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Digital audio – Interface for non-linear PCM encoded audio bitstreams applying IEC 60958 – Part 1: General

Audionumérique – Interface pour les flux de bits audio à codage MIC non linéaire conformément à la CEI 60958 – Partie 1: Généralités

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Part 1: General

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This consolidated version of IEC 61937-1 consists of the second edition (2007) [documents 100/1101/CDV and 100/1192/RVC] and its amendment 1 (2011) [documents 100/1810/CDV and 100/1883/RVC]. It bears the edition number 2.1.

The technical content is therefore identical to the base edition and its amendment and has been prepared for user convenience. A vertical line in the margin shows where the base publication has been modified by amendment 1. Additions and deletions are displayed in red, with deletions being struck through.

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International Standard IEC 61937-1 has been prepared by technical area 4: Digital system interfaces and protocols, of IEC technical committee 100: Audio, video and multimedia systems and equipment.

This second edition of IEC 61937-1 cancels and replaces the first edition published in 2000. This edition contains the following significant technical changes with respect to the previous edition.

a) The data-type field in Pc is expanded from bit 0-4 to bit 0-6.

b) A new additional definition of Pd is specified.

c) The numbers of times for symbol frequency are changed to refer to each part of IEC 61937.

d) The requirement for burst spacing is changed.

The bilingual version (2011-04) corresponds to the monolingual English version, published in 2007-01.

The French version of this standard has not been voted upon.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The list of all the parts of IEC 61937, under the general title *Digital audio – Interface for non-linear PCM encoded audio bitstreams applying IEC 60958* can be found on the IEC website.

The committee has decided that the contents of the base publication and its amendments will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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INTRODUCTION
(to Amendment 1)

The revision of IEC 61937-1 (2007) has become necessary to specify the additional definition of length-code. Amendment 1 contains the following significant technical changes with respect to the base publication (IEC 61937-1, second edition).

– New 8-bytes unit definition of length-code is added.

– An erratum in Clause 7 as for indication of the burst-payload type is corrected.

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DIGITAL AUDIO – INTERFACE FOR NON-LINEAR PCM ENCODED AUDIO BITSTREAMS APPLYING IEC 60958 –

Part 1: General

1 Scope

This part of IEC 61937 applies to the digital audio interface using the IEC 60958 series for the conveying of non-linear PCM encoded audio bitstreams.

It describes the way in which this digital interface can be used in consumer applications.

The professional mode (AES/EBU) is not considered within the scope of this standard.

2 Normative references

The following referenced documents are indispensable for the application 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 60958 (all parts), *Digital audio interface*

IEC 61937 (all parts), *Digital audio – Interface for non-linear PCM encoded audio bitstreams applying IEC 60958*

3 Terms, definitions, abbreviations and presentation

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

3.1 Definitions

3.1.1
audio data-burst
data-burst with an encoded audio frame as burst-payload

3.1.2
audio data-word
16-bit data word

3.1.3
audio frame
fixed number of audio samples

NOTE The number of samples in an audio frame is dependent on the particular encoding system which is used to encode the audio frame into the encoded audio frame.

3.1.4
audio gap
period in the sequence of baseband audio samples where valid samples of audio are not available

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3.1.5
bitstream
non-linear PCM encoded audio source, represented in a sequence of bits

NOTE In this interface the bitstream consists of a sequence of data-bursts.

3.1.6
data-burst
packet of data, including the burst-preamble, to be transmitted across the interface

3.1.7
burst-payload
information content of the data-burst

3.1.8
burst-preamble
header for the data-burst, containing synchronization, and information about the data contained in the burst-payload

3.1.9
data-type
reference to the type of payload of the data-bursts

3.1.10
encoded audio frame
minimum decodable unit of an encoded data sequence

NOTE Each encoded audio frame is the encoded representation of a fixed number of audio samples (for each original audio channel). The number of samples which are encoded into an encoded audio frame depends on the particular encoding system which is used to encode the audio frame into the encoded audio frame.

3.1.11
idle
state in which the interface is not used to convey any sequence of data-bursts or PCM data

NOTE The channel status data is still active (bit b1 is set to '1' when further non-linear PCM encoded audio is anticipated; see Figure 7).

