

Specification for Digital audio interface

**BS EN
60958:1995
BS 7239:1989
IEC 958:1989**

*Incorporating
Amendments Nos. 1, 2
and 3 to BS 7239:1989
(Including
Amendments Nos. 1
and 2 to
IEC 958:1989)*

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The preparation of this British Standard was entrusted by the Electronic Equipment Standards Policy Committee (EEL/-) to Technical Committee EEL/32, upon which the following bodies were represented:

- Association for Consumer Research (ACRE)
- Association of British Theatre Technicians
- Audio Engineering Society
- British Educational Equipment Association
- British Kinematograph, Sound and Television Society
- British Radio & Electronic Equipment Manufacturers Association
- British Telecommunications Plc
- Consumer Policy Committee of BSI
- Federation of British Audio
- Independent Broadcasting Authority
- Independent Television Association
- Institution of Electrical Engineers
- Radio Electrical and Television Retailers Association
- Royal Institute of British Architects
- Royal National Institute for the Deaf
- Society of Cable Television Engineers
- Sound and Communication Industries Federation

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National foreword

This British Standard has been prepared by Technical Committee EPL 87 and is the English language version of EN 60958:1990, *Digital audio interface* and its amendments A1:June 1994 and A2:December 1995, published by the European Committee for Electrotechnical Standardization (CENELEC). It is identical with IEC 958:1989 and its amendments 1:1993 and 2:1995, published by the International Electrotechnical Commission (IEC).

This British Standard renumbered BS 7239 as BS EN 60958, however, agreement has been given to retain for the moment the cross-reference of this standard, and any reference to BS 7239 should be read as a reference to BS EN 60958.

Cross-references

International Standard	Corresponding British Standard
IEC 268-11:1987 (HD 483.11 S3)	BS 6840 <i>Sound system equipment</i> Part 11:1994 <i>Specification for application of connectors for the interconnection of sound system components</i> BS EN 60268 <i>Sound system equipment</i>
IEC 268-12:1987 (EN 60268-12:1995)	BS EN 60268-12:1995 <i>Application of connectors for broadcast and similar use</i>
IEC 841:1988 (HD 544 S1:1989)	BS 7133:1989 <i>Specification for audio recording — PCM encoder/decoder system</i>
IEC 908:1987 (EN 60908:1992)	BS EN 60908:1983 <i>Specification for compact disc digital audio system</i>

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 32, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Digital audio interface (includes Amendments A1:1994 and A2:1995)

(IEC 958:1989 + amendment 1:1993 + amendment 2:1995)

Interface audionumérique
(Inclut les amendements A1:1994 et A2:1995)
(IEC 958:1989 + A1:1993 + A2:1995)

Digitalton-Schnittstelle
(IEC 958:1989)
(Enthält Änderungen A1:1994 und A2:1995)
(IEC 958:1989 + A1:1993 + A2:1995)

This European Standard was approved by CENELEC on 1 September 1990, amendment A1 was approved by CENELEC on 1994-03-08 and amendment A2 was approved by CENELEC on 1995-09-20. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

The CENELEC questionnaire procedure, performed for finding out whether or not the International Standard IEC 958:1989 could be accepted without textual changes, has shown that no CENELEC common modifications were necessary for the acceptance as European Standard.

The reference document was submitted to the CENELEC members for formal vote and acceptance by CENELEC as EN 60958 on 1990-09-01.

The following dates were fixed:

- latest date of publication of an identical national standard (dop) 1991-09-15
- latest date of withdrawal of conflicting national standards (dow) 1991-09-15

Endorsement notice

The text of the International Standard IEC 958:1989 was approved by CENELEC as European Standard without any modifications.

Foreword to amendment A1

The CENELEC questionnaire procedure, performed for finding out whether or not amendment 1:1993 to the International Standard IEC 958:1989 could be accepted without textual changes, has shown that no CENELEC common modifications were necessary for the acceptance as European Standard.

The reference document was submitted to the CENELEC members for formal vote and was approved by CENELEC as amendment A1 to EN 60958 on 8 March 1994.

