ANSI/SMPTE 252M-1996
Revision of
ANSI/SMPTE 252M-1991

# SMPTE STANDARD

## for Television Analog Recording — 1/2-in Type M-2 — Pulse Code Modulation Audio



## 1 Scope

This standard specifies the pulse code modulation (PCM) audio mode of encoding and recording system utilizing a 1/2-in type M-2 helical-scan video tape recorder operating with video signals having a typical scanning structure of 525 lines, 59.94 fields/s, 2:1 interlace, and the cassettes specified in ANSI/SMPTE 250M.

## 2 Normative references

The following documents 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 249M-1996, Television Analog Recording — 1/2-in Type M-2 — Records

ANSI/SMPTE 250M-1996, Television Analog Recording — 1/2-in Type M-2 — Tapes and Cassettes

SMPTE RP 155–1995, Audio Levels for Digital Audio Records on Digital Television Tape Recorders

## 3 Recording location

The PCM audio signal is recorded on tape regions PD, PE, and PF, located on the video track as shown in ANSI/SMPTE 249M. Since the recording area for longitudinal audio CH-1 is allocated for the PCM recording, longitudinal audio recording can be accomplished only on one channel (CH-2).

## 4 Audio signal recording

The recording of PCM audio signals in each of two channels is accomplished by using the luminance and chrominance heads provided for video signal recording as shown in figure 1.

The recording is accomplished beyond the overlap area on the tape produced by making the wrap angle on the scanner more than 180°. Direct recording of time compressed digital modulation is employed.

### 4.1 Source coding

The source data consists of the audio data and the ID (identification) data.

#### 4.1.1 Audio data specifications

Number of channels: Two channels (CH-5 and CH-6).

Reference level: The input required to give –20 dB full-scale at A/D converter (at 1 kHz) shall be the reference level and its digital value shall be as specified in SMPTE RP 155.

Track allocation: CH-5 shall be recorded by the luminance head. CH-6 shall be recorded by the chrominance head.

Stereo mode: CH-5 is the left channel. CH-6 is the right channel.

#### 4.1.2 Audio data coding

– Sampling frequency: 48 kHz (synchronous with video signal)
– Sampling order: CH-5, CH-6 simultaneous
– Quantization: 16-bit linear
– Coding: Twos complement binary code


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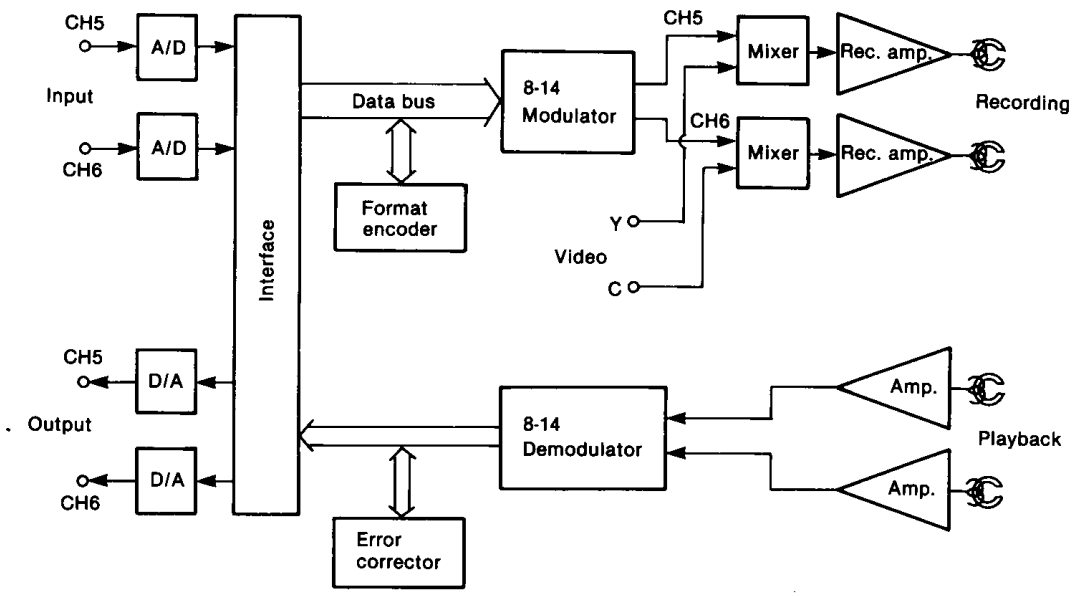



**Figure 1 — Block diagram of PCM audio recording system**

#### 4.1.3 ID data coding

– Data capacity: 6-byte or 8-byte/field as shown in tables 1 and 2.

– Coding: NRZ

#### 4.1.4 Source data arrangement

The source data arrangement within one audio field period is shown by tables 1 and 2. The 16-bit audio samples shown in tables 1 and 2 are each divided into upper and lower 8-bit samples which are arranged in an order starting from suffix 0. However, in this five audio field periodic sequence, the data D 800U and D 800L are available in audio fields 0, 1, 2, and 3, but the data in audio field 4 shall be replaced by ID6 and ID7.

#### 4.1.5 ID data specification

The ID data region is available for the user, and its contents are shown in figure 2 and tables 1 and 2.

### 4.2 Signal processing

The 800 or 801 audio data samples per field are divided into 67 blocks, and the block sync signal (SYNC), block address signal (ADDRESS), block address error detecting code (CRCC), and the error correction code (ECC2 and ECC1) are added to each block. The signal format is shown in figure 3 where the recording order for each data sample is MSB first.

