

Standards and Recommended Practices

Proposed SMPTE Standard

A Proposed SMPTE Standard is published here for a trial period and public review: SMPTE 299M, Television — 24-Bit Digital Audio Format for HDTV Bit-Serial Interface. The proposal will be submitted to the American National Standards Institute if no adverse comments are received from publication. Comments should be addressed to Carlos V. Girod, Jr., Director of Engineering, at Society Headquarters prior to October 1, 1996. SMPTE 299M is available from Society Headquarters for \$18.00.

Proposed SMPTE Engineering Guideline

Published here for a trial period and public review is EG 32, Emphasis of AES/EBU Audio in Television Systems and Preferred Audio Sampling Rate. Comments should be forwarded to Carlos V. Girod, Jr., Director of Engineering, prior to October 1, 1996. The proposal may be obtained from Headquarters for \$10.00.

Approved American National Standards

The American National Standards Institute recently approved four American National Standards: ANSI/SMPTE 18M-1996, Television Analog Recording — 1-in Type C — Basic System and Transport Geometry Parameters; ANSI/SMPTE 19M-1996, Television Analog Recording — 1-in Type C — Records; ANSI/SMPTE 20M-1996, Television Analog Recording — 1-in Type C Recorders and Reproducers — Longitudinal Audio Characteristics; and ANSI/SMPTE 292M-1996, Television — Bit-Serial Digital Interface for High-Definition Television Systems. ANSI/SMPTE 18M, 19M, and 20M are available from Headquarters for \$10.00 each and ANSI/SMPTE 292M for \$16.00.

— *Carlos V. Girod, Jr., P.E.,
Director of Engineering*

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PROPOSED SMPTE STANDARD

for Television — 24-Bit Digital Audio Format for HDTV Bit-Serial Interface

SMPTE 299M

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1 Scope

1.1 This standard defines the mapping of 24-bit AES digital audio data and associated control information into ancillary data space of a serial digital video conforming to ANSI/SMPTE 292M. The audio data are derived from ANSI S4.40, hereafter referred to as AES audio.

1.2 Audio signal, sampled at a clock frequency of 48 kHz locked (synchronous) to video, is the preferred implementation for intrastudio applications. As an option, this standard supports AES audio at synchronous or asynchronous sampling rates from 32 kHz to 48 kHz.

1.3 The number of transmitted audio channels ranges from a minimum of two audio channels to a maximum of 16 audio channels. Audio channels are transmitted in pairs, and where appropriate, in groups of four. Each group is identified by a unique ancillary data ID.

1.4 Audio data packets are multiplexed into the horizontal ancillary data space of the C_b/C_r parallel data stream, and audio control packets are multiplexed into the horizontal ancillary data space of the Y parallel data stream.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions referenced 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 editions of the documents indicated below.

ANSI S4.40-1992, Digital Audio Engineering — Serial Transmission Format for Two-Channel Linearly Represented Digital Audio Data (AES-3)

SMPTE 260M-1992, Television — Digital Representation and Bit-Parallel Interface — 1125/60 High-Definition Production System

ANSI/SMPTE 272M-1994, Television — Formatting AES/EBU Audio and Auxiliary Data into Digital Video Ancillary Data Space

ANSI/SMPTE 274M-1995, Television — 1920 × 1080 Scanning and Interface

ANSI/SMPTE 291M-1996, Television — Ancillary Data Packet and Space Formatting

ANSI/SMPTE 292M-1996, Television — Bit-Serial Digital Interface for High-Definition Television Systems

SMPTE 296M, Television — 1280 × 720 Scanning, Analog and Digital Representation and Analog Interface

3 Definition of terms

3.1 **AES audio:** All the data, audio and auxiliary, associated with one AES digital stream as defined in ANSI S4.40.

3.2 **AES frame:** Two AES subframes, one with audio data for channel 1 followed by one with audio data for channel 2.

3.3 **AES subframe:** All data associated with one AES audio sample for one channel in a channel pair.

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3.4 **audio clock phase data:** Audio clock phase is indicated by the number of video clocks between the first word of EAV and the video sample appearing at the same time as the audio sample at the input to the formatter.

3.5 **audio control packet:** An ancillary data packet occurring once a field and containing data used in the process of decoding the audio data stream.

3.6 **audio data:** 29 bits: 24 bits of AES audio associated with one audio sample, including AES auxiliary data, plus sample validity bit (V), channel status bit (C), user data bit (U), even parity bit (P), and Z flag which is derived from the preamble of the AES-3 stream. The Z bit is common to two channels of AES channel pair.

3.7 **audio data packet:** An ancillary data packet containing audio clock phase data, audio data for 2 channel pairs (4 channels), and error correction code. An audio data packet shall contain audio data of one sample associated with each audio channel.

3.8 **audio frame number:** A number, starting at 1, for each frame within the audio frame sequence. For the example in 3.9, 48-kHz sampling at 30.00/1.001 frames/s system, the frame numbers would be 1, 2, 3, 4, and 5.

3.9 **audio frame sequence:** The number of video frames required for an integer number of audio samples in synchronous operation. As an example, the audio frame sequence for synchronous 48-kHz sampling at 30.00/1.001 frames/s system is 5 frames.

3.10 **audio group:** Consists of two channel pairs which are contained in one ancillary data packet. Each audio group has a unique ID as defined in 5.1 and 6.1. Audio groups are numbered 1 through 4.