The following dates were fixed:

- latest date of publication of an identical national standard (dop) 1995-03-15
- latest date of withdrawal of conflicting national standards (dow) 1995-03-15

Annexes designated “normative” are part of the body of the standard. In this standard, Annex A, Annex C, Annex D, Annex E, Annex F, Annex G, Annex H, Annex J, Annex K, Annex L are normative.

Foreword to amendment A2

The text of document 84/398/DIS, future amendment 2 to IEC 958:1989, prepared by IEC TC 84, Equipment and systems in the field of audio, video and audiovisual engineering, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as amendment A2 to EN 60958:1990 on 1995-09-20.

The following dates were fixed:

- latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1996-08-01
- latest date by which the national standards conflicting with the amendment have to be withdrawn (dow) 1996-08-01

Annexes designated “normative” are part of the body of the standard. In this standard, Annex M and Annex N are normative.

1 Scope

This standard describes a serial, uni-directional, self-clocking interface for the interconnection of digital audio equipment for consumer and professional applications.

When used in a consumer digital processing environment, the interface is primarily intended to carry stereophonic programmes, with a resolution of up to 20 bits per sample, an extension to 24 bits per sample being possible.

When used in a broadcasting studio environment, the interface is primarily intended to carry monophonic or stereophonic programmes, at a 48 kHz sampling frequency and with a resolution of up to 24 bits per sample; it may alternatively be used to carry one or two signals sampled at 32 kHz.

In both cases, the clock references and auxiliary information are transmitted along with the programme. Provision is also made to allow the interface to carry data related to computer software.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreement based on this International Standard should apply the most recent editions of the standards listed below. Members of ISO and IEC maintain registers of currently valid International Standards.

IEC 268-11:1987, *Sound system equipment, Part 11: Application of connectors for the interconnection of sound system components*.

IEC 268-12:1987, *Part 12: Application of connectors for broadcast and similar use*.

IEC 841:1988, *Audio recording — PCM encoder/decoder system*.

IEC 908:1987, *Compact disc digital audio system*.

ISO 646:1983, *Information processing — ISO 7-bit coded character set for information interchange*.

CCITT Recommendation J.17:1972, *Pre-emphasis used on sound-programme circuits*.

CCITT Recommendation V.11:1976, 1980, *Electrical characteristics for balanced double-current interchange circuits for general use with integrated circuit equipment in the field of data communications*.

CCIR Recommendation No. 647, *A digital audio interface for broadcasting studios*.

3 Interface format

3.1 Definitions

For the purpose of this International Standard the following definitions apply.

3.1.1

sampling frequency

the sampling frequency is the frequency of the samples representing audio signals. When more than one signal is transmitted through the same interface, the sampling frequencies shall be identical

3.1.2

audio sample word

the audio sample word represents the amplitude of a digital audio sample. Representation is linear in 2's complement binary form. Positive numbers correspond to positive analogue voltages at the input of the ADC

the number of bits allocated per word is either 24 or 20. If the source provides fewer bits than the interface format requires, the unused least significant bits of the audio sample word shall be set to the logical "0"

3.1.3

auxiliary sample bits

the auxiliary sample bits can be used for auxiliary information or word length expansion of the audio sample word

3.1.4**validity flag**

the validity flag is associated with each audio sample word and indicates whether its value is reliable or not

3.1.5**channel status**

the channel status carries, in a fixed format, information associated with each audio channel which is decodable by any interface user

examples of information to be carried in the channel status are: length of audio sample words, pre-emphasis, sampling frequency, time codes, alphanumeric source and destination codes

3.1.6**user data**

the user data channel is provided to carry any other information

3.1.7**parity bit**

the parity bit is provided to permit the detection of an odd number of errors resulting from malfunctions in the interface

3.1.8**preambles**

preambles are specific patterns used for synchronization. There are three different preambles (see 3.3.2)

3.1.9**sub-frame**

the sub-frame is the fixed structure used to carry the information described in 3.1.1 to 3.1.8 (see 3.2.1 and 3.2.2)

3.1.10**frame**

the frame is a sequence of sub-frames mentioned in the previous item

3.1.11**block**

the block is a group of 192 consecutive frames providing, for each channel, the 192 channel status data bits and possibly providing a structure for 192 user data bits. The start of a block is designated by a special sub-frame preamble

3.1.12**channel coding**

the channel coding describes the method of modulation by which the binary digits are represented for transmission through the interface

3.2 Structure of format**3.2.1 Sub-frame format**

Each sub-frame is divided into 32 time slots, numbered from 0 to 31 (see Figure 1).

