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REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

Digital audio – Interface for non-linear PCM encoded audio bitstreams applying IEC 60958 –
Part 3: Non-linear PCM bitstreams according to the AC-3 and enhanced AC-3 formats

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International Standard IEC 61937-3 has been prepared by subcommittee technical area 4: Digital system interfaces and protocols, of IEC technical committee 100: Audio, video and multimedia systems and equipment.

This third edition of IEC 61937-3 cancels and replaces the second edition published in 2007. This edition constitutes a technical revision.

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

a) removal of support for enhanced AC-3 bitstreams with a sampling frequency of 32 kHz;

b) updates to normative and informative references;

c) clarification of pause data-burst usage for enhanced AC-3 bitstreams.

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

CDV	Report on voting
100/2720/CDV	100/2934/RVC

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

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

A list of all parts in the IEC 61973 series, published 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 this document will remain unchanged until the stability date indicated on the IEC website under "http://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- withdrawn,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.

A bilingual version of this publication may be issued at a later date.

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

Part 3: Non-linear PCM bitstreams according to the AC-3 and enhanced AC-3 formats

1 Scope

This part of IEC 61937 describes the method used to convey non-linear PCM bitstreams encoded according to the AC-3 and enhanced AC-3 formats.

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 60958 (all parts), *Digital audio interface*~~

IEC 61937-1:2007, *Digital audio interface for non-linear PCM encoded audio bit streams applying IEC 60958 – Part 1: General*

IEC 61937-1:2007/AMD1:2011, *Digital audio interface for non-linear PCM encoded audio bit streams applying IEC 60958 – Part 1: General*

IEC 61937-2~~:2007~~, *Digital audio interface for non-linear PCM encoded audio bit streams applying IEC 60958 – Part 2: Burst-info*

~~ATSC Standard A/52B, *Digital Audio Compression (AC-3, E-AC-3), Rev. B*~~

ETSI TS 102 366, *Digital Audio Compression (AC-3, Enhanced AC-3) Standard*

3 Terms, definitions and abbreviated terms

For the purposes of this document, the following terms and definitions ~~and abbreviations~~ 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
block identification flag
~~if the stream type value of an enhanced AC-3 substream is two, indicating that the bitstream has been converted from an AC-3 bitstream, this bit is set to 1 to indicate that the first block in this enhanced AC-3 frame was the first block in the original standard AC-3 frame~~
flag used to indicate that the first audio block of an enhanced AC-3 syncframe with a stream type value of two formed the first audio block in the AC-3 syncframe from which it was converted

3.2
converter synchronization flag
flag used for synchronization by a device that converts an enhanced AC-3 bitstream to a bitstream compliant with an AC-3 decoder and indicates that the first block in this enhanced AC-3 syncframe will form the first block of the AC-3 syncframe output by the conversion process

3.3
latency
delay time of an external audio decoder to decode an AC-3 or enhanced AC-3 data burst, defined as the sum of two values: the receiving delay time and the decoding delay time

3.4
stream type
parameter of an enhanced AC-3 syncframe identifying the type of substream of which the syncframe is a part

Note 1 to entry: An enhanced AC-3 bitstream is constructed from one or more substreams, with each substream being constructed from a sequence of syncframes.

3.5
substream identification
~~substream identification~~ parameter of an enhanced AC-3 syncframe which, in conjunction with the stream type parameter, identifies the substream in the bitstream of which the ~~enhanced AC-3~~ syncframe is a part

3.6
syncframe
minimum portion of the AC-3 or enhanced AC-3 audio serial bitstream capable of being fully decoded, also known as a synchronization frame

3.7 Abbreviated terms

ATSC	Advanced Television ~~Standards~~ Systems Committee
ETSI	European Telecommunications Standards Institute
~~IEC~~	~~International Electrotechnical Commission~~
~~ISO/IEC MPEG~~	~~Moving Pictures Expert Group, a joint committee of ISO and IEC~~

4 Mapping of the audio bitstream on to IEC 61937-1

4.1 General

The coding of the bitstream and data-burst is in accordance with IEC 61937-1, IEC 61937-1:2007/AMD1:2011 and IEC 61937-2, including field names such as "Pc", "Pa" and "R".

4.2 AC-3 and enhanced AC-3 burst-info

The 16-bit burst-info contains information about the data that will be found in the data-burst (see Table 1).

