IEC 61937-3
(First edition – 2003)

Digital audio –
Interface for non-linear PCM encoded audio bitstreams applying IEC 60958 –

Part 3: Non-linear PCM bitstreams according to the AC-3 format

CORRIGENDUM 1

Page 3

Foreword

Add, as a second paragraph, the following text:

This standard cancels and replaces IEC 61937, published in 2000, which has been divided into four parts (see below). This first edition constitutes a technical revision.

March 2004

INTERNATIONAL

STANDARD

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61937-3

First edition
2003-05

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CONTENTS

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DIGITAL AUDIO –
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AUDIO BITSTREAMS APPLYING IEC 60958 –

Part 3: Non-linear PCM bitstreams according to the AC-3 format

FOREWORD

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

The text of this standard is based on the following documents:

FDIS	Report on voting
100/646/FDIS	100/672/RVD

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

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

IEC 61937 consists of the following parts under the general title *Digital audio – Interface for non-linear PCM encoded audio bistreams applying IEC 60958*:

Part 1:   General

Part 2:   Burst-info

Part 3:   Non-linear PCM bitstreams according to the AC-3 format

Part 4:   Non-linear PCM bitstreams according to the MPEG audio formats

Part 5: Non-linear PCM bitstreams according to the DTS (Digital Theatre Systems) format(s)

Part 6: Non-linear PCM bitstreams according to the MPEG-2 AAC format

Part 7: Non-linear PCM bitstreams according to the ATRAC and ATRAC2/3 formats

The committee has decided that the contents of this publication will remain unchanged until October 2005. At this date, the publication will be

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- withdrawn;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

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

Part-3: Non-linear PCM bitstreams according to the AC-3 format

1 Scope

This part of IEC 61937 specifies the method for the digital audio interface specified in IEC 60958 to convey non-linear PCM bitstreams encoded in accordance with the AC-3 format.

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

ITU-R Recommendation BS.1196-1, *Audio coding for digital terrestrial television broadcasting*

AC.3, Advanced Television Systems Committee (ATSC) document A/52, *Digital Audio Compression (AC-3) Standard*

3 Terms and definitions

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

3.1 Definitions

3.1.1
latency
delay time of an external audio decoder to decode an AC-3 data burst, defined as the sum of two values of the receiving delay time and the decoding delay time.

3.2 Abbreviations

3.2.1
ATSC
Advanced Television Systems Committee

3.2.2
MPEG
Moving Pictures Expert Group, a joint committee of ISO and IEC

3.2.3
ITU-R
International Telecommunication Union, Radio Communication Bureau

3.3 Presentation convention

F872h

Value 'F872' in hexadecimal format

4 Mapping of the audio bitstream on to IEC 61937

The coding of the bitstream and data-burst is in accordance with IEC 61937-1.

4.1 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

Bits of Pc	Value	Contents	Reference point R	Repetition period of data-burst in IEC 60958 frames
0 – 4		Data-type		
	0	According to IEC 61937-1		
	1	AC-3	R-AC-3	1 536
	2-31	According to IEC 61937-1		
5 - 15		According to IEC 61937-1		

5 Format of AC-3 data-burst

5.1 General

This clause specifies the audio data-burst AC-3. Specific properties such as reference points, repetition period, the method of filling stream gaps, and decoding latency are specified for each data-type.

The decoding latency (or delay), indicated for the data-types, 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-burst for AC-3 is given in Table 2.

Table 2 – Repetition period of pause data-bursts

Data-type of audio data-burst	Repetition period of pause data-burst	
	Mandatory	Recommended
AC-3	–	3 IEC 60958 frames

5.3 Audio data-bursts

5.3.1 The data AC-3

The AC-3 bitstream consists of a sequence of AC-3 frames. The data-type of a AC-3 data-burst is 01h. An AC-3 frame 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 1 complete AC-3-frame.

The length of the AC-3 data-burst will depend on the encoded bit rate (which determines the AC-3-frame length). The specification for the AC-3 bitstream may be found in ATSC document A/52 or in ITU-R Recommendation BS.1196-1.
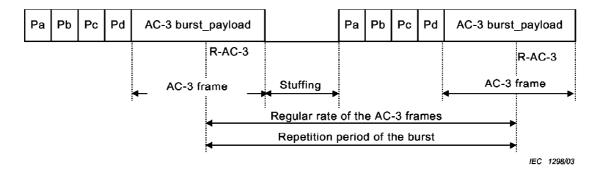

IEC　1298/03

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

The data-type-dependent info for AC-3 is given in Table 3.

Table 3 – Data-type-dependent when data-type = 1

Bits of Pc LSB..MSB	Data type dependent, bit number LSB..MSB	Contents
8-10	0-2	Value of bsmod in AC-3 elementary stream
11 -12	3-4	Reserved, shall be set to '00'

The data-bursts containing AC-3-frames 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 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 2/3 of the way through the AC-3 payload. The definition of the 2/3 value is the closest integer to the value of the AC-3 frame size measured in 32-bit words multiplied by the value 2/3, or

$$2/3 \text{ frame size} = \text{int } (0,5 + (2/3) \times (\text{frame size in 32-bit words}))$$

5.3.2　Latency of AC-3 decoding

The latency of an AC-3 decoder which receives this signal is specified, with respect to the reference point of the AC-3 burst, to be equal to 1 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).
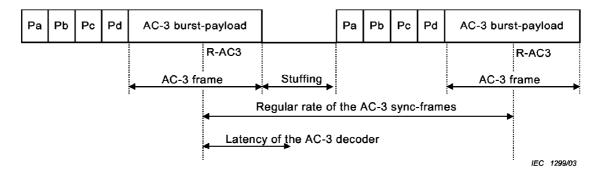
| Pa | Pb | Pc | Pd | AC-3 burst-payload | | Pa | Pb | Pc | Pd | AC-3 burst-payload |

R-AC3

AC-3 frame ←——————→ ← Stuffing → R-AC3

AC-3 frame

Regular rate of the AC-3 sync-frames

Latency of the AC-3 decoder

IEC 1299/03

Figure 2 – Latency of AC-3 decoding

It is recommended that pause data-bursts are 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 3 sampling periods of the audio, except when other repetition periods are necessary to fill the precise stream gap length (which may not be a multiple of 3 sampling periods of the audio), or to meet the requirement on burst spacing (refer to IEC 61937-1, 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 1536 sampling periods following the Pa of the previous AC-3 frame. 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 3 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-frames 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 samples. Thus, audio gaps of length 256, 512, 768, etc. sampling periods of the audio are strongly preferred, and transmitters should provide stream gaps that represent audio gaps with this granularity.

It is possible for there to be an audio gap in an AC-3 stream carried over this interface without there also being a stream gap. This can happen when the audio gap length is small, and there is a bit rate change in the interrupted AC-3 bit stream and the bit rate following the gap is larger than the bit rate prior to the gap. Because of the definition of the reference point of the AC-3 data burst, it is possible for the Pa of the first burst following a bitstream interruption to be less than 1536 sampling periods of the audio following the Pa of the burst preceding the gap, while the reference point of the first burst following the bit stream interruption is more than 1536 sampling periods of the audio after the reference point of the burst preceding the gap. When this case occurs, since there is no stream gap to fill with pause bursts, there is no need to send any pause bursts. The audio decoder will never be starved for data and can calculate the length of the audio gap based on the reference points of the received AC-3 bursts.

Bibliography

The following document has served as a reference for the specification of the related data-type and other parts of IEC 61937.

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

———————

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