#### 4.2.1 PCM signal construction

The PCM signal construction is shown in figure 4.

– Preamble area:

– Length: one horizontal line (63.5 μs).

– Content: a single frequency signal of 5.0625 MHz (basic)

NOTE - A basic dimension is a fundamental dimen sion to which no tolerance is applicable.

**Table 1 – Source data arrangement for fields 0, 1, 2 and 3**

| Block Number | #0 | #1 | #2 | #3 | #4 | #31 | #32 | #33 | #34 | #35 | #63 | #64 | #65 | #66 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Data Symbol | D0U | D 2U | D 4U | D 6U | D 8U | D 62U | D 64U | D 66U | D 1U | D 3U | D 59U | D 61U | D 63U | D 65U |
| | D0L | D 2L | D 4L | D 6L | D 8L | D 62L | D 64L | D66L | D 1L | D 3L | D 59L | D 61L | D 63L | D 65L |
| | D 67U | D 69U | D 71U | D 73U | D 75U | D129U | D131U | D133U | D 68U | D 70U | D126U | D128U | D130U | D132U |
| | | | | | | | | | | | | | | |
| | D737U | D739U | D741U | D743U | D745U | D799U | ID 0 | ID 4 | D738U | D740U | D796U | D798U | D800U | ID 2 |
| | D737L | D739L | D741L | D743L | D745L | D799L | ID 1 | ID 5 | D738L | D740L | D796L | D798L | D800L | ID 3 |
| NOTE – U stands for the upper 8 bits, and L for the lower 8 bits. | | | | | | | | | | | | | | |

**Table 2 – Source data arrangement for field 4**

| Block Number | #0 | #1 | #2 | #3 | #4 | #31 | #32 | #33 | #34 | #35 | #63 | #64 | #65 | #66 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Data Symbol | D 0U | D 2U | D 4U | D 6U | D 8U | D 62U | D 64U | D 66U | D 1U | D 3U | D 59U | D 61U | D 63U | D 65U |
| | D 0L | D 2L | D 4L | D 6L | D 8L | D 62L | D 64L | D 66L | D 1L | D 3L | D 59L | D 61L | D 63L | D 65L |
| | D 67U | D 69U | D 71U | D 73U | D 75U | D129U | D131U | D133U | D 68U | D 70U | D126U | D128U | D130U | D132U |
| | | | | | | | | | | | | | | |
| | D737U | D739U | D741U | D743U | D745U | D799U | ID 0 | ID 4 | D738U | D740U | D796U | D798U | ID 6 | ID 2 |
| | D737L | D739L | D741L | D743L | D745L | D799L | ID 1 | ID 5 | D738L | D740L | D796L | D798L | ID 7 | ID 3 |
| NOTE – U stands for the upper 8 bits, and L for the lower 8 bits. | | | | | | | | | | | | | | |

Phase continuity to the beginning of the sync block shall be established.

– Postamble area:

– Length: one horizontal line (63.5 μs).

– Content: a single frequency signal of 5.0625 MHz (basic)

Phase continuity to the end of the data block shall be established.

– SYNC: Specified in 4.2.4.

– ADDRESS: Started from “00" by the sequential address for the identification of each of the 67 blocks.

– CRCC: CRCC is used for block ADDRESS error detection; this detected error pointer is referred to data error correction. The error detection method is based upon a CRC code containing 8 bits and its generator polynominal G1 (x) is as follows:

$G1(x) = X^8 + 1$ (preset all “1")

– DATA: Data shall be arranged in the order shown in tables 1 and 2 and figure 3.

– ECC2, ECC1: Specified in 4.2.2.

– Transmission data rate: 11.57 Mbps per channel.

