# SMPTE RECOMMENDED PRACTICE — RP 136–1986

## *Time and Control Codes for 24, 25 or 30 Frame-Per-Second Motion-Picture Systems*



1. *Scope*

This practice specifies digital code formats and modulation methods for motion-picture film to be used for timing, control, editing, and synchronization purposes. This practice also specifies the relationship of the code to the motion-picture frame. The codes described in this practice are similar to the continuous code described in American National Standard for Television—Time and Control Code—Video and Audio Tape for 525-Line/60-Field Systems, ANSI/SMPTE 12M-1986.

There are two types of codes described in this practice. The first type, type C, is a continuous code which is very similar to the continuous code specified in ANSI/SMPTE 12M-1986. This type of code can be used in situations where the film is moving continuously at the time of both recording and reproduction.

The second type of code, type B, is a noncontinuous, block-type code, composed of blocks of data, each complete in itself, with gaps between the blocks. It is designed so that the code may be recorded and played back on equipment with intermittent film motion but still be decoded with the same type of electronic equipment used to read the type C or continuous time code.

The codes described in this practice can be used at various frame rates, the ones currently of interest being 24, 25, and 30 frames per second.

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.

3. *Code Formats*

Two code formats are described: type C and type B. Sections 3.1 and 3.2 describe the unique characteristics of the two code types. The other sections, 3.3 and 3.4, apply to both code types.

3.1 Type C Code Format

3.1.1 Each motion-picture frame shall be defined by a unique and complete address.

3.1.2 The frames shall be numbered successively 0 through 23, 24, or 29, corresponding to the frame rate being used.

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

3.1.4 The bits shall be assigned as shown in the appropriate columns of Fig. 1 and the table.

3.1.5 Timing of the 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 fully occupy the address period, which is one frame. Consequently, the bit rate shall be 80 times the frame rate in frames per second.

3.1.6 The start of the address, i.e., the clock edge before the first bit, shall coincide with the frameline at the beginning of the image to which the address refers. The tolerance of this location is + 0% (in direction of film travel) and —50% of a frame length (in the other direction). (Thus, the start of the address may lie anywhere in the top half of the frame with the preferred position at the frameline.) (See Fig. 2.)