3.11 **auxiliary data:** Four bits of data associated with one AES audio sample defined as auxiliary data by ANSI S4.40. The four bits may be used to extend the resolution of the audio sample.

3.12 **channel pair:** Two digital audio channels, derived from the same AES audio source.

3.13 **data ID:** A word in the ancillary data packet which identifies the use of the data therein.

3.14 **error correction code:** BCH (31, 25) code (an error-correction method) in each bit sequence of b0-b7. Errors between the first word of ancillary data flag (ADF) through the last word of audio data of channel 4 (CH4) in user data words (UDW) will be corrected or detected within the capability of this code.

3.15 **horizontal ancillary data block:** An ancillary data space in the digital line blanking interval of one television line.

3.16 **synchronous audio:** Audio is defined as being clock synchronous with video if the sampling rate of audio is such that the number of audio samples occurring within an integer number of video frames is itself a constant integer number, shown in the following example:

Audio sampling rate	Samples/frame	
	30.00 frame/s	30.00/1.001 frame/s
48.0 kHz	1600/1	8008/5
44.1 kHz	1470/1	147147/100
32.0 kHz	3200/3	16016/15

4 Overview

4.1 Audio data derived from two channel pairs are configured in an audio data packet as shown in figure 1. Both channels of a channel pair are derived from the same AES audio source. The number of samples per channel used for one audio data packet is constant and is equal to one. The number of audio data packets in a given group is 0, 1, or 2 in a horizontal ancillary data block.

4.2 Two types of ancillary data packets carrying AES audio information are defined and formatted per ANSI/SMPTE 292M. Each audio data packet carries all of the information in the AES bit stream as defined by ANSI S4.40. The audio data packet is located in the horizontal ancillary data space of the C_b/C_r parallel data stream. An audio control packet is transmitted once per field in the horizontal ancillary data space of the second line after the switching point of the Y parallel data stream.

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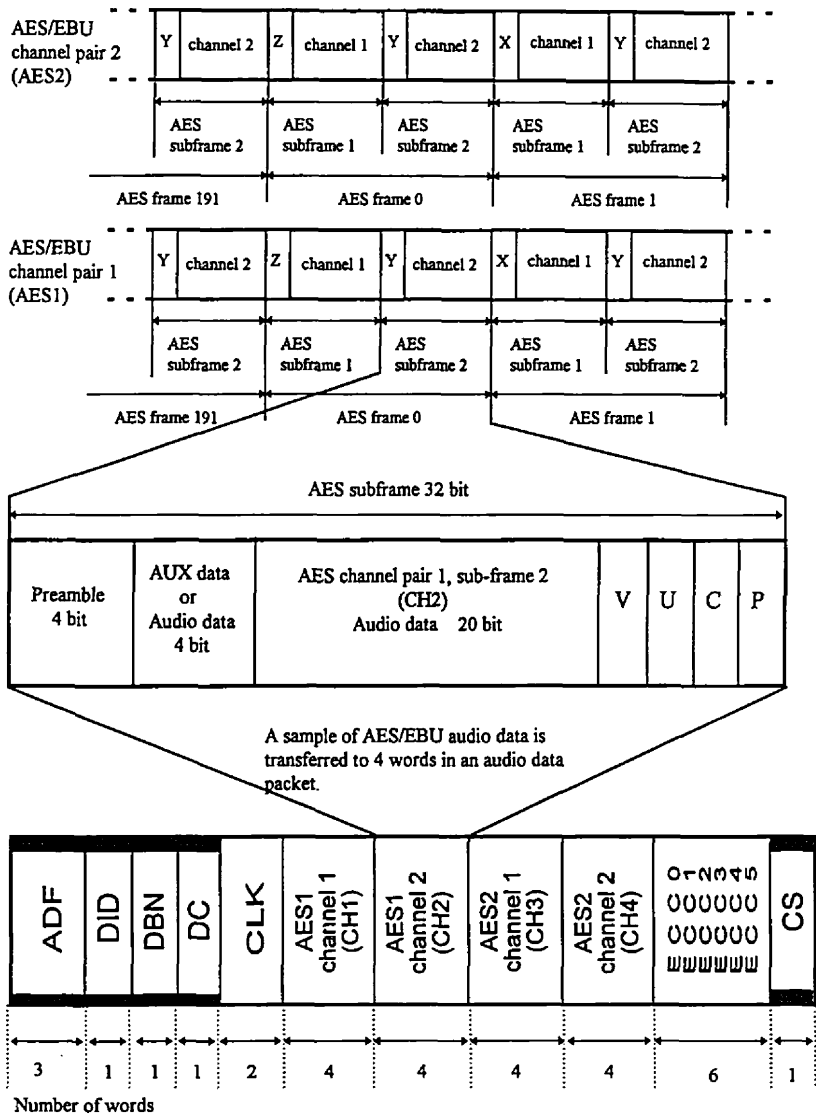


Figure 1 – Relationship between AES/EBU audio and audio data packet

4.3 Data ID are defined for four separate packets of each packet type. This allows for up to eight channel pairs. In this standard, the audio groups are numbered 1 through 4 and the channels are numbered 1 through 4 and the channels are numbered 1 through 4. Channels 1 through 4 are in group 1, channels 5 through 8 are in group 2, and so on.