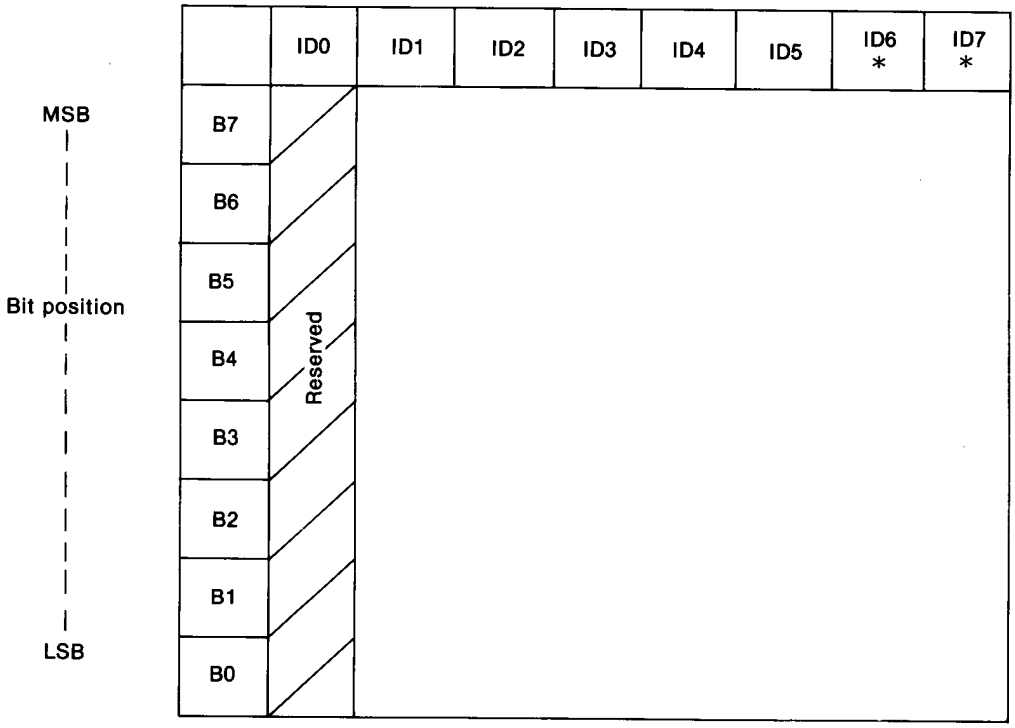
### 4.2.2 Error correction codes

The error detection and correction system (ECC) shall be based on the Reed-Solomon code which contains the elements of Galois field $2^8$, and its generator polynominal G2(x) and primitive polynominal G3(x) are given by:

$$G2(x) = \prod_{i=0}^{3} (x - a^i)$$

$$G3(x) = X^8 + X^4 + x^3 + X^2 + 1$$

The generation scheme of error correction codes ECC1 and ECC2 is shown in figure 5.




Reserved Region:

| Field Address | $B_0$ | $B_1$ | $B_2$ | $B_3$ | $B_4$ | $B_5$ | $B_6$ | $B_7$ |
|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | | | | | |
| 1 | 1 | 0 | 0 | | | | | |
| 2 | 0 | 1 | 0 | | | Not specified | | |
| 3 | 1 | 1 | 0 | | | | | |
| 4 | 0 | 0 | 1 | | | | | |

NOTE – Not available in fields 0, 1, 2, 3

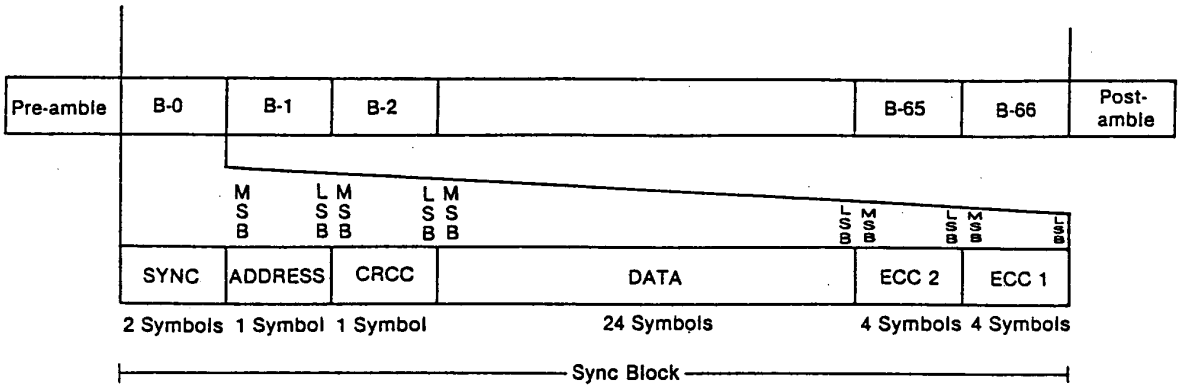
**Figure 2 – ID data content and reserved region for field address**

Block Address →

Recording Direction ↓

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| SYNC | SYNC | SYNC | SYNC | | SYNC | SYNC | | SYNC | SYNC |
| ADDRESS | ADR0 | ADR1 | ADR2 | | ADR33 | ADR34 | | ADR65 | ADR66 |
| CRCC | CRCC | CRCC | CRCC | | CRCC | CRCC | | CRCC | CRCC |
| DATA | D 0U | D 2U | D 4U | | D 66U | D 1U | | D 63U | D 65U |
| | D 0L | D 2L | D 4L | | D 66L | D 1L | | D 63L | D 65L |
| | D 67U | D 69U | D 71U | | D 133U | D 68U | | D 130U | D 132U |
| | | | | | | | | | |
| | D 737U | D 739U | D 741U | | ID 4 | D 738U | | * | ID 2 |
| | D 737L | D 739L | D 741L | | ID 5 | D 738L | | ** | ID 3 |
| ECC2 | ECC2 0 | ECC2 1 | ECC2 2 | | ECC2 33 | ECC2 34 | | ECC2 65 | ECC2 66 |
| ECC1 | ECC1 0 | ECC1 1 | ECC1 2 | | ECC1 33 | ECC1 34 | | ECC1 65 | ECC1 66 |

**Figure 3 – PCM signal format**




NOTE – 1 symbol = 8 bits.