Table 1 – Fields of burst-info

~~Data-type~~ ~~Value of Pc bits 0-4~~	~~Sub-data-type~~ ~~Value of Pc bits 5-6~~	~~Contents~~	~~Reference point R~~	~~Repetition period of data-burst measured in IEC 60958 frames~~
~~1~~	~~0~~	~~AC-3~~	~~R-AC-3~~	~~1 536~~
~~21~~	~~0~~	~~Enhanced AC-3~~	~~Bit 0 of Pa~~	~~6 144~~
	~~1-3~~	~~Reserved~~	~~Reserved~~	~~Reserved~~

Bits of Pc	Data-type bits 0-4	Data-type bits 5-6	Contents	Reference point R	Repetition period of data-burst measured in IEC 60958 frames
0 to 6	1	0	AC-3	R-AC-3	1 536
		1 to 3	Reserved		
	2 to 20	According to IEC 61937			
	21	0	Enhanced AC-3	Bit 0 of Pa	6 144
		1 to 3	According to IEC 61937		
	22 to 31	According to IEC 61937			
7 to 15	According to IEC 61937				

5 Format of AC-3 and enhanced AC-3 data-bursts

5.1 General

This clause specifies the audio data-bursts AC-3 and enhanced AC-3. Specific properties such as reference points, repetition periods, the method of filling stream gaps and decoding latency are specified.

The decoding latency (or delay), indicated for the data-type bits 0-4, should be used by the transmitter to schedule data-bursts as necessary to establish synchronization between picture and decoded audio.

5.2 Pause data-burst

Pause data-bursts for AC-3 and enhanced AC-3 are given in Table 2.

Table 2 – Repetition period of the pause data-bursts

Data-type bits 0-4 of audio data-burst	Repetition period of pause data-burst	
	Mandatory	Recommended
AC-3	-	3 IEC 60958 frames
Enhanced AC-3	-	4 IEC 60958 frames

5.3 Audio data-bursts

5.3.1 AC-3 data

The AC-3 bitstream consists of a sequence of AC-3 syncframes. The data-type bits 0-4 of an AC 3 data-burst is 1. An AC-3 syncframe represents 1 536 samples of each encoded audio channel (left, centre, etc.). The data-burst is headed with a burst-preamble followed by the burst-payload. The burst-payload of each data-burst of AC-3 data shall contain one complete AC-3 syncframe. Figure 1 shows the structure of the AC-3 data-burst.

The length of the AC-3 data-burst will depend on the encoded bit rate (which determines the AC-3 syncframe ~~length~~ size). ~~The specification for the AC-3 bitstream may be found in ATSC Standard A52/B or~~ The AC-3 bitstream is specified in ETSI TS 102 366 (see also ATSC A/52:2012).

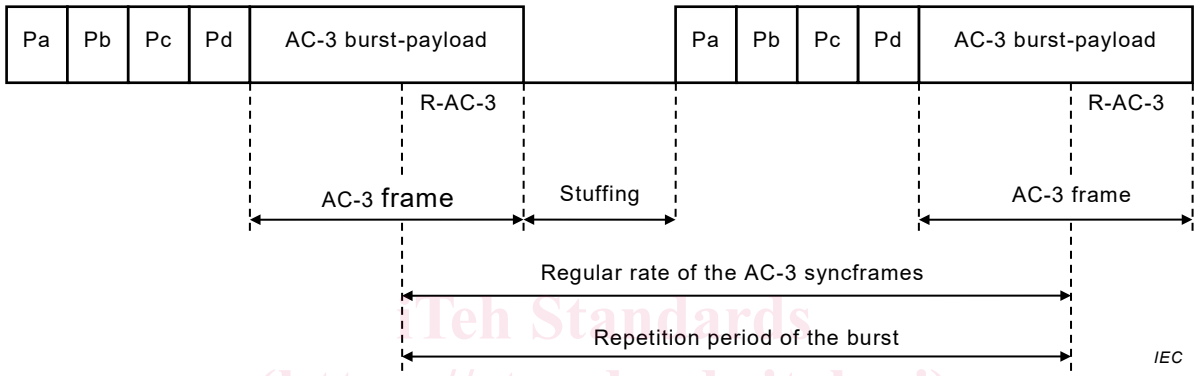

Figure 1 – AC-3 data-burst, with reference point R

The data-type-dependent info for bits 0-4 of AC-3 is given in Table 3.

Table 3 – Data-type-dependent information when data-type bits 0-4 = 1

Bits of Pc LSB..MSB	Data-type bits 0-4 dependent, bit number LSB...MSB	Contents
8 to 10	0 to 2	Value of 'bsmod' parameter in AC-3 elementary stream
11, 12	3 and 4	Reserved

The data-bursts containing AC-3 syncframes shall occur at a regular rate, with the reference point of each AC-3 data-burst beginning (except in the case of a gap) 1 536 ~~sampling periods of the audio~~ frames (IEC 60958 frames) after the reference point of the preceding AC-3 data-burst (of the same bitstream number).