5 Audio data packet

5.1 Structure of audio data packet

5.1.1 The structure of the audio data packet shall be as shown in figure 2. Audio data packets consist of ancillary data flag (ADF), data identification (DID), data block number (DBN), data count (DC), user data words (UDW), and checksum (CS). ADF, DBN, DC, and CS are subject to ANSI/SMPTE 291M. DC is always 218h.

5.1.2 DID is defined as 2E7h for audio group 1 (channel 1-4), 1E6h for audio group 2 (channel 5-8), 1E5h for audio group 3 (channel 9-12),

and 2E4h for audio group 4 (channel 13-16), respectively.

5.1.3 UDW is defined in 5.2. In this standard, UDWx means the xth user data word. There are always 24 words in the UDW of an audio data packet; i.e., UDW0, UDW1 ... UDW22, UDW23.

5.1.4 All audio channels in a given audio group shall have identical sampling rate, identical sampling phase, and identical synchronous/asynchronous status.

5.1.5 For a given audio data packet, one sample of the audio data of each channel (CH1-CH4) is always transmitted. Even when only one of the four channels (CH1-CH4) is active, all audio data of the 4 channels shall be transmitted. In such case, the value of audio data, V, U, C, and P bits of all inactive channels shall be set to zero.

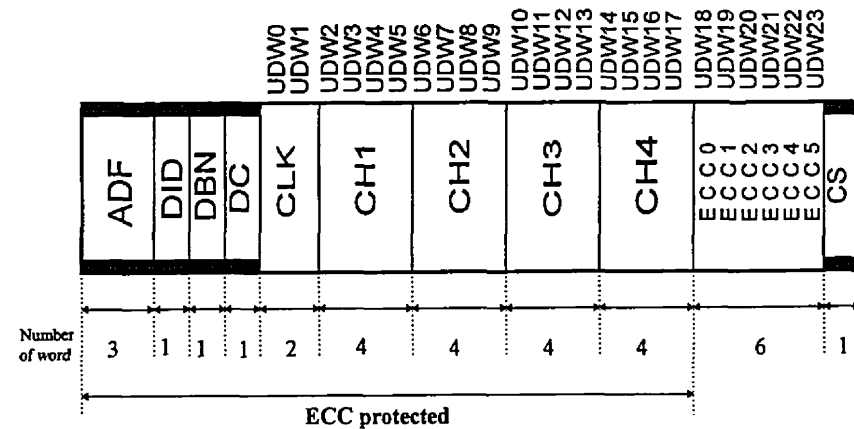


Figure 2 – Structure of audio data packet

5.2 Structure of user data words (UDW)

UDW consists of three kinds of data defined in 5.2.1 ~ 5.2.3. The description in this clause covers only audio group 1. The description for audio groups 2, 3, and 4 is similar to that for audio group 1 where channels 5, 9, and 13 correspond to channel 1; channels 6, 10, and 14 correspond to channel 2; channels 7, 11, and 15 correspond to channel 3; and channels 8, 12, and 16 correspond to channel 4, respectively.

5.2.1 CLK (audio clock phase data)

CLK is used to regenerate the audio sampling clock at the receiving side, especially for asynchronous audio. Bit assignment of CLK shall be as shown in table 1.

5.2.1.2 Bits of ck0 to ck11 indicate the number of video clocks between the first word of EAV and the video sample at the same time that the audio sample appears at the input of the formatter. For example, the value of ck0-11 is in the range of 0 to 2199 for all HDTV systems that use 74.25 MHz or 74.25/1.001 MHz clocks covered by ANSI/SMPTE 292M. The relationship among video, sampling instants of digital audio, and audio clock phase data is shown in figure 3A (30.00 Hz frame rate) and figure 3B (30.00/1.001 Hz frame rate).

5.2.1.3 The formatter places the audio data packet in the horizontal ancillary space following

the video line during which the audio sample occurred. Following a switching point, the audio data packet is delayed one additional line to prevent data corruption.

Flag bit ck12 defines the audio data packet position in the multiplexed output stream relative to the associated video data.

When bit ck12 = 0, it indicates that the audio data packet is located immediately after the video line during which the audio sample occurred.

When bit ck12 = 1, it indicates that the audio data packet is located in the second line following the video line during which the audio sample occurred.

The relationship between the multiplex position flag (ck12) and the multiplex position of the audio data packet is shown in figure 4.

5.2.2 CHn (audio data)

5.2.2.1 Bit assignment of CHn (n = 1-4) shall be as shown in table 2. All bits of an AES subframe are transferred transparently to four consecutive UDW words (UDW4n-2, UDW4n-1, UDW4n, UDW4n+1). UDW2 through UDW17 are always used for CHn in audio data packets.

5.2.2.2 Bit 3 of UDW2 and UDW10 indicates the status of the Z flag which corresponds to the AES block sync. The Z bit in UDW2 is for CH1 and CH2, and in UDW10 for CH3 and CH4, respectively.

Table 1 – Bit assignment of CLK

Bit number	UDW0	UDW1
b9 (MSB)	Not b8	Not b8
b8	Even parity ¹⁾	Even parity ¹⁾
b7	ck7 audio clock phase data	0
b6	ck6 audio clock phase data	0
b5	ck5 audio clock phase data	0
b4	ck4 audio clock phase data	ck12 multiplex position flag
b3	ck3 audio clock phase data	ck11 audio clock phase data (MSB)
b2	ck2 audio clock phase data	ck10 audio clock phase data
b1	ck1 audio clock phase data	ck9 audio clock phase data
b0 (LSB)	ck0 audio clock phase data (LSB)	ck8 audio clock phase data

¹⁾ Even parity for b0 through b7.