**Figure 4 – PCM signal construction**

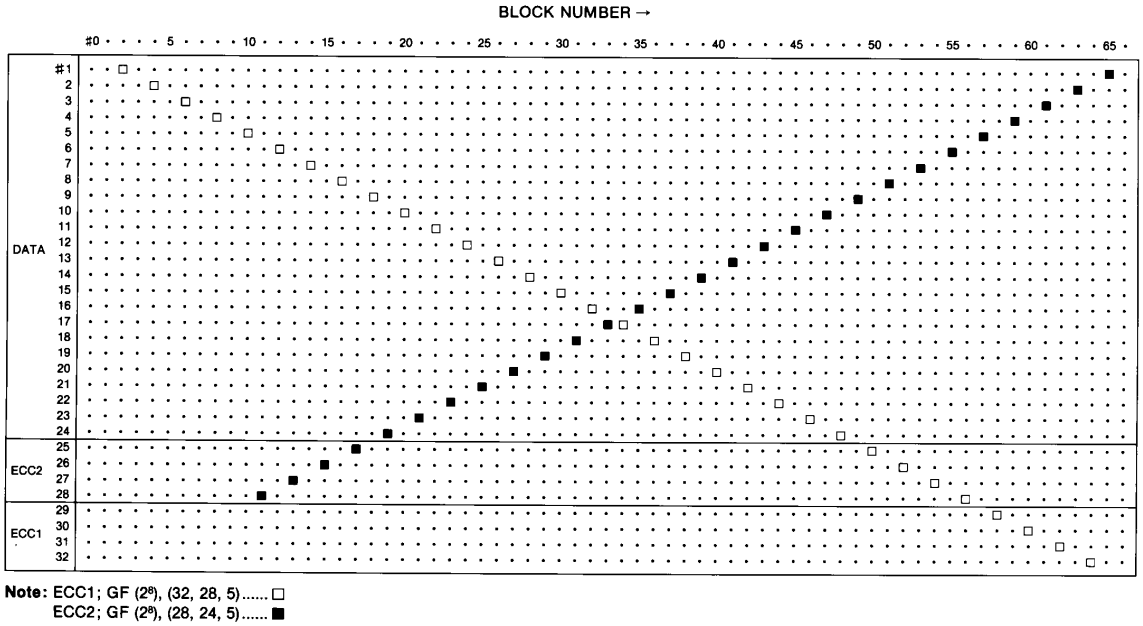



**Figure 5 – Error correction format**

### 4.2.3 Channel coding

The channel code shall conform to the 8-14 modulation method (see figure 6 and tables 3 and 5). This method is based on an algorithm where the DC component is minimized when the 8-bit data is converted to a 14-bit code. The data converted by the 8-14 modulation method shall be further transformed by NRZI conversion process before it is recorded.

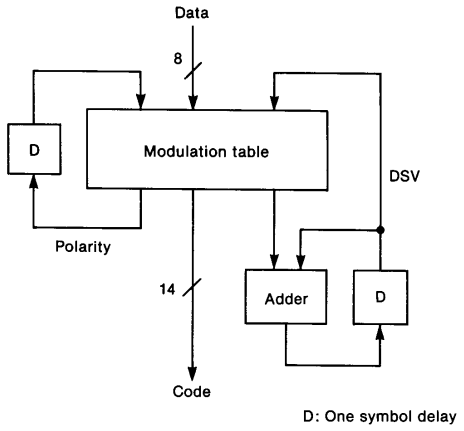



**Figure 6 – Block diagram for 8-14 modulation**

**Table 3 – Selection of modulation code**

| Preceding DSV | Preceding polarity | Selection of modulation code |
|---|---|---|
| Positive polarity | Positive | Select group A |
| | Negative | Select group B |
| Zero | — | Select small absolute value of CDS |
| Negative polarity | Positive | Select group B |
| | Negative | Select group A |

NOTES

1 DSV. DSV is an abbreviation for digital sum value and indicates the integral value which is counted from the beginning of the NRZI-modulated waveform, taking high-level = 1 and low level = –1.

2 CDS. CDS is an abbreviation for code word digital sum and indicates the DSV of one symbol modulation code where NRZI modulation starts from the low level.

3 Polarity. Positive polarity indicates a high level of the NRZI-modulated waveform. Negative polarity indicates a low level of the NRZI-modulated waveform.

### 4.2.4 Sync pattern

The sync pattern shall be constructed as shown in figure 7.

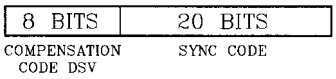



**Figure 7 – Sync pattern**

The sync code shall be defined as follows:

00100000001000000010

Compensation code DSV shall be chosen in such a way as to compensate the DC component of the last block. Table 4 shows this compensation code.

**Table 4 – Compensation code**

| | Polarity | |
|---|---|---|
| DSV | Positive | Negative |
| –4 | 00101000 | 01000001 |
| –2 | 01010001 | 00100001 |
| 0 | 00001000 | 00001000 |
| 2 | 00100001 | 01010001 |
| 4 | 01000001 | 00101000 |

### 4.2.5 Record physical offset

The physical offset between the two PCM audio channels shall be as shown in figure 8 due to the Y/C head offset as shown in table 2 of ANSI/SMPTE 249M.