The reference point of an AC-3 data-burst (R-AC-3) is the IEC 60958 frame that occurs two-thirds of the way through the AC-3 burst-payload. The definition of the two-thirds value is the closest integer to the value of the AC-3 syncframe size measured in 32-bit words multiplied by the value 2/3, or:

~~2/3 frame size = int (0,5 + (2/3) × (frame size in 32-bit words))~~

$$\frac{2}{3} \times \text{AC3syncframesize} = \text{rint}(\frac{2}{3} \times \text{AC3syncframesize32})$$

where:

- AC3syncframesize is "AC-3 syncframe size";
- AC3syncframesize32 is "AC-3 syncframe size in 32-bit words";
- rint() rounds to the nearest integer.

5.3.2 Latency of AC-3 decoding

The latency of an AC-3 decoder which receives the signal is specified, with respect to the reference point of the AC-3 burst, to be equal to one AC-3 block time, which is equal to the time occupied by 256 PCM samples at the encoded sampling frequency (5,33 ms for 48 kHz sampling frequency; see Figure 2).

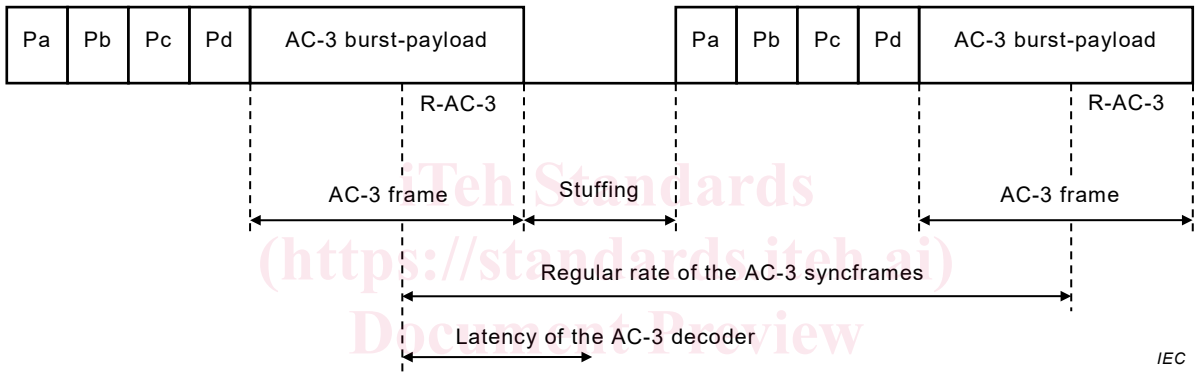

Figure 2 – Latency of AC-3 decoding

It is recommended that pause data-bursts be used to fill stream gaps in the AC-3 bitstream, as described in IEC 61937-1, and that pause data-bursts be transmitted with a repetition period of three IEC 60958 frames, except when other repetition periods are necessary to fill the precise stream gap length (which may not be a multiple of three IEC 60958 frames), or to meet the requirement on burst spacing (see IEC 61937-1:2007, 6.3.3).

When a stream gap in an AC-3 stream is filled by a sequence of pause data-bursts, the Pa of the first pause data-burst shall be located one ~~frame~~ data-burst repetition period following the Pa of the previous AC-3 syncframe. It is recommended that the sequence(s) of pause data-bursts which fill the stream gap should continue from this point up to (as close as possible considering the three IEC 60958 frame length of the pause data-burst) the Pa of the first AC-3 data-burst which follows the stream gap.

The gap length parameter contained in the pause data-burst is intended to be interpreted by the AC-3 decoder as an indication of the number of decoded PCM samples which are missing (due to the resulting audio gap). If the sizes of the AC-3 syncframes before and after the stream gap are not equal (due to a bit rate change in the interrupted AC-3 bitstream), this value may differ from the actual number of sampling periods of the audio contained in the stream gap due to the definition of the AC-3 burst reference points.

Some AC-3 decoders may be capable of "concealing" audio gaps. The indication of the audio gap length (gap-length) which may be included in the payload of the pause data-burst allows the decoder to know how long an audio gap will need to be concealed, and thus allow the decoder to optimize the concealment process for the actual audio gap length. AC-3 decoders will most easily conceal audio gaps that have a length equal to an integral multiple of 256