted Peak Flutter of Sound Recording and Reproducing Equipment, ANSI/IEEE Std 193-1971.

2.6 Azimuth. The azimuth of the sound record shall be 90° ± 5' to the reference edge of the film.

2.7 Signal Identification. Each test section and segment shall be preceded by voice announcements identifying the content. Voice announcements shall be recorded at a level approximately 10 dB below program level. (See Sec. 3.4.)

3. *Test Sections*

3.1 Azimuth Section

3.1.1 Frequency. A frequency of 5000 Hz for Type 18 film or 6300 Hz for Type 24 film ± 2 percent shall be recorded ahead of all other tones on the film.

3.1.2 Recorded Level. The azimuth frequency shall be a recording having an rms short circuit flux per unit track width of 19.85 nanowebers per meter for Type 18 or 16.08 nWb/m for Type 24.

3.1.3 Duration. The minimum duration of this section shall be 30 seconds.

3.1.4 Purpose. The purpose of this section is to confirm reproduce head azimuth before response check.

3.2 Reference Frequency Section

3.2.1 Frequency. A frequency of 400 Hz ± 2 percent shall be recorded ahead of the Frequency Response Section.

3.2.2 Recorded Level. The reference frequency shall be a recording having an rms short circuit flux per unit track width of 58.50 ± 10 nWb/m (10 dB below program level).

3.2.3 Duration. The minimum duration of this section shall be 30 seconds.

3.2.4 Purpose. The purpose of this section is to establish a comparative reference level for the following frequency response section.

3.3 Frequency Response Section

3.3.1 Frequencies. The following test segment frequencies in hertz ± 2 percent shall be recorded in the order given:

5000 for Type 18 or 6300 for Type 24 azimuth / 400 reference level / 7500 for Type 18 or 10 000 and 8000 for Type 24 / 6300 / 5000 / 3150 / 2000 / 1000 / 500 / 315 / 200 / 100 / 50 / 400 program level

3.3.2 Recorded Levels. The values in the table may be expressed as a curve that is the composite of (a) the inverse of the voltage attenuation of a single resistance-capacitance high-pass filter having a time constant, τ_1, and (b) the voltage attenuation of a single resistance-capacitance low-pass filter having a time constant, τ_2. The ordinates of this curve, expressed in decibels, are

$$N_{(dB)} = -20 \log_{10} \omega\tau_1 \sqrt{\frac{1 + (\omega\tau_2)^2}{1 + (\omega\tau_1)^2}}$$

where $\omega = 2\pi f$, f = frequency in hertz, $\tau_1 = 3180$ μs, and $\tau_2 = 90$ μs.

THIS PROPOSAL IS PUBLISHED FOR COMMENT ONLY

3.3.3 Flux Level Variation. The film flux level at each frequency in respect to the value specified in Sec. 3.3.2 shall be as follows:

Type 24 Film	
50 to 100 Hz	+1 —2 dB
200 to 5000 Hz	±1 dB
6300 to 10 000 Hz	+1 —2 dB
Type 18 Film	
50 to 100 Hz	+1 —2 dB
200 to 3150 Hz	±1 dB
5000 to 7500 Hz	+1 —2 dB

3.3.4 Duration. The duration of frequency response test segments shall be approximately 10 seconds.

Flux Level Versus Frequency

Frequency (Hz)	Short Circuit Flux (nWb/m)	Relative Level (dB)
6300 azimuth (Type 24 only)	16.08	—11.22
5000 azimuth (Type 18 only)	19.85	—9.39
400 reference level	58.50	0
10 000 (Type 24 only)	10.37	—15.03
8000 (Type 24 only)	12.85	—13.17
7500 (Type 18 only)	13.65	—12.64
6300	16.08	—11.22
5000	19.85	—9.39
3150	29.14	—6.05
2000	39.44	—3.43
1000	51.87	—1.04
500	57.56	—0.14
315	59.33	+0.12
200	60.96	+0.36
100	66.45	+1.11
50	84.18	+3.16
400 program level	185.00	+10.00

3.4 Program Level Section

3.4.1 Frequency. A frequency of 400 Hz ± 2 percent shall be recorded after the Frequency Response Section.

3.4.2 Recorded Level. The program level frequency shall be a recording having an rms short circuit flux per unit track width of 185 ± 10 nanowebers per meter.