3.1.12
length-code
code indicating the length of the data-burst-payload in bits, ~~or~~ bytes or 8-bytes unit

3.1.13
repetition period
period between the reference point of the current data-burst and the reference point of the immediately following data-burst of the same data-type

3.1.14
sampling frequency
sampling frequency of the encoded PCM audio samples (i.e. before encoding and after decoding)

3.1.15
sampling period
time period related to the sampling frequency of the PCM audio samples, represented in the encoded bitstream

3.1.16
stuffing
occupying the unused data capacity of the interface

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3.1.17
stuffing subframe
occupying the unused data capacity in 16-bit audio data words

3.1.18
stream gap
period within the encoded audio bitstream without any audio frame; a discontinuity in the bitstream

NOTE Typically, a stream gap will occur between encoded audio frames.

3.2 Abbreviations

3.2.1
MPEG
Moving Pictures Expert Group, a joint committee of ISO and IEC

3.2.2
SMPTE
The Society of Motion Picture and Television Engineers

3.2.3
ETSI
European Telecommunication Standards Institute

3.2.4
ATSC
Advanced Television Standards Committee

3.3 Presentation convention

F872h
Value 'F872' in hexadecimal format

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4 General description

The format of the IEC 60958 interface consists of a sequence of IEC 60958 subframes. Each IEC 60958 subframe is normally used to carry one linear PCM sample but may also be used to convey data. The non-linear PCM encoded audio bitstreams to be transported over this interface are formed into a sequence of data-bursts.

Each data-burst consists of a 64-bit burst-preamble, followed by the burst-payload. The burst-preamble consists of a sync-word, information about the burst-payload and a bitstream number.

The interface may convey one or more bitstreams. Each type of bitstream may impose a particular requirement for the repetition period for the data-bursts that make up the bitstream (see Clause 7).

The 16 bits of a data-burst are placed in time-slots 12-27 of an IEC 60958 subframe. Both odd and even IEC 60958 subframes (ch1, ch2) are simultaneously used to carry 32 bits of data. This allows IEC 60958, in the consumer mode, to convey either two-channel linear PCM audio, or a set of non-linear PCM encoded bitstreams (alternating data words), but not both simultaneously.

5 Interface format

The interface format as defined in IEC 60958-1 and IEC 60958-3 is used.

6 Mapping of the audio bitstream on to IEC 60958

6.1 Coding of the bitstream

The non-linear PCM encoded audio bitstream is transferred using the basic 16-bit data area of the IEC 60958 subframes, i.e. in time-slots 12 to 27. Because the non-linear PCM encoded audio bitstream to be transported is at a lower data rate than that supported by the IEC 60958 interface, the audio bitstream is broken into a sequence of discrete data-bursts, and stuffing between the data-bursts is necessary (see 6.3).

Each data-burst contains data of an encoded audio frame that is the encoded representation of a fixed number of audio samples per PCM audio channel. The number of samples to be encoded into an encoded audio frame depends on the particular encoding system.

It is possible for this interface to simultaneously convey multiple non-linear PCM encoded audio bitstreams. One of the applications of this capability would be to convey both a main audio service and an associated audio service.