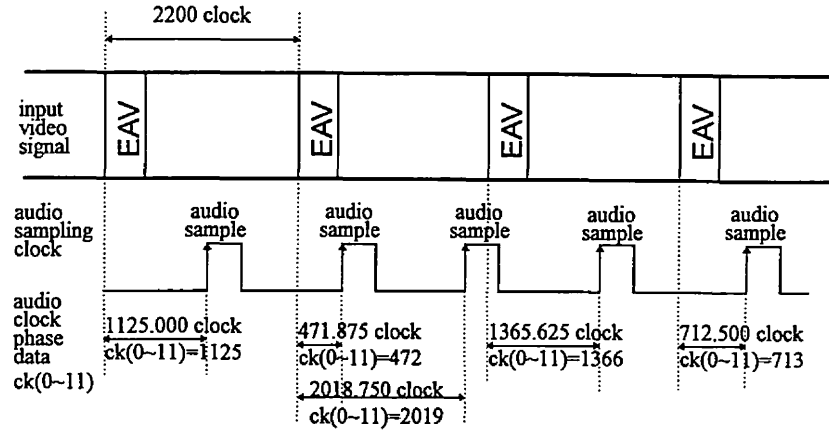


Figure 3A – Relationship among video, sampling instants of digital audio, and audio clock phase data (48-kHz audio sampling rate and 30.00-Hz video frame rate)

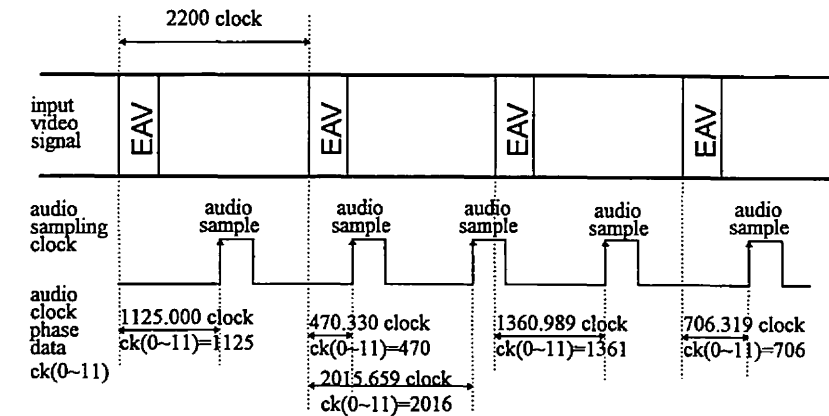
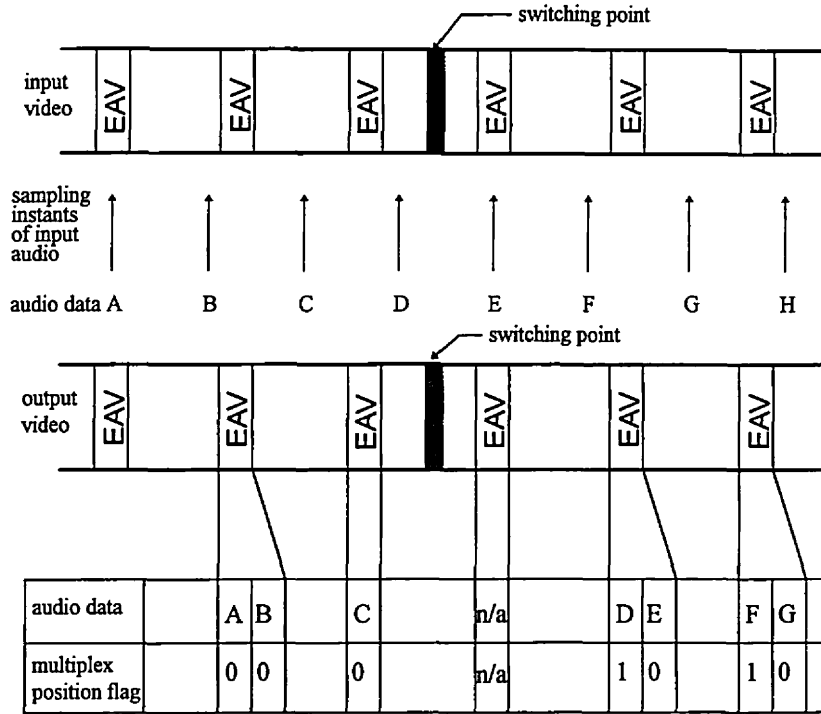


Figure 3B – Relationship among video, sampling instants of digital audio, and audio clock phase data (48-kHz audio sampling rate and 30.00/1.001-Hz video frame rate)



NOTES

- 1 For example sample A, B, C, E, and G, ck12 = 0 because the ancillary data packet is multiplexed in the horizontal ancillary data space of the next line relative to input timing of the audio sample.
- 2 N/A shows that the line subsequent to switching point precludes the insertion of ancillary data packets.
- 3 For example sample D and F, ck12 = 1 because the ancillary data packet is multiplexed in the horizontal ancillary data space of the second line relative to input timing of the audio sample.