3.4.3 Duration. The minimum duration of this section shall be 30 seconds.

3.4.4 Purpose. The purpose of this section is to verify and reestablish the program level after the possible preceding adjustments.

4. *Film Stock*

4.1 The film stock shall be full-coat, splice-free, of the low-shrinkage, safety type in compliance with American National Standard Specifications for Motion-Picture Safety Film, PH22.31-1967 (R1973), and cut and perforated in accordance with American National Standard Dimensions for 8-mm Motion-Picture Film Perforated 8-mm Type S (Super 8), 1R, PH22.149-1975.

4.2 The film stock shall be conditioned for 10 days at 20°C ± 3° (68°F ± 5.4°) at a relative humidity of 50 ± 10 percent prior to recording.

4.3 The film shall be recorded and packaged within the temperature and humidity limits specified in Sec. 4.2. The recorded film shall be packaged in a metal can and sealed either with a low-moisture permeability plastic tape or a fabric tape having a moisture barrier.

5. *Identification*

Each test film shall be suitably identified.

6. *Calibration*

6.1 Flux. The short circuit flux on the test film shall be determined by means of the calibrated short-gap ferromagnetic core reproducer technique. The technique is described in American National Standard Method of Measuring Recorded Flux of Magnetic Sound Records at Medium Wavelengths, ANSI/IEEE Std 347-1972.

6.2 Level Fluctuation. The signal level measurements specified in Sec. 2.4 shall be measured with a standard volume indicator conforming to American National Standard Volume Measurements of Electrical Speech and Program Waves, ANSI/IEEE Std 152-1953 (R1976).

NOTE: Test films made in accordance with this practice are available from the Society of Motion Picture and Television Engineers.

PROPOSED

SMPTE RECOMMENDED PRACTICE — RP 93

Requirements for Recording American National Standard Time and Control Code on 1-in Types A, B, and C 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 Types A, B, and C helical-scan video tape recorders as specified in American National Standard Time and Control Code for Video and Audio Tape for 525 Line/60 Field Television Systems, C98.12-1975 as revised.

2. *Format Standards and Practices*

American National Standards and SMPTE Recommended Practices referred to in this practice for the various formats are given in the table.

3. *Position of the Code on the Video Tape*

3.1 The code, if used, shall be recorded on the Audio 2 track for the Type A format and on the Audio 3 track for the Type B and C formats.

3.2 The start of the address for original recording shall be as specified in Section 3.5 of ANSI C98.12-1975 as revised.

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

4. *Recorded Signal*

4.1 The input waveform of the recorder for original time and control code recordings shall be as specified in ANSI C98.12-1975 as revised.

4.2 Response of the recording channel shall be as required to meet the appropriate American National Standard or SMPTE Recommended Practice for the audio track being used in each format.

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 275 nWb/m of track width for the Type A format and 185 nWb/m of track width for the Type B and C formats.

Specifications	Type A	Type B	Type C
Basic System Parameters (lists associated documents)	Not assigned	ANSI C98.15	ANSI C98.18
Dimensions and Locations of Records	Not assigned	ANSI C98.16	ANSI C98.19
Frequency Response and Audio Recording Levels	Not assigned	ANSI C98.17	ANSI C98.20

THIS PROPOSAL IS PUBLISHED FOR COMMENT ONLY

Appendix

(The Appendix is not a part of this SMPTE Recommended Practice, but is included for information purposes 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 indicator reads 0 vu. If the recording level of the code then is adjusted so that the volume indicator reads +2 vu for the Type A format and 0 vu for the Type B and C formats, 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 American National Standard Volume Measurements of Electrical Speech and Program Waves, ANSI/IEEE Std 152-1953 (R1971). 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 C98.12, and the sections 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 in each format.

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 Section 6 of ANSI C98.12-1975 as revised. The resulting waveform will not comply with Sec. 3.5 of C98.12 thereby allowing build-up of video-to-address timing errors on multiple-generation dubs.

A2.2.2 Reshape the time code waveform to meet Secs. 6.1 and 6.2 of ANSI C98.12 as revised. Video-to-address timing errors and waveform transition jitter will build up on multiple-generation dubs.

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