3.2 Type B Code Format

3.2.1 Each motion-picture frame shall be identified by a unique and complete address.



*Approved 23 April 1986*







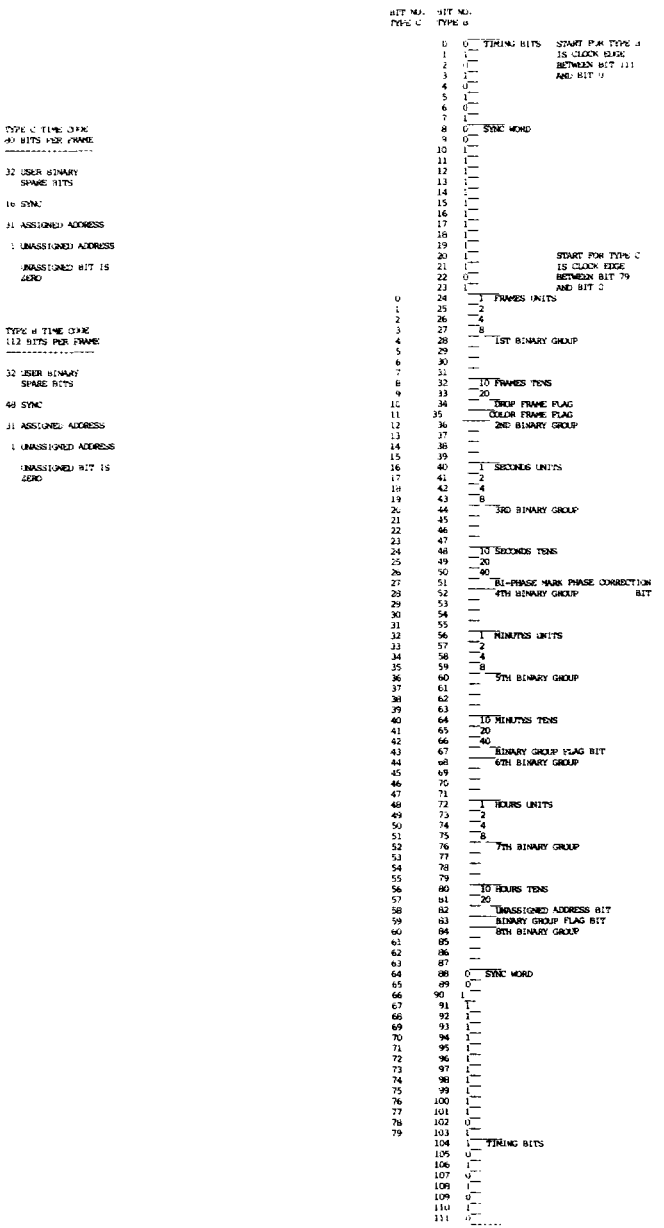


**Fig. 1**
**Bit Assignment**

**Table**

| Bits Type C Code | Bits Type B Code | |
|---|---|---|
| • | 0-7 | Alternating zero, one pattern |
| • | 8-23 | Synchronizing word |
| • | 8-9 | Fixed zero |
| • | 10-21 | Fixed one |
| • | 22 | Fixed zero |
| • | 23 | Fixed one |
| 0-3 | 24-27 | Units of frame |
| 4-7 | 28-31 | First binary group |
| 8-9 | 32-33 | Tens of frames |
| 10 | 34 | Drop frame flag (see 3.4) |
| 11 | 35 | Color frame flag (see 3.4) |
| 12-15 | 36-39 | Second binary group |
| 16-19 | 40-43 | Units of seconds |
| 20-23 | 44-47 | Third binary group |
| 24-26 | 48-50 | Tens of seconds |
| 27 | 51 | Bi-phase Mark Phase correction bit (see 3.4) |
| 28-31 | 52-55 | Fourth binary group |
| 32-35 | 56-59 | Units of minutes |
| 36-39 | 60-63 | Fifth binary group |
| 40-42 | 64-66 | Tens of minutes |
| 43 | 67 | Binary group flag bit (see 3.4) |
| 44-47 | 68-71 | Sixth binary group |
| 48-51 | 72-75 | Units of hours |
| 52-55 | 76-79 | Seventh binary group |
| 56-57 | 80-81 | Tens of hours |
| 58 | 82 | Unassigned address bit (0 until assigned by the SMPTE) |
| 59 | 83 | Binary group flag bit (see 3.4) |
| 60-63 | 84-87 | Eighth binary group |
| 64-79 | 88-103 | Synchronizing word |
| 64-65 | 88-89 | Fixed zero |
| 66-77 | 90-101 | Fixed one |
| 78 | 102 | Fixed zero |
| 79 | 103 | Fixed one |
| • | 104-111 | Alternating one, zero pattern |

*These bits do not exist in the Type C code.

3.2.2 The frames shall be numbered successively 0 through 23, 24, or 29, corresponding to the frame rate being used.

3.2.3 Each address shall consist of 112 bits numbered 0 through 111.

3.2.4 The bits shall be assigned as shown in the appropriate columns of Fig. 1 and in the table.

3.2.5 Boundaries of the Address. The block of data for a single frame may be recorded anywhere within that frame except that no part of the block may occupy the region extending from the frameline to 5% of a frame length on either side of it. This region is thus a gap in the data which has a minimum length of 10% of a frame length. (See Fig. 3.)

3.2.6 Bit Length. The length of any one bit shall not differ by more than 5% from the length of either adjacent bit. In addition, the length of no bit shall be so short as to make the recording and reproduction of that data, using practical equipment, unreliable; and the length of no series of bits may cause the total length of 112 bits to exceed 90% of frame length.

3.2.7 Data in the Gap. In order to reduce the dc content of the signal, a repetitive pattern of zeros and ones shall be recorded in as much of gap area (the frameline region defined in 3.2.5) as is practical. In no case may this region contain a sync word nor may these bits, together with the second sync word of the previous frame and the first sync word of the following frame, be decodable as a valid time code word. The bit length tolerance in 3.2.6 does not apply to data in the gap.

3.3 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 fashion without restrictions if the character set used for the data insertion is not specified and the binary group flag bits, Nos. 43 and 59, both are zero.