Figure 4 – Relationship between multiplex position flag (ck12) and multiplex position of audio data packet

Table 2 – Bit assignment of audio data (CHn)

Bit number	UDW2	UDW3	UDW4	UDW5	
CH1	b9 (MSB)	Not b8	Not b8	Not b8	Not b8
	b8	Even parity ¹	Even parity ¹	Even parity ¹	Even parity ¹
	b7	aud ₁ 3	aud ₁ 11	aud ₁ 19	P ₁
	b6	aud ₁ 2	aud ₁ 10	aud ₁ 18	C ₁
	b5	aud ₁ 1	aud ₁ 9	aud ₁ 17	U ₁
	b4	aud ₁ 0 (LSB)	aud ₁ 8	aud ₁ 16	V ₁
	b3	Z	aud ₁ 7	aud ₁ 15	aud ₁ 23 (MSB)
	b2	0	aud ₁ 6	aud ₁ 14	aud ₁ 22
	b1	0	aud ₁ 5	aud ₁ 13	aud ₁ 21
	b0 (LSB)	0	aud ₁ 4	aud ₁ 12	aud ₁ 20
Bit number	UDW6	UDW7	UDW8	UDW9	
CH2	b9 (MSB)	Not b8	Not b8	Not b8	Not b8
	b8	Even parity ¹	Even parity ¹	Even parity ¹	Even parity ¹
	b7	aud ₂ 3	aud ₂ 11	aud ₂ 19	P ₂
	b6	aud ₂ 2	aud ₂ 10	aud ₂ 18	C ₂
	b5	aud ₂ 1	aud ₂ 9	aud ₂ 17	U ₂
	b4	aud ₂ 0 (LSB)	aud ₂ 8	aud ₂ 16	V ₂
	b3	0	aud ₂ 7	aud ₂ 15	aud ₂ 23 (MSB)
	b2	0	aud ₂ 6	aud ₂ 14	aud ₂ 22
	b1	0	aud ₂ 5	aud ₂ 13	aud ₂ 21
	b0 (LSB)	0	aud ₂ 4	aud ₂ 12	aud ₂ 20
Bit number	UDW10	UDW11	UDW12	UDW13	
CH3	b9 (MSB)	Not b8	Not b8	Not b8	Not b8
	b8	Even parity ¹	Even parity ¹	Even parity ¹	Even parity ¹
	b7	aud ₃ 3	aud ₃ 11	aud ₃ 19	P ₃
	b6	aud ₃ 2	aud ₃ 10	aud ₃ 18	C ₃
	b5	aud ₃ 1	aud ₃ 9	aud ₃ 17	U ₃
	b4	aud ₃ 0 (LSB)	aud ₃ 8	aud ₃ 16	V ₃
	b3	Z	aud ₃ 7	aud ₃ 15	aud ₃ 23 (MSB)
	b2	0	aud ₃ 6	aud ₃ 14	aud ₃ 22
	b1	0	aud ₃ 5	aud ₃ 13	aud ₃ 21
	b0 (LSB)	0	aud ₃ 4	aud ₃ 12	aud ₃ 20
Bit number	UDW14	UDW15	UDW16	UDW17	
CH4	b9 (MSB)	Not b8	Not b8	Not b8	Not b8
	b8	Even parity ¹	Even parity ¹	Even parity ¹	Even parity ¹
	b7	aud ₄ 3	aud ₄ 11	aud ₄ 19	P ₄
	b6	aud ₄ 2	aud ₄ 10	aud ₄ 18	C ₄
	b5	aud ₄ 1	aud ₄ 9	aud ₄ 17	U ₄
	b4	aud ₄ 0 (LSB)	aud ₄ 8	aud ₄ 16	V ₄
	b3	0	aud ₄ 7	aud ₄ 15	aud ₄ 23 (MSB)
	b2	0	aud ₄ 6	aud ₄ 14	aud ₄ 22
	b1	0	aud ₄ 5	aud ₄ 13	aud ₄ 21
	b0 (LSB)	0	aud ₄ 4	aud ₄ 12	aud ₄ 20

NOTES

- 1 Even parity for b0 through b7.
- 2 Z = AES block sync.
- 3 Un = AES user bit of CHn.
- 4 Pn = AES parity bit of CHn.
- 5 aud(0-23) = 24-bit AES audio data of CHn.
- 6 Vn = AES sample validity bit of CHn.
- 7 Cn = AES channel status bit of CHn.
- 8 The value of Vn, Un, Cn, and Pn is equal to that of AES subframe, respectively.

5.2.2.3 Bits b0 through b2 in UDW2, UDW6, UDW10, and UDW14, and bit b3 of UDW6 and UDW14 are set to zero.

5.2.3 ECC (Error correction codes)

5.2.3.1 ECC are used to correct or detect errors in 24 words from the first word of ADF through UDW17. The error correction code is BCH(31,25) code. The BCH code is formed for each bit sequence of b0-b7, respectively. ECC consists of six words determined by the polynomial generator equation:

$$ECC(X) = (X+1)(X^5+X^2+1) = X^6+X^5+X^3+X^2+X+1$$

The initial value of all FFn is set to zero. The calculation starts at the first word of ADF and ends at the final word of CH4 (UDW17) for each bit of b0 to b7, respectively. The remaining data in the FFn is ECCn (n = 0-5). (FFn stands for flip flop number. For example, the data of FF0 is ECC0; the data of FF5 is ECC5.)