Time slots 0 to 3 carry one of the three permitted preambles (see Figure 2). These are used to affect synchronization of sub-frames, frames and blocks (see 3.3.2).

Time slots 4 to 27 carry the audio sample word in linear 2's complement representation. The most significant bit is carried by time slot 27.

When a 24-bit coding range is used, the least significant bit is in time slot 4.

When a 20-bit coding range is sufficient, the least significant bit is in time slot 8 and time slots 4 to 7 may be used for other applications. Under these circumstances, the bits in the time slots 4 to 7 are designated auxiliary sample bits.

If the source provides fewer bits than the interface allows (24 or 20), the unused least significant bits shall be set to a logical "0" By this procedure, equipment using different numbers of bits may be connected together.

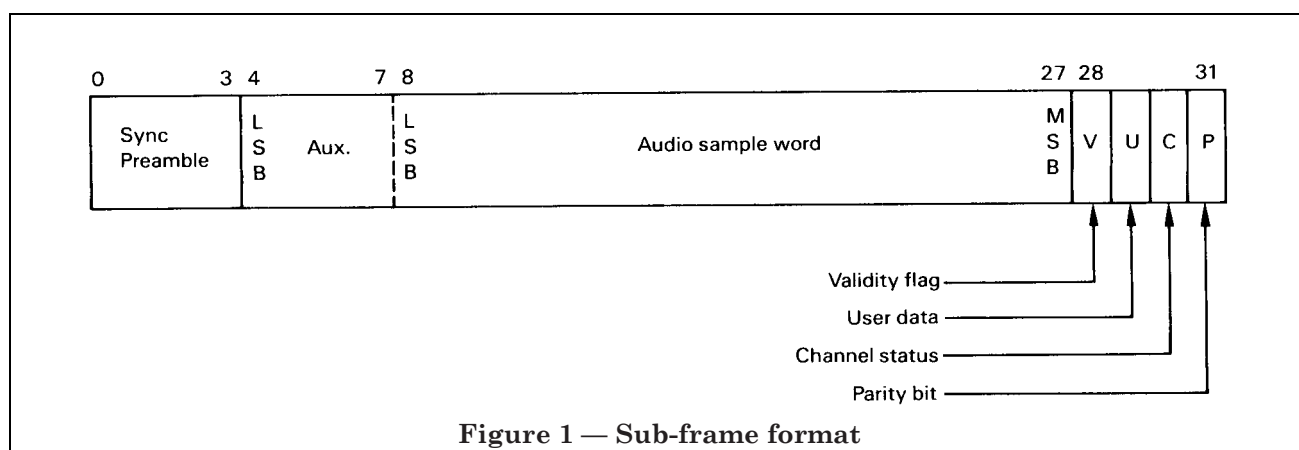
Time slot 28 carries the validity flag associated with the audio sample word. This flag is set to logical “0” if the audio sample is reliable. It is set to logical “1” if unreliable.

Time slot 29 carries one bit of the user data channel associated with the audio channel transmitted in the same sub-frame.

The default value of the user bit is logical “0”.

Time slot 30 carries one bit of the channel status word associated with the audio channel transmitted in the same sub-frame.

Time slot 31 carries a parity bit such that time slots 4 to 31 inclusive will carry an even number of ones and an even number of zeros.