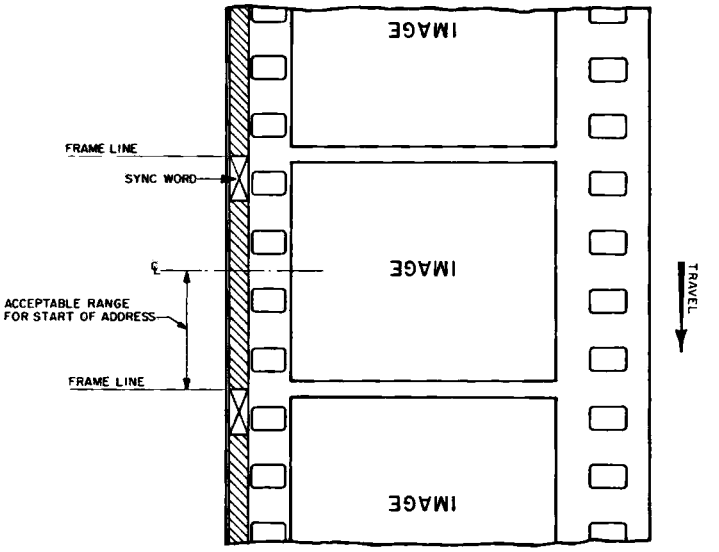


**Fig. 2**
**Type C Code**

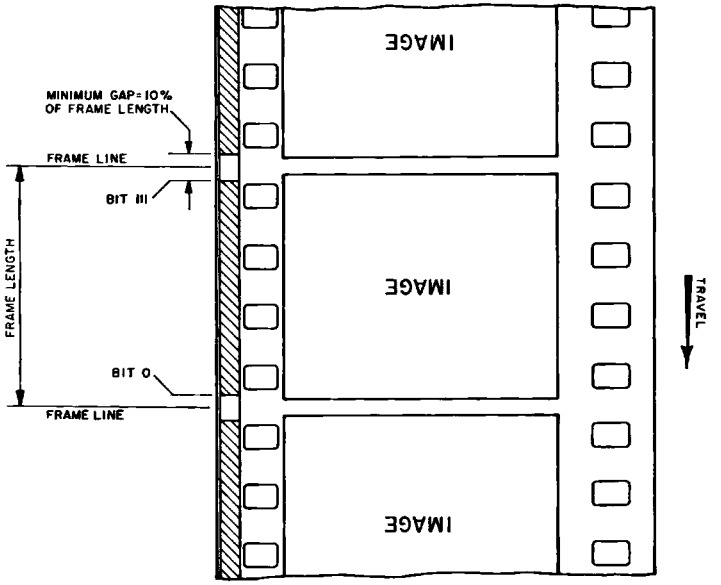


**Fig. 3**
**Type B Code**

(Figs. 2 and 3 illustrate the preferred longitudinal placement of a frame of time code relative to the picture frame. It it not intended to identify the track position on the film. The figures apply to all film formats, even though 35-mm film is shown.)

The binary group flag bits 43 and 59 (67 and 83 for Type B code) shall be set according to the following truth table:

| | Bit 43 (67) | Bit 59 (83) |
|---|---|---|
| Character set not specified | 0 | 0 |
| Character set as defined in International Standard ISO 2022-1982, Information Processing — ISO 7-Bit and 8-Bit Coded Character Sets — Code Extension Techniques | 1 | 0 |
| Data and checksum as defined in SMPTE Recommended Practice on Use of Binary User Groups in Motion-Picture Time and Control Codes, RP 135-1986 | 0 | 1 |
| Unassigned | 1 | 1 |

The unassigned state of the truth table cannot be used and its assignment is reserved to the SMPTE.

3.4 Assigned and Unassigned Address Bits. Six bits are reserved within the address groups, 4 for identifying operational modes when this type of code is used for television systems (see ANSI/SMPTE 12M-1986), 1 for bi-phase correction, and 1 unassigned but reserved for future assignment and defined as zero until further specified by the SMPTE.

Bit 10, Type C code; Bit 34, Type B code — Drop Frame Flag. If certain numbers are being dropped to resolve the difference between real time and color time, as defined in 4.2.2, a "1" shall be recorded.

Bit 11, Type C code; Bit 35, Type B code — Color Frame Flag. If color frame identification has been intentionally applied, a "1" shall be recorded.

Bit 27, Type C code; Bit 51, Type B code — "Bi-phase Mark" Phase Correction. Shall be put in a state so that every 80- or 112-bit word will contain an even number of logic zeros. This requirement results in the following truth table for Bit 27 (51):

| Number of Logic Zeros in Bits 0 to 26 (24 to 50), and Bits 28 to 63 (52 to 87) | Type C Bit 27 | Type B Bit 51 |
|---|---|---|
| Odd | 1 | 0 |
| Even | 0 | 1 |

Bits 43, 59, Type C code; Bits 67, 83, Type B code — Binary Group Flag Bits. These two bits shall be set in accordance with the truth table as specified in 3.3.