5.2.3.2 Bit assignment of ECC shall be as shown in table 3. An example of the block diagram of the BCH-code information circuit is shown in figure 5.

Table 3 – Bit assignment of ECC

Bit number	UDW18	UDW19	UDW20	UDW21	UDW22	UDW23
	ECC0	ECC1	ECC2	ECC3	ECC4	ECC5
b9 (MSB)	Not b8	Not b8	Not b8	Not b8	Not b8	Not b8
b8	Even parity ¹⁾	Even parity ¹⁾	Even parity ¹⁾	Even parity ¹⁾	Even parity ¹⁾	Even parity ¹⁾
b7	ecc0 7	ecc1 7	ecc2 7	ecc3 7	ecc4 7	ecc5 7
b6	ecc0 6	ecc1 6	ecc2 6	ecc3 6	ecc4 6	ecc5 6
b5	ecc0 5	ecc1 5	ecc2 5	ecc3 5	ecc4 5	ecc5 5
b4	ecc0 4	ecc1 4	ecc2 4	ecc3 4	ecc4 4	ecc5 4
b3	ecc0 3	ecc1 3	ecc2 3	ecc3 3	ecc4 3	ecc5 3
b2	ecc0 2	ecc1 2	ecc2 2	ecc3 2	ecc4 2	ecc5 2
b1	ecc0 1	ecc1 1	ecc2 1	ecc3 1	ecc4 1	ecc5 1
b0 (LSB)	ecc0 0	ecc1 0	ecc2 0	ecc3 0	ecc4 0	ecc5 0

¹⁾ Even parity for b0 through b7.

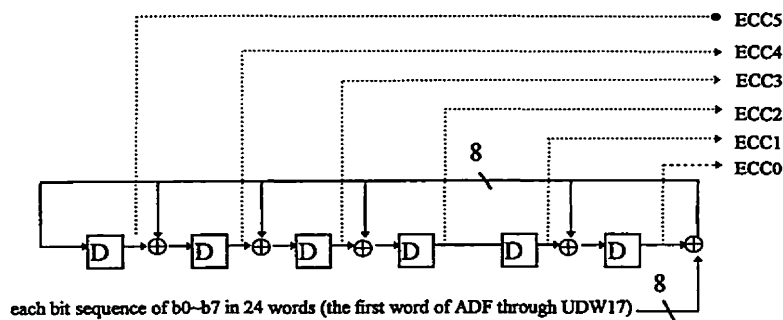


Figure 5 – Example of block diagram of the BCH-code formation circuitry

5.3 Multiplexing of audio data packet

5.3.1 Only the horizontal ancillary data space of the color-difference data stream (Cb/Cr) shall be used for transmission of the audio data packet.

5.3.2 The audio data packet shall not be multiplexed into the horizontal ancillary data space of the line subsequent to the switching point defined by the source format. As an example, the ancillary data space available for the audio data packet in the 1125/60 system is shown in figure 6.

5.3.3 The number of samples per audio channel which can be multiplexed in one horizontal ancillary data space is 0, 1, or 2. When two samples of the audio data are transmitted in one horizontal ancillary data block, the packet of the audio sample which appears earlier at the input of the formatter shall be transmitted first.

5.3.4 An audio data packet shall be multiplexed in the horizontal ancillary data space of the first or second line following the line during which the audio sample occurred at the input to the formatter.

NOTE – Audio phase must be maintained across the audio groups carrying the multiple-channel audio.

5.3.5 The audio data packet shall be multiplexed following the CRC, which is defined in ANSI/SMPTE 292M.

5.3.6 When more than two audio data packets are transmitted in one horizontal ancillary data block, the audio data packets shall be contiguous to each other.

6 Audio control packet

6.1 Structure of audio control packet

6.1.1 The structure of the audio control packet shall be as shown in figure 7. Audio control packets consist of ancillary data flag (ADF), data identification (DID), data block number (DBN), data count (DC), user data words (UDW), and checksum (CS). ADF, DC, and CS are subject to ANSI/SMPTE 291M. DC is always 10Bh and DBN is always 200h.

6.1.2 DID is defined as 1E3h for audio group 1 (channel 1-4), 2E2h for audio group 2 (channel 5-8),

2E1h for audio group 3 (channel 9-12), and 1E0h for audio group 4 (channels 13-16), respectively.

6.1.3 UDW is defined in 6.2. In this standard, UDWx means the xth user data word. There are always 11 words in the UDW of an audio control packet; i.e., UDW0, UDW1 ... UDW9, UDW10.

6.2 Structure of user data words (UDW)

UDW consists of five types of data defined in 6.2.1-6.2.5. The description in this clause covers only audio group 1. The description for audio groups 2, 3, and 4 is similar to audio group 1 where channels 5, 9, and 13 correspond to channel 1; channels 6, 10, and 14 correspond to channel 2; channels 7, 11, and 15 correspond to channel 3; and channels 8, 12, and 16 correspond to channel 4, respectively.

6.2.1 AF (audio frame number data)

6.2.1.1 Audio frame number data (AF) provide a sequential numbering of video frames to indicate where they fall in the progression of noninteger number of samples per video frame (audio frame sequence). The first number of the sequence is always 1 and the final number is equal to the length of the audio frame sequence. A value of AF equal to all zeros indicates that frame numbering is not available.