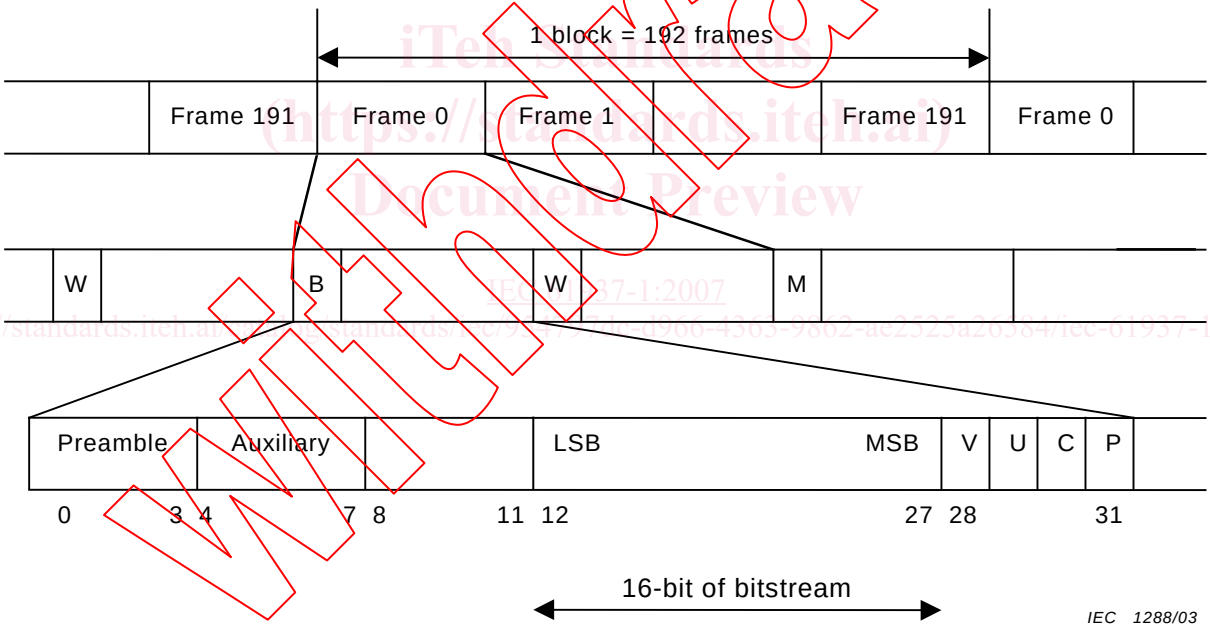

Figure 1 – IEC 60958 interface format

Table 1 – Bit allocation of the IEC 60958 frame

Field	IEC 60958 time-slot	Value
0 – 3	Preamble	IEC 60958 preamble
4 – 7	Auxiliary field	Not used, all “0”
8 – 11	Unused data bits	Not used, all “0”
12 – 27	16-bit data	Sections of the bitstream
28	Validity flag	According to IEC 60958
29	User data	According to IEC 60958
30	Channel status	According to IEC 60958
31	Parity bit	According to IEC 60958

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6.1.1 Bit map of bitstream

The method of placing the data into the IEC 60958 bitstream is to format the data to be transmitted into data-bursts and to send each data-burst in a continuous sequence of IEC 60958 frames.

Table 2 – Bit allocation of data-burst in IEC 60958 subframes

Subframe	Bit of subframes				
	MSB b27	b26	b25 …… b14	b13	LSB b12
Frame 0; subframe B or M	0	1		14	15
Frame 0; subframe W	16	17		30	31
Frame 1; subframe B or M	32	33		46	47
Frame 1; subframe W	48	49		62	63
Frame 2; subframe B or M	64	65		78	79
----------			----------		
Last subframe B or M of data-burst	n-32	n-31		n-18	n-17
Last subframe W of data-burst	n-16	n-15		n-2	n-1

Considering the data within an IEC 60958 subframe as a 16-bit word out of a serial stream of bits, the first bit of the burst-payload in a data-burst would occupy the MSB of subframe 1 (time-slot 27), and the 32nd bit would occupy the LSB (or what would be the LSB for 16-bit PCM audio) of subframe 2 (time-slot 12). The next 32 bits of the burst-payload would occupy the next IEC 60958 frame. The last data bits of the audio data-burst might occupy only a fraction of the last frame. Any unused bits in the last frame will be ignored by the receiver. In the case where the audio data-burst contains a multiple of 16-bit, all used IEC 60958 sub-frames are completely filled. When it is not a multiple of 16-bit, the bits of the burst-payload to be conveyed in the last IEC 60958 subframe will be MSB aligned; the remaining bits shall be stuffed with '0's.

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6.1.2 IEC 60958 validity flag

It is recommended to set the validity bit to a logical '1'. This is intended to prevent accidental decoding of non-audio data to analogue before a complete channel status block is received.

6.1.3 IEC 60958 channel status bit 1

The purpose of channel status bit 1 is to indicate if IEC 60958 is used to convey linear PCM or to indicate that the interface is used for other purposes (see Annex A). This bit shall be set to '1' when IEC 60958 is used to convey non-linear PCM encoded audio bitstreams.

6.1.4 Symbol frequency

When the IEC 60958 bitstream conveys linear PCM audio, the symbol frequency is 64 times the PCM sampling frequency (32 time-slots per PCM sample, times two channels). When a non-linear PCM encoded audio bitstream is conveyed by the interface, the symbol frequency is normally 64 times the sampling rate of the encoded audio within that bitstream, and other times should be referred to each parts of IEC 61937.

6.1.5 The format of the data-bursts

Each data-burst contains a burst-preamble consisting of four 16-bit words (Pa, Pb, Pc and Pd) followed by the burst-payload which contains data of an encoded audio frame.