Bit 58, Type C code; Bit 82, Type B code — — Unassigned Address. "0" until assigned by SMPTE.

4. *Time Discrepancies*

4.1 When the film on which the time code is recorded is transferred from or will be transferred to television, or is otherwise used in conjunction with a 525-line/60-field television system, there may be a need to use the drop frame counting mode. This section presents pertinent definitions.

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 (30-frame code only). 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 (34) of each address shall be a "0" as specified in 3.4.

4.2.2 Drop Frame — Compensated Mode (30-frame code only). 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 (34) of each address shall be a "1" as specified in 3.4.

5. *Structure of the Address Bits*

The basic structure of the address is based on 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. (Bits shown in parentheses are for Type B code.)

5.1 Units Frames. Bits 0-3 (24-27) — 4 bit BCD arranged 1, 2, 4, 8. Count 0-9.

5.2 Tens Frames. Bits 8-9 (32-33) — 2 bit BCD arranged 1, 2. Count 0-2.

5.3 Units Seconds. Bits 16-19 (40-43) — 4 bit BCD arranged 1, 2, 4, 8. Count 0-9.

5.4 Tens Seconds. Bits 24-26 (48-50) — 3 bit BCD arranged 1, 2, 4. Count 0-5.

5.5 Units Minutes. Bits 32-35 (56-59) — 4 bit BCD arranged 1, 2, 4, 8. Count 0-9.

5.6 Tens Minutes. Bits 40-42 (64-66) — 3 bit BCD arranged 1, 2, 4. Count 0-5.





5.7 Units Hours. Bits 48-51 (72-75) — 4 bit BCD arranged 1, 2, 4, 8 Count 0-9.

5.8 Tens Hours. Bits 56-57 (80-81) — 2 bit BCD arranged 1.2. Count 0-2.
(The 24-hour clock system is used; 2:00 p.m. is 14 hours, 0 minutes.)

6. *Position of the Address on Motion-Picture Film*

6.1 Optical Tracks

6.1.1 35-mm Release Print Film. The address shall be recorded in the data track whose location is specified in SMPTE Recommended Practice on Dimensions of Photographic Control and Data Record on 35-mm Motion-Picture Release Prints, RP 115-1983.

6.1.2 35-mm Camera Film. The address shall be recorded in the data track whose location is specified in SMPTE Recommended Practice on Dimensions of Photographic Control and Data Record on 35-mm Motion-Picture Camera Negatives, RP 116-1983.

6.1.3 16-mm Film. The address shall be recorded in the data track whose location is specified in SMPTE Recommended Practice on Dimensions of Photographic Control and Data Record on 16-mm Motion-Picture Film, RP 114-1983.

6.1.4 Super 8 Release Prints. The address shall be recorded in the data track whose location is specified in SMPTE Recommended Practice on Dimensions of Photographic Control and Data Record on 8-mm Type S Motion-Picture Release Prints, RP 118-1983.

6.2 Magnetic Tracks

6.2.1 Super 8 Film. The address shall be recorded in the data track whose location is specified in SMPTE Recommended Practice on Dimensions of Magnetic Control and Data Record on 8-mm Type S Motion-Picture Film, RP 117-1983.

6.3 Low-Dispersion Magnetic Tracks

6.3.1 35-mm Film. The address shall be recorded in the data track whose location is specified in SMPTE Recommended Practice on Dimensions for Data Track on Low-Dispersion Magnetic Coatings on 35-mm Motion-Picture Film, RP 137-1986.

7. *Addresses on Motion-Picture Prints*

When the time code is used on final prints, the time code of the "picture start" frame shall be 01 hours, 00 minutes, 00 seconds, 00 frames. All frames on the reel prior to the "picture start" frame shall each have the time code 01 hours, 00 minutes, 00 seconds, 00 frames. If the film is longer than one reel, the "picture start" frame and all preceding frames on the second reel shall be 02 hours, 00 minutes, 00 seconds, 00 frames. Successive reels shall be numbered likewise with the number of hours increasing sequentially and the minutes, seconds, and frames being zero for the "picture start" frame.

The "picture start" frame referred to above precedes the first frame to be projected by exactly eight seconds, as identified in American National Standard for Motion-Picture Film — Leaders and Cue Marks — 35- and 16-mm Audio Release Prints, ANSI PH22.55-1983.