6.2.1.2 The bit assignment of AF shall be as shown in table 4. The AF is common for all channels in a given audio group.

6.2.1.3 For correct use of the audio frame number, the audio frame sequence shall be defined. Three synchronous sampling rates are defined in this standard (see 3.16).

All audio frame sequences are based on two integer numbers of samples per frame (m and m+1) with audio frame numbers starting at 1 and proceeding to the end of the sequence. Odd-numbered audio frames (1, 3, 5, etc.) have the larger integer number of samples and even-numbered audio frames (2, 4, 6, etc.) have the smaller integer number of samples with the exception tabulated in table 5.

NOTE – Receiver designers should be aware that some existing equipment may not conform to the sequence restriction specifications of 6.2.1.3. Receivers should have the ability to receive correctly audio data sequence even when 6.2.1.3 is not implemented.

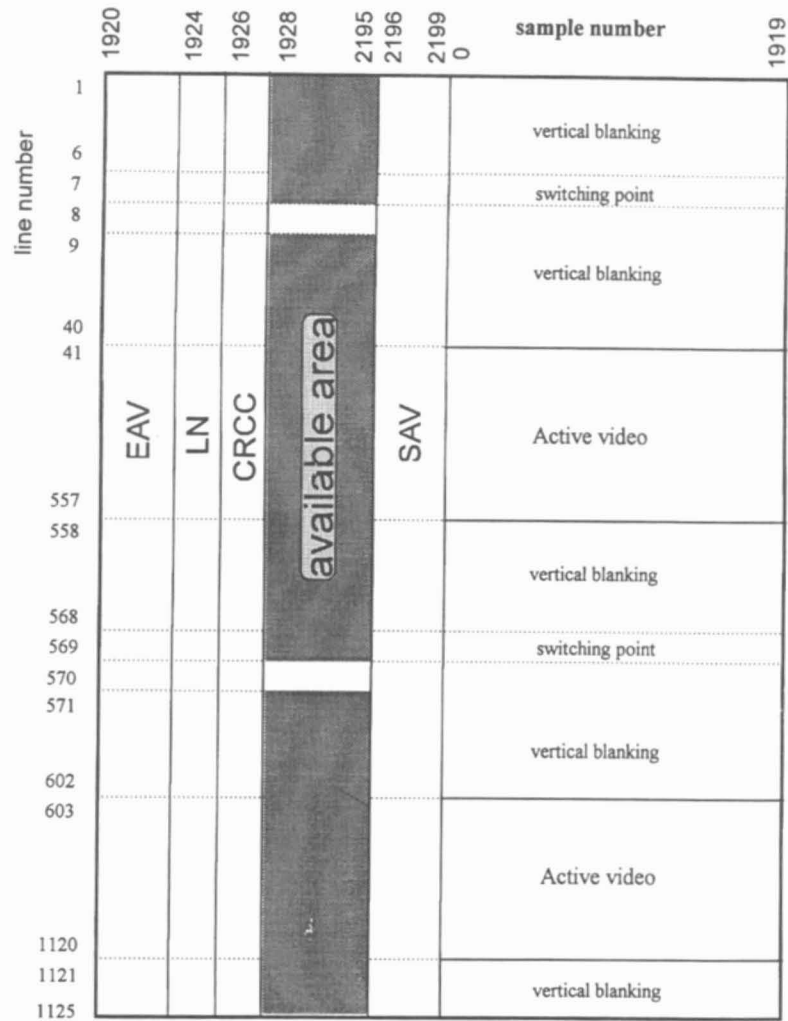


Figure 6 – Ancillary data space of C_b/C_r parallel data stream available for transmission of audio data packets (1125/60 system)

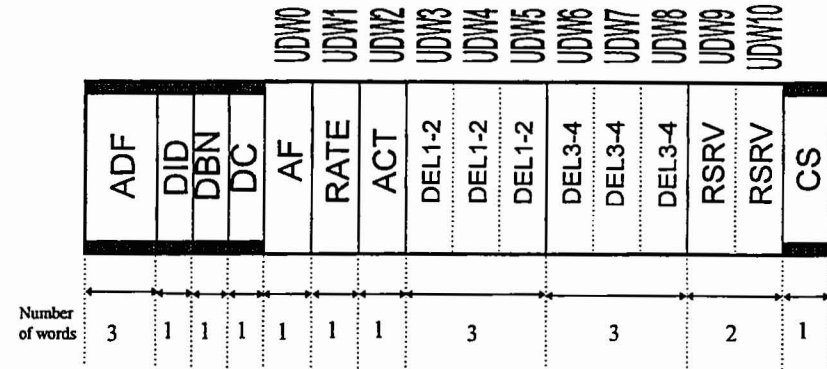


Figure 7 – Structure of audio control packet

Table 4 – Bit assignment of AF

Bit number	UDW0
	AF
b9 (MSB)	Not b8
b8	f8 audio frame number (MSB)
b7	f7 audio frame number
b6	f6 audio frame number
b5	f5 audio frame number
b4	f4 audio frame number
b3	f3 audio frame number
b2	f2 audio frame number
b1	f1 audio frame number
b0 (LSB)	f0 audio frame number (LSB)

Table 5 – Exception to audio frame sequence

Television system	Sampling rate (kHz)	Frame sequence	Basic numbering		Exceptions	
			Samples per odd audio frame (m)	Samples per even audio frame (m+1)	Frame number	Number of samples
30 frame/s	48.0	1	1600		none	
	44.1	1	1470		none	
	32.0	3	1067	1066	none	
29.97 frame/s	48.0	5	1602	1601	none	
	44.1	100	1472	1471	23, 47, 71	1471
	32.0	15	1068	1067	4, 8, 12	1068

6.2.1.4 When channel pairs in a given audio group are operating in asynchronous mode, the AF word in the audio control packet is not used and b0-b8 should be set to zero.

