IEC 61937-14

Edition 1.0 2017-08

INTERNATIONAL STANDARD

Digital audio – Interface for non-linear pcm encoded audio bitstreams applying IEC 60958 – Part 14: Non-linear PCM bit streams according to the AC-4 format

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IEC 61937-14:2017-08(en)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ICS 33.160.30; 33.170

ISBN 978-2-8322-4705-1

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Part 14: Non-linear PCM bit streams according to the AC-4 format

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International Standard IEC 61937-14 has been prepared by technical area 4: Digital system interfaces and protocols, of IEC technical committee 100: Audio, video and multimedia systems and equipment.

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

CDV	Report on voting
100/2723/CDV	100/2932/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 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 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- withdrawn,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 14: Non-linear PCM bit streams according to the AC-4 format

1 Scope

This part of IEC 61937 describes the method to convey non-linear PCM bit streams encoded according to the AC-4 format.

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*

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

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

IEC 61937-2, *Digital audio interface for non-linear PCM encoded audio bitstreams applying IEC 60958 – Part 2: Burst Information*

ETSI TS 103 190 v.1.1.1, 2014, *Digital Audio Compression (AC-4) Standard*

3 Terms, definitions and abbreviated terms

For the purpose of this standard, the following 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
AC-4 frame
AC-4 sync frame, as specified in Annex A

3.2
audio frame rate
number of AC-4 audio frames per second, indicated by the value of the *frame_rate_index* AC-4 bit stream parameter as specified in ETSI TS 103 190

3.3
base sampling frequency
sampling frequency of the AC-4 bit stream, indicated by the value of the *fs_index* AC-4 bit stream parameter as specified in ETSI TS 103 190

Note 1 to entry: AC-4 supports base sampling frequencies of 44.1 and 48 kHz only.

3.4
latency
delay time of an external audio decoder to decode an AC-4 data burst defined as the sum of two values: the receiving delay time and the decoding delay time

3.5
fractional frame rates
fractional audio frame rates supported by AC-4

Note 1 to entry: These frame rates are written in shorthand notation, as specified in Table 1.

Table 1 – Shorthand notation for fractional frame rates

Fractional AC-4 audio frame rate (fps)	Shorthand version
$24 \times {}^{1\,000}/_{1\,001}$	23,976
$30 \times {}^{1\,000}/_{1\,001}$	29,97
$48 \times {}^{1\,000}/_{1\,001}$	47,952
$60 \times {}^{1\,000}/_{1\,001}$	59,94
$120 \times {}^{1\,000}/_{1\,001}$	119,88
${}^{12\,000}/_{512}$	23,438
${}^{11\,025}/_{512}$	21,533

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3.6 Abbreviated terms

ETSI	European Telecommunication Standards Institute
fps	frames per second
HBR	high bit rate
IEC	International Electrotechnical Commission
LD	low delay
UIMSBF	unsigned integer, most significant bit first

4 Mapping of the audio bit stream on to IEC 61937-1

4.1 General

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

4.2 AC-4 burst-info

The 16-bit burst-info contains information about the data which will be found in the data-burst (see Table 2).

Table 2 – Fields of burst-info

Bits of Pc	Data-type value (bits 0 – 4)	Data-type value (bits 5 – 6)	Contents	Reference point R	Repetition period of data-burst in IEC 60958 frames
0 – 6	1 – 23	According to IEC 61937-2			
	24	0	AC-4	bit 0 of Pa	See Table 4
		1	AC-4 HBR4	bit 0 of Pa	See Table 10
		2	AC-4 HBR16	bit 0 of Pa	See Table 16
		3	AC-4 LD	bit 0 of Pa	See Table 22
	25 – 31	According to IEC 61937-2			
7 – 15	According to IEC 61937-1				

5 Format of AC-4 data-bursts

5.1 General

This clause specifies the AC-4 audio data-burst. Specific properties such as reference points, repetition period, the method of filling stream gaps, and decoding latency are specified.

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

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5.2 Pause data-burst

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The pause data-burst for AC-4 is given in Table 3.

Table 3 – Repetition period of the Pause data-bursts

Data-type of audio data-burst	Repetition period of pause data-burst	
	Mandatory	Recommended
AC-4	-	3
AC-4 HBR4	-	4
AC-4 HBR16	-	4
AC-4 LD	-	3

5.3 Audio data-burst

5.3.1 The AC-4 data

An AC-4 bit stream consists of a sequence of AC-4 frames. The AC-4 data-burst is headed with a burst-preamble, followed by the burst-payload. The structure of the AC-4 data-burst is shown in Figure 1. The data-type bits 0-4 of an AC-4 data-burst is 24, and the data-type bits 5-6 is 0. When AC-4 data is being transmitted, the transmission device shall ensure that both the data-type bits 0-4 and data-type bits 5-6 values are set correctly. Additionally, the receiving device shall utilize both the data-type bits 0-4 and data-type bits 5-6 values to ensure that the content of the data-burst is correctly identified as AC-4.

