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Digital audio interface – Part 1: General

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IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FOREWORD

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IEC 60958-1 has been prepared by technical area 20: Analogue and digital audio, of IEC technical committee 100: Audio, video and multimedia systems and equipment. It is an International Standard.

This fourth edition cancels and replaces the third edition published in 2008, and Amendment 1:2014. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) The relevant part of IEC 60958-5 is supported.

The text of this International Standard is based on the following documents:

Draft	Report on voting
100/3544/CDV	100/3593/RVC

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

A list of all parts of the IEC 60958 series, under the general title *Digital audio interface*, can be found on the IEC website.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

DIGITAL AUDIO INTERFACE –

Part 1: General

1 Scope

This part of IEC 60958 describes a serial, uni-directional, self-clocking interface for the interconnection of digital audio equipment for consumer and professional applications.

It provides the basic structure of the interface. Separate documents define items specific to particular applications.

The interface is primarily intended to carry monophonic or stereophonic programmes, encoded using linear PCM and with a resolution of up to 24 bits per sample.

When used for other purposes, the interface is able to carry audio data coded other than as linear PCM coded audio samples. Provision is also made to allow the interface to carry data related to computer software, multimedia technologies, or signals coded using non-linear PCM. The format specification for these applications is not part of this document.

The interface is intended for operation at audio sampling frequencies of 32 kHz and above. Auxiliary information is transmitted along with the programme.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60268-11:1987, *Sound system equipment – Part 11: Application of connectors for the interconnection of sound system components*

IEC 60958-3, *Digital audio interface – Part 3: Consumer applications*

IEC 60958-4 (all parts), *Digital audio interface – Part 4: Professional applications*

IEC 60958-5, *Digital audio interface – Part 5: Consumer application enhancement*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
sampling frequency
frequency of the samples representing an audio signal

Note 1 to entry: When more than one signal is transmitted through the same interface, the sampling frequencies are identical.

3.2
audio sample word
value of a digital audio sample; representation is linear in 2's complement binary form

Note 1 to entry: Positive numbers correspond to positive analogue voltages at the input of the analogue-to-digital converter (ADC).

3.3
auxiliary sample bit
four least significant bits (LSBs) which can be assigned as auxiliary sample bits and used for auxiliary information when the number of audio sample bits in the main data field is less than or equal to 20

3.4
validity bit
bit indicating whether the main data field bits in the sub-frame (time slots 4 to 27 or 8 to 27, depending on the audio word length as described in 4.1.1) are reliable or not

3.5
channel status
data carrying, in a fixed format, information associated with each main data field channel which is decodable by any interface user

Note 1 to entry: 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.

3.6
user data
data provided to carry any other information

3.7
parity bit
bit provided to permit the detection of an odd number of errors resulting from malfunctions in the interface

3.8
preamble
specific patterns used for synchronization

Note 1 to entry: There are three different preambles (see 4.3).

3.9
sub-frame
fixed structure used to carry information (see 4.1.1 and 4.1.2)

3.10
frame
sequence of two successive and associated sub-frames

3.11
block
group of 192 consecutive frames

Note 1 to entry: The start of a block is designated by a special sub-frame preamble (see 4.3).

3.12
channel coding
coding method by which the binary digits are represented for transmission through the interface

3.13
unit interval (UI)
shortest nominal time interval in the coding scheme

Note 1 to entry: There are 128 UI in a sample frame.

3.14
interface jitter
deviation in the timing of interface data transitions (zero crossings) when compared with an ideal clock

3.15
intrinsic jitter
output interface jitter of a device that is either free-running or is synchronized to a jitter-free reference

3.16
jitter gain
ratio of the amplitude of jitter components at the output to their amplitude at the synchronization input to the device under test

4 Interface format

4.1 Structure of format

4.1.1 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 (preambles) carry one of the three permitted preambles (see 4.1.2 and 4.3; also see Figure 2).

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

When a 24-bit coding range is used, the LSB is in time slot 4 (see Figure 1).

When a 20-bit coding range is used, time slots 8 to 27 carry the audio sample word with the LSB in time slot 8. 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 (see Figure 1).

If the source provides fewer bits than the interface allows (either 20 or 24), the unused LSBs are set to a logical "0".

For a non-linear PCM audio application or a data application the main data field may carry any other information.

Time slot 28 (validity bit) carries the validity bit associated with the main data field (see 4.4).

Time slot 29 (user data bit) carries 1 bit of the user data channel associated with the main data field channel transmitted in the same sub-frame. For the applications, refer to the other parts of IEC 60958.

Time slot 30 (channel status bit) carries 1 bit of the channel status information associated with the main data field channel transmitted in the same sub-frame. For details refer to the other parts of IEC 60958.

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

NOTE The preambles have even parity as an explicit property.