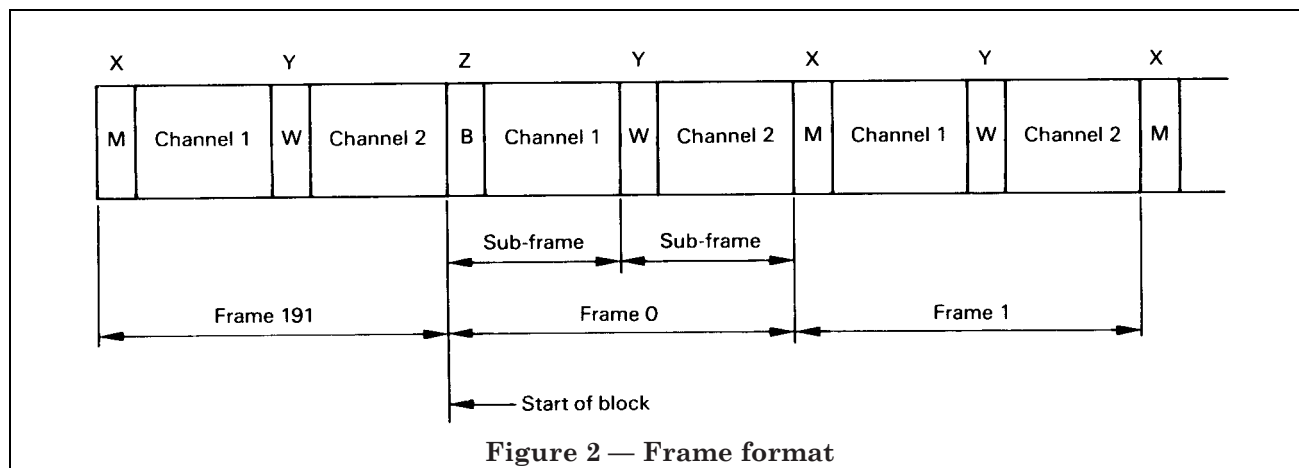


3.2.2 Frame format

A frame is uniquely composed of two sub-frames (see Figure 2). The rate of transmission of frames corresponds exactly to the source sampling frequency.

In the 2-channel operation mode, the samples taken from both channels are transmitted by time multiplexing in consecutive sub-frames. Sub-frames related to channel 1 (left or “A” channel in stereophonic operation and primary channel in monophonic operation) normally use preamble M. However, the preamble is changed to preamble B once every 192 frames. This defines the block structure used to organize the channel status information (see 3.1.5 and 4.). Sub-frames of channel 2 (right or “B” in stereophonic operation and secondary channel in monophonic operation) always use preamble W.

In the single channel operation mode in a broadcasting studio environment the frame format is equal to the 2-channel mode. Data is carried only in channel 1. In the sub-frames allocated to channel 2, time slot 28 (validity flag) shall be set to logical “1” (sample not valid).

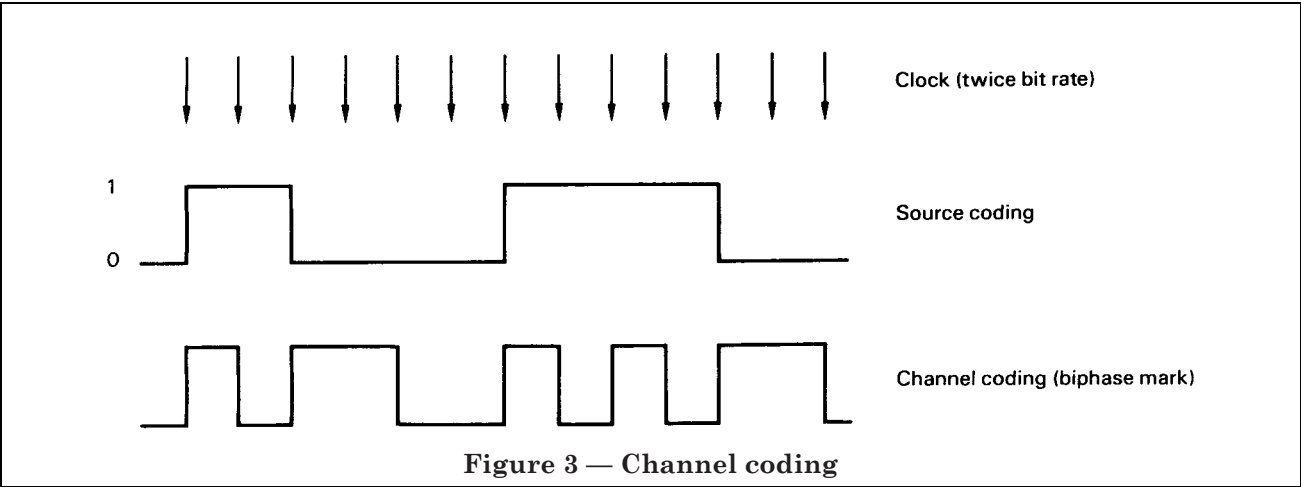


3.3 Modulation

3.3.1 Channel coding

To minimize the d.c. component on the transmission line, to facilitate clock recovery from the data stream and to make the interface insensitive to the polarity of connections, time slots 4 to 31 are encoded in biphasc-mark.