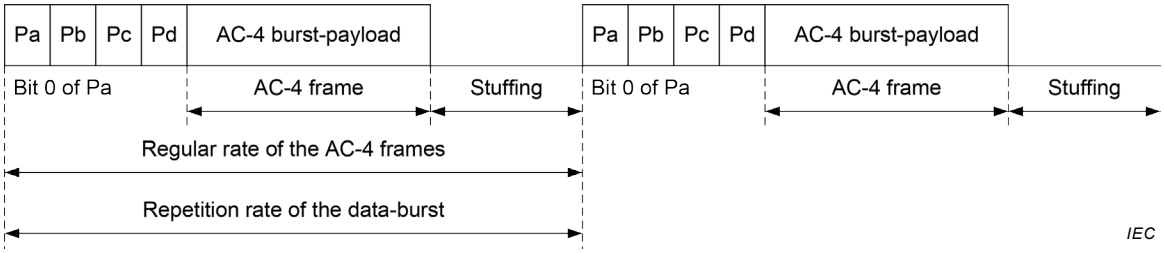

Figure 1 – AC-4 data-burst

The data-type bits 0-4 dependent information for AC-4 is specified in Table 4.

Table 4 – Data-type-dependent information for AC-4

Bits of Pc LSB..MSB	Value	Meaning
8 – 11	See Table 7 and Table 8	Repetition period of the data-burst in IEC 60958 frames
12	Reserved	

The AC-4 burst-payload shall always contain a single AC-4 frame. The transmission device shall ensure that the AC-4 burst-payload is constructed only from a single complete AC-4 frame. It is prohibited to transmit a single AC-4 frame using multiple data-bursts. The length of the AC-4 data-burst will depend on the encoded bit rate (which determines the AC-4 frame length). The AC-4 bit stream is specified in ETSI TS 103 190.

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The reference point of an AC-4 data-burst is bit 0 of Pa. The repetition period of the AC-4 data-burst shall be defined by the base sampling frequency (indicated by the value of the *fs_index* AC-4 bit stream parameter as specified in ETSI TS 103 190) and frame rate (indicated by the value of the *frame_rate_index* AC-4 bit stream parameter as specified in ETSI TS 103 190) of the AC-4 audio bit stream. The IEC 60958 frame rate shall be equal to the base sampling frequency of the AC-4 bit stream. As AC-4 supports multiple audio frame rates that match commonly used video frame rates, the transmission device shall ensure that the selected AC-4 data-burst repetition rate is equal to the duration of the AC-4 frame, as specified in Table 5.

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Table 5 – AC-4 base sampling frequency, AC-4 audio framerate and corresponding AC-4 data-burst repetition period

AC-4 base sampling frequency	AC-4 audio frame rate (fps)	AC-4 data-burst repetition period in IEC 60958 frames
48 kHz	23,976	2 002
	24	2 000
	25	1 920
	29,97	1 601 / 1 602 (see Table 6)
	30	1 600
	47,952	1 001
	48	1 000
	50	960
	59,94	800 / 801 (see Table 6)
	60	800
	100	480
	119,88	400 / 401 (see Table 6)
	120	400
	23,438	2 048
44,1 kHz	21,533	2 048

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For AC-4 audio frame rates of 29,97, 59,94 and 119,88 fps, the duration of an AC-4 audio frame does not correspond to an integer number of IEC 60958 frames. To ensure that precise time alignment is maintained between the AC-4 data-burst and the AC-4 audio frames at these frame rates, the repetition period of data-bursts varies so that over a sequence of 5 data bursts, five AC-4 data-bursts$_{0...4}$ are time-aligned with the corresponding 5 audio frames, as specified in Table 6.

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Table 6 – AC-4 data-burst sequence and repetition period variance at 29,97, 59,94 and 119,88 fps

AC-4 audio frame rate	Repetition periods for AC-4 data-burst sequence in IEC 60958 frames				
	Data-burst$_0$	Data-burst$_1$	Data-burst$_2$	Data-burst$_3$	Data-burst$_4$
29,97 fps	1 602	1 601	1 602	1 601	1 602
59,94 fps	801	801	800	801	801
119,88 fps	400	401	400	401	400

The value of bits 8 to 11 Pc shall indicate the repetition period of the AC-4 data-burst. The interpretation of these bits is dependent on the base sampling frequency of the AC-4 bit stream and the IEC 60958 frame rate, as specified in Table 7 and Table 8.