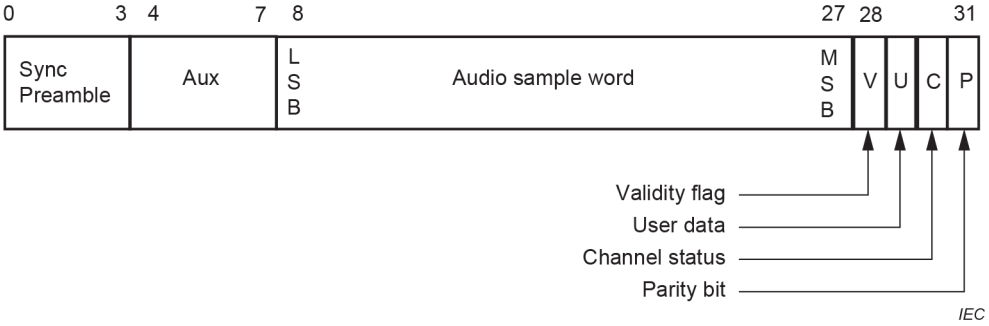

Figure 1 – Sub-frame format (linear PCM application)

Annex E describes the IEC 60958 series conformant data format that utilises the sub-frame format.

4.1.2 Frame format

A frame is uniquely composed of two sub-frames (see Figure 2). For linear coded audio applications, the rate of transmission of frames normally corresponds exactly to the source sampling frequency.

In 2-channel operation mode, the samples taken from both channels are transmitted by time multiplexing in consecutive sub-frames. The first sub-frame (left or "A" channel in stereophonic operation and primary channel in monophonic operation) normally starts with preamble "M". However, the preamble changes to preamble "B" once every 192 frames to identify the start of the block structure used to organize the channel status information. The second sub-frame (right or "B" channel in stereophonic operation and secondary channel in monophonic operation) always starts with preamble "W".

In single channel operation mode in a professional application, the frame format is the same as in the 2-channel mode. Data is carried in the first sub-frame and may be duplicated in the second sub-frame. If the second sub-frame is not carrying duplicate data, then time slot 28, (validity flag) shall be set to logical "1".

NOTE For historical reasons preambles "B", "M" and "W" are, for use in professional applications, referred to as "Z", "X" and "Y", respectively.

Annex C describes the relation of the IEC 60958 series families based on the frame format.

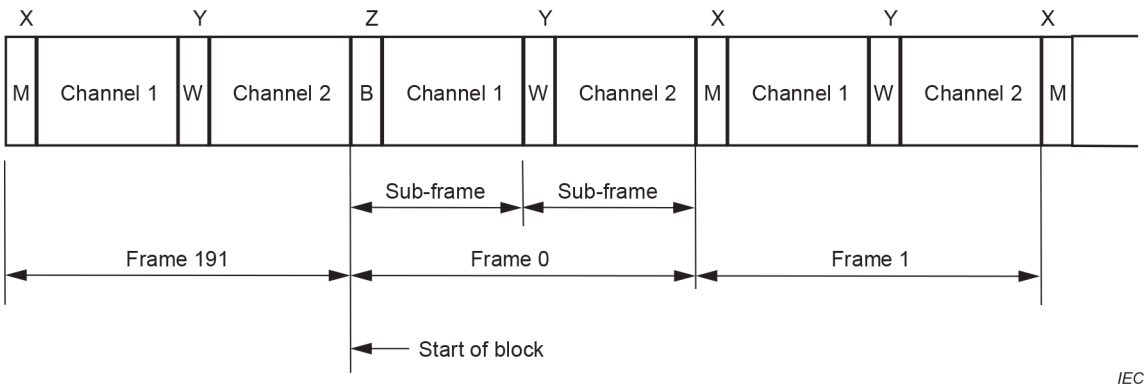

Figure 2 – Frame format

4.2 Channel coding

To minimize the direct current (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 biphase-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).

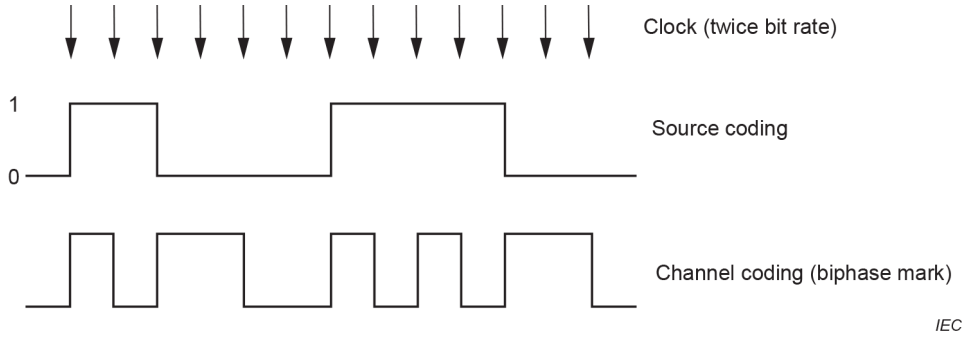

Figure 3 – Channel coding

4.3 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 biphase-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 at the start of each sub-frame (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 as shown in Table 1.

Table 1 – Preamble coding

Preceding state	**0**	**1**	
Preamble code	**Channel coding**		
"B" or "Z" (see note to 4.1.2)	11101000	00010111	Sub-frame 1 and the start of the block
"M" or "X"	11100010	00011101	Sub-frame 1
"W" or "Y"	11100100	00011011	Sub-frame 2

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

Figure 4 represents preamble "M".

NOTE Owing to the even-parity bit in time slot 31, all preambles start with a transition in the same direction (see 4.1.1). Thus, only one of these sets of preambles is, in practice, transmitted through the interface. However, it is necessary for both sets to be decodable because either polarity is possible in a connection.