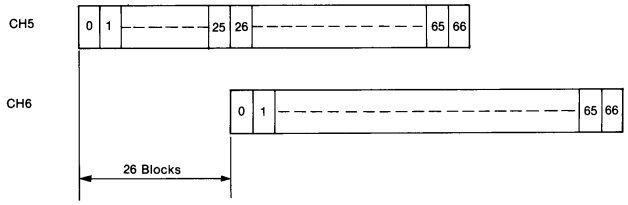
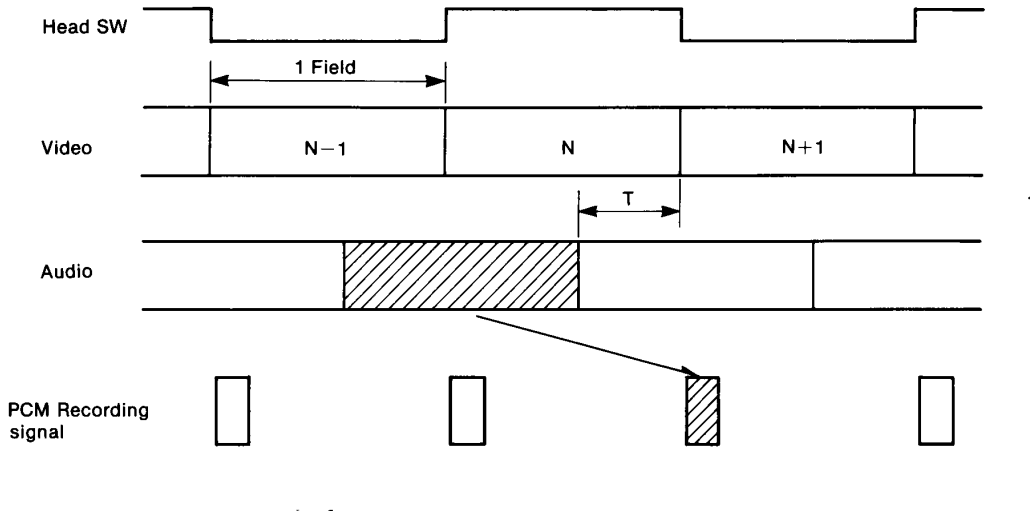



**Figure 8 – Physical offset between two audio channels**

### 4.2.6 Recording video and audio timing

The recording timing between video and audio signals shall be as shown in figure 9.




NOTE – T = 3.0 ms ± 0.2 ms.

**Figure 9 – Recording video and audio timing**

## Table 5 – 8-14 modulation

| Data | Group A (Positive) | | Group B (Negative) | |
|---|---|---|---|---|
| | Code | CDS | Code | CDS |
| 00 | 01001010101010 | 0 | 01001010101010 | 0 |
| 01 | 01010100101010 | 0 | 01010100101010 | 0 |
| 02 | 01010101010010 | 0 | 01010101010010 | 0 |
| 03 | 10010010101010 | 0 | 10010010101010 | 0 |
| 04 | 10010101001010 | 0 | 10010101001010 | 0 |
| 05 | 10010101010100 | 0 | 10010101010100 | 0 |
| 06 | 10100100101010 | 0 | 10100100101010 | 0 |
| 07 | 10100101010010 | 0 | 10100101010010 | 0 |
| 08 | 10101001001010 | 0 | 10101001001010 | 0 |
| 09 | 10101001010100 | 0 | 10101001010100 | 0 |
| 0A | 10101010010010 | 0 | 10101010010010 | 0 |
| 0B | 10101010100100 | 0 | 10101010100100 | 0 |
| 0C | 01001001010010 | 0 | 01001001010010 | 0 |
| 0D | 01010010010010 | 0 | 01010010010010 | 0 |
| 0E | 01010010100100 | 0 | 01010010100100 | 0 |
| 0F | 01001001000100 | 0 | 01001001000100 | 0 |
| 10 | 10001000100100 | 0 | 10001000100100 | 0 |
| 11 | 10001001001000 | 0 | 10001001001000 | 0 |
| 12 | 10010001000100 | 0 | 10010001000100 | 0 |
| 13 | 10010010001000 | 0 | 10010010001000 | 0 |
| 14 | 01001000101010 | 0 | 01001000101010 | 0 |
| 15 | 01001010100010 | 0 | 01001010100010 | 0 |
| 16 | 01010001001010 | 0 | 01010001001010 | 0 |
| 17 | 01010001010100 | 0 | 01010001010100 | 0 |
| 18 | 01010100100010 | 0 | 01010100100010 | 0 |
| 19 | 01010101000100 | 0 | 01010101000100 | 0 |
| 1A | 10010001010010 | 0 | 10010001010010 | 0 |
| 1B | 10010010100010 | 0 | 10010010100010 | 0 |
| 1C | 10100010010010 | 0 | 10100010010010 | 0 |
| 1D | 10100010100100 | 0 | 10100010100100 | 0 |
| 1E | 10100100100010 | 0 | 10100100100010 | 0 |
| 1F | 10100101000100 | 0 | 10100101000100 | 0 |
| 20 | 01000100010010 | 0 | 01000100010010 | 0 |
| 21 | 01000100100100 | 0 | 01000100100100 | 0 |
| 22 | 01000101001000 | 0 | 01000101001000 | 0 |
| 23 | 01001000100010 | 0 | 01001000100010 | 0 |
| 24 | 01001010001000 | 0 | 01001010001000 | 0 |
| 25 | 01010010000100 | 0 | 01010010000100 | 0 |
| 26 | 10000100010100 | 0 | 10000100010100 | 0 |
| 27 | 10000100101000 | 0 | 10000100101000 | 0 |
| 28 | 10001000010010 | 0 | 10001000010010 | 0 |
| 29 | 10001010010000 | 0 | 10001010010000 | 0 |
| 2A | 10010000100010 | 0 | 10010000100010 | 0 |
| 2B | 10010100010000 | 0 | 10010100010000 | 0 |
| 2C | 10100010000100 | 0 | 10100010000100 | 0 |
| 2D | 10100100001000 | 0 | 10100100001000 | 0 |
| 2E | 10010000101010 | 0 | 10010000101010 | 0 |
| 2F | 10010101000010 | 0 | 10010101000010 | 0 |
| 30 | 10100001001010 | 0 | 10100001001010 | 0 |
| 31 | 10100001010100 | 0 | 10100001010100 | 0 |
| 32 | 10101001000010 | 0 | 10101001000010 | 0 |
| 33 | 10101010000100 | 0 | 10101010000100 | 0 |
| 34 | 01000010001010 | 0 | 01000010001010 | 0 |
| 35 | 01000010010100 | 0 | 01000010010100 | 0 |
| 36 | 01000010101000 | 0 | 01000010101000 | 0 |
| 37 | 01010001000010 | 0 | 01010001000010 | 0 |
| 38 | 01010100001000 | 0 | 01010100001000 | 0 |
| 39 | 10000100001010 | 0 | 10000100001010 | 0 |
| 3A | 10000101010000 | 0 | 10000101010000 | 0 |
| 3B | 10100001000010 | 0 | 10100001000010 | 0 |
| 3C | 10101000010000 | 0 | 10101000010000 | 0 |
| 3D | 01000100000100 | 0 | 01000100000100 | |
| 3E | 01001000001000 | 0 | 01001000001000 | 0 |
| 3F | 01000010000010 | 0 | 01000010000010 | 0 |
| 40 | 01010000010000 | 0 | 01010000010000 | 0 |
| 41 | 10001000000100 | 0 | 10001000000100 | 0 |
| 42 | 10010000001000 | 0 | 10010000001000 | 0 |
| 43 | 10000100000010 | 0 | 10000100000010 | 0 |
| 44 | 10100000010000 | 0 | 10100000010000 | 0 |
| 45 | 01001001010100 | 2 | 00010100100100 | −4 |
| 46 | 01001010100100 | 2 | 00100100010100 | −4 |
| 47 | 01010100100100 | 2 | 00101000100100 | −4 |
| 48 | 10001001010010 | 2 | 01001000101000 | −4 |
| 49 | 10010010010010 | 2 | 01010010010000 | −4 |
| 4A | 10000100100010 | 4 | 00010101010010 | −2 |
| 4B | 00100010010000 | 4 | 00101010100010 | −2 |
| 4C | 10000010000100 | 4 | 01010010100010 | −2 |
| 4D | 01010100001010 | 4 | 00001000101010 | −2 |
| 4E | 10000101010010 | 4 | 00010001010100 | −2 |
| 4F | 10100101010000 | 4 | 00010101000100 | −2 |
| 50 | 10100100010010 | 2 | 00001010010010 | −4 |
| 51 | 10100101001000 | 2 | 00100100001010 | −4 |
| 52 | 10000100010010 | 2 | 00101000010010 | −4 |
| 53 | 00010001001000 | 2 | 01001001010000 | −4 |
| 54 | 00100100010000 | 2 | 10010000101000 | −4 |
| 55 | 10101000101010 | 2 | 10100001001000 | −4 |
| 56 | 01000101000010 | 4 | 00101000100010 | −2 |
| 57 | 10000101000100 | 4 | 01000100010100 | −2 |
| 58 | 10001010000100 | 4 | 01001000010010 | −2 |
| 59 | 00100010101010 | 2 | 00001010000100 | −4 |
| 5A | 00010001010000 | 4 | 01010001000100 | −2 |
| 5B | 01000010001000 | 4 | 10001000101000 | −2 |
| 5C | 00101010001010 | 2 | 01001000001010 | −4 |