Each bit to be transmitted is represented by a symbol comprising two consecutive binary states. The first state of a symbol is always different from the second state of the previous symbol. The second state of the symbol is identical to the first if the bit to be transmitted is logical “0”, however it is different if the bit is logical “1” (see Figure 3).



3.3.2 Preambles

Preambles are specific patterns providing synchronization and identification of the sub-frames and blocks. To achieve synchronization within one sampling period and to make this process completely reliable, these patterns violate the biphasc mark code rules, thereby avoiding the possibility of data imitating the preambles.

A set of three preambles is used. These preambles are transmitted in the time allocated to four time slots (time slots 0 to 3) and are represented by eight successive states. The first state of the preamble is always different from the second state of the previous symbol (representing the parity bit). Depending on this state the preambles are:

Preceding state	0	1
	Channel coding	
“B”	11101000	00010111
“M”	11100010	00011101
“W”	11100100	00011011

The preamble preceding each digital audio sample shall indicate the beginning of a sample:

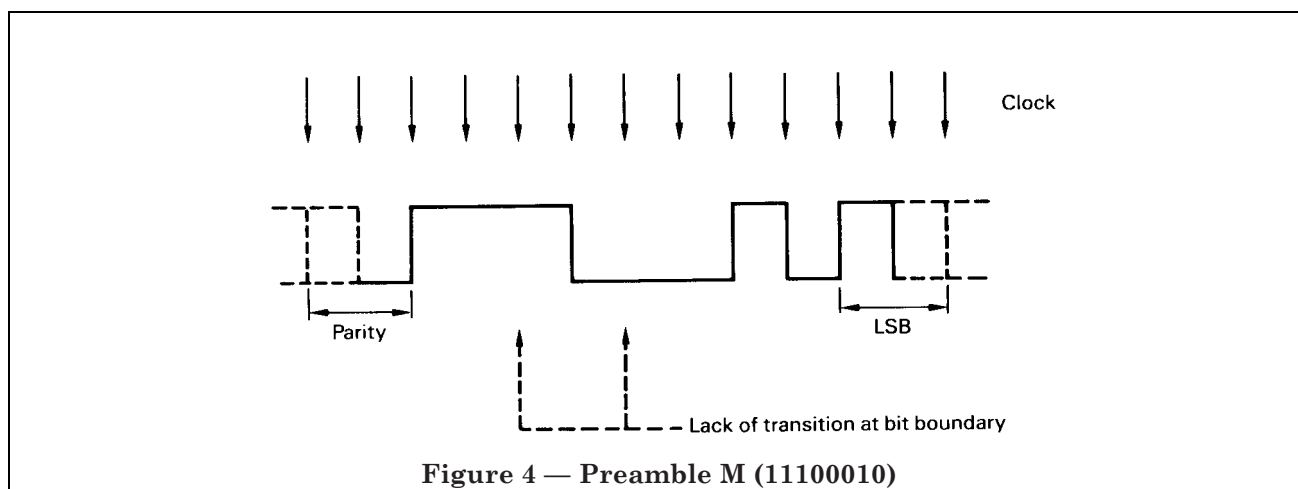
- of channel A and of a block = “B”¹⁾
- of channel A, but not a block = “M”¹⁾
- of channel B = “W”¹⁾

¹⁾ In a broadcasting studio environment the letters B, M, W are denoted by Z, X, Y (see Figure 2).

Like biphasc code, these preambles are d.c. free and provide clock recovery. They differ in at least two states from any valid biphasc sequence.

Figure 4 represents preamble M.

NOTE Due to the even parity bit in time slot 31, all preambles will start with a transition in the same direction (see 3.2.1). Thus only one of these sets of preambles will, in practice, be transmitted through the interface. However, it is necessary for either set to be decodable because a polarity reversal may occur in the connection.



3.4 User data format

User data bits may be used in any way required by the user. It may be advantageous in some applications to adopt a block structure similar to that of the channel status, with block boundaries aligned with those of the channel status blocks.