6.2.2 RATE (sampling rate)

6.2.2.1 The sampling rate for all channel pairs is defined by the word RATE. The bit assignment of RATE shall be as shown in table 6.

6.2.2.2 The sync mode bit asx, when set to one, indicates that the channel pairs in a given audio group are operating asynchronously.

6.2.2.3 The rate code is currently defined as shown in table 7.

6.2.3 ACT

The word ACT indicates active channels. Bits a1 to a4 are set to one for each active channel in a given audio group; otherwise, they are set to zero. The bit assignment of ACT is shown in table 8.

6.2.4 DELm-n

6.2.4.1 The words DELm-n indicate the amount of accumulated audio processing delay relative to video, measured in audio sample intervals, for each channel pair of CHm and CHn.

6.2.4.2 The bit assignment of DELm-n shall be as shown in table 9. The e bit is set to one to indicate valid audio delay data. The delay words

are referenced to the point where the AES/EBU data are input to the formatter. The delay words represent the average delay value, inherent in the formatting process, over a period no less than the length of the audio frame sequence plus any preexisting audio delay.

6.2.4.3 The audio delay data (del 0-del 25) is represented in the format of 26-bit twos complement. Positive values indicate that the video leads the audio.

6.2.5 RSRV

6.2.5.1 The words marked RSRV are reserved for future use.

6.2.5.2 The bit assignment of the RSRV word shall be as shown in table 10.

6.3 Multiplexing of the audio control packet

6.3.1 The audio control packets shall be transmitted once every field.

6.3.2 The audio control packets shall be transmitted in the horizontal ancillary data space of the second line after the switching point of the Y parallel data stream. For example, since the switching point for the 1125/60 system exists in lines 7 and 569, the audio control packets are transmitted in the horizontal ancillary data space of lines 9 and 571 of the Y parallel data stream. Ancillary data space available for the transmission of audio control packets is shown in figure 8.

Table 6 – Bit assignment of RATE

Bit number	UDW1
	RATE
b9(MSB)	Not b8
b8	0
b7	0
b6	0
b5	0
b4	0
b3	X2 (MSB)
b2	X1 rate code
b1	X0 (LSB)
b0 (LSB)	asx synchronous audio: 0 asynchronous audio: 1

Table 7 – Assignment of rate code

X2	X1	X0	Sample rate
0	0	0	48.0 kHz
0	0	1	44.1 kHz
0	1	0	32.0 kHz
1	1	1	Free running
0	1	1	Reserved
:	:	:	:
1	1	0	Reserved

Table 8 – Bit assignment of ACT

Bit number	UDW2
	ACT
b9 (MSB)	Not b8
b8	Even parity ¹⁾
b7	0
b6	0
b5	0
b4	0
b3	a4 active: 1, inactive: 0 (CH4)
b2	a3 active: 1, inactive: 0 (CH3)
b1	a2 active: 1, inactive: 0 (CH2)
b0 (LSB)	a1 active: 1, inactive: 0 (CH1)

¹⁾ Even parity for b0 through b7.

Table 9 – Bit assignment of DELm-n

Bit number	UDW3	UDW4	UDW5	UDW6	UDW7	UDW8
	DEL 1-2			DEL 3-4		
b9 (MSB)	Not b8	Not b8	Not b8	Not b8	Not b8	Not b8
b8	del 7	del 16	del 25 (±)	del 7	del 16	del 25 (±)
b7	del 6	del 15	del 24 (MSB)	del 6	del 15	del 24 (MSB)
b6	del 5	del 14	del 23	del 5	del 14	del 23
b5	del 4	del 13	del 22	del 4	del 13	del 22
b4	del 3	del 12	del 21	del 3	del 12	del 21
b3	del 2	del 11	del 20	del 2	del 11	del 20
b2	del 1	del 10	del 19	del 1	del 10	del 19
b1	del 0 (LSB)	del 9	del 18	del 0 (LSB)	del 9	del 18
b0 (LSB)	e	del 8	del 17	e	del 8	del 17

Table 10 – Bit assignment of RSRV

Bit number	UDW9	UDW10
	RSRV	RSRV
b9 (MSB)	Not b8	Not b8
b8	Reserved (set to 0)	Reserved (set to 0)
b7	Reserved (set to 0)	Reserved (set to 0)
b6	Reserved (set to 0)	Reserved (set to 0)
b5	Reserved (set to 0)	Reserved (set to 0)
b4	Reserved (set to 0)	Reserved (set to 0)
b3	Reserved (set to 0)	Reserved (set to 0)
b2	Reserved (set to 0)	Reserved (set to 0)
b1	Reserved (set to 0)	Reserved (set to 0)
b0 (LSB)	Reserved (set to 0)	Reserved (set to 0)