| Data | Group A (Positive) | | Group B (Negative) | |
|---|---|---|---|---|
| | Code | CDS | Code | CDS |
| 5D | 01000100101010 | 2 | 10010000010100 | −4 |
| 5E | 01000001010010 | 4 | 10010010010000 | −2 |
| 5F | 10000001001010 | 4 | 00001000100010 | −2 |
| 60 | 10010010000010 | 4 | 00010010000100 | −2 |
| 61 | 01010010001010 | 2 | 00010010000010 | −4 |
| 62 | 00010000010100 | 4 | 00010000010000 | −2 |
| 63 | 01000001000100 | 4 | 01010000101010 | −2 |
| 64 | 01010100010010 | 2 | 10010000001010 | −4 |
| 65 | 10001010100010 | 2 | 00100100000010 | −4 |
| 66 | 10010100100010 | 2 | 01001000000010 | −4 |
| 67 | 10100010001010 | 2 | 10010000000010 | −4 |
| 68 | 10100010101000 | 2 | 00010100010100 | −6 |
| 69 | 10101010001000 | 2 | 00101000101000 | −6 |
| 6A | 10001010001010 | 6 | 10100101000010 | −2 |
| 6B | 01000100100010 | 2 | 00001010010100 | −6 |
| 6C | 10000010001010 | 2 | 00010100001010 | −6 |
| 6D | 10001000100010 | 2 | 00101000010100 | −6 |
| 6E | 10010010000100 | 2 | 01010000101000 | −6 |
| 6F | 00010000100100 | 2 | 10100001010000 | −6 |
| 70 | 10001010101000 | 6 | 01000100001010 | −2 |
| 71 | 10010100101000 | 6 | 01010000100010 | −2 |
| 72 | 10000010001000 | 6 | 10001001010000 | −2 |
| 73 | 10000101010100 | 6 | 10100001000100 | −2 |
| 74 | 10010101010000 | 6 | 00010001000010 | −2 |
| 75 | 10101001010000 | 6 | 00100100000100 | −2 |
| 76 | 00100001010000 | 6 | 10101010000010 | −2 |
| 77 | 00100001000100 | 2 | 01010000010100 | −6 |
| 78 | 01000010010000 | 6 | 10001000001010 | −2 |
| 79 | 01001000010000 | 2 | 00001010000010 | −6 |
| 7A | 10101000001010 | 6 | 00101000001000 | −2 |
| 7B | 10001000001000 | 2 | 01010000001010 | −6 |
| 7C | 00100101000010 | 2 | 00010100000010 | −6 |
| 7D | 00100000101000 | 6 | 01010000001000 | −2 |
| 7E | 01000010010010 | 2 | 10100000001010 | −6 |
| 7F | 10000000100010 | 6 | 10001000000010 | −2 |
| 80 | 01001001000010 | 2 | 01010000000010 | −6 |
| 81 | 01000010100100 | 2 | 00101000000010 | −6 |
| 82 | 01000001001000 | 6 | 10010000000100 | −2 |
| 83 | 10001010000010 | 6 | 01000100000010 | −2 |
| 84 | 00100001010010 | 2 | 10100000010100 | −6 |
| 85 | 10000010100010 | 6 | 01001000000100 | −2 |
| 86 | 10000010101010 | 6 | 00100010000010 | −2 |
| 87 | 10000001000100 | 6 | 10100000100010 | −2 |
| 88 | 01000100001000 | 2 | 10100000101000 | −6 |
| 89 | 00010010010000 | 2 | 00101000001010 | −6 |
| 8A | 10000101000010 | 6 | 10100000101010 | −2 |
| 8B | 10101000010100 | 6 | 00010100001000 | −2 |