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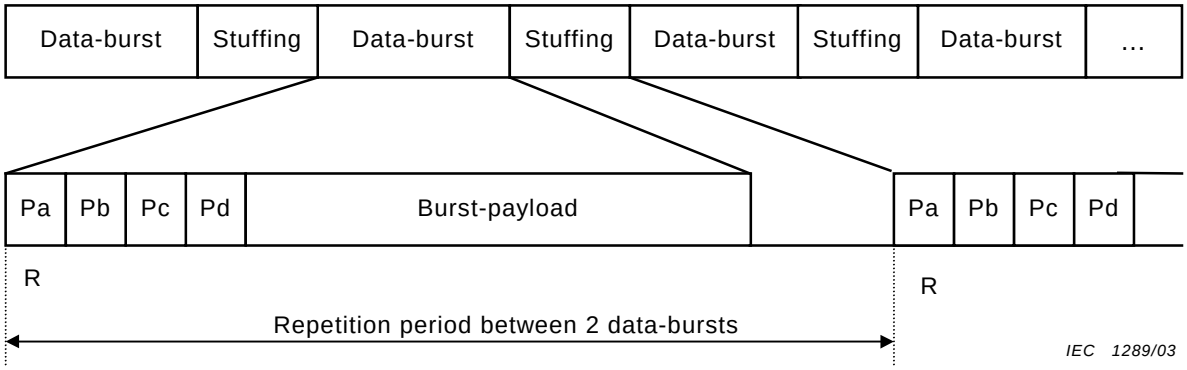

Figure 2 – Data-burst format

The repetition period of these bursts is defined as the length between the reference points R (measured in IEC 60958 frames) of one data-burst and the next data-burst (with the same bit-stream-number). The data representing each individual encoded audio frame is typically specified to be packaged into a single individual data-burst, with a repetition period (measured in IEC 60958 frames) for that data-burst equal to the number of encoded audio samples of each channel contained within that encoded audio frame.

It is possible for a number of data-bursts representing multiple bitstreams to be interleaved on the interface. When more than one non-linear PCM encoded audio bitstream are transmitted through the same interface, the audio sampling rates of these bitstreams are identical to each other.

6.1.6 Burst-preamble

~~The burst-preamble consists of four mandatory fields. Pa and Pb represent a synchronization word. Pc gives information about the type of data, and some information/control for the receiver. Pd gives the length of the burst-payload, limited to 65 535 bits in the case of Pd represent bits length, or limited to 65 535 bytes in the case of Pd represent bytes length.~~

The burst-preamble consists of four mandatory fields. Pa and Pb represent a synchronization word. Pc gives information about the type of data, and some information/control for the receiver. Pd gives the length of the burst-payload, limited to 65 535 bits in the case of Pd represent bits length, limited to 65 535 bytes in the case of Pd represent bytes length or limited to 524 280 bytes in the case of Pd represent 8-bytes unit length.

The four preamble words are contained in two sequential IEC 60958 frames. The frame beginning the data-burst contains preamble word Pa in subframe 1, and Pb in subframe 2. The next frame contains Pc in subframe 1 and Pd in subframe 2. When placed into an IEC 60958 subframe, the MSB of a 16-bit burst-preamble word is placed into time-slot 27 and the LSB is placed into time-slot 12.

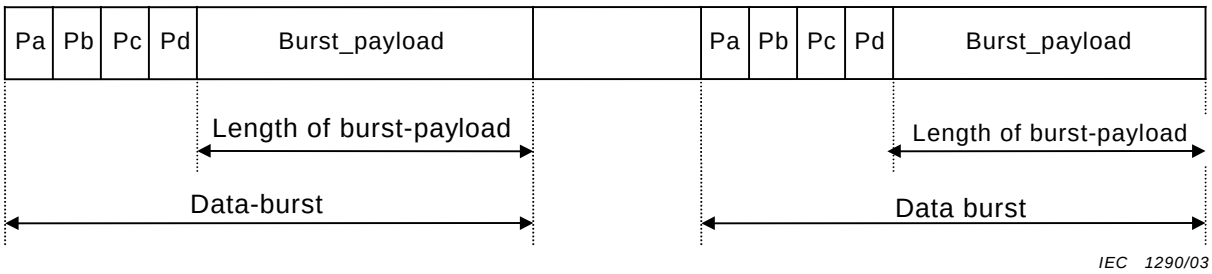

Figure 3 – Burst-preamble

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