For example, in some synchronizing schemes, where it may be necessary to repeat or discard samples to maintain long-term synchronism, the disturbance to both channel status and user data can be minimized by arranging for the repetition or discarding to involve samples in blocks of 192 bits as defined by the block structure of the interface.

The default value of the user bits is logical “0”.

4 Channel status

4.1 General

Examples of information to be carried in the channel status are: length of audio sample words, number of audio channels, sampling frequency, copy permit, clock accuracy and pre-emphasis.

Channel status information is organized in 192-bit words. The first bit of each word is carried in the frame with preamble “B”.

The primary application is indicated by this first channel status bit.

For broadcasting studios this first channel status bit equals “1”.

For consumer digital audio equipment this first channel status bit equals “0”.

Secondary applications may be defined within the framework of these primary applications.

4.2 Applications

4.2.1 Broadcasting studio use

The channel status data is organized into byte wide increments. Consequently there are 24 bytes per block (see Figure 5).

The specific organization follows, wherein the suffix 0 designates the first byte or bit:

Byte 0

<i>bit 0</i>	“0”	Consumer use of channel status block.
	“1”	Professional use of channel status block.
<i>bit 1</i>	“0”	Normal audio mode.
	“1”	Non-audio mode.
<i>bits 2–4</i>		Encoded audio signal emphasis.

bit	2 3 4	
state	"0 0 0"	Emphasis not indicated. Receiver defaults to no emphasis with manual override enabled.
	"1 0 0"	No emphasis. Receiver manual override disabled.
	"1 1 0"	50/15 µs emphasis. Receiver manual override disabled.
	"1 1 1"	CCITT J.17 emphasis (with 6,5 dB insertion loss at 800 Hz). Receiver manual override disabled.
	All other states of bits 2–4 are reserved for future standardization.	
<i>bit 5</i>	"1"	Source sampling frequency unlocked.
	"0"	Default and source sampling frequency locked.
<i>bits 6–7</i>	Encoded sampling frequency.	
bit	6 7	
state	"0 0"	Sampling frequency not indicated. Receiver default to 48 kHz and manual override or auto set enabled.
	"0 1"	48 kHz sampling frequency. Manual override or auto set disabled.
	"1 0"	44,1 kHz sampling frequency. Manual override or auto set disabled.
	"1 1"	32 kHz sampling frequency. Manual override or auto set disabled.

NOTE The significance of bits 0–4 is such that transmission from a consumer interface can be recognized and a receiver conforming only to the consumer format will correctly receive an appropriately formatted signal from a professional transmitter.

Byte 1

bits 0–3	Encoded channel mode.	
bit	0 1 2 3	
state	“0 0 0 0”	Mode not indicated. Receiver default to two-channel mode. Manual override enabled.
	“0 0 0 1”	Two-channel mode. Manual override disabled.
	“0 0 1 0”	Single channel mode (monophonic). Manual override disabled.
	“0 0 1 1”	Primary/secondary mode (channel 1 is primary). Manual override disabled.
	“0 1 0 0”	Stereophonic mode (channel 1 is left channel). Manual override disabled.
	“0 1 0 1”	Reserved for future standardization.
	to	
	“1 1 1 0”	Reserved for future standardization.
	“1 1 1 1”	
	Vector to byte 3 for future applications.	

bits 4–7 Encoded user bits management. Reserved but not defined at present.

For any channel, if the channel status is implemented, then all data in bytes 0 and 1 of that channel status block shall be transmitted.

If the channel status is not implemented, then all data of the channel status block shall be set to logical "0". In this event, the receiving interface shall default to 48 kHz sampling frequency, in 2-channel mode use with 20-bit audio sample data and no emphasis assumed.

In this state, it should be noted that no communication from a consumer transmitter can be received.

Byte 2

<i>bits 0–2</i>	Encoded use of auxiliary sample bits.	
bit	0 1 2	
state	"0 0 0"	Auxiliary sample bits use not defined. Audio sample word length is 20 bits.
	"0 0 1"	Auxiliary sample bits used for main audio sample data. Audio sample word length is 24 bits.
	0 1 0	Reserved for future standardization.
	to	
	"1 1 1"	Reserved for future standardization.