| Data | Group A (Positive) | | Group B (Negative) | |
|---|---|---|---|---|
| | Code | CDS | Code | CDS |
| 8C | 10010100001010 | 6 | 00001010001000 | −2 |
| 8D | 10000101001010 | 6 | 10010000010010 | −2 |
| 8E | 10101000101000 | 6 | 10001000010100 | −2 |
| 8F | 10010100010100 | 6 | 01000101010000 | −2 |
| 90 | 10001010010100 | 6 | 00001010100010 | −2 |
| 91 | 00001000101000 | 2 | 01010001010000 | −6 |
| 92 | 10001010001000 | 2 | 00101001010000 | −6 |
| 93 | 10000100100100 | 2 | 00010101010000 | −6 |
| 94 | 01000101000100 | 2 | 00001010101000 | −6 |
| 95 | 00100010100010 | 2 | 00001010001010 | −6 |
| 96 | 10000100010000 | 6 | 10100001010010 | −2 |
| 97 | 10101000100010 | 2 | 00010100101000 | −6 |
| 98 | 10100010010100 | 2 | 10100000000100 | −4 |
| 99 | 10010101000100 | 2 | 01010000000100 | −4 |
| 9A | 10010001010100 | 2 | 00101000000100 | −4 |
| 9B | 10001000101010 | 2 | 10100000010010 | −4 |
| 9C | 10000000010000 | 4 | 01010101000010 | −2 |
| 9D | 00100000010010 | 4 | 00001010101010 | −2 |
| 9E | 01010010101000 | 2 | 00010100000100 | −4 |
| 9F | 10010100000100 | 4 | 00001000001000 | −2 |
| A0 | 10000010100100 | 4 | 00001001000100 | −2 |
| A1 | 01001010000010 | 4 | 10100010001000 | −2 |
| A2 | 01000101010010 | 2 | 10100000100100 | −4 |
| A3 | 00101010101000 | 2 | 01010000010010 | −4 |
| A4 | 10000001000010 | 4 | 10010000100100 | −2 |
| A5 | 00100000100100 | 4 | 01010100010000 | −2 |
| A6 | 00010000101000 | 4 | 01001010010000 | −2 |
| A7 | 10101010100010 | 2 | 00001001000010 | −4 |
| A8 | 10001001000010 | 4 | 01000100101000 | −2 |
| A9 | 10000010010010 | 4 | 00101010001000 | −2 |
| AA | 01000010100010 | 4 | 00100010101000 | −2 |
| AB | 10001010101010 | 2 | 10010001010000 | −4 |
| AC | 00100010001000 | 2 | 01010000100100 | −4 |
| AD | 10001001000100 | 2 | 01001000010100 | −4 |
| AE | 10101001000100 | 2 | 00100101010000 | −4 |
| AF | 10100100100100 | 2 | 00001010100100 | −4 |
| B0 | 10101000010010 | 4 | 00100010001010 | −2 |
| B1 | 10100100001010 | 4 | 00010100100010 | −2 |
| B2 | 01010101010000 | 4 | 00001001010010 | −2 |
| B3 | 01000010101010 | 4 | 10100010100010 | −2 |
| B4 | 01000100010000 | 4 | 01010001010010 | −2 |
| B5 | 00100001001000 | 4 | 00101000101010 | −2 |
| B6 | 10010010100100 | 2 | 10100010010000 | −4 |
| B7 | 10010001001010 | 2 | 01010001001000 | −4 |
| B8 | 01010101001000 | 2 | 00101010010000 | −4 |
| B9 | 01010010010100 | 2 | 00100100101000 | −4 |
| BA | 01001010010010 | 2 | 00010101001000 | −4 |

| Data | Group A (Positive) | | Group B (Negative) | |
|---|---|---|---|---|
| | Code | CDS | Code | CDS |
| BB | 01001001001010 | 2 | 00010100010010 | −4 |
| BC | 00101010010100 | 2 | 00010010101000 | −4 |
| BD | 00100101010100 | 2 | 00010010001010 | −4 |
| BE | 00100101001010 | 2 | 00001001010100 | −4 |
| BF | 10101001010010 | 2 | 00001001001010 | −4 |
| C0 | 10101010010000 | 4 | 00010100101010 | −2 |
| C1 | 10101000100100 | 4 | 10101010101000 | −2 |
| C2 | 10100100101000 | 4 | 10101010001010 | −2 |
| C3 | 10100100010100 | 4 | 10100010101010 | −2 |
| C4 | 10010100010010 | 4 | 10100100010000 | −2 |
| C5 | 10010010101000 | 4 | 10010001001000 | −2 |
| C6 | 10010010001010 | 4 | 01010010001000 | −2 |
| C7 | 10001010100100 | 4 | 01001001001000 | −2 |
| C8 | 10001010010010 | 4 | 01001000100100 | −2 |
| C9 | 10000100101010 | 4 | 00101001000100 | −2 |
| CA | 01010100101000 | 4 | 00100101001000 | −2 |
| CB | 01010100010100 | 4 | 00100100010010 | −2 |
| CC | 01001010101000 | 4 | 00100010010100 | −2 |
| CD | 01001010001010 | 4 | 00010010100100 | −2 |
| CE | 01000101010100 | 4 | 00010010010010 | −2 |
| CF | 01000101001010 | 4 | 00010001001010 | −2 |
| D0 | 10001000010000 | 4 | 00101001010010 | −2 |
| D1 | 10000100001000 | 4 | 10101010010100 | −2 |
| D2 | 10010101010010 | 2 | 00101001001000 | −4 |
| D3 | 10010100101010 | 2 | 00010010010100 | −4 |
| D4 | 10101001001000 | 4 | 10100101010100 | −2 |
| D5 | 10010101001000 | 4 | 10100101001010 | −2 |
| D6 | 10010100100100 | 4 | 01010101010100 | −2 |
| D7 | 10010010010100 | 4 | 01010101001010 | −2 |
| D8 | 10001001010100 | 4 | 01010010101010 | −2 |
| D9 | 10001001001010 | 4 | 00101010101010 | −2 |
| DA | 01001010010100 | 4 | 00100100100100 | −2 |
| DB | 10101010101010 | 2 | 00001000010000 | −4 |
| DC | 00100000010000 | 0 | 00100000010000 | 0 |
| DD | 00001000000100 | 0 | 00001000000100 | 0 |
| DE | 00010000001000 | 0 | 00010000001000 | 0 |
| DF | 00101000010000 | 0 | 00101000010000 | 0 |
| E0 | 00100001000010 | 0 | 00100001000010 | 0 |
| E1 | 00001010010000 | 0 | 00001010010000 | 0 |
| E2 | 00101010000100 | 0 | 00101010000100 | 0 |
| E3 | 00101001000010 | 0 | 00101001000010 | 0 |
| E4 | 00100001010100 | 0 | 00100001010100 | 0 |
| E5 | 00010101000010 | 0 | 00010101000010 | 0 |
| E6 | 00010000101010 | 0 | 00010000101010 | 0 |
| E7 | 00100100001000 | 0 | 00100100001000 | 0 |
| E8 | 00100010000100 | 0 | 00100010000100 | 0 |
| E9 | 00010100010000 | 0 | 00010100010000 | 0 |

| Data | Group A (Positive) | | Group B (Negative) | |
|---|---|---|---|---|
| | Code | CDS | Code | CDS |
| EA | 00010000100010 | 0 | 00010000100010 | 0 |
| EB | 00001001001000 | 0 | 00001001001000 | 0 |
| EC | 00001000010010 | 0 | 00001000010010 | 0 |
| ED | 00100101000100 | 0 | 00100101000100 | 0 |
| EE | 00100100100010 | 0 | 00100100100010 | 0 |
| EF | 00100010100100 | 0 | 00100010100100 | 0 |
| F0 | 00100001001010 | 0 | 00100001001010 | 0 |
| F1 | 00010010100010 | 0 | 00010010100010 | 0 |
| F2 | 00010001010010 | 0 | 00010001010010 | 0 |
| F3 | 00010101010100 | 0 | 00010101010100 | 0 |
| F4 | 00010101001010 | 0 | 00010101001010 | 0 |
| F5 | 00010010001000 | 0 | 00010010001000 | 0 |
| F6 | 00010001000100 | 0 | 00010001000100 | 0 |
| F7 | 00001000100100 | 0 | 00001000100100 | 0 |
| F8 | 00100010010010 | 0 | 00100010010010 | 0 |
| F9 | 00101010100100 | 0 | 00101010100100 | 0 |
| FA | 00101010010010 | 0 | 00101010010010 | 0 |
| FB | 00101001010100 | 0 | 00101001010100 | 0 |
| FC | 00101001001010 | 0 | 00101001001010 | 0 |
| FD | 00100101010010 | 0 | 00100101010010 | 0 |
| FE | 00100100101010 | 0 | 00100100101010 | 0 |
| FF | 00010010101010 | 0 | 00010010101010 | 0 |

## **Annex A** (informative)
## **Bibliography**

ANSI/SMPTE 251M-1996, Television Analog Recording — 1/2-in Type M-2 — Electrical Parameters of Video, Audio, Time and Control Code and Tracking Control

SMPTE RP 158-1991 (R1995), Basic System and Transport Geometry Parameters for 1/2-in